Philips A1 and A3 Patient Monitors

A1 Models: M3921A
M3922A
M3923A
M3924A

A3 Models: M3926A
M3927A
M3928A
M3929A

Service Guide

Part Number M3921-9000C

Printed in the U.S.A. February 2002

First Edition

PHILIPS

About this Manual

Proprietary Information

Philips Medical Systems
3000 Minuteman Road
Andover, MA 01810-1085
(978) 687-1501

Publication number
M3921-9000C
Printed in USA

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Printing History

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

The documentation printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates that are incorporated at reprint do not cause the date to change.) The document part number changes when extensive technical changes are incorporated.

This edition, M3921-9000C combines both A1 and A3 Service Guides into one book. There is no M3921-9000B book.

First Edition..... February 2002

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Text Conventions

The following conventions for Notes, Cautions, and Warnings are used in this manual.

NOTE

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

Caution

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

Warning

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

Explanation of Symbols

Symbols on products and packaging mean the following:

 Battery Gauge icon

 Defibrillator-proof type CF equipment

 On/Standby button.

 Alarm Limits icon.

 Adjust Screen Contrast to display (monochrome) or invert the video to (color).

 Adjust Heart Rate Tone volume.

 Initiate NiBP measurement

 NiBP

 ECG

T Temperature

SpO_2 SpO_2

 Located on recorder. Produces a 20 Second Snapshot

 Located on recorder. Produces a Continuous Print

 Signal (ECG) Input

 Signal (ECG) Output

 Data input/output

 Alternating Current

 Direct Current

 Temperature

 Humidity

 Altitude or atmospheric pressure


Contains parts that may not be put into normal waste disposal but must be recycled or i disposed as chemical waste


Fragile, handle with care

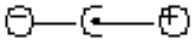

Keep dry

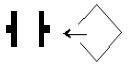

Consult instructions for use

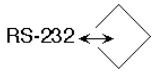

Date of manufacture


Refer to User's Guide

DC Lines


DC Input


Defib Sync.

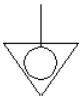


RS-232 I/O


Class II Equipment


Power supply if for indoor use only


Silence Alarm


Equipotential Ground


Recorder’s front-panel charging LED


Recorder’s front-panel communication LED


Ground Wire

Contents

1 Introduction

Manual Overview

This manual contains information for servicing the A1 and A3 patient monitors, subsequently referred to as *the monitor* throughout this manual. Only where there are differences in service procedures for the two monitor types is each monitor referred to specifically as A1 and A3. Only qualified service personnel should service this product. Before servicing the monitor, read the *User Guide* carefully for a thorough understanding of operation.

Patient Monitor Description

The purpose and function of the patient monitor is to monitor: ECG; heart rate; noninvasive blood pressure (systolic, diastolic, and mean arterial pressures); functional arterial oxygen saturation; respiration rate (A3 only); and temperature for adult and pediatric patients in all hospital areas and hospital-type facilities. It can be used during hospital transport and in mobile, land-based environments, such as ambulances.

The physical and operational characteristics of the monitor are described in the *User Guide*.

The measurement parameters and features for each model are indicated below.

Model	Measurement Parameters and Features						
	NIBP	**SpO_2**	**Temp**	**ECG**	**Resp**	**Integral Recorder**	**Color/ Mono**
A1 Monitor							
M3921A	Yes	Yes	No	No	No	No	Mono
M3922A	Yes	Yes	Yes	No	No	No	Mono
M3923A	Yes	Yes	No	Yes	No	No	Mono
M3924A	Yes	Yes	Yes	Yes	No	No	Mono
M3925A	Optional Standalone Recorder for A1						
A3 Monitor							
M3926A	Yes	Yes	Yes	Yes	Yes	No	Mono
M3927A	Yes	Yes	Yes	Yes	Yes	Yes	Mono
M3928A	Yes	Yes	Yes	Yes	Yes	No	Color
M3929A	Yes	Yes	Yes	Yes	Yes	Yes	Color

Introduction to External Recorder (M3925A)

The recorder is an optional, standalone printer designed for use with the A1 patient monitor. The recorder communicates with the monitor using a null-modem cable connected between each device's RS-232 connector.

The recorder contains an internal battery, which, when fully charged, will operate the recorder for 3 hours (typical, at 25°C, producing fifteen 20-second printouts per hour). The recorder can be connected to AC power using an external power supply. The recorder uses the same type of power supply as the A1 monitor, the PS-120V or PS-240V.

The recorder does not have an On/Off switch. The recorder can sense when it has an established communication link with the monitor. At that time, the green LINKED indicator on the front panel lights, indicating that the recorder is ready for operation. See the recorder's *User Guide* for more information regarding its operation.

Related Documents

To perform test and troubleshooting procedures and to understand the principles of operation and circuit analysis sections of this manual, you must know how to operate the monitor. Refer to the *User Guide* to understand the various sensors, ECG lead, blood pressure cuffs, and temperature probes that work with the monitor. Refer also to the user guide and individual directions for use that accompany these accessories.

2
Routine Maintenance

Cleaning

Warning ***Do not immerse the monitor or its accessories in liquid or clean with caustic or abrasive cleaners. Do not spray or pour any liquid on the monitor or its accessories.***

To clean the monitor, dampen a cloth with a commercial, nonabrasive cleaner and wipe the exterior surfaces lightly. Do not allow any liquids to come in contact with the power connector or switches. Do not allow any liquids to penetrate connectors or openings in the instrument. For cables, sensors and cuffs, follow the cleaning instructions in the directions for use that accompany these accessories.

Periodic Safety And Functional Checks

The monitor requires cleaning, battery maintenance and NiBP performance and verification check every two years. The following performance verification tests may be used following repair or during routine maintenance (if required by your local institution).

1. Inspect the exterior of the monitor for damage.
2. Inspect labels for legibility. If the labels are not legible, contact Philips' Response Center or your local Philips representative.
3. Verify that the NiBP performs properly as described in "Verification of Pneumatic System" on page 21.

Battery

If the monitor has not been used for a long period of time, the battery will need charging. To charge the battery, connect the monitor to an AC outlet, or external DC supply in the case of the A3, as described in "Battery Charge" on page 13 or the "Setup and Use" chapter of the *User Guide*.

Note Storing the monitor for a long period without charging the battery can degrade the battery capacity. A complete battery recharge requires 8 hours.

The battery can be recharged while the monitor is in use, in which case, the battery requires 14 hours to be recharged.

The battery can require a full discharge/charge cycle to restore normal capacity.

If the monitor operates[1] for less than one hour on battery power before the low battery alarm occurs, the battery should be conditioned.

If the same symptom persists even after the battery is conditioned and indicating a full charge, the battery should be replaced.

Refer to Chapter 6, “Disassembly Guide”.

Environmental Protection

Follow local governing ordinances and recycling plans regarding disposal or recycling batteries and other device components.

1. See “Battery Performance Test” on page 14 for typical battery operating times and conditions.

3
Performance Verification

Introduction

This section discusses the tests used to verify performance following repairs or during routine maintenance. All tests can be performed without removing the covers of the monitor.

If the monitor fails to perform as specified in any test, repairs must correct the problem before the monitor is returned to the user.

Test And Inspection Matrix

The following test map shows which tests are required in which situations.

Table 1 Test Map

Service Event (When Performing…)	Test Blocks Required (…Complete these Tests)
Installation	Visual and Power On Tests
Repairs	
A. Unit Exchange	Visual and Power On Tests
B. Unit Opened	Power On Test Basic Pneumatic Leakage Test (BPL) Ground Integrity Test Leakage Current Test
C. NBP Pump replaced	Power On Test NBP Tests: Pneumatic Leakage and Inflation Rate
D. SpO_2 Module replaced	Power On Test BPL Test SpO_2 Tests: Dynamic Operating Range and LED Excitation
E. Front End Connectors replaced	Power On Test BPL Test Performance test for the parameter that had the connector replaced.
F. Power Supply replaced (A3 only)	Power On, BPL, and Safety tests
G. Component level repair on any PC board	Power On Test All Performance Tests All Safety Tests
H. Main PC board replaced	Power On Test All Performance tests except Battery Charge Test and Battery Performance Test
All software upgrades	Power On
Preventative maintenance	Power On and NBP Performance Tests

Table 2 Test and Inspection Reporting

Test[1]	Expected Results	What to Record[2]
Visual: Inspect exterior of monitor for damage	No Visual Damage	V:P or V:F
Power-On Self-Test	Displays Normal Monitoring Screen Configuration and emits tones	PO:P or PO:F
Basic Pneumatic Leakage Test (NBP test)	After 1 minute at approximately 250 mmHg, pressure drops no more than 6 mmHg.	BPL: Px6 Where x6 =Pressure Drop in mmHg
NiBP Accuracy Test	250 mmHg; ±5 mmHg	PN:P/X1…X4 (or X5[3]) PN:F/X1…X4 (or X5[3]) *Record Pressure in mmHg = X1*
NiBP Leakage Test	After 1 Minute at 250 mmHg, pressure drops no more than 6 mmHg	*Record Pressure Drop in mmHg = X2*
NiBP Inflation Rate Test	Monitor Reports NiBP = 280 mmHg in <6 seconds	*Record Time to 280 mmHg in Seconds = X3*
NiBP Overpressure Test	Overpressure Deflation is activated at a value between 280 mmHg to 330 mmHg	*Record value in mmHg at which Overpressure Deflation occurs =X4*
NiBP Deflation Rate Test (A3 only)	Monitor reports NiBP >10 mmHg and <190 mmHg	*Record value in mmHg on monitor at 1 min = X5*
Safety Performance Tests	All Safety Performance Tests are in range of Table 5 to Table 12	S:P or S:F

1. Details of the tests are included later in this chapter.
2. When authorized Philips Medical Systems personnel service the instrument. The results are reported back to Philips. The collected data form a database to be used in product development. It is not necessary for hospital personnel to report these results.
3. In the case of the NiBP Deflation Rate Test, applicable to the A3 only.

Equipment Needed

The following table lists the equipment required for performance verification.

Table 3 Required Test Equipment

Equipment	Description	Required For	
		A1	A3
Digital multimeter (DMM)	Fluke Model 87 or equivalent	●	●
Sensor extension cable	M4787A	●	●
Finger clip sensor	M4789A	●	●
Oxisensor® II adhesive sensor	D-25	●	●
ECG cable	M3913A	M3923A and M3924A only	●
ECG electrodes	Standard	M3923A and M3924A only	●
ECG leads	M3914A (IEC) or M3915A (AAMI)	M3923A and M3924A only	●
NiBP tubing	M3918A	●	●
NiBP cuff	40401C	●	●
Pulse oximeter tester	Nellcor Puritan Bennett SRC-2	●	●
ECG simulator	Dynatech Nevada medSim 300 or equivalent	●	●
NiBP simulator	Bio-Tek BP Pump or equivalent	●	●
Temperature simulator	medSim 300 or equivalent	M3922A and M3924A only	●
Respiration simulator	medSim 300 or equivalent	–	●
Safety analyzer	Bio-Tek 601 Pro or equivalent	●	●
Stopwatch	Manual or electronic	●	●

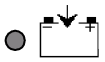
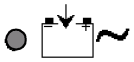
Performance Tests

The battery charge and battery performance test should be performed before monitor repairs whenever the battery is suspected as being a source of the problems. All other tests can be used following repairs or during routine maintenance (if required by your local institution). Before performing the battery performance test, ensure that the battery is fully charged. (See "Battery Charge" below).

This section is written using factory-set power-up defaults. If your institution has pre configured custom defaults, those values display.

Battery Charge

To fully charge the battery:

1. Connect the monitor to an AC power source using the proper power cord. For the A1, use the PS-120V or PS-240V external power supply and power cord.
2. • For the A1, verify that the **EXTERNAL POWER** indicator  is lit.
   • For the A3, verify that the **BATTERY CHARGING/AC SOURCE** indicator  is lit.
3. Charge the battery for at least 8 hours.

   The battery can require a complete discharge/charge cycle to restore its normal capacity, depending on its previous usage.
4. To check for a full charge, perform the procedure described in "Battery Performance Test" on page 12.

Battery Performance Test

The the A1 and A3 mono monitors are specified to typically operate on battery power for a minimum of 4 hours, at 25°C, with no printing, and one NiBP measurement every 15 minutes. The A3 color monitor is specified to typically operate on battery power for a minimum of 3 hours, at 25°C, with no printing, and one NiBP measurement every 15 minutes. Before performing this test, ensure that the battery is fully charged (see “Battery Charge”).

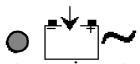
1. Connect the Nellcor Puritan Bennett SRC-2 pulse oximeter tester to the monitor via the M4787A sensor cable.
2. Connect the NiBP simulator to the monitor via the M3918A tubing.
3. Set the SRC-2 switches as follows:

SWITCH	POSITION
RATE	38
LIGHT	LOW
MODULATION	LOW
RCAL/MODE	RCAL 63/LOCAL

4. Set the NiBP simulator to simulate a pressure setting of 120/80 mmHg and heart rate of 80 bpm.
5. Ensure that the monitor is **not** connected to AC power.
6. With the monitor turned off, press the **ON/STANDBY** button  and verify that the battery icon appears at the bottom of the display after the power-on self-test is completed. The boxes in the battery icon should all be filled, indicating that the battery is charged.
7. Verify that the monitor is responding to the SpO_2 simulator signal and that the audible alarm is sounding. Use the wheel to select the SpO_2 Menu and permanently silence the SpO_2 audible alarm.
8. Use the wheel to select the NiBP Menu and set the Automatic Measurement Interval to 15 minutes. Exit the menu and press the front panel NiBP button  to manually start the first NiBP measurement. Subsequent NiBP measurements are taken automatically every 15 minutes.

9. The A1 and A3 mono monitors must operate for at least 4 hours before they automatically power down due to low battery condition. The A3 color monitor must operate for at least 3 hours before the monitor automatically powers down due to low battery condition.
10. Verify that the low battery alarm occurs 15-30 minutes before the battery fully discharges.
11. Allow the monitor to operate until it automatically powers down due to low battery condition. Verify that the audible alarm sounds when the monitor automatically shuts down. Press the Alarm Silence button to terminate this audible alarm.
12. If monitor passes this test, immediately recharge the battery. (See "Battery Charge" on page 11*)*.

Power-On Self-Test

1. Connect the monitor to an AC power source. For the A1, use the PS-120V or PS-240V power supply and power cord. For the A3, use the proper power cord supplied.
2. • For the A1, verify that the **EXTERNAL POWER** indicator  is lit.
   • For the A3, verify that the **BATTERY CHARGING/AC SOURCE** indicator  is lit.
3. Do not connect any input cables to the monitor.
4. Observe the monitor front panel. With the monitor off, press the **ON/STANDBY** button  . The monitor must perform the following sequence:
   a. The A1 emits a beep.
      The A3 emits three consecutively higher pitched beeps.
   b. A few seconds later, the display backlight illuminates, but the display is blank.
   c. The version numbers of the boot and operational software display in the lower left corner of the display.
   d. A beep signals the end of the power-on self-test. Power-on self-test takes approximately 10 seconds to complete.
   e. Upon successful completion of the power-on self-test, the display is in normal monitoring screen configuration. No vital-sign numeric values or waveforms are displayed.

Hardware and Software Tests

Hardware and software testing includes the following tests applicable to the indicated models in the series:

Test	Applies to Model(s)
SpO_2 Testing	A1, A3 - all models
Operation with an ECG Simulator	A1 - M3923A, M3924A A3 - all models
Operation with a Respiration Simulator	A3 - all models
Verification of Pneumatic System	A1, A3 - all models
Operation with a Temperature Simulator	A1 - M3922A, M3924A A3 - all models
General Operation	A1, A3 - all models

SpO_2 Testing

SpO_2 testing includes the following tests:

- Alarms and Alarm Silence
- Heart Rate Tone Volume Control
- Dynamic Operating Range
- LED Excitation Test

Alarms and Alarm Silence

1. Connect the SRC-2 pulse oximeter tester to the M4787A sensor cable and connect the cable to the monitor.
2. Set SRC-2 as follows:

SWITCH	POSITION
RATE	38
LIGHT	LOW
MODULATION	OFF
RCAL/MODE	RCAL 63/LOCAL

3. Press the **ON/STANDBY**  button to turn the monitor on.
4. After the normal power-up sequence, verify that the SpO_2% display initially

indicates zero or is blank. The pulse bar can occasionally indicate a step change as the monitor is in the pulse search mode.

5. Move the modulation switch on the SRC-2 to LOW.
6. Verify the following monitor reaction:
   a. The pulse bar begins to track the artificial pulse signal from the SRC-2.
   b. Initially, zero is displayed in the SpO_2 frame, or it is blank.
   c. After about 10 to 20 seconds, the monitor displays saturation and heart rate as specified by the tester. Verify that the values are within the following tolerances:

      Oxygen Saturation Range 79% to 83%

      Heart Rate Range 35 to 41 bpm

   d. The audible alarm sounds and both the SpO_2% and HEART RATE displays flash, indicating both parameters have violated the default alarm limits.
   e. The heart rate tone is heard. For this test, the user should set the heart rate tone source to SpO_2 from the Heart Rate Menu.
7. Press the **ALARM SILENCE** button  on the front panel of the monitor. The audible alarm is temporarily silenced.
8. Verify the following:
   a. The audible alarm remains silenced.
   b. The slashed bell icon appears in each numeric frame on the display.
   c. The SpO_2% and **HEART RATE** displays continue flashing.
   d. The heart rate tone remains audible.
   e. The audible alarm returns in approximately 60 seconds.

Heart Rate Tone Volume Control

1. Connect the SRC-2 pulse oximeter tester to the M4787A sensor cable and connect the cable to the monitor.
2. Set SRC-2 as follows:

SWITCH	POSITION	
	A1	**A3**
RATE	38	38
LIGHT	LOW	LOW
MODULATION	LOW	OFF
RCAL/MODE	RCAL 63/LOCAL	RCAL 63/LOCAL

3. Power on the monitor and verify that the SpO_2 and heart rate values are correctly displayed.
4. Press the **ALARM SILENCE** button  on the front panel of the monitor to temporarily silence the audible alarm.
5. Verify that the heart rate tone source, found in the Heart Rate Menu, is set to **SpO$_2$**.
6. Press the Heart Rate Tone **VOLUME** button  on the front panel of the monitor. Within 3 seconds of having pressed the button, rotate the wheel clockwise and verify that the beeping heart rate tone sound level increases.
7. Rotate the wheel counterclockwise and verify that the beeping heart rate tone decreases until it is no longer audible. Rotate the wheel clockwise to return the beep volume to a comfortable level.

3 seconds after the last button-press or rotation of the wheel, function of the wheel reverts to moving the highlight on the display screen.

Dynamic Operating Range

The following test sequence verifies proper monitor operation over a range of input signals.

1. Connect the pulse oximeter tester to the monitor and turn the monitor on.
2. Place the SRC-2 pulse oximeter tester in the **RCAL 63/LOCAL** mode.
3. Set the SRC-2 as indicated in below. Verify that the monitor readings are within the indicated tolerances. Allow the monitor several seconds to stabilize the readings.

Table 4 SRC 2 Settings and Monitor Indications

SRC-2 Settings			Monitor Indications	
RATE	**LIGHT**	**MODULATION**	**SpO2**	**Pulse Rate**
38	HIGH2	LOW	79-83*	35-41*
112	HIGH1	HIGH	79-83*	109-115
201	LOW	LOW	79-83*	195-207*
201	LOW	HIGH	79-83*	195-207*

An * indicates values that produce an alarm. Press the ALARM SILENCE button to temporarily silence the audible alarm.

For the pulse rate setting of 201 bpm, the pulse rate tolerance of 195 to 207 bpm is greater than the ±3 bpm accuracy specification of the monitor, due to the performance characteristics of the SRC-2 tester.

4. Turn the monitor off.

LED Excitation Test

This procedure uses normal system components to test circuit operation. A

Nellcor Puritan Bennett *Oxisensor II* adhesive sensor, model D-25, is used to examine LED intensity control. The red LED is used to verify intensity modulation caused by the LED intensity control circuit.

1. Connect a M4787A sensor extension cable to the monitor.
2. Connect a D-25 sensor to the sensor extension cable.
3. Press the **ON/STANDBY** button  to turn the monitor on.
4. Leave the sensor open with the LED and photo detector visible.
5. After the monitor completes its normal power-up sequence, verify that the sensor LED is brightly lit.
6. Slowly move the sensor LED in proximity to the photo detector element of the sensor. Verify, as the LED approaches the optical sensor, that the LED intensity decreases.
7. Open the sensor and notice that the LED intensity increases.
8. Repeat step 6 and the intensity again decreases. This variation is an indication that the micro-processor is in proper control of LED intensity.
9. Turn the monitor off.

Operation with an ECG Simulator

1. With the monitor off, connect the ECG leads to the appropriate jacks on the ECG tester.
2. Connect the leads to the ECG cable.
3. Connect the cable to the ECG input port on the monitor.
4. Set the ECG simulator as follows:

Heart rate:	30 bpm
Amplitude:	1 millivolt
Lead select:	II
Wave Type:	Normal sinus rhythm
Patient Type:	Adult mode

Note

The accuracy of the monitor's ECG measurements is ±5 bpm. In the procedure below, add the tolerance of the simulator to the acceptable range of readings.

5. Press On/Standby button  to turn monitor on.

6. After normal power-up sequence, verify the following monitor reactions:
   a. After at least five heartbeats, the monitor displays a heart rate of 30 ±5 bpm.
   b. The audible alarm sounds and the **HEART RATE** display flashes, indicating heart rate is below the default lower alarm limit.
7. Press the **ALARM SILENCE**  button. Verify that the audible alarm is silenced.
8. Increase the heart rate setting on the ECG simulator to 240 bpm.
9. After at least five heartbeats, verify that the monitor displays a heart rate of 240 ±5 bpm.
10. Verify that the audible alarm sounds and the **HEART RATE** display flashes, indicating that the heart rate is above the default upper alarm limit.
11. Press **ALARM SILENCE**  button to silence alarm.
12. Decrease the heart rate setting on ECG simulator to 120 bpm.
13. After at least five heartbeats, verify that the monitor displays a heart rate of 120 ±5 bpm.
14. Disconnect the LL lead from ECG simulator.
15. Verify that the **Leads Off** alarm message appears, three dashes are displayed in **HEART RATE** display, and the low priority audible alarm sounds.
16. Reconnect the LL lead to ECG simulator. Verify that the **Leads Off** alarm message no longer appears and audible alarm is silenced.
17. Repeat steps 14 through 16 for LA and RA leads.
18. Turn the monitor off.

Operation with a Respiration Simulator (A3 only)

1. With the monitor off, connect the ECG leads to the appropriate jacks on the respiration simulator.
2. Connect the ECG leads to the ECG cable.
3. Connect the cable to the ECG input port on the monitor.

Note

The accuracy of A3 measurements is ±3 breaths per minute. In the procedure below, add the tolerance of the simulator to the acceptable range of readings.

---

4. Set the simulator for a respiration rate of 120 breaths per minute.
5. Press the **ON/STANDBY** button  to turn the monitor on.

6. After the normal power-up sequence, verify the following monitor reactions:
   a. The monitor displays a respiration rate of 120 ±3 breaths per minute.
   b. The audible alarm sounds and **RESPIRATION RATE** display flashes, indicating respiration rate is above default upper alarm limit.
7. Press the **ALARM SILENCE** button  . Verify that the alarm is silenced.
8. Decrease the respiration rate setting on the respiration simulator to 20 breaths per minute.
9. Verify that the monitor displays a respiration rate of 20 ±3 breaths per minute.

Verification of Pneumatic System

The following tests, from “Basic Pneumatic Leakage Test” on page 19 through “Over-Pressure” on page 23, verify the functionality of the pneumatic system of the monitor. All these tests, with the exception of the Basic Pneumatic Leakage Test, require the use of an appropriate NiBP simulator. Although the tests were designed to use the Bio-Tek BP Pump noninvasive blood pressure simulator, any equivalent NiBP simulator with the same internal test volume can be used. The internal test volume of the Bio-Tek simulator is 250 ml.

The monitor must be placed in Diagnostic Mode, with the NiBP Test screen active for each of the NiBP tests. For a detailed explanation of the Diagnostic Mode, refer to Chapter 4, “Power-up Defaults Menu And Diagnostic Mode”.

Basic Pneumatic Leakage Test

The purpose of this test is to verify the integrity of the NiBP Pneumatic System after the monitor has been opened. This covers all external and internal tubing and tubing connections. No simulator is required for this test.

In cases where the performance of the NiBP is in question or could have been compromised during repair the complete set of NiBP performance tests described in this service manual should be used (see test map, page 8, for guidance).

1. Attach an NiBP cuff (adult model 40401C is recommended) and the NiBP adapter cable to the monitor NiBP connector.
2. Wrap the cuff around itself and place on a table for the test, DO NOT place the cuff on your arm.

3. Power on the monitor and enter the NiBP test screen.
   a. Use the wheel to select Set up menu (screwdriver icon  on bottom of screen.)
   b. Select the Power up defaults menu.
   c. Use the wheel to select password 2-1-5.
   d. Select **`Enter Diagnostic Mode= yes`**.
   e. Select NBP test.
4. Press the Heart Rate Tone **VOLUME** button  to close valves.
5. Press NBP start/stop switch, hold until the monitor screen shows 250 mmHg.
6. Wait 15-20 seconds to allow the value to stabilize.
7. Note the value on the screen, start 1-minute timer.
8. After 1 minute note the value on the screen, if the difference is less than or equal to 6 mmHg the test has passed.
9. Press and hold the Heart Rate Tone **VOLUME** button  until the screen shows the pressure has released and the value is 0 mmHg.
10. Turn the monitor off.

