Accutorr® 7/VS-900c

Vital Signs Monitor

Service Manual

AVOBUS EQUIPMENT

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WARNING

- **Federal Law (USA) restricts this device to sale by or on the order of a physician.**

NOTE

- **This manual describes all features and options. The equipment may not have all of them. Contact Mindray service department for any questions.**

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- All installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel; and
- The electrical installation of the relevant room complies with the applicable national and local requirements; and
- This product is operated under strict observance of this manual.

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In the event that it becomes necessary to return a unit to Mindray, follow the instructions below.

1. Obtain a return authorization.

   Contact the Mindray Service Department and obtain a Mindray Customer Service Authorization Number. The Mindray Customer Service Authorization Number must appear on the outside of the shipping container. Return shipments will not be accepted if the Mindray Customer Service Authorization Number is not clearly visible. Please provide the model number, serial number, and a brief description of the reason for return.

2. Freight policy

   The customer is responsible for freight charges when this product is shipped to Mindray for service (including any relevant customs fees or other freight related charges).

3. Return address

   Please send the part(s) or equipment to the address offered by Customer Service Department.

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Preface

Manual Purpose

This manual provides detailed information about the assembling, dissembling, testing and troubleshooting of the equipment to support effective troubleshooting and repair. It is not intended to be a comprehensive, in-depth explanation of the product architecture or technical implementation.

Observance of the manual is a prerequisite for proper equipment maintenance and prevents equipment damage and personnel injury.

Intended Audience

This manual is for biomedical engineers, authorized technicians or service representatives responsible for troubleshooting, repairing and maintaining the equipment.

Passwords

A password may be required to access different modes of the following equipment. The passwords are listed below:

- User maintenance: 888888
- Configuration mode: 315666
- Demo mode : Contact Mindray service personnel for the password
- Factory maintenace: Contact Mindray service personnel for the password

It is recommended that the user should change the passwords for user maintenance and configuration mode once they take ownership of the equipment.

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1 Introduction

1.1 Manual Information

Version	Revision History
1.0	New
2.0	Modify temperature module test method, update parts list
3.0	Modify the Wi-Fi content
4.0	Delete the equipment symbols
5.0	Modify the description of equipment symbols, add the patent information
6.0	Add CO_2 description
7.0	Update parts list for new cleaning and disinfecting agents
8.0	Add VS-900c

1.2 Safety Information

⚠WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, will result in death or serious injury.**

⚠CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.2.1 Warnings

⚠WARNING

- **All installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel.**
- **There is high voltage inside the equipment. Never disassemble the equipment before it is disconnected from the AC power source or the battery.**
- **When you disassemble/reassemble a parameter module, a patient leakage current test must be performed before it is used again for monitoring.**
- **The equipment must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **Disposal of the packaging material should observe the applicable waste control regulations and keeping it out of children's reach.**

1.2.2 Cautions

⚠CAUTION

- **Make sure that no electromagnetic radiation interferes with the performance of the equipment when preparing to carry out performance tests. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the receiver to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the unit's label or in this manual.**
- **Protect the equipment from damage caused by drop, impact, strong vibration or other mechanical force during servicing.**

1.2.3 Notes

NOTE

- **Refer to the operator's manual for detailed operation and other information.**

1.3 Equipment Symbols

See theapplicable Operator's Manual for information about the symbols used on this product and its packaging.

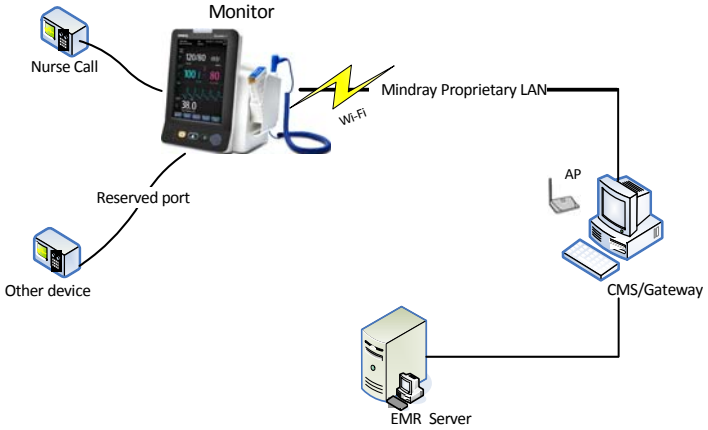
2 Theory of Operation

2.1 Overview

The Monitor is intended for monitoring physiologic parameters, including SpO_2, Pulse Rate, NIBP and Temperature, on adult, pediatric, and neonatal patients in healthcare facilities by clinical physicians or appropriate medical staff under the direction of physicians.

The equipment also:

- Provides audible and visual alarm indications in case of patient or equipment problems;
- Provides display, review, storage and printing of monitored information;
- Incorporates multiple input devices such as buttons, knob, and touchscreen; and,
- Enables program upgrade over the network.



The above figure shows a system consisting of the vital signs monitor and its peripheral devices. The vital signs monitor:

- Can be used for monitoring the physiological parameters, giving alarms and reviewing patient data, etc.
- Supports recorder.
- Supports nurse call function.
- Supports Wi-Fi module, wired network, remote view, and communication with the BeneVision Central Monitoring System (hereinafter called CMS) (only available for the Accutorr 7).
- Supports external AC power source and an internal battery.
- Supports clinical data acquisition: by SD card or by USB drive.

NOTE

- **Wi-Fi module is only available for the Accutorr 7.**

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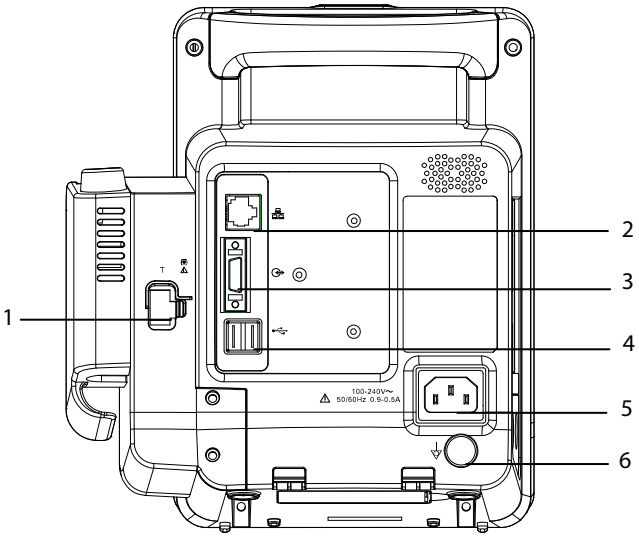
2.2 Connectors for Peripheral Devices



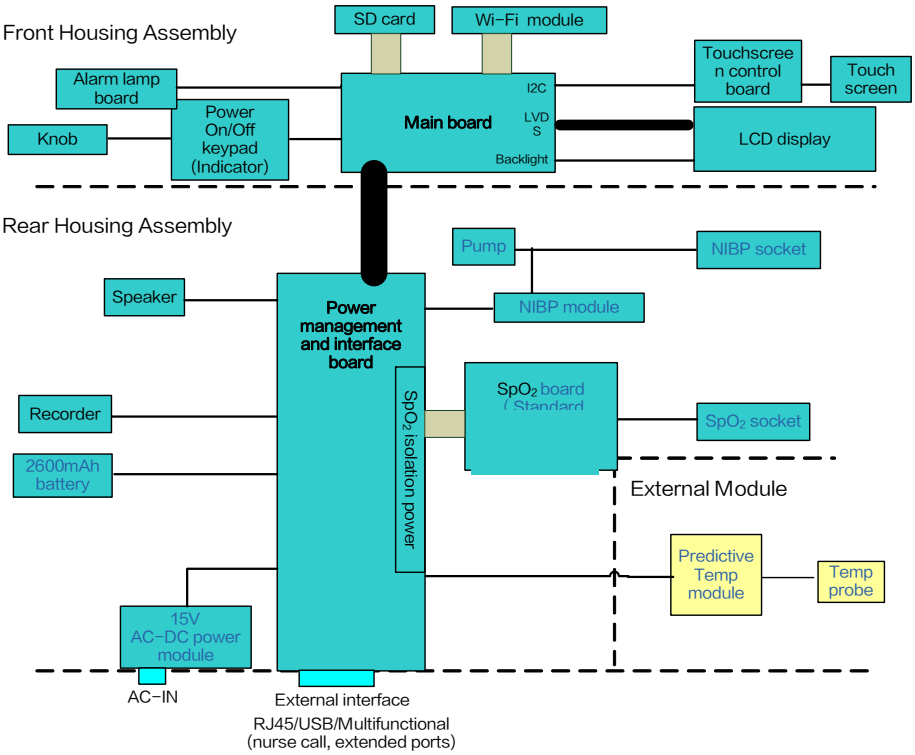
1. Connector for Temperature probe
2. Network connector: It is a standard RJ45 connector used to communicate with external devices, such as central monitoring system, e-Gateway, or used to export data or upgrade the system.
3. Multi-function connector: connects to the hospital's nurse call system, or connects external devices through DIAP protocol.
4. USB connector: connects to barcode scanner or USB disk.
5. AC Power Input
6. Equipotential grounding terminal: When the equipment and other devices are to be used together, their equipotential grounding terminals should be connected together to eliminate the potential difference between them.

2.3 Main Unit

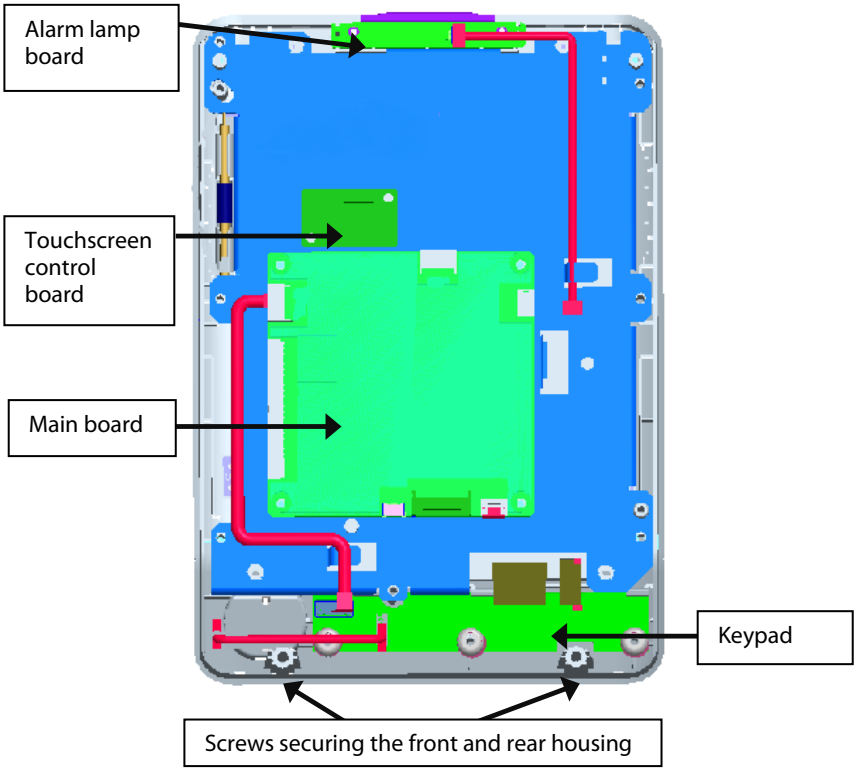
The main unit of the vital signs monitor consists of three parts:

- Front housing assembly: main board, Wi-Fi module (only available for Accutorr 7), keypad board assembly (knob), display, touchscreen, and alarm lamp board.
- Rear housing assembly: power module (AC/DC), power management and interface board (including SpO_2 isolation power), recorder, speaker, battery, NIBP module, and SpO_2 board.
- External module:Temperature module.

The following figure shows the main unit architecture of the vital signs monitor.



2.4 Front Housing Assembly



2.5 Main Board

The main board is the control center of the equipment. It provides communication, display, and data storage functions, including:

- Communication with SpO_2 board, NIBP module, and Temperature module through connector;
- Communication with power management board, keypad board, and recorder through connectors;
- Providing drive for display and backlight;
- Providing 2 USB connectors, a network connector, and a multifunctional connector;
- Communication with touchscreen control board through I2C;
- Providing drive for SD card; and,
- Providing drive for Wi-Fi module(only available for Accutorr 7).

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■

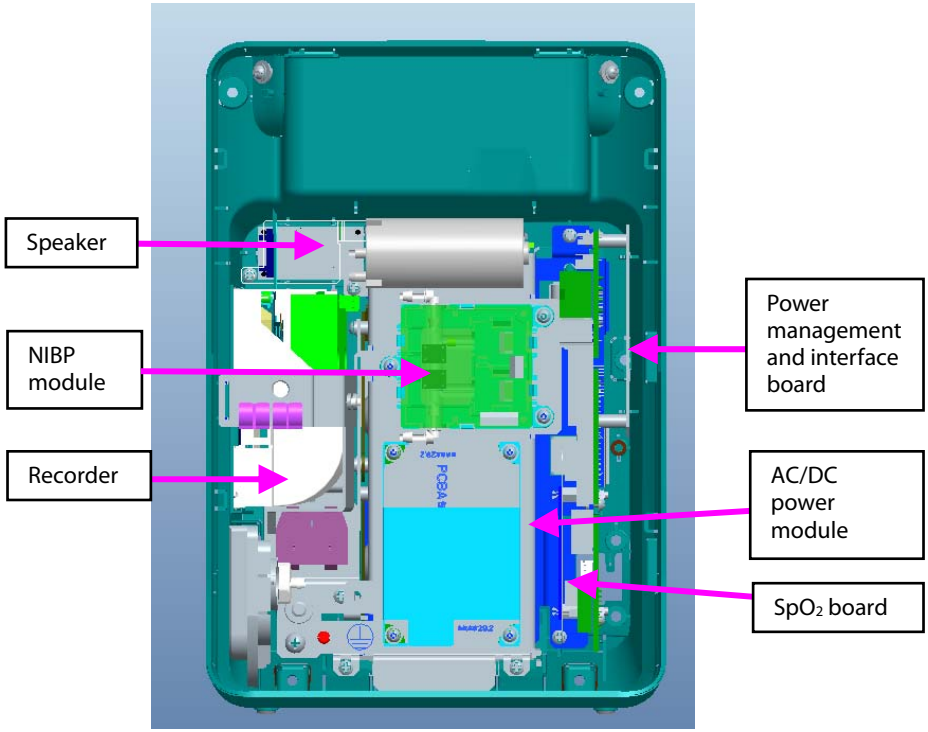
Keypad
The keypad scans and detects the input of keys and encoder, integrates the power on/off key, and connects AC and battery indicators.

