NELLCOR®

SERVICE MANUAL

NELLCOR SYMPHONY®
N-3100 Blood Pressure Monitor

To contact Nellcor Puritan Bennett's representative: In the United States, call 1-800-NELLCOR or 510 463-4000; outside the United States, call your local Nellcor Puritan Bennett representative.

Caution: Federal law (U.S.) restricts this device to sale by or on the order of a physician.

034134B-0298

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To obtain information about a warranty, if any, for this product, contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION 1: INTRODUCTION

1.1 MANUAL OVERVIEW

This manual contains information for servicing the *NELLCOR SYMPHONY* N-3100 blood pressure monitor. Only qualified service personnel should service this product. Before servicing the N-3100, read the operator's manual carefully for a thorough understanding of operation.

1.2 WARNINGS, CAUTIONS, AND NOTES

This manual uses three terms that are important for proper operation of the monitor: Warning, Caution, and Note.

1.2.1 Warning

A warning precedes an action that may result in injury or death to the patient or user. Warnings are boxed and highlighted in boldface type.

1.2.2 Caution

A caution precedes an action that may result in damage to, or malfunction of, the monitor. Cautions are highlighted in boldface type.

1.2.3 Note

A note gives information that requires special attention.

1.3 N-3100 BLOOD PRESSURE MONITOR DESCRIPTION

The N-3100 is a noninvasive blood pressure monitor that measures systolic, diastolic, and mean arterial blood pressure. It also derives the patient's pulse rate at the time of blood pressure measurement. The N-3100 is intended for hospital use to monitor adult, pediatric, or neonatal patients. The N-3100 can be used in mobile environments when stacked with the N-3000, the N-3200, or both. When used in mobile environments, the N-3100 must be protected from excessive moisture such as direct rainfall.

The N-3100 can operate as a standalone monitor or it can be connected to (stacked with) other *NELLCOR SYMPHONY* instruments, such as the N-3000 pulse oximeter, the N-3200 display/printer, or both.

The physical and operational characteristics of the monitor are described in the operator's manual and Section 9, *Specifications*, of this manual.

Figures 1-1 and 1-2 depict the North American and International front panels of the N-3100 and the names of its displays and controls.

Note: All graphics presented in this manual relevant to the monitor are depicted in the International symbol format. Refer to your operator's manual and Figures 1-1 and 1-2 of this manual for applicable translations.

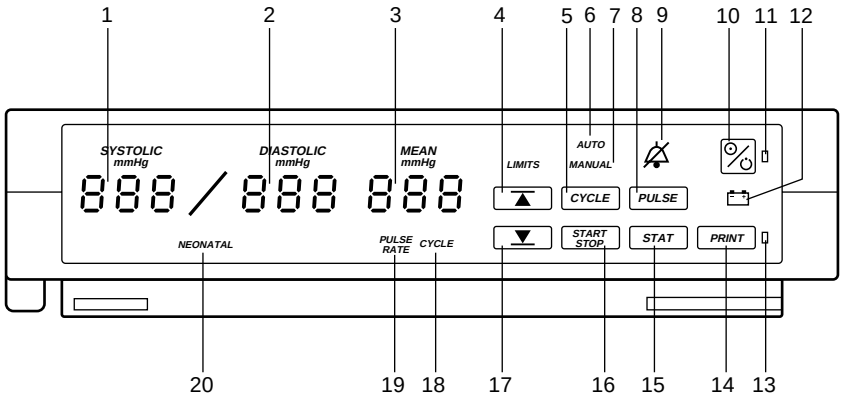


Figure 1-1: N-3100 Front Panel (North American)

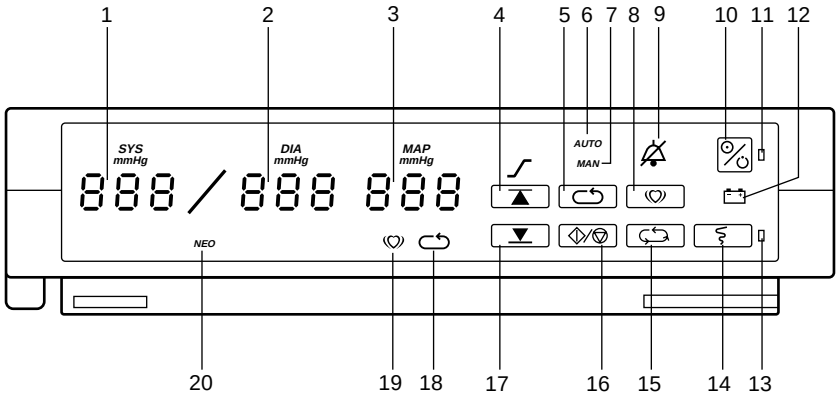


Figure 1-2: N-3100 Front Panel (International)

1	SYSTOLIC display	11	POWER ON indicator
2	DIASTOLIC display	12	BATTERY IN USE/BATTERY LOW indicator
3	MEAN/PULSE RATE display	13	PRINTER IN USE/STACKED indicator
4	UPPER ALARM LIMIT button	14	PRINT button
5	CYCLE button	15	STAT MODE button
6	AUTOMATIC MODE indicator	16	START/STOP MEASUREMENT button
7	MANUAL MODE indicator	17	LOWER ALARM LIMIT button
8	PULSE button	18	CYCLE indicator
9	AUDIBLE ALARM OFF indicator	19	PULSE RATE indicator
10	ON/STANDBY button	20	NEONATAL MODE indicator

1.4 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 N-3100 operator's manual. To understand the various *Nellcor Puritan Bennett* cuffs and hose that work with the monitor, refer to the individual cuff and hose directions for use.

SECTION 2: ROUTINE MAINTENANCE

2.1 CLEANING

Caution: Do not immerse the N-3100 or its accessories in liquid or use caustic or abrasive cleaners. Do not spray or pour any liquid on the monitor or its accessories.

To clean the N-3100, dampen a cloth with a commercial, nonabrasive cleaner and wipe the instrument exterior surfaces lightly. Do not allow any liquids to come in contact with the power connector, fuse holder, or switches. Do not allow any liquids to penetrate connectors or openings in the instrument cover. For cuffs and hoses, follow individual directions for use.

2.2 PERIODIC SAFETY AND FUNCTIONAL CHECKS

The following safety checks should be performed by a qualified service technician after any repair or opening of the case, upon return of the instrument from any use outside your institution's control, or at least every 2 years.

1. Inspect the exterior of the N-3100 and verify that there is no evidence of damage. Refer to Section 5, *Troubleshooting* for repair. If the N-3100 cannot be repaired, contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

2. Inspect safety labels for legibility. If labels are not legible, contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

3. Verify that the monitor performs properly as described in paragraph 3.3.

4. Perform the electrical safety tests detailed in paragraph 3.4. If the unit fails these electrical safety tests, do not attempt to repair, contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

5. Inspect fuse(s) for proper rating (AC inlet fuse: 0.8 Amp, 250 Volt). If necessary, replace as described in paragraph 6.2.

2.3 BATTERIES

Nellcor Puritan Bennett recommends replacing all instrument batteries at least every 2 years. To replace the batteries, refer to Section 6, *Disassembly Guide*.

If the N-3100 has been stored for more than 30 days and has not been connected to an SPS power supply, charge the battery before use. A fully discharged battery requires a 14-hour charge for a full charge. A 6-hour charge is required for 1 hour of operating time. Connect the N-3100 to an SPS external power supply during storage to ensure that the battery remains fully charged and the N-3100 is ready for immediate use.

SECTION 3: PERFORMANCE VERIFICATION

3.1 INTRODUCTION

This section discusses the tests used to verify performance of the monitor. All tests are accomplished through the control panel.

3.2 EQUIPMENT NEEDED

Equipment	Description
AC Power Adapter	SPS-I or SPS-I1 (International) or SPS-N or SPS-N1 (North American)
Electrical Safety Analyzer	Must meet current AAMI specifications
Blood Pressure Simulator	Bio-tek “BP Pump” Noninvasive Blood Pressure Analyzer or equivalent

3.3 PERFORMANCE TESTS

The following tests are used to verify performance of the N-3100 and should be performed following troubleshooting and repairs. If the N-3100 fails any test, refer to Section 5, *Troubleshooting*.

3.3.1 Power-up

The power-up tests (paragraphs 3.3.1.1 through 3.3.1.3) verify the following monitor functions:

- Power-On Self-Test
- Power-On Defaults for Adult-Pediatric Alarm Limits and Ranges
- Power-On Defaults for Neonatal Alarm Limits and Ranges

3.3.1.1 Power-On Self-Test

1. Connect the monitor to model SPS-I (or SPS-I1) or model SPS-N (or SPS-N1) external power supply or, if stacked with the N-3200, connect AC power to the N-3200.

2. Do not connect any hoses or cuffs to the monitor.

3. Observe the monitor front panel. With the N-3100 in STANDBY (turned off), press the ON/STANDBY button. In order to successfully complete the self-test, the monitor must perform the following sequence.

   a. The monitor emits three consecutively higher-pitched beeps.

   b. All indicators light momentarily as illustrated in Figure 3-1. Verify that "8.8.8." is shown in the SYSTOLIC, DIASTOLIC, and MEAN/PULSE RATE displays.

      Note: Slight differences in the brightness of display segments and indicators are normal and acceptable.

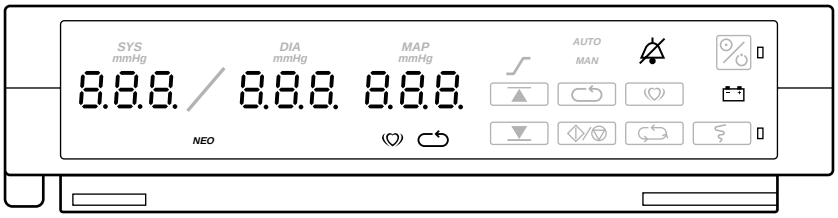


Figure 3-1: Self-Test Display

   c. All displays (except the POWER ON indicator) turn off briefly.

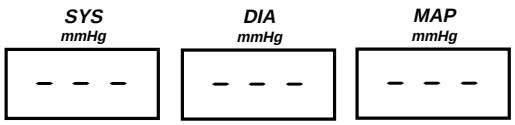
   d. Each segment in the digital displays lights individually in sequence in a scanning, or firefly, test pattern and all indicators light momentarily.

   e. The sequence of steps b and c will be repeated until all internal tests are complete.

      Note: The number of times the sequence of steps b and c is repeated is dependent on the amount of information stored in trend memory. Typically, you will see two cycles of the sequence.

   f. A single, 1-second beep is produced and all displays again illuminate momentarily, indicating the automatic Power-On Self-Test is complete.

   g. The POWER ON indicator and the MANUAL MODE indicator are illuminated. A "–" is displayed in each window of the SYSTOLIC, DIASTOLIC and MEAN/PULSE RATE displays. This is referred to as the normal mode steady state.



Caution: Pressing and holding the NEW PATIENT/NEONATAL button (3 seconds or more) until three beeps sound clears all previously stored patient data.

h. Press and hold the NEW PATIENT/NEONATAL button (located on the rear panel) for approximately 3 seconds until you hear three beeps to indicate that stored patient data is cleared.

3.3.1.2 Power-On Defaults for Adult-Pediatric Alarm Limits and Ranges

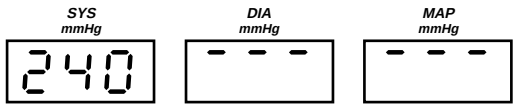
Note: The following procedure is written using Nellcor Puritan Bennett factory-set power-on default settings. If your institution has other custom power-on default settings, those values will be displayed and should be substituted in the following procedure. The N-3100 can be reset to factory power-on defaults using the service mode procedure described in Paragraph 4.3.11, Menu Item 20, or configuration mode, as described in Paragraph 4.2.13, Configuration Menu (item 3).

In the following procedures, each time the UPPER ALARM LIMIT button or the LOWER ALARM LIMIT button is pressed, the N-3100 will emit a beep.

When observing or changing default limits, a 3-second timeout is in effect, that is, if no action is taken within 3 seconds, the monitor automatically returns to the normal operating mode steady state.

The following procedures use the N-3100 UP and DOWN ARROW buttons located on the top of the monitor. When the N-3100 is stacked with the N-3000, the N-3200, or both, the Nellcor knob on either of these units can be used to perform the function of the N-3100 UP and DOWN ARROW buttons. Turning the Nellcor knob in a clockwise direction is equivalent to pressing the N-3100 UP ARROW button. Turning the knob in a counterclockwise direction is equivalent to pressing the N-3100 DOWN ARROW button. There will be no sounds or beeps associated with turning a Nellcor knob. When the N-3100 is stacked with the N-3000, the UP and DOWN ARROW buttons are not accessible and the Nellcor knob must be used.

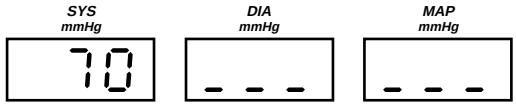
1. Press the ON/STANDBY button to turn the unit on. Verify that the N-3100 is in adult-pediatric mode, which is indicated by the NEONATAL MODE indicator being off. If the indicator is lit, quickly press and release the NEW PATIENT/NEONATAL button twice to place the N-3100 in the adult-pediatric mode. When the unit is in the normal mode steady state, press and release the UPPER ALARM LIMIT button. Verify that the monitor emits a single beep when you press the button. Verify that the SYSTOLIC display indicates the default alarm limit value of “240” for a few seconds and verify that the other displays show dashes while the “240” is displayed as shown below. Do not press any buttons for at least 3 seconds and all displays will change to show a dash in the center of each character (normal mode steady state).



2. From the normal mode steady state, press and release the UPPER ALARM LIMIT button. Press and hold the DOWN ARROW button until a value of “70.” is shown in the SYSTOLIC display.

   Note: A period (“.”) following a displayed alarm limit value is an indication that the alarm limit value has been changed from the power-on default value previously set in the N-3100.

3. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Verify that the monitor emits a single beep when you press the button. Within 3 seconds, verify the SYSTOLIC display indicates an alarm limit value of “70” and verify that the other displays show a dash at the bottom while the “70” is displayed as shown below.



4. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Within 3 seconds, press and hold the DOWN ARROW button until “60.” is displayed in the SYSTOLIC display. Verify “60.” is the lowest value to which the lower alarm limit can be adjusted.

5. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Within 3 seconds, press and hold the UP ARROW button and verify that the upper alarm limit setting of “70.” is the highest value to which the lower systolic alarm limit can be adjusted.

6. From the normal mode steady state, press and release the UPPER ALARM LIMIT button twice. Verify that the monitor emits a single beep each time you press the button. Verify that the DIASTOLIC display indicates default alarm limit value of “210” for a few seconds and verify that the other displays show dashes at the top while the “210” is displayed.

7. From the normal mode steady state, press and release the UPPER ALARM LIMIT button twice. Press and hold the DOWN ARROW button until “50.” is shown in the DIASTOLIC display

8. From the normal mode steady state, press and release the LOWER ALARM LIMIT button twice. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the DIASTOLIC display indicates an alarm limit value of “50” and verify that the other displays show dashes at the bottom while the “50” is displayed.

9. From the normal mode steady state, press and release the LOWER ALARM LIMIT button twice. Within 3 seconds, press and hold the DOWN ARROW button until “40.” is displayed in the DIASTOLIC display. Verify that “40.” is the lowest value to which the lower alarm limit can be adjusted.

10. From the normal mode steady state, press and release the LOWER ALARM LIMIT button twice. Within 3 seconds, press and hold the UP ARROW button and verify that “50.” is the highest value to which the lower alarm limit can be adjusted.

11. From the normal mode steady state, press and release the UPPER ALARM LIMIT button three times. Verify that the monitor emits a single beep each time you press the button. Verify that the MEAN/PULSE RATE display indicates an alarm limit value of “225” for a few seconds and verify that the other displays show dashes at the top while the “225” is displayed.

12. From the normal mode steady state, press and release the UPPER ALARM LIMIT button three times. Press and hold the DOWN ARROW button until “55.” is displayed in the MEAN/PULSE RATE display.

13. From the normal mode steady state, press and release the LOWER ALARM LIMIT button three times. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the MEAN/PULSE RATE display indicates the default alarm limit value of “55” and verify that the other displays show dashes at the bottom while the “55” is displayed.

14. From the normal mode steady state, press and release the LOWER ALARM LIMIT button three times. Within 3 seconds, press and hold the DOWN ARROW button until “55.” is shown in the MEAN/PULSE RATE display. Verify that “55.” is the lowest value to which the lower alarm limit can be adjusted.

15. From the normal mode steady state, press and release the LOWER ALARM LIMIT button three times. Within 3 seconds, press and hold the UP ARROW button and verify that “55.” is the highest value to which the lower alarm limit can be adjusted.

16. From the normal mode steady state, press and release the UPPER ALARM LIMIT button four times. Verify that the monitor emits a single beep each time you press the button. Verify that the PULSE RATE indicator is lit and the MEAN/PULSE RATE display indicates the default alarm limit value of “170” for a few seconds and verify that the other displays show a dash at the top of each display character while the “170” is displayed.

17. From the normal mode steady state, press and release the UPPER ALARM LIMIT button four times. Press and hold the DOWN ARROW button until “40.” is shown in the MEAN/PULSE RATE display.

18. From the normal mode steady state, press and release the LOWER ALARM LIMIT button four times. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the PULSE RATE indicator is lit and the MEAN/PULSE RATE display indicates the default alarm limit value of “40” and verify that the other displays show dashes at the bottom while the “40” is displayed.

19. From the normal mode steady state, press and release the LOWER ALARM LIMIT button four times. Within 3 seconds, press and hold the DOWN ARROW button until “30.” is displayed in the MEAN/PULSE RATE display. Verify that “30.” is the lowest value to which the lower alarm limit can be adjusted.

20. From the normal mode steady state, press and release the LOWER ALARM LIMIT button four times. Within 3 seconds, press and hold the UP ARROW button and verify that “40.” is the highest value to which the lower alarm limit can be adjusted.

21. Press the ON/STANDBY button to turn the monitor off. Verify that the monitor emits three consecutively lower-pitched beeps.

22. Press the ON/STANDBY button to turn the monitor on. The monitor performs the Power-On Self-Test described in 3.3.1.1, steps 3a. through 3g.

23. From the normal mode steady state, press and release the UPPER ALARM LIMIT button. Verify that the monitor emits a single beep and the SYSTOLIC display indicates an alarm limit of “240” for a few seconds.

24. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Verify that the monitor emits a single beep and that the SYSTOLIC display indicates an alarm limit of “70” for a few seconds.

25. From the normal mode steady state, press the UPPER ALARM LIMIT button two times rapidly. Verify that the monitor emits two beeps and that the DIASTOLIC display indicates an alarm limit of “210” for a few seconds.

26. From the normal mode steady state, press the LOWER ALARM LIMIT button two times rapidly. Verify that the monitor emits two beeps and that the DIASTOLIC display indicates an alarm limit of “50” for a few seconds.

27. From the normal mode steady state, press the UPPER ALARM LIMIT button three times rapidly. Verify that the monitor emits three beeps and that the MEAN/PULSE RATE display indicates an alarm limit of “225” for a few seconds.

28. From the normal mode steady state, press the LOWER ALARM LIMIT button three times rapidly. Verify that the monitor emits three beeps and the MEAN/PULSE RATE display indicates an alarm limit of “55” for a few seconds.

29. From the normal mode steady state, press the UPPER ALARM LIMIT button four times rapidly. Verify that the monitor emits four beeps, the PULSE RATE indicator lights and that the MEAN/PULSE RATE display indicates an alarm limit of “170” for a few seconds.