Note

If the test fails, ensure the integrity of the cuff and adapter tubing, then test again. If the test fails again, verify the integrity of all the pneumatic system tubing inside the monitor. If the test still does not pass, see test map, page 8.

Each of the tests mentioned below must be performed to verify pneumatic system functionality. These tests can be performed individually (in any order) or sequentially. Prior to performing any of these tests, perform the following setup procedure. If these tests are performed in sequence, this procedure needs to be performed once prior to the first test.

1. Turn on the Bio-Tek simulator and press the **MODE** button to place the simulator in test mode. The simulator screen indicates **`Internal Cuff`** and **`Pressure Gauge`**.
2. Connect the simulator tubing to the NiBP connector on the monitor.
3. Follow the procedure described in Chapter 4 to place the monitor in Diagnostic Mode with the NiBP Test screen active.

Pressure Transducer Accuracy

The pressure transducer accuracy test verifies the pressure accuracy of the monitor's pressure transducer.

1. Confirm that the Bio-Tek simulator is in test mode. The simulator should display **`Pressure Gauge`**.
2. Confirm that the simulator is set up for the internal cuff.
3. Confirm that the NiBP Test screen is active on the monitor.
   - On the A1, press, then release, the Heart Rate Tone **VOLUME** button  to verify that the valve is closed.
   - On the A3, press the **ALARM SILENCE** button  to ensure that both valves are closed.
4. Perform an offset adjustment so that the simulator and monitor both display a pressure of 0 mmHg by doing the following:
   a. Press the **CONTRAST**  button on the monitor.
   b. Press the **ZERO** button on the simulator.
5. Press the **SELECT** button on the simulator until the simulator displays **`Pressure Source Set Test Pressure`**.
6. Use the **UP/DOWN** buttons on the simulator to adjust for a pressure of 250 mmHg.
7. Press the **START PUMP** button on the simulator. The simulator begins to pressurize. The current pressure in mmHg is displayed on both the simulator and the monitor displays.
8. Allow 15-20 seconds for the pressure to stabilize.

   The pressure displayed on the monitor and the simulator should be within 5 mmHg of one another to complete the test successfully.
9. Press the **STOP PUMP** button on the simulator to stop the test.
10. Press and hold the Heart Rate Tone **VOLUME** button  until the monitor displays a pressure of 0 mmHg.

Additional NiBP tests can be performed at this time. If no further NiBP tests are to be conducted, turn the monitor off. Normal monitoring operation returns the next time the monitor is turned on.

Pneumatic Leakage

The pneumatic leakage test verifies the integrity of the pneumatic system.

1. Ensure that the Bio-Tek simulator is in test mode. The simulator should display **`Pressure Gauge`**.
2. Confirm that the simulator is set up for the internal cuff.
3. Ensure that the NiBP Test screen is active on the monitor.
4. Press the Heart Rate Tone **VOLUME** button  on the monitor.
   - On the A1, this verifies that the valve is closed.
   - On the A3, this verifies that both the valves are closed.
5. Perform an offset adjustment so that the simulator and monitor both display a pressure of 0 mmHg by doing the following:
   a. Press the **CONTRAST** button  on the monitor.
   b. Press the **ZERO** button on the simulator.
6. Press the **NiBP** button  on the monitor to activate the pump.
7. Hold the **NiBP** button  until the monitor displays a pressure of approximately 250 mmHg.
8. Allow 15-20 seconds for the pressure to stabilize.
9. Record the pressure displayed on the monitor.
10. Start a 1 minute timer.
11. After 1 minute, again record the pressure displayed.

    The test is successfully completed if the pressure has dropped by 6 mmHg, or less, during the 1 minute period.
12. Press and hold the Heart Rate Tone **VOLUME** button  until the monitor displays a pressure of 0 mmHg.

Additional NiBP tests can be performed at this time. If no further NiBP tests are to be conducted, turn the monitor off. Normal monitoring operation returns the next time the monitor is turned on.

Inflation Rate

The inflation rate test verifies the inflation rate of the monitor.

1. Ensure that the Bio-Tek simulator is in test mode. The simulator should display **`Pressure Gauge`**.
2. Confirm that the simulator is set up for the internal cuff.
3. Ensure that the NiBP Test screen is active on the monitor.
4. Press the Heart Rate Tone **VOLUME** button  on the monitor.
   - On the A1, this verifies that the valve is closed.
   - On the A3, this verifies that both the valves are closed.
5. Perform an offset adjustment so that the simulator and monitor both display a pressure of 0 mmHg by doing the following:
   a. Press the **CONTRAST** button  on the monitor.
   b. Press the **ZERO** button on the simulator.
1. Press the **NiBP** button  on the monitor to activate the pump, and simultaneously start the timer.
2. Hold the **NiBP** button  until the monitor displays a pressure of 280 mmHg, then stop the timer.

   The test is successfully completed if the inflation time is between 1 and 6 seconds.
3. Press and hold the Heart Rate Tone **VOLUME** button  until the monitor displays a pressure of 0 mmHg.

Additional NiBP tests can be performed at this time. If no further NiBP tests are to be conducted, turn the monitor off. Normal monitoring operation returns the next time the monitor is turned on.

Over-Pressure

The over-pressure test verifies the functionality of the over-pressure relief system of the monitor.

1. Ensure that the Bio-Tek simulator is in test mode. The simulator should display **`Pressure Gauge`**.
2. Confirm that the simulator is set up for the internal cuff.
3. Ensure that the NiBP Test screen is active on the monitor.
4. Press the Heart Rate Tone **VOLUME** button  on the monitor.
   - On the A1, this verifies that the valve is closed.
   - On the A3, this verifies that both the valves are closed.
5. Perform an offset adjustment so that the simulator and monitor both display a

pressure of 0 mmHg by doing the following:

a. Press the **CONTRAST** button  on the monitor.

b. Press the **ZERO** button on the simulator.

6. Press the **NiBP** button  on the monitor to activate the pump.

7. Hold the **NiBP** button  until the monitor displays a pressure of approximately 250 mmHg.

8. Press the **SELECT** button on the simulator until the simulator displays **`Overpressure Test`**.

9. Press the **START TEST** button on the simulator. The simulator pressurizes the system until the monitor's overpressure relief system activates, including the warning display screen. The simulator displays the pressure value that caused the monitor's overpressure relief system to activate. The test is successfully completed if the simulator displays a pressure reading of 280 mmHg to 330 mmHg.

10. Press and hold the Heart Rate Tone **VOLUME** button  to ensure that the monitor displays a pressure of 0 mmHg.

Additional NiBP tests can be performed at this time. If no further NiBP tests are to be conducted, turn the monitor off. Normal monitoring operation returns the next time the monitor is turned on.

Deflation Rate

The deflation rate test verifies the deflation rate of the A3 monitor. (There is no deflation rate test for the A1).

1. Ensure that the Bio-Tek simulator is in test mode. The simulator should display **`Pressure Gauge`**.

2. Confirm that the simulator is set up for the internal cuff.

3. Ensure that the NiBP Test screen is active on the monitor.

4. Press the Heart Rate Tone **VOLUME** button  on the monitor. This verifies that both the valves are closed.

5. Perform an offset adjustment so that the simulator and monitor both display a pressure of 0 mmHg by doing the following:

a. Press the **CONTRAST** button  on the monitor.

b. Press the **ZERO** button on the simulator.

6. Press the **NiBP** button  on the monitor to activate the pump.

7. Hold the **NiBP** button  until the monitor displays a pressure of approximately 250 mmHg.
8. Start 1 minute timer, and simultaneously press and hold the **ALARM SILENCE** button  on the monitor.

   This causes the pneumatic system to deflate at a rate of 3 mmHg/s ±1.5 mmHg/s.
9. After 1 minute, record the pressure displayed on the monitor. The test has been successfully completed if the monitor displays a pressure reading of 10 mmHg to 190 mmHg.
10. Press and hold Heart Rate Tone **VOLUME** button  until monitor displays a pressure of 0 mmHg.

Additional NIBP tests can be performed at this time. If no further NiBP tests are to be conducted, turn the monitor off. Normal monitoring operation returns the next time the monitor is turned on.

Operation with a Temperature Simulator (A1 only)

1. Remove the probe from its holder.
2. Insert the calibration key in the temperature input port ***T*** on the A1.
3. Press the **ON/STANDBY** button  to turn the monitor on. After the normal power-up sequence, verify that the temperature reads 36.3 ± 0.1°C (or 97.3 ± 0.2°F).
4. Turn the monitor off.

Operation with a Temperature Simulator (A3 only)

1. With monitor off, connect the temperature cable (supplied with the temperature simulator) to the appropriate connector on temperature simulator.
2. Connect the temperature cable to the temperature input port on the A3.
3. Set the temperature simulator as follows:

   Temperature: 37°C (98.6°F)

   Probe Type: YSI 400 Series

Note

The accuracy of A3 temperature measurements is ±0.1°C (±0.2°F). In the procedure below, add the tolerance of the simulator to the acceptable range of readings.

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4. Press the **ON/STANDBY** button  to turn monitor on.
5. After normal power-up sequence, verify temperature reads 37°C ±0.1°C (98.6°F ±0.2°F if Fahrenheit is selected as temperature units.)
6. Turn the monitor off.

General Operation

The following tests provide an overall performance check of the system:

- Serial Interface Test
- Printer Verification (for optional printer - A1 only)

Serial Interface Test

Note — Perform only if nurse call signal is used.

Perform the following procedure to test the serial port voltages. The test is qualitative and only verifies that the serial interface port is powered correctly, and that the Nurse Call signal is operational. The serial connector is a male DB-9 located on the monitor's real panel, identified with the RS-232 symbol

 ***RS-232*** .

1. Turn the monitor on.
2. Set up the DMM with the function set to **VDC** at a range of 10 volts.
3. Connect the DMM negative lead to connector pin 5 (GND), or the shell of the RS-232 connector.
4. Referring to the following table, connect the DMM positive lead to each pin in turn, and verify the voltage values listed. Voltage for pin 9 is that listed for the **`no alarm`** condition.

Table 5 Serial Interface Voltages

Pin	Signal	Direction	Measurement (V)		
			Min.	Typical	Max.
1	not used		0.4	0.0	0.4
2	RXD<<<	input	–0.4	0.0	0.4
3	TXD>>>	output	–0.5	–9.0	–15.0
4	DTR>>>	output	–5.0	–9.0	–15.0
5	GND		–0.4	0.0	0.4
6	DSR<<<	input	–0.4	0.0	0.4
7	RTS>>>	output	–5.0	–9.0	–15.0
8	CTS<<<	input	–0.4	0.0	0.4
9	Alarm Out>>> (no alarm)	output	–5.0	–9.0	–15.0
9	Alarm Out>>> (alarm underway)	output	5.0	9.0	15.0

5. Connect the Nellcor Puritan Bennett SRC-2 pulse oximeter tester to the monitor via the M4787A sensor extension cable.
6. Set the SRC-2 switches as follows:

SWITCH	POSITION
RATE	38
LIGHT	LOW
MODULATION	LOW
RCAL/MODE	RCAL 63/LOCAL

7. Verify that the monitor is responding to the SpO_2 simulator signal and the audible alarm is sounding. If desired, press the **ALARM SILENCE** button  to temporarily silence the audible alarm.
8. Connect the DMM positive lead to pin 9 and verify the voltage value listed in Table 5. Voltage for pin 9 is that listed for the **`alarm underway`** condition.

Printer Verification (For A1 Optional Printer M3925A)

Printer verification consists of connecting the printer to the monitor and the monitor to a human subject for a qualitative test.

1. Connect the output of the appropriate power supply, PS-240V or PS-120V, to the labeled connector 15V ~ 1A on the rear of the printer. When the printer's external power supply is connected, the printer front-panel charging LED is lit.
2. Connect the serial cable between the labeled connectors RS-232 on the rear panels of the monitor and the printer.
3. The printer front panel communication LED is lit when the RS-232 communications link is completed.
4. Rotate the monitor wheel to highlight the setup icon . Press the wheel and ensure Communications Selection is **Printer**.
5. Connect a M4787A sensor extension cable to the monitor. Connect an oxygen transducer to the sensor extension cable. Attach it to the subject as described in the sensor directions for use.
6. Press the **ON/STANDBY** button to turn the monitor on and verify that the monitor is operating.
7. The monitor should stabilize on the subject's physiological signal in about 15 to 30 seconds. Verify that the saturation and heart rate is reasonable for the subject.
8. Press the printer **CONTINUOUS** button . Verify that the printout contains vital signs across the top of the paper, and that a SpO_2 waveform, with grid marks, occupies the center portion of the paper. To terminate the printout, press the **CONTINUOUS** button again.
9. Disconnect the sensor and shut off the monitor.

Safety Tests

Philips safety tests meet the standards of, and are performed in accordance with IEC 601-1, Clause 19 (EN60601-1, Second Edition, 1988; Amendment 1, 1991-11, Amendment 2, 1995-03).

The A1 patient monitor is a Class II device. It is double insulated and does not require a protective earth (ground) wire. The A3 patient monitor is a Class I device. It requires a protective earth (ground) wire. Test requirements differ for Class I and Class II devices. Be aware of the differences and use the appropriate test procedure for the monitor in use.

There are two categories of safety tests:

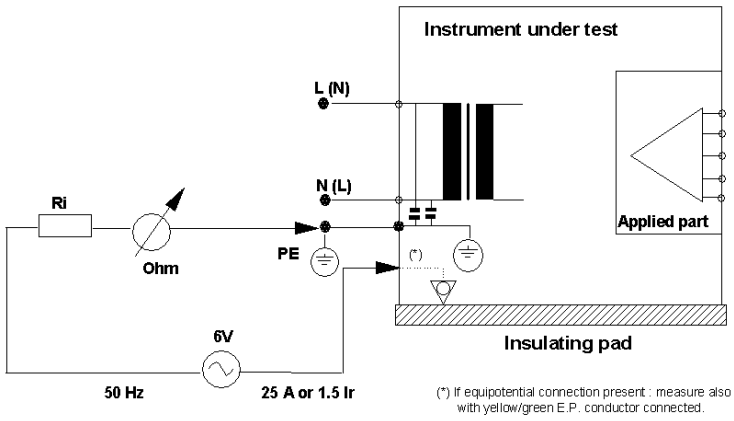
- Ground Integrity
- Electrical Leakage

Ground Integrity

Table 6 Ground Integrity

Test or “Inspection” to Perform	Expected Test Results
Protective Earth See “Safety Test Diagram - Protective Earth” on page 30	With mains cable: Maximum impedance = x <= 100 mOhms

Safety Test Diagram - Protective Earth

Test or Inspection to Perform

Measures impedance of Protective Earth (PE) terminal to all exposed metal parts of IUT, which are for safety reasons connected to the Protective Earth (PE). Max. 100 mOhm. Test current 25 Amps applied for 5 to 10 seconds. We recommend to flex the main cable during the test in order to identify potential **bad** contact or damage of the earth wire. *Safety test according to EN60601-1 (Clause 18).* Report largest value.

Note

The A1 does not require an isolated Earth Ground terminal, neither is one installed. No Protective Ground Continuity check is required.

Electrical Leakage

The following tests verify the electrical leakage of the monitor:

- Earth Leakage Current (A3 only)
- Enclosure Leakage Current
- Patient Leakage Current
- Patient Source Current, with Mains Voltage on the Applied Part

Perform all leakage tests any time the unit is opened.

Earth Leakage Current (A3 only)

This test is in compliance with IEC 601-1 (Earth Leakage Current). In locations where mains voltage is 100-120 volts, the applied voltage is 132 volts. In locations where mains voltage is 220-240 volts, the applied voltage is 264 volts. The applied AC frequency should be the same as the local mains (50 or 60 Hz).

All measurements shall be made with the power switch in both **ON** and **OFF** positions.

1. Connect the monitor AC plug to the electrical safety analyzer as recommended by the analyzer operating instructions.
2. Perform test as recommended by analyzer operating instructions.

Earth leakage current is measured under various conditions of the AC mains and protective earth conductor. For each condition, the measured leakage current must not exceed that indicated below

Table 7 Earth Leakage Current Values (A3 Only).

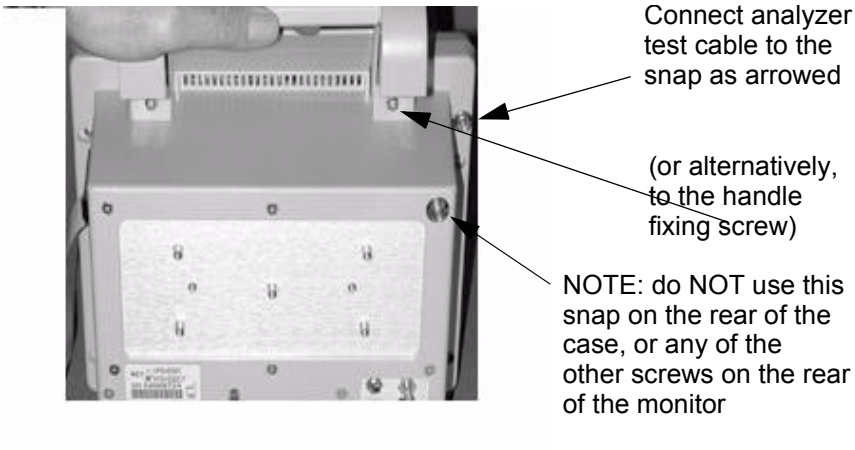
Test Condition	Polarity	Allowable Leakage Current
Normal	Normal	300 µA
	Reversed	300 µA
S.F.C[1] Open Supply	Normal	1000 µA
	Reversed	1000 µA

1. S.F.C = Single Fault Condition

Enclosure Leakage Current

This test is compliance with EN60601-1 (Enclosure Leakage Current). Test at 110% of the nominal line voltage.

1. Connect the A3's AC mains power cord to the analyzer as recommended by the analyzer operating instructions.
2. Using the appropriate test cable, connect the analyzer to the snap nearest to the handle fixing screw as shown in the following photograph.



3. Turn the monitor on.
4. Perform the test as recommended by the analyzer operating instructions.

The analyzer leakage current indication must not exceed the values listed below.

Table 8 Enclosure Leakage Current

EN60601-1 (1990 + A1, A2, A11, A12, A13) and UL2601 (2nd Ed. 1997) US Deviations

Test Condition	Polarity	Allowable Leakage Current
Normal	Normal	100 µA
	Reversed	100 µA
S.F.C[1] Open Supply (A1 Only)	Normal	150 µA
	Reversed	150 µA
S.F.C[1] Open Protective Earth (A3 Only)	Normal	300 µA
	Reversed	300 µA

1. S.F.C = Single Fault Condition

Patient Leakage Current

This test measures patient leakage current in accordance with EN60601-1, Clause 19, for Class I, type CF equipment. Patient leakage current in this test is measured from any individual patient connection to earth (power ground).

This test requires a sample patient cable for each device parameter. These must be configured as recommended by the safety analyzer operating instructions.

1. Configure the electrical safety analyzer as recommended by the analyzer operating instructions.
2. • A1 - Connect the appropriate external power supply input power cord to the analyzer as recommended by the analyzer operating instructions. Connect the external power supply output cord to the monitor.
   • A3 - Connect the monitor's AC mains power cord to the analyzer as recommended by analyzer operating instructions.
3. Connect the ECG test cable between the ECG connector on the monitor and the appropriate input connector on the analyzer.
4. Turn the monitor on.
5. Perform the test as recommended by the analyzer operating instructions.

   Patient leakage current is measured under various conditions of the AC mains and protective earth conductor. For each condition, the measured leakage current must not exceed that indicated below.
6. Repeat the test for SpO_2 and temperature patient connections, using appropriate test cables.

Table 9 Patient Leakage Current Values

Test Condition	Polarity	Allowable Leakage Current (Max.)
		Type CF
Normal	Normal	10 µA
	Reversed	10 µA
S.F.C.[1] (Open Supply) (A1 Only)	Normal	50 µA
	Reversed	50 µA
S.F.C.[1](Open Earth/Ground) (A3 Only)	Normal	50 µA
	Reversed	50 µA

1. S.F.C. = Single Fault Condition

Patient Leakage Current, with Mains Voltage on the Applied Part

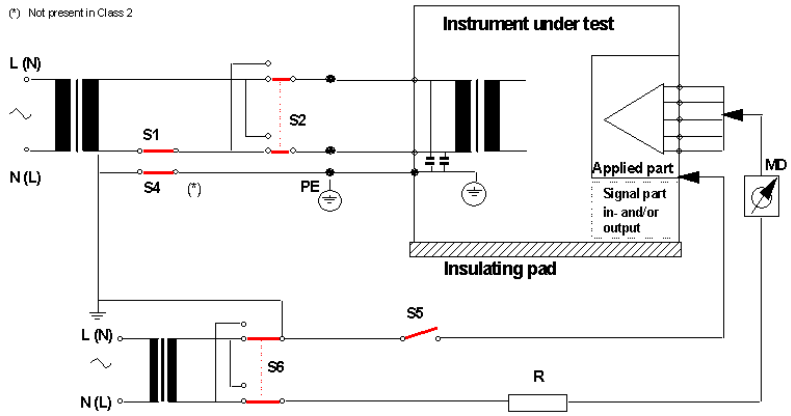
This test measures patient leakage current in accordance with EN60601-1, Clause 19, for Class I, type CF equipment. In this test, 110% of mains voltage is applied between each patient connection and earth (power ground). Patient leakage current is then measured from any individual patient connection to earth.

Warning ***AC mains voltage is present on the applied part terminals during this test. Exercise caution to avoid electrical shock hazard.***

Table 10 Safety Tests - Patient Leakage Current, with Mains Voltage on the Applied Part

Test or "Inspection" to Perform	Expected Test Results
Patient Leakage Current - AC See "Safety Test Diagram - Patient Leakage Current - AC" on page 35	Maximum leakage current = x <= 50 µA @ 250V (IEC601-1 or UL2601-1) Test at 110% of the nominal line voltage.

Safety Test Diagram - Patient Leakage Current - AC

Test or Inspection to Perform

Measures patient leakage current from Applied Part to earth caused by external mains voltage on Applied Part with switch S5 open and closed. Each polarity combination possible is tested using S2 and S6. *Safety test according to EN60601-1 (Clause 19.4.h).* Report largest value.

4
Power-up Defaults Menu And Diagnostic Mode

Introduction

This section discusses use of the Power-up Defaults Menu to configure power-on default settings, and the Diagnostic Mode to obtain service-related information about the monitor.

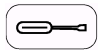
Power-up Defaults Menu

The purpose of the Power-up Defaults Menu is to allow the authorized user to create a power-up default for each setting in the monitor. Power-up defaults are the settings in effect each time the monitor is powered on. Once the Power-up Defaults Menu is entered, physiological monitoring is terminated. The screen layouts do not display any information associated with normal monitoring operation.

Use the following procedure to configure the power-up default settings for the monitor:

1. Set the monitor to normal monitoring mode.
2. Adjust each accessible setting on the monitor as desired.

Note — Use the techniques described in the *User Guide*. Such settings include alarm limits, choice of display type for the graphic frames, and ECG lead select.

3. Use the wheel to invoke the Set-up Menu (choose the screwdriver icon  found along the bottom of the display).
4. Select menu item **`Enter Power-Up Defaults Menu`**. Once selected, a pop-up box will appear with the text **`Enter 3-Digit Passcode`**.
5. Use the wheel to enter the passcode, **`2 1 5`**.

Note — This passcode is set at the factory and cannot be changed.

6. The Power-up Defaults Menu is now present. The available menu items are explained below. Make changes to these menu items as desired.

Menu Item*	Choices**	Explanation
Accept Current Settings as Power-Up Defaults?	**Yes** No	If **Yes** is chosen, the current monitor settings become the power-up defaults.
Adult/Neonatal Mode (A3 only)		Neonatal mode is not available at this time; thus, when this item is selected, the following pop-up message will appear: **Selection not available**.
Alarm Silence Period	30 s, 60 s, 90 s, 120 s	Time is indicated in seconds. Pressing the front-panel **Alarm Silence** button temporarily silences audible alarms for the time indicated in the Silence Period menu item. Alarm state(s) in effect at the end of the pre-set interval cause the audible alarm to sound. Pressing the **Alarm Silence** button a second time (while the silence interval is still in effect) ends the interval immediately. Silencing audible alarms does not affect visual alarm indications.
Permanent Audible Alarm Silent	**Make Available** Deny Access	If **Make Available** is chosen, the caregiver may permanently silence the audible alarm for a particular parameter via the Alarm/Limits Menu. Some institutions may wish to prevent audible alarms from being permanently silenced. If so, **Deny Access** should be selected.
Alarm Suspend	Make Available **Deny Access**	If **Make Available** is chosen, the caregiver may invoke the Alarm Suspend Mode by pressing and holding the **Alarm Silence** button for 2 seconds. Some institutions may wish to prevent Alarm Suspend from being invoked. If so, **Deny Access** should be selected.
Auto-Set Limits	**Make Available** Deny Access	If **Make Available** is chosen, the caregiver may invoke the Auto-Set Limits function via the Alarm/Limits Menu. Some institutions may wish to prevent Auto-Set Limits from being invoked. If so, **Deny Access** should be selected.
SpotCheck Mode (A1 only)	**Deny Access** Make Available	If **Make Available** is chosen, the caregiver will invoke the SpotCheck Mode as one of four choices available through the Display icon in the Menu Frame. The factory default is to **Deny Access**, allowing only three choices available through the Display icon in the Menu Frame.