Alarm Lamp Board
The alarm lamp board is located at the top of front housing. It has two-color indicators, red and yellow. The alarm lamp board directly connects the main board through a cable. It is controlled directly by the main board.

Touchscreen and Touchscreen Control Board
The touchscreen control board drives the touchscreen and implements communication with the vital signs monitor.

Wi-Fi Module (Optional, Only Available for Accutorr 7)
The Wi-Fi Module enables the equipment to connect to an 802.11 a/b/g/n Mindray proprietary network.

2.6 Rear Housing Assembly



Rear housing assembly consists of power module (AC/DC), power management and interface board (including SpO_2 isolation power), recorder, speaker, battery, NIBP module, and SpO_2 board.

AC/DC Power Module
The AC/DC power board transforms the input AC into DC power, which is the power source for all voltages in the equipment.

Power Management and Interface Board
The power management and interface board provides the following functions:

- Charge and discharge of battery and charge detection;
- DC/DC conversion: outputs 12V and 5V DC power;
- Control over power on/off key and AC, BAT indicator;
- Communication transmission among parameter modules;
- Providing isolation power for SpO_2 module; and,
- Providing external connectors, filter and protection for these connectors.

Recorder
The recorder receives data from the main board and sends them to the thermal printhead for printing.

NIBP Module
The NIBP module consists of blood pressure measurement board and pump and valve assembly, providing measurement acquisition of blood pressure data. The main functions of the NIBP module are:

- NIBP measurement; and,
- Data exchange with the main board.

SpO_2 Board
The SpO_2 board collects SpO_2 signals, processes SpO_2 algorithm and sends measurement results to the main board. The power management interface board provides isolation power for it.

CO_2 Module (Only Available for Accutorr 7)
CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient' airway by measuring the absorption of infrared (IR) light of specific wavelengths. The main functions of the CO_2 module are:

- Provides a CO_2 waveform, and EtCO2, $FiCO_2$, awRR measurement; and
- Data exchange with the main board through the serial ports.

2.7 External Module

An external Temp module can be attached to the monitor.

The independently developed Mindray Temperature module consists of an isolation power board, Temperature measurement board, and probes. The Temperature measurement board collects Temperature signals, processes algorithm and sends measurement results to the main board.

3 Equipment Installation

3.1 Unpacking the Equipment

Open the package and take out the packing list. Check that all the articles included in the packing list are available and the quantity and specification are correct. Make sure that:

- All the optional parts purchased by the customer have been received.
- Notify Mindray North America if your order is incorrect or is incomplete.
- In case of damage during transportation, keep the packing material and notify Mindray North America immediately.
- Keep the packing material until all equipment is checked and accepted.

3.2 Preparation for Installation

3.2.1 Preparation for Installation Site

1. Ensure that the site meets all safety, environmental and power requirements.
2. Ensure that a network connector is available if the equipment needs to be connected to network.

3.2.2 Environmental Requirements

To avoid explosion hazard, do not use the equipment in the presence of flammable anesthetics, vapors or liquids. The environment where the equipment will be used should be reasonably free from vibration, dust and corrosive substances. If these conditions are not met, the system may not function normally.

The environmental specification is as follows:

Main Unit			
Item	**Temperature (℃)**	**Relative humidity (noncondensing)**	**Altitude (mmHg)**
Operating environment	0 to 40 (without Temperature module) 5 to 40 (with Temperature module)	15% to 95%	427.5 to 805.5
Storage environment	-30 to 70	10% to 95%	120.0 to 805.5

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NOTE

- **The environmental specifications of unspecified accessories are the same as those of the main unit.**

3.2.3 Electrical Requirements

Check cables and power cords. Make sure that:

1. System cables, power cords, and power plugs are not damaged, and that the pins are not loose. If damage is noted, discontinue use and replace.
2. Patient cables and connections are secure.

WARNING

- **Use only properly grounded power outlets.**
- **Use the supplied power cord only!**

Voltage	100 to 240V AC
Current	0.9 to 0.5A
Frequency	50/60 Hz

3.3 Equipment Installation

Follow the procedure below to install the equipment:

1. Ensure the unit and accessories are not damaged.
2. Install the battery (optional). For detailed operations, please refer to the operator's manual.
3. Connect AC power.
4. Connect the accessories.

Installation Support

The vital signs monitor can be mounted on a wall bracket or on a rolling stand. The wall bracket or rolling stand can be ordered optionally. Each type of mounting bracket is delivered with a complete set of mounting hardware and instructions. For detailed installation information, please refer to ***Wall-mount Bracket Instructions for Use (PN: 0010-20-42933)*** and ***Rollstand Instructions for Use (PN: 0010-20-42934***).

CAUTION

- **Use only Mindray supplied or approved mounting solutions.**
- **The mounting bracket should be installed by qualified service personnel.**

3.3.1 Preparation for Power on

1. Before using the equipment, check for any mechanical damage and make sure that all external cables, plug-ins and accessories are properly connected.
2. Plug the power cord into the AC power source. If you run the equipment on battery power, ensure that the battery is sufficiently charged.
3. Press the Power ON/OFF button ( ) on the front panel to turn on the equipment.

FOR YOUR NOTES

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4 Testing and Maintenance

4.1 Introduction

The expected service life of the equipment is five years. To ensure the equipment always functions normally, qualified service personnel should perform regular inspection, maintenance and test. This chapter provides a checklist of the testing procedures for the equipment with recommended test equipment and frequency. The service personnel should perform the testing and maintenance procedures as required and use appropriate test equipment.

The testing procedures provided in this chapter are intended to verify that the equipment meets the performance specifications. If the equipment or a module fails to perform as specified in any test, repairs or replacements must be done to correct the problem. If you have any question, contact our Technical Support Department.

⚠CAUTION

- **All tests should be performed by qualified service personnel only.**
- **Care should be taken to avoid changing the settings in [User Settings >>] and [Factory Maintenance >>] menus to avoid loss of data.**
- **Service personnel should acquaint themselves with the test tools and make sure that test tools and cables are available.**

4.2 Performance Tests

Performance test are designed to ensure that measurement results are accurate. The following sections provide a list of performance and accuracy tests and their recommended frequencies.

4.2.1 Performance Test Frequencies

Check/Maintenance Item		Frequency
Visual inspection		1. When first installed or reinstalled.
SpO_2test		1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. Every two years. Note: Per year is recommended for NIBP and CO_2 tests.
NIBP test	Leakage test	
	Accuracy test	
	NIBP cuff overpressure test	
CO_2 test (Accutorr 7 only)	Performance test	
	Calibration	
TEMP test		

4.2.2 Visual Inspection

Perform an overall inspection on the appearance of the equipment. The test is passed if the equipment has no obvious signs of damage. Follow these guidelines when inspecting the equipment:

- Carefully inspect the case, display screen, buttons, and knob for obvious signs of damage.
- Inspect all external connections for loose connectors, bent pins or frayed cables.
- Inspect all connectors on the equipment for loose connectors or bent pins.
- Make sure that safety labels and data plates on the equipment are clearly legible.

4.2.3 SpO_2 test

Test Method 1

Tool required:

- None

Test procedure:

1. Connect SpO_2 sensor for adult to the SpO_2 connector of the monitor. Set [**Patient Category**] to [**Adult**].
2. Place the SpO_2 sensor on your finger.
3. Verify the Pleth Wave and Pulse Rate are displayed on the screen.
4. Remove the SpO_2 sensor from your finger and make sure that the SpO_2 Sensor Off alarm is triggered.

Measurement validation

The SpO_2 accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed, and only about two-thirds of the measurements can be expected to fall within the specified accuracy compared to CO-oximeter measurements.

NOTE

- **The SpO2 simulator can only be used to verify that the pulse oximeter operates properly. It cannot be used to verify the accuracy of the pulse oximeter or the SpO2 sensor. To verify the accuracy, clinical tests are required.**

Test Method 2

Tool required:

- SpO_2 simulator, Index-2 recommended

Test procedure:

1. Connect the SpO_2 sensor to the SpO_2 simulator.
2. Selected the model and manufacturer of the SpO_2 module to be tested on the simulator, and set the simulator as follows: SpO_2 to 96% and Pulse Rate to 80 bmp.

3. Set the patient type to [**Adult**], [**Pediatric**], and [Neonatal] respectively. Observe the monitor and make sure the displayed SpO_2 and Pulse Rate value fall in the following range.

Manufacturer	SpO_2	Pulse Rate
Nellcor	96% ± 2% (Adult, pediatric) 96% ± 3% (Neonate)	80 ± 3 bpm
Masimo	96% ± 2% (Adult, pediatric) 96% ± 3% (Neonate)	80 ± 3 bpm

4.2.4 NIBP Test

Leakage Test

NOTE

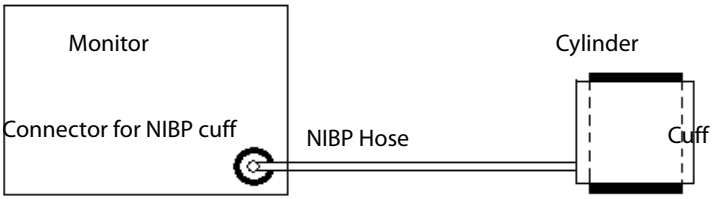
- **Perform NIBP leakage test before any other NIBP test and calibration.**

Tools required:

- Adult NIBP Cuff
- NIBP Hose
- Cylinder

Follow this procedure to perform the leakage test:

1. In the [**Patient Demographics**] menu, set [**Patient Category**] to [**Adult**].
2. Connect the NIBP cuff to the NIBP connector on the monitor.
3. Apply the cuff to the cylinder as shown below.



4. Select [**Main**]→[**Maintenance >>**]→[**User Settings>>**]→Enter required password→→[**Module Maintenance >>**]→[**NIBP Leakage Test**]. The message [**Leakage Testing…**] is displayed in the NIBP parameter area.

After about 20 seconds, the monitor will automatically deflate. This means the test is complete. If no message is displayed in the NIBP parameter area, it indicates that the system has no leakage. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the system may have a leak. Check the tubing and connections for leakages. Ensure that the tubing and connections are all correct, perform a leakage test again. If the problem persists, Support Department.

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You may also perform a manual leakage test:

1. Perform steps 1 to 4 in the NIBP Accuracy Test section.
2. Raise the pressure in the rigid vessel to 250 mmHg with the manometer bulb. Then, wait for 5 seconds to allow the pressure to stabilize.
3. Record the current pressure value, wait 60 seconds and record the pressure again.
4. Compare the two pressure values and verify the difference is 6mmHg or less.

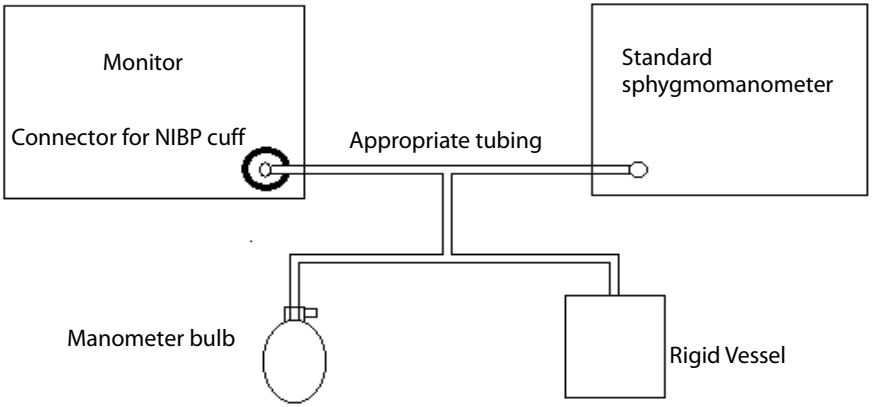
NIBP Accuracy Test

Tool required:

- T-shape connector
- Appropriate tubing
- Manometer bulb
- Rigid Vessel with volume 500 ± 25 ml
- Reference manometer (calibrated with accuracy equal to or better than 0.75 mmHg)

Follow this procedure to perform the accuracy test:

1. Connect the equipment as shown below.



2. Before inflation, check that the reading of the manometer is 0. If not, turn off the manometer bulb to let the whole airway open to the atmosphere. Turn on the manometer bulb after the reading is 0.
3. Select [**Main**]→[**Maintenance >>**]→[**User Settings>>**]→Enter required password→[**Module Maintenance >>**]→[**NIBP Accuracy Test**].
4. Check the manometer values and the monitor values. Both should be 0 mmHg.
5. Raise the pressure in the rigid vessel to 50 mmHg with the manometer bulb. Then, wait for 10 seconds to let the measured values become stable.
6. Compare the manometer values with the monitor values. The difference between the manometer and displayed values should be ± 3 mmHg. If it is greater than ± 3 mmHg, contact Mindray Technical Support.

7. Raise the pressure in the rigid vessel to 200 mmHg with the manometer bulb. Then, wait for 10 seconds to let the measured values become stable. Repeat step 6.

