

3.6 Disassembly Instructions

CAUTION: The Inside Of This Instrument Contains Static Sensitive Components. Use correct static protection safeguards.

1. Power down the Accutorr Plus and remove the AC power cable.
2. Remove all cables and hoses from the front and rear of the instrument.
3. Remove temperature measuring module and recorder module, if equipped.

3.6.1 Removal of the Rear Housing

1. Place the Accutorr Plus with the display side down, onto a protective surface.

NOTE: Special care should be taken to insure that the front panel and glare screen are not scratched.

2. Remove the 4 screws from the corners of the back housing recess and the two screws in the center channel of the rear case.
3. Slowly lift the rear housing up and place in a safe location.
4. Disconnect battery connector (J4) from the Power Supply board.

3.6.2 Removal of the Front Bezel

1. Place the front housing with the display side down, onto a protective surface.
2. Disconnect the SpO₂ ribbon cable (J3) from the SpO₂ circuit board and the tubing from the NIBP front panel connector.
3. Slowly separate the assembly up and away from the front housing.

3.6.3 Removal of the Keyboard Assembly

1. Place the instrument with the display side down, onto a protective surface.
2. Remove the Front Bezel, as described above.
3. Remove the screws (6) securing the Keyboard Assembly and lift the keyboard, supporting and separating the connector to the LED/Tone board.

3.6.4 Removal of the LED/Tone board

1. Remove front bezel and keyboard.
2. Disconnect cable from J4, the speaker connection.
3. Remove the four screws holding the circuit board. Pull circuit board forward, disconnecting the rear J-1 connector.

3.6.5 Removal of the CPU / NIBP board

- 1.** Disconnect J-505 NIBP pump connector, J-7 SpO₂ interface connector (advanced model), and J-502 Power supply connector, all on the top edge of the board.
- 2.** Disengage the captive cable connectors for the Recorder and Temperature options at the bottom left and right edges of the board.
- 3.** Disconnect gray ribbon cable at J-603 to the external interface connectors.
- 4.** Disconnect J-651 the LED backlight connector (advanced model).
- 5.** Disconnect silicon hose from pump, at the right angle elbow.
- 6.** Remove the four hexagonal spacers and one Phillips head screw on the board.
- 7.** Lift board up gently and disconnect data ribbon cable from J-8 to the LCD display (advanced model).

3.6.6 Removal of the Power Supply Assembly

1. Remove AC mains power cord and internal battery. Remove rear case.
2. Disconnect ribbon cable at J-3 on the power supply. Disconnect battery J-4 connector cable. Disconnect input cable at J-2.
3. Remove screws as shown in Figure 3-1.

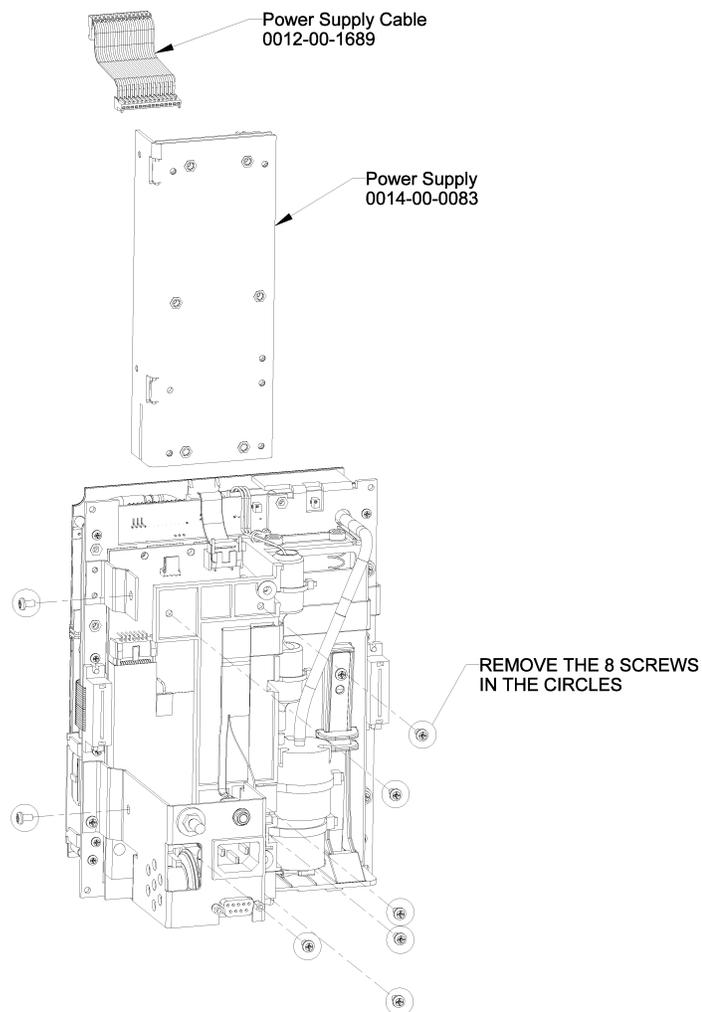


FIGURE 3-1 Power Supply Assembly Diagram

3.6.7 Removal of the LCD Display (Advanced Model)

1. Remove the right side support bracket for the LCD. Disconnect data ribbon cable.
2. Disengage LCD circuit board from left side support bracket and disconnect backlight cable from the CPU / NIBP board.

3.6.8 Removal and replacement of the Internal Li-Ion Battery

To remove the externally accessible battery, press the quick release tab on the battery access door and open door. The battery is retained internally in a sliding compartment, captured by a spring loaded release tab. Press the tab away from the battery; the battery will eject with a spring assist mechanism.

Reverse the process to install the replacement battery.