Menu Item*	Choices**	Explanation
Language***	English French German Italian Japanese Portuguese Spanish Russian Chinese Dutch Turkish Arabic Norwegian Swedish Finnish Polish Czech	The language selected will be used for all the text shown on the display; the selected language will be effective the next time the monitor is powered up. **Note: Language selection screen upon boot up can be reactivated by following the steps listed in the section *Restoring Factory Settings*.**
Enter Diagnostic Mode	Yes No	If **Yes** is chosen, the Power-up Defaults Menu is exited and the Diagnostic Menu appears.
Done		When selected, the Power-up Defaults Menu is immediately exited and the user is instructed to power down the monitor.
* The choice in effect at the time the screen is accessed is shown in parentheses following the menu item.		
** Bold type indicates the choice when the factory-set default menu appears. The highlighting is displayed in reverse video.		
*** Although the language choices are shown here in English, they appear in their own respective language and script on the Boot Up Screen and in the Power-up Defaults Menu.		

7. After making any desired changes to the menu items, choose the menu item **Accept current setting?**
8. Select **YES**.
9. Select **Done**.

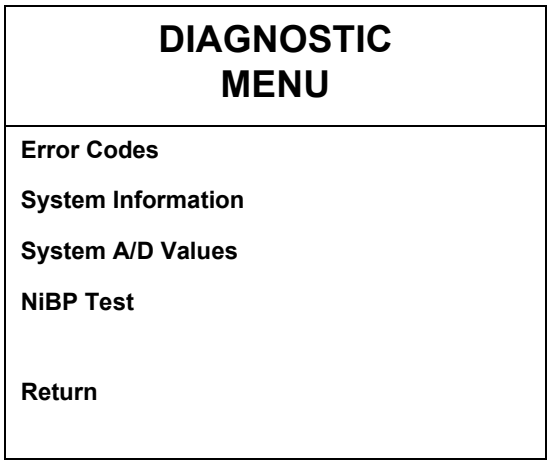
Upon selecting **Done**, a Notice Screen appears, with the directions that the monitor must be powered off, and that any changes made to the power-up defaults are in effect the next time the unit is powered up.

Diagnostic Mode

The purpose of Diagnostic Mode is to allow factory, field-service, and hospital biomedical technicians access to a series of test and system-related information screens for the purpose of verifying monitor performance or troubleshooting problems.

To access the Diagnostic Mode:

1. Invoke the Power-up Defaults Menu. (See “Power-up Defaults Menu” on page 37.).
2. Select the menu item, **`Enter Diagnostic Mode`**.
3. Choose **`Yes`**. The Power-up Defaults Menu is exited and the Diagnostic menu appears.



The Diagnostic Menu lists the test and system-related information screens. Selection of an item in the menu invokes that test or information screen. The test and information screens that appear in the Diagnostic menu are as follows:

- Error Codes
- System Information
- System A/D Values
- NiBP Test
- Return

Error Codes

This screen displays the 10 most recent error code types, logged by the monitor. After 10 error code types have been logged, the oldest error code type is deleted as new error code types are added. Adjacent to each error code is an entry which is the number of occurrences of that error. This means that if there are many occurrences of one type of error code, that one error code won’t overwrite the other 9 error codes.

Next to the occurrence field is the time and date of the most recent occurrence of the

error code. Error codes cannot be changed or reset in this screen. When in the Error Code screen, the **Return** item is always highlighted; a press of the wheel returns the user to the Diagnostic Menu. Rotating the wheel while in the Error Code screen has no effect.

Refer to “Error Codes”, Chapter 5, for more detail on error codes.

System Information

SYSTEM INFORMATION	
Monitor On-Time	**1563**
Backlight On-Time	**871**
Recorder On-Time[1]	**37**
Battery Deep Discharges	**152**
System Software Version	**V1.02**
SpO_2 Software Version	**V1.2.0**
Return	

1. A3 only

This screen displays several system-related items:

- **Monitor On-time**: Displays the number of hours, rounded to the nearest hour, that the Main PCB has been operational. This value cannot be reset.

Note — The Monitor On-time, Backlight On-time, and Battery Deep Discharge values are stored in nonvolatile memory. When a new Main PCB is installed, this value is reset to zero.

- **Backlight On-time**: Displays the number of hours, rounded to the nearest hour, that the LCD Backlight has been operational. This value can be reset to zero, for instance at the time when a technician changes the backlight or installs a new LCD.
- **Recorder On-time**: Displays the number of hours, rounded to the nearest hour, that the A3 Recorder has been

operational. This value can be reset to zero, for instance at the time when a technician installs a new recorder.

- **Battery Deep Discharges**: Displays the number of deep-discharge cycles seen by the battery. The monitor records a deep discharge cycle when the battery volt-age reaches 5.6 volts, the voltage at which a **`Low Battery`** alarm is issued. This value can be reset to zero, for instance at the time when a technician installs a new battery.
- **System Software Version**: Displays the revision level of the system software. The revision level is also momentarily shown on the LCD as part of the Copyright screen. This value cannot be changed by the user.
- **SpO_2 Software Version**: Displays the revision level of the software of the MP-205 SpO_2 module. This value cannot be changed by the user.

When in the System Information screen, the wheel can be rotated to select any of the changeable items. If one of those items is selected, a press of the wheel causes a pop-up menu to appear. The first item in the pop-up reads **`Make no change`**; the second item in the pop-up reads **`Reset to zero`**. Exiting the screen is accomplished in the normal manner, by selecting **`Return`**.

System A/D Values

The System A/D screen displays the current value of each analog-to-digital (A/D) channel in volts. Some of the channels are for AC-coupled signals (such as ECG input), so the numbers on the screen are constantly changing when an input signal is present. These AC-coupled values are shown to give an indication as to whether basic functionality of the channel is present, but no significance can be derived from the values of the numbers displayed. However, others of the A/D channels read DC voltages, (for example, power supply voltages and battery voltage) and those voltage values directly provide useful diagnostic information.

The Primary and Secondary Status messages from the SpO_2 module are displayed and updated at the rate of about once per second. Presence of the correct SpO_2 message indicates that, at a basic level, communication between the SpO_2 module and the main monitor processor is working correctly. None of the displayed values can be changed or reset in this screen.When in the System A/D screen, the **`Return`** item is always highlighted; a press of the wheel returns the user to the Diagnostic Menu. Rotating the wheel while in the System A/D screen has no effect. The A/D channel designators are shown below.

A/D Channel Designators			
A1		A3	
1.	ECG	1.	ECG
2.	RWAVE	2.	RWAVE
3.	PACEMAKER	3.	PACEMAKER
4.	TEMP 1 (93° TO 112°)	4.	RESPIRATION
5.	PRESSURE XDUCER 1	5.	PRESSURE XDUCER 1
6.	PRESSURE XDUCER 2	6.	PRESSURE XDUCER 2
7.	NiBP OSCILLATORY	7.	NiBP OSCILLATORY
8.	ECG LEAD OFF	8.	ECG LEAD OFF
9.	TEMP 2 (59° TO 93°)	9.	TEMPERATURE
10.	ISOLATED VOLTAGE REF	10.	ISOLATED VOLTAGE REF
11.	ISOLATED VOLTAGE ZERO	11.	ISOLATED VOLTAGE ZERO
	SpO_2 S1 S018		SpO_2 S1 S018
12.	(BATTERY VOLTAGE) X 0.5	12.	(BATTERY VOLTAGE) X 0.5
13.	TEMP PROBE <=0=ORAL, 1=RECTAL, 2=CAL KEY, >=3 NONE)	13.	NOT USED
14.	+3.3 VDC POWER SUPPLY	14.	+3.3 VDC POWER SUPPLY
15.	(NiBP VOLTAGE REF) X 0.5	15.	(+12 VDC POWER SUPPLY) X 0.33
16.	GROUND REFERENCE	16.	(NiBP VOLTAGE REF) X 0.8
17.	(+5 VDC POWER SUPPLY) X 0.5	17.	GROUND REFERENCE
18.	ADC MID-SCALE VALUE	18.	(+5 VDC POWER SUPPLY) X 0.8
19.	ADC ZERO-SCALE VALUE	19.	ADC MID-SCALE VALUE
20.	ADC FULL-SCALE VALUE	20.	ADC ZERO-SCALE VALUE
		21.	ADC FULL-SCALE VALUE

NIBP Test

Warning ***A blood pressure cuff, connected to the monitor, should never be applied to a human subject while the monitor is in Diagnostic Mode. Injury could result.***

NiBP TEST	
Pressure (mmHg)	**179**
Valve:	**OPEN**
Press `NiBP` to activate pump; release to stop pump.	
Press `Volume` to open valve; release to close valve.	
Press `Alarm Silence` to open proportional valve and deflate at 3 mmHg/s; release to close valve.	
Press `Contrast` to perform offset adjust.	
Return	

An NiBP Test screen is provided to facilitate troubleshooting problems and performing verification testing for the NiBP subsystem. Typically, when these tests are performed, the pneumatic system is connected to an external pressure-reading device and a closed reference volume. The NiBP Test screen provides a real-time numeric display of the pressure in the pneumatic system, means for controlling the pump and valves, and a display indicating whether the proportional and safety valves are open or closed.

The NiBP Test screen elements are described below:

- **Pressure Display:** The real-time value of the system pneumatic pressure is displayed in mmHg. The value is updated at the rate of approximately two times per second.
- **Proportional Valve Display:** The display indicates whether the proportional valve is open or closed.
- **Safety Valve Display:** The display indicates whether the safety valve is open or closed.
- **Activate Pump:** For as long as the NiBP Start/Stop button  is pressed, the pump runs. If system pressure reaches the hardware over-pressure protection point (280 to 330 mmHg), the safety valve opens and the pump disables, until the pressure falls below the safety threshold.
- **Deflate:** For as long as the **ALARM SILENCE** button

 is pressed, the proportional valve opens and bleeds off pressure at the rate of 3 ±1.5 mmHg/s. It is useful to control the bleed rate to 3 mmHg/second to facilitate certain AAMI SP10 tests. Any time the bleed rate falls below 3 mmHg/second, the valve opens and remains at maximum as long as the button is pressed.

- **Open Valve (A1):** While the Heart Rate Tone **VOLUME** button  is pressed, the valve opens and remains at maximum as long as the button is pressed.
- **Open Both Valves (A3):** For as long as the Heart Rate Tone **VOLUME** button  is pressed, the safety valve and proportional valve opens and remains at maximum as long as the button is pressed.
- **Offset Adjust:** A momentary press of the **CONTRAST ADJUST** button  invokes the **`zero calibration`** routine that is performed immediately prior to each blood pressure measurement. This routine looks at the pressure in the system, and if the pressure is non-zero, an offset is applied which causes the system pressure to display as **`zero`**.

When in the NiBP Test screen, the **`Return`** item is always highlighted; a press of the wheel returns the user to the Diagnostic Menu. Rotating the wheel while in the NiBP Test screen has no effect.

Restoring Factory Settings

Caution **In addition to restoring factory defaults, this procedure clears the contents of trend memory.**

Note Read this procedure completely before performing the first step.

The following technique can be used to restore the monitor's power-up default

settings which were originally established at the factory:

1. With the monitor powered off, simultaneously press the **VOLUME**  and **CONTRAST**  buttons on the front keypad.
2. While continuing to press the **VOLUME**  and **CONTRAST**  buttons, power-up the monitor.
3. Continue to keep the **VOLUME**  and **CONTRAST**  buttons depressed until the power-up diagnostic sequence is complete. When the normal monitoring screen appears, release the two buttons.

5 Troubleshooting

Introduction

This section explains how to troubleshoot the monitor if problems arise. Tables are supplied that list possible monitor difficulties, along with probable causes, and recommended actions to correct the difficulty.

How To Use This Section

Use this section in conjunction with Chapter 3, “Performance Verification”, and Chapter 7, “Spare Parts”. To remove and replace a part you suspect is defective, follow the instructions in Chapter 6, “Disassembly Guide”. The Circuit Analysis chapter in the *Concepts Guide* offers information on how the monitor functions.

Who Should Perform Repairs

Only qualified service personnel should open the monitor housing, remove and replace components, or make adjustments. If your medical facility does not have qualified service personnel, contact Philips’ Response Center or your local Philips representative.

Replacement Level Supported

The replacement level supported for this product is to the printed circuit board (PCB) and major subassembly level. Once you isolate a suspected PCB, follow the procedures in Chapter 6, “Disassembly Guide”, to replace the PCB. Check to see if the symptom disappears and that the monitor passes all performance tests. If the symptom persists, swap back the replacement PCB with the suspected malfunctioning PCB (the original PCB that was installed when you started troubleshooting) and continue troubleshooting as directed in this section.

Obtaining Replacement Parts

Philips' Response Center provides technical assistance information and replacement parts. To obtain replacement parts, contact your local Philips representative. Refer to parts by the part names and part numbers listed in Chapter 7, "Spare Parts".

Troubleshooting Guide

Problems with the monitor are separated into the categories indicated below. Refer to the section indicated for further troubleshooting instructions.

Taking the recommended actions discussed in this section will correct the majority of problems you may encounter. However, problems not covered here can be resolved by calling Philips' Response Center or your local representative.

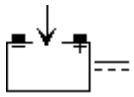
Problem Area	Refer To:
1. Power • No power-up • Fails power-on self-test • Powers down without apparent cause	"Power" on page 48
2. Error Messages	"Error Codes" on page 51
3. Buttons/Wheel • Monitor does not respond properly to buttons	"Buttons/Wheels (All Monitors)" on page 56
4. Display/Audible Tones • Display does not respond properly • Tones do not sound properly	"Display/Audible Tones (All Monitors)" on page 57
5. Operational Performance • Displays appear to be operational, but monitor shows no readings • Suspect readings • Recorder not responding	"Operational Performance" on page 58

All categories listed above are discussed in the following sections.

Power

The following table lists recommended actions to address A1 power

problems.

Condition	Recommended Action
1. With external power supply connected the green **EXTERNAL POWER** indicator  on the front panel is not lit.	1. Ensure that the external power supply input (PS-120V or PS-240V) is plugged into an operational AC outlet of appropriate voltage and frequency. 2. Disconnect the power supply output cable from the monitor. Measure the voltage across pins 1 and 4 of output connector. If the open circuit voltage does not measure approximately 17 ±3 V~RMS, replace the power supply. 3. If the battery is severely discharged or shorted, the **EXTERNAL POWER** indicator does not light. Connect the external power supply to an AC outlet and to the monitor. Allow the battery to charge for 30 minutes. If the **EXTERNAL POWER** indicator still does not light, replace the battery. 4. Inside the monitor, check the ribbon cable and ensure that it is properly connected to the main PCB. 5. The **EXTERNAL POWER** indicator is embedded in the keypad. Ensure that the keypad is plugged into Main PCB. If the connection is good, replace the keypad. 6. If the problem persists, replace main PCB.
2. The A1 fails to power-up when the **ON/STANDBY** button is pressed…with the monitor connected to external power supply.	1. Connect the appropriate external power supply (PS-120V or PS-240V) to the monitor. Ensure that the external power supply input is plugged into an operational AC outlet of the appropriate voltage and frequency. Ensure that the green **EXTERNAL POWER** indicator is lit. If the indicator is not lit, follow the steps described in Condition 1, above. 2. Ensure that the keypad is plugged into Main PCB. If the connection is good, replace keypad. 3. If the problem persists, replace the main PCB.
3. The A1 fails to power-up when the **ON/STANDBY** button is pressed with the monitor *not* connected to external power supply.	1. First, follow the steps described in Condition 2, above, to ensure that the monitor operates when connected to an external power supply. 2. Check fuse F301 located on the Main PCB, near the battery cable connector. Replace fuse if necessary. 3. Recharge the battery as directed in “Battery Charge” on page 11. If the battery fails to hold a charge, replace the battery. 4. If the problem persists, replace the main PCB.

Condition	Recommended Action
4. The A1 turns on, then shuts off and sounds an alarm and no error code is displayed.	1. Press the alarm silence button to terminate the audible alarm. Ensure that the external power supply is connected and the green **EXTERNAL POWER** indicator is lit. If the monitor operates successfully, the battery could be discharged, or the battery fuse could be blown. 2. Recharge the battery as directed in “Battery Charge” on page 11. If the battery fails to hold a charge, replace the battery. 3. Check fuse F301 located on the Main PCB, near the battery cable connector. Replace the fuse if necessary. 4. If problem persists, replace the main PCB.

The following table lists recommended actions to address A3 power problems.

Condition	Recommended Action
1. The A3 fails to power-up when the **ON/STANDBY** button is pressed.	1. Ensure power cord is plugged into operational AC outlet of appropriate voltage and frequency. Ensure green **BATTERY CHARGING/AC SOURCE** indicator is lit. If indicator is not lit, replace power supply assembly. 2. Check fuses located on power supply assembly above AC inlet receptacle. Replace fuses if necessary. 3. Inside monitor, check main ribbon cable and ensure that it is connected to main PCB and power supply assembly. 4. Ensure that the keypad is plugged into Main PCB. If the connection is good, replace the keypad. 5. If the problem persists, replace main PCB.

Condition	Recommended Action
2. The A3 turns on, then shuts off and sounds an alarm and no error code is displayed.	1. Press Alarm Silence switch to terminate audible alarm. Ensure AC power cord is connected and green **BATTERY CHARGING/AC SOURCE** indicator is lit, or ensure DC source is connected and green **BATTERY CHARGING/DC SOURCE** is lit. If monitor operates successfully, battery can be discharged. 2. Recharge the battery as directed in "Battery Charge" on page 11. If the battery fails to hold a charge, replace the battery. 3. If the problem persists, replace the main PCB. 4. If the problem persists, replace the power supply assembly.

Error Codes

When the monitor detects an error condition, the monitor shows an error code on the display screen. If such an error occurs during monitoring operation, an audible alarm tone also sounds. Press the **ALARM SILENCE** button  to terminate the audible alarm tone.

When an error code appears on the display, a number in hexadecimal representation indicates the nature of the error. Additionally, Diagnostic Mode can be used to gain access to an error code record, stored in nonvolatile memory, of the last 10 error codes encountered by the monitor. See Chapter 4 for further details on Diagnostic Mode.

Each error code corresponds to a particular problem in the monitor. Recommended actions to take when an error code is encountered are listed in the sections that follow.

As an aid to troubleshooting, the A1 provides the capability for technicians to print out a copy of the error log.

Generating an Error Log Printout (A1 only)

1. Connect the recorder to the monitor, and its power supply to an appropriate source. Refer to the operator's manual.
2. Use the **SETUP** button  and displayed menu to verify that the Recorder mode is the selected option for the Communications Selection item. (It is the factory-set default value.)
3. Turn monitor power OFF.

4. Simultaneously press the **CONTRAST** button  and the **ON/STANDBY** button  to power up the monitor. Keep the contrast button depressed until the monitoring screen appears (after 10 seconds). The error code printout is generated automatically.

If error codes listed on the Diagnostic Mode error code screen or on the error log printout are in the range from 1 to 65 (hex), a hardware problem has been detected. Refer to the section titled, "Serviceable Hardware Error Codes" for additional information on these codes.

Serviceable Hardware Error Codes

Serviceable Hardware Error Codes for A1

Listed below are error codes for the A1 that correspond to hardware problems, and the recommended actions to take should such an error be encountered.

Hex Code	Explanation	Recommended Action
1	Improper shutdown.	1. Cycle power. 2. If this error persists, return monitor for service.
2	NiBP Sensor Error. • The two pressure system. transducers do not agree.	1. Check for blocked tubing in the pneumatic system. 2. Replace Main PCB.
3	NiBP Pressure Violation Error. • The pressure on the cuff could not be removed by normal means. • A fault has been detected in the NiBP system that could not be handled by releasing pressure by normal means.	1. Cycle power. 2. Check for blocked tubing in the pneumatic system. 3. Replace Main PCB.
4	The measured value of the 3.3V power supply is low.	1. Check power supply. 2. Replace Main PCB.
5	The measured value of the 3.3V power supply is high.	1. Check power supply. 2. Replace Main PCB.
7	The measured value of the 12V power supply is high.	1. Check power supply. 2. Replace Main PCB.
8	The measured value of the 5V power supply is low.	1. Check power supply. 2. Replace Main PCB.
9	The measured value of the 5V power supply is high.	1. Check power supply. 2. Replace Main PCB.

Hex Code	Explanation	Recommended Action
A	The measured value of the isolated reference supply on the front end is low.	1. Check power supply. 2. Replace Main PCB.
B	The measured value of the isolated reference supply on the front end is high.	1. Check power supply. 2. Replace Main PCB.
D	A checksum error is detected on the NiBP region of Flash Memory.	1. Cycle power. 2. If error persists, replace main PCB.
E	A checksum error is detected on the power-up settings region of Flash memory.	1. Turn Power Off. 2. Turn power back on while pressing both the **CONTRAST** and **VOLUME** buttons. See “Restoring Factory Settings” on page 45, Chapter 4. 3. All user selections must be restored. 4. If error persists, replace Main PCB.
64	The SpO_2 module is sending an error message to the host CPU.	1. Cycle power. 2. If problem persists, replace Main PCB.
65	The SpO_2 module is not communicating with the host CPU.	1. Cycle power. 2. If problem persists, replace main PCB.

Serviceable Hardware Error Codes for A3

IListed below are error codes for the A3 that correspond to hardware problems, and the recommended actions to take should such an error be encountered.

Hex Code	Explanation	Recommended Action
1	Improper shutdown.	1. Cycle power. 2. If this error persists, return monitor for service.
2	NiBP Sensor Error. • The two pressure system. transducers do not agree.	1. Check for blocked tubing in the pneumatic system. 2. Replace Main PCB.

Hex Code	Explanation	Recommended Action
3	NiBP Pressure Violation Error. • The pressure on the cuff could not be removed by normal means. • A fault has been detected in the NiBP system that could not be handled by releasing pressure by normal means. • NiBP system has released pressure using safety valve.	1. Cycle power. 2. Check for blocked tubing in the pneumatic system. 3. Replace Main PCB. **Note: This error may occur during a blood pressure measurement in STAT mode, if the leg cuff is used.**
4	The measured value of the 3.3V power supply is low.	1. Check power supply. 2. Replace power supply assembly.
5	The measured value of the 3.3V power supply is high.	1. Check power supply. 2. Replace power supply assembly.
6	The measured value of the 12V power supply is low.	1. Check power supply. 2. Replace power supply assembly.
7	The measured value of the 12V power supply is high.	1. Check power supply. 2. Replace power supply assembly.
8	The measured value of the 5V power supply is low.	1. Check power supply. 2. Replace power supply assembly.
9	The measured value of the 5V power supply is high.	1. Check power supply. 2. Replace Main PCB.
A	The measured value of the isolated reference supply on the front end is low.	1. Check power supply. 2. Replace Main PCB.
B	The measured value of the isolated reference supply on the front end is high.	1. Check power supply. 2. Replace Main PCB.
C	The measured value of the isolated reference supply on the front end is high.	1. Check power supply. 2. Replace Main PCB.
64	The SpO_2 module is sending an error message to the host CPU.	1. Ensure MP-205 module is properly connected. 2. Replace MP-205 module. 3. If problem persists, replace Main PCB.

Hex Code	Explanation	Recommended Action
65, 66	MP-205 SpO_2 module has detected an error during initialization.	1. Replace MP-205 module. 2. If problem persists, replace Main PCB.
6E-71	MP-205 SpO_2 module has detected an error on its serial port.	1. Replace MP-205 module. 2. If problem persists, replace Main PCB.

Other Error Codes (All Monitors)

If an error code occurs that is not listed in "Serviceable Hardware Error Codes", take the following actions:

1. Turn the monitor off, then on again.
2. If the error code still appears, take the monitor out of service and contact Philips' Response Center or your local Philips representative for advice on remedial action.
3. If the monitor powers up and the error code does not recur, enter the Diagnostic Mode and invoke the Error Code screen. Examine the record of the last 10 error codes and determine if the same error code occurred previously.
4. If the Error Code screen indicates that the same error has occurred previously, take the monitor out of service and contact Philips' Response Center or your local Philips representative for advice on remedial action.
5. If the Error Code screen indicates no previous occurrences of this error, the monitor can be returned to service.

As a reference, following lists the general categories for other error codes. The error code categories are shown only in hexadecimal format.

Code (hex)	Explanation
500xxxx	internal user interface error
501xxxx	remote serial port error
502xxxx	date and time error
503xxxx	NiBP error
504xxxx	front end error
505xxxx	alarm error
506xxxx	audio error
507xxxx	recorder error

Code (hex)	Explanation
508xxxx	trend error
509xxxx	flash memory data error
50axxxx	SpO_2 error
50bxxxx	ECG error
50cxxxx	power-down task error
50dxxxx	on-board diagnostic error
50exxxx	power monitor error
50fxxxx	temperature measurement error
510xxxx	internal user interface error
511xxxx	error handling error
513xxxx	serial driver error
514xxxx	system software errors (A1 only)

Buttons/Wheels (All Monitors)

The following lists recommended actions to address problems with the wheel and front-panel buttons.

Condition	Recommended Action
1. The monitor fails to power-up when the **ON/STANDBY** button is pressed.	1. Take steps as noted in “Power” on page 48.
2. The monitor powers-up, but some/one of the other buttons does not respond.	1. Ensure that the keypad is plugged into the Main PCB. If the connection is good, change the keypad. 2. If the problem persists, change the Main PCB.
3. When the wheel is rotated, no highlight appears on the display screen, and/or the monitor does not respond to wheel presses.	1. Ensure that the encoder cable is plugged into the Main PCB. If the connection is good, change the encoder. 2. If the problem persists, replace the Main PCB.

Display/Audible Tones (All Monitors)

The following lists recommended actions to address problems with the display and audible tones.