NOTE

- **You can use an NIBP simulator to replace the manometer bulb and the reference manometer to perform the test.**

NIBP Cuff Overpressure Test
Tools required:

- T-shape connector
- Appropriate tubing
- Manometer bulb
- Metal Vessel with volume 500 ± 25 ml
- Reference manometer (calibrated, with accuracy equal to or better than 0.75 mmHg)

Follow this procedure to perform the calibration:

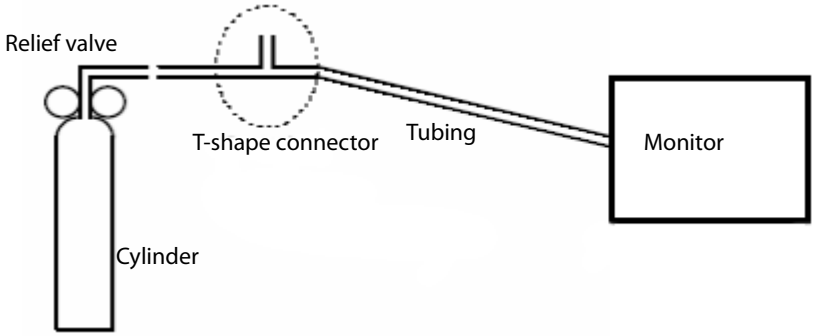
1. Perform steps 1 to 4 in the NIBP Accuracy Test section.
2. Select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Calibrate NIBP >>**]→[**Overpressure Protection Circuit**].
3. In [**Overpressure Protection Circuit**] menu, set [**Patient Category**] to [**Adu/Ped**]. Raise the pressure to 330 mmHg. After the pressure value is stabilized, select [**Calibrate**] to start calibration.
4. In the [**Overpressure Protection Circuit**] menu, set [**Patient Category**] to [**Neonatal**]. Raise the pressure to 165 mmHg. When the pressure value is stabilized, select [**Calibrate**] to start calibration.
5. All calibration results are displayed in the [**Calibrate NIBP**] menu. If the calibration fails, check the test system for leakage and perform another calibration.

4.2.5 CO_2 Test (Only Available For Accutorr 7)

Accuracy Test
Tools required:

- A steel gas cylinder with 5% CO_2, 21% O_2, and balance gas N_2 (P/N 0075-00-0033-01)
- T-shape connector
- Tubing

1. Select **[Main]**→ [**Maintenance >>**]→[**User Maintenance>>**]→enter the required password→ [**Module Maintenance>>**]→[**Calibrate CO2>>**]
2. Connect the test system as follows:



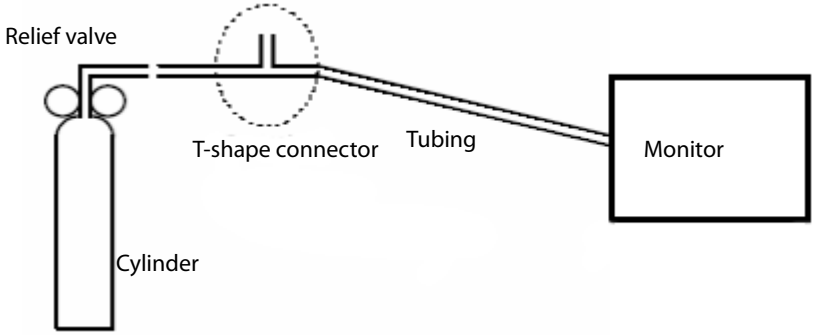
3. Open the valve to start flowing CO_2 and make sure that there is sufficient flow to vent to atmosphere.
4. Verify the realtime CO_2 value is within 5.0 ± 0.3% in the [**Calibrate CO2**] menu.

CO2 Calibration

Tools required:

- A steel gas cylinder with 5% CO_2, 21% O_2, and balance gas N_2 (P/N 0075-00-0033-01)
- T-shape connector
- Tubing

1. Select [**Main**]→ [**Maintenance >>**]→[**User Maintenance>>**]→enter the required password→ [**Module Maintenance>>**]→[**Calibrate CO2>>**].
2. In the [**Calibrate CO2**] menu, select [**Zero**].
3. After the zero calibration is finished successfully, connect the equipment as follows:



4. Open the valve to start flowing CO_2 and make sure that there is sufficient flow to vent to atmosphere.
5. In the [**Calibrate CO2**] menu, enter the CO_2 concentration in the [**CO2**] field.

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6. In the [**Calibrate CO2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO2**] to calibrate the CO_2 module.

If the calibration is completed successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO2**] menu. If the calibration fails, the message [**Calibration Failed**] is displayed. In this case, attempt to calibrate the CO_2 module again.

4.2.6 Temperature Test

Required Tool:

- Thermostatic oil tank (HART 7102 recommended) or Water Bath and Precision Thermometer for reference

Test procedure:

1. Set the temperature of the oil tank or water bath to 37°C and conduct the test after the temperature stabilizes.
2. Set temperature unit to °C.
3. Select temperature parameter area to access [**Temp Setup**] menu, and then set temperature type to [**Monitor**].
4. In Monitor Mode, remove the Temperature probe from the probe sheath, insert a probe cover, and place the probe into the oil tank or water bath.
5. Wait till the Temp value displayed on the monitor stabilizes. Verify that the displayed value is ±0.1°C of the oil bath thermostat setting or reference thermometer.

Contact our Technical Support Department if the Temperature test fails.

NOTE

- **Due to the different application environment and the test object in vivo and vitro conditions, there are deviations in the measurement result. The maximum deviation of 2.5℃ may exist in predictive Temperature measurement by liquid bath techniques.**

4.3 Electrical Safety and Other Tests

4.3.1 Electrical Safety and Other Test Frequencies

Check/Maintenance Item		Frequency
Electric Safety Tests		1. Following any repair or replacement of any module 2. If monitor is physically damaged. 3. Every two years. For details, refer to ***A*** Electrical Safety Inspection**.**
Power-on test		1. When first installed or reinstalled. 2. Following any repairs or replacement of any main unit parts.
Touchscreen calibration		1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
Bar code scanner test		Following any repair or replacement of the bar code scanner.
Battery check	Functional test	1. When first installed. 2. Whenever a battery is replaced.
	Performance test	Once per year or if the battery run time reduced significantly.
Nurse call function test		If the user suspects that the nurse call function does not work well.

4.3.2 Electric Safety Tests

See Appendix ***A*** Electrical Safety Inspection for electrical safety tests.

4.3.3 Power-on Test

This test is to verify that the equipment can power up correctly. This test is passed if the equipment starts up by following this procedure:

1. Insert the battery in the battery compartment, and connect the equipment to the AC mains. The AC mains indicator and battery indicator light up.
2. Press the Power ON/OFF button ( ) on the front panel to turn on the equipment. The work status indicator lights up inside the Power ON/OFF button.
3. The equipment gives a beep, which indicates that the selftest for alarm audio is passed, and the alarm lamp turns yellow, then red, and then off, which indicates that the selftest for alarm lamp has passed.
4. The welcome screen clears and the normal operation screen is displayed.

4.3.4 Touchscreen Calibration

Tool required:

- None

Test procedure:

1. Select [**Main**]→[**Maintenance >>**]→[**Calibrate Touchscreen**].
2. The symbol will appear at different positions of the screen.
3. Select, in turn, the central point of the symbol.
4. After the calibration is completed, the message [**Screen Calibration Completed!**]. Select [**Ok**] to confirm the completion of calibration.

4.3.5 Recorder check

Tool required:

- None

Test procedure:

1. Print SpO_2 Pleth waveform. The recorder should print correctly and the printout should be clear.
2. Remove the paper from the recorder then try to print and verify that an error message (recorder out of paper) appears. Reinstall the paper and verify the recorder functions properly.
3. Set the recorder to print trend data. Verify the recorder prints trends correctly.

Contact our Technical Support Department if the recorder test fails.

4.3.6 Bar Code Scanner Test

Tool required:

- None

Test procedure:

1. Aim the bar code scanner at the target bar code. Adjust the field of view to capture the bar code.
2. Hold the trigger until the bar code scanner gives a beep, indicating the bar code is successfully decoded. Meanwhile, the scanned characters are displayed on the monitor.

Please contact our service personnel if the bar code scanner fails to work normally.

4.3.7 Battery Check

Tool required:

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Functional Test

1. Remove the battery (if equipped), then connect the equipment to AC power.
2. Verify that the equipment works correctly when powered form an AC source.
3. Disconnect AC power and reinstall the battery.
4. Verify the equipment functions properly on battery power.

Performance Test

Run the equipment on battery power and verify it performs in accordance to the specifications stated in the Battery chapter in the operator's manual (P/N: 046-004882-00 or P/N: 046-013024-00).

4.3.8 Nurse Call Reply Performance Test

Tool required:

- Oscilloscope

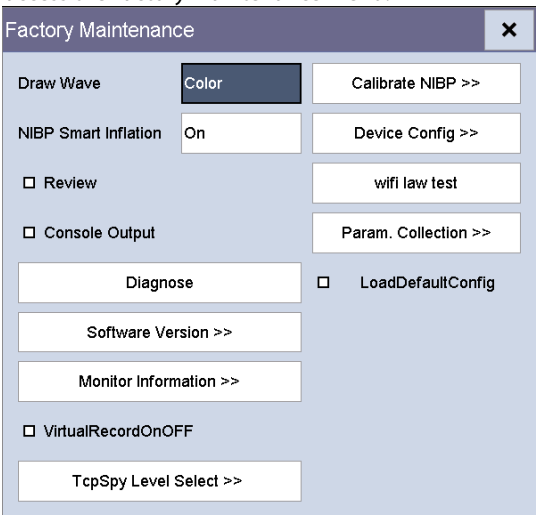
Test procedure:

1. Connect the nurse call cable to the Multi-function connector on the rear panel.
2. Select [**Main**]→[**Maintenance >>**]→[**User Settings >>**]→enter the required password→[**Ok**]→[**Nurse Call >>**].
3. In the [**Nurse Call Setup**] menu, select the [**Alarm Level**] and [**Alarm Category**], and set [**Contact Type**] to [Normally Open, and [**Signal Type**] to [**Continuous**].
4. Click × to save the changes and quit the menu.
5. Select [**Main**]→[**Maintenance >>**]→[**Demo >>**]→enter the required password→[**Ok**] to enter demo mode.
6. Make the monitor to generate an alarm and check that the oscilloscope outputs continuous high level when there is an alarm.
7. Quit the demo mode, and repeat step 2.
8. In the [**Nurse Call Setup**] menu, select the [**Alarm Level**] and [**Alarm Category**], and set [**Contact Type**] to [**Normally Open]**, and [**Signal Type**] to [**Pulse**].
9. Repeat steps 4 and 5.
10. Create an alarm condition and verify that the oscilloscope displays positive pulses of 1 second width when there is an alarm.

4.4 Factory Maintenance

4.4.1 Accessing Factory Maintenance Menu

Select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Ok**] to access the Factory Maintenance menu.



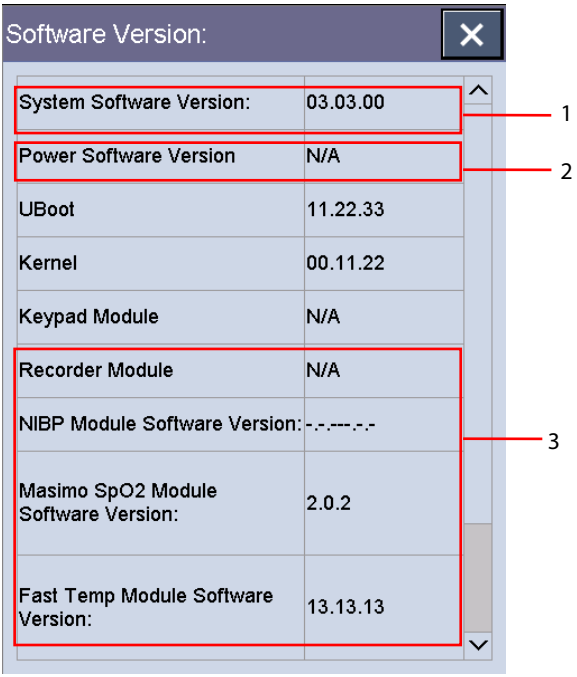
4.4.2 Drawing Waves

There are two methods for drawing waves: [**Color**] and [**Mono**].

- Color: selecting Color will have smoother waveforms.
- Mono: selecting Mono will have a wider viewing angle.

4.4.3 Software Version

Selecting the [**Software Version** >>] will show software version information, as shown below:



1. System software version
2. Power software version
3. Module software version

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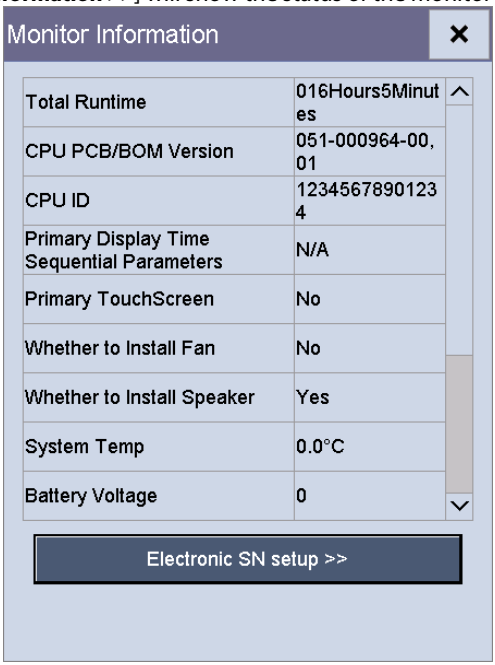
4.4.4 Monitor Information

Selecting [**Monitor Information >>**] will show the status of the monitor as shown below:



NOTE

- **If the main board is replaced, the serial number of the monitor must be entered on the new main board in the Electronic SN Setup menu.**

FOR YOUR NOTES

5 Troubleshooting

5.1 Overview

In this chapter, equipment problems are listed along with possible causes and recommended corrective actions. Refer to the tables to check the monitor, identify and correct problems.

The tables provided are meant as a general guide. For more detailed troubleshooting assistance, contact our Technical Support Department.

5.2 Part Replacement

Printed circuit boards (PCBs), major parts and components in the monitor are replaceable. Once you isolate a PCB you suspect defective, follow the instructions in chapter 6 Disassembly and Repair to replace the PCB with a known good one and check that the trouble disappears or the equipment passes all performance tests.