NOTE: **New batteries are shipped in a discharged state for safety reasons. A new battery must be charged for 4 hours for Li-Ion before first use. The monitor may be used with AC mains power during the charge cycle but battery operation could be limited during this time.**

3.6.9 Removal of the AC Input Receptacle Assembly

1. Press the plastic locking tabs on the rear of the AC receptacle. A small screwdriver may be inserted at the cut out on the left of the AC connector, to release the locking tabs.
2. From the front side of the receptacle, starting at the edge closest to the Interface connector, press upwards, while pulling the connector out.
3. Disconnect the cable end from the Power Supply circuit board.
4. Remove the locking nuts from the safety ground terminal stud; remove ground conductor.

3.6.10 Thermal Printer (optional module)

1. Detach the complete module from the main NIBP section, by removing the two screws in the plastic housing. Grasp the plastic housing and pull to the rear to disengage the Interface connector.
2. Remove the two screws retaining the circuit board and the anti static shield assembly. Remove the shield.
3. Remove the remaining two screws and lift the circuit board out.

3.6.11 Thermometer, Predictive (optional module)

1. Detach the complete module from the main NIBP section by removing the two screws in the plastic housing. Grasp the plastic housing and pull to the rear to disengage the interface connector.

2. Remove J2 and J3 connectors from the circuit board to front panel input receptacle.

**NOTE: The connectors may be reversed or interchanged
 without affecting final function.**

3. Remove the three screws securing the circuit board and anti static shield. Remove the assembly.

3.6.12 AccuTemp IR, Infrared Thermometer (optional module)

The AccuTemp IR has no user accessible adjustments or replaceable parts, except for the 9 Volt battery. If problems arise, contact Technical Service.

3.6.13 AccuTemp IR Mounting Cradle

The mounting cradle has no adjustments or replaceable parts. The mounting cradle houses a small circuit board and a photocell sensor.

Calibration

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5.1 Introduction

The Accutorr Plus is a state of the art device employing digital determination and verification systems to obtain superior performance for the life of the product. Most function calibration constants are written into the operating software, therefore, for the most part, there are no means to calibrate or adjust system functions. The instrument contains extensive Service Diagnostics that will, in most cases, isolate a malfunction to the lowest serviceable module.

NOTE: This procedure refers to this instrument as the UUT (Unit Under Test).

All internal verifications and adjustments should be performed with the internal battery disconnected. Operate the UUT on the main power supply. This will insure a reliable power source for the test, as well as providing a measure of safety in case of accidental overload of the power source. To re-initialize the low battery detector circuits, reconnect the battery at the conclusion of all tests while the UUT is on A.C. power source. Reset the real-time clock and date, if required.

5.1.1 Status and Error Code Table

The Accutorr Plus uses the various displays on the front panel to display the operational status. Error codes listed below can generally be resolved by the user however, error codes with an asterisk (*) may require resolution by a qualified technical service person.

5.1.1.1 Error Codes

Table 5-1

TYPE	CODE	DESCRIPTION	REASON
NIBP	8810	Retry - Unable to Measure	Motion artifact, cycle time-out, weak pulsations or no pulsations. A triple beep tone is generated.
	8811	Retry - Pump Higher	Insufficient cuff pressure. A triple beep tone is generated.
	8812	Stop - Cuff Overpressure	Excessive cuff pressure detected by the software. A triple beep tone is generated.
	8813	Stop - Unable to Measure	4 successive measurement attempts failed. A triple beep tone is generated.
TEMP (PTM)	8830	Check Probe	Tissue contact may have been lost.
	8831	Replace Probe	Defective probe or connection.

Table 5-1

TYPE	CODE	DESCRIPTION	REASON
SpO ₂	8850	No Sensor	No sensor connected.
	8851	Sensor Off	Sensor not on patient. (Masimo® SpO ₂ only)
	8852	Interference	Interference on signal. (Masimo® SpO ₂ only)
	8853	Pulse Search	Unit cannot find signal. (Nellcor® SpO ₂ module will report “Pulse Search”-8853- when the sensor is not on the patient.)
	8854	Weak Pulse	Weak pulse detected. (Masimo® SpO ₂ only)
	8856	Check Sensor	Sensor problem. (Masimo® SpO ₂ only)
	8857	PR<21	Pulse rate is less than 21 bpm. (Nellcor® SpO ₂ only)
	8857	PR<26	Pulse rate is less than 26 bpm. (Masimo® SpO ₂ only)
	8858	PR>249	Pulse rate is greater than 249 bpm. (Nellcor® SpO ₂ only)
	8858	PR>239	Pulse rate is greater than 239 bpm. (Masimo® SpO ₂ only)
SYSTEM	984*	NIBP Hardware Failure	NIBP A/D failure detected.
	985*	NIBP Overpressure Circuit not Programmed	The overpressure circuit is not set to the current patient size.
	986*	NIBP Overpressure Circuit not Tracking	The two pressure transducers are not tracking each other.
	987*	Stop - Hardware Overpressure	Excessive cuff pressure detected by hardware overpressure sensor. A triple beep tone is generated.
	988*	TEMP Bad Calibration	Thermometer needs calibration.
	990*	TEMP Illegal Mode	Thermometer switch is set wrong.
	991*	TEMP Module Failed	Thermometer internal failure.
	995*	SpO ₂ Uncalibrated	SpO ₂ fails calibration check.
	996*	SpO ₂ Failure	SpO ₂ failed self-test.

5.2 Precautions And Guidelines

In the event that the instrument covers are removed, observe these following precautions and general guidelines:

- Do not short component leads together.
- Perform all steps in the order given.
- Use extreme care when reaching inside the opened instrument. Do not contact exposed metal parts which may become live.

Read through each step in the procedure so it is understood prior to beginning the step.

5.3 Test Equipment And Special Tools Required

Equipment types other than these listed may be utilized if they equal or exceed the listed equipment performance.