30. From the normal mode steady state, press the LOWER ALARM LIMIT button four times rapidly. Verify that the monitor emits four beeps, the PULSE RATE indicator lights, and the MEAN/PULSE RATE display indicates an alarm limit of “40” for a few seconds.

31. Press the ON/STANDBY button to place the N-3100 in the standby mode. Verify that the monitor emits three consecutively higher-pitched beeps.

3.3.1.3 Power-On Defaults for Neonatal Alarm Limits and Ranges

Note: The following procedure is written using Nellcor Puritan Bennett factory-set power-on default settings. If your institution has other custom power-on default settings, those values will be displayed and should be substituted in the following procedure. The N-3100 can be reset to factory power-on defaults using the service mode procedure described in Paragraph 4.3.11, Menu Item 20, or configuration mode, as described in Paragraph 4.2.13, Configuration Menu (item 3).

In the following procedures, each time the UPPER ALARM LIMIT button or the LOWER ALARM LIMIT button is pressed, the N-3100 will emit a beep.

When observing or changing default limits, a 3-second timeout is in effect, i.e., if no action is taken within 3 seconds, the monitor automatically returns to the normal operating mode steady state.

The following procedures use the N-3100 UP and DOWN ARROW buttons located on the top of the monitor. When the N-3100 is stacked with the N-3000, the Nellcor knob on this unit can be used to perform the function of the N-3100 UP and DOWN ARROW buttons. Turning the Nellcor knob in a clockwise direction is equivalent to pressing the N-3100 UP ARROW button. Turning the knob in a counterclockwise direction is equivalent to pressing the N-3100 DOWN ARROW button. There will be no sounds or beeps associated with turning the knob. When the N-3100 is stacked with the N-3000, the UP and DOWN ARROW buttons are not accessible and the Nellcor knob must be used.

1. Press the ON/STANDBY button to turn the unit on. Verify that the N-3100 is in the neonatal mode, which is indicated by the NEONATAL MODE indicator being lit. If the indicator is not lit, quickly press and release the NEW PATIENT/NEONATAL button twice to place the N-3100 in the neonatal mode. When the unit is in the normal mode steady state, press and release the UPPER ALARM LIMIT button. Verify that the monitor emits a single beep when you press the UPPER ALARM LIMIT button. Verify that the SYSTOLIC display indicates an alarm limit value of “120” for a few seconds and verify that the other displays show dashes at the top while the “120” is displayed. Do not press any buttons for at least 3 seconds and all displays will change to show a dash in the center of each character (normal mode steady state).

2. From the normal mode steady state, press and release the UPPER ALARM LIMIT button. Press and hold the DOWN ARROW button until “50.” is displayed the SYSTOLIC display.

   Note: A period (“.”) following a displayed alarm limit value is an indication that the alarm limit value has been changed from the power-on default value previously set in the N-3100.

3. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Verify that the monitor emits a single beep when you press the button. Within 3 seconds, verify that the SYSTOLIC display indicates an alarm limit value of “50” (the default systolic lower alarm limit) and verify that the other displays show dashes at the bottom while the “50” is displayed.

4. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Within 3 seconds, press and hold the DOWN ARROW button until “40.” is displayed in the SYSTOLIC display. Verify that “40.” is the lowest value to which the lower alarm limit can be adjusted.

5. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Within 3 seconds, press and hold the UP ARROW button and verify that “50.” is the highest value to which the lower alarm limit can be adjusted.

6. From the normal mode steady state, press the UPPER ALARM LIMIT button twice. Verify that the monitor emits a single beep each time you press the button. Verify that the DIASTOLIC display indicates a default alarm limit value of “80” for a few seconds and verify that the other displays show dashes at the top while the “80” is displayed.

7. From the normal mode steady state, press the UPPER ALARM LIMIT button twice. Press and hold the DOWN ARROW button until “30.” is shown in the DIASTOLIC display.

8. From the normal mode steady state, press the LOWER ALARM LIMIT button twice. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the DIASTOLIC display indicates a default alarm limit value of “30” (the default diastolic lower alarm limit) and verify that the other displays show dashes at the bottom while the “30” is displayed.

9. From the normal mode steady state, press the LOWER ALARM LIMIT button twice. Within 3 seconds, press and hold the DOWN ARROW button until “20.” is displayed in the DIASTOLIC display. Verify that “20.” is the lowest value to which the lower alarm limit can be adjusted.

10. From the normal mode steady state, press and release the LOWER ALARM LIMIT button twice. Within 3 seconds, press and hold the UP ARROW button and verify that “30.” is the highest value to which the lower alarm limit can be adjusted.

11. From the normal mode steady state, press the UPPER ALARM LIMIT button three times. Verify that the monitor emits a single beep each time you press the button. Verify that the MEAN/PULSE RATE display indicates an alarm limit value of “95” (the default mean upper alarm limit) for a few seconds, and verify that the other displays show dashes at the top while the “95” is displayed.

12. From the normal mode steady state, press and release the UPPER ALARM LIMIT button three times. Press and hold the DOWN ARROW button until “45.” is shown in the MEAN/PULSE RATE display.

13. From the normal mode steady state, press the LOWER ALARM LIMIT button three times. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the MEAN/PULSE RATE display indicates an alarm limit value of “45” and verify that the other displays show a dash at the bottom of each display character while the “45” is displayed.

14. From the normal mode steady state, press the LOWER ALARM LIMIT button three times. Within 3 seconds, press and hold the DOWN ARROW button until “35.” is displayed in the MEAN/PULSE RATE display. Verify that “35.” is the lowest value to which the lower alarm limit can be adjusted.

15. From the normal mode steady state, press the LOWER ALARM LIMIT button three times. Within 3 seconds, press and hold the UP ARROW button and verify that “45.” is the highest value to which the lower alarm limit can be adjusted.

16. From the normal mode steady state, press the UPPER ALARM LIMIT button four times. Verify that the monitor emits a single beep each time you press the button. Verify that the PULSE RATE indicator is lit and the MEAN/PULSE RATE display indicates an alarm limit value of “230” (the default pulse rate upper alarm limit) for a few seconds and verify that the other displays show dashes at the top while the “230” is displayed.

17. From the normal mode steady state, press the UPPER ALARM LIMIT button four times. Press and hold the DOWN ARROW button until “40.” is shown in the MEAN/PULSE RATE display.

18. From the normal mode steady state, press the LOWER ALARM LIMIT button four times. Verify that the monitor emits a single beep each time you press the button. Within 3 seconds, verify that the PULSE RATE indicator is lit and the MEAN/PULSE RATE display indicates an alarm limit value of “40” and verify that the other displays show dashes at the bottom while the “40” is displayed.

19. From the normal mode steady state, press the LOWER ALARM LIMIT button four times. Within 3 seconds, press and hold the DOWN ARROW button until “30.” is displayed in the MEAN/PULSE RATE display. Verify that “45.” is the lowest value to which the lower alarm limit can be adjusted.

20. From the normal mode steady state, press and release the LOWER ALARM LIMIT button four times. Within 3 seconds, press and hold the UP ARROW button and verify “40.” is the highest value to which the lower alarm limit can be adjusted.

21. Press the ON/STANDBY button to turn the monitor off. Verify that the monitor emits three consecutively lower-pitched beeps.

22. Press the N-3100 ON/STANDBY button to turn the monitor on. The monitor performs the Power-On Self-Test described in 3.3.1.1, steps 3a. through 3g.

23. From the normal mode steady state, press and release the UPPER ALARM LIMIT button. Verify that the monitor emits a single beep and that the SYSTOLIC display indicates an alarm limit of “120” for a few seconds.

24. From the normal mode steady state, press and release the LOWER ALARM LIMIT button. Verify that the monitor emits a single beep and that the SYSTOLIC display indicates an alarm limit of “50” for a few seconds.

25. From the normal mode steady state, rapidly press the UPPER ALARM LIMIT button twice. Verify that the monitor emits two beeps and that the DIASTOLIC display indicates an alarm limit of “80” for a few seconds.

26. From the normal mode steady state, rapidly press the LOWER ALARM LIMIT button twice. Verify that the monitor emits two beeps and that the DIASTOLIC display indicates an alarm limit of “30” for a few seconds.

27. From the normal mode steady state, rapidly press the UPPER ALARM LIMIT button three times. Verify that the monitor emits three beeps and that the MEAN/PULSE RATE display indicates an alarm limit of “95” for a few seconds.

28. From the normal mode steady state, rapidly press the LOWER ALARM LIMIT button three times. Verify that the monitor emits three beeps and that the MEAN/PULSE RATE display indicates an alarm limit of “45” for a few seconds.

29. From the normal mode steady state, rapidly press the UPPER ALARM LIMIT button four times. Verify that the monitor emits four beeps, the PULSE RATE indicator lights and that the MEAN/PULSE RATE display indicates an alarm limit of “230” for a few seconds.

30. From the normal mode steady state, rapidly press the LOWER ALARM LIMIT button four times. Verify that the monitor emits four beeps, the PULSE RATE indicator lights, and the MEAN/PULSE RATE display indicates an alarm limit of “40” for a few seconds.

31. Press the ON/STANDBY button to place the N-3100 in the standby mode. Verify that the monitor emits three consecutively higher-pitched beeps.

3.3.2 Verification of Pneumatic System

Tests in paragraphs 3.3.2.1 through 3.3.2.7 verify the functionality of the N-3100 pneumatic system. These tests were designed to use the Bio-Tek “BP Pump” noninvasive blood pressure (NIBP) simulator. The internal test volume of the Bio-Tek simulator is 250 cm^3, which is used to calculate the inflation/deflation rate periods. The Bio-Tek simulator or an equivalent NIBP simulator is required to perform these tests.

The N-3100 should be placed in the service mode for each of these tests. For a detailed explanation of the service mode, refer to Section 4, *Configuration and Service Modes*.

Note: The N-3100 cannot be placed in the service mode while it is stacked with the N-3000. Disconnect the N-3000 from the N-3100 before performing the verification tests.

Perform all of the following tests to verify the pneumatic system functionality:

- Paragraph 3.3.2.1 Pressure Transducer Accuracy
- Paragraph 3.3.2.2 Pneumatic Leakage - Adult
- Paragraph 3.3.2.3 Pneumatic Leakage - Neonate
- Paragraph 3.3.2.4 Cuff Inflation Rate
- Paragraph 3.3.2.5 Cuff Deflation Rate
- Paragraph 3.3.2.6 High Pressure - Adult
- Paragraph 3.3.2.7 High Pressure - Neonate

These tests can be performed individually (in any order) or sequentially. However, *all* of the tests must be performed to verify the pneumatic system functionality. 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 three times to place the simulator in the tests mode. The simulator screen will indicate "Internal Cuff" and "Pressure Gauge."

2. Connect the simulator hose to the hose connector on the right side panel of the N-3100.

3. With the N-3100 in the standby mode (off) and connected to AC power, while simultaneously pressing and holding the UPPER ALARM LIMIT button, the LOWER ALARM LIMIT button, and the PRINT button, press and release the ON/STANDBY button. Continue to hold down the UPPER ALARM LIMIT, LOWER ALARM LIMIT and PRINT buttons until the Power-On Self-Test is complete. "SEr" will flash in the MEAN/PULSE RATE display.

4. Within 15 seconds, press and release the PRINT button to place the N-3100 in the service mode steady state. "SEr" is continuously displayed in the MEAN/PULSE RATE display.

   Note: To exit any test and return to the service mode steady state, press the LOWER ALARM LIMIT button.

   To exit the service mode steady state at any time, press the ON/STANDBY button to turn the N-3100 off.

   If there is no button activity for 5 minutes, the N-3100 will shut itself off and exit the service mode.

3.3.2.1 Pressure Transducer Accuracy

Perform the following test to verify the pressure accuracy of the N-3100 pressure transducer. Prior to performing this procedure, the setup procedure in paragraph 3.3.2, "Verification of Pneumatic System" must be completed.

1. Press the UP/DOWN ARROW buttons until menu item 30 is displayed in the SYSTOLIC display.

2. Press the UPPER ALARM LIMIT button.

3. Press the START/STOP button. The simulator begins to pressurize. The current pressure in mmHg is displayed in the DIASTOLIC display.

4. Allow 30 seconds for the pressure to stabilize.

5. The numbers displayed by the simulator and in the DIASTOLIC display should be within 4 mmHg of each other to successfully complete the test.

6. Manually stop the test with the START/STOP button.

   Note: If the test is not stopped manually within 10 minutes, the N-3100 will automatically stop the test.

7. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.2 Pneumatic Leakage—Adult

The pneumatic leakage test verifies the integrity of the pneumatic system in the adult mode. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the UP/DOWN ARROW buttons until menu item 33 is displayed in the SYSTOLIC display.

2. Press the UPPER ALARM LIMIT button.

3. Press the START/STOP button. The simulator begins to pressurize. The current pressure reading will be displayed in the DIASTOLIC display until the test is completed.

4. Approximately 4 to 5 minutes later, the simulator will depressurize. The SYSTOLIC display indicates menu item “33.0.” The DIASTOLIC display indicates the change in pressure in mmHg from the reference pressure reading until the end of the 4 to 5 minute period.

5. A reading of 6 mmHg or less indicates successful completion of the test.

6. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.3 Pneumatic Leakage—Neonate

The pneumatic leakage test verifies the integrity of the pneumatic system in the neonate mode. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the UP/DOWN ARROW buttons until menu item 34 is displayed in the SYSTOLIC display.

2. Press the UPPER ALARM LIMIT button.

3. Press the START/STOP button. The simulator begins to pressurize. The current pressure reading will be displayed until the test is completed.

4. Approximately 4 to 5 minutes later, the simulator will depressurize. The SYSTOLIC display indicates menu item “34.0.” The DIASTOLIC display indicates the change in pressure in mmHg from the reference pressure reading until the end of the 4 to 5 minute period.

5. A reading of 6 mmHg or less indicates successful completion of the test.

6. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.4 Cuff Inflation Rate

The cuff inflation rate test verifies the inflation rate of the N-3100. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the UP/DOWN ARROW buttons until menu item “31” is displayed in the SYSTOLIC display.

2. Press and release the UPPER ALARM LIMIT button.

3. Press and release the START/STOP button. The simulator begins to pressurize. The current pressure in mmHg is displayed in the DIASTOLIC display.

4. At the end of the test cycle, the simulator depressurizes and the SYSTOLIC display indicates submenu item number “31.0.” The DIASTOLIC display indicates the time in seconds, to the nearest tenth, required to pressurize to 250 mmHg. A reading of 3.0–9.0 seconds indicates successful completion of the test.

5. Press the UP ARROW button to display menu item “31.1” in the SYSTOLIC display. The DIASTOLIC display indicates the time in seconds, to the nearest tenth, required to pressurize to 300 mmHg. A reading of 4.0–9.0 seconds indicates successful completion of the test.

6. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.5 Cuff Deflation Rate

The cuff deflation rate test verifies the deflation rate. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the UP/DOWN ARROW buttons until menu item “32” is displayed in the SYSTOLIC display.

2. Press the UPPER ALARM LIMIT button.

3. Press the START/STOP button. The simulator begins to pressurize. The current pressure in mmHg is displayed in the DIASTOLIC display.

4. At the end of the test cycle, the simulator depressurizes and the SYSTOLIC display indicates submenu item number “32.0.” The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 260 to 180 mmHg. A reading of 4.6–6.2 seconds indicates successful completion of the test.

5. Press the UP ARROW button to display menu item 32.1 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 180 to 100 mmHg. A reading of 4.6–6.2 seconds indicates successful completion of the test.

6. Press the UP ARROW button to display menu item 32.2 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 100 to 60 mmHg. A reading of 3.3–5.2 seconds indicates successful completion of the test.

7. Press the UP ARROW button to display menu item 32.3 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 60 to 30 mmHg. A reading of 2.6–4.4 seconds indicates successful completion of the test.

8. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.6 High Pressure—Adult

The high-pressure test verifies the functionality of the high-pressure relief valve in the adult mode. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the SELECT button on the Bio-Tek simulator until Over Pressure Test is displayed.

2. From the N-3100 service mode steady state, press the UP/DOWN ARROW button until menu item 35 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. As soon as the N-3100 pump begins to operate, press the START TEST button on the simulator. The current pressure in mmHg is displayed in the DIASTOLIC display. The simulator begins to pressurize until the high-pressure relief valve opens. If the pressure relief valve does not open by the time 331 mmHg is reached, the test is unsuccessful.

5. The SYSTOLIC display indicates menu item 35. The DIASTOLIC display indicates the maximum pressure achieved. If the high-pressure relief valve does not open, the DIASTOLIC display flashes. A reading of 330 mmHg or less indicates successful completion of the test.

6. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.2.7 High-Pressure—Neonate

The high-pressure test verifies the functionality of the high-pressure relief valve in the neonate mode. Prior to performing this procedure, the setup procedure in paragraph 3.3.2 must be completed.

1. Press the SELECT button on the Bio-Tek simulator until Over Pressure Test is displayed.

2. From the service mode steady state, press the UP/DOWN ARROW buttons until menu item 36 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. As soon as the N-3100 pump begins to operate, press the START TEST button on the simulator. The current pressure in mmHg is displayed in the DIASTOLIC display. The simulator begins to pressurize until the high-pressure relief valve opens. If the pressure relief valve does not open by the time 166 mmHg is reached, the test is unsuccessful.

5. The test is complete when the pressure has increased, deflated, and the MANUAL indicator turns off.

6. The SYSTOLIC display indicates menu item 36. A nonflashing DIASTOLIC display indicates the maximum pressure achieved. If the high-pressure relief valve does not open, the DIASTOLIC display flashes. A reading of 165 mmHg or less indicates successful completion of the test.

7. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

3.3.3 Pulse Rate Accuracy Tests

The following tests verify the functionality of pulse rate detection. A Bio-Tek "BP Pump" Noninvasive Blood Pressure Simulator or equivalent is required. The N-3100 will be used in the manual mode.

3.3.3.1 Pulse Rate Accuracy Test—Adult

This test verifies the accuracy of the blood pressure and pulse rate detection in the adult mode.

1. Turn on the Bio-Tek simulator and press the MODE button three times to place it in the Tests mode. The simulator screen will indicate "Internal Cuff" and "Pressure Gauge."

2. Connect the simulator hose to the hose connector on the right side panel of the N-3100.

3. Place the simulator in the Adult Internal Cuff mode and return to Tests mode.

4. Press the MODE button on the simulator until Simulation mode is displayed.

5. Using the SELECT and ARROW buttons on the simulator, set the systolic/diastolic values to 180/120, with a heart rate value of 100.

6. Turn the N-3100 on and ensure it is in the manual mode (the MANUAL indicator is lit).

7. Set the N-3100 to the adult-pediatric mode (the NEONATAL MODE indicator is not lit).

8. Press and release the START/STOP button on the N-3100.

9. After completion of the blood pressure test cycle, press the PULSE button on the N-3100. The measured pulse rate appears in the MEAN/PULSE RATE display.

10. A reading between 95–105 bpm indicates successful completion of the test.

3.3.3.2 Pulse Rate Accuracy Test—Neonate

This test verifies the functionality of the pulse rate detection in the neonate mode.

1. Turn on the Bio-Tek simulator and press the MODE button three times to place it in the Tests mode. The simulator screen will indicate "Internal Cuff" and "Pressure Gauge."

2. Connect the simulator hose to the hose connector on the right side panel of the N-3100.

3. Place the simulator in the Neonate Internal Cuff mode and return to Tests mode.

4. Press the MODE button on the simulator until Simulation mode is displayed.

5. Using the SELECT and ARROW buttons on the simulator, set the systolic/diastolic values to 70/40, with a heart rate value of 140 and a pulse volume of 35%.