Condition	Recommended Action
1. System powers-up and… • LCD screen is totally black or white. Or, • LCD screen is illuminated, but no data is visible. Or, • LCD screen has data, but is not illuminated.	**Note: Pressing the A3 contrast adjust switch causes the LCD contrast setting to immediately change to normal, factory-default value. Pressing the A3 contrast adjust switch toggles the display between the two different color schemes (black background and white background).** 1. A1 and A3: Adjust the LCD screen contrast by pressing the **CONTRAST** button momentarily, then turning the wheel four revolutions in each direction. Turning the wheel clockwise should brighten the screen; turning the wheel counter-clockwise should darken the screen. 2. A3: Ensure red LED, located on the top left corner of the Main PCB, is illuminated. If the LED is not illuminated, the monitor is not in **on** state: follow troubleshooting steps in “Power” on page 48. 3. Ensure that the backlight cable is connected to the Main PCB. 4. Ensure that the LCD connector is properly connected to the Main PCB and LCD PCB. 5. If problem persists, replace Main PCB. 6. A3: If problem persists, replace backlight PCB. 7. If problem persists, replace LCD assembly.
2. Monitor responds to button press, but key press tone fails to sound.	1. Ensure that the speaker cable is connected to the Main PCB. 2. If the problem persists, replace the speaker assembly. 3. If the problem persists, replace the Main PCB.
3. Audible alarm does not sound.	1. Verify alarm volume setting in the Alarm/Limits menu, and test operation of the alarm tone by pressing the volume button while the alarm volume setting is displayed. 2. Ensure that the speaker cable is connected to the Main PCB. 3. If the problem persists, replace the speaker assembly. 4. If the problem persists, replace the Main PCB.

Operational Performance

Operational Performance Problems - A1

The following lists recommended actions to address problems related to operational performance of the A1.

Condition	Recommended Action
1. The monitor appears to be operational, but the physiological values are suspect or nonexistent.	1. Replace each patient cable (or tubing) with a known good cable.
	2. Ensure that the Patient Connector PCB is properly connected to the Main PCB. Ensure that the tubing in the pneumatic system are properly connected, and that the NiBP pump motor is connected to the Rear Connector PCB.
	3. If the problem persists, replace the Patient Connector PCB.
	4. If the problem persists, replace Main PCB.

Operational Performance Problems - A3

The following lists recommended actions to address problems related to operational performance of the A3.

Condition	Recommended Action
1. Monitor appears to be operational, but physiological values are suspect or nonexistent.	1. Replace each patient cable (or tubing) with a known serviceable cable. 2. Ensure internal ECG, temperature, and SpO2 cables are connected to Main PCB. Ensure tubing in pneumatic system are properly connected, and NiBP pump motor is connected to power supply PCB. 3. If problem persists, replace main PCB.
2. Recorder paper will not advance.	1. Open recorder door and check paper is present. Press recorder module firmly into monitor to ensure recorder module is fully engaged with connector on recorder PCB. 2. Cycle power on monitor. Recorder should execute a line feed at conclusion of power-up sequence. 3. If problem persists, ensure main ribbon cable is connected to printer PCB, power supply and Main PCB. 4. If problem persists, replace recorder. 5. If problem persists, replace recorder PCB. 6. If problem persists, replace Main PCB.

Condition	Recommended Action
3. Recorder paper will advance but paper remains blank when printing should be present.	1. Open recorder door and check paper is oriented correctly; paper should exit from bottom of roll. See *User Guide* for an illustration of correct paper orientation. 2. If problem persists, replace recorder.

6
Disassembly Guide

Warning ***Performance verification: do not place the monitor into operation after repair or maintenance has been performed, until all recommended Performance Tests and Safety Tests listed in Chapter 3 of this service manual have been performed. Failure to perform all tests could result in erroneous monitor readings.***

Introduction

The monitor can be disassembled down to all major component parts, including:

- PCBs
- battery
- cables
- function buttons
- chassis enclosures

The following tools are required:

- small/medium, Phillips-head screwdriver
- needle-nose pliers
- 9/16-inch socket (for wheel encoder)
- 3/16-inch socket (for rear-panel RS-232 connector).

Warning ***Before attempting to open or disassemble the monitor, disconnect the power supply from the monitor.***

Warning ***High voltage is generated by the LCD backlight driver. Exercise caution when operating the monitor with the covers open.***

Caution **Observe ESD (electrostatic discharge) precautions when working within the unit.**

Caution **If the internal battery cable has been disconnected, pay particular attention to the polarity of the cable before reattaching. If the battery cable polarity is reversed, it is likely that circuit damage will occur.**

How To Use This Chapter

The step-by-step procedures that are used to access replaceable parts of the monitor are illustrated in the Disassembly sections which follow. These describe and photographically illustrate procedures for disassembling the monitor to enable removal and replacement of suspected defective assemblies/components.

The monitor consists of two main assemblies, the front case assembly, and the rear case assembly. The main PCB assembly is separable from the front case assembly.

All part numbers and exploded views of some assemblies are found in Chapter 7, “Spare Parts”.

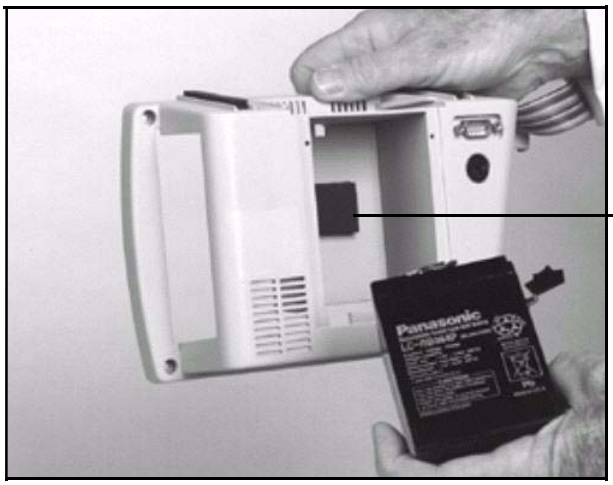
Disassembly Procedures (A1)

Closed Case Disassembly Procedures

This section describes the items that can be removed without disassembling the main case of the A1 monitor.

Procedure to remove the battery from Models M3921A and M3923A when a temperature module is *not* installed:

1. Use a Phillips-head screwdriver to remove the two screws fastening the battery cover to the rear case.

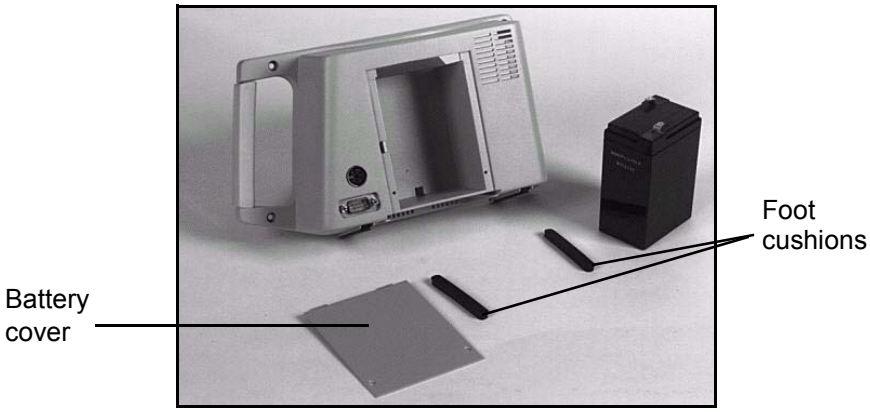


2. Remove the battery cover.
3. Disconnect the spade terminal connectors from the battery terminals.

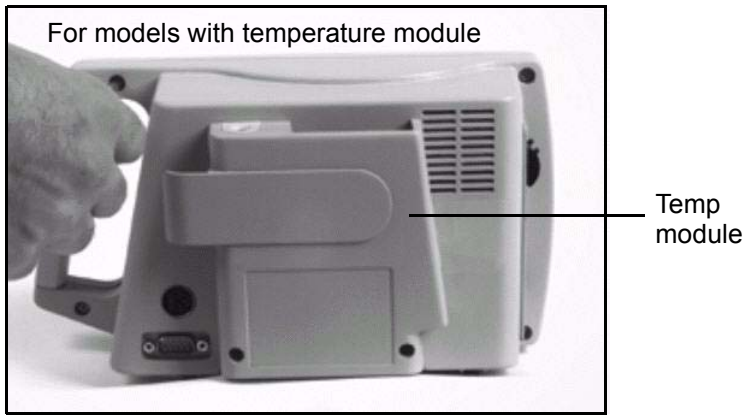
Caution **During reassembly, pay particular attention to the polarity of the battery cable before reattaching. The polarity is marked on the circuit board. Red connects to the +ve terminal, black connects to the –ve terminal. If battery cable polarity is reversed, it is likely that circuit damage will occur.**

4. Remove the battery.

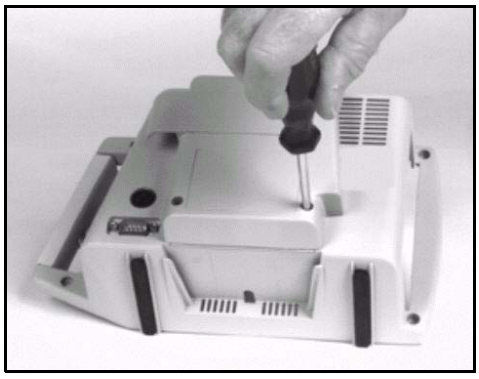
5. As required, remove the battery cushions on the inside of the battery compartment, and the battery cover.



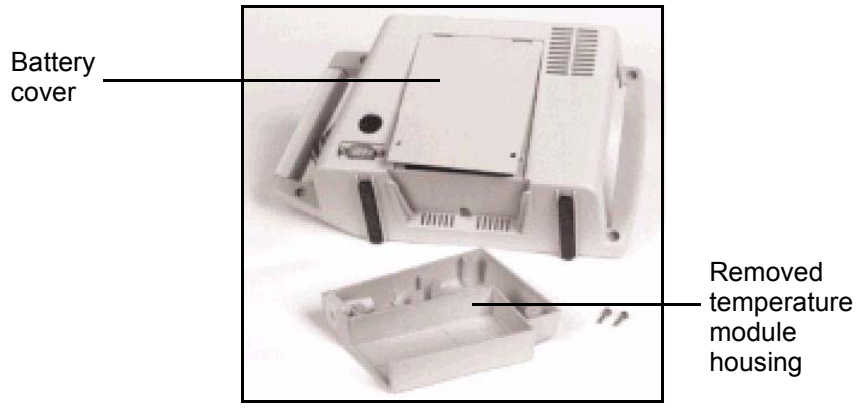
Procedure to remove the battery from the monitor when a temperature module *is* installed:



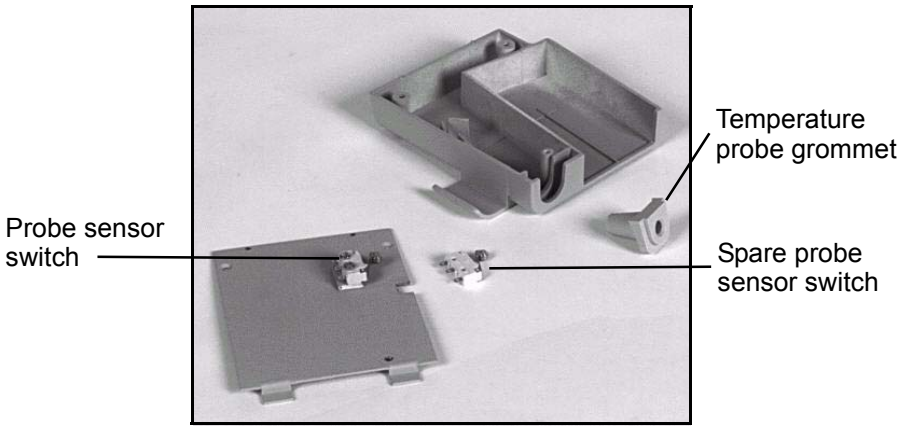
1. Use a Phillips-head screwdriver to remove the two screws fastening the temperature module housing to the rear case assembly. The same screws also hold the battery cover.



2. Remove the temperature module housing and the battery cover.



3. The probe sensor contact switch is mounted on the outer side of the battery cover. As required, disconnect the leads from the probe sensor switch to the rear panel connector.
4. Remove the switch.

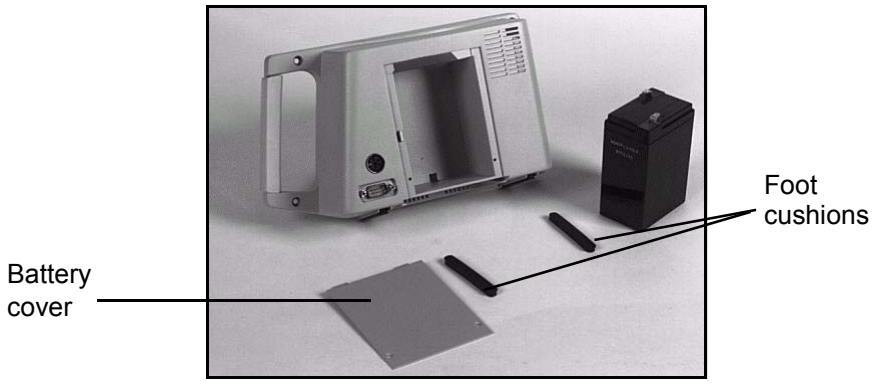


5. Disconnect the spade terminal connectors from the battery terminals.

Caution **During reassembly, pay particular attention to the polarity of the battery cable before reattaching. The polarity is marked on the circuit board. Red connects to the +ve terminal, black connects to the –ve terminal. If battery cable polarity is reversed, it is likely that circuit damage will occur.**

6. Remove the battery.
7. As required, remove the battery cushions on the inside of the battery

compartment, and the battery cover.

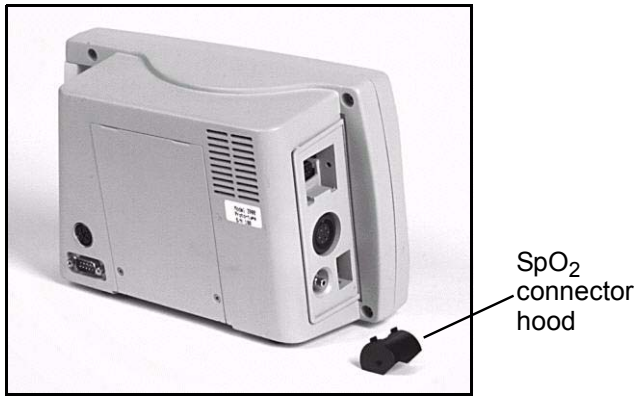


Separation of Front and Rear Case Assemblies

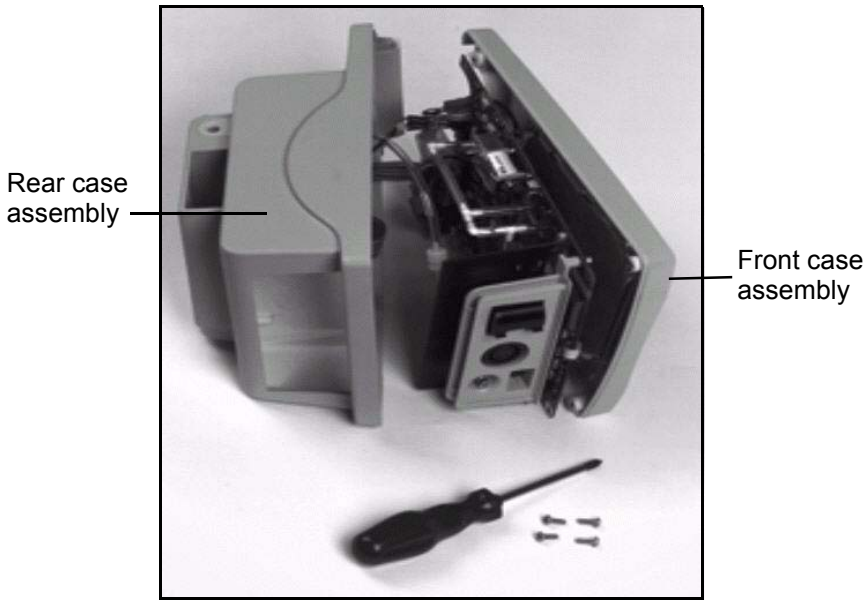
This section describes the procedures required to separate the front and rear case assemblies of the A1 monitor.

Procedure to separate the front and rear case assemblies:

1. Remove the SpO_2 connector hood by squeezing the sides to release the detents holding the hood in place.
   During reassembly, the notch on the SpO_2 connector hood should be facing down.

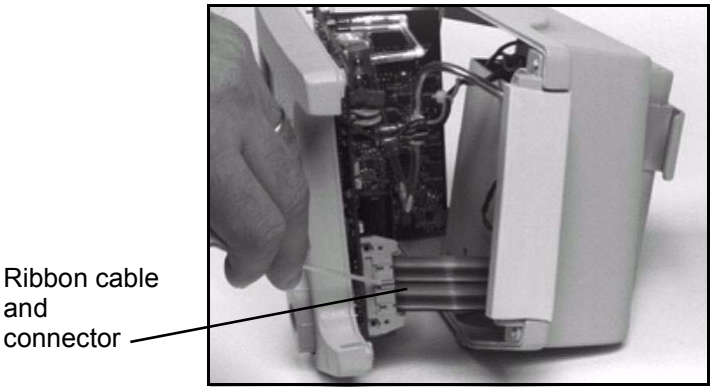


2. Use a Phillips-head screwdriver to remove the four screws fastening together the front and rear case assemblies.
3. Separate the main front and rear case assemblies.
4. If the rear cover gasket seal is to be replaced, remove it.



During reassembly, align the ridge in the front case assembly with the groove in rear case assembly. The gasket snake break should be placed at the bottom of the unit. Line up the connector panel with the slots in the rear case, making sure speaker wire is out of the way. Power up the monitor prior to installing the final four screws. If the monitor boots properly, insert the four screws and proceed to the performance tests.

5. Disconnect the ribbon cable and its connector from the PCB assembly.



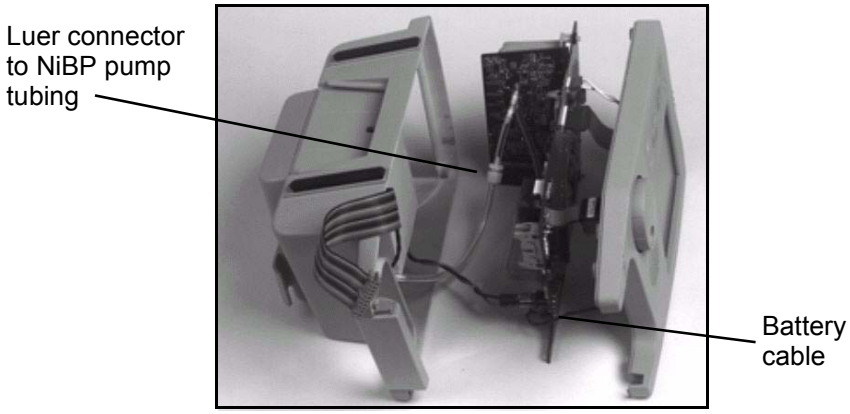
6. Disconnect the battery cable spade terminals from the main PCB assembly. If the battery cable is to be removed, the cable must also be disconnected from the battery.

Caution **During reassembly, pay particular attention to the polarity of the battery cable before reattaching. The polarity is marked on the circuit board. Red connects to the +ve terminal, black connects to the –ve terminal. If battery cable polarity is reversed, it is likely that circuit damage will occur.**

7. Unscrew the NiBP Luer connector.

   During reassembly, preload the NBP Luer connector by twisting the silicone NBP tubing in opposite directions prior to making the Luer connection. This prevents disconnection.

Front and rear case assemblies are now completely separate from one another.



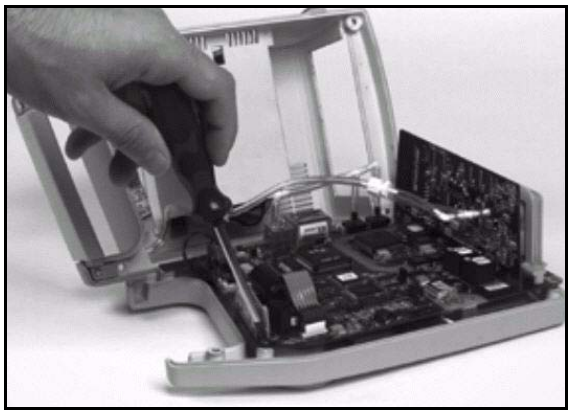
Front Case Disassembly Procedures

This section describes how to remove/replace items from the front case assembly. First separate the front and rear assemblies as described in the section “Separation of Front and Rear Case Assemblies” on page 78.

Procedure to remove the main PCB assembly from the front case assembly:

1. Use a Phillips-head screwdriver to remove the screw holding the main PCB assembly in place in the front cover assembly.

   For reassembly, note the two guides in the cover and the corresponding two notches in the PCB.



2. Remove the board by gently pulling to disconnect from LED connector. Pull straight back to avoid bending the pins.

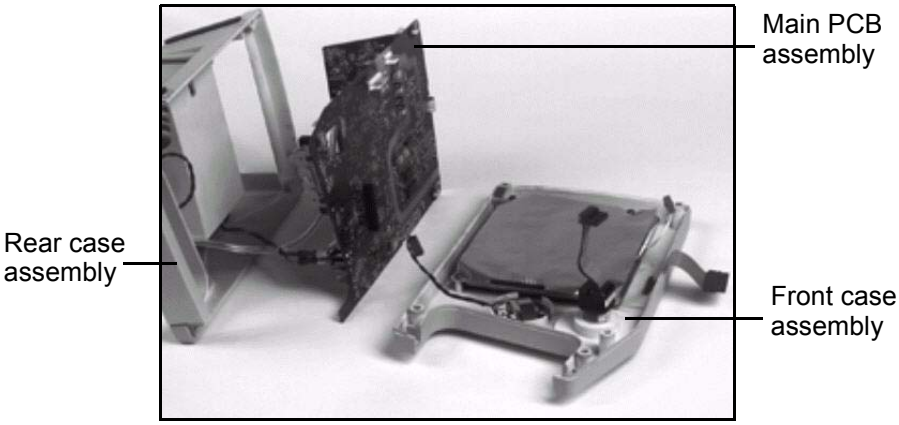
   During reassembly, line up the LED connector when replacing the main PCB in the front case assembly, press gently into position, and feed the ribbon cable through the hole for the wheel.

3. Disconnect the backlight, keypad, speaker connector, and wheel ribbon connector.

   During reassembly, tuck the speaker cable out of the way.

There are now three separate items:

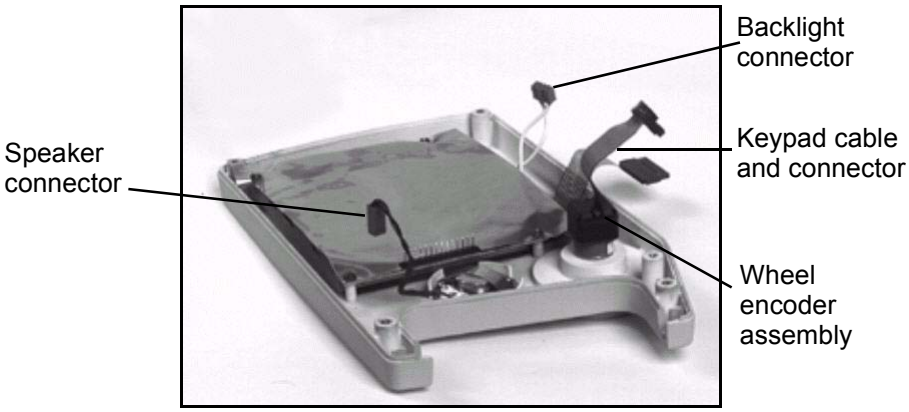
- Front case assembly
- Rear case assembly
- Main PCB assembly



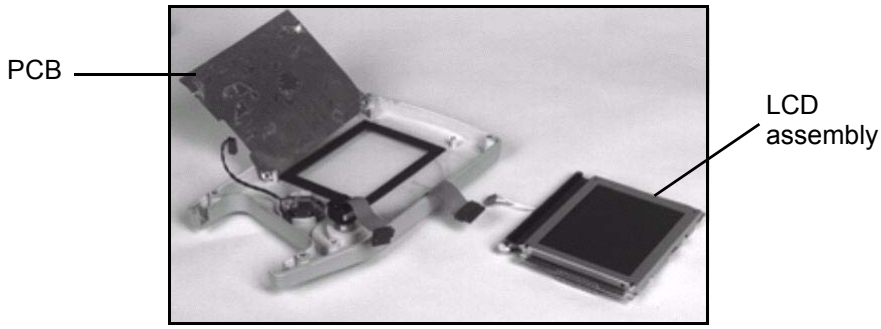
Procedure to remove the display:

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

1. Use a Phillips-head screwdriver to unfasten the four corner screws. These screws also hold the LCD assembly in place.
2. Remove the display shield.

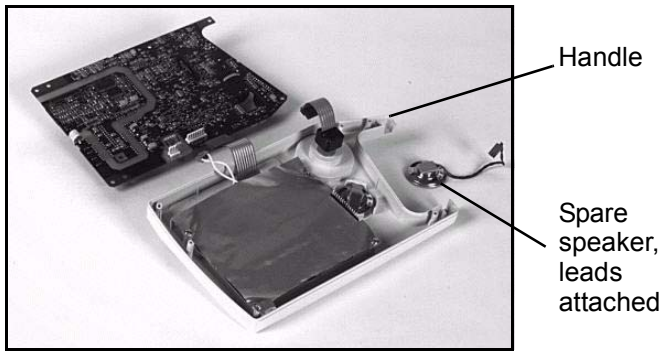


3. Remove the LCD assembly, providing access to the display window.
4. Remove the display window by carefully prying up one corner and then peeling back.



Procedure to remove the speaker:

1. Remove the retaining spring clip.
2. Remove the speaker.
3. Orient the speaker wires towards the handle (as shown in the photograph).