- Non-Invasive Blood Pressure Simulator
- Stopwatch
- SpO₂ Simulator
- RS232 Test Connector (pins 2 and 3 shorted), 9-pin male “D” and software download port tester
- Phono plug (tip and ring shorted)
- 700 cc Dummy Cuff (P/N 0138-00-0001-01)
- Chart Paper (P/N 0683-00-0447-01)
- Water Bath, stirred, heated 80° to 120° F
- Reference Thermometer, 0.1%

5.4 Power-up Sequence, Internal Testing

1. Attach the AC power cord into the UUT rear panel AC Input module.
2. Press the **ON/STANDBY** key to turn the UUT On. The UUT automatically performs internal self diagnostics. The Timer / Temp. display starts a count down from 20. This is the initial software verification. Allow the unit to complete the start up sequence until there is a single LED light steadily illuminated above the Patient Setup key. After the initial power up sequence, “a” is displayed in the bed LED, and “0” is displayed in the Room LEDs.
3. Press the **ON/STANDBY** key to turn the UUT off.

5.5 Service Diagnostics

The Service Diagnostics tests must be run in the sequence indicated. The numbers and letters in parentheses after the title of each test, represent the room number and bed letter used to access the test.

5.5.1 Introduction (Hidden Key)

To enter the Service Diagnostics mode, while powering on the unit, press and hold the hidden key until two beeps are heard. The hidden key is the Adult symbol above the Patient **SETUP** key.

Verify that after the initial power up sequence a “0” is displayed in the Room LED, “a” is displayed in the Bed LED, and “ddd” is displayed in the Systolic LEDs.

5.5.2 Software Version Test (0a, 0b)

This test displays the installed software version (s) in the monitor. The results are displayed in the read outs illustrated in Figure 5-1 on page 5-6.

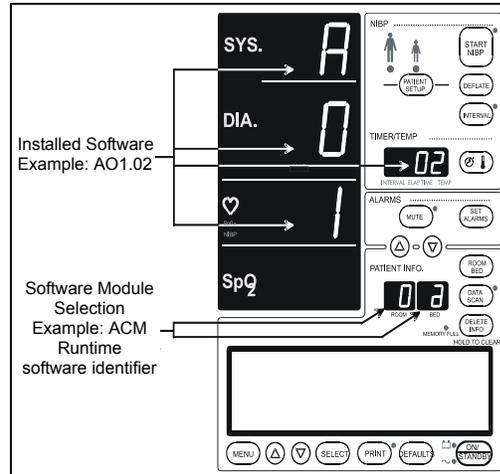


FIGURE 5-1 - Software Version Test

Confirm that the ROOM number is at “0”; otherwise use the “**ROOM/BED**” key to select the “ROOM”, and the **UP/DOWN** keys to set Room number to “0”.

Press **ROOM/BED** key to select BED. Use the **UP/DOWN ARROW** keys to select test “a” or “b”. Monitors without SpO₂ option may not display results for tests “0c” and “0d”. Press ROOM/BED again to lock in selection.

Press the **START NIBP** key.

Press the **DEFLATE** key until a beep is heard. This allows a selection of the next test.

Repeat process for test “b”.

Table 5-2

DESCRIPTION OF SOFTWARE MODULE	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
ACM Runtime Software Version	0	a
ACM Boot Software Version	0	b

5.5.3 Keypad Test

1. Press the Room Up arrow to change the Room Number to "1".
2. Press the Start NIBP key to run the keypad test.
3. Press any key on the keyboard. A number will appear in the Patient Bed Letter Display. This number is identified in Figure 5-1 on page 5-6. Verify that the correct number appears in the Patient Bed Letter Display when each key is pressed.