6. Turn the N-3100 on and ensure that it is in the manual mode (the MANUAL indicator is lit).

7. Set the N-3100 to the neonatal mode (the NEONATAL MODE indicator is lit).

8. Press and release the START/STOP button on the N-3100.

9. After completion of the blood pressure test cycle, press the PULSE button on the N-3100. The measured pulse rate appears in the MEAN/PULSE RATE display.

10. A reading between 135–145 bpm indicates successful completion of the test.

3.4 SAFETY TESTS

WARNING: To ensure the safety of the operator and patient when the N-3100 is stacked with and powered by an N-3200, also perform the safety tests in the N-3200 service manual. Failure to comply could result in serious injury or death.

N-3100 safety tests consist of:

- Ground Integrity
- Electrical Leakage

3.4.1 Ground Integrity

This test verifies the integrity of the power cord ground wire from the AC plug and the connection with the SPS external power supply chassis ground.

1. Set up the electrical safety analyzer as follows:

Function:	Ground Resistance Test
Range:	mΩ (milliohms)

2. Connect the monitor's AC plug to the analyzer as recommended in the analyzer operating instructions.

3. Connect the analyzer resistance input lead to the equipotential terminal (grounding stud) on the external power supply. Verify that the analyzer indicates 150 milliohms or less.

3.4.2 Electrical Leakage

The following tests verify the electrical leakage of the monitor:

- Earth Leakage Current
- Patient Leakage Current
- Patient Source Current (Mains on Applied Part)

3.4.2.1 Earth Leakage Current

This test is in compliance with IEC 601-1 and AAMI Standard ES1, paragraph 3.3.1, Chassis Source Current, between the power ground and (Part B) exposed conductive hardware.

1. Configure the electrical safety analyzer as follows:

   Function: Leakage
   Range: µA

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

3. Connect the electrical safety analyzer "leakage" input lead to the monitor's equipotential terminal.

4. The equipotential terminal is not connected to ground.

5. All functional earth terminals are not connected to ground.

Table 3-1: Earth Leakage Current Limits

AC LINE POLARITY	NEUTRAL LINE	POWER LINE EARTH	LEAKAGE CURRENT
Normal	Closed	Closed	100 µA
Normal	Closed	Open	300 µA

3.4.2.2 Patient Leakage Current

This test is in compliance with AAMI Standard ES1, paragraph 3.3.2 and IEC 601-1. Patient Leakage Current is measured between any individual patient connection and power (earth) ground.

1. Configure the electrical safety analyzer as follows:

   Function: Patient Leakage
   Range: µA

2. Connect the monitor AC plug to the electrical safety analyzer as recommended by the analyzer operating instructions for Patient Leakage Current.

3. Connect the electrical safety analyzer patient leakage input lead to the monitor's patient connector.

4. The equipotential terminal is not connected to ground.

5. All functional earth terminals are not connected to ground.

6. The leakage current must not exceed the values shown in the table below:

Table 3-2: Patient Leakage Current Limits

AC LINE POLARITY	NEUTRAL LINE	POWER LINE GROUND CABLE	LEAKAGE CURRENT
Normal	Closed	Closed	10 µA
Normal	Open	Closed	10 µA
Normal	Closed	Open	10 µA
Reverse	Closed	Closed	10 µA
Reverse	Open	Closed	10 µA
Reverse	Closed	Open	10 µA

3.4.2.3 Patient Leakage Current (Mains Voltage on the Applied Part)

This test is in compliance with AAMI Standard ES1, paragraph 4.4 and IEC 601-1. Patient Leakage Current is the measured value in a patient connection if a source of 240 Volts, 50 Hz with respect to power (earth) ground, is connected to that patient connection.

Warning: AC mains voltage will be present on the patient applied part terminals during this test. Exercise caution to avoid electrical shock hazard.

1. Configure the electrical safety analyzer as follows:

   Function: Patient Leakage (MOAP)
   Range: µA

2. Connect the monitor AC plug to the electrical safety analyzer as recommended by the operating instructions for patient sink (leakage) current.

3. Connect the electrical safety analyzer patient leakage input lead to the patient connector on the monitor's sensor input.

4. The equipotential terminal is not connected to ground.

5. All functional earth terminals are not connected to ground.

6. The analyzer leakage current must not exceed 10 µA for any of the conditions shown below.

Table 3-3: Patient Leakage Current Test Configurations — Mains Voltage on the Applied Part

AC LINE POLARITY	NEUTRAL LINE	POWER LINE GROUND CABLE
Normal	Closed	Closed
Reverse	Closed	Closed

SECTION 4: CONFIGURATION AND SERVICE MODES

4.1 INTRODUCTION

This section discusses use of the configuration mode to configure power-on default values and the service mode to identify and correct monitor difficulties.

4.2 CONFIGURATION MODE

The following paragraphs describe how to enter the N-3100 configuration mode and change factory power-on default settings.

Note: The N-3100 can be powered by an SPS external power supply or by an N-3200 when the N-3100 and N-3200 are stacked.

The following procedures use the N-3100 UP and DOWN ARROW buttons located on the top of the N-3100. When the N-3100 is stacked with the N-3000, the N-3200, or both, the Nellcor knob on either of these units can be used to perform the function of the N-3100 UP and DOWN ARROW buttons. Turning the Nellcor knob in a clockwise direction is equivalent to pressing the N-3100 UP ARROW button. Turning the Nellcor knob in a counterclockwise direction is equivalent to pressing the N-3100 DOWN ARROW button. There are no sounds or beeps associated with turning a Nellcor knob. When the N-3100 is stacked with the N-3000, the UP and DOWN ARROW buttons are not accessible and the Nellcor knob must be used.

To enter configuration mode:

1. If the monitor is on, turn it off.

2. While simultaneously pressing both UPPER and LOWER ALARM LIMIT buttons, turn the monitor on. Continue to hold down both the UPPER and LOWER ALARM LIMIT buttons until “CFG” begins flashing in the MEAN/PULSE RATE display.

3. Release the UPPER and LOWER ALARM LIMIT buttons.

4. Press the PRINT button. “CFG” stops flashing and remains displayed in the MEAN/PULSE RATE display. (If you do not press the PRINT button within 15 seconds, the monitor turns off automatically.)

You are now in configuration mode steady state. The N-3100 automatically shuts off if there is no button action for approximately 2 minutes.

When an alarm limit is changed from the previous default value, a decimal point appears next to the value in the display window.

To exit the configuration mode, turn the monitor off by pressing the ON/STANDBY button or allow the monitor to turn off automatically after a 2-minute timeout. The monitor retains the configuration settings existing at the moment the N-3100 is turned off as the power-on default settings.

Note: While changing limits, there must be some user interaction with the monitor within a 3-second period or the monitor returns to configuration mode steady state operation.

Table 4-1 lists the default settings that can be configured and the respective buttons to press to access the settings. Methods used to change the default settings are detailed in paragraphs 4.2.1 through 4.2.13.

Table 4-1: Configuration Mode Menu

Default Setting	Buttons to Press While in Configuration Mode Steady State
Systolic Upper Alarm Limit	Press UPPER ALARM LIMIT button once
Systolic Lower Alarm Limit	Press LOWER ALARM LIMIT button once
Diastolic Upper Alarm Limit	Press UPPER ALARM LIMIT button twice
Diastolic Lower Alarm Limit	Press LOWER ALARM LIMIT button twice
Mean Upper Alarm Limit	Press UPPER ALARM LIMIT button three times
Mean Lower Alarm Limit	Press LOWER ALARM LIMIT button three times
Pulse Rate Upper Alarm Limit	Press UPPER ALARM LIMIT button four times
Pulse Rate Lower Alarm Limit	Press LOWER ALARM LIMIT button four times
Alarm Volume	Press and hold ALARM SILENCE button
Alarm Silence Duration	Press ALARM SILENCE button and within 3 seconds press UP or DOWN ARROW button
Auto Measurement Cycle Interval	Press CYCLE button
Configuration Menu	Press UPPER and LOWER ALARM LIMIT buttons simultaneously
Adult-Pediatric/Neonatal Power-up Mode	Press NEW PATIENT/NEONATAL button twice within 2 seconds

Note: To change neonate default alarm limits, first enter the neonatal mode from configuration mode steady state by pressing the NEW PATIENT/NEONATAL button twice within 2 seconds. Then change the desired limit using the same method as for adult default limits.

4.2.1 Adult-Pediatric/Neonatal Mode Default

The operating mode that the monitor is in when you exit the configuration mode (adult-pediatric or neonatal), becomes the power-on default operating mode.

4.2.2 Systolic Upper Alarm Limit

1. From configuration mode steady state, press the UPPER ALARM LIMIT button once. The current default value is displayed in the SYSTOLIC display.

2. To change the upper alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot decrease the value lower than the set lower alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.3 Systolic Lower Alarm Limit

1. From configuration mode steady state, press the LOWER ALARM LIMIT button once. The current default value is displayed in the SYSTOLIC display.

2. To change the lower alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot increase the value higher than the set upper alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.4 Diastolic Upper Alarm Limit

1. From configuration mode steady state, press the UPPER ALARM LIMIT button twice. The current default value is displayed in the DIASTOLIC display.

2. To change the upper alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot decrease the value lower than the set lower alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.5 Diastolic Lower Alarm Limit

1. From configuration mode steady state, press the LOWER ALARM LIMIT button twice. The current default value is displayed in the DIASTOLIC display.

2. To change the lower alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot increase the value higher than the set upper alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.6 Mean Upper Alarm Limit

1. From configuration mode steady state, press the UPPER ALARM LIMIT button three times. The current default value is displayed in the MEAN/PULSE RATE display.

2. To change the upper alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot decrease the value lower than the set lower alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.7 Mean Lower Alarm Limit

1. From configuration mode steady state, press the LOWER ALARM LIMIT button three times. The current default value is displayed in the MEAN/PULSE RATE display.

2. To change the lower alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot increase the value higher than the set upper alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.8 Pulse Rate Upper Alarm Limit

1. From configuration mode steady state, press the UPPER ALARM LIMIT button four times. The PULSE RATE indicator will light and the current default value will be displayed in the MEAN/PULSE RATE display.

2. To change the upper alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot decrease the value lower than the set lower alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.9 Pulse Rate Lower Alarm Limit

1. From configuration mode steady state, press the LOWER ALARM LIMIT button three times. The PULSE RATE indicator will light and the current default value will be displayed in the MEAN/PULSE RATE display.

2. To change the lower alarm limit value, press and hold the UP or DOWN ARROW button on top of the monitor. You cannot increase the value higher than the set upper alarm limit.

3. To place the monitor back into configuration mode steady state, allow the display to time out (3 seconds).

4.2.10 Alarm Volume

Use the following procedure to adjust the alarm volume default:

1. From the configuration mode steady state, press and hold the ALARM SILENCE button for approximately 3 seconds. A continuous tone at the current volume setting is emitted.

2. "VOL" is displayed in the DIASTOLIC display. A value from 1 to 10 (1 = lowest, 10 = highest) corresponding to the current volume setting is displayed in the MEAN/PULSE RATE display.

3. Continue to hold the ALARM SILENCE button and press the UP or DOWN ARROW button to increase or decrease the volume.

4. To exit this procedure and set the alarm volume default, release the ALARM SILENCE button.

4.2.11 Alarm Silence Duration

Use the following procedure to adjust the alarm silence duration default:

1. From the configuration mode steady state, press and hold the ALARM SILENCE button. The current default setting, in seconds, for the silence duration appears in the DIASTOLIC display. The SYSTOLIC display indicates "CFG," while the MEAN/PULSE RATE display indicates "SEC" (seconds).

2. Within 3 seconds and while holding the ALARM SILENCE button, press the UP or DOWN ARROW button to adjust the silence duration. Silence duration choices are 30 SEC, 60 SEC, 90 SEC, and 120 SEC.

3. To exit this procedure and set the alarm silence duration default, release the ALARM SILENCE button and return to the configuration mode steady state.

4.2.12 Auto Measurement Cycle Interval

Use the following procedure to adjust the auto measurement cycle interval default:

1. From the configuration mode steady state, press and release the CYCLE button. The current default setting, in minutes, for the auto measurement cycle interval appears in the MEAN/PULSE RATE display. The SYSTOLIC display indicates "CFG." The CYCLE indicator lights.

2. Use the UP or DOWN arrows to adjust the cycle interval default. Cycle interval choices are 1, 3, 5, 10, 15, 30, 60, 90 minutes and OFF.

3. To exit this procedure and set the monitor to power-up in the *manual* mode, select OFF as the cycle interval and allow the unit to time out and return to the configuration mode steady state.

   To exit this procedure and set the monitor to power-up in the *automatic* mode, select a cycle interval other than OFF and allow the unit to time out and return to the configuration mode steady state. The cycle interval selected will be the default cycle interval.

4.2.13 Configuration Menu

Entering the configuration *menu* steady state from the configuration *mode* steady state, allows you to view the UIF software version, enable/disable the measurement complete tone, or reset to factory power-on defaults. To return to the configuration *mode* steady state from the configuration *menu* steady state, while in the configuration *mode* steady state, press the LOWER ALARM LIMIT button.

1. From configuration mode steady state, press the UPPER and LOWER ALARM LIMIT buttons simultaneously to access the configuration menu steady state. The currently selected menu item number (1 to 3) is displayed in the SYSTOLIC display.

2. To view the software version of the UIF module, press the UP or DOWN ARROW buttons until "1" is displayed in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The PULSE RATE indicator will light.

   The digit in the left-hand display character of the SYSTOLIC display represents the software version. The next two characters in the SYSTOLIC display represent the major software revision. The three characters in the DIASTOLIC display represent the minor software revision. To return to the configuration menu steady state, press the LOWER ALARM LIMIT button or allow the unit to time out (10 seconds).

3. To enable or disable the measurement complete tone, press the UP or DOWN ARROW buttons until "2" is displayed in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The PULSE RATE indicator will light. The current state is displayed in the DIASTOLIC display (0 = disabled, 1 = enabled).

   To change the current state, press the UP/DOWN ARROW buttons until the desired state is displayed. To return to the configuration menu steady state, press the LOWER ALARM LIMIT key or allow the unit to time out (10 seconds).

4. To reset institutional default parameters to factory default values, press the UP ARROW button until "3" is displayed in the SYSTOLIC display. Press the UPPER ALARM LIMIT button to reset the parameters. The monitor automatically returns to the configuration menu steady state when the values are reset.

4.3 SERVICE MODE

The service mode allows a service technician to select menu items that set up the N-3100 to perform tests that determine monitor functionality. The service mode also allows access to the error log report.

Caution: Menu items 70 and above are for factory purposes only. Adjustment of menu items 70 and above by personnel other than qualified factory personnel may cause the N-3100 to malfunction.

Note: In order to change default settings, you must be able to access the UP and DOWN ARROW buttons located on the top of N-3100. If the N-3100 is stacked with the N-3000, disconnect the N-3000 from the stack before entering the service mode. The N-3100 can be powered by an SPS external power supply or by an N-3200 when the N-3100 is stacked with the N-3200.

Use the following procedure to place the monitor in the service mode:

1. If the monitor is on, turn it off.

2. While simultaneously holding down the UPPER and LOWER ALARM LIMIT buttons and the PRINT button, press and release the ON/STANDBY button. Continue to hold down the UPPER and LOWER ALARM LIMIT and PRINT buttons while the monitor performs the power-on self-test (POST).

3. When “SEr” begins flashing in the MEAN/PULSE RATE display, release the UPPER and LOWER ALARM LIMIT and PRINT buttons.

4. Within 15 seconds, press the PRINT button to set the N-3100 to the service mode steady state. You must press the PRINT button within 15 seconds or the monitor will turn itself off automatically. In the service mode steady state, “SEr” stops flashing and is continuously displayed. The number of the service mode main menu item is shown in the SYSTOLIC display.

   Note: Failure error codes (refer to Section 5, *Troubleshooting* for an explanation of error codes) may be reported upon entering the service mode. The N-3100 should automatically access the menu item used to correct the situation.

   If a user-correctable error code (a code beginning with “0”) is displayed while in the service mode, press the LOWER ALARM LIMIT button to clear the error.

5. Use the UP or DOWN ARROW buttons to move from one main menu item to the next.

   Note: While in the service mode steady state, the UPPER and LOWER ALARM LIMIT buttons are used as enter and exit buttons, respectively. You must press the UPPER ALARM LIMIT button to select an item and move to the submenu level. To return to the service mode steady state, you press the LOWER ALARM LIMIT button.

6. When you have scrolled to the desired menu item, press the UPPER ALARM LIMIT button. The PULSE RATE indicator lights.

   This indicates that you are now in a submenu level of the selected menu item. Use the UP and DOWN ARROW buttons to move from one submenu item to another.

   Note: Some menu items do not have submenu item selections.

7. To return to the service mode steady state from a menu item, press the LOWER ALARM LIMIT button.

8. To exit the service mode, turn off the monitor by pressing the ON/STANDBY button. The N-3100 automatically turns off if no action is taken for approximately 5 minutes.

Main menu items available from the service mode (shown in Table 4-2) are discussed in numerical order in the following paragraphs.

Table 4-2: Service Mode Menu

Menu No.	Type of Report/Test
1	Software Version Report
2	Lamp Test Mode
3	Button Test Mode
4	Speaker Test Mode
5	Internal Configuration Code Report
6	Total Operating Hours Report
7	Error Log Record 1
8	Error Log Record 2
9	Error Log Record 3
10	Error Log Record 4
11	Error Log Record 5
12	Error Log Record 6
13	Error Log Record 7
14	Error Log Record 8
15	Error Log Record 9
16	Error Log Record 10
17	Instrument Identification Report
18	Power Management and Battery Status
19	Persistent Time Sense Report
20	Reset to Factory Defaults
21	Cluster Instrument Number (CIN) Adjustment
23	Enable/Disable Alarm Silence Reminder
24	Pressure Calculation Algorithm Selection
29	Compatibility Report
30	Pressure Transducer Accuracy Test Mode
31	Inflation Time Test Mode
32	Deflation Rate Test Mode
33	Adult Leak Test Mode
34	Neonate Leak Test Mode
35	Adult Maximum Pump Pressure Test Mode
36	Neonate Maximum Pump Pressure Test Mode
37	Blood Pressure Module Self-Check Report

4.3.1 Menu Item 1: Software Version Report

This report identifies the software versions of the UIF PCB and blood pressure module.

1. From the service mode steady state, select menu item 1 by pressing the UP or DOWN ARROW buttons until "1" appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The UIF software version number is displayed in the left-hand character of the DIASTOLIC display. The UIF module major revision number is displayed in the next two characters of the DIASTOLIC display. The UIF module minor revision number is displayed in the MEAN/PULSE RATE display.

2. Press the UP ARROW button to view the blood pressure module version in the SYSTOLIC display.

3. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.2 Menu Item 2: Lamp Test Mode

This test verifies that indicators and front-panel lamps are functional.

1. From the service mode steady state, select menu item 2 by pressing the UP or DOWN ARROW buttons until "2" appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button.

2. Initially, all indicators will light. Press and hold the UP ARROW button to light each display segment, decimal, and indicator, in a sequential scanning pattern to verify that each lamp works. After each lamp has lit, all lamps will turn off.

   Note: The POWER-ON indicator is not tested with this procedure. It can be verified by turning the monitor on and off.

3. Press and hold the DOWN ARROW button to reverse the firefly pattern.

4. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.3 Menu Item 3: Button Test Mode

This test verifies proper operation of individual buttons and button combinations.