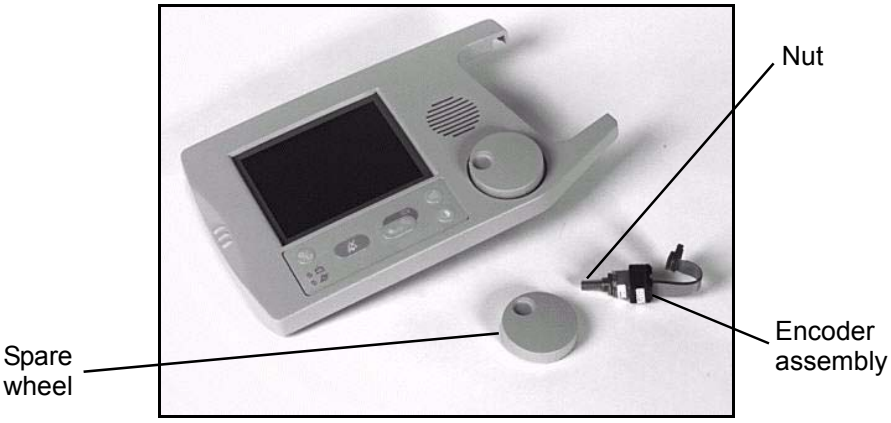
Procedure to remove the wheel and encoder:

1. From the front, remove the wheel by grasping the sides of the wheel firmly and pulling straight back from the monitor. (The wheel is friction fit on the stem of the encoder assembly).

   If the wheel is not easily removable by hand, a small flat-headed screwdriver can be used to gently pry off the wheel. If necessary, apply some adhesive tape to the front cover and the head of the screwdriver to prevent any damage.

2. Use a 9/16” hex socket to unscrew the fastening nut on the outside of the front case. The encoder can now be pulled away from the front case.

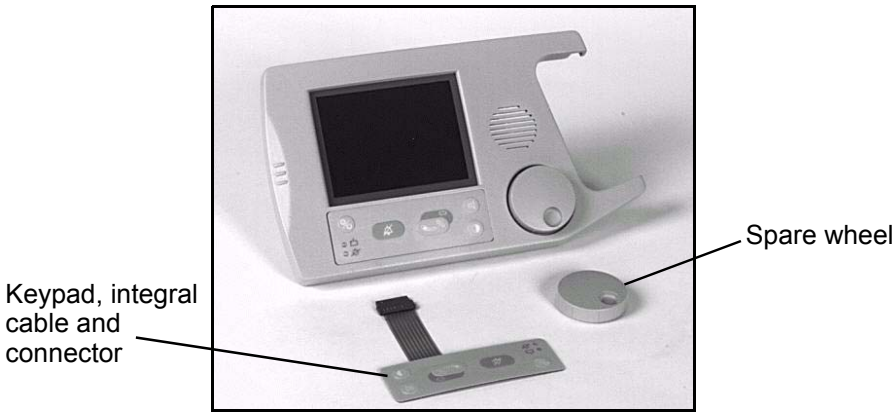
   During reassembly, orient the ribbon connector so that the cable lies parallel to the bottom of the board and pin 1 is oriented close to the handle.



Procedure to remove the keypad:

The keypad is attached with an adhesive to the front panel.

1. From the front side of the panel, carefully pry up one corner of the keypad from the cover, and then peel it away from the cover.
2. Carefully thread the cable out through the slot in the cover.

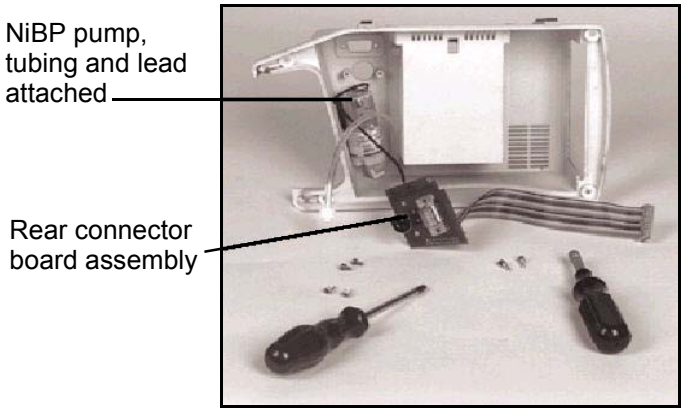


Rear Case Disassembly Procedures

This section describes the items that can be removed or replaced on the rear case assembly of the A1 monitor. First separate the front and rear assemblies as described in the section “Separation of Front and Rear Case Assemblies” on page 78.

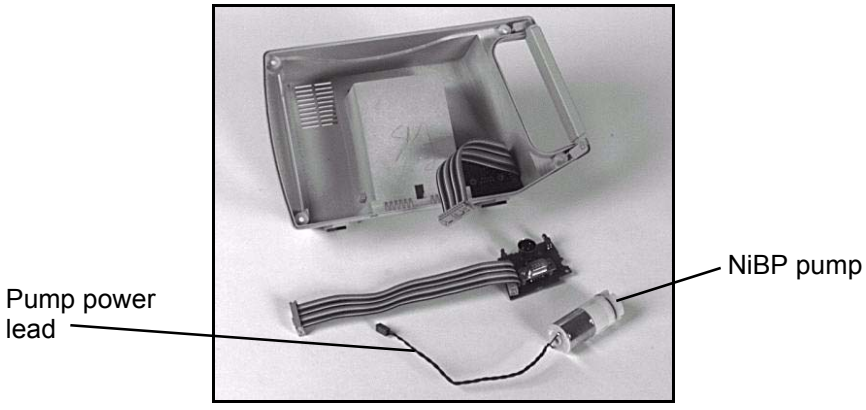
Procedure to remove a rear connector PCB:

1. Use a Phillips-head screwdriver to remove the two screws holding the rear connector PCB to the rear cover.
2. From outside the rear cover, use a 3/16 socket driver to remove the two standoff fasteners of the RS-232 connector.
3. From inside the rear cover, remove the rear connector PCB assembly.



Procedure to remove NIBP pump:

1. Use a Phillips-head screwdriver to unfasten the screw holding the clamp to the rear cover.
2. Disconnect the power lead from the rear connector PCB.
3. Remove the clamp and the pump.



Procedure to remove handle and foot cushions:

Each end of the handle is friction-fit onto a cross-shaped boss.

1. Use flat-bladed screwdriver to carefully pry one end of the handle.
2. When the end of the handle has begun to loosen from the boss, use the same technique to begin to pry up the other end.
3. Alternately apply this prying action between each end of the handle until the handle is free of the rear case.
4. The foot cushions are attached with an adhesive to the bottom surface of the rear cover, and can be removed by lifting one end of the foot and peeling off.

Main PCB Disassembly Procedures

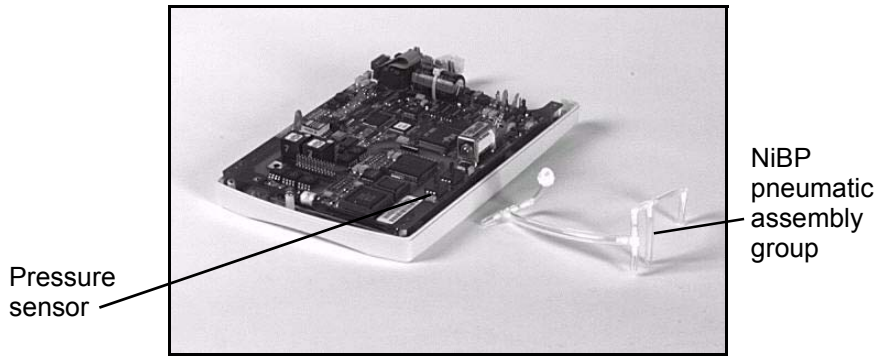
This section describes the items that can be removed or replaced from the main PCB assembly of the A1 monitor. The main PCB assembly is separable from the front case assembly.

First separate the front and rear assemblies as described in the section “Separation of Front and Rear Case Assemblies” on page 66.

Then perform “Procedure to remove the main PCB assembly from the front case assembly”, page 68.

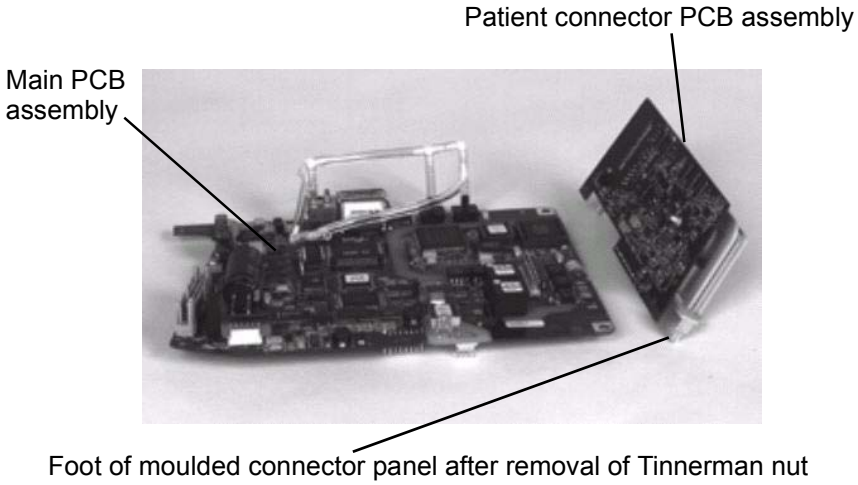
Procedure to remove NiBP pneumatic assembly from the main PCB assembly:

1. Pull the tubing from the barbed fitting on the rear of the NiBP panel connector.
2. Pull the tubing from the fittings on the the pressure sensors and valve.



Procedure to separate the patient connector PCB assembly from the main PCB assembly:

1. Use needle-nose pliers or a Tinnerman tool to remove the two Tinnerman fasteners securing the patient connector PCB assembly to the underside of the main PCB.
2. Disconnect the patient connector PCB assembly by pulling it straight up from the main PCB.
3. The battery fuse F301, located near the battery cable connector on the main PCB can be replaced if necessary. (The battery fuse is located between the two round yellow poly fuses).

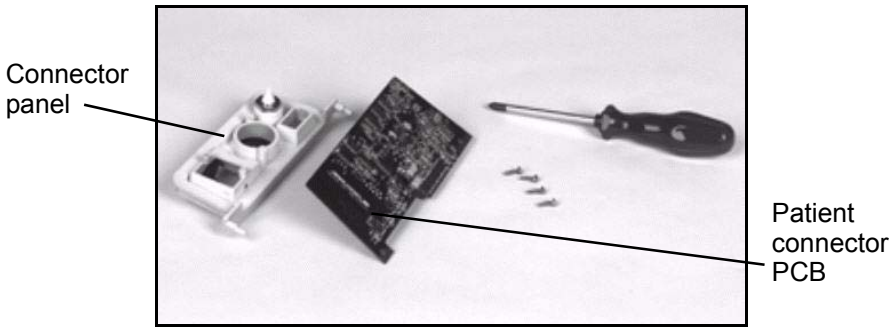


Procedure to separate the patient connector PCB from the connector panel:

1. Use a Phillips-head screwdriver to remove four screws fastening the two assemblies together.

   Two of the screws are accessible on the face of the connector PCB, two are accessible through access holes in the PCB.

2. Separate the two assemblies.



Disassembly Procedures (A3)

Closed Case Disassembly Procedures

This section describes the items that can be removed without disassembling the main case of the A3 monitor.

Procedure to remove front panel wheel:

The wheel is friction-fit on the encoder shaft.

1. Grasp the sides of wheel firmly and pull straight back from the monitor. The wheel should slip off the encoder shaft.
2. If wheel does not move, separate front and rear cases as described in “Separation of Front and Rear Case Assemblies” on page 78. There is a hole in the front cover behind the wheel. Insert a small screwdriver blade in the hole and push firmly against the back of the wheel.

Procedure to remove carrying handle:

1. Use screwdriver to remove the two fastening screws and washers. Retain them for reassembly.
2. Remove the handle by sliding it straight back towards the rear of the monitor.

Procedure to remove recorder:

1. Press the **Paper Eject** button on the right side of the recorder. The door drops forward.
2. Remove the paper roll, if installed. Two fastening screws are visible on the back panel of the recorder.
3. Use a screwdriver to back out the captive fastening screws.
4. Pull the recorder straight out of the side of the monitor, disengaging the connector at the rear of the module from the recorder PCB in the assembly.

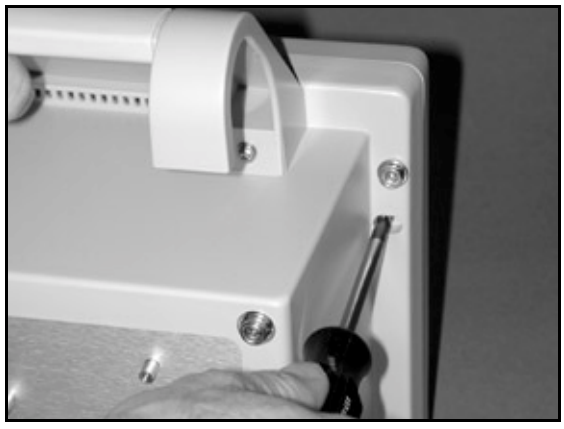
   Note that removal of the recorder PCB can be accomplished only after the front and rear cases are separated.

Separation of Front and Rear Case Assemblies

Procedure to separate front and rear case assemblies:

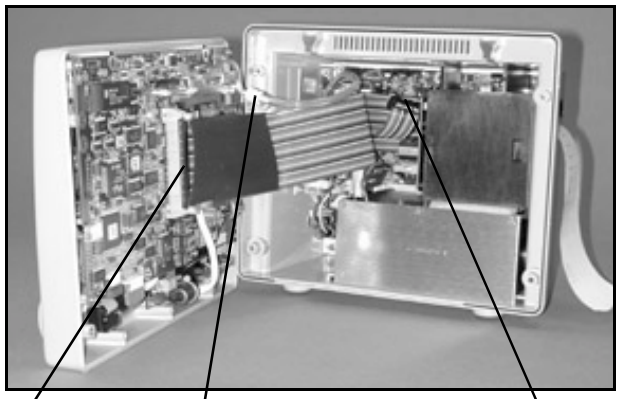
1. Remove handle as indicated in procedure on page 77.
2. Use screwdriver to remove four screws fastening Rear Case Assembly to Front Case Assembly to Front Case Assembly. Retain for reassembly.

   Note that the gasket must be inserted around the top of the rear case before reassembly.

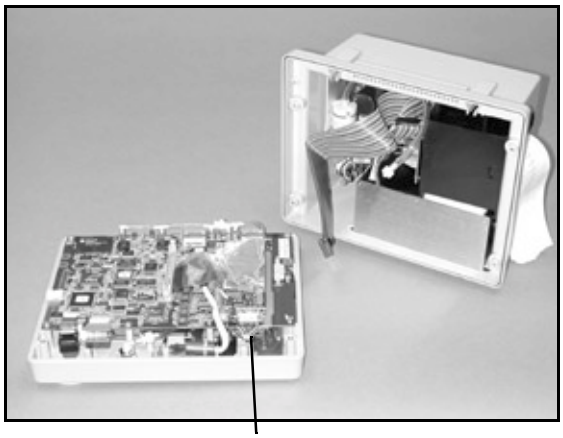


3. Separate the two major case assemblies. There is enough cable and tubing slack to permit the two assemblies to remain at an angle of approximately 90 degrees to each other.

   During reassembly, preload the NBP Luer connector by twisting the silicone NBP tubing in opposite directions prior to making the Luer connection. This prevents disconnection.



4. Disconnect the large ribbon-cable connector from the main PCB.
5. Unscrew the NiBP tubing connector from the pump to the main PCB. The front and rear case assemblies are now completely separate from one another.



Front Case Disassembly Procedures

Procedure to remove SpO_2 module, ECG/Temp connector assembly, and encoder assembly:

- **SpO_2 module**: remove the three screws located at the corners of the SpO_2 module and lift off the ground wire and the foil shield. Then pull the SpO_2 module straight up to disengage it from main PCB.

Note

Important for reassembly: the insulator goes on the non-foil screw hole. The washers, star-washers, and foil screw holes should be assembled together.

- **ECG/Temp cable/connector assembly**: unplug the connector from the main PCB. Remove the screws fastening the ECG connector to the front case, rotate the temperature connector counter-clockwise to unscrew it from the fastening nut on outside of the front case.

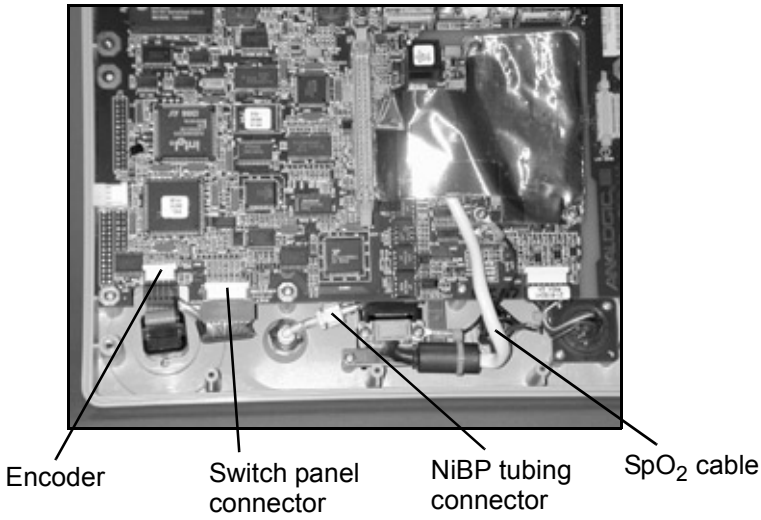
  Disconnect the white cable and move the SpO_2 front connector ground cable before attempting to disconnect the temperature connector.

- **The encoder assembly**: unplug the connector from the main PCB. Remove the wheel, as described in step 1A. Use a 9/16” hex socket to unscrew the fastening nut on the outside of the front case. The encoder can then be pulled away from the front case.

  During reassembly, the ribbon cable should orient towards the PCB, and after connection, the excess should be fed under the PCB.

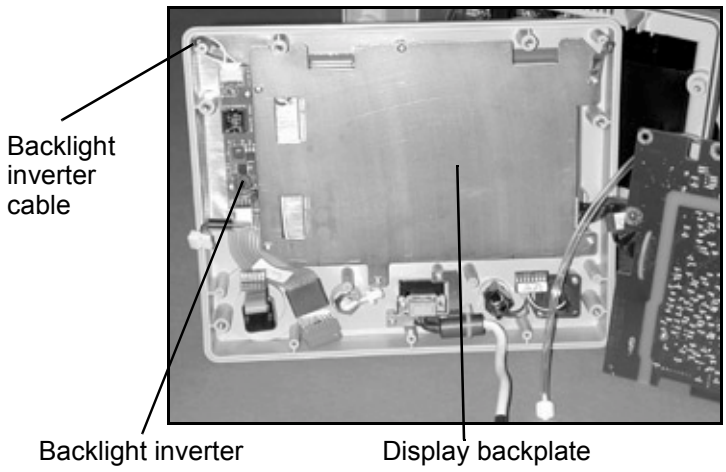
Procedure to remove the main PCB:

1. Disconnect the connectors from the main PCB for:
   - Switch panel
   - SpO_2
   - ECG/Temp
   - Encoder
   - LCD (display). Do not cut the tie wrap over the connector, slide it out of the way to remove the connector.
   - Backlight



2. Use a screwdriver to remove the six fastening screws around the periphery of the main PCB. Retain the fastening screws for reassembly.
3. Lift the main PCB slightly and unscrew the tubing connector near the NiBP front panel fitting.
4. The main PCB can now be removed. This allows access to the SpO_2 front panel connector, NiBP fitting and backlight inverter. These can be removed by removing the appropriate screws or nuts.

   During reassembly, the backlight inverter cable should be wrapped over the screw post. (See the upper left hand corner of the picture).



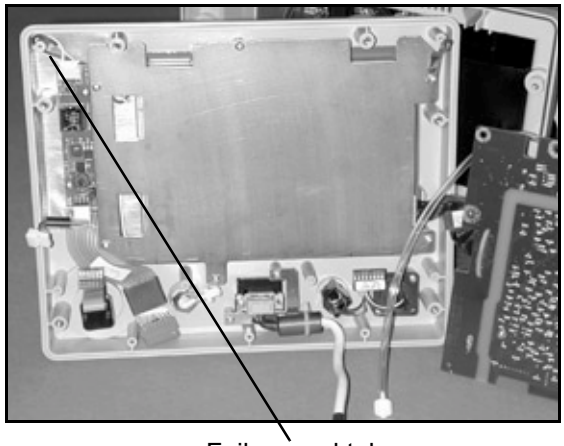
Procedure to remove the switch panel:

1. The switch panel is attached with an adhesive to the front panel.
2. Carefully lift up one corner of the switch panel and peel it away from the front panel. When the switch panel is free, feed the connector through the slot in the front panel.

Procedure to remove the LCD:

1. Remove the six fastening screws around the periphery of the display backplate. Retain the fastening screws for reassembly.
2. Carefully remove the metal and foil grounding tabs and washer noting their location and orientation for reassembly. The display backplate can now be removed.
3. Disconnect the backlight connector from the backlight inverter. The LCD can now be lifted out of the front bezel assembly.

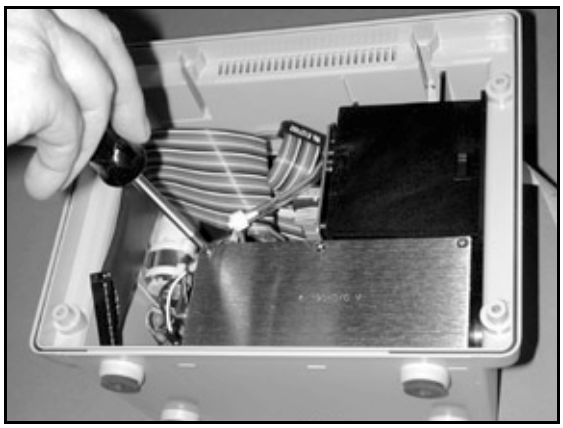
   For reassembly, place the LCD into the backplate before seating down on the screws. Confirm that the foil ground tab and unused white wire cable is placed out of the way and over the taller standoff.



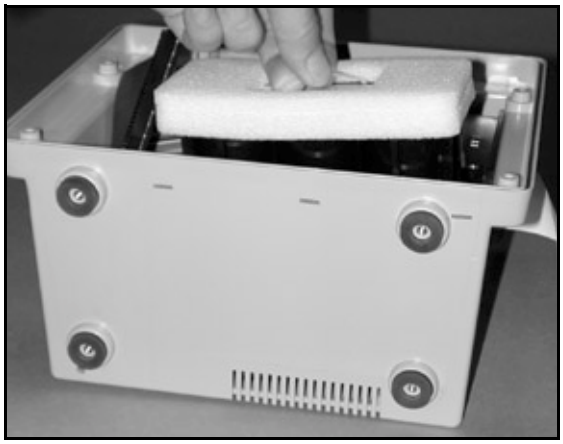
Rear Case Disassembly Procedures

Procedure to remove the battery:

1. Use a screwdriver to remove the three screws holding the battery cover plate in place.

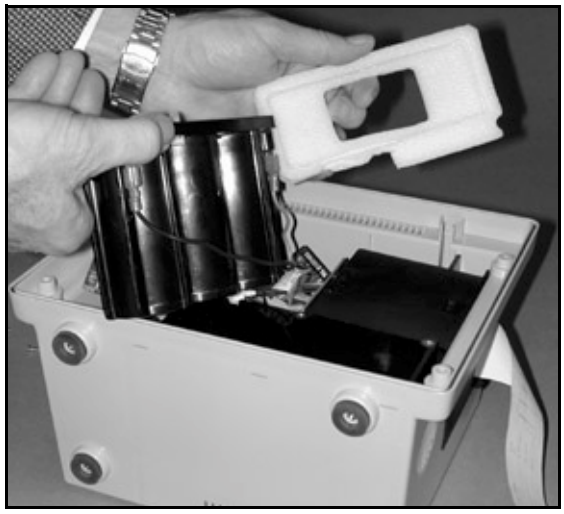


2. Grasp the strap, accessible through the opening in the top foam cover, and gently pull the battery from its housing.



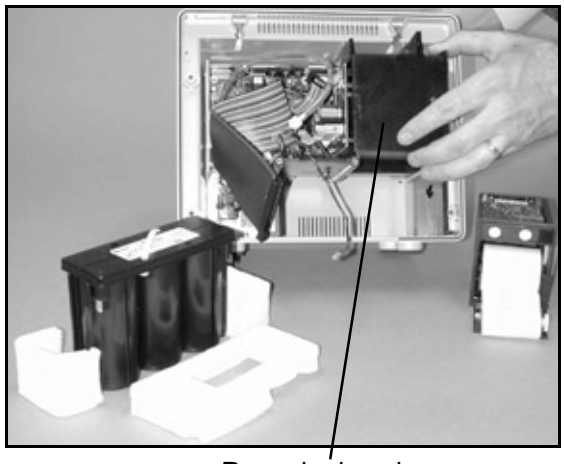
3. Remove the wire connectors from the battery clips. Remember that the red wire is connected to the plus (+) side of the battery pack.

   The + indicator is located under the foam piece.