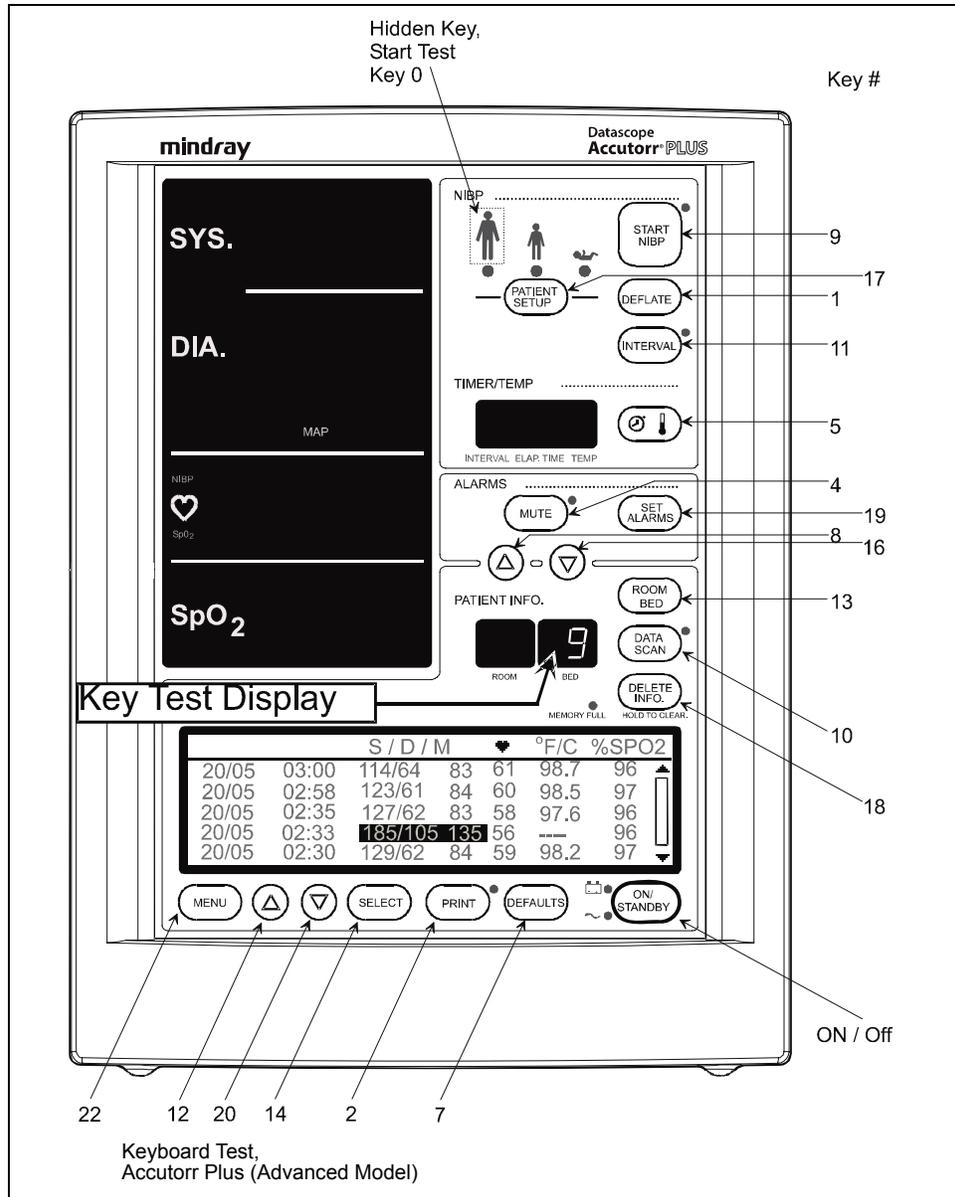


FIGURE 5-2

4. Press the **DEFLATE** key for 3 seconds to exit keypad test.

5.5.4 LED Test (2a, 2b)

This test allows the LED function to be verified by driving all seven LEDs with numbers from 0 to 9, in sequential order. For this test, all annunciator LEDs turn on for 1 second.

Table 5-3

TEST DESCRIPTION	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
7 Segment LED Test	2	a
Annunciator LED Test	2	b

5.5.5 Communication Test (3a, 3b)

This test checks the integrity of the external communication systems. Test 3a checks the external RS232 interface and requires that the transmit and receive pins be connected together. Test 3b checks the Download port and requires that the tip (transmit) and ring (receive) pins be connected together. The CRC table is transmitted and received. If the CRC data received matches the CRC table transmitted, the test passes; otherwise a failure is reported.

Table 5-4

TEST DESCRIPTION	SHORT CONNECTOR PINS	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
RS232 Port Test	Transmit (2) and Receive (3)	3	a
Download Port Test	Tip and Ring	3	b

5.5.6 Recorder Test (4)

1. Select Room Number 4 and press the NIBP **START** key to activate the test. This test prints out a pattern on the recorder if a recorder module is attached. A strip similar to Figure 5-3 will be printed.

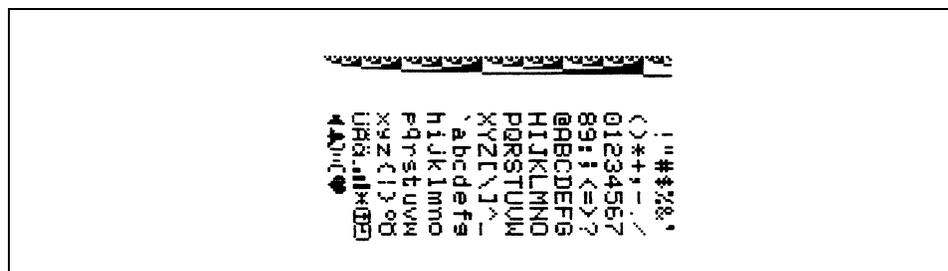


FIGURE 5-3

5.5.7 Pump Test (5)

NOTE: 700 cc dummy cuff must be used.

Select Room Number 5 and press NIBP **START** key to activate the test.

This test evaluates the ability of the pump to pressurize a fixed volume representative of an adult cuff to a typical adult pressure.

A fixed volume of 700 cc is pumped to a pressure of 300 mmHg. While the pump is operational, the elapsed time is displayed in the Timer/Temperature display. When the target pressure is reached, the elapsed time display holds its current reading and the pump deflates the chamber for another test. The test passes if the chamber is inflated in less than 35 seconds. Pressing the **DEFLATE** key at any time *during* the test causes the NIBP module to open all valves to release the pressure, clear the MAP display, and exit the test. Pressing the **DEFLATE** key *after* the test is completed will clear the MAP display and exit the test.

5.5.7.1 Bleed Rate Test (6a, 6b)

NOTE: 700 cc dummy cuff must be used.

Press the NIBP **START** key to activate the selected test. See Table 5-5 on page 5-9.

This test evaluates the ability of the instrument to maintain a constant bleed rate, for the purpose of accurate and repeatable NIBP measurements. This test also evaluates the ability of the system to reduce cuff pressure quickly.

A fixed volume of 700 cc is pumped to approximately 20 mmHg over the specified start pressure (see Table 5-5 on page 5-9), then vented to atmosphere through one of two different valves. During the test, the MAP display indicates the real-time system pressure and the Timer/Temperature display indicates the elapsed time in seconds. When the stop pressure is reached, the MAP display is blanked and the elapsed time displays the current reading. Pressing the **DEFLATE** key deflates the chamber, clears the MAP display, and exits the test. Each test is uniquely identified in the Patient Bed Letter Display as described in Table 5-5 on page 5-9. The table identifies each test, the corresponding start and stop pressures and required completion times.