1. From the service mode, select menu item 3 by pressing the UP or DOWN ARROW buttons until "3" appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button.

2. Press each of the buttons and button combinations listed below. The corresponding number should appear in the DIASTOLIC display to indicate that these keys and key combinations are functioning correctly.

Press the following button and/or button combinations:	Displayed number:
No buttons pressed	0
LOWER ALARM LIMIT	1
UPPER ALARM LIMIT	2
CYCLE	3
PULSE	4
CYCLE and PULSE, simultaneously	5
ALARM SILENCE	6
LOWER ALARM LIMIT and ALARM SILENCE, simultaneously	7
UPPER ALARM LIMIT and ALARM SILENCE, simultaneously	8
STAT	9
START/STOP	10
PRINT	11
NEW PATIENT/NEONATAL (rear panel)	12
Any combination not listed	13
UPPER and LOWER ALARM LIMIT, simultaneously	14
UPPER and LOWER ALARM LIMIT and PRINT, simultaneously	15

3. Press the UP or DOWN ARROW button to return to the service mode steady state.

4.3.4 Menu Item 4: Speaker Test Mode

This menu item verifies that the volume control is functional and determines whether or not there are any discontinuities or saturation conditions in the audible output.

1. From the service mode steady state, select menu item 4 by pressing the UP or DOWN ARROW buttons until “4” appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. A “1” should appear in the DIASTOLIC display.

2. Press the UP ARROW button. As the number in the DIASTOLIC display increases to a maximum of 254, the volume should correspondingly increase.

3. Press the DOWN ARROW button to decrease the volume.

4. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.5 Menu Item 5: Internal Configuration Code (ICC) Report

This menu item confirms whether or not the current monitor configuration is the desired configuration. The ICC is the hexadecimal representation of the instrument hardware configuration derived by the processor through direct internal examination of the hardware and software present in the N-3100.

1. From the service mode, select menu item 5 by pressing the UP/DOWN ARROW buttons until "5" appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The ICC value (should be "0") appears in the DIASTOLIC display, followed by the letter "H." If the displayed ICC differs from the value stored in the EEPROM, then the displayed value will flash.

2. If the displayed value is flashing, press the UPPER ALARM LIMIT button to save the value as the default.

3. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.6 Menu Item 6: Total Operating Hours Report

This report displays the total number of operating hours logged by the UIF PCB since it was produced. From the service mode, select menu item 6 by pressing the UP or DOWN ARROW buttons until "6" appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The total number of operating hours is displayed in the SYSTOLIC and DIASTOLIC displays. Possible values are from 0 to 999,999 hours. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.7 Menu Items 7-16: Error Log Record Report

This report provides information regarding the last ten error codes recorded by the monitor before it was turned off, the number of occurrences of that particular error, and the number of operating hours since the most recent occurrence of the error. The error log has ten entries (menu items 7-16), as indicated below. Note: Refer to Section 5, *Troubleshooting*, and the Appendix for an explanation of error codes.

The procedure below is for Error Log Record 1 (menu item 7). Use the same procedure to access Error Log Records 2 through 10 (menu items 8 through 16).

1. In the service mode, select menu item 7 by pressing the UP or DOWN ARROW buttons until “7” appears in the SYSTOLIC display. Press the UPPER ALARM LIMIT button. The number “7.0” appears in the SYSTOLIC display.

2. Read the error code in the DIASTOLIC display. A value of “0” indicates that the error log entry is not in use.

3. Press the UP ARROW button to display “7.1” in the SYSTOLIC display.

4. Read the number of occurrences of this particular error code in the DIASTOLIC display. A value of 256 indicates there have been 256 or more occurrences.

5. Press the UP ARROW button again. The time (in operating hours) of the last occurrence of the error is displayed in the SYSTOLIC and DIASTOLIC display fields.

6. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.8 Menu Item 17: Instrument Identification (IID) Report

This report displays a hexadecimal number corresponding to the instrument identifier. This number should agree with the address label on the outside of the instrument. However, the label and the internal value may disagree if the monitor UIF module was replaced and the external label was not changed.

1. From the service mode, select menu item 17 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button. A hexadecimal number should appear across the entire monitor display field, with an H in the last (far right) position.

2. Verify that this number agrees with the number on the monitor’s external label. If the numbers do not agree, contact Nellcor Puritan Bennett’s Technical Services Department or your local Nellcor Puritan Bennett representative.

3. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.9 Menu Item 18: Power and Battery Status Report

This menu item allows you to determine battery conditions.

1. From the service mode steady state, select menu item 18 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button. The number “18.0” should appear in the SYSTOLIC display and the current battery voltage in volts appears in the DIASTOLIC display.

2. Press the UP ARROW button to display “18.1” in the SYSTOLIC display. The number shown in the DIASTOLIC display field represents the current charge bus voltage in volts.

3. Press the UP ARROW button to display “18.2” in the SYSTOLIC display. The number shown in the DIASTOLIC display represents the lower lithium cell voltage in volts.

4. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.10 Menu Item 19: Persistent Time Sense Report

This report allows you to determine if the internal persistent time circuit is keeping time correctly.

1. From the service mode steady state, select menu item 19 by pressing the UP or DOWN ARROW buttons.

2. Press the UPPER ALARM LIMIT button. The persistent time in seconds is displayed in the SYSTOLIC and DIASTOLIC displays. Using a watch or other timepiece, note the time to the nearest second.

3. Wait 3 minutes from the time you originally noted.

4. Subtract the first figure you noted from the figure now displayed. The difference should equal approximately 3 minutes (180 seconds).

5. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.11 Menu Item 20: Reset to Factory Defaults

This function allows the service technician to reset the monitor to the Nellcor factory default settings (see the *Specifications* section of this manual).

1. From the service mode steady state, select menu item 20 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button.

2. Verify that the N-3100 emits three short beeps to indicate that the default settings have been successfully reset to the factory default values. Any alarm limit that was set to a value other than the factory default is now lost. The N-3100 automatically exits the menu item and returns to the service mode. If the reset is successful, the monitor will beep. If the reset was not successful, an error code will be displayed.

4.3.12 Menu Item 21: Initial Cluster Instrument Number (CIN) Selection

This function allows the service technician to select the initial cluster instrument number (CIN) address for an N-3100 that is being used in a stacked configuration.

1. From the service mode steady state, select menu item 21 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button. The number 21 is shown in the SYSTOLIC display and the current hexadecimal CIN is shown in the DIASTOLIC display. If the displayed CIN is different from the number stored in the N-3100 memory, the CIN will flash.

2. To select a new CIN, press the UP and DOWN ARROW buttons. New CIN values must be in the range of 1 to 15.

3. Once you have selected a new CIN, press the UPPER ALARM LIMIT button to save the new CIN in the N-3100 memory.

4. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.13 Menu Item 23: Enable/Disable Alarm Silence Reminder

This function allows the service technician to disable or enable the Alarm Silence Reminder feature.

1. From the service mode steady state, select menu item 23 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button.

2. Observe the current Alarm Silence Reminder setting of "0" (disabled) or "1" (enabled) in the DIASTOLIC display. If the displayed value is different from the stored power-on default value, the displayed value will flash.

3. To change the Alarm Silence Reminder setting, press the UP or DOWN ARROW button until the desired setting is displayed.

4. Press the UPPER ALARM LIMIT button to store the displayed value as the power-on default.

5. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.14 Menu Item 24: Pressure Calculation Algorithm Selection

This function allows the service technician to select the algorithm used for computing blood pressure values to be displayed.

1. From the service mode, select menu item 24 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button.

2. Observe the current pressure calculation algorithm setting (1 = raw; 2 = adjusted) in the DIASTOLIC display. If the displayed value is different from the power-on value, the displayed value will flash.

3. To change the pressure calculation algorithm setting, press the UP or DOWN ARROW button until the desired setting is displayed.

4. Press the UPPER ALARM LIMIT button to store the displayed value as the power-on default.

5. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

Note: When pressure calculation algorithm 2 (adjusted) is selected and the N-3100 is operating in the adult-pediatric mode, the displayed systolic blood pressure value will be adjusted by -2 mmHg from the value measured by the NIBP module. In addition, the displayed diastolic blood pressure value will be adjusted by +5 mmHg from the value measured by the NIBP module. When pressure algorithm 1 (raw) is selected and the N-3100 is operating in the adult-pediatric mode, the displayed systolic and diastolic blood pressure values will be the same as the values measured by the NIBP module. When the N-3100 is operating in the neonatal mode, the displayed systolic and diastolic blood pressure values will be the same as the values measured by the NIBP module with no adjustments, regardless of the pressure calculation algorithm that is selected. Typically, pressure calculation algorithm 1 (raw) is selected for N-3100 applications in Japan. For N-3100 applications in the Americas,

Europe, the South Pacific and other parts of Asia, pressure calculation algorithm 2 (adjusted) is selected. The pressure calculation algorithm should be selected to be consistent with practices used in the country or institution where the N-3100 is to be used.

4.3.15 Menu Item 29: Instrument Compatibility Report

This function is used by the service technician to display the sensorbus protocol version and the multicast version. To function properly in a stack, the N-3100 must have the same protocol version and multicast version as other instruments in the stack.

1. From the service mode, select menu item 29 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button. The SYSTOLIC display will show 29.0 and the DIASTOLIC display will show a number representing the version and revision of the sensorbus protocol software in the N-3100. The two digits preceding the decimal point are the version, and the number following the decimal point is the revision.

2. Press the UP ARROW button. The SYSTOLIC display will show 29.1 and the DIASTOLIC display will show a number representing the version and revision of the multicast software in the N-3100. The two digits preceding the decimal point are the version, and the number following the decimal point is the revision.

3. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

4.3.16 Menu Item 30: Pressure Transducer Accuracy Test Mode

Note: Menu items 30 through 36 are discussed in the *Performance Verification* section, paragraph 3.3.2, "Verification of Pneumatic System." Refer to those procedures for verification standards. The use of test chambers and the manual inflation pump mentioned in this section is an optional method of using these service mode menu items.

The pressure transducer accuracy test verifies the pressure accuracy of the sensor and requires a 220 cm^3 test chamber, a manometer, and a manual inflation pump.

1. Connect the 220 cm^3 test chamber to the N-3100 hose connector.

2. Using an adapter, connect the manometer and pump in parallel with the test chamber.

3. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 30 is displayed in the SYSTOLIC display.

4. Press and release the UPPER ALARM LIMIT button.

5. Press and release the START/STOP button. The chamber begins to pressurize to approximately 180 mmHg. The current chamber pressure in mmHg is displayed in the DIASTOLIC display.

6. Using the hand pump, manually pressurize the system to approximately 300 mmHg, comparing the manometer readings to the value displayed in the N-3100 DIASTOLIC display.

7. Using the air bleed on the hand pump, manually depressurize the system, comparing the manometer readings to the N-3100 displayed values.

8. Manually stop the test with the START/STOP button.

   Note: If the test is not manually stopped within 10 minutes, the N-3100 will automatically stop the test.

9. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.17 Menu Item 31: Inflation Time Test Mode

This function allows the service technician to test the time to inflate a cuff from 0 to 250 mmHg and from 0 to 300 mmHg. A 700 cm^3 test chamber is required.

1. Connect the 700 cm^3 test chamber to the N-3100 hose connector.

2. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 31 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. The chamber begins to pressurize to approximately 300 mmHg. The current chamber pressure in mmHg is displayed in the DIASTOLIC display.

5. At the end of the test cycle, the chamber depressurizes and the SYSTOLIC display indicates submenu item number 31.0. The DIASTOLIC display indicates the time in seconds, to the nearest tenth, required to pressurize to 250 mmHg.

6. Press the UP ARROW button. The number “31.1” is displayed in the SYSTOLIC display. The DIASTOLIC display indicates the time in seconds, to the nearest tenth, required to pressurize to 300 mmHg.

7. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.18 Menu Item 32: Deflation Rate Test Mode

This function allows the service technician to test the time required to deflate the cuff. A 220 cm^3 test chamber is required.

1. Connect the 220 cm^3 test chamber to the N-3100 hose connector.

2. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 32 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. The chamber begins to pressurize to approximately 300 mmHg. The current chamber pressure in mmHg is displayed in the DIASTOLIC display.

5. At the end of the test cycle, the chamber depressurizes and the SYSTOLIC display indicates submenu item number 32.0. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 260 to 180 mmHg.

6. Using the UP ARROW button, go to menu item 32.1 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 180 to 100 mmHg.

7. Using the UP ARROW button, go to menu item 32.2 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 100 to 60 mmHg.

8. Using the UP ARROW button, go to menu item 32.3 in the SYSTOLIC display. The DIASTOLIC display indicates the rate in mmHg per second, to the nearest tenth, required to depressurize from 60 to 30 mmHg.

9. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.19 Menu Item 33: Adult Leak Test Mode

The adult leak test verifies the integrity of the pneumatic system in the adult mode. A 220 cm^3 test chamber is required.

1. Connect the 220 cm^3 test chamber to the hose connector on the right side panel of the N-3100.

2. From the service mode steady state press, the UP or DOWN ARROW buttons until menu item 33 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. The chamber begins to pressurize to approximately 300 mmHg.

5. The current pressure reading will be displayed in the DIASTOLIC display until the test is completed.

6. Approximately 4 minutes later, the chamber will depressurize. The SYSTOLIC display indicates menu item “33.0.” The DIASTOLIC display indicates the change in pressure from the reference pressure reading until the end of the 4-minute period, in mmHg.

7. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.20 Menu Item 34: Neonate Leak Test Mode

The neonate leak test verifies the integrity of the pneumatic system in the neonate mode. A 220 cm^3 test chamber is required.

1. Connect the 220 cm^3 test chamber to the N-3100 hose connector.

2. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 34 is displayed in the SYSTOLIC display.

3. Press and release the UPPER ALARM LIMIT button.

4. Press and release the START/STOP button. The chamber begins to pressurize to approximately 150 mmHg.

5. The current pressure reading will be displayed until the test is completed.

6. Approximately four minutes later, the chamber will depressurize. The SYSTOLIC display indicates menu item "34.0." The DIASTOLIC display indicates the change in pressure from the reference pressure reading until the end of the 4-minute period, in mmHg.

7. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.21 Menu Item 35: Adult Maximum Pump Pressure Test Mode

The adult maximum pump pressure test verifies the functionality of the high pressure relief valve in the adult mode, and requires a 220 cm^3 test chamber, a manometer, a manual inflation pump, and an adapter.

1. Connect the 220 cm^3 test chamber to the N-3100 hose connector.

2. Using an adapter, connect the manometer and pump in parallel with the test chamber.

3. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 35 is displayed in the SYSTOLIC display.

4. Press and release the UPPER ALARM LIMIT button.

5. Press and release the START/STOP button. The chamber begins to pressurize to approximately 300 mmHg. The current chamber pressure in mmHg is displayed in the DIASTOLIC display.

6. Manually increase the pressure until the pressure relief valve opens. This normally should happen before the pressure reaches 331 mmHg.

7. The SYSTOLIC display indicates menu item 35. The DIASTOLIC display indicates the maximum chamber pressure achieved. If the pressure relief valve does not open, the DIASTOLIC display flashes.

8. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.22 Menu Item 36: Neonate Maximum Pump Pressure Test Mode

The neonate maximum pump pressure test verifies the functionality of the high-pressure relief valve in the neonate mode, and requires a 220 cm^3 test chamber, a manometer, a manual inflation pump, and an adapter.

1. Connect the 220 cm^3 test chamber to the N-3100 hose connector.

2. Using an adapter, connect the manometer and pump in parallel to the test chamber.

3. From the service mode steady state, press the UP or DOWN ARROW buttons until menu item 36 is displayed in the SYSTOLIC display.

4. Press and release the UPPER ALARM LIMIT button.

5. Press and release the START/STOP button. The chamber begins to pressurize to approximately 150 mmHg. The current chamber pressure in mmHg is displayed in the DIASTOLIC display.

6. Manually increase the pressure until the pressure relief valve opens. This normally should happen before the pressure reaches 171 mmHg.

7. The SYSTOLIC display indicates menu item 36. A nonflashing DIASTOLIC display indicates the maximum chamber pressure achieved. If the pressure relief valve does not open, the DIASTOLIC display flashes.

8. Return to the service mode steady state by pressing the LOWER ALARM LIMIT button.

4.3.23 Menu Item 37: Blood Pressure Module Self-Check Report

This function allows the service technician to display the results of the blood pressure module internal self-check.

1. From the service mode steady state, select menu item 37 by pressing the UP or DOWN ARROW buttons. Press the UPPER ALARM LIMIT button to begin the test.

2. While the test is in progress, “37” will be displayed in the SYSTOLIC display and the DIASTOLIC display will contain a sequentially scanning pattern.

3. After completion of the self-test, “37.0” will be displayed in the SYSTOLIC display and the resulting error from the self-test will be displayed in the DIASTOLIC field (0 = no error; 1 = RAM error; 2 = ROM error).

4. Press the UP ARROW button to display “37.1” in the SYSTOLIC display.

5. The left and middle characters of the DIASTOLIC display will be the year and the right character with the left character of the MEAN/PULSE RATE display will be the month of the program date. The middle and right characters of the MEAN/PULSE RATE display will be the day of the month of the program date.

6. Press the UP ARROW button to display “37.2” in the SYSTOLIC display.

7. The first two digits of the DIASTOLIC display will be the first byte of the version in hexadecimal format. The third digit will be “H,” indicating this is a hexadecimal representation. The first two digits of the MEAN/PULSE RATE display will be the second byte of the version in hexadecimal format. Again, the third digit will be “H,” indicating this is a hexadecimal representation.

8. Press the UP ARROW button to display “37.3” in the SYSTOLIC display.

9. The first two digits of the DIASTOLIC display will be the third byte of the version in hexadecimal format. The third digit will be “H.” The first two digits of the MEAN/PULSE RATE display will be the fourth byte of the version in hexadecimal format. The third digit will be “H.”

10. Press the UP ARROW button to display “37.4” in the SYSTOLIC display.

11. The first two digits of the DIASTOLIC display will be the fifth byte of the version in hexadecimal format. The third digit will be “H.” The first two digits of the MEAN/PULSE RATE display will be the sixth byte of the version in hexadecimal format. The third digit will be “H.”

12. Press the UP ARROW button to display “37.5” in the SYSTOLIC display.

13. The first two digits of the DIASTOLIC display will be the seventh byte of the version in hexadecimal format. The third digit will be “H.”

14. Press the LOWER ALARM LIMIT button to return to the service mode steady state.

Caution: Menu items 70 and above are for factory purposes only. Adjustment of menu items 70 and above by other than qualified factory personnel may cause the N-3100 to malfunction.

SECTION 5: TROUBLESHOOTING

5.1 INTRODUCTION

This section explains how to troubleshoot the N-3100 if problems arise. Tables are included that list possible monitor difficulties, along with probable causes, and recommended actions to correct the difficulties.

5.2 HOW TO USE THIS SECTION

Use this section in conjunction with Section 3, *Performance Verification*, and Section 7, *Spare Parts*. To remove and replace a defective part, follow the instructions in Section 6, *Disassembly Guide*. The circuit analysis section in the *Technical Supplement* also offers information on how the monitor functions that you may find useful in troubleshooting.

5.3 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 Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

5.4 REPLACEMENT LEVEL SUPPORTED

The replacement level supported for this product is limited to the printed circuit board (PCB) and major subassembly level. Once you isolate a suspect PCB, follow the procedures in Section 6, *Disassembly Guide*, to replace the PCB with a known good PCB. Check to see if the trouble symptom disappears and the monitor passes all performance tests. If the trouble symptom persists, continue troubleshooting to isolate another suspect PCB.