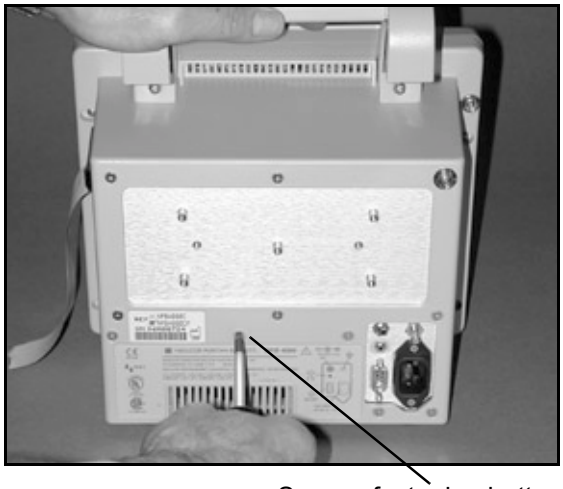
Procedure to remove the recorder and the battery housing:

1. Remove the battery as described in the procedure on page 83. Carefully remove the two foam battery pads from the battery housing.
2. If a recorder is installed, remove it as described in the procedure on page 78.
3. If a recorder is not installed, remove the recorder blanking cover by slipping a small flat-blade screwdriver into one of the slots on the blanking cover. Use a screwdriver to gently depress the snap-tab on the inside of the cover, while pulling the cover away from the monitor. After the first tab is released, repeat the process on the other side of the cover and remove cover.

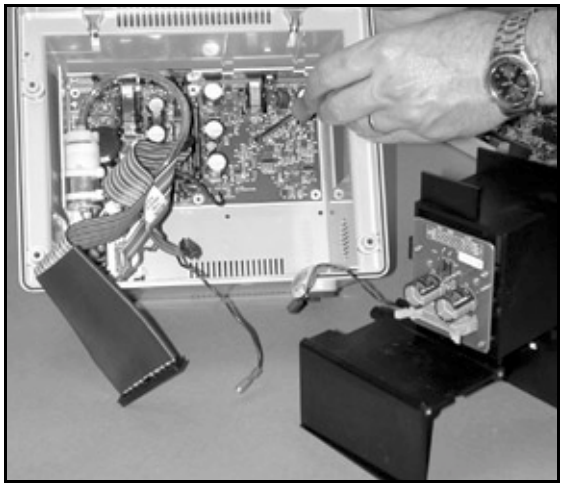


4. On the rear panel of the monitor, remove the three screws fastening the battery housing.

5. Carefully slide the battery housing from the rear case assembly.

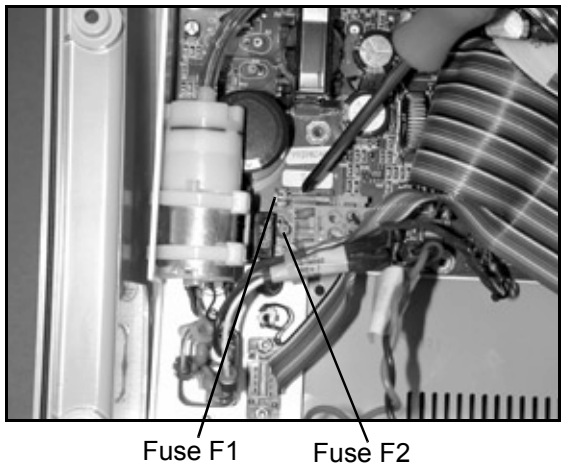


6. Disconnect the speaker twisted-pair-connector from the power supply PCB. The speaker is mounted on one side of the battery housing.
7. If a recorder is installed, disconnect the ribbon cable from the recorder PCB. The recorder PCB can be removed by removing the four screws fastening the PCB to the battery housing.



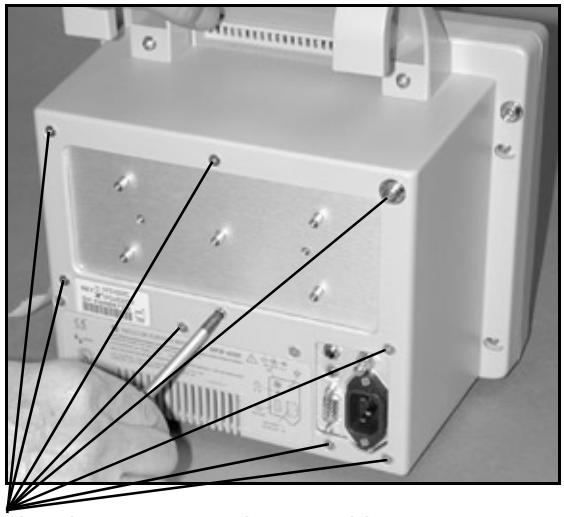
Procedure to remove fuses:

1. Remove the AC power input fuses, as shown, using the fuse pullers.



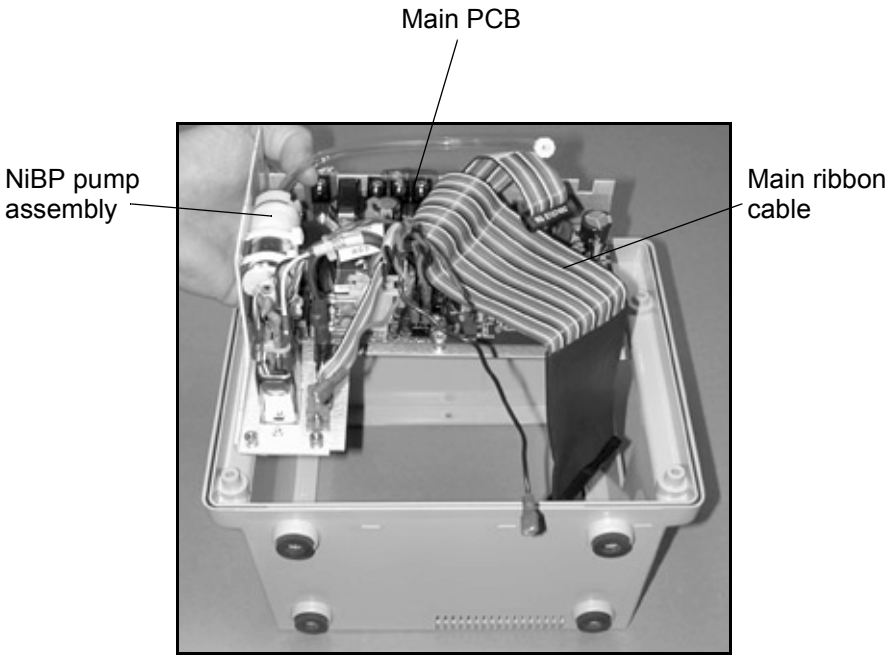
Procedure to remove the power supply assembly:

1. On the rear panel of the monitor, remove the eight screws holding the power supply assembly.



Screws fastening the power supply assembly

2. Carefully lift the power supply assembly from the rear case.
3. The power supply assembly can be disassembled into the following elements:
   - Power supply PCB
   - NiBP pump
   - Heat sink/chassis
   - Main ribbon cable


Main PCB
NiBP pump assembly
Main ribbon cable

7
Spare Parts

Introduction

Spare parts, along with part numbers, are listed in the tables that follow. *Item No.* corresponds to the callout number in Figure 1 through Figure 12. The *Page Ref.* indicates the page number of the relevant disassembly procedures in Chapter 6.

Small Parts Kit

Most small parts and hardware (screws, fuses, and so forth) can be found in the Small Parts Kit, Part Number M3921-64102.

Top Level Assembly

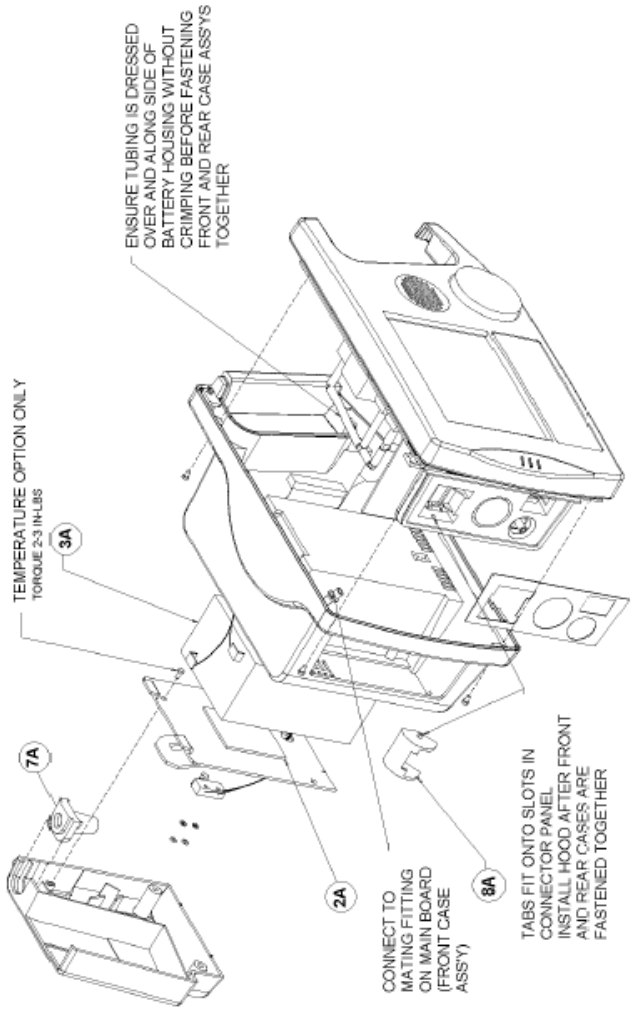


Figure 1 A1 Top Level Assembly Drawing (1 of 2)

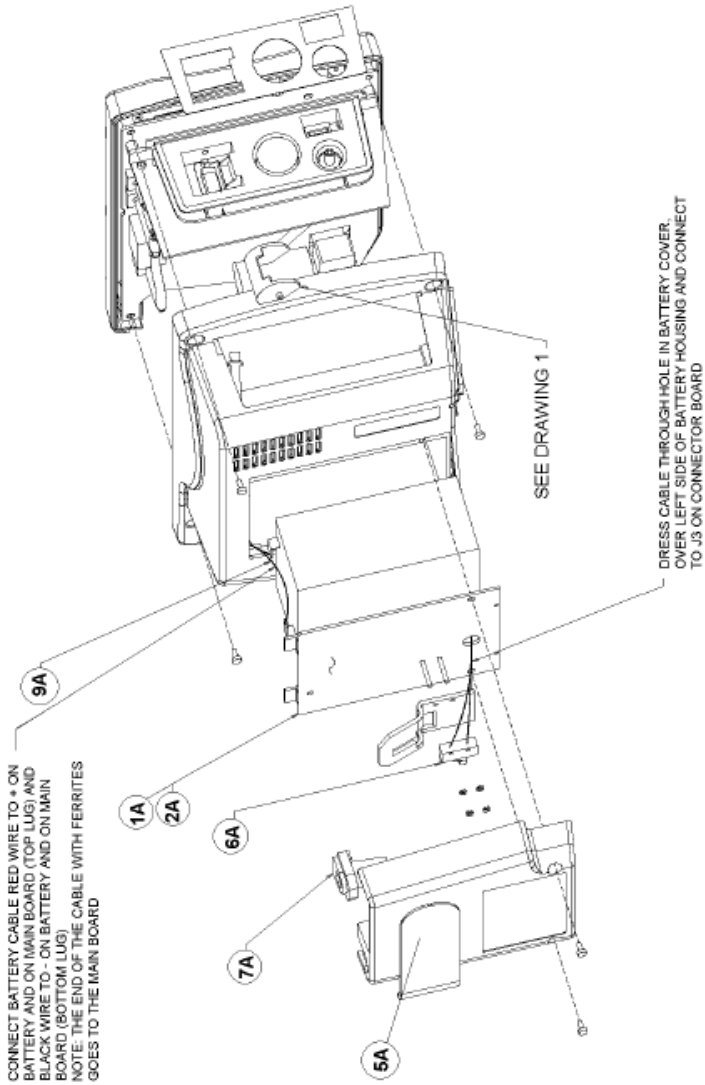


Figure 2 A1 Top Level Assembly Drawing (2 of 2)

Item No.	Part No.	Description	Page Ref.
1A	M3921-60100	Battery Cover (no temperature module)	page 63
2A	M3922-60100	Battery Cover (with temperature module)	page 64
3A	M3921-60101	Battery	page 63
4A	M3921-60102	Battery Pads	page 64
5A	M3922-60200	Temperature Module Housing	page 64
6A	M3922-60201	Temperature Probe Sensor Switch	page 63
7A	M3922-60202	Temperature Probe Grommet	page 65
8A	M3921-60300	SpO_2 Connector Hood	page 66
-	M3921-60301	Rear Cover Gasket	page 63
9A	M3921-60103	Battery Cable	page 63

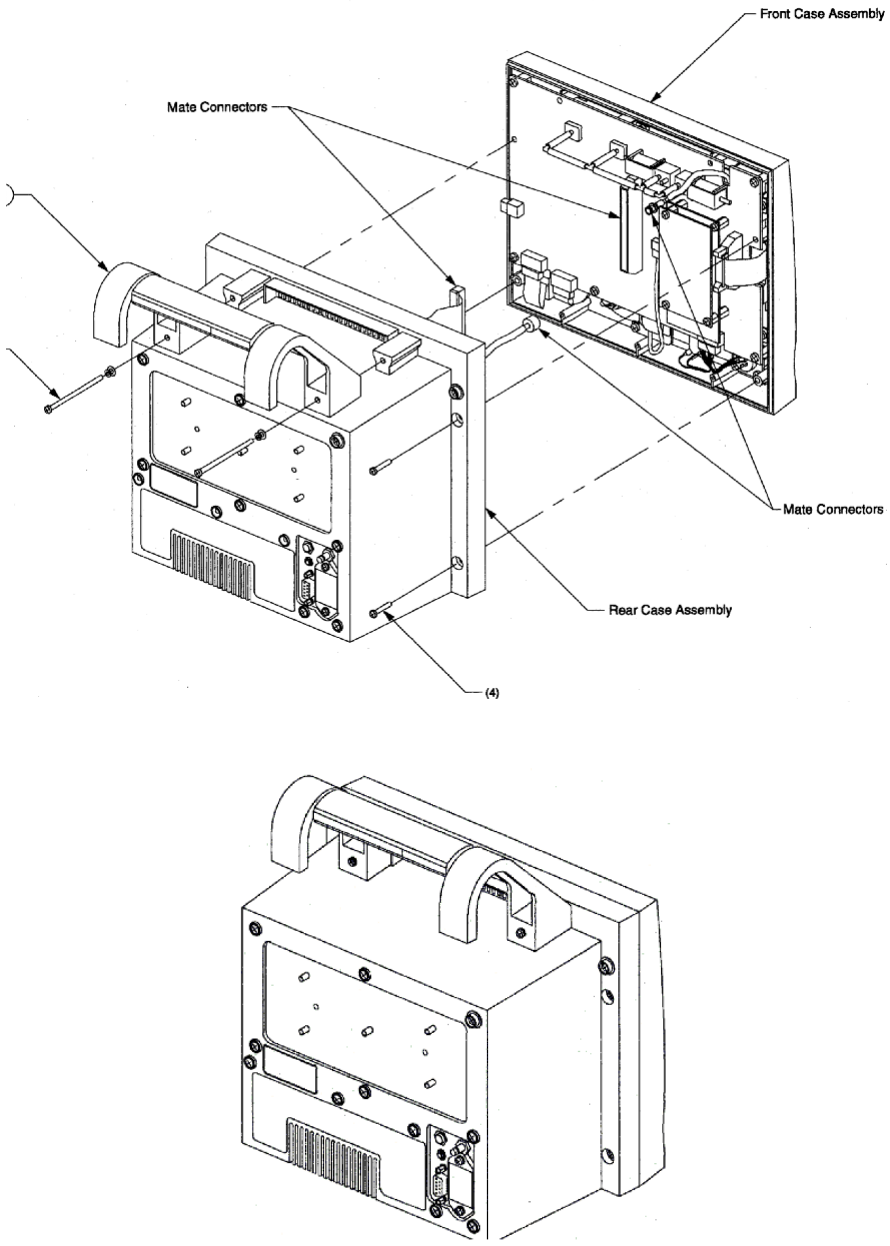


Figure 3 A3 Top Level Assembly Drawing

Item No.	Part No.	Description	Page Ref.
All A3 Models			
2	M3926-60800	Handle	page 77

Front Case Assembly

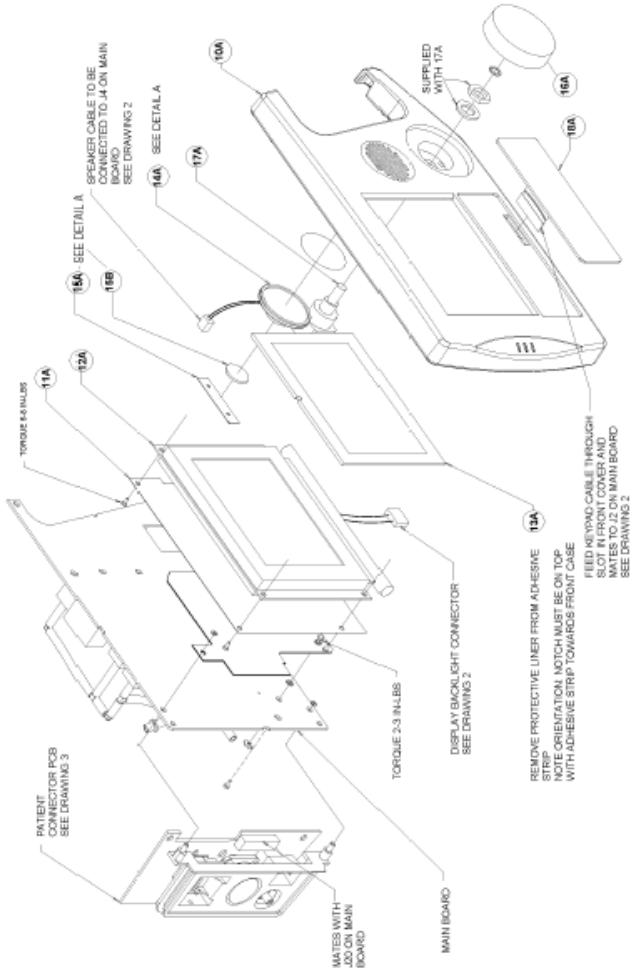


Figure 4 A1 Front Case Assembly Drawing (1 of 3)

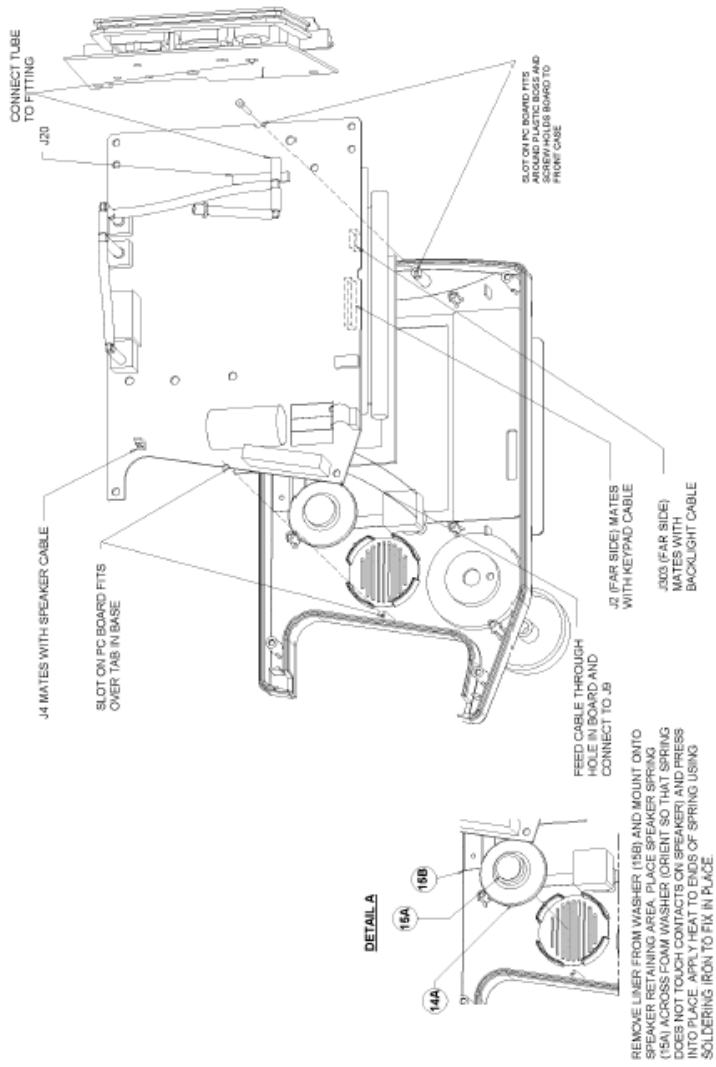


Figure 5 A1 Front Case Assembly Drawing (2 of 3)

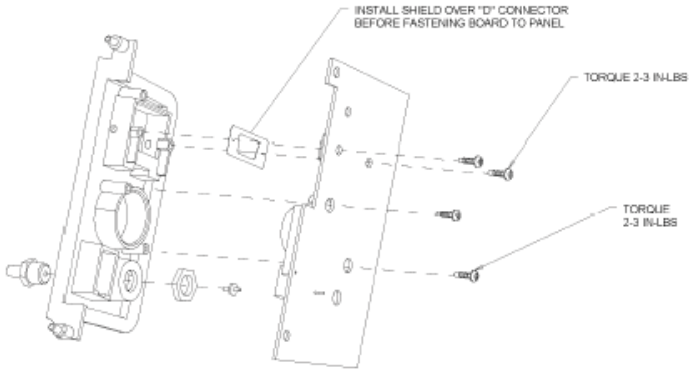


Figure 6 A1 Front Case Assembly Drawing (3 of 3)
Connector Panel and Patient Connector PCB

Item No.	Part No.	Description	Page Ref.
10A	M3921-60400	Front Cover Assembly (with keypad and display window)	page 70
11A	M3921-60401	Display Shield	page 70
12A	M3921-60402	LCD Assembly	page 70
13A	M3921-60403	Display Window (with gasket)	page 70
14A	M3921-60404	Speaker	page 71
15A 15B	M3921-60405	Spring Retainer Clip and Pad	page 71
16A	M3921-60406	Knob	page 71
17A	M3921-60407	Encoder	page 71
18A	M3921-60408	Keypad	page 72

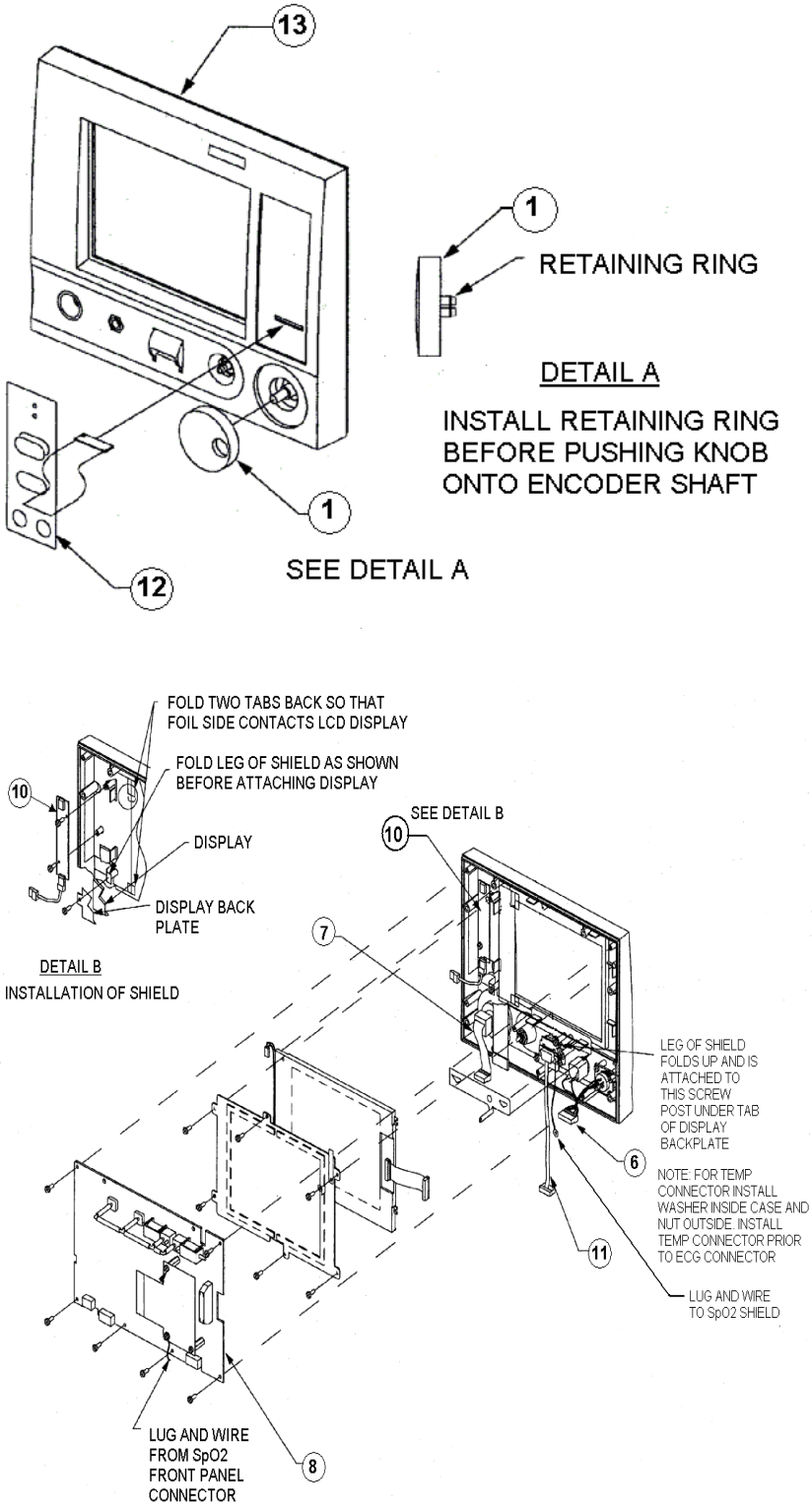


Figure 7 A3 Front Case Assembly Drawing (1 of 2)