Table 5-5

TEST DESCRIPTION	START PRESSURE (MMHG)	STOP PRESSURE (MMHG)	TIME (SEC.)	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
Linear Bleed Valve Test	180	60	15-25 secs.	6	a
Dump Valve Test	250	20	14 sec. max.	6	b

5.5.8 Leak Test (7)

NOTE: 700 cc dummy cuff must be used.

Select Room Number 7 and press the NIBP **START** key to activate the test.

This test evaluates the ability of the system to maintain a steady pressure.

A fixed volume is pumped up to an initial differential pressure of approximately 250 mmHg and monitored for a fixed period of time. While the pump is operational, peak pressure is displayed in the MAP display. When the target pump pressure is reached, the peak pressure is frozen in the MAP display during a five second dwell. During leakage measurement, the current pressure leakage is displayed in the MAP display and the elapsed test time (in seconds) is displayed in the Temperature/Time/Interval display. After the leakage measurement time has elapsed, the MAP and Temperature/Time/Interval displays are blanked and a “00” (Pass) or “FF” (Fail) will be displayed in the Bed window. Pressing the **DEFLATE** key at any time *during* the test causes the NIBP module to open all valves to release the pressure, clear the MAP display, and end the test. The maximum pressure drop is no more than 10 mmHg in any 90 second period when connected to a 700 cc volume. Pressing the **DEFLATE** key *after* the test is completed will clear the MAP display and exit the test.

5.5.9 Over Pressure Test (8a, 8b, 8c)

NOTE: 700 cc dummy cuff must be used.

Select Room Number and Bed Letter per Table 5-6 on page 5-10. Press the NIBP **START** key to activate the test.

This test evaluates the ability of the system to prevent an over pressure condition, independent of software control, for each of 3 over pressure settings. A fixed volume of 700 cc's is pumped to a target pressure that is above the maximum over pressure specified for the respective over pressure limit (see Table 5-6 on page 5-10), while displaying the real-time system pressure in the MAP display. For this test, the software over pressure monitor is disabled. On completion, the MAP display indicates the maximum pressure reached and the Patient Bed Letter Display indicates if the over pressure sensor was activated (00) or not (FF). Pressing the **DEFLATE** key at any time during the test causes the NIBP module to open all valves to release the pressure and end the test.

Following each overpressure hardware test, the UUT must be turned off and rebooted in the diagnostic mode in order to re-enable the pump.

Table 5-6

TEST SIZE/MODE	TARGET PUMP PRESSURE (MMHG)	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
Low	157, ±5	8	a
Medium	210, ±10	8	b
High	315, ±15	8	c

5.5.10 Pulse Channel DC Offset Test (9a, 9b, 9c)

Select Room Number and Bed Letter per Table 5-7 on page 5-11, and press the NIBP **START** key to activate the test.

This test measures the DC offset for each of the three electronic gain settings available on the pulse channel. Results for each gain setting are displayed in the Timer/Temperature display (in Volts). Table 5-7 on page 5-11 describes the tests performed.

Press the **DEFLATE** key after each test to exit.

Table 5-7

TEST DESCRIPTION	ACCEPTABLE LIMIT (V)	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
Gain 1 (Low) Test	1.50 to 1.83	9	a
Gain 2 (Med) Test	1.50 to 1.83	9	b
Gain 3 (High) Test	1.50 to 1.83	9	c

5.5.11 Pulse Channel Average Noise Test (10a, 10b, 10c)

Select Room Number and Bed Letter per Table 5-8 on page 5-11, and press the NIBP **START** key to activate the test.

This test measures the average noise for each of three electronic gain settings available on the pulse channel. Results for each gain setting are displayed in the Timer/Temperature display (in millivolts). Table 5-8 on page 5-11 describes the tests performed.

Press the **DEFLATE** key after each test to exit.

Table 5-8

TEST DESCRIPTION	ACCEPTABLE LIMIT (MV)	TEST ROOM NUMBER	SUB TEST PATIENT BED LETTER
Gain 1 (Low) Test	<25	10	a
Gain 2 (Med) Test	<50	10	b
Gain 3 (High) Test	<75	10	c

5.5.12 Main Pressure Transducer Verification Test (11a, 11b, 11c)

NOTE: 700 cc dummy cuff must be used.

This tests the calibration of the main pressure transducer in LOW, MED, and HIGH modes. This is done by comparing the readings of the UUT to an external pressure gauge in LOW mode below 100 mmHg, in MED mode between 100 mmHg to 200 mmHg, and in HIGH mode between 200 mmHg to 300 mmHg. In the event of a disagreement between the device and an external gauge, the transducer must be calibrated by performing the calibration in section 5.5.15 “Main Pressure Transducer Calibration” on page 5-14.

1. Select diagnostic test “11” (Room) “a” (Bed).

2. Press the **START** NIBP key to start the LOW calibration test. Verify that the pump comes on, the pressure increases, and then the pump stops. After 10 seconds, verify that the pressure settles below 100 mmHg. Compare the final pressure displayed to an accurate external pressure gauge. The MAP LEDs reading should agree within $\pm 1\%$ with the external pressure gauge. If it does not agree, a failure has occurred and proceed to section 5.5.15 “Main Pressure Transducer Calibration” on page 5-14.
3. Press the **DEFLATE** key to release the pressure and exit the test.
4. Select diagnostic test “11” (Room) “b” (Bed).
5. Press the **START** NIBP key to start the MED calibration test. Verify that the pump comes on, the pressure increases, and then the pump stops. After 10 seconds, verify that the pressure settles between 100 mmHg and 200 mmHg. Compare the pressure displayed to an accurate external pressure gauge. The pressure MAP LEDs reading should agree within $\pm 1\%$ with the external pressure gauge. If it does not agree, a failure has occurred and proceed to section 5.5.15 “Main Pressure Transducer Calibration” on page 5-14.
6. Press the **DEFLATE** key to release the pressure and exit the test.
7. Select diagnostic test “11” (Room) “c” (Bed).
8. Press the **START** NIBP key to start the HIGH calibration test. Verify that the pump comes on, the pressure increases, and then the pump stops. After 10 seconds, verify that the pressure settles between 200 mmHg and 300 mmHg. Compare the final pressure displayed to an accurate external pressure gauge; the MAP LEDs reading should agree within $\pm 1\%$ with the external pressure gauge. If it does not agree, a failure has occurred and proceed to section 5.5.15 “Main Pressure Transducer Calibration” on page 5-14.
9. Press the **DEFLATE** key to release the pressure and exit the test.