To obtain information on replacement parts or order them, refer to chapter 7 Parts.

5.3 Checking Equipment Status

Some troubleshooting tasks may require you to identify the hardware version and status of your monitor. To check equipment status:

1. Select [**Main**]→[**Maintenance >>**]→[**Monitor Information >>**]. Then you can view the information on system start time, selfcheck, etc.
2. Select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Ok**]→[**Monitor Information >>**]. You can also view the information on the monitor's current status.

5.4 Checking Software Version

Some troubleshooting may involve software compatibility. Thus it requires you to know your monitor configuration and software version. For detailed information on version compatibility, please contact our Customer Service Department. To view information on the system configuration and system software version,

Select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→Enter the required password→[**Ok**]→[**Software Version >>**]. You can also view the information on system software version and module software version.

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5.5 Checking Technical Alarms

Before troubleshooting the monitor, check for technical alarm messages. Correct all Technical Alarms before continuing.

For detailed information on technical alarm message, possible cause and corrective action, refer to the monitor's operation manual.

5.6 Troubleshooting Guide

5.6.1 Power On/Off Failure

Symptoms	Possible Cause	Troubleshooting
The monitor fails to start.	AC mains not connected or battery too low	Check that AC mains is properly connected or battery capacity is sufficient.
	Cable defective	1. Check that the cable between the keypad board and main board is correctly connected. 2. Check that the cable between the power board and power management board is correctly connected. 3. Check that the cable between the main board and power management board is correctly connected.
	Power board defective	Replace the power board.
	Power management board defective	Replace the power management board.
	The main board failed.	Replace the main board.

5.6.2 Display Failures

Symptoms	Possible Cause	Troubleshooting
The display is blank or black.	Cable defective	1. Check if the cable between the display and main board and the backlight cable are correctly connected. 2. Check that the cables and connectors are not damaged.
	Main board defective	Replace the main board.
	Display defective	Replace the display.
Images overlapped or distorted	Main board error	Replace the main board, or upgrade the main board with the upgrade software.
	Cable defective	Check if the cable between the display and main board and the backlight cable are correctly connected.
Touchscreen does not respond.	Touchscreen disabled	Check if there is a symbol displayed above the [**Main**] quickkey. If yes, press and hold the [**Main Menu**] quickkey for more than 3 seconds to enable the touchscreen.
	Cable defective	1. Check that the cable between the touchscreen and touchscreen control board is correctly connected. 2. Check that the cable between the touchscreen control board and main board is correctly connected.
	Touchscreen control board defective	Replace the touchscreen control board.
	Touchscreen defective	Replace the touchscreen.
	The main board failed.	Replace the main board.
Touch position invalid	Touchscreen not calibrated	Calibrate the touchscreen.

5.6.3 Alarm Lamp Failures

Symptoms	Possible Cause	Troubleshooting
The Alarm Lamp does not illuminate properly or not at all.	Cable defective	1. Check that the cable between the alarm lamp board and main board is correctly connected. 2. Check that the cables and connectors are not damaged.
	Alarm lamp board defective	Replace the alarm lamp board
	The main board failed.	Replace the main board.

5.6.4 Button and Encoder Failures

Symptoms	Possible Cause	Troubleshooting
Buttons do not work	Cable defective	Check that the cable between the keypad board and main board is correctly connected.
	Keypad board failure	Replace the keypad board.
Encoder does not work	Cable defective	1. Check that the cable between the knob and keypad board is correctly connected. 2. Check that the cable between the keypad board and main board is correctly connected.
	Knob failure	Replace the encoder.
	Keypad board failure	Replace the keypad board.

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5.6.5 Sound Failures

Symptoms	Possible Cause	Troubleshooting
No hardkey or encoder sound, or hardkey or encoder sound abnormal	The key volume is set to 0.	Select [**Main**]→[**General Setup >>**] to adjust the key volume.
	Cable defective	Check that the cable between the speaker and interface board is properly connected.
	Speaker defective	Replace the speaker.
	The main board failed.	Replace the main board.
	Power management board defective	Replace the power management board.
No alarm sound or alarm sound abnormal	The alarm volume is set to 0.	Select [**Main**]→[**Maintenance >>**]→]**User Settings >>**]→enter the required password→[**Ok**]→[**Alarm Setup >>**] and set the [**Minimum Alarm Volume**] to a proper level in the prompt menu. Select [**Main**]→[**General Setup >>**] to adjust the key volume.
	Cable defective	1. Check that the cable between the speaker and interface board is properly connected.
	Speaker defective	Replace the speaker.
	The main board failed.	Replace the main board.
	Power management board defective	Replace the power management board.

5.6.6 Battery Failures

Symptoms	Possible Cause	Troubleshooting
Battery cannot be charged	Battery defective	Replace the battery.
	Cable defective	Check that the cable between the battery interface board and power management board is correctly connected.
	Power management board defective	Replace the power management board.
	Battery interface board defective	Replace the battery interface board.

NOTE

- **If the Battery Module fails, it may affect other modules or boards in the main unit.**
- **Components of the main unit are powered by the power module. In the event that a component malfunctions, check if the operating voltage is correct.**

5.6.7 Recorder Failures

Symptoms	Possible Cause	Troubleshooting
No printout	Recorder module disabled	1. Check if the recorder status indicator lights. 2. If yes, select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Ok**]→[**Device Config. >>**] and check the recorder box in the prompt menu to enable the recorder. Otherwise, check for other possible causes.
	Paper reversed	Re-install the paper roll.
	Cable defective	Check that the cable between the recorder and main board is correctly connected.
	Recorder defective	Replace the recorder.
Poor print quality or paper not feeding properly	Paper roll not properly installed	Stop the recorder and re-install the paper roll.
	Print head dirty	1. Check the thermal print head and the paper roller for foreign matter. 2. Clean the thermal print head with an appropriate cleaning solution such as contact cleaner or isopropal alcohol.
	Recorder defective	Replace the recorder.

5.6.8 Output Interface Failure

Symptoms	Possible Cause	Troubleshooting
Unable to use the USB devices; USB drive data transfer failure	Cable defective	1. Check that the cable between the power management board and main board is correctly connected. 2. Check that the cable between power management board and interface board is correctly connected.
	The connector board failed.	Replace the connector board.
	Power management board defective	Replace the power management board.
	The main board failed.	Replace the main board.
	Improper setup	Select [**Main**]→ [**Transfer Data to USB**]

5.6.9 Data Storage Failure

Symptoms	Possible Cause	Troubleshooting
Fails to review archived patient data	Abnormal patient admitting	Admit the patient properly.
	SD card full; unavailable for more patient data	Delete uneeded patient data, clear the related alarm, and readmit the patient.
	The main board failed.	Replace the main board.
SD card failure	SD card not formatted	Format the SD card.
	SD card failure	Replace the SD card.
	SD card is locked	Unlock the SD card.
	Main board defective	Replace the main board.

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5.6.10 Wired Network Related Problems

Symptoms	Possible Cause	Troubleshooting
Unable to connect the wired network	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 meters.
	Incorrect IP address configuration	Check for IP address conflict. If yes, reconfigure the IP address.
	Cable defective	1. Check that the cable between the power management board and main board is correctly connected. 2. Check that the cable between power management board and interface board is correctly connected.
	The connector board failed.	Replace the connector board.
	Power management board defective	Replace the power management board.
	The main board failed.	Replace the main board.
The monitor is frequently off line or disconnects from the network.	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 meters.
The monitor is connected to a LAN but cannot view other patients under the View Others mode	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 meters.
	Excessive requests for viewing the monitor at the same time	A monitor can only be viewed by four other monitors at the same time under the View Others mode. The excessive view requests system will be ignored.
	Incorrect IP address configuration	Check for IP address conflict. If yes, reconfigure the IP address.

5.6.11 Wi-Fi Related Problems (Only Available for Accutorr 7)

Symptoms	Possible Cause	Troubleshooting
The monitor is frequently off line or disconnects from the Wi-Fi network.	The Wi-Fi signal is unstable in the operating area.	Check the signal quality of the Mindray Wi-Fi network.
	The monitor's Wi-Fi antenna is detached or not properly connects the Wi-Fi module.	Disassemble the monitor and fix the Wi-Fi antenna.
	Antenna damaged	Replace the Wi-Fi antenna.
	Wi-Fi module defective	Replace the Wi-Fi module.
Unable to connect the Wi-Fi network.	Incorrect IP address configuration	Check for IP address conflict. If yes, reconfigure the IP address.
	The Wi-Fi signal is unstable in the operating area.	Check the signal quality of the Mindray Wi-Fi network.
	The monitor's Wi-Fi antenna is detached or not connected to the Wi-Fi module.	Fix the Wi-Fi antenna.
	Antenna damaged	Replace the Wi-Fi antenna.
	Wi-Fi module defective	Replace the Wi-Fi module.
	Main board defective	Replace the main board.

5.6.12 Module defective

Symptoms	Possible Cause	Troubleshooting
Failed to connect the external parameter modules	Module defective	1. Check that the cable between the external converter board inside the module and the converter board is correctly connected. 2. Replace the converter board.
	Main unit defective	1. Check that the cable between the main board and power management board is correctly connected. 2. Replace the power management board. 3. Replace the main board.
Module can be loaded, but "XX communication	Cable defective inside the module	Check the cables connecting the converter board and corresponding parameter module.

Symptoms	Possible Cause	Troubleshooting
stopped" is reported or some parameters cannot be used	Parameter module defective	Replace the corresponding module.
	Converter board defective inside the module	Replace corresponding converter board.

"XX" indicates the configured modules, such as NIBP, SpO2 and Temperature.

5.6.13 CO_2 Module Problems (Only Available for Accutorr 7)

Symptoms	Possible Cause	Troubleshooting
CO_2 Sensor High Temp	Ambient temperature is too high or there is a module failure.	Lower the operating temperature. If the alarm persists, the CO_2 module may have a failure. Change the CO_2 module.
CO_2 Zero Failed	The zeroing failed.	Wait for the next successful zeroing, or repower the module.
CO_2 No Filterline	The mini water trap disconnected.	Make sure that the mini watertrap and sampling line is connected.
CO_2 FilterLine Occluded	The airway or mini water tarp is occluded.	Check the airway and remove the occlusion.
CO_2 frequently zeroes during the first hour after start-up.	The CO_2 module temperature is not stable.	No action is required. The zeroing does not affect measurement accuracy. The zeroing frequency will decrease over time.

5.6.14 Technical Alarm Messages

Please refer to the operator's manual.

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6 Disassembly and Repair

6.1 Tools Required

To disassemble and replace the parts and components, the following tools may be required:

- Philips screwdrivers
- Tweezers
- Sharp nose pliers
- Clamp
- Slot-type screwdriver

6.2 Preparations for Disassembly

Before disassembling the equipment, finish the following preparations:

- Stop monitoring, turn off the equipment, and disconnect all the accessories and peripheral devices.
- Disconnect the AC power source and remove the battery.

⚠ WARNING

- **Before disassembling the equipment, be sure to eliminate the static charges first. When disassembling the parts labeled with static-sensitive symbols, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**
- **Properly connect and route the cables and wires when reassembling the equipment to avoid short circuit.**
- **Follow correct sequence to disassembly the equipment. Otherwise, the equipment may be damaged permanently.**
- **Be sure to disconnect all the cables before disassembling any parts. Be sure not to damage any cables or connectors.**
- **Place the screws and parts from the same module together to facilitate reassembling.**
- **Use care during reassembly to ensure cables are properly routed and all gaskets are intact and correctly positioned.**

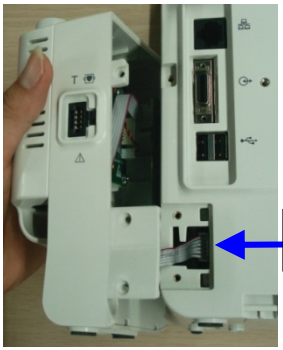
6.3 Disassembling the Main Unit

NOTE

- **The recorder can be disassembled separately.**
- **To disassemble the equipment, place the equipment on a work surface free from foreign material, avoiding damaging the antiglare screen, touchscreen and the knob. Be careful not to break the two cotters on the front ends of rear housing.**
- **All repairs should be performed in an anti-static environment by qualified service personnel.**

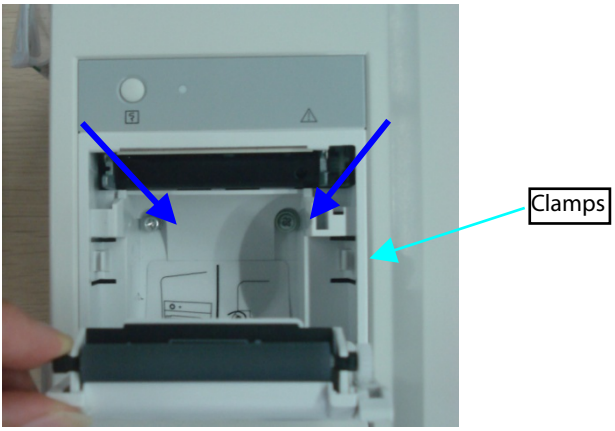
6.3.1 Disassembling the Temperature Module (Optional)

1. Lay the monitor on a table as shown below. Unscrew the three M3×6 screws, pull the Temperature module up, and disconnect the Temperature cable.



6.3.2 Removing the Recorder

Unscrew the two M3×6 screws and pull the clamps as indicated to remove the recorder. Then disconnect the cable.