5.5 OBTAINING REPLACEMENT PARTS

Nellcor Puritan Bennett Technical Services provides technical assistance information and replacement parts. To obtain replacement parts, contact Nellcor Puritan Bennett. Refer to parts by the part names and part numbers listed in Section 7, *Spare Parts*.

5.6 TROUBLESHOOTING GUIDE

Problems with the N-3100 are separated into the categories indicated in Table 5-1. Refer to the paragraph indicated for further troubleshooting instructions.

Note: Taking the recommended actions discussed in this section will correct the majority of problems you will encounter. However, problems not covered here can be resolved by contacting Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative

Table 5-1: Problem Categories

Problem Area	Refer to Paragraph
1. AC Power • No power-up • Fails power-on self-test	5.6.1
2. Error Codes	5.6.2
3. Buttons • Monitor does not respond properly to buttons when pressed	5.6.3
4. Display/Alarms • Displays do not respond properly • Alarms or other tones do not sound properly or are generated without apparent cause	5.6.4
5. Operational • Displays appear to be operational, but monitor shows no readings • Suspect readings	5.6.5
6. Stacked Configuration • N-3100 operates properly when used alone but not when stacked	5.6.6

5.6.1 AC Power

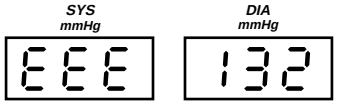
Most AC power problems result in one of two symptoms. Either there is no response when the ON/STANDBY button is pressed, or the microprocessor failure alarm sounds. If the microprocessor failure alarm sounds and an error code is displayed, refer to paragraph 5.6.2. Otherwise, refer to Table 5-2.

Table 5-2: Power Problems

Condition	Recommended Action
1. The N-3100 fails to turn on when the ON/STANDBY button is pressed.	1. If the N-3100 is powered by an SPS external power supply, ensure that the power supply is plugged into an operational AC outlet. If it is, and the green POWER AVAILABLE indicator is not lit, replace the power supply. 2. If the N-3100 is powered by an SPS external power supply and the green power supply POWER AVAILABLE indicator is lit, ensure that the power supply is properly plugged into the N-3100. 3. If the N-3100 is stacked with the N-3200, ensure that the N-3200 is plugged into an operational AC outlet. If it is, and the N-3200 POWER ON indicator is not lit, troubleshoot the N-3200. 4. If the N-3100 is stacked with the N-3200 and the N-3200 POWER ON indicator is lit, ensure that the N-3200 is properly stacked with the N-3100. 5. Check the N-3100 fuse. The fuse is located on the Lower Docking Connector PCB as indicated in paragraph 6.2 of the *Disassembly Guide* section. Replace if necessary. 6. Check the ribbon connector from the bottom enclosure to the UIF PCB. If the connection is good, replace the UIF PCB.
2. The microprocessor failure alarm sounds and no error code is displayed.	Replace the UIF PCB.

5.6.2 Error Codes

When there is a problem within the N-3100 monitor, an error code may be displayed on the front panel, as illustrated:



These codes correspond to messages that indicate what part of the monitor is at fault. Actions to take for specific error codes are listed below. For a more thorough understanding of the error codes, refer to Appendix A.

5.6.2.1 User-Correctable Error Codes

Table 5-3 lists the error codes that can be corrected by the operator. Refer to the number of the error code that is displayed on the N-3100, then perform the recommended action for the listed error code. Turn the N-3100 off and back on and verify that the error code no longer appears.

Table 5-3: N-3100 User-Correctable Error Codes

Error Code	Description	Recommended Action
055	Alarm limits and other settings have been returned to power-on defaults.	Press UPPER or LOWER ALARM LIMIT button as needed and if necessary, set alarm limits, alarm volume, audible alarm silence duration, and operating mode to the desired value.
058	Alarm silence duration and alarm volume have been returned to power-on defaults.	Press the ALARM SILENCE button. If necessary, check and adjust alarm silence duration and alarm volume.
085	A measurement could not be completed due to faulty cuff/hose, improper cuff application, or patient motion or physiology.	Check patient. Check cuff connections. Check cuff application and orientation. If necessary, replace cuff.
086	Measured values not in proper relationship (for example, systolic should be greater than mean, etc.) or pulse rate out of range of N-3100.	Check patient. Check cuff application and orientation. If necessary, replace cuff. Check for interference sources near monitor. If necessary, move monitor away from interference sources.

Table 5-3: N-3100 User-Correctable Error Codes (Cont.)

088	The N-3100 has received more button pushes than it can retain while it processes the current operation.	Let the current operation proceed.
093	Blood pressure test failed. This code only displayed in service mode.	Check cuff connections. Check cuff application and orientation. If necessary, replace cuff. Press UPPER ALARM LIMIT button and perform test again.
094	Blood pressure valve opened. This code only displayed in service mode.	Check cuff connections. Check cuff application and orientation. If necessary, replace cuff. Press UPPER ALARM LIMIT button and perform test again.
097	Communication with pump assembly lost.	Take a blood pressure measurement. Error will clear when a successful measurement is taken.

5.6.2.2 Failure Error Codes

Failure error codes are displayed by the monitor with a leading digit of "1." These codes may be cleared only by turning the monitor off and then on again.

Table 5-4 lists the possible failure error codes and the recommended action to take. Refer to Appendix A2 for a more detailed explanation of the codes.

Table 5-4: N-3100 Failure Error Codes

Error Code	Recommended Action
103	1. Turn the monitor off, then on again. 2. If the error code still appears, turn off the monitor and replace the blood pressure module.
106, 113, 114, 125, 152, 175, 176, 179, 189	1. Turn the monitor off, then on again. 2. If the error code still appears, turn off the monitor and replace the UIF PCB.
110	1. Turn the monitor off, then on again. 2. If the error code still appears, turn off the monitor and replace both lithium backup batteries. 3. If the error code still appears, turn the monitor off and replace the UIF PCB.

Table 5-4: N-3100 Failure Error Codes (Cont.)

112	1. Turn the monitor off, then on again and enter service mode. 2. Menu item 5 will be displayed. Save the ICC value as described in Section 4, *Configuration and Service Modes* (paragraph 4.3.5, menu item 5).
159	1. Use the service mode to reset the institutional default values to factory default values as discussed in Section 4, *Configuration and Service Modes* (paragraph 4.3.11, menu item 20). 2. If the error code still appears, turn off the monitor and replace the UIF PCB.
177	1. Turn the monitor off, then on again. 2. If stacked and STACKED indicator is not lit, turn all units in the stack off and then on again.
178, 191	1. Turn the monitor off, then on again. 2. If the error code still appears, use the service mode to reset the institutional default values to factory default values as discussed in Section 4, *Configuration and Service Modes* (Paragraph 4.3.11, menu item 20). 3. If the error code still appears, turn off the monitor and replace the UIF PCB.
183	1. Turn the monitor off, then on again.
192, 195, 196	1. Turn the monitor off, then on again. 2. Verify compatibility of software as discussed in Section 4, *Configuration and Service Modes* (paragraph 4.3.15, menu item 29). 3. If the error code still appears, verify compatibility of the ROMs by calling Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative.

5.6.3 Buttons

Table 5-5 lists symptoms of problems relating to nonresponsive buttons and provides recommended actions. If the action requires replacement of a PCB, refer to Section 6, *Disassembly Guide*.

Table 5-5: Button Problems

Condition	Recommended Action
1. The N-3100 turns on but does not respond to *one* of the buttons (other buttons are operational).	1. Check connection between the UIF PCB and the Display PCB. 2. Replace the Display PCB.
2. The N-3100 turns on but does not respond to *any* of the buttons.	1. Press the NEW PATIENT/NEONATAL button twice rapidly. If the NEONATAL MODE indicator lights, replace the Display PCB. 2. If the NEONATAL MODE indicator does not light, replace the UIF PCB.

5.6.4 Display/Alarms

Table 5-6 lists symptoms of problems relating to nonfunctioning displays, audible tones or alarms, and recommended actions. If the action requires replacement of a PCB or module, refer to Section 6, *Disassembly Guide*.

Table 5-6: Display/Alarms Problems

Condition	Recommended Action
1. Display values are missing or erratic.	1. Replace the Display PCB. 2. If the condition still persists, replace the UIF PCB.
2. Display segments do not light.	1. Check the connection between the UIF PCB and the Display PCB. 2. If the condition does not change, replace the Display PCB. 3. If the condition still persists, replace the UIF PCB.
3. Alarm sounds for no apparent reason.	1. Moisture or spilled liquids can cause an alarm to sound. Allow the monitor to dry thoroughly before using. 2. Replace UIF PCB.
4. N-3100 responds to button press but tone fails to sound.	1. Check the connection between the UIF PCB and the speaker. 2. If the condition does not change, replace the speaker. 3. If the condition still persists, replace the UIF PCB.

5.6.5 Operational Performance

Table 5-7 lists symptoms of problems relating to operational performance (no error codes displayed) and recommended actions. If the action requires replacement of a PCB or module, refer to Section 6, *Disassembly Guide*.

Table 5-7: Operational Performance Problems

Condition	Recommended Action
1. The display appears to be operational but the readings are suspect or nonexistent.	1. Check the hose and cuff for leaks and that a good connection is made. Replace cuff or hose if necessary. 2. Perform verification of pneumatic system as described in Section 3, *Performance Verification* (Paragraph 3.3.2). 3. If the condition still persists, replace the UIF PCB. 4. If the condition still persists, replace the pump assembly.

5.6.6 Stacked Configuration

Table 5-8 lists symptoms and recommended actions for problems encountered while in the stacked configuration. Refer to the N-3000 or the N-3200 service manual for more troubleshooting information.

Table 5-8: Stack Problems

Condition	Recommended Action
1. While stacked with N-3000 only, BATTERY IN USE/BATTERY LOW indicators on the N-3000 and N-3100 light steadily while they are connected to AC. Both units are operational.	1. If stacked with N-3000 only, ensure that the SPS power supply is plugged into an operational AC outlet. If it is, and the green indicator light is not lit, replace the power supply. 2. If the green SPS indicator is lit, ensure that the power supply is properly plugged into the N-3100.
2. While stacked with N-3200, BATTERY IN USE/BATTERY LOW indicators on the N-3200 and N-3100 light steadily while they are connected to AC. Both units are operational.	1. Ensure that the power cord is properly connected to the N-3200 rear panel and an AC power outlet. 2. Ensure that the N-3200 main power switch is turned on.

Table 5-8: Stack Problems (Cont.)

3. BATTERY IN USE/ BATTERY LOW indicators on the N-3000 light steadily but do not on the N-3100 and N-3200 while they are connected to AC via the external power supply. All units are operational.	1. Ensure that a good docking connection exists between the N-3000 and N-3100. 2. Check the N-3000 fuse. Replace if necessary as indicated in the *Disassembly Guide* section of the N-3000 service manual. 3. Refer to the *Troubleshooting* section of the N-3000 service manual.
4. BATTERY IN USE/ BATTERY LOW indicators on the N-3100 light steadily but do not on the N-3000 while they are connected to AC via the external power supply. Both units are operational.	Check the N-3100 fuse. Replace if necessary as indicated in the *Disassembly Guide* section of this service manual.
5. The N-3000 and/or N-3200 and N-3100 do not operate when disconnected from the external power supply.	1. The N-3000 or N-3200 battery may be discharged. To recharge the battery, keep the N-3000 connected to its external power supply, or connect the N-3200 to AC power. Confirm that the BATTERY CHARGING indicator lights. The battery will be fully charged when, after powering the unit off and then on again, the BATTERY CHARGING indicator does not light. The monitors may be used with a less than fully charged battery, but with a corresponding decrease in operating time from that charge. 2. If the battery fails to hold a charge, replace it as indicated in the *Disassembly Guide* section of the N-3000 or N-3200 service manual.
6. BATTERY IN USE/BATTERY LOW indicator flashes during DC operation.	There is 25% or less usable charge left on the N-3000 and/or N-3200 battery. At this point, if possible, discontinue use of the N-3000/ N-3200 on battery power, connect it to its external power source and allow it to recharge (approximately 12 hours).

Table 5-8: Stack Problems (Cont.)

7. While operating on battery power, N-3000 operates with BATTERY IN USE/BATTERY LOW indicator lighting steadily but N-3100 does not operate.	Ensure that a good docking connection exists between the N-3000 and N-3100.
8. Serial data or the alarm active function from the N-3100 is not available at the serial data output of the N-3000 or cannot be displayed on the N-3200.	1. Ensure that a good docking connection exists between the N-3100 and the N-3000, the N-3200, or both. 2. Check that an SPS power supply connected to the N-3100 is functioning properly or that AC power connected to the N-3200 is correct.
9. The AUDIBLE ALARM SILENCE button and knob on an N-3000 stacked with the N-3100 have no effect on the N-3100.	Earlier N-3000 versions do not have the ability to communicate properly with the N-3100. After ensuring that a good docking connection exists, contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritant Bennett representative for information on retrofitting the N-3000.

SECTION 6: DISASSEMBLY GUIDE

6.1 INTRODUCTION

The N-3100 can be disassembled down to all major component parts, including:

- PCBs
- lithium batteries
- cables
- function keys
- chassis enclosures

Tools required for disassembly:

- small, Phillips-head screwdriver
- medium, Phillips-head screwdriver
- needle-nose pliers

WARNING: Before attempting to open or disassemble the N-3100, disconnect the AC power cord from the N-3100.

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

If the bottom cover is removed while disassembling the monitor, do not connect the SPS Power Supply to the monitor while the power supply is plugged into AC power. Instead, first connect the power supply to the monitor, then connect the power supply to AC power. Failure to do so may result in damage to the monitor.

Note: Some spare parts have a business reply card attached. When you receive these spare parts, please fill out and return the card.

6.2 FUSE REPLACEMENT

See Figure 6-1. To replace the fuse on the lower docking connector board:

1. Disconnect the N-3100 from the SPS power supply. If you are operating in the stacked configuration, remove the N-3000 from the stack.

2. Set the N-3100 upside down, facing you.

3. Loosen the two screws on the left end of the bottom cover.

4. Squeeze the middle of the cover and lift the cover up and off the chassis.

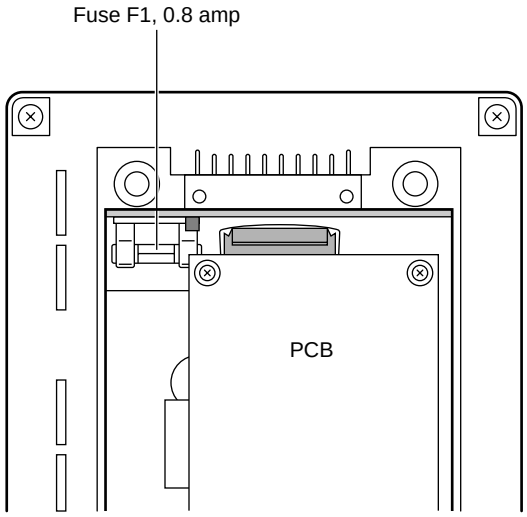


Figure 6-1: Fuse Replacement

5. Replace the fuse, as illustrated above, with one of same value and rating (0.8 amp, 250 volt).

6. Replace the bottom cover.

6.3 MONITOR DISASSEMBLY

1. Place the N-3100 in the standby mode by pressing the ON/STANDBY button.

2. Disconnect the unit from the SPS power supply. If operating in the stacked configuration, remove the monitor from the stack.

3. Set the N-3100 upside down, facing you.

4. Remove the four corner screws that hold the unit together (Figure 6-2).

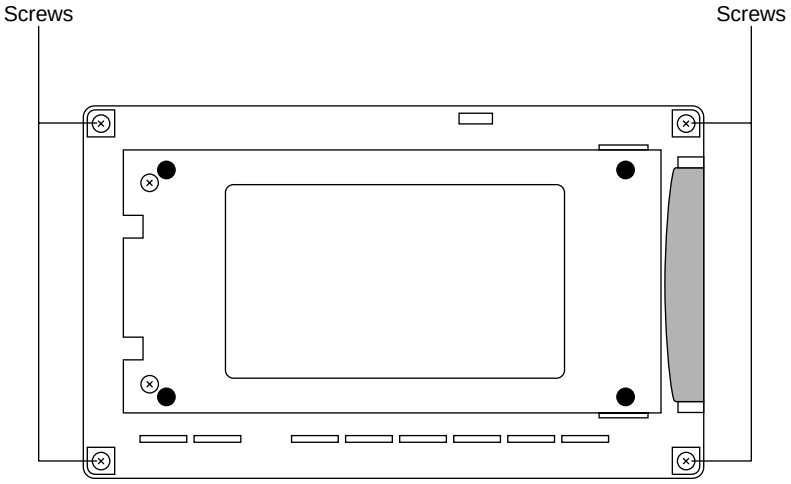


Figure 6-2: N-3100 Corner Screws

5. Separate the bottom enclosure from the top half of the monitor, keeping the right side panel attached to the bottom enclosure and the left side panel attached to the top.

6. Disconnect the blood pressure module ribbon connector from the UIF board as illustrated in Figure 6-3.

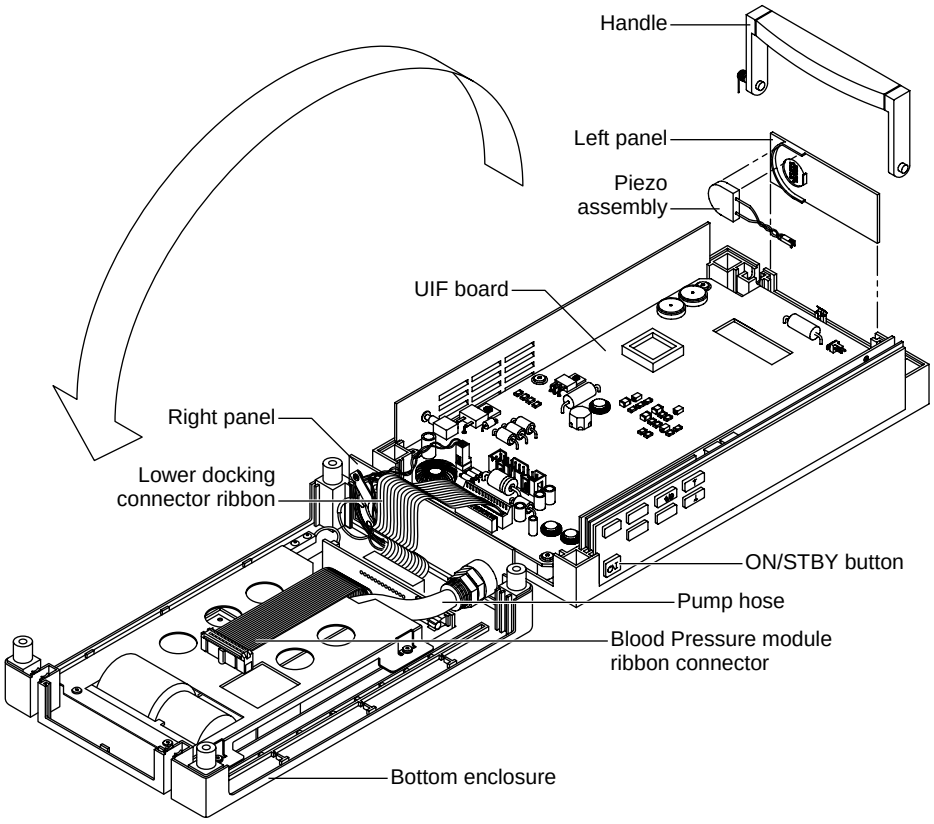


Figure 6-3: Separating the Monitor and Disconnecting the Cables

6.3.1 Replacing the Piezo Speaker

To replace the Piezo speaker:

1. Disconnect the Piezo assembly wires from the UIF board.

2. Unsnap the speaker from the form-fitted side cover by gently prying it with a small screwdriver.

3. Install a new speaker.

6.3.2 Replacing the Monitor Speaker

To replace the monitor speaker:

1. Disconnect the lower docking connector ribbon from the UIF board by depressing the bar at the top of the connector on the UIF board and carefully pulling on the ribbon cable.