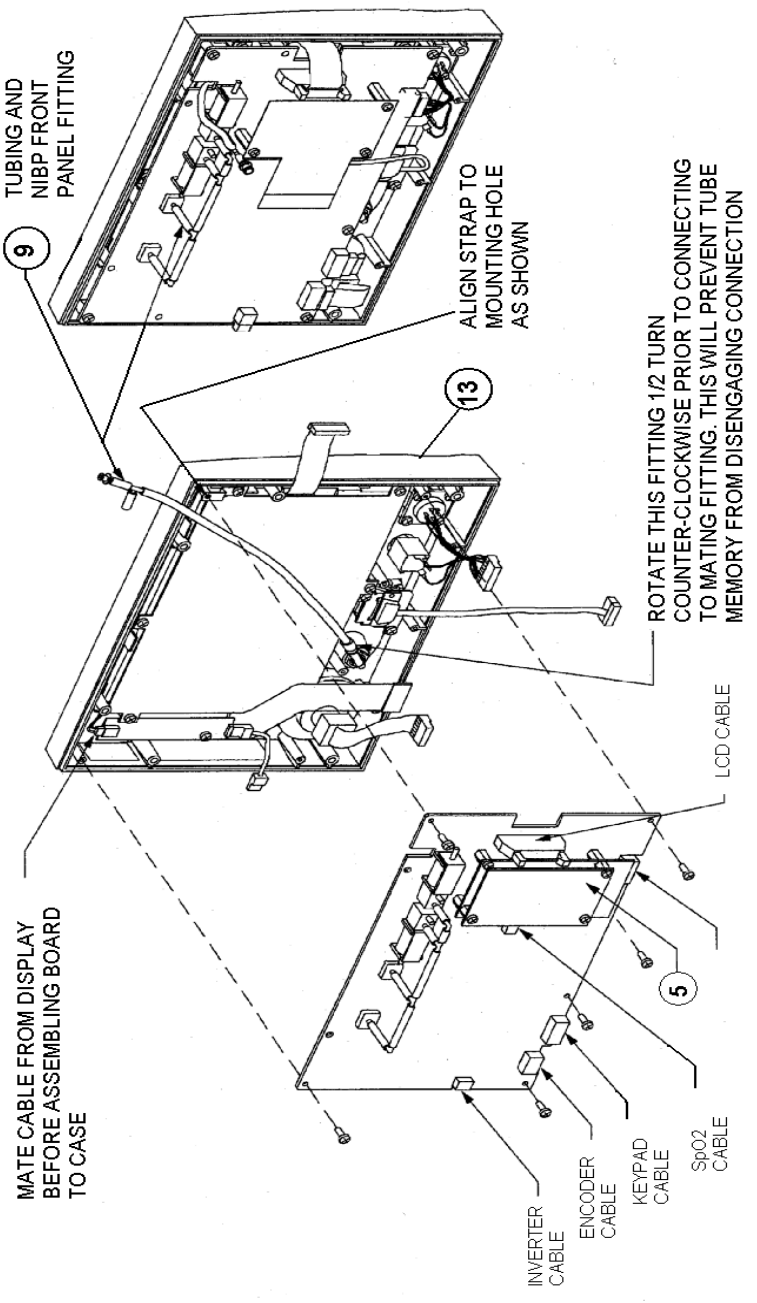


Figure 8 A3 Front Case Assembly Drawing (2 of 2)

Item No.	Part No.	Description	Page Ref.
All A3 Models			
1	M3921-60406	Wheel	page 77
5	M3926-60400	SpO_2 module	page 80
6	M3926-60305	Connector/cable, ECG/temp	page 80
7	M3921-60407	Encoder	page 80
9	M3926-60600	NiBP fitting and tubing	page 81
11	M3926-60401	Cable, SpO_2	page 80
12	M3926-60304	Switch panel	page 82
M3926A & M3927A			
8	M3926-60500	PCB, main, new part	page 80
8	M3926-68500	PCB, main, Version 3.0–Exchange part	page 80
10	M3926-60303	Inverter, backlight	page 82
13	M3926-60300	Bezel, front	page 82
M3928A & M3929A			
8	M3928-60500	PCB, main, new part	page 80
8	M3928-68500	PCB, main–Exchange part	page 80
10	M3928-60303	Inverter, backlight	page 82
13	M3928-60300	Bezel, front	page 82

Rear Case Assembly

Item No.	No.	Description Part	Page Ref.
-	M3921-68500	Rear Connector PCB (with ribbon cable) exchange	page 73
	M3921-60500	Rear Connector PCB (with ribbon cable) new	page 73
-	M3921-60501	Pump Clamp	page 73
-	M3921-60502	Pump Pad	page 73
-	M3921-60503	NiBP Pump, Fitting, and Tubing	page 73
-	M3921-60505	Foot Cushion	page 74
-	M3921-60506	Handle	page 74

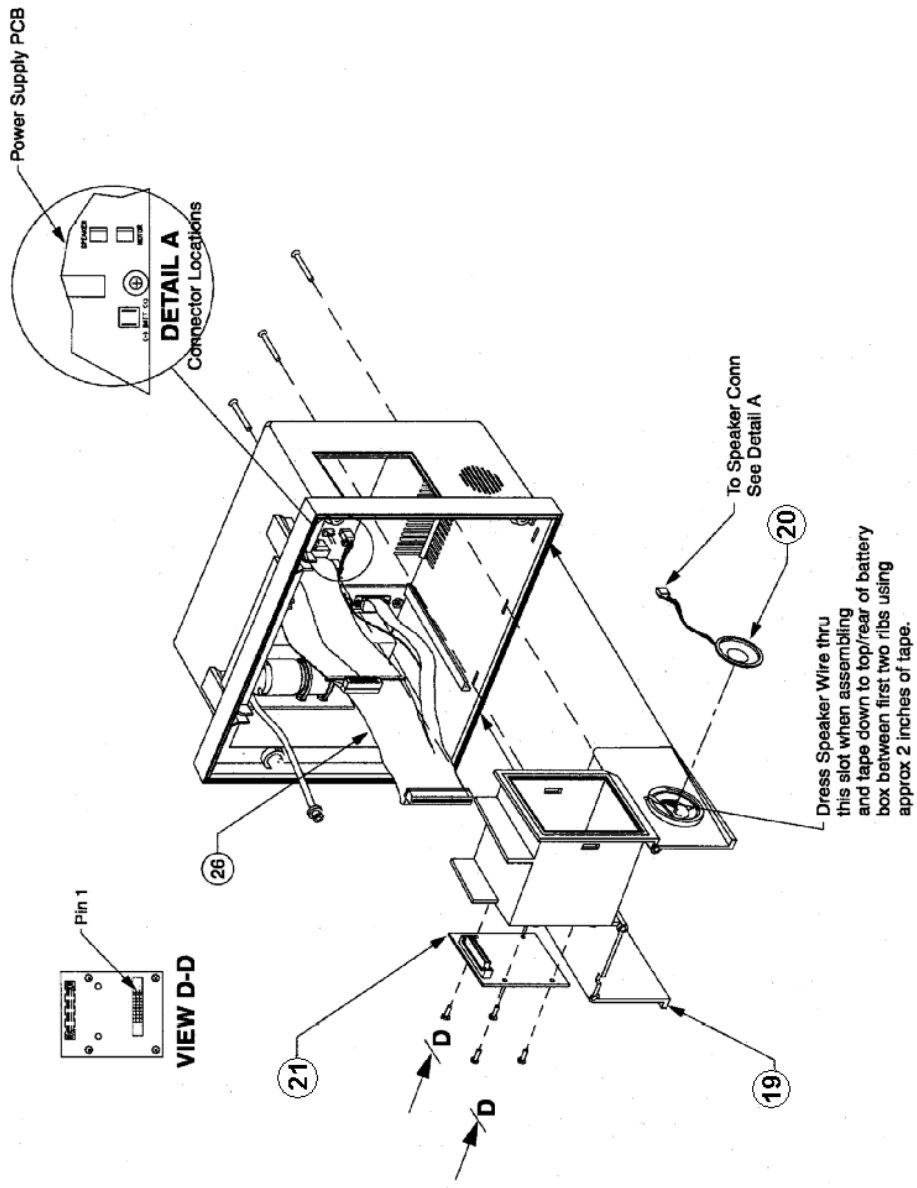


Figure 9 A3 Rear Case Assembly Drawing (1 of 3)

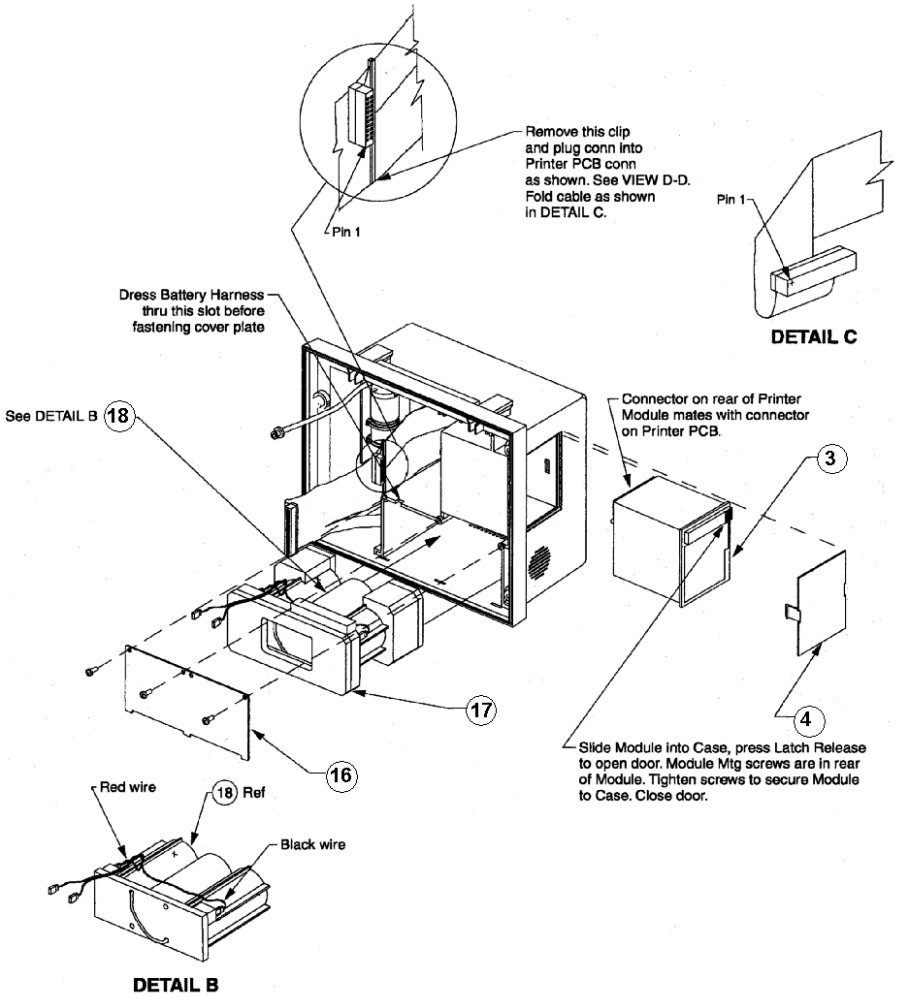


Figure 10 A3 Rear Case Assembly Drawing (2 of 3)

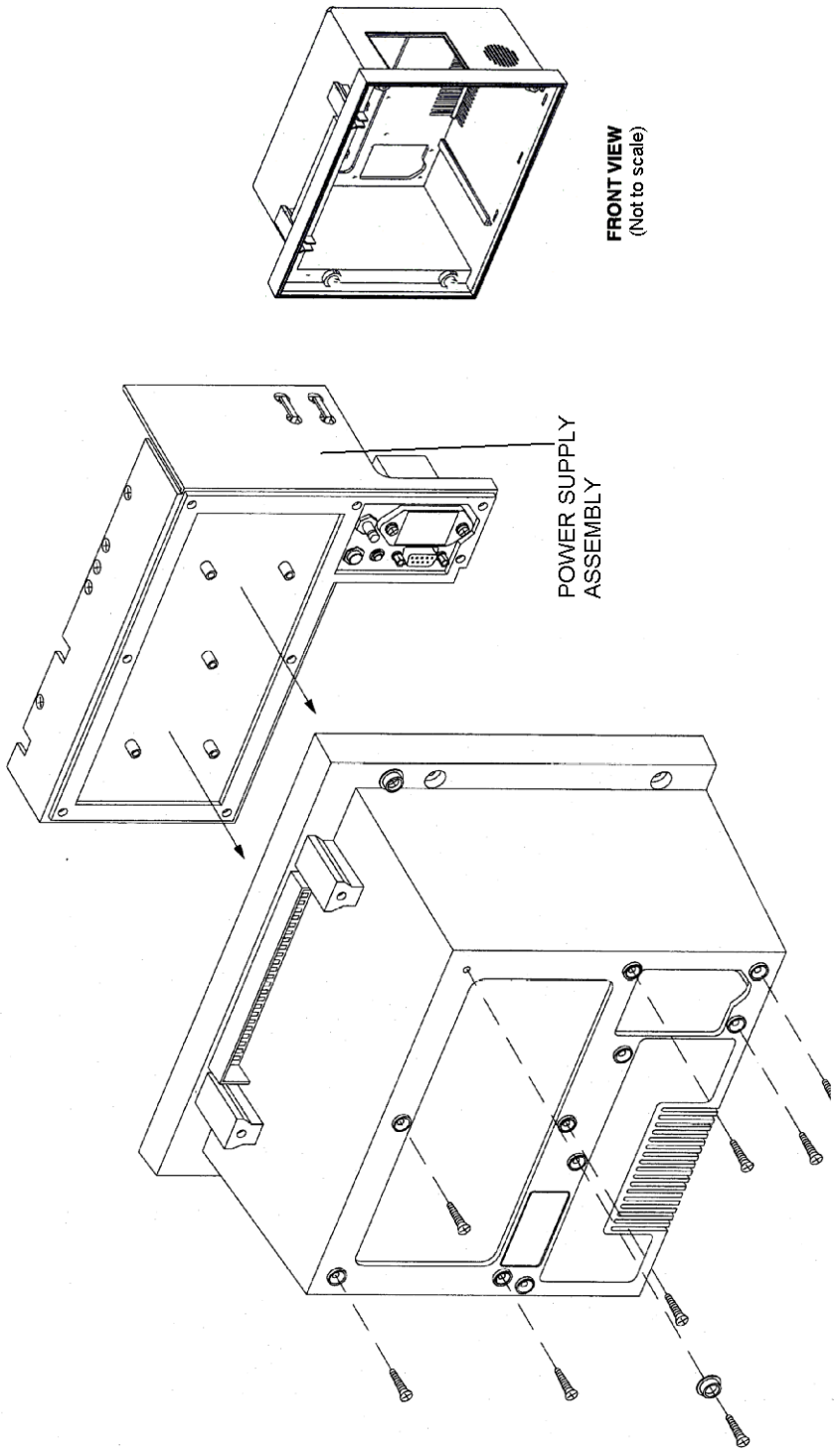


Figure 11 A3 Rear Case Assembly Drawing (3 of 3)

Item No.	Part No.	Description	Page Ref.
Agilent A3 (All Models)			
3	M3927-62000	Recorder module (M3927A/M3929A)	page 78
4	M3926-60106	Plate, recorder blanking (M3926A/ M3928A)	page 78
16	M3926-60105	Cover, battery	page 83
17	M3926-60102	Pads, battery	page 84
18	M3926-60101	Battery	page 83
19	M3926-60103	Housing, battery	page 84
20	M3926-60104	Speaker	page 85
21	M3927-60201	PCB, recorder (M3927A/M3929A)	page 85
26	M3926-60703	Cable, main ribbon	page 86

Main PCB Assembly (A1)

Part No.	Description	Page Ref.
M3921-68600	Main PCB (Model M3921A) - exchange	page 75
M3921-60600	Main PCB (Model M3921A) - new	page 75
M3922-68600	Main PCB (Models M3922A/M3924A) exchange	page 75
M3922-60600	Main PCB (Models M3922A/M3924A) new	page 75
M3923-68600	Main PCB (Model M3923A) exchange	page 75
M3923-60600	Main PCB (Model M3923A) new	page 75
M3921-60700	NiBP Pneumatic Assembly with Tubing and Fittings	page 75
M3921-68800	Patient Connector PCB (Model M3921A) exchange	page 75
M3921-60800	Patient Connector PCB (Model M3921A) new	page 75
M3922-68800	Patient Connector PCB (Model M3922A) exchange	page 75
M3922-60800	Patient Connector PCB (Model M3922A) new	page 75

Part No.	Description	Page Ref.
M3923-68800	Patient Connector PCB (Model M3923A) exchange	page 75
M3923-60800	Patient Connector PCB (Model M3923A) new	page 75
M3924-68800	Patient Connector PCB (Model M3924A) exchange	page 75
M3924-60800	Patient Connector PCB (Model 3924A) new	page 75
Located in Small Parts Kit M3921-64102	Fuse F301, 4A	page 75

Note

The Main PCB for all of the A1 models has jumpers which must be set correctly so that the User Interface software is configured to support the measuring parameters of each particular model. There are two jumpers, marked JP101 and JP102 located immediately below the NiBP valve. Ensure that the jumpers are installed as noted in the table which follows.

Model Number	JP101	JP102
M3921A	Installed	Installed
M3922A	Installed	Empty
M3923A	Empty	Installed
M3924A	Empty	Empty

Power Supply, Cables, and Miscellaneous Parts

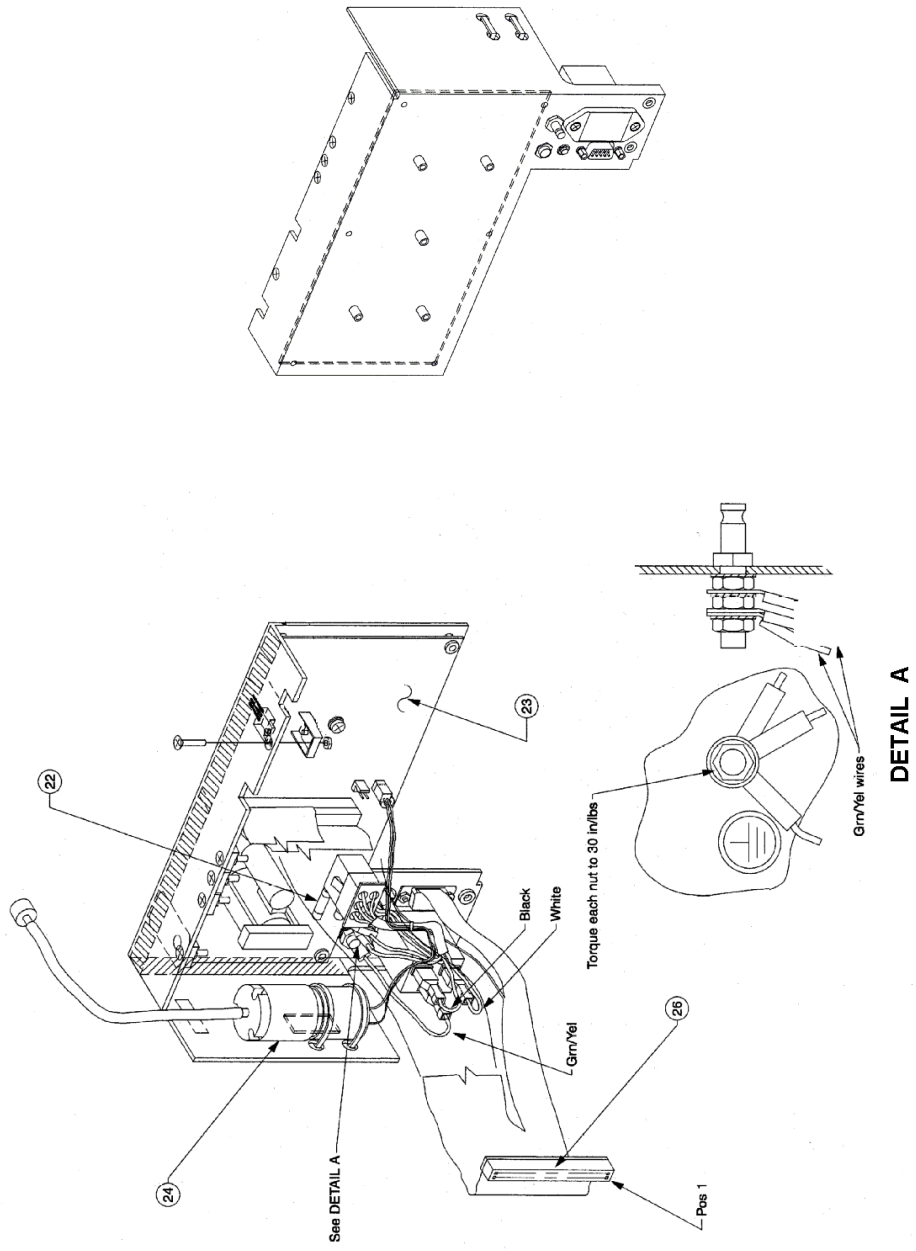


Figure 12 A3 Power Supply/Heat Sink Assembly Drawing

Part No.	Description
M3921-61000	Power Supply Assembly - 110V
M3921-61010	Power Supply Assembly - 220V

Item No.	Part No.	Description	Page Ref.
-	M3926-60700	Power Supply Assembly-new part	page 86
-	M3926-68700	Power Supply Assembly-exchange part	page 86
22	Located in Small Parts Kit M3921-64102	Fuse, 0.75A, slo-blow, 250V, 5x20 mm	page 86
23	M3926-60702	PCB, power supply	page 86
24	M3926-60601	Pump, NiBP	page 86
26	M3926-60703	Cable, main ribbon	page 86

Part No.	Description	Applies To	
		A1	A3
8120-5429	Power Cord, US (903) 2.4m	●	●
8120-1689	Power Cord, Europe (902) 2.0m	●	●
8120-1351	Power Cord, UK (900) 2.3m	●	●
8120-4475	Power Cord, Australia (901) 2.0m	●	●
8120-2104	Power Cord, Switzerland (906) 2.0m	●	●
8120-2956	Power Cord, Denmark (912) 2.0m	●	●
8120-4211	Power Cord, South Africa/India (917) 2.0m	●	●
8120-5342	Power Cord, Japan (918) 2.5m	●	●
8120-5182	Power Cord, Israel (919) 2.0m	●	●
8120-6869	Power Cord, Argentina (920) 2.0m	●	●
8120-6980	Power Cord, Chile (921) 2.0m	●	●

Part No.	Description	Applies To	
		A1	A3
8120-8376	Power Cord, China (922) 2.0m	●	●
M3926-60801	Feet	–	●
M3926-60402	SpO_2 Door	–	●
M3926-61000	DC Input Cable	–	●
M3926-61010	Defib Sync Cable	–	●
M3921-61030	Nurse Call Cable	●	●
M3921-61040	PC RS-232 Null Modem Cable	●	●

Exchange Unit Part Numbers

Part Number	Description
M3925-60000	Thermal Recorder for A1 Patient Monitor GSI
M3921-68020	A1 Patient Monitor, Exchange Unit
M3922-68020	A1 Patient Monitor, Exchange Unit
M3923-68020	A1 Patient Monitor, Exchange Unit
M3924-68020	A1 Patient Monitor, Exchange Unit

Part Number	Description
M3927-62000	Thermal Recorder for A3 Patient Monitor GSI
M3926-68020	A3 Patient Monitor, Exchange Unit
M3927-68020	A3 Patient Monitor, Exchange Unit
M3928-68020	A3 Patient Monitor, Exchange Unit
M3929-68020	A3 Patient Monitor, Exchange Unit

8
Packing For Shipment

General Instructions

To ship the monitor for any reason, follow the instructions in this section.

Pack the monitor carefully. Failure to follow the instructions in this section can result in loss or damage not covered by the warranty. If the original shipping carton is not available, use another suitable carton.

Prior to shipping the monitor, contact your Philips Response Center for a returned goods authorization (RGA) number. Mark the shipping carton and any shipping documents with the RGA number.

Repacking In Original Carton

If available, use the original carton and packing materials. Pack the monitor as follows:

1. Place the monitor and, if necessary, accessory items in original packaging.
2. Place in shipping carton and seal carton with packaging tape.
3. Label carton with shipping address, return address and RGA number, if applicable.

Repacking In A Different Carton

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

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

9
RS-232 Interface

Proper Use

Caution

Connection to a battery operated PC should only be allowed by the end user.

Connection to a line powered device with an ITE Class II power supply is acceptable provided it passes all 60601-1-1 tests without a problem.

If there is a line powered device with a Class I power supply, such as a line powered PC or a laser printer in the system, there must be either optical isolation of the data cable or the Class I devices must have isolation transformers.

If you connect the monitor to any instrument, verify proper operation before clinical use. Refer to the other device's manual for full instructions.

Accessory equipment connected to the monitor's data interface must be certified according to IEC Standard 950 for data-processing equipment or IEC Standard 601-1 for electromedical equipment. All combinations of equipment must be in compliance with IEC Standard 601-1-1 systems requirements.

Anyone who connects additional equipment to the signal inport port or signal output port configures a medical system and is therefore responsible to ensure that the system complies with the requirements of system standard IEC Standard 601-1-1. If in doubt, consult Philips' Response Center or you local Philips representative.

- `This ISM device complies with Canadian ICES-001.`
- `Cet appareil ISM est conforme a la norme NMB du Canada.`

Note

The monitor and its accessories must be tested by qualified service personnel at regular intervals to verify proper operation, according to the procedures of the user's institution.

Additional important safety information is located in the User's Guide.

Cable Connections

The 9-pin connector mounted on the rear panel provides an access port for a serial (RS-232) interface to a suitably configured personal computer. Or, alternatively, qualified service personnel can use the connector to send a Nurse Call signal.