NOTE

- **The recorder can be disassembled separately.**

6.3.3 Separating the Front and Rear Half of the Monitor

1. Lay the monitor on a table as shown below. Unscrew the four M3 screws.

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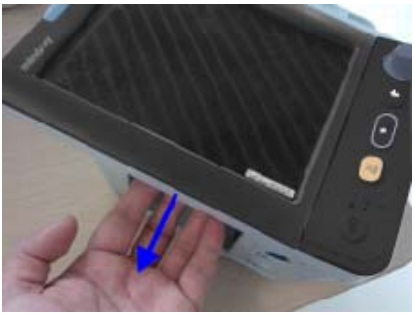
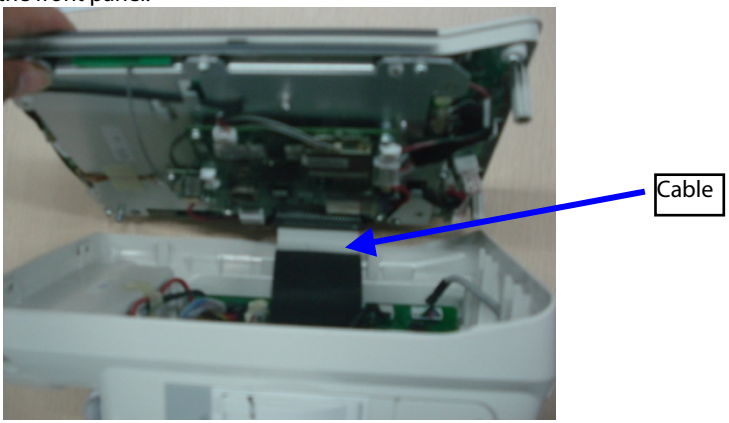
2. Remove the recorder or recorder cover, and pull the rear housing out as indicated below to separate the front and rear housing.



3. Stand the monitor and separate the front housing assembly and rear housing assembly with caution. Disconnect the cable between the main board and power management board and then take off the front panel.

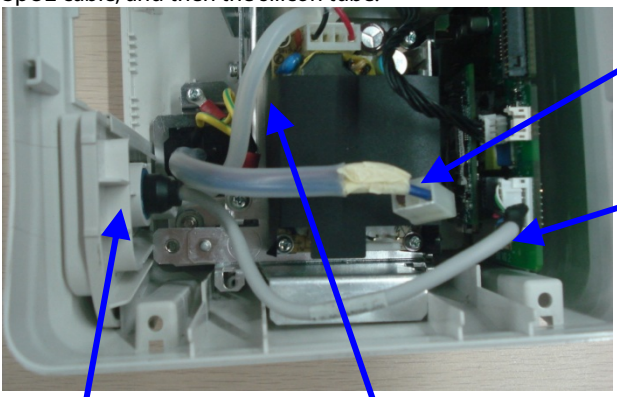


NOTE

- **When reassembling the equipment, be sure to check if the front housing waterproof strip is correctly placed.**

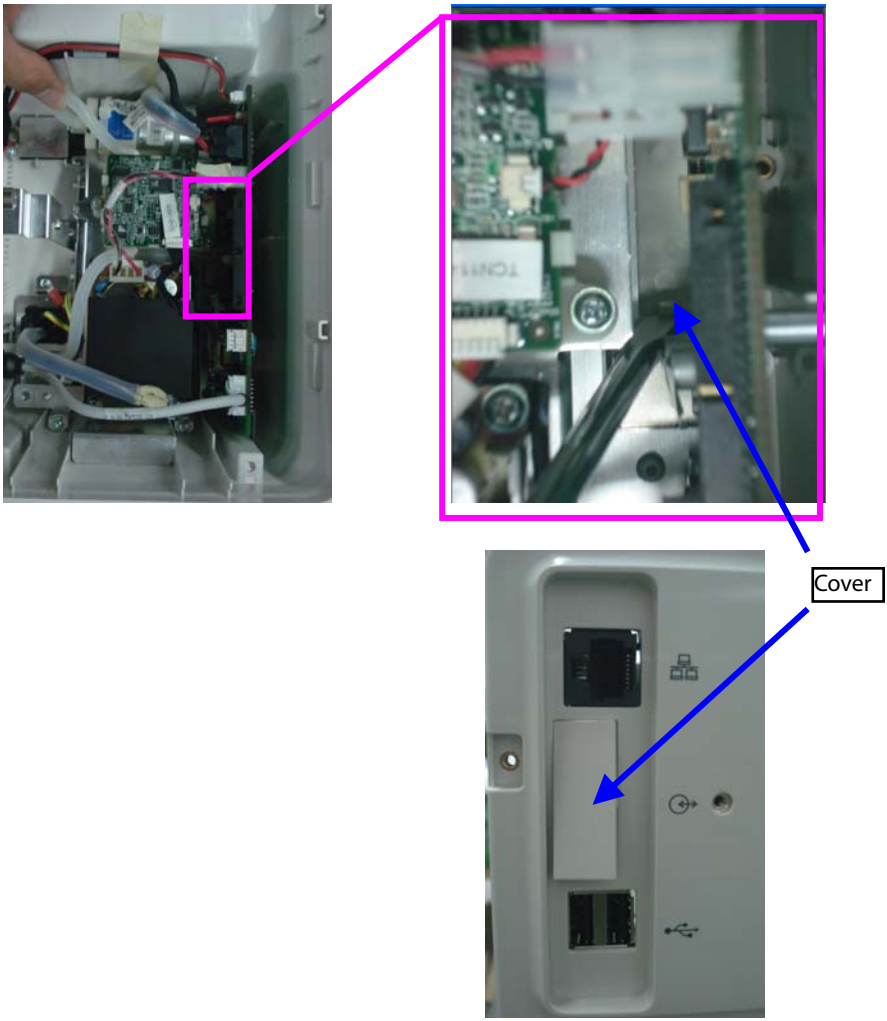
6.3.4 Removing the Parameter Connector Panel Assembly

Lay the rear housing assembly of the equipment on a table. Disconnect the cable for AC receptacle and SpO2 cable, and then the silicon tube.



6.3.5 Disassembling the Main Bracket Assembly

1. For monitors without a multi-function connector, use a flat blade screwdriver to gently lift the cover release on the inside of the unit, and then remove the cover.



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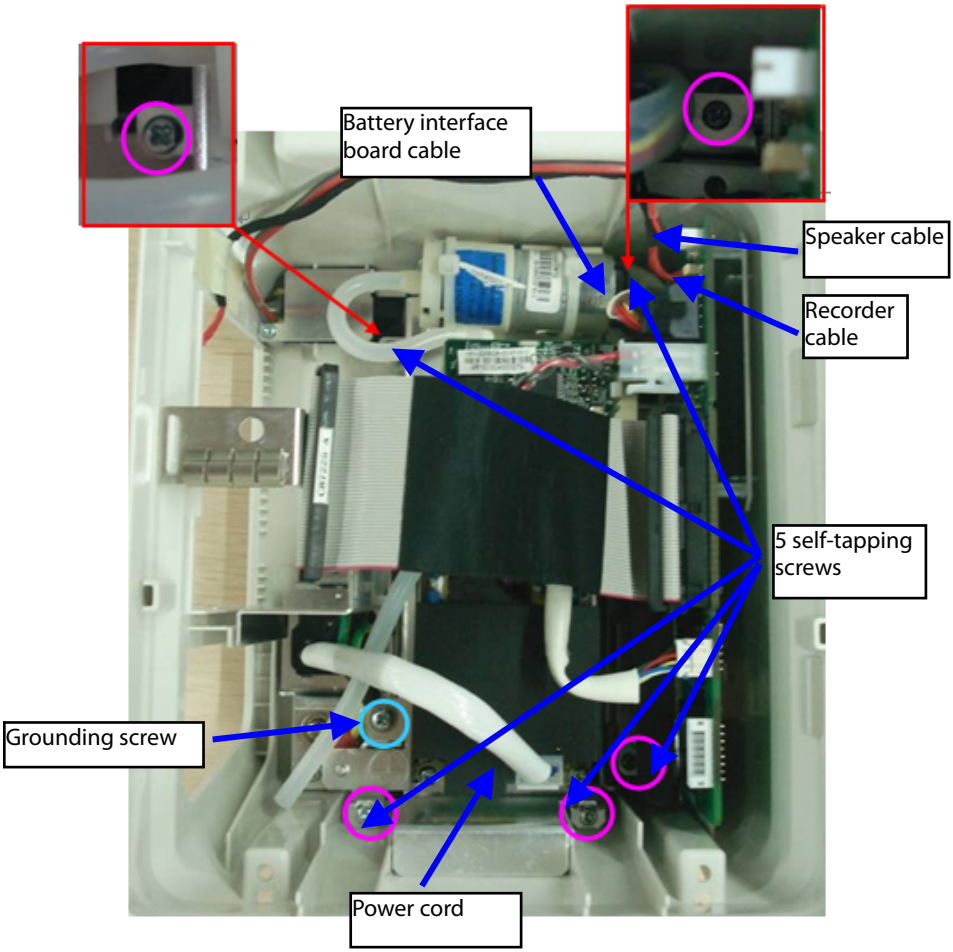
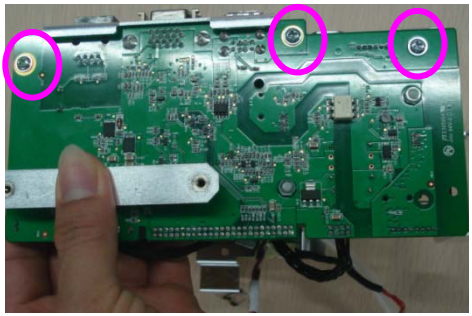
2. Disconnect the speaker cable, recorder cable, power cord and battery interface board cable.
3. Unscrew the five self-tapping screws and one grounding screw. Then remove the main bracket assembly.

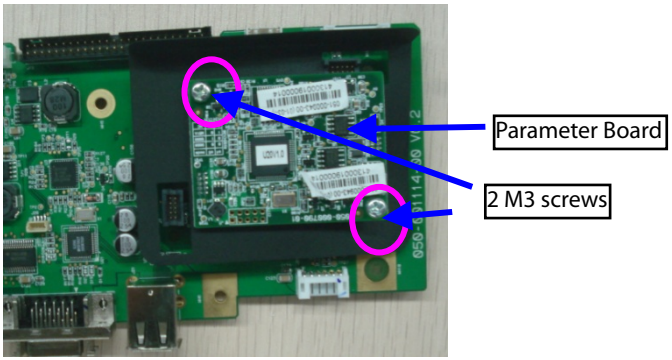


6.3.6 Removing the Parameter Board (SpO_2 Optional) and Power Management Board

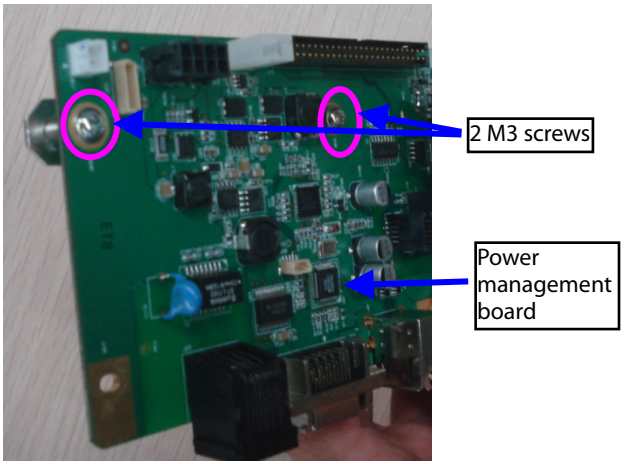
1. Unscrew the three screws and remove the power management board assembly from the main bracket assembly.



2. Unscrew the two M3 screws and remove the parameter board from the power management board assembly.

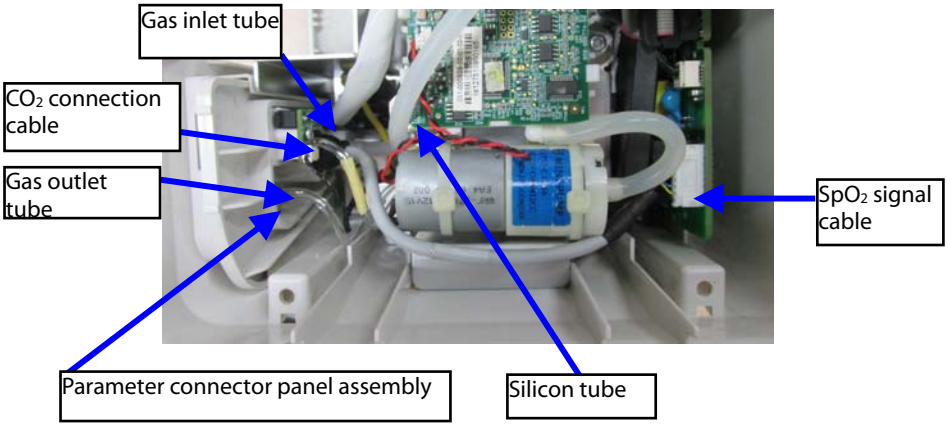


3. Unscrew the two M3 screws and remove the power management board assembly.



6.3.7 Removing the Parameter Connector Panel Assembly (With CO_2, Only Available for Accutorr 7)

1. Lay the rear housing assembly of the equipment on a table.
2. Pull out the AC receptacle, SpO_2 cable, and then the silicon tube, gas inlet tube, gas outlet tube and CO_2 connection cable.