2. Disconnect the speaker connector from the UIF board.

3. Loosen the two screws securing the monitor speaker assembly to the right side panel as illustrated in Figure 6-4.

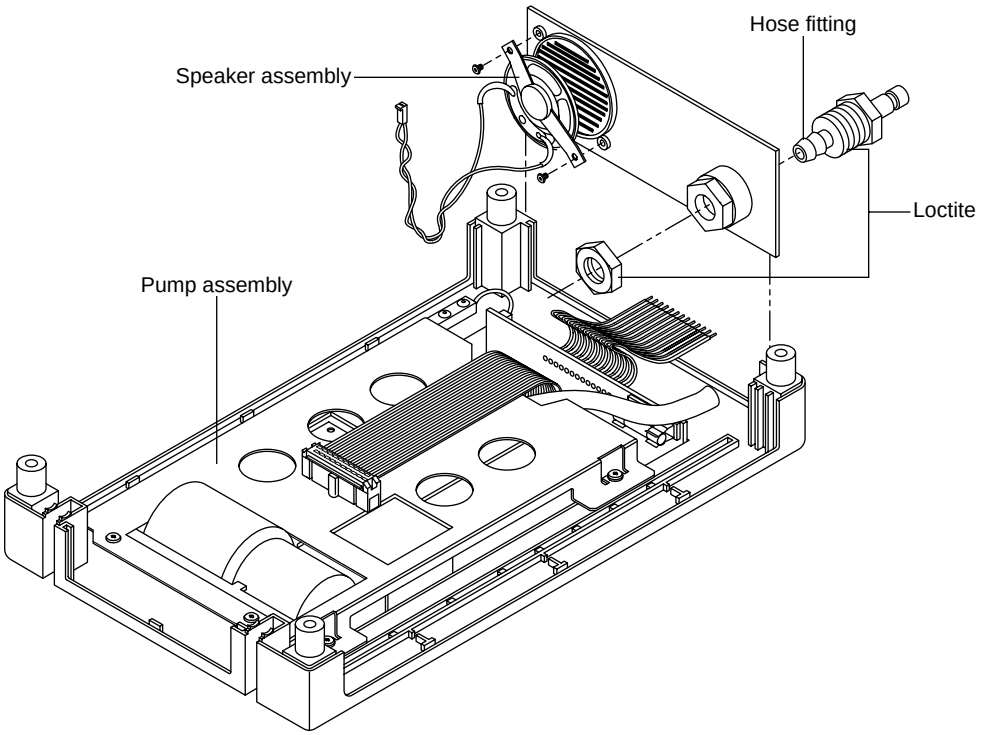


Figure 6-4: Removing the Monitor Speaker Assembly

4. Remove the speaker from the molded housing.

5. Install a new speaker.

6. Tighten the two screws.

6.3.3 Replacing the Hose Fitting

To replace the hose fitting:

1. Perform step 1 in paragraph 6.3.2.
2. Disconnect the pump hose from the fitting on the side panel.
3. Loosen and remove the retaining nut.
4. Pull fitting out of the side-panel molded housing.
5. Install the new fitting, applying LocTite (removable thread locker 242) or equivalent on the hose fitting and retaining nut, as illustrated in Figure 6-4.
6. Ensure that the hose is located as indicated in Figure 6-4 to avoid crimping when the monitor is reassembled. Connect the hose to the fitting.

6.3.4 Removing the UIF Board

When replacing the UIF PCB, ensure that the Instrument Identification on the bottom of the unit (see Figure 6-2) is replaced with the one provided with the replacement PCB. To remove the UIF board:

1. Disassemble the monitor as indicated in paragraph 6.3 and 6.3.2, steps 1 through 3.
2. Remove the five screws securing the board to the chassis, as shown in Figure 6-5.
3. Lift up, carefully prying up on the left side where J3 is connected to the top docking connector, which is mounted to the chassis.
4. Disconnect the Display board from the UIF board.

To remove the display panel front lens, loosen the five screws securing the UIF board first, then lift the cover up and away from the chassis.

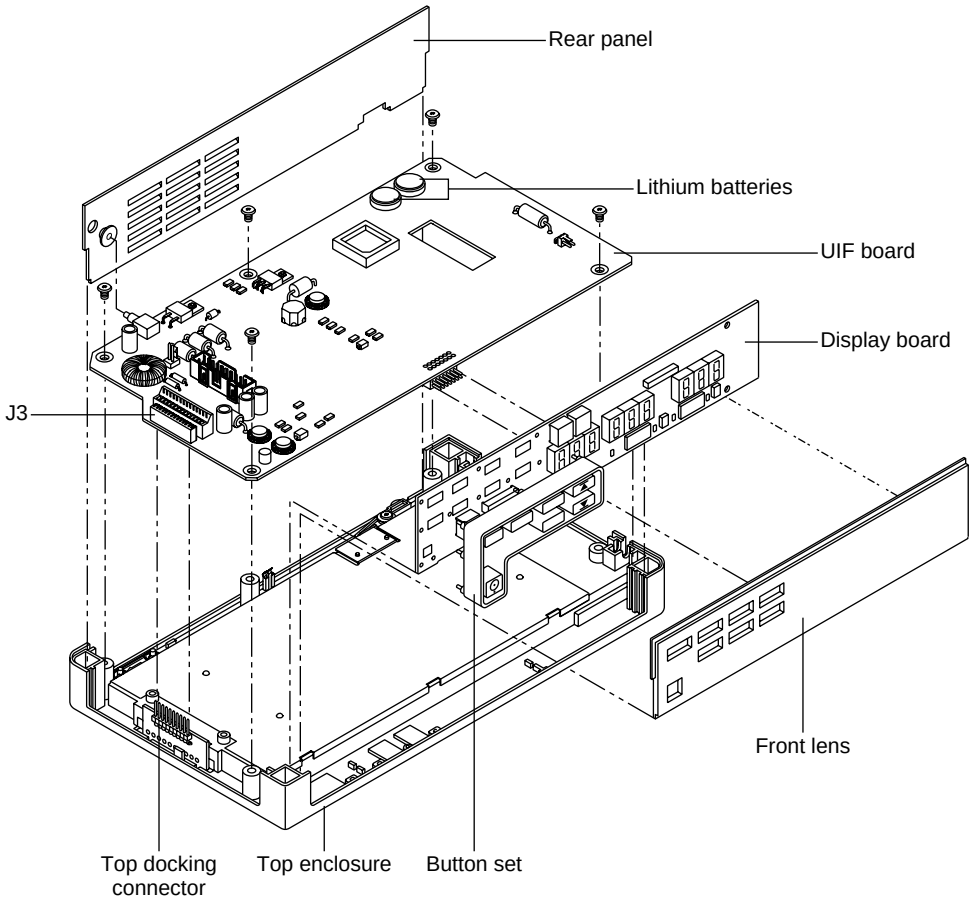


Figure 6-5: Removing UIF and Display PCBs

6.3.5 Removing the Pump Module

To remove the pump module:

1. Remove the four screws securing the module to the bottom enclosure, as shown in Figure 6-6.

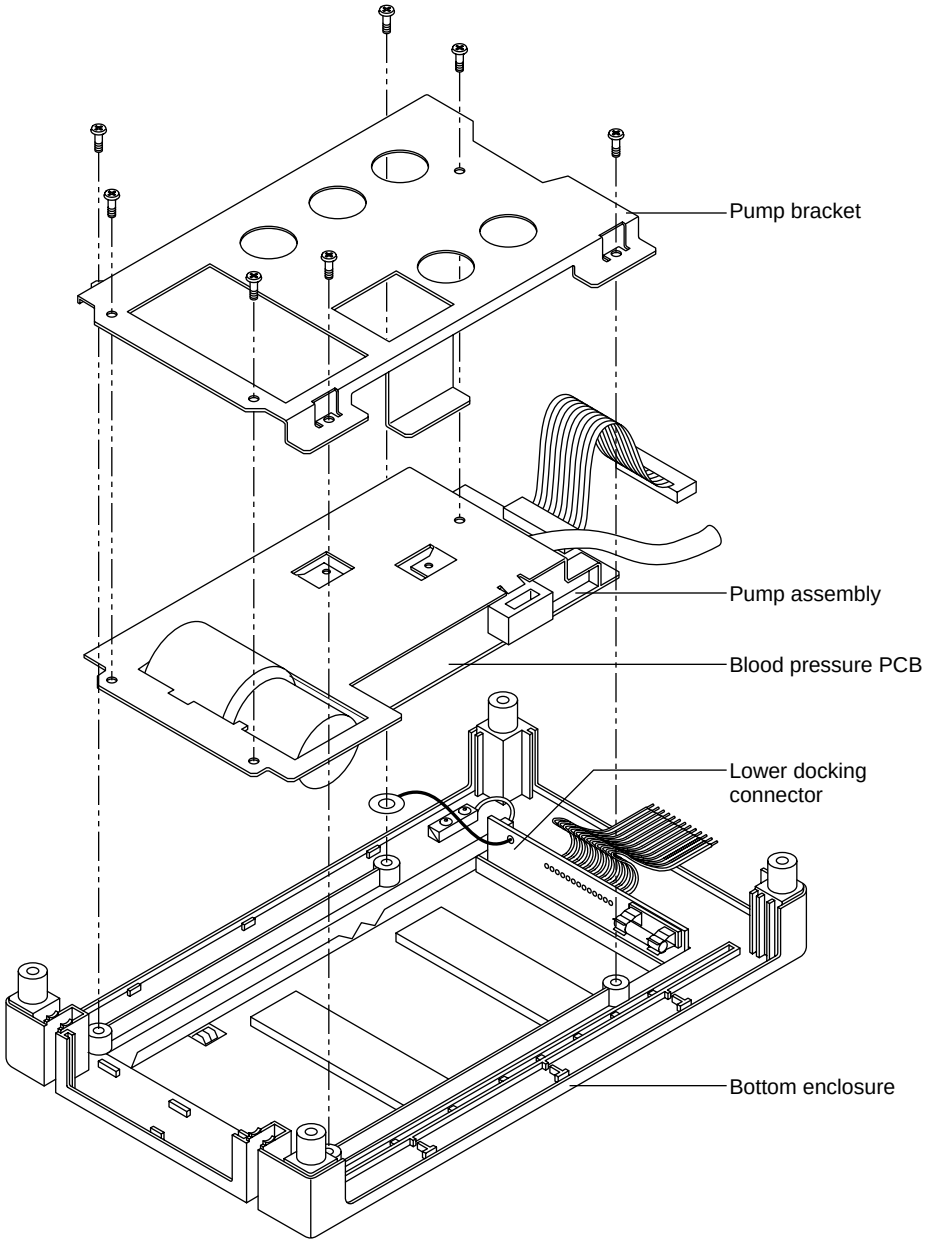


Figure 6-6: Removing Pump Module

2. Remove the three screws securing the pump bracket to the pump module.

3. Lift the module up and out of the chassis housing. Use caution when removing to ensure that the pump module does not damage the lower docking connector. Note: The pump and Blood Pressure PCB are not field- repairable.

6.4 LITHIUM BATTERY REPLACEMENT

1. Place the N-3100 in the standby mode by pressing the ON/STANDBY button.

2. Disconnect the unit from the SPS power supply. If operating in the stacked configuration, remove the N-3100 from the stack.

3. Set the N-3100 upside down, facing you.

4. Remove the four corner screws that hold the unit together, and separate the two halves of the monitor.

5. Locate the two 3-volt lithium batteries on the UIF board (Figure 6-5).

6. Slide the batteries from underneath the spring clips. Do not dispose of lithium batteries by placing them in the regular trash. Dispose of properly or return them to Nellcor Puritan Bennet's Technical Services Department for disposal.

7. Replace batteries, observing correct polarity (positive terminal up).

8. Reassemble chassis.

6.5 REASSEMBLY

Reassemble the monitor by performing the disassembly steps in reverse order.

1. Ensure that all plastic isolation shields are reinstalled correctly.

2. Ensure that the small, copper wiper fingers that make contact with the side-panel metalized coating throughout the top chassis fit properly.

3. Ensure that all buttons are seated properly and operate smoothly.

4. All of the side panels have channel guides molded into the top and bottom chassis to assist in proper location and seating.

5. To install the handle, locate the small spring attached to one side. After all PCBs and side panels have been properly seated in the top chassis, install the handle into the cradle in a vertical position, as illustrated in Figure 6-7. Guide the spring into the molded channel located at the rear of the top chassis while leaning the handle to the inside of the unit. When properly seated, the handle will rotate out with a small amount of spring tension and naturally return to the vertical resting position.

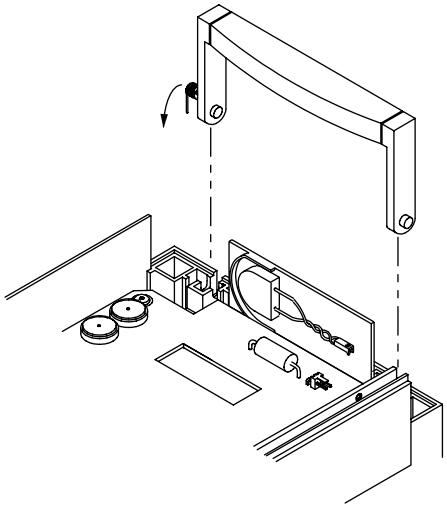


Figure 6-7: Installing the Handle

6. Depending upon the level of repairs, you may have to reconfigure the monitor's Internal Configuration Code (ICC) in order to get the monitor to operate properly. Reconfiguration is performed using menu item 20 of the service mode. Refer to Section 4, *Configuration and Service Mode*.

SECTION 7: SPARE PARTS

7.1 INTRODUCTION

Spare parts, along with corresponding part numbers, are shown below. Numbers in parentheses correspond to the callouts in Figure 7-1.

Item Number		Part Number
(1)	Blood pressure module ribbon cable	030375
(2)	Lower docking connector PCB	031773
(3)	Fuse	691122
(4)	Bottom enclosure	031646
(5)	Handle assembly	030783
(6)	Left panel	030083
(7)	Display PCB	030158
(8)	UIF PCB	031769
(9)	Control buttons, International	030748
(9)	Control buttons, North American	030530
(10)	Front lens, International	031776
(10)	Front lens, North American	031775
(11)	Connector cover	030167
(12)	Top enclosure	030401
(13)	Upper docking connector PCB	031771
(14)	Hose fitting	030361
(15)	Right panel	030079
(16)	Speaker assembly	031779
(17)	Lithium batteries	640112
(18)	Piezo speaker	031780
(19)	Rear panel	030110
(20)	Torsion spring	030472
(21)	Battery cover	031764
(22)	Proximity switch	030800
(23)	Blood pressure module	031777
(24)	Pump bracket	031509
Power supply, International, SPS-I1		033867
Power supply, North American, SPS-N1		033877
NPC-I Hospital-grade power cord, International		901862
NPC-I Hospital-grade power cord, North American		901861

Figure 7-1 shows the N-3100 expanded view with numbered callouts relating to item numbers listed on the spare parts list.

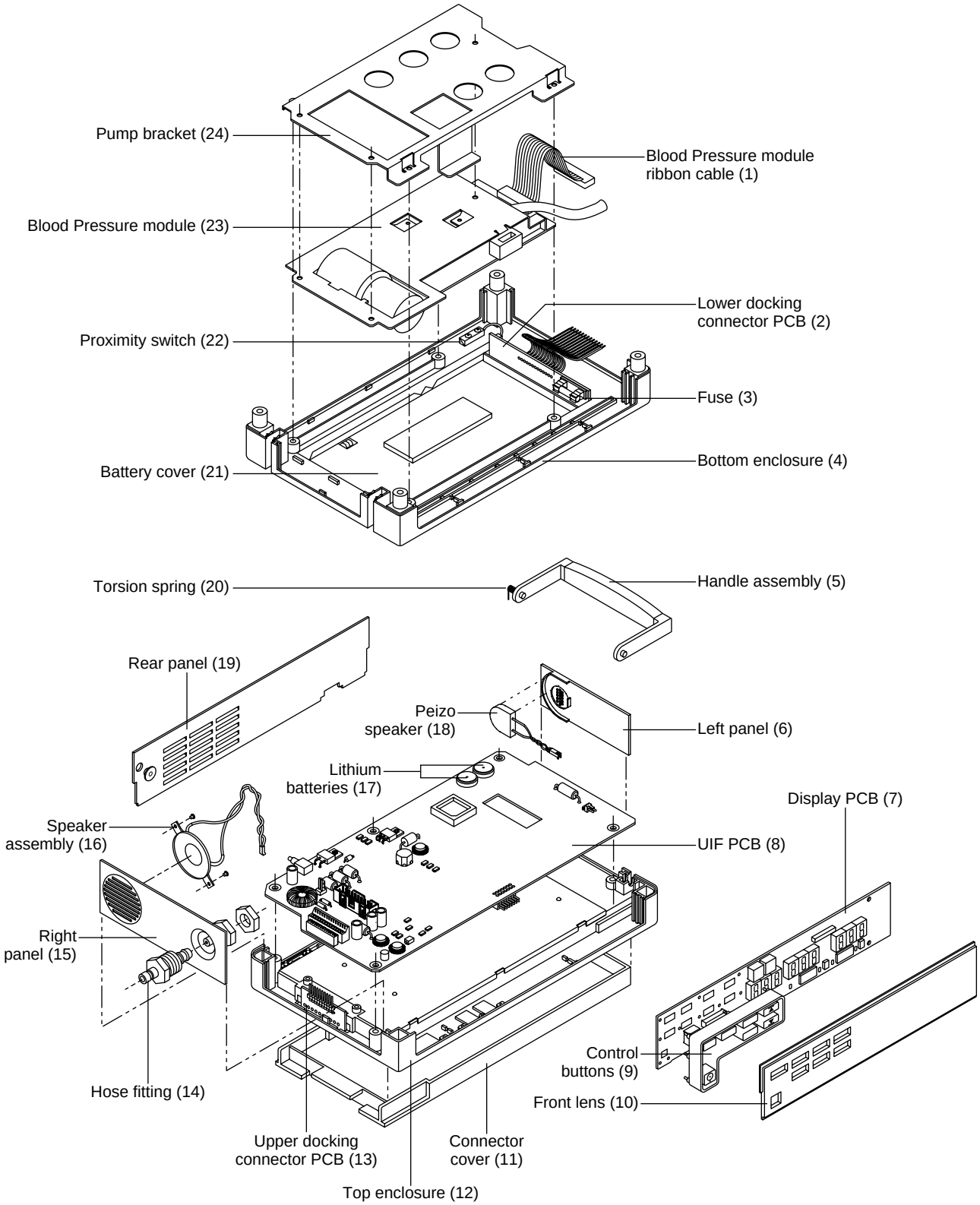


Figure 7-1: N-3100 Expanded View

SECTION 8: PACKING FOR SHIPMENT

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

8.1 GENERAL INSTRUCTIONS

Pack the monitor carefully. Failure to follow the instructions in this section may result in loss or damage not covered by the Nellcor Puritan Bennett warranty. If the original shipping carton is not available, use another suitable carton. North American customers may call Nellcor Puritan Bennett's Technical Services Department to obtain a shipping carton.