5.5.13 Verification of Accutorr Plus Pneumatic Performance using an NIBP Simulator (11d)

Select Room Number 11 and Bed Letter d, and press the NIBP **START** key to activate the test.

For these tests, program the NIBP simulator to perform the desired test. Instead of pumping up the cuff, this test uses the NIBP simulator to verify the Accutorr Plus pressure reading for the NIBP Leak Test, Over Pressure test, and the Main Pressure Transducer Verification Test. The Accutorr displays the pressure in the MAP display. Pressing the **DEFLATE** key at any time during the test causes the NIBP module to open all valves, clear the MAP display, and exit the test. The NIBP simulator must be exited separately.

NOTE: **The reading and setting accuracy will be dependent on the accuracy of the NIBP simulator and the condition of the Accutorr Plus.**

The NIBP standard dynamic pressure simulation may produce Systolic / Mean / Diastolic read outs on the Accutorr Plus outside of the specified limits. The pressure simulation results may not be accepted as a measure of the Accutorr Plus clinical performance.

5.5.14 Overpressure Transducer Verification <12c, 12a, 12b>

This test verifies that the overpressure transducer is calibrated correctly. Calibration is checked in the Low level pressure mode so that the limit displayed in the MAP window should say 158 mmHg (± 1). If it does not, the transducer needs to be calibrated by proceeding to 5.5.16 “Overpressure Transducer Calibration” on page 5-15. The overpressure transducer should also be verified in the High and Mid level pressure modes.

1. Select diagnostic test “12” (Room) “a” (Bed). Low Limit
2. Press the **START NIBP** key to start the test.
3. Verify that the overpressure value displayed in the MAP LEDs is 158 mmHg (± 1).
4. Repeat steps 1 through 3, but select test “12” “c” to check overpressure limit, 315 mmHg (± 15); and test “12” “b” for Mid level overpressure limit, 210 mmHg (± 10).
5. Press the **DEFLATE** key to exit this test.

5.5.15 Main Pressure Transducer Calibration

NOTE: This procedure should only be performed in the event that there was a failure in 5.5.12 “Main Pressure Transducer Verification Test (11a, 11b, 11c)” on page 5-11.

NOTE: 700 cc dummy cuff must be used.

This is the procedure for calibrating the main pressure transducer in the event that there is a disagreement between the UUT and the external pressure gauge in the proceeding test. The device is calibrated by comparison with the NIBP simulator at 158 mmHg (± 1) and then by adjusting R540 on the 0670-00-0814 PCB (see Figure 5-5).

1. Connect the NIBP simulator to the Accutorr Plus cuff connector, and connect a 700 cc test chamber to the open port of the simulator. Select the manometer function of the simulator.
2. Select diagnostic test “11” (Room) “d” (Bed).
3. Press the **START NIBP** Key to start HIGH calibration procedure.
4. Pump up the NIBP simulator to 158 ± 1 mmHg.
5. Allow pressure to stabilize for 10 seconds. Read the pressure in the MAP display.
6. Adjust R540 on the 0670-00-0814 PCB until the MAP readout is the same as the simulator’s manometer reading.
7. Press the **DEFLATE** key to exit this test.
8. Repeat 5.5.12 “Main Pressure Transducer Verification Test (11a, 11b, 11c)” on page 5-11.

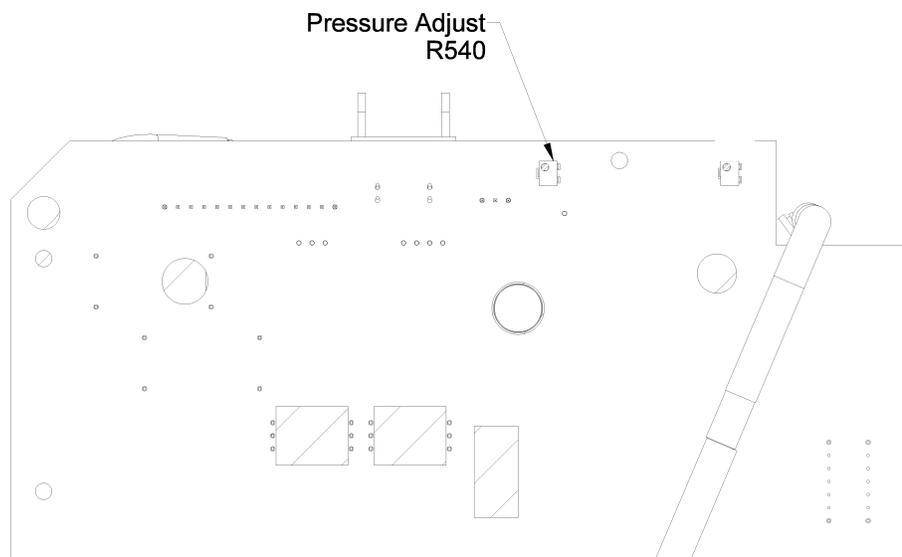


FIGURE 5-4 Pressure Adjust (R540)

5.5.16 Overpressure Transducer Calibration

NOTE: This procedure should only be performed if a failure occurred in steps 1 through 3 of 5.5.14 “Overpressure Transducer Verification <12c, 12a, 12b>” on page 5-13.