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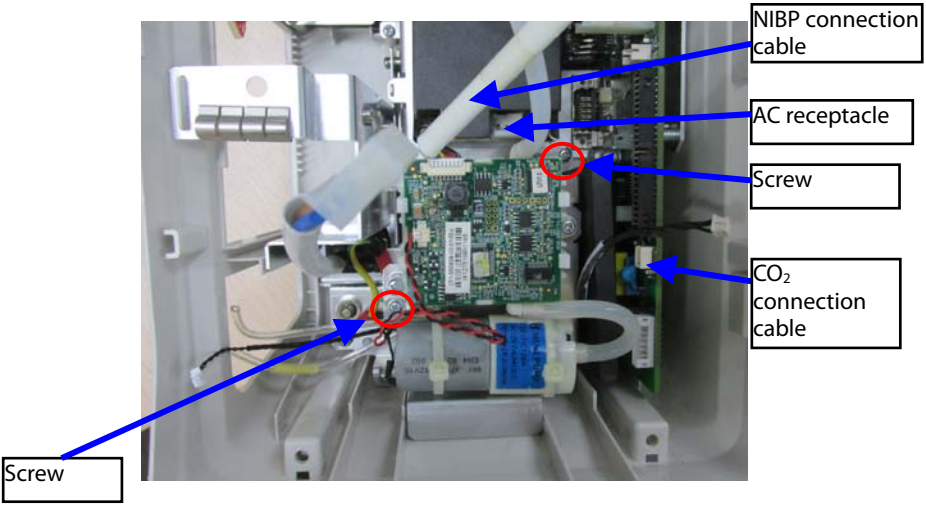
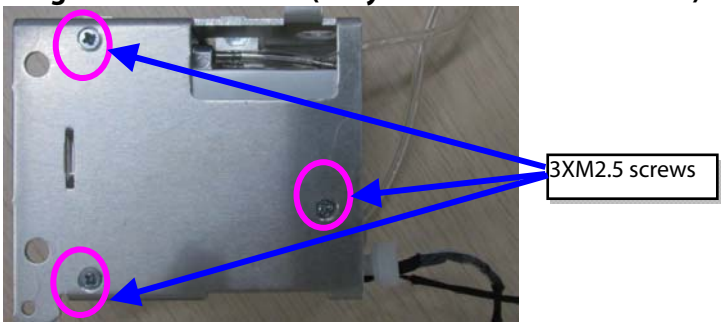
6.3.8 Disassembling the CO_2 Module Assembly (Only Available for Accutorr 7)

1. Pull out the AC receptacle, NIBP connection cable, CO2 connection cable.
2. Unscrew two M3X6 screws.
3. Remove the CO_2 module.

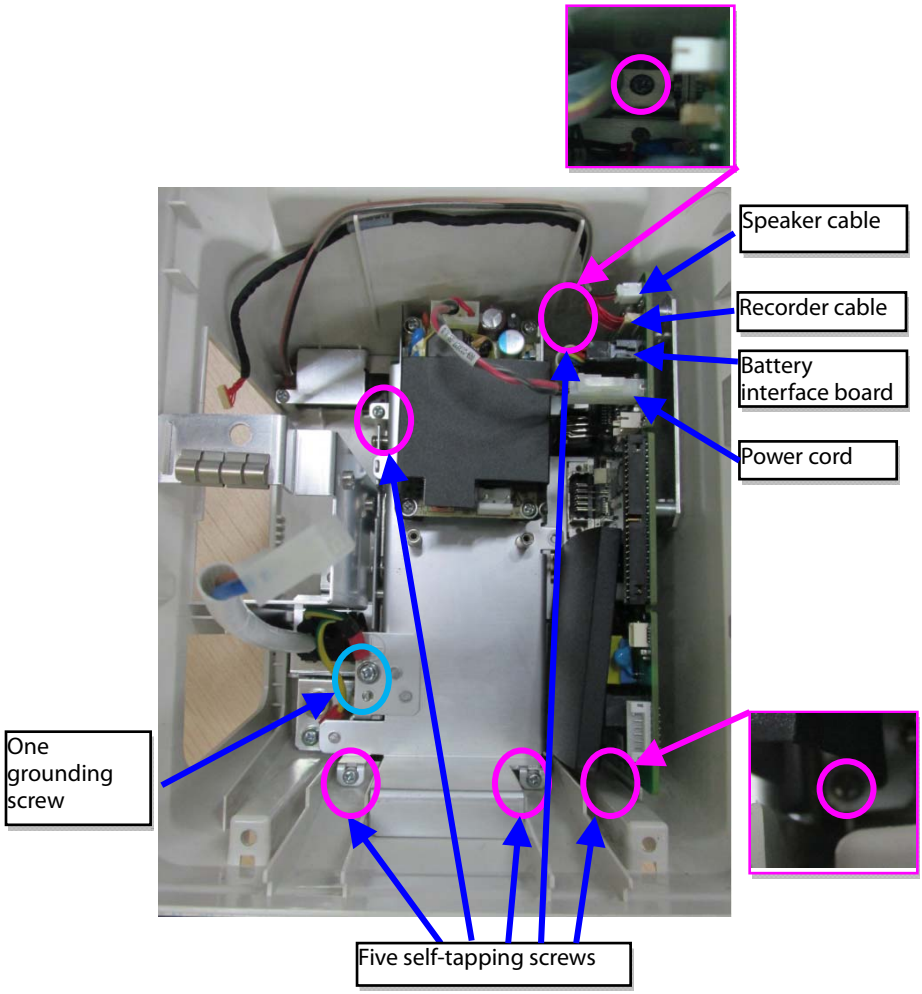


6.3.9 Disassembling CO2 main Module (Only Available for Accutorr 7)



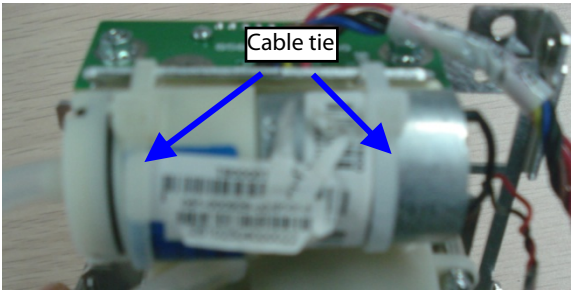
6.3.10 Disassembling the Main Bracket Assembly (With CO_2, Only Available for Accutorr 7)

1. Disconnect the speaker cable, recorder cable, power cable, and battery interface board cable. Unscrew the five PT3×8 screws and M4 screw.
2. Take out the main bracket assembly.

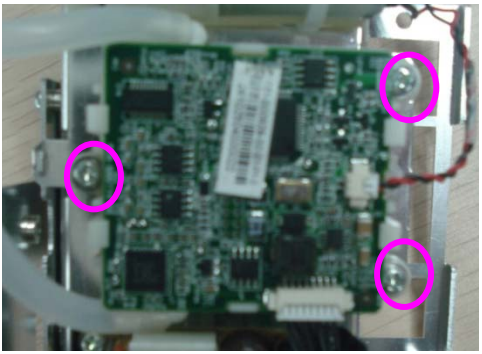


6.3.11 Disassembling Pumps and Valves

1. Cut the two cable ties and remove the pump.

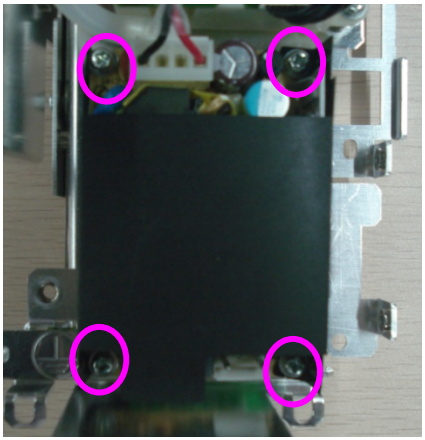


2. Unscrew the three screws as indicated and remove the NIBP board.



6.3.12 Disassembling AC/DC Power Board and Battery Converter Board

1. Unscrew the four screws as indicated and remove the AC/DC power board.



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2. Unscrew the two M3 nuts to remove the battery interface board.

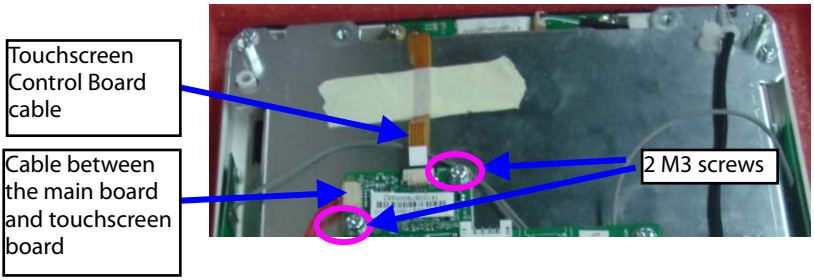
6.4 Disassembling the Front Housing Assembly

NOTE

- **To disassemble the equipment, place the equipment on a work surface free from foreign material, avoiding damaging the antiglare screen, touchscreen and the knob.**
- **Remember to install the screen support pad properly during reassembly.**
- **Operations relating to optional parts may not apply to your equipment.**
- **Position the touchscreen properly with the flexible cable facing down.**

6.4.1 Removing the Touchscreen Control Board

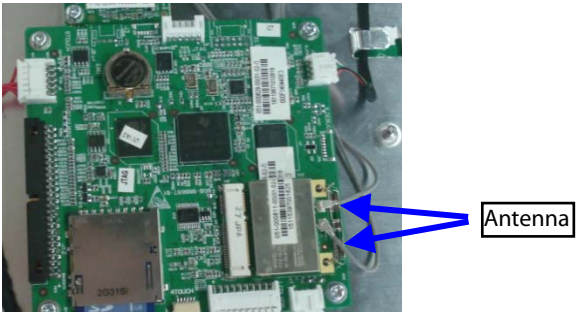
Remove the two M3 screws as shown below. Disconnect the cable between main board and touchscreen board, and the touchscreen control board cable, and then remove the touchscreen control board.



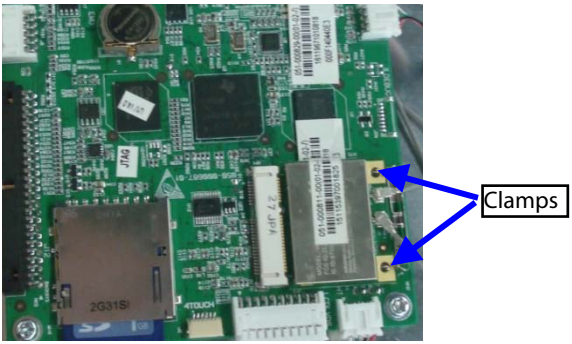
6.4.2 Removing the 2.4G Wi-Fi Module (Optional, Only Available for Accutorr 7)

1. Remove the two antennas on the front panel from the slots as shown below:

2. Remove the antennas from the Wi-Fi module PCBA.

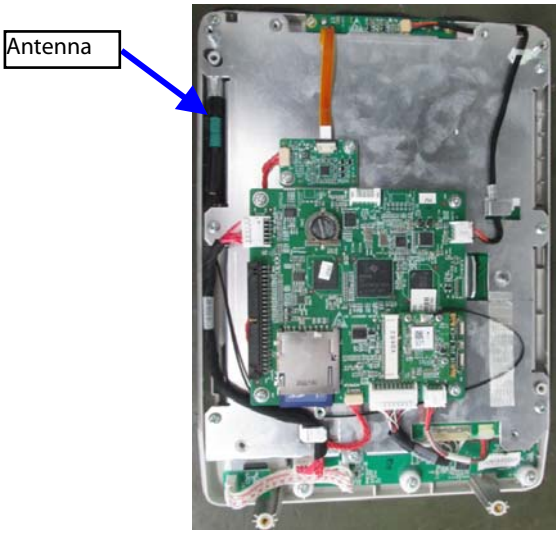


3. Push the clamps aside to remove the Wi-Fi module.

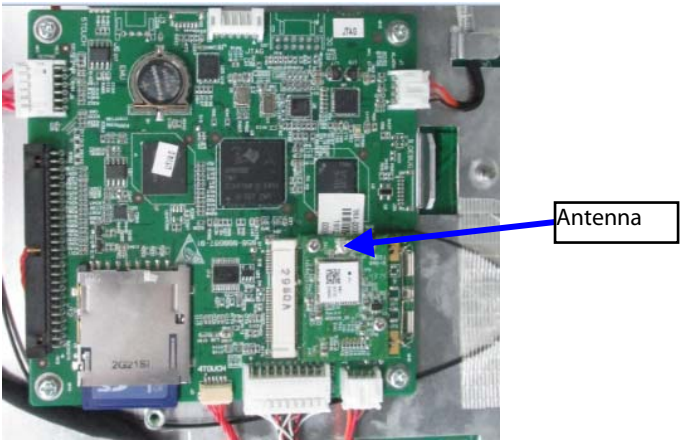


6.4.3 Removing the 5G Wi-Fi Module (Optional, Only Available for Accutorr 7)

1. Remove the antennas on the front panel from the slots as shown below:



2. Remove the antennas from the Wi-Fi module PCBA.



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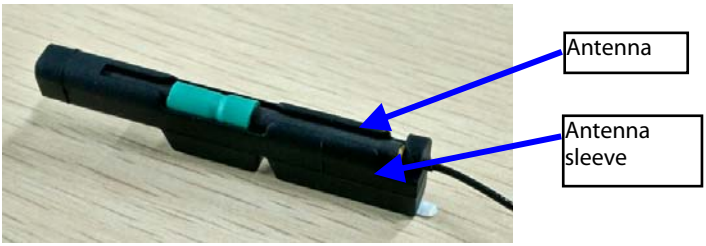
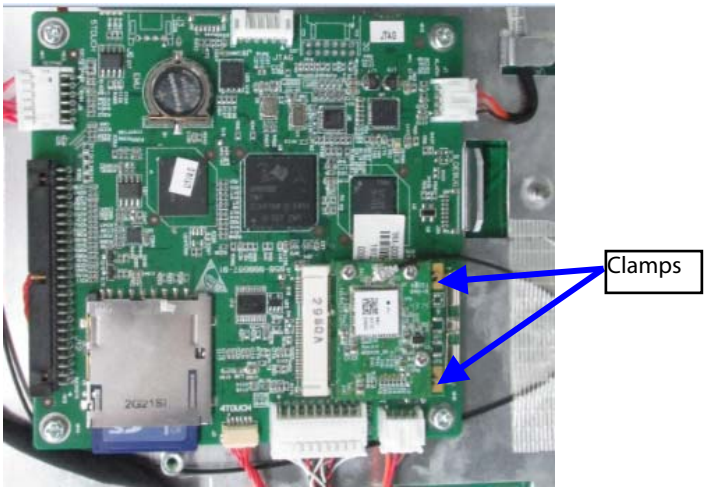
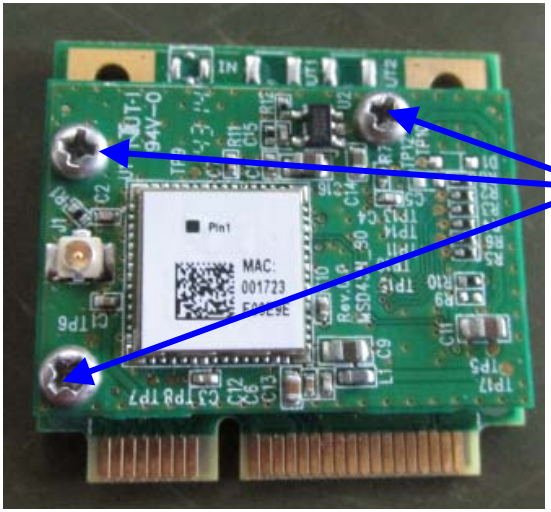
3. Remove the antennas from antenna sleeve.