Prior to shipping the monitor, contact your supplier or the local Nellcor Puriatn Bennett office (Technical Service Department) for a returned goods authorization (RGA) number.

Mark the shipping carton and any shipping forms with the RGA number. Return the monitor by any shipping method that provides proof of delivery.

8.2 REPACKING IN ORIGINAL CARTON

If available, use the original carton and packing materials as illustrated in Figure 8-1.

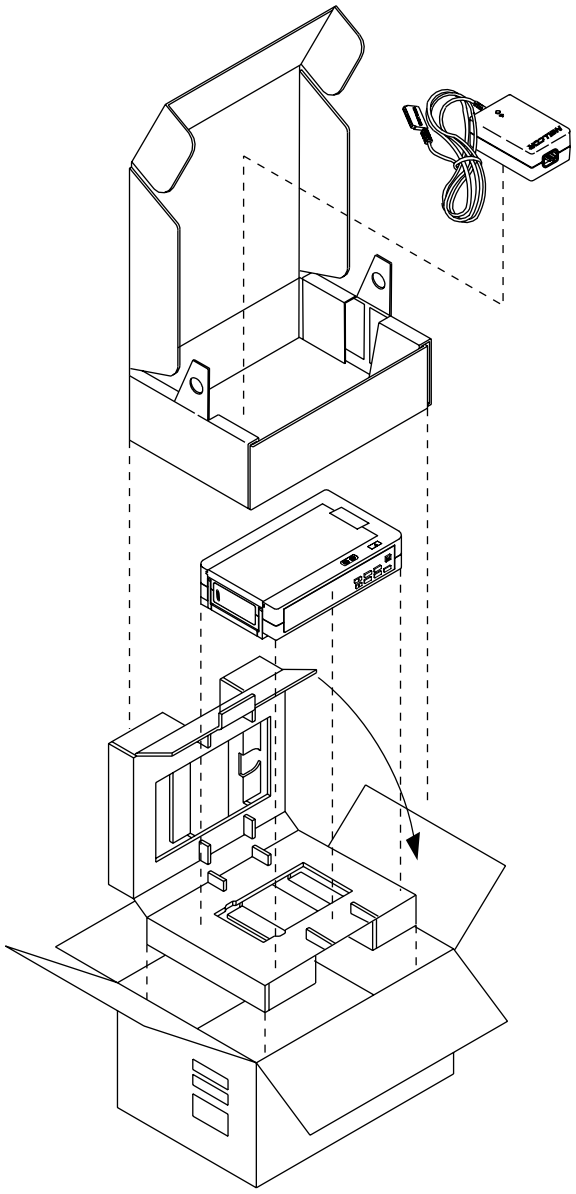


Figure 8-1: Repacking the N-3100

1. Place the monitor and, if necessary, accessory items in the original packaging.

   Note: Additional packing materials will be needed around loose accessory items.

2. Place in the shipping carton and seal the carton with packaging tape.

3. Label the carton with the shipping address, return address, and RGA number, if applicable.

8.3 REPACKING IN A DIFFERENT CARTON

If the original carton is not available:

1. Place the monitor in a plastic bag.
2. Use 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.

SECTION 9: SPECIFICATIONS

9.1 GENERAL

Designed to meet safety requirements of:

UL 544, CSA-C22.2 No. 601.1-M90, IEC 601-1, IEC 601-1 (type CF), ISO 9919, RFE per VFG 243, EMC per IEC 801 series and per CISPR 11, Class A and VDE 0871, Class B (Vfg. 243/1991).

The *NELLCOR SYMPHONY* N-3100 blood pressure monitor adheres to ANSI/AAMI Standard SP10-1992, Standards for Electronic Automated Sphygmomanometers when tested in the supine position.

9.2 ELECTRICAL

Protection Class

Class I when connected to N-3000: per I.E.C. 601-1, clause 2.2.4

Degree of Protection

Type CF: per I.E.C. 601-1, clause 2.2.26

Input Voltage	15 ⎓ (DC)
Fuse	0.8A, 250V

External Power Supply

Model SPS-I or SPS-I1	AC input: 100–240V~, 500 mA (maximum), 50/60 Hz
Model SPS-N or SPS-N1	AC input: 100–120 VAC, 500 mA (maximum), 50/60 Hz

9.3 PHYSICAL CHARACTERISTICS

Dimensions	6.35 cm x 23.88 cm x 14.73 cm (2.5 in. x 9.4 in. x 5.8 in.)
Weight	1.06 kg (2.34 lb.)

9.4 ENVIRONMENTAL

Operating Temperature	+5° to +40°C (+41°F to +104°F)
Storage Temperature (unboxed)	-20° to +60°C (-4°F to +140°F)
Storage Temperature (boxed)	-40° to +70°C (-40°F to +158°F)

Operating Altitude	-390m to +3,048m (-1,280 ft. to +10,000 ft.)
Operating Relative Humidity	15 to 95%, noncondensing

9.5 ALARMS

Adult Alarm Limit Range	
Systolic Blood Pressure	60–250 mmHg
Diastolic Blood Pressure	40–220 mmHg
Mean Blood Pressure	45–235 mmHg
Pulse Rate	30–180 bpm

Neonatal Alarm Limit Range	
Systolic Blood Pressure	40–130 mmHg
Diastolic Blood Pressure	20–90 mmHg
Mean Blood Pressure	35–105 mmHg
Pulse Rate	30–240 bpm

9.6 FACTORY DEFAULTS

Factory Default Alarm Limit Settings

	Adult	**Neonatal**
Systolic Blood Pressure Upper Limit:	240 mmHg	120 mmHg
Systolic Blood Pressure Lower Limit:	70 mmHg	50 mmHg
Diastolic Blood Pressure Upper Limit:	210 mmHg	80 mmHg
Diastolic Blood Pressure Lower Limit:	50 mmHg	30 mmHg
Mean Blood Pressure Upper Limit:	225 mmHg	95 mmHg
Mean Blood Pressure Lower Limit:	55 mmHg	45 mmHg
Pulse Rate Upper Limit:	170 bpm	230 bpm
Pulse Rate Lower Limit:	40 bpm	40 bpm

Other Factory Default Settings

Operating Mode	Adult-Pediatric
Audible Alarm Volume	Level 5
Audible Alarm Silence Period	60 seconds
Alarm Silence Reminder	On
Measurement Interval	Off (Manual)
Measurement Completion Tone	On
Pressure Calibration Algorithm	2 (Adjusted)
Initial Inflation Pressure (Adult-Pediatric)	180 mmHg
Initial Inflation Pressure (Neonatal)	120 mmHg

9.7 PERFORMANCE

Range

Adult-Pediatric Measurement Range:

Systolic Blood Pressure	60–250 mmHg
Diastolic Blood Pressure	40–220 mmHg
Mean Arterial Blood Pressure	45–235 mmHg
Pulse Rate	40–200 bpm

Neonatal Measurement Range:

Systolic Blood Pressure	40–130 mmHg
Diastolic Blood Pressure	20–90 mmHg
Mean Arterial Blood Pressure	35–105 mmHg
Pulse Rate	40–240 bpm

Measurement Accuracy

Adult-Pediatric:

Pulse Rate Accuracy: Displayed pulse rates in the range of 40–200 bpm are accurate to within ± 2 bpm or 2%, whichever is greater.

Pressure scale range in the adult-pediatric mode is 10–300 mmHg. Values in the pressure scale range will be displayed while the N-3100 is inflating and deflating the cuff. When the cuff pressure is within this range, the pressure indicated by the N-3100 is within ± 3 mmHg or ± 2%, whichever is greater, of the actual cuff pressure.

Note: Accuracy is not specified for displayed values outside of the stated ranges.

Neonatal:

Pulse Rate Accuracy: Displayed pulse rate in the range of 40–240 bpm are accurate to within ± 2 bpm or 2%, whichever is greater.

Pressure scale range in the neonatal mode is 5–150 mmHg. Values in the pressure scale range will be displayed while the N-3100 is inflating and deflating the cuff. When the cuff pressure is within this range, the pressure indicated by the N-3100 is within ± 3 mmHg or ± 2%, whichever is greater, of the actual cuff pressure.

Note: Accuracy is not specified for displayed values outside of the stated ranges.

APPENDIX

A1 INTEGRITY TESTS

The N-3100 routinely performs internal system integrity tests to verify and monitor proper operation. As a result, error codes are recorded in the internal Error Log and codes may be displayed on the monitor front-panel display. These error codes help establish a starting point for troubleshooting the N-3100.

Failure error codes are produced by the N-3100 when one of the following automatic integrity tests detects an error:

- POST (Power-On Self-Test) and Watchdog: The POST tests and verifies microprocessor memory, display, speaker, communications, time sense device, control logic, and blood pressure module hardware. The watchdog circuit monitors the operational status of the microprocessor.

- Background Test: Background tests periodically run during normal operation and check the memory integrity and microprocessor operation. Internal communication variables and parameters are checked for the appropriate values and timeliness.

- Failure Error Detection: A failure error may occur at any time. The failure error detection process attempts to make an entry into the Error Log, displays an error code, sounds an alarm, and places the instrument into a state (including ceasing monitoring) that minimizes the chance of additional risk to patient or caregiver.

A2 ERROR TYPES

There are six classes of errors in the N-3100 as indicated in Table A-1.

Table A-1: Error Types

Error Type	Description
1. Generic POST/ microprocessor failure.	In this case, nothing may happen, or a shrill continuous alarm may sound and the display may go blank. This represents a severe hardware failure. For example, the UIF microprocessor could not activate the display or speaker facilities.
2. Initialization failure.	An EEExxx code representing the failure is displayed and a low-priority alarm sound is produced, but no entry is made in the Error Log. POST has proceeded to the point that the UIF microprocessor has control of the display and speaker facilities. The error cannot be logged because the Error Log portion of the EEPROM has failed, or internal communications to the Error Log cannot be established.
3. Failure error at the end of initialization or during steady state operation.	An EEExxx code representing the failure is displayed, a low-priority alarm sound is produced, and a failure type error entry is made in the Error Log.
4. Internally corrected error.	These errors do not appear on the display and they do not cause an alarm. However, they are entered in the Error Log. These errors represent events that have occurred in the instrument that are undesirable, but for which the instrument has effective means of recovery. Examples of these types of errors include such things as watchdog resets, data stream restarts due to data underrun or stoppage, and resource exhaustion, for example, not enough memory buffers or not enough CPU cycles.

Table A-1: Error Types (Cont.)

Error Type	Description
5. User-correctable error.	An EEE0xx code representing the failure is displayed and a low-priority alarm sound is produced, but no entry is made in the Error Log. These types of errors represent hardware failure conditions that can be corrected by the user, such as replacing a faulty cuff or unkinking the hose. These errors are not logged because they are caused by conditions external to the N-3100. They are readily identified by the 0 leading digit in the error number displayed along with EEE (failure errors have a leading digit other than 0).
6. Unexpected loss of power.	This condition results in a power-failure alarm. Nothing is logged in the Error Log and the display is blank because the primary power in the instrument has failed. This alarm is powered by the secondary backup lithium batteries located on the UIF board.

In all cases, an attempt to store an error in the Error Log may fail due to failure or corruption of the Error Log in EEPROM. This condition alone does not constitute a failure error and operation of the instrument proceeds as if the error has been successfully logged.

A3 USER-CORRECTABLE ERROR CODES

The following error codes are user-correctable.

Error Code	Explanation
055	Alarm limits and other settings have been returned to power-on defaults
058	Alarm silence duration and alarm volume have been returned to power-on defaults
085	A measurement could not be completed, probably due to patient motion or physiology
	No cuff was present, or adult cuff used in Neonatal mode
	Neonatal cuff used while in Adult mode
	Measured values not in proper relationship (for example, systolic should be greater than mean) or pulse rate out of range of N-3100
083	Invalid measurement data
088	The N-3100 has received more button pushes than it can retain while it processes the current operation

User-correctable error codes (cont.)

093 Blood pressure test failed, displayed only in service mode

094 Blood pressure test failed, displayed only in service mode

097 Communication failure with the pump assembly, displayed only in service mode

A4 FAILURE ERROR CODES

Table A-2 lists the possible failure error codes in numerical order.

Table A-2: N-3100 Failure Error Codes

Error Code	Explanation
103	Blood pressure module failed startup tests
106	POST failure
110	Lithium battery voltage below acceptable threshold
112	Hardware configuration does not match
113	Internal component failure on UIF PCB
114	System is unstable; the number of resets in the last minute is excessive
159	Operation not completed
175	A persistent communication failure has been detected
176	A persistent communication failure has been detected
177	Communication between stacked instruments has failed
178	An EEPROM memory corruption has been detected
179	Internal tests indicate an invalid program configuration
183	Module reset occurred while in configuration or service mode
189	Internal component failure on UIF PCB
191	An EEPROM memory corruption has been detected
192	Unstable communication bus network
195	Two instruments in the stack are of incompatible versions
196	The modes of the stacked instruments are incompatible

A5 INTERNALLY CORRECTED ERROR CODES

Internally corrected error codes are not normally displayed. These errors are logged on the internal Error Log and the N-3100 watchdog circuitry resets the monitor. They can be accessed only by using the service mode (menu items 7 through 16) as indicated in Paragraph 4.3, service mode.

Table A-3 lists the internally corrected error codes. Note: It is not normally necessary for service personnel to access the Error Log. However, if you find it necessary to contact Nellcor Puritan Bennett's Technical Services Department or your local Nellcor Puritan Bennett representative, they may request information from the Error Log.

Table A-3: N-3100 Internally Corrected Error Codes

Error Code	Explanation
101	General failure of POST
111	A blood pressure module POST error has occurred
125	Software cannot allocate a resource (ran out of a dynamic resource, memory corruption during initialization, or a logic error resulting from a low-probability combination of events)
126	Temporary program memory has been exceeded (stack)
150	A program task has been found to be over-or under-dispatched
151	An illogical state or result has occurred that is likely to have been caused by working memory corruption or other device malfunction
152	A program memory corruption has been detected
153	An unknown microprocessor interrupt has occurred
154	Operating system failure
156	An unexpected result has occurred in communication bus-related utility software
157	An unexpected event or condition has occurred in an application program
183	Operating mode has changed unexpectedly
184	Internal memory structures have been corrupted or an expected parcel has been misdirected or corrupted

TECHNICAL SUPPLEMENT

S1 INTRODUCTION

This Technical Supplement provides the reader with a summary of the N-3100 operating principles and an in-depth discussion of N-3100 circuits. A functional overview and detailed circuit analysis are supported by block and schematic diagrams. The schematic diagrams are located at the end of this supplement.

S2 OVERVIEW

The N-3100 uses an oscillometric technique to provide noninvasive blood pressure measurements at selected intervals. The N-3100 uses the inflatable sphygmomanometer cuff similar to that used by clinicians in routine auscultatory blood pressure measurements. The clinician normally inflates the cuff manually, then deflates the cuff slowly, listening for Korotkoff's sounds associated with systole and diastole. The oscillometric technique uses a pressure transducer and electronic data processing to determine systolic, mean, and diastolic pressures.

A motorized pump inflates the cuff to approximately 180 mmHg (120 mmHg for neonatal patients) initially. The N-3100 then deflates cuff pressure gradually. A pressure transducer detects air pressure and sends a signal to the measurement circuits. As pressure in the cuff is reduced, blood flows in the previously occluded artery and the pressure read by the transducer changes. The point at which oscillation increases sharply is defined as the systolic pressure. As the cuff deflates further, oscillation amplitude increases to a maximum, then decreases. The point of 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. Figure S2-1 shows the inflation and deflation process and the oscillation of the pressure as seen by the transducer.

The N-3100 is factory-set to self-calibrate before every measurement.

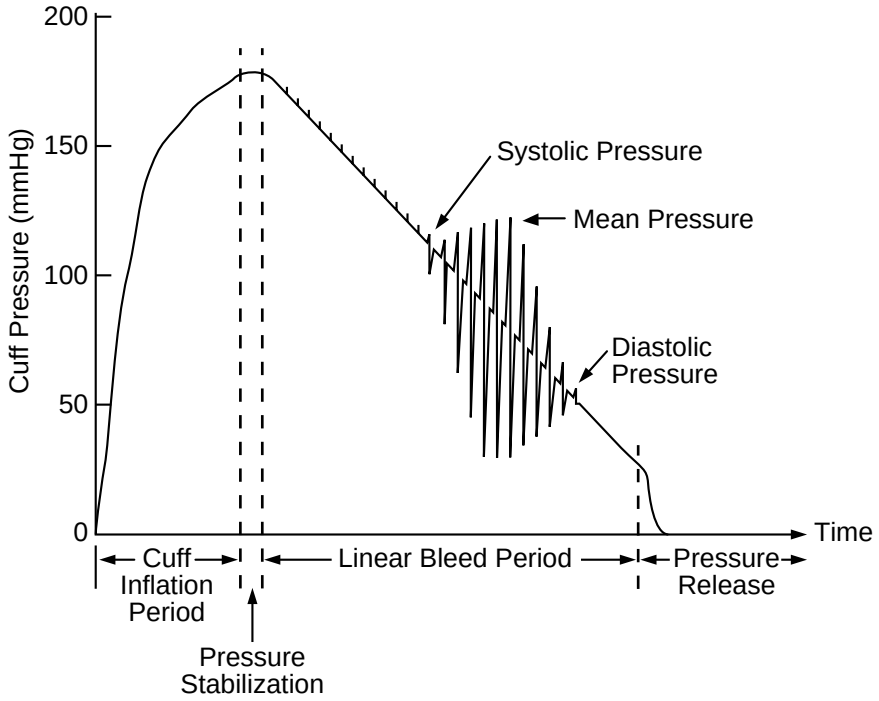


Figure S2-1: Oscillatory Blood Pressure Measurement

S3 STACKBUS INTERCONNECT

Stackbus is the general term for the communication interconnect between the N-3000 and the N-3100 instruments.

The internal communication bus is used for communications between the UIF/Power Supply PCB and the Blood Pressure module. Information is transmitted over a single PCB trace using the Arcnet (discussed in S4, Circuit Analysis) local area network standard as the message protocol.

The external Stackbus is used for communications between the N-3000 and the N-3100. Information is exchanged over two pins on the N-3000 docking connector and two sockets on the N-3100 upper docking connector. As with the internal communication bus, the Arcnet local area network standard is used as the protocol. RS-485 drivers and receivers are used for signaling. A proximity sensor on the N-3100 UIF PCB detects when the N-3000 is docked, which enables the internal communication bus signals.

Access to the Stackbus is accomplished through token passing. A token designates which station (module or instrument) has control of the Stackbus. The token passes in a circular manner from station to station. The station holding the token has the exclusive right to transmit onto the Stackbus, but the right to transmit may be temporarily donated to another station to acknowledge a transmission by the token holder. The token holder must relinquish control of the Stackbus by passing the token to the next station on the loop within a specified period of time. During normal operation, the right to access the Stackbus passes from station to station in a continuous, consistent manner.

All stations participate in the loop when stacked and turned on. Maintenance of token passing, loop initialization, lost token recovery, and the addition of new stations is implemented in the N-3000's UIF/Gateway and SpO_2 modules and in the N-3100 by the Arcnet.

S4 CIRCUIT ANALYSIS

This section provides a descriptive overview of the N-3100 modular design, as well as a detailed circuit analysis.

S4.1 FUNCTIONAL OVERVIEW

The monitor functional block diagram is shown in Figure S4-1.