This is the procedure for calibrating the overpressure transducer in the event that the display does not read 158 mmHg during the test for Low pressure mode in 5.5.14 “Overpressure Transducer Verification <12c, 12a, 12b>” on page 5-13. The transducer is calibrated using R504 on the 0670-00-0814 PCB (see Figure 5-5).

1. Adjust R504 on the 0670-00-0814 PCB until the MAP readout is 158 mmHg.
2. Repeat 5.5.14 “Overpressure Transducer Verification <12c, 12a, 12b>” on page 5-13.

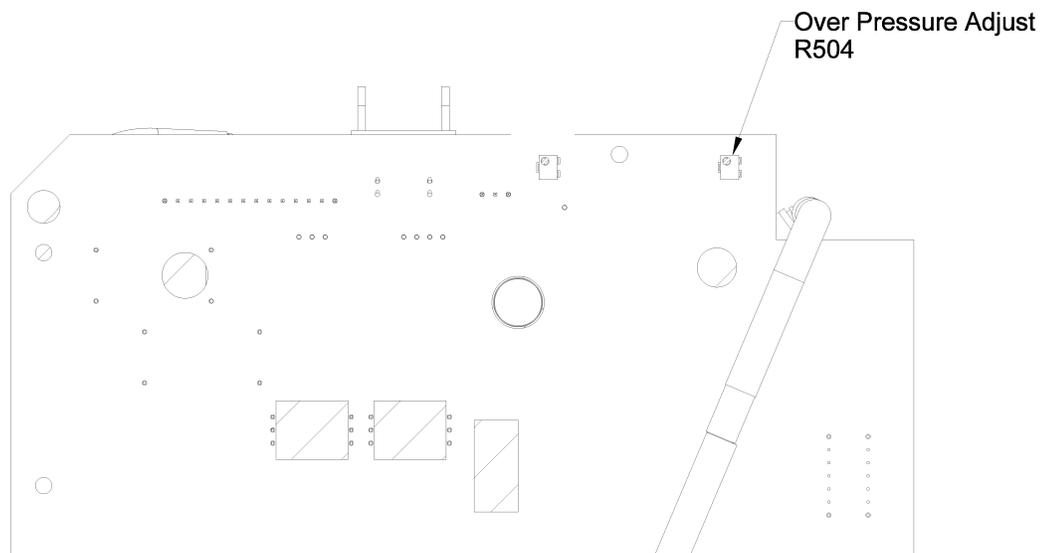


FIGURE 5-5 Overpressure Adjust (R504)

5.6 Predictive Thermometer Verification And Calibration

The Water Bath Method, utilizes laboratory grade stirred water bath to confirm that the PTM is operating within the specified limits.

In case of failure or inaccuracy of readings, the System Calibration Procedure may be followed to re-adjust the device to factory specifications.

This procedure requires high accuracy test equipment and therefore it is not recommended for field calibration. A comprehensive factory service program to support this product is available.

5.6.1 Water Bath Method

1. Prepare a water bath set to 89.6 to 110.0°F as a temperature reference. Confirm temperature with a separate precision thermometer.
2. Snap a protective sheath onto the temperature probe, and immerse into the reference water bath for 30 seconds, or until the temperature display stops flashing. Record the temperature shown on the temperature display.

5.6.2 Temperature Verification Test, Infrared Thermometer (Applicable Only To Units Equipped With A Temperature Option)

1. Pre-heat water bath to 100°F. Place floating Black Body device into water bath and allow to stabilize until step 7, or a minimum of 30 seconds.
2. Prepare the thermometer for the verification process, by removing any disposable probe covers. Clean the probe lens with a swab dipped in alcohol.
3. Completely cover probe tip with a piece of aluminum foil, from the lens to the probe neck portion. Allow 5 minutes for the probe and foil to stabilize at ambient temperature.
4. Activate the thermometer, by pressing the button. Read the ambient temperature displayed and record the number as $T_A = \underline{\quad}$.
5. Remove the aluminum foil.
6. Check the water bath temperature against a laboratory grade mercury thermometer, with a verified accuracy of 0.4 °F (0.2 °C) or better. Record the water bath temperature as $TT = \underline{\quad}$.
7. Attach a disposable probe cover to the thermometer head. Insert the head into the floating Black Body cavity, such that the instrument is looking into the needle shaped end.

8. Press the button to measure the temperature. Record the temperature as $T_{DCALC} = \underline{\hspace{2cm}}$.
9. Select the appropriate correction factor from the following choices:
10. Core temperature correction: $K_{core} = 1.087$
11. Oral temperature correction: $K_{ora} = 1.058$
12. Rectal temperature correction: $K_{rectal} = 1.095$
13. The standard infrared thermometer is calibrated to indicate Core temperature, thus the correction factor to be used is $K = 1.087$.
14. Calculate the display temperature according to the following formula:

$K(T_T - T_A) + T_A = T_{dcalc}$ where:

T_{dcalc} is Calculated Display Temperature.

$K_{core} = 1.087$ Correction Factor for Core Temperature.

T_T is Target Temperature.

T_A is Ambient Temperature.

Sample Calculation:

Ambient temperature (T_A) measured: 72 °F

Water Bath temperature (T_T) measured: 98.6 °F

Correction Factor (K_{core}) = 1.087

$1.087(98.6 - 72) + 72 = 100.9$ °F thus,

Temperature displayed by thermometer is 100.9 °F, and calculated temperature is 100.9 °F, the accuracy has been verified.