4. Push the clamps aside to remove the Wi-Fi module.

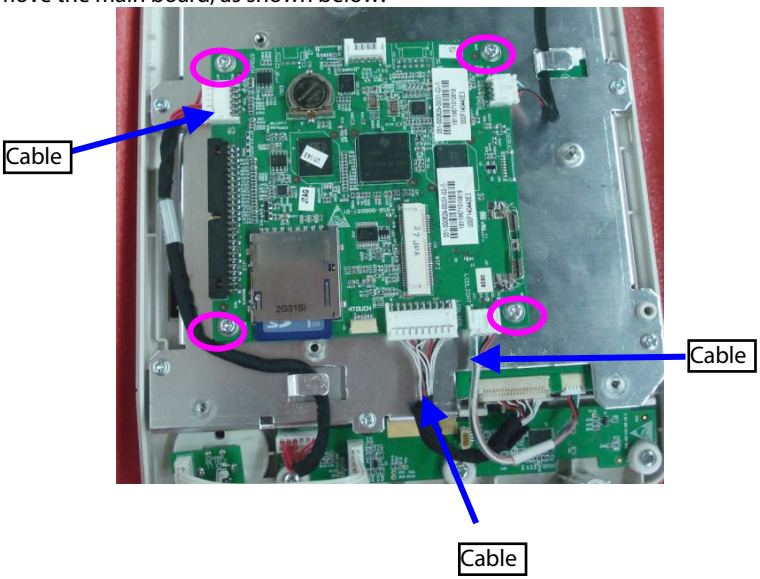


5. Remove the Wi-Fi module.



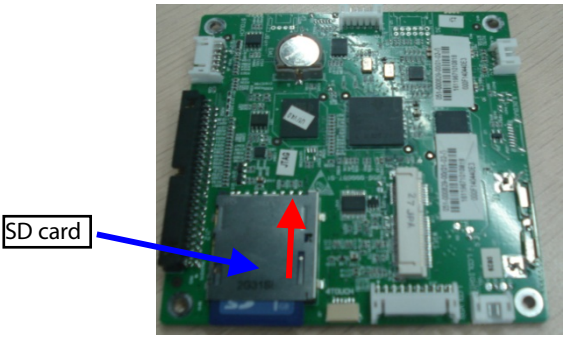
6.4.4 Removing the Main Control Board

Disconnect the alarm lamp cable, cable for display backlight, display cable, and the cable between the main board and keypad board respectively. Unscrew the four M3×8 screws and remove the main board, as shown below:



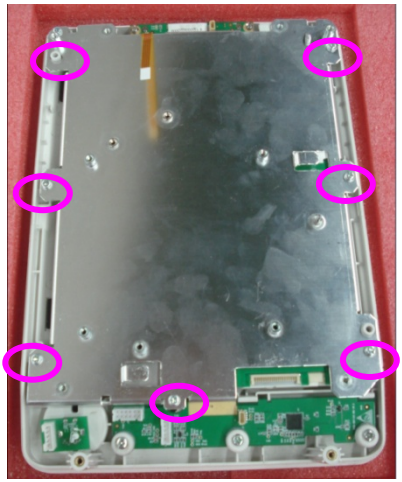
6.4.5 Removing SD Card

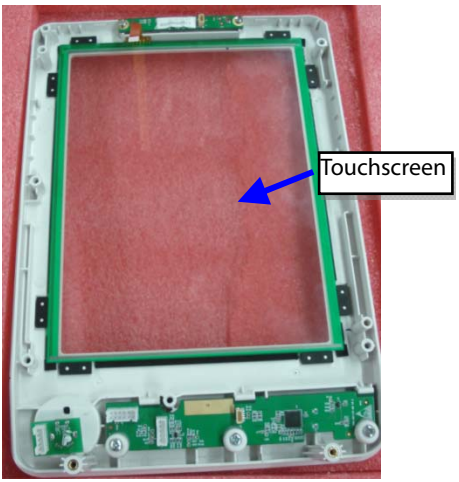
Remove the main board, and push the SD card as indicated below to remove the SD card.



6.4.6 Removing the Touchscreen

Unscrew the seven PT3×8 screws as indicated below. Remove the touchscreen assembly and then the touchscreen.





6.4.7 Disassembling the Display

Unscrew the four M3×6 screws indicated below to remove the screen.

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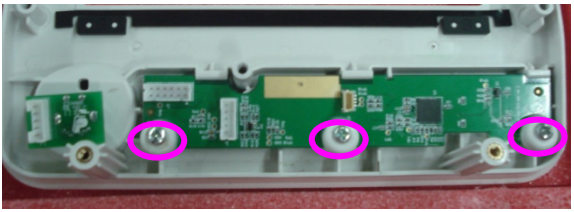
6.4.8 Removing the Keypad

Unplug the encoder cable and unscrew the three PT3×8 screws indicated below. Remove the keypad.

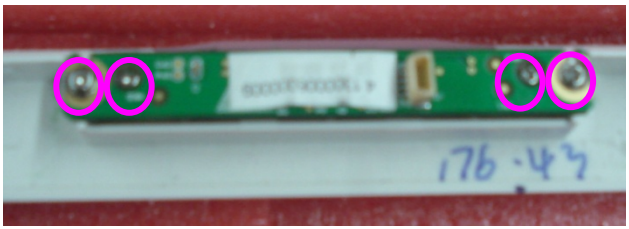


6.4.9 Removing the Encoder

Pull the knob off the encoder shaft. Remove the retaining nut. Then remove the encoder.

6.4.10 Removing the Alarm Lamp

Unscrew the four PT2×6 screws indicated below and remove the alarm lamp board and alarm lamp.

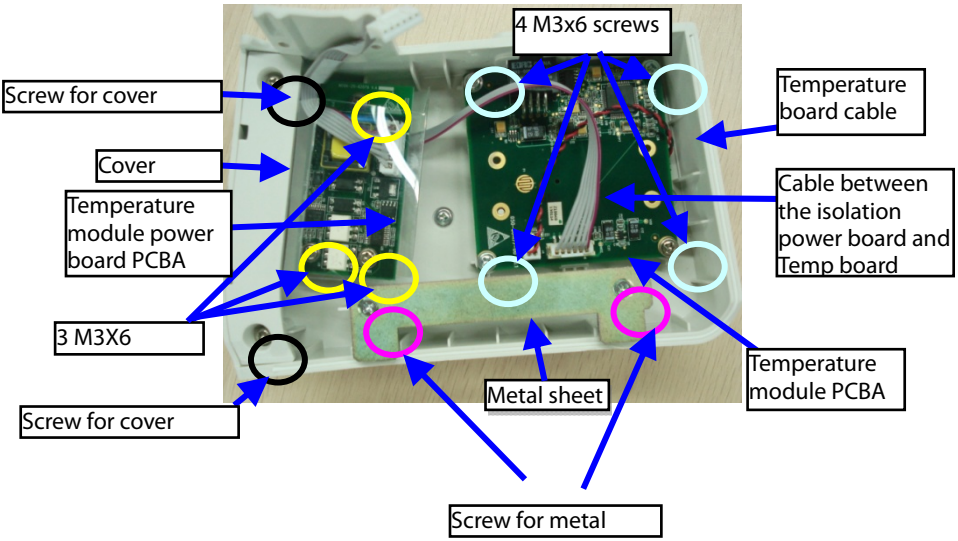


6.5 Disassembling the Temperature Module (Optional)

6.5.1 Removing the Temperature Module PCBA and Module Power Board PCBA

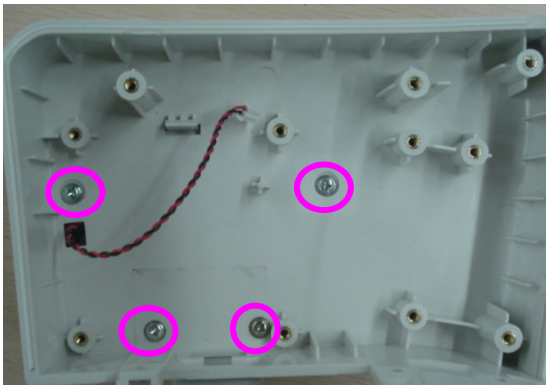
Unscrew the two M3×6 screws and the two M3 screws. Remove the cover board and metal sheet.

Disconnect the Temperature board cable and the cable between Temperature isolation power board and Temperature board. Unscrew the four M3×6 screws, you can remove the Temperature module PCBA. Then unscrew the three M3×6 screws, you can remove the Temperature module power board PCBA.

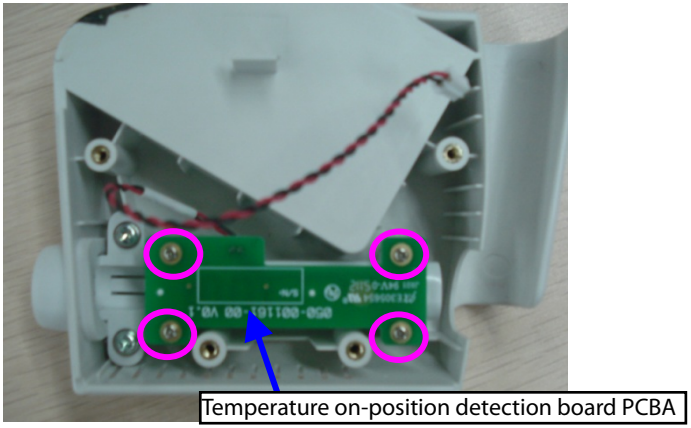


6.5.2 Disassembling the Temperature On-Position Detection Board PCBA

1. Unscrew the four M3×6 screws as indicated and remove the temperature module housing.



2. Unscrew the four M2 screws as indicated below and remove the Temperature on-position detection board PCBA.



NOTE

- **Remember to assemble the silicon button for the Temperature on-position detection switch during reassembly.**

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FOR YOUR NOTES

7 Parts

7.1 Introduction

This section contains the exploded views and parts lists of the main unit to identify the parts during disassembly of the monitor and replacing the parts.

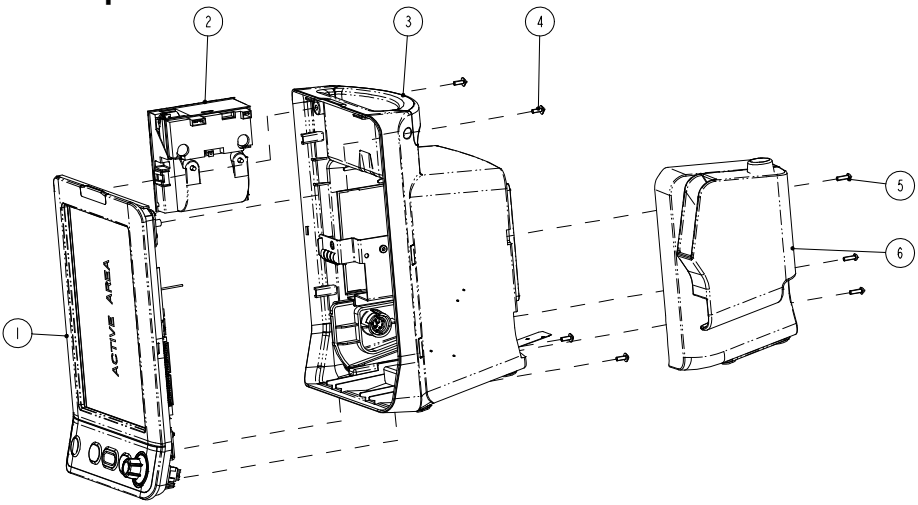
This manual is based on a fully loaded configuration. Your equipment may not contain all options and therefore may not be appear the same as the unit in this manual.