Pin #	Signal	Direction
1	not used	
2	Rx data	input
3	Tx data	output
4	DTR	output
5	Signal Ground	input/output
6	DSR	input
7	RTS	output
8	CTS	input
9	Alarm Out	output

Nurse Call

Pin 9 of the RS-232 serial interface connector provides an **`Alarm Out`** signal. Any time there is any alarm condition active in the monitor, pin 9 goes to plus RS-232 level voltage (> +5 VDC), if **`Nurse Call Signal`** is set to **`ON`** in the Set-up Menu. Any time there is no active alarm condition, pin 9 is at minus RS-232 level voltage (< –5 VDC).

The **ALARM SILENCE** button  does NOT deactivate the **`Nurse Call Signal.`** All alarm conditions must cease before the signal level returns to minus RS-232 level voltage (–5 VDC).

If in the Set-up Menu **`Nurse Call Signal`** is set to **`OFF`**, pin 9 is always be at the minus RS-232 level voltage. In order to make use of the **`Alarm Out`** signal, pin 9 should be connected to a high-impedance circuit (>1000) and protected against transient voltages.

10
Training Program

Introduction

The purpose of this chapter is to provide a complete, flexible training program that addresses the needs of technical personnel who service the monitor at all levels of involvement.

The training is self-paced. This chapter guides you through the entire service training program. All the information you require is in this chapter, or referred to in this chapter.

Levels of Involvement

Preventative Maintenance Only

If you are performing only preventative maintenance on the monitor, you must review the following sections of this chapter:

- Overview
- Preventative Maintenance

Phone Support or Service

If you are providing phone support or servicing of the monitor, you must review the following sections of this document:

- Overview
- Support Strategies
- Theory of Operation and System Architecture
- Troubleshooting
- Monitor Applications and Algorithms
- Disassembly
- Preventative Maintenance

Training Materials

Essential Materials

The essential materials to complete this training:

- This A1 & A3 Service Guide (M3921-9000C)

For Philips Service Personnel, a Training Completion Form must be signed and returned to your supervisor referencing the course number "MWPMD-A1/A3SUPP".

Optional Materials

Optional materials that can assist you in this training:

- An A1 and an A3 monitor
- The A1 and A3 User’s Guide
- See page 10 of this service manual. This lists the tools needed for performance verification of the monitor.

Overview

This section provides a high level overview of the monitors and their options.

Model	Measurement Parameters and Features						
	NiBP	SpO_2	Temp	ECG	Resp	Integral Recorder	Color/ Mono
A1 Monitor							
M3921A	Yes	Yes	No	No	No	No	Mono
M3922A	Yes	Yes	Yes	No	No	No	Mono
M3923A	Yes	Yes	No	Yes	No	No	Mono
M3924A	Yes	Yes	Yes	Yes	No	No	Mono
M3925A	Optional Standalone Recorder for A1						
A3 Monitor							
M3926A	Yes	Yes	Yes	Yes	Yes	No	Mono
M3927A	Yes	Yes	Yes	Yes	Yes	Yes	Mono
M3928A	Yes	Yes	Yes	Yes	Yes	No	Color
M3929A	Yes	Yes	Yes	Yes	Yes	Yes	Color

Note — The monitor is designed for non-invasive use only.

Common use models include:

- Physicians' offices
- Transport within a care facility
- Low-acuity monitoring in any clinical environment

The monitor has an RS-232 interface, and this port is used as follows:

- A1 - for Nurse Call and for connecting the optional M3925A standalone recorder
  It is not possible to use the Nurse Call and the recorder at the same time.
- A3 - for Nurse Call only

The configuration of this port is on page 113.

Support Strategies

This section provides a summary of how the monitor was designed to be supported and how Philips provides that support.

There are two main methods of repairing the monitor:

- Unit exchange
- Bench repair

Unit exchange

The primary repair method used by Philips service personnel is unit exchange. The current design of the monitor requires testing if the case is opened.

Bench repair

The secondary repair method is bench repair. Special tools are required and are listed in Chapter 3 under the section “Equipment Needed”. If the case is opened, specific tests must be performed. These tests are listed in detail along with the Test Map in Chapter 3.

At the Philips parts center, we will stock the board level assemblies and mechanical parts based on existing failure data and customer demand. These parts are listed in Chapter 7. The availability of the spare parts will be notified by service notes, as soon as they are set up at our parts center.

The troubleshooting guide in Chapter 5 is sufficient for assembly level bench repairs. Before a repair is performed, consider whether a repair or a replacement is most suitable. The main PCB for the monitor is only slightly less expensive than an exchange device. Therefore, if troubleshooting indicates that the fault lies in the main PCB, it is highly recommended that an exchange unit is ordered and the defective returned. Not only does this save time and effort, but it is also a more cost-effective solution.

Theory of Operation and System Architecture

General

This section contains a high level overview of the theory of operation of the major functional modules of the monitor. Philips service providers perform Bench Repair at the assembly level. For this purpose, they should review this high level information.

Anyone wishing to perform component level repairs should review the detailed information provided in the *Concepts Guide*.

Please be aware that Philips only stocks assembly level parts.

System Overview - A1

This section contains a system overview for the A1 monitor, including the overall block diagram, power supply, isolated front end, NiBP control, the SpO2 processing module, and microcontroller.

Block Diagram - A1

The monitor contains an isolated front-end section, powered by an isolated power supply, and in which the signals from SpO_2, temperature, and ECG sensors are processed (see Figure 1).

The plastic tubing provides sufficient isolation for signals from the cuff in NiBP monitoring.

A single A/D converter is used to digitize processed temperature, NiBP, and ECG inputs; the SpO_2 module produces digitized data.

A microcontroller, Intel 386, requests and receives instructions from a flash memory. The processor has a 16-bit data bus, and uses 19 of the 24-bit address bus. These, and eight control signals, are used to read and write to the DRAM, flash memory, UART, and FPGA (programmable gate array). Other interface connections are made through the I/O port signals, timer signals, and interrupt signals.

The FPGA provides signals for control and data to the LCD. Bias voltage and backlight power for the LCD are provided by the power supply section. The FPGA processes front-panel button and A1 wheel operations.

Circuit details for these blocks are contained in the *Concepts Guide*.

Block Diagram - A1

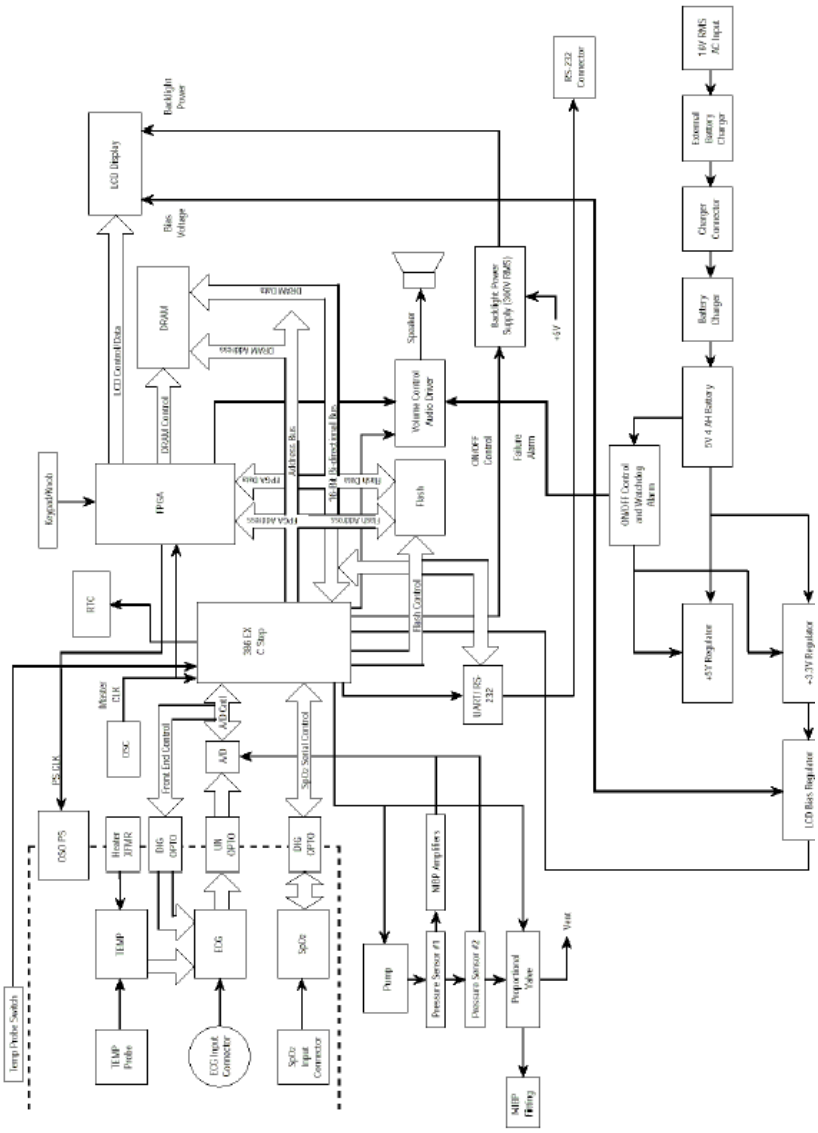


Figure 1 A1 Block Diagram

System Overview - A3

The A3 is a full function monitor for use on adult and pediatric patients.

The functions performed by the system include monitoring patient ECG, heart rate, respiration rate, blood pressures, blood oxygen saturation, and temperature.

In addition to monitoring and displaying the status of these physiological parameters, the instrument performs various microprocessor-programmed analytical functions, such as:

- Creating both visual and audible alarm signals when set limits are violated
- Creating and displaying warning messages when conditions are detected that would degrade or prevent valid measurements
- Creating and displaying trend waveforms or tabular data;
- Providing a synchronizing pulse for defibrillator operation;
- Providing input to an optional recorder for printout of current or trend waveforms or tabular data.

The monitor is essentially a battery-powered instrument. An internal charging unit is designed to accept either an AC line voltage or DC source input voltage. The charger uses these external power sources to maintain a “float” voltage source available from the batteries.

Block Diagram - A3

The A3 functions are represented graphically in the System Block Diagram, Figure 2.

Each section of the System Block Diagram is described briefly in the text that follows the illustration. This is followed by more detailed descriptions of the theory of operation of each block.

Block Diagram - A3

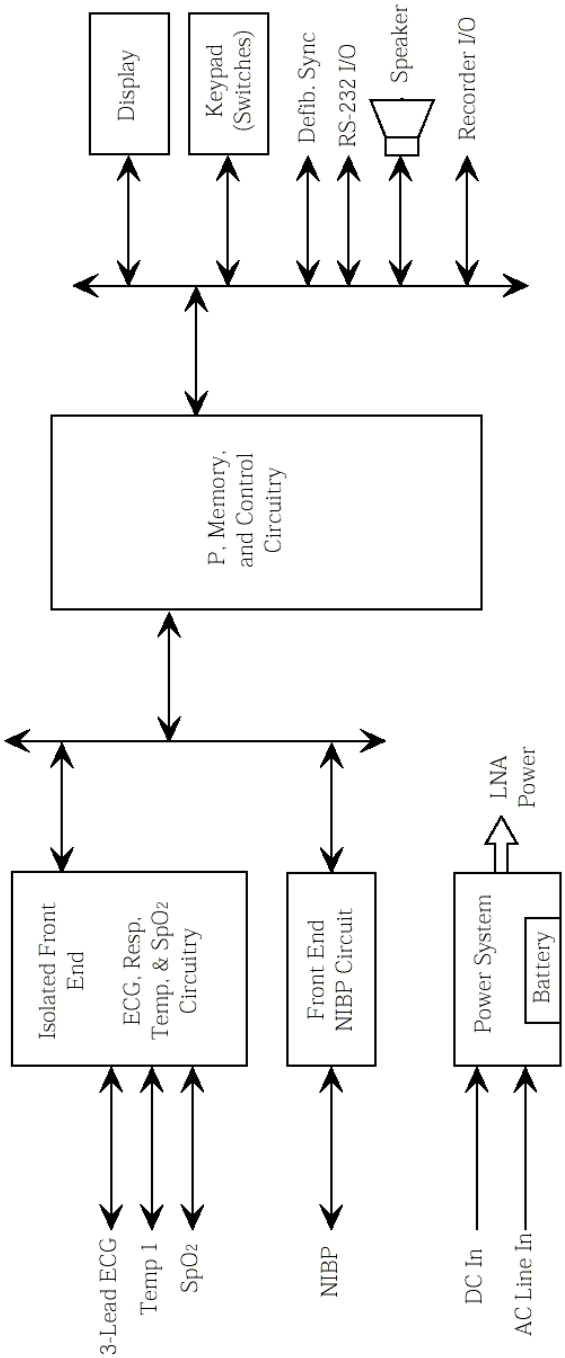


Figure 2 A3 Block Diagram

Isolated Front End The Isolated Front End section includes all the circuitry to convert ECG,

SpO2, and temperature measurements to digital format and to connect this information to the processor. The respiration detection is obtained from two of the three electrodes of the ECG connections.

Galvanic isolation of these circuits from the remainder of the monitor is accomplished by utilizing an isolated power supply and by incorporating opto-isolators between the Front End outputs and inputs to the microprocessor computation and control circuitry.

NiBP Front End

The NiBP section contains the pumps, valves, pressure measurement circuitry, and control circuitry for the noninvasive blood pressure measurement. Pressure data is converted to digital format and conveyed to the processor section.

Power System

The power system section contains a power supply capable of operating the monitor and charging the battery from either an AC source of 100 to 240 volts AC at 50 to 60 Hz or a DC input of 10 to 16 volts. This section also contains the circuitry. The battery provides the operating power for the monitor.

Power system outputs of ±12 volts DC, +5 volts DC, and –24 volts DC are developed for use throughout the non-isolated portions of the monitor.

Microprocessor, Memory and Control

The microprocessor (µP), Memory and Control section contains the system CPU and all digital support circuitry. The latter includes the RAM, nonvolatile memory, and real-time clock. This section also contains the display logic, keypad (switch) interface logic, RS-232 I/O control, defibrillator synchronization control, and printer logic.

Display

The display is a cold-cathode, backlit, fluorescent LCD unit. The pixel resolution of 0.23 mm provides a 640 x 480 line display. For the A3 models M3926A and M3927A, the display is presented in black and white mode only (no gray scale). The A3 models M3928A and M3929A have color a display.

Keypad (Switches) and Wheel

The keypad circuit contains five push-switch membrane switches and two green LEDs. The LEDs are driven by the power supply system and indicate (AC or DC), the charging of the batteries, and the condition of the source cable in-line fuses.

Signals from the LEDs are returned to the microcomputer for processing and control as required.

The power switch, connected directly to the supply, toggles the power between Standby and On modes. When in Standby, the display is blank, and

no monitoring is performed. However, the batteries are charging if either an AC or DC power source is connected to the rear panel.

The alarm silencing switch is connected directly to the processor and to the system power supply. Pressing this switch turns off the battery fuse alarm in the system power supply. Response of the processor depends upon the action in pressing this switch. If momentarily pressed (less than 2 seconds), alarms are silenced temporarily for a preset interval determined by the menu selection. If held pressed for 2 seconds or more, the Alarm Suspend condition is initiated.

The NiBP switch output is connected to the processor. Response of the processor depends upon the state of NiBP operation at the time and the action in pressing this switch. If momentarily pressed (less than 2 seconds), a single NiBP measurement is obtained. If pressed for 2 seconds or more, the processor initiates a STAT monitoring sequence. Pressing the NiBP switch at any time a pressure measurement is in effect causes the processor to terminate the measurement and to deflate the cuff.

The display Contrast switch operates in conjunction with the navigation wheel to determine the apparent black/white contrast setting in the display. Changing contrast is actually a change in the viewing angle. Outputs of the switch and wheel are connected to the processor.

Momentarily pressing the switch sets the contrast to mid-range, factory-default value.

Momentary pressing of the switch, followed within 3 seconds by a rotation of the wheel are processed to vary the contrast of the display. When there has been no wheel rotation for three seconds, the contrast control function is terminated by the processor. The contrast control function is also terminated if the wheel is pressed any time within this 3 second interval.

Operation of the Volume switch accomplishes similar functions for the volume of the heart rate audible tone as the display contrast control switch does for the display. Pressing this switch enables the wheel to vary the tone volume.

Navigation Wheel

This is a rotating, push-switch wheel. The associated wheel circuitry generates a pulse when pressed and generates a digitally encoded pair of quadrature signals whose relative magnitudes and polarities represent the angular position of the wheel. These outputs are connected to the processor where they are interpreted as required for the functions involved. Successive angular positions determine the direction of wheel rotation.

In addition to the functions performed when in conjunction with the keypad switches as described above, the wheel operates in conjunction with the display to select menus and lists of parameter variables.

RS-232 I/O

This is a rear panel 9-pin connector providing interfaces with other computer systems or equipment. The driver for this "port" is a Universal Asynchronous Receive-Transmit (UART) integrated circuit that interfaces this port with the microprocessor. The baud rate for this serial transmission function is programmable from 1200 baud to 38.4 kilobaud.

Pin number 9 of the RS-232 connector is reserved for a Nurse Call signal. The nurse call signal reacts when a low, medium, or high level alarm is activated.

Defib Sync Pulse

The rear panel connector for the Defib Sync Pulse is keyed so that the connection of a cable can be detected by the processor. When a connection is detected, the processor software initiates the generation by hardware of a TTL-compatible pulse capable of driving 1 TTL load over a three-meter cable with less that 200 pF capacitance.

The defib pulse is triggered by the detection of the R-wave in the QRS sequence of the ECG wave-form complex. The pulse signal is active for 100 ±10 ms.

Speaker

The speaker is capable of providing 73 dBA of volume at a distance of one meter during alarm conditions. The processor drives the speaker in different patterns as specified for the different alarm priorities and conditions. Refer to the operator's manual for descriptions of alarm responses.

Recorder

The optional recorder module is installed in the right panel of the monitor. Refer to the *User Guide* for printing procedures. It provides users with the capability to obtain hard-copy records of selected vital signs information.

Basic control of the recorder is implemented by two push-switch controls on the recorder front panel. One of these is used to obtain continuous recordings of the real-time waveforms displayed in the top two graphic frames. Along with the waveforms, the recorder prints the values of the vital signs being displayed. The printing continues until the user presses either recorder switch a second time.

The other control switch initiates a printout for 20 seconds of the same information recorded by the continuous control.

If scrolling is enabled in a display frame containing trend data when the continuous recording switch is operated, then the trend record for that vital sign is printed. If the snapshot recording switch is operated, then only the trend data on the display is printed.

The recorder may be programmed via the monitor menu display to print a snapshot recording when an alarm condition occurs.

Printing is accomplished on 50 mm wide thermal paper at recorder speeds programmable up to 50 mm/s.

ECG Processing

The technique used in ECG senses the varying potential difference between two points at the skin surface which respond to the electro-chemical actions of the muscular activity of the heart.

Three electrodes are attached to the patient's right arm (RA), left arm (LA) and left leg (LL). The varying potentials at these locations are cable-connected to the ECG circuit inputs where they are conditioned, and the difference of potential between two selected leads is digitized before transmitting through opto-isolators to the processor. The processor-installed algorithms operate on the signals to develop drivers for the graphic display and to compute the heart rate in beats per minute (BPM).

In addition to the acquisition of the QRS waveform complex, the ECG input and subsequent signal processing computing circuitry perform a number of other functions:

- They detect a "lead-off" condition if one of the electrode connections is disrupted.
- They detect the presence of pacemaker signals within the QRS waveform complex of the ECG.
- They generate a synchronization pulse for external use with defibrillators. The Defib Sync Pulse output is available at a connector in the rear panel.

Respiration Processing

The patient's respiration is detected by using two of the three leads of the ECG electrodes and cable. A low-level excitation signal is applied to these leads, and the variation of the thoracic impedance caused by the breathing is sensed and processed for display and measurement.

NiBP Processing

The NiBP processing uses an oscillometric technique to provide needed measurements at selected intervals. This technique uses an inflatable sphygmomanometer cuff similar to those used by clinicians in routine measurements.

A motorized pump inflates the cuff to approximately 180 mmHg initially, at which point the pressure effectively stops the flow of blood. Then, under monitor control, the pressure in the cuff is gradually reduced, while a pressure transducer detects the air pressure and transmits the parameter signal to the NiBP input circuitry.

As the pressure is reduced, blood flows in the previously occluded artery, and changes the measurements made by the transducer. The point at which

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

SpO_2 Processing

Measurement of oxygen saturation in the blood uses a specrophotometry technique. It is based on the facts that oxyhemoglobin and deoxyhemoglobin differ in their absorption of red and infrared light, and that the volume of arterial blood in tissue changes during the pulse.

Using these facts, a pulse oximeter passes red and infrared light into an arteriolar bed and measures changes in light absorption during the pulsatile cycle. The light sources are red and infrared light emitting diodes (LEDs), while the detection is accomplished by a photo diode.

To identify the oxygen saturation of arterial hemoglobin, the monitor uses the pulsatile nature of arterial flow. During systole, a new pulse of arterial blood enters the vascular bed, and both blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The measurement is based upon the difference between maximum and minimum absorption, focusing on the pulsatile arterial blood.

In addition to the oximetry function, the input signals may be used to calculate heart rate.

Temperature Processing

Measurement of patient temperature is accomplished by processing the signal from a probe containing a resistor whose impedance is temperature dependent. The class of such components is called thermistor.

The A3 is designed to accept the signals from electrically isolated Series 400 probes manufactured by Yellow Springs Incorporated. Interchangeable probes in this series may be used for esophageal, rectal, skin or surface, or airway temperature measurement. Probes are furnished with a standard 10-feet lead. Extension leads are available.

The signal from the probe is conditioned by the monitor input circuitry, processed, and used to drive the numeric display.

Troubleshooting

Service personnel concerned with troubleshooting should review the following topics in this manual:

- Error Codes (see Chapter 5)
- Boot Sequence (see Chapter 3)
- Performance verification (see Chapter 3)

This is intended to be a practical, hands-on part of the training program. If possible, therefore, use a monitor to help you learn about troubleshooting the monitor.

When faced with a call regarding the monitor, there are some simple steps that are recommended to solve the failures described below. These failures account for the majority of known failure modes.

Nature of Problem	Recommended Action
1. The alarm will not silence.	Ensure the external power supply on the A1 or the power cord on the A3 is plugged into AC power.
2 Power related problems.	Step 1: Ensure the external power supply on the A1 or the power cord on the A3 is plugged into AC power. Step 2: If the problem persists, follow the troubleshooting table in Chapter 5.
3 Problems not related to power, and the customer is willing to loose patient data and settings.	Reset all settings to factory presets. This will reinitialize all hardware and software components. The following instructions work for both the A1 and A3: Step 1: With the monitor powered off, simultaneously press the Volume and Contrast buttons on the front keypad. Step 2: While continuing to press the Volume and Contrast buttons, power on the monitor. Step 3: Continue to keep the Volume and Contrast buttons pressed until the power-up diagnostic sequence is complete. When the normal monitoring screen appears, release the two buttons.

Nature of Problem	Recommended Action
4 The fuse of the external power supply on the A1 can be blown if there is a defect on the main PCB. In this state the monitor will no longer boot. Therefore if the AC indicator on the A1 does not light...	Step 1: Try to boot up the A1. **Note: Do not plug in an operational external power supply to an A1 that will not boot up.** Step 2: If the monitor fails to boot, use a different A1 to test the external power supply for operation, if possible. If the fuse is blown, the Battery Charge, green LED, indicator will not come on and the DC power indicator in the display screen will stay on. **Note: The fuse in the external power supply is not replaceable.**
5 The A1 and A3 NIBP valves can stick if they are inactive for several months in extreme environments.	Exercise the valves by using the NiBP test or just through normal use. They will free themselves up.
6 In the A3 with an optional integral recorder, there is a recorder error message.	Press the **SNAPSHOT** button on the recorder. • If the paper advances, the problem lies in the monitor, not the recorder. • If the paper does not respond, then the problem lies in the recorder. Replace the recorder.

Whenever the monitor has been opened, there are specific steps regarding reassembly, described in the disassembly instructions in Chapter 6, that must be followed. If these instructions are not followed, various errors may result. See Chapter 6 for a review of the disassembly and reassembly procedures.

For monitors that are defective on arrival, first go through points 1 to 4 in the troubleshooting table above. If these are not successful, and a replacement monitor is necessary, please contact an Philips sales representative to arrange a replacement.

Disassembly

Disassembly procedures are described in the disassembly guide in Chapter 6. Please read the whole chapter.

Whenever the monitor has been opened, there are specific steps regarding reassembly, described in the disassembly instructions in Chapter 6, that must be followed. If these instructions are not followed, errors may result.

If the monitor fails the required performance tests described in Chapter 3, then please review the reassembly.

Monitor Applications and Algorithms

Reference Documents and Other Sources

There are various reference documents available to both service providers and the end user. Frequently requested information can be found in the following places:

Information about...	Found in...
Supplies/transducer types	http://shop.healthcare.agilent.com/hsgstore/catalog/default.asp reference website or Appendix C in the *User Guide*, *Technical Data Sheet*
Basic monitor specifications	Chapter 14 of the *User Guide*, *Technical Data Sheet*
Regulatory compliance	Chapter 14 of the *User Guide*, *Technical Data Sheet*
Other data about algorithms	Chapter 14 of the *User Guide*, *Technical Data Sheet*

Preventative Maintenance

This part of the training program shows you how to carry out effective preventative maintenance. For the tools required for this, see page 10 of this service guide.

Please read:

- Routine Maintenance - Chapter 2

Please review:

- Visual inspection - Chapter 3 (page 8 for the test map)
- Performance verification - Chapter 3
- Power-on tests - Chapter 3
- Safety testing procedures - Chapter 3

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