Temperature value deviations: The calculated value is a function of the accuracy of the water bath temperature. As an example, a $\pm 1\%$ reading error of water temperature will result in a ± 1 °F reading input into the formula, resulting in a final calculated values of 99.9 to 101.9 °F.

With a display resolution of ± 1 digit and an over all resolution of ± 0.2 °F, the final, calculated reading may fall between 98.6 and 102.2.

5.6.3 Low Battery Sensing

The low battery threshold is not adjustable. When the battery has reached the low battery threshold, the power supply will report this condition to the CPU on the Accutorr Plus.

5.7 Setting the Current Time

1. Press and hold the **TIMER/TEMP** key for 6 seconds. The hour digit only displays.
2. Press the **UP** or **DOWN ARROW** key to change the number.
3. Press the **TIMER/TEMP** key to activate the minute display.

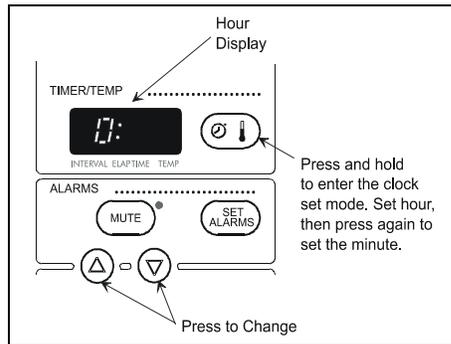


FIGURE 5-6 Hour Display

NOTE: The Accutorr Plus always displays time in a 24 hour format.

4. Press the **UP** or **DOWN ARROW** key (12 or 13) to change the number. Continue pressing the **TIMER/TEMP** key and the **ARROW** keys to set the month, day, and year (in that order).

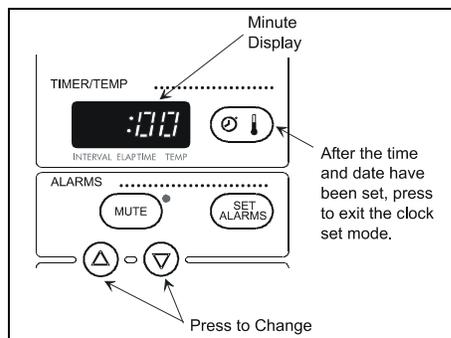


FIGURE 5-7 Minute Display

5.8 NIBP Normal Operation

1. Press the left **ARROW** key on the NIBP simulator to highlight **SELECT BP**, then press the **ENT** key. Set pressure test to 120/80 (90) and press the **ENT** key.
2. Select a NIBP simulation of 120/80 mmHg with a Heart rate of 60 BPM.
3. Attach the NIBP simulator to the input pressure fitting of UUT.
4. Press the **INTERVAL** key of the keypad until a 1 is shown in the Timer/Temp./ Interval LED of the UUT. Press the **PATIENT SIZE** key to select Adult size indicator.
5. Press the Set **ALARMS** key to enter the alarm setting mode. Use the **UP** and **DOWN ARROW** keys to set the Systolic Low alarm to 130 mmHg.
6. Press the Set **ALARMS** key again and set the Diastolic Low Alarm to 95 mmHg.
7. Press the Start **NIBP** key. Verify the monitor takes a measurement and the Systolic and the Diastolic low alarms are violated. The LEDs for these parameters will blink on and off and an alarm tone will sound for the violation. Press the **MUTE** Key to silence the alarms.
8. After the fifth measurement is complete, allow the cuff to pump up. Press **DEFLATE** key. Verify cuff deflates.
9. Review the data that was stored in the database, by scrolling through the patient trend information. Use the **UP** and **DOWN ROOM** and **BED** keys or LED display of the UUT and verify that the Systolic and Diastolic information is available in the LEDs for each stored settings
10. Remove the cuff from the UUT and press the **START** key. Confirm that the UUT pump runs and that it displays 8810 in the Room/Bed window within 60 seconds and attempts another inflation. Press the **DEFLATE** key to stop test.

5.9 Trend Memory Initialization

1. To clear the UUT Trend Memory for all patient settings, press and hold the **DELETE INFO.** key while powering up the unit.

5.10 SpO₂ Normal Operation (Accutorr Plus model with SpO₂)

The purpose of this test is to verify that an SpO₂ signal is recognized, alarm limits are captured and the data is trended. A full operational test may be conducted, if so warranted, within the limits of the published specification. See chapter 3 of this manual for specifications.

1. Set the simulator to an SpO₂ saturation level of 98%, pulse rate of 60 bpm, and a pulse amplitude of 100%.
2. Set the Accutorr Plus SpO₂ HI alarm limit to 95% and the pulse rate HI alarm limit to 55 bpm.
3. Connect an NIBP cuff or a suitable simulator to the Accutorr Plus and start a measurement.
4. Confirm that the Accutorr Plus has determined an SpO₂ saturation level and has violated the SpO₂ HI alarm and the pulse rate HI alarm (flashing digits and alarm tone). Press the **MUTE** key to silence the alarms.
5. Check the trend screen to confirm that the measurement information has been saved.
6. Set the SpO₂ HI alarm to OFF and SpO₂ LOW alarm to 86.
7. Set the simulator to an SpO₂ saturation level of 90%, pulse rate of 95 bpm, and the pulse amplitude to approximately 10% (low perfusion Masimo® SpO₂ only).
8. The Accutorr Plus may intermittently determine SpO₂ values or indicate a status code of 8853 (Pulse Search) or 8854 (Weak Pulse / Low Perfusion will display). Adjust the simulators pulse amplitude up and down until either status code of 8853 or 8854 displays.
9. Restore normal simulation parameters as described in step 1.
10. Remove the sensor from the simulator to induce a status code of 8851 (Sensor Off) (Masimo® SpO₂ only).
11. Disconnect the sensor from the Accutorr Plus to produce a status code of 8850 (No Sensor).