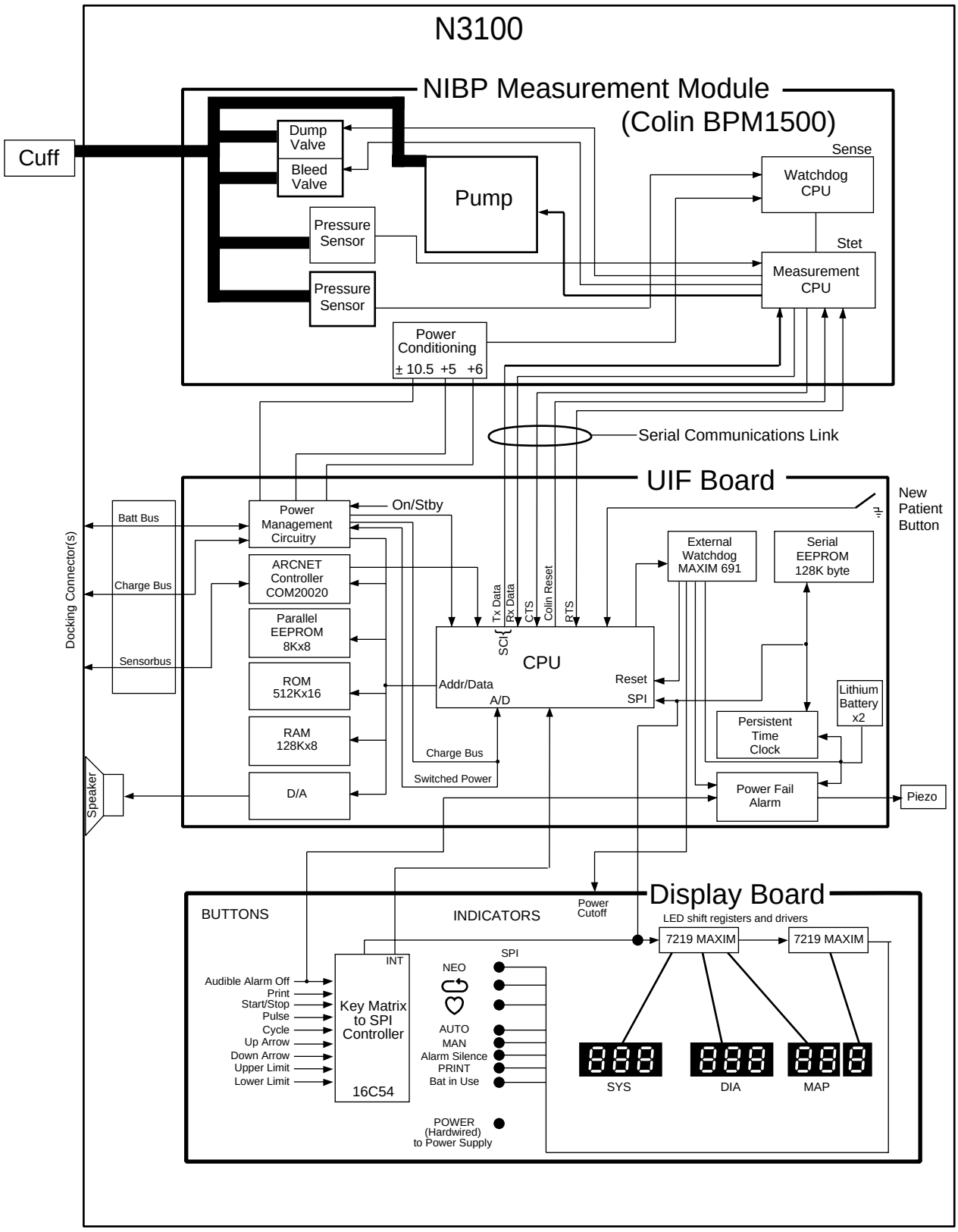


Figure S4-1: N-3100 Functional Block Diagram

S4.2 DETAILED CIRCUIT ANALYSIS

The following paragraphs discuss the operation of each of the printed circuit boards within the N-3100 blood pressure monitor. (Refer to the appropriate schematic diagram at the end of this appendix, as necessary.)

S4.2.1 UIF/Power Supply Module

The UIF module, located on the UIF/Power Supply PCB, provides power to the other modules within the N-3100 and controls communication between each module.

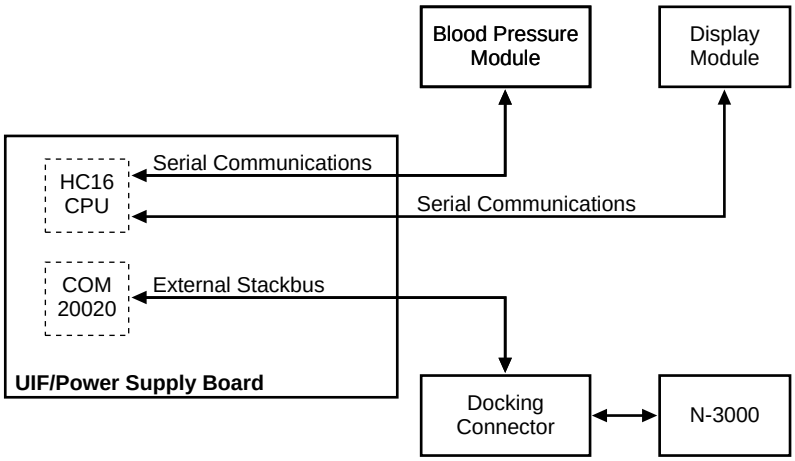


Figure S4-2 Internal/External Bus Connections

S4.2.1.1 Microprocessor

The primary microprocessor for this board is U3, a Motorola MC68HC16Z1 IC, also referred to as the HC16. This microprocessor uses a 16-bit CPU and contains several submodules, including A/D converters, pulse width modulators, internal RAM, and a queued serial module. The microprocessor also contains a non-multiplexed data/address bus and input/output timer pins. A synthesized clock signal is produced using the signal from Y2, a 32.768 kHz crystal. Software determines the operating clock frequency.

Queued Serial Module
The queued serial module (QSM) provides the microcontroller unit with two serial communication interfaces divided into two submodules, the queued serial peripheral interface and the serial communications interface (SCI). The queued serial peripheral interface submodule is used to communicate to the following four different devices:

- a real-time clock on the UIF board
- a serial EEPROM on the UIF board
- a PIC microprocessor on the Display board
- the display drivers on the Display board

The QSM allows the real-time clock to communicate to the QSM by connecting the MISO and MOSI lines. The signals from the QSM are tied to the 5-volt power supply through resistors.

The SCI submodule communicates with the blood pressure module in an EIA-232 format at the 5-volt level.

Analog to Digital Converter Module
The A/D Converter module has eight analog inputs that can be converted to digital representations. A voltage divider is used to reduce the input voltages to a value that is within the 0-5 volt range of the A/D converter.

System Integration Module
The system integration module provides configuration control, system clock control, internal bus transfer control, and interrupt handling control. Port E uses the HC16 bus signals for bit positions 2 through 7 and discrete input signals for bit positions 0 and 1. Port F can be configured to be either discrete signals or interrupt requests.

S4.2.1.2. Peripheral and Support ICs

The peripheral and support ICs for the U3 microprocessor include program memory chip U10, data and variable memory U13, trend memory U4, serial EEPROM U7, real-time clock U12, Arcnet controller U8, digital-to-analog converter U5, power on reset/watchdog timer U21, and the display buttons.

Program memory — U10 contains the program code in a 512K x 16 EPROM. The UIF uses chip select CSBOOT to select the EPROM.

Data and variable memory — U13 uses a scratchpad memory to retain variables and data during operation. The UIF uses chip select CS0 to select the 128K x 16 SRAM.

Trend memory — Trend data is retained in parallel EEPROM U4. The 8K x 8 chip will retain data when the N-3100 is turned off. It is selected by CS3 (device select) and CS4 (write enable).

Serial EEPROM — U7 contains instrument configuration, limit data, and the Error Log. It is accessed by the QSPI serial data line and enabled by PSC1 chip select.

Real-Time Clock — U12 provides a time sense for the UIF/Power Supply. It is powered while the unit is off by the lithium batteries. It is accessed by the WSQI serial data line and is enabled by PSC2 chip select.

Arcnet controller — U8 is used to implement the communication bus protocol. It is a memory-mapped device that controls all the Stackbus communications.

DAC — U5 is used to control speaker volume. It is an 8-bit, memory-mapped device and is enabled by chip select CS5.

Watchdog Timer — U21 ensures that the U3 microprocessor does not operate when the +5 volt supply falls below 4.5 volts minimum. This chip holds U3 in reset until the power supply is back within an acceptable range of voltage levels. Whenever the power supply falls out of regulation, this chip resets the microprocessor.

The watchdog timer also resets the microprocessor if the CLRWD signal is not toggled within the timeout period. When the watchdog times out, a WDOL signal is transmitted, causing the alarm oscillator to emit a tone to the Piezo speaker and blank the display. This signal remains active until the AUDIBLE ALARM OFF button is pressed.

Display drivers — The QSM serial port is used to communicate with the two display drivers on the Display board through the serial line. The driver data lines are daisy-chained together so that only PCS0 is needed to communicate to both drivers.

S4.2.1.3 Power Supply

The UIF/Power Supply PCB contains three DC-DC converters that convert voltages from the SPS power supply or the N-3000 battery to the +5 voltage needed in the N-3100. There are additional DC-DC power converters that supply +6 volts to the pump valves and the ±10.5 volts that power the analog circuits and dump valves in the Blood Pressure module.

Power on/off — A latch composed of two gates of CMOS U20 controls the power-on FET. The input voltage is filtered and reduced by CR15 to approximately 9.5 volts when the unit is on and approximately 9.8 volts when the unit is off.

Switch U19 controls the destination of the front-panel ON/STANDBY button. If the +5 volt supply is off, the button press sets the latch, allowing the power to the DC-DC converters. When the supply is on, a button press generates an level 6 interrupt to the HC16 and the latch is turned off by the software.

Battery backup — The real-time clock, the power-on reset and watchdog timer, and the power loss/CPU failure logic are the only elements on the board that have the battery backup capability. The 691 chip is used to select the power source for the real-time clock and Piezo alarm circuitry from either the +5 volt power supply or the lithium battery supply.

+5 volt DC-DC converter — The +5 volt supply converts the input voltage from inductor T4 into 5 volts for the digital electronics. The switching converter circuit is made using switching regulators. The circuit contains a current-limiting resistor designed to stop the converter if a short circuit exists. Capacitors are provided at the output for better load regulation.

S4.2.1.4 Speaker Driver and Volume Control

As illustrated in Figure S4-3, speaker tones originate from the U3 GPT output compare-pin (OC2). The GPT pin outputs a square wave whose frequency is under software control. This signal is buffered by U6, then input into DAC U5. The DAC may be programmed to attenuate the signal to one of 256 levels, effectively acting as a volume control. This signal is then sent to speaker driver U22 that drives an 8–32Ω speaker.

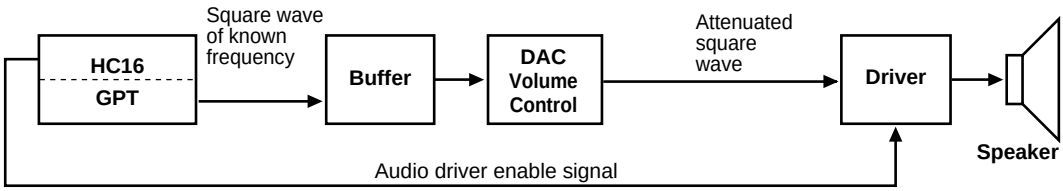


Figure S4-3: Speaker Driver and Volume Control Block Diagram

S4.2.1.5 Connectors

This section describes UIF connectors and provides tables that detail connector pin-outs.

J1 — is a 20-pin connector that interfaces the UIF/Power Supply PCB to the Blood Pressure module. A ribbon cable is attached from J1 to the Blood Pressure module.

Table S4-1: J1 Connector

Pin No.	Pin Description	Input/Output/ Power
1	Transmit data to Blood Pressure module (TXD)	Output
2	Receive data from Blood Pressure module (RXD)	Input
3	Request to send (XRTS)	Output
4	Status from Blood Pressure module (OK = LOW)	Power
5	Logic ground	Input
6	VDD	Power
7	Blood Pressure module power (positive)	Power
8	Blood Pressure module power (positive)	Power
9	Module power ground	Power
10	Module power ground	Power
11	Blood Pressure module power (negative)	Power
12	Pump power	Power
13	Pump power	Power
14	Pump power	Power
15	Pump power ground	Power
16	Pump power ground	Power
17	Pump power ground	Power
18	Reserved	
19	Spare	
20	Reset signal to Blood Pressure module	Output

J5 — contains power and signal lines used in the stack configuration to communicate with the N-3000. These signal lines include the battery bus, charge bus, digital and case ground, and the external Stackbus.

Table S4-2: J5 Upper Inter-Stack Connector

Pin No.	Pin Description	Input/Output/ Power
1	Chassis (case) ground	Power
2	Stackbus differential (positive)	Input/Output
3	Stackbus differential (negative)	Input/Output
4	Digital ground	Power
5	External charge bus	Power
6	Battery bus voltage	Power
7	N/C	n/a
8	Not used	n/a
9	Not used	n/a
10	Not used	n/a

J2 — connects to the monitor speaker.

Table S4-3: J2 Speaker Connector

Pin No.	Pin Description	Input/Output/ Power
1	Differential speaker signal +	Input/Output
2	Differential speaker signal –	Input/Output

S4.2.2 Blood Pressure Module

The Blood Pressure module uses the Colin, model 1500 blood pressure module. It consists of main CPU U2 for measuring blood pressure and sub CPU U14 for monitoring the pressure and measuring time.

The pressure signal detected by HIC pressure sensor PM1 is calibrated to approximately 10mv/mmHg by gain amplifier U12. The signal output is converted by A/D converter U7 and read as pressure by U2 and U14.

The pulse wave is detected from the pressure signal and is filtered, amplified, converted into a DC signal, and read by U2. The adult signal is amplified by U18 and the neonate signal is amplified by U19.

The mechanical parts are a pump and bleed/dump valve.

S4.2.2.1 System Flow

When power is applied to the Blood Pressure module, initialization and zero calibration of the pressure is performed. The module is then in a ready condition which permits interruption from the UIF CPU.

When the start command from the UIF is received, the Blood Pressure module closes the bleed/dump valve and drives the pump to increase the cuff pressure to the preset value. The cuff is deflated by the opening of the bleed valve to measure the blood pressure. When the measurement is complete, the Blood Pressure module sends the blood pressure value to the UIF board and returns to the ready condition.

Sub CPU U14 monitors the main CPU with regard to the pressure, inflation rate, deflation rate, watchdog, and analog voltage. If U14 detects a problem, it disables the drive circuit of the pump and bleed/dump valve and resets U2, which sends an error message to the UIF board.

S4.2.3 Display Board

The N-3100 display board contains the front-panel display for the monitor. The display board is connected to, and controlled by, the UIF. The Display board block diagram is shown in Figure S4-4.

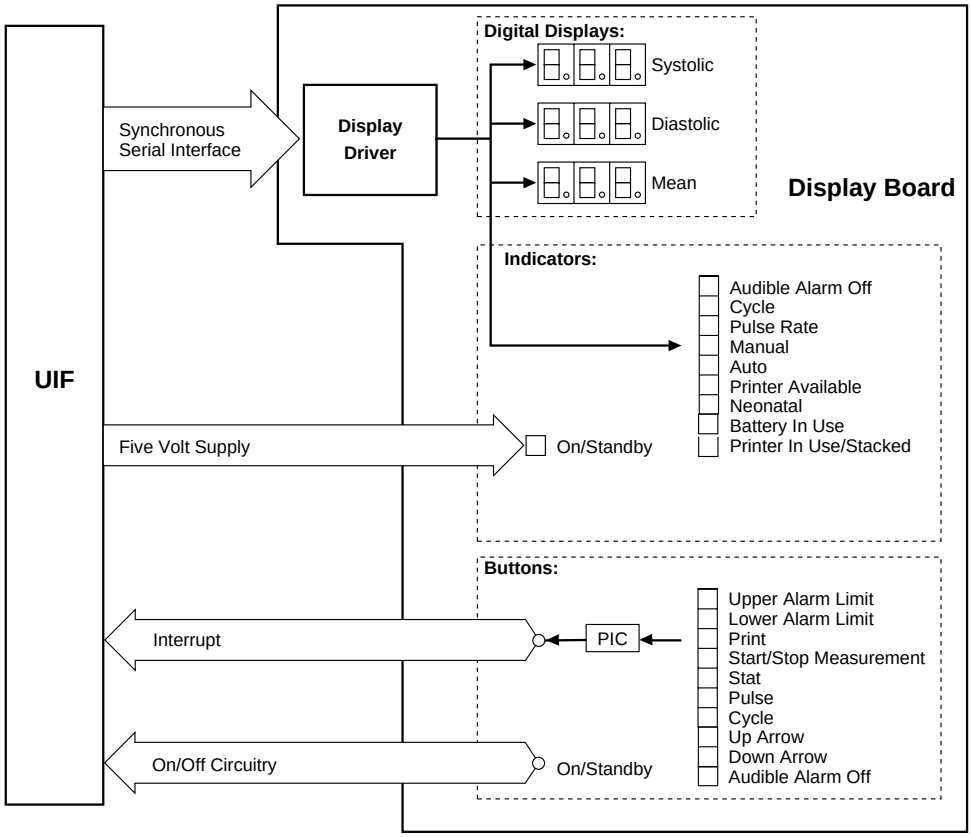


Figure S4-4 Display Board Block Diagram

The display driver ICs consist of U1 and U2, which use a 3-wire serial interface connect to the CPU U3 on the UIF/Power Supply module. The two drivers used on this module are cascaded together and require that the host microprocessor write 32 bits (16 x 2) to the board per each display update.

The front-panel POWER LED (DS23) is lit whenever the monitor power supply is on.

There are 11 buttons on the display panel: the ON/STANDBY button (SW1) and the AUDIBLE ALARM OFF button (SW2) are connected directly to the UIF/Power Supply module. All the buttons except the ON/STANDBY button are connected to an input matrix of PIC microprocessor U3. The PIC is responsible for communicating with the UIF.

U3 is used to indicate a button change of state. The buttons are input through a matrix form to the PIC. The PIC will recognize when a button is pressed or released and request an HC16 interrupt on the UIF/Power Supply. When the HC16 responds by initiating a serial communication, the PIC inputs this information to the HC16. Although the PIC requests a serial communication link, it has no other control over the communications.

The J1 connector pin-outs are as follows:

1 +5V power for display drivers
2 +5V power for display drivers
3 Enable for PIC microprocessor
4 Serial clock to display drivers
5 Load data to display drivers
6 Serial data to display drivers
7 N/C
8 Audible alarm off
9 ON/Standby button signal
10 N/C
11 PIC Interrupt
12 +5 volts for green LED
13 Ground
14 Ground

S.5 SCHEMATIC DIAGRAMS

The following schematics and part locator diagrams are included in this section:

Figure	Description
Figure S5-1	Display PCB Part Locator Diagram
Figure S5-2	UIF PCB Part Locator Diagram
Figure S5-3	Display PCB Schematic Diagram
Figure S5-4	UIF PCB Schematic Diagram
Figure S5-5	Upper Docking Connector PCB Schematic Diagram
Figure S5-6	Lower Docking Connector Board Schematic Diagram
Figure S5-7	Blood Pressure PCB Schematic Diagram