NOTE

- **For parts in the Parts List below that contain two part numbers, the first part number is for patient monitors built with one version of plastic material, the second part number is for patient monitors built with another version of plastic material. The way to distinguish which material your monitor is built from is if it contains the symbol .**

7.2 Main Unit

7.2.1 Exploded View



7.2.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Accutorr 7 Front Housing Assembly	115-022922-00/ 115-050858-00	Touch screen
1	VS-900c Front Housing Assembly	115-057544-00	Touch screen
2	TR6F recorder for Accutorr 7	115-001290-00/ 115-046892-00	N/A
2	TR6F recorder for VS-900c	115-046892-00	N/A
3	Rear Housing Assembly	115-017698-00/ 115-048904-00	Cover assembly
4	Screw, Pan head with washer, Phillips M3×8	M04-004015---	N/A
5	Screw, pan head Phillips, M3×8	M04-000605---	N/A
6	Temperature module	115-017716-00/ 115-048910-00	N/A

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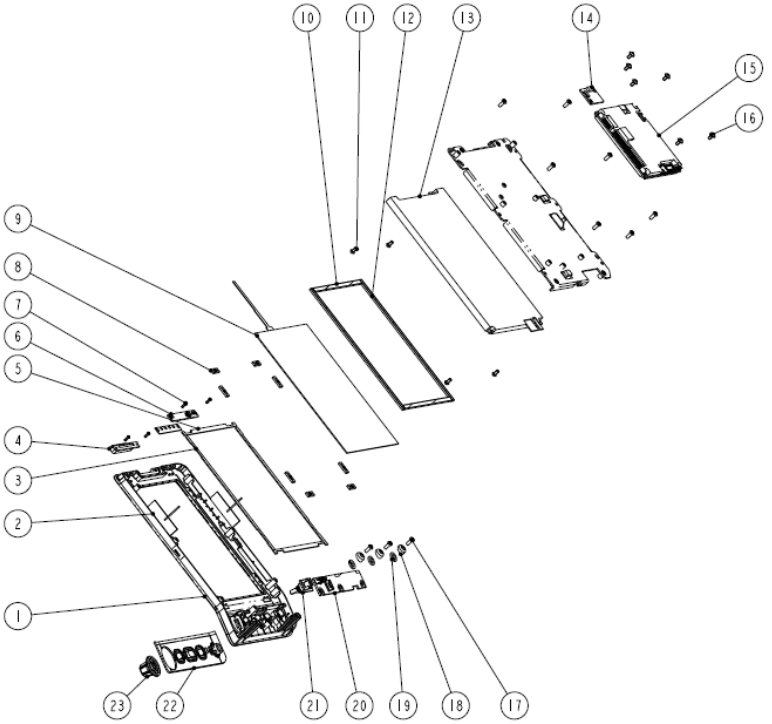
7.3 Front Housing Subassembly (Touchscreen)

7.3.1 Exploded View



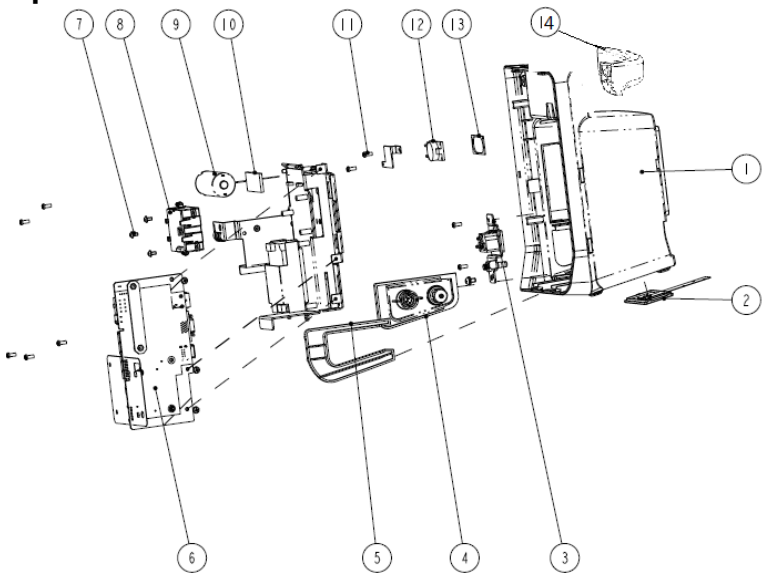
7.3.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Accutorr 7 Front housing	115-022921-00/ 115-050857-00	Accutorr 7 front housing service kit
3	Silicon water-proof strip		
4	Alarm lamp		
5	Silicon water-proof strip		
8	Touchscreen position pad (8")		
1	VS-900c Front housing	115-057546-00	VS-900c front housing service kit
3	Silicon water-proof strip		
4	Alarm lamp		
5	Silicon water-proof strip		
8	Touchscreen position pad (8")		
2	Antenna cable	2.4G: 0012-00-1730-01 5G: 115-035362-00/ 115-048914-00	N/A
6	Alarm Lamp Board	051-001362-00	N/A
7	Cross recessed pan head self-tapping screw PT2X6	M04-051003---	N/A
9	Touch-panel, resistive-type, 8.4"	021-000058-00 or 021-000271-00	N/A
10	8" display-short	115-018259-00	N/A
12	8" display-long		
13	LCD TFT 8.4"		
11	Screw, pan head Phillips, M3×6	M04-002505---	N/A
14	Touchscreen control board PCBA	051-000881-00	N/A
15	Main board PCBA	115-023203-00	N/A
16	Screw, Pan Head W/Washer Phillips M3X6	M04-004012---	N/A
17	ST3.3X8 screw	030-000338-00	N/A
18	Keypad board adjusting sleeve	115-020467-00	N/A
19	Keypad board cushion		

Item No.	Description	FRU part number	Remarks
20	Keypad PCBA	051-001359-00	N/A
21	Encoder	801-0010-00010-00	N/A
22	Accutorr 7 silicon buttons	049-000607-00	Accutorr 7
22	Silicon buttons	049-000998-00	VS-900c
23	Knob	043-003372-01	Accutorr 7
23	Knob	043-010368-00	VS-900c

7.4 Rear Housing Assembly (without CO_2 module, CO_2 Only Available for Accutorr 7)

7.4.1 Exploded View



7.4.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Rear Housing Subassembly for Accutorr	115-017698-00/ 115-048904-00	N/A
1	Rear Housing Subassembly for VS-900c	115-048904-00	N/A
	ıssembly	043-003359-01/	N/A

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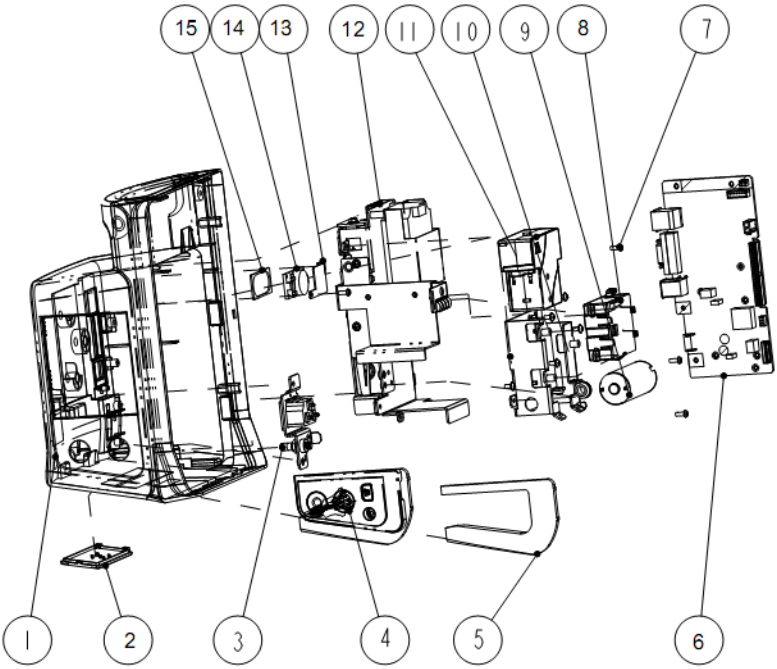
To Purchase, Visit Avobus.com or call 1-800-674-3655

Item No.	Description	FRU part number	Remarks
3	AC socket assembly	115-017699-00	N/A
4	Parameter connector panel assembly	115-017711-00/ 115-048908-00	Without SpO_2
		115-017706-00/ 115-048906-00	With Masimo SpO_2
		115-017707-00/ 115-048907-00	With Nellcor SpO_2
5	Parameter connector board support	043-003168-00	N/A
6	Power management board	115-018262-00	With multi-IO
7	Screw, Pan head with washer, Phillips M3X6	M04-004012---	N/A
8	Valve assembly	115-017679-00	N/A
9	Pump	801-9261-00040-00	NIBP pump service kit
10	Shock absorption cushion for pump	047-005212-01	N/A
11	ST3.3X8 screw	030-000338-00	N/A
12	Speaker	801-9261-00010-00	N/A
13	Speaker pad		
14	Handle	043-003165-01/ 043-008828-00	N/A
/	Cable between the power management board and power board	009-003237-00	N/A
/	Cable between the interface board and main board	9211-20-87225	N/A
/	Cable between NIBP module and power management board	009-003238-00	N/A
/	Recorder cable	009-001969-00	N/A
/	multifunctional connector cap	043-003311-01	N/A

7.5 Rear Housing Assembly (with CO_2 module, Only Available for Accutorr 7)

7.5.1 Exploded View



7.5.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Rear Housing Subassembly	115-017698-00/ 115-048904-00	N/A
2	Battery door assembly	043-003359-01/ 043-008878-00	N/A
3	AC socket assembly	115-017699-00	N/A
4	Parameter connector panel assembly	115-038391-00/ 115-051242-00	Nellcor SpO_2
	Parameter connector panel assembly	115-038392-00/ 115-051243-00	Masimo SpO_2
5	Parameter connector board support	043-003168-00	N/A

Item No.	Description	FRU part number	Remarks
6	Power management board	115-018262-00	With multi-IO
7	Screw, Pan head with washer, Phillips M3X6	M04-004012---	N/A
8	Valve assembly	115-017679-00	N/A
9	Pump	801-9261-00040-00	NIBP pump service kit
10	Shock absorption cushion for pump		
/	Fixing strip		
11	M02D CO_2 module	115-038402-00	/
12	Main bracket assembly	115-038394-00	N/A
13	Speaker bolster plate	042-008296-00	N/A
14	Speaker	020-000027-00	N/A
15	Speaker pad		
/	Cable between the power management board and power board	009-003237-00	N/A
/	Cable between the interface board and main board	9211-20-87225	N/A
/	Cable between NIBP module and power management board	009-003238-00	N/A
/	Recorder cable	009-001969-00	N/A
/	multifunctional connector cap	043-003311-01	N/A

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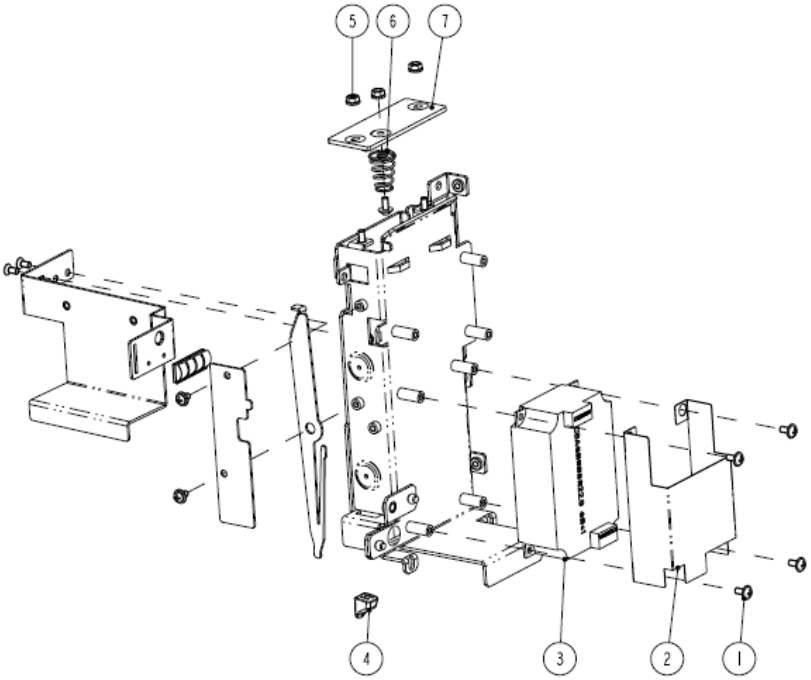
To Purchase, Visit Avobus.com or call 1-800-674-3655

7.6 Main Bracket Assembly

7.6.1 Exploded View

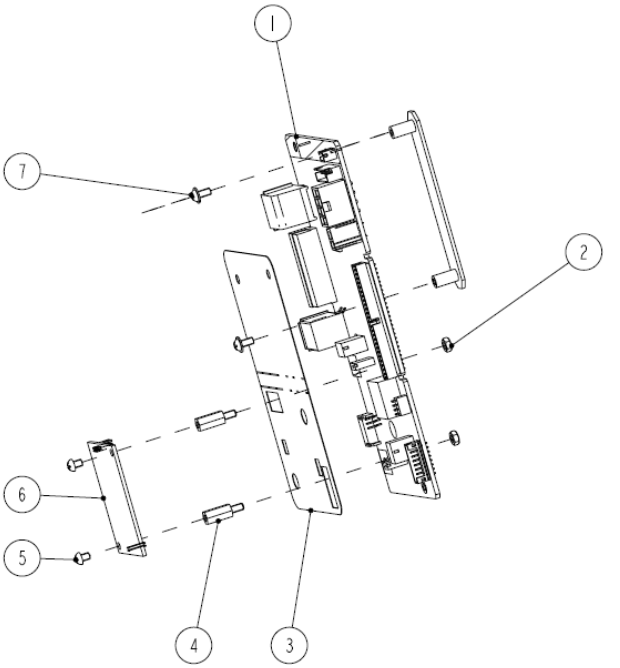


7.6.2 Parts List

Item No.	Description	FRU part number
1	Screw, Pan head w/washer	M04-004012---
2	Power board insulator	047-010575-00
3	Power board	022-000125-00
4	Knob, Battery latch	0380-00-0593
5	Nut with washer	115-018254-00
6	Battery spring	
7	6301 battery interface PCBA	

7.7 Power Management Board Assembly

7.7.1 Exploded View

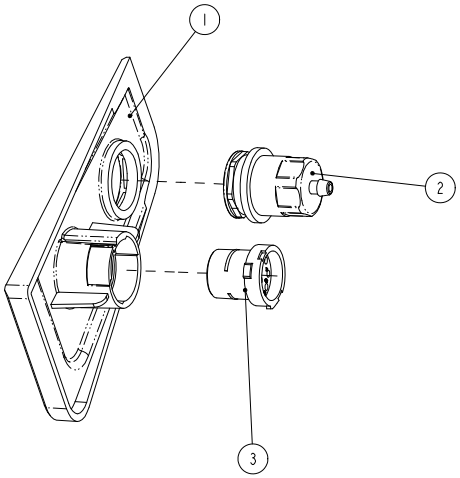


7.7.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Power management board service kit	115-018262-00	with multifunctional connector
2	Plastic hexagon nut	M90-000156---	N/A
3	SpO_2 shield	047-010576-00	N/A
4	Plastic hexagon bolt	099-000129-00	N/A
5	Screw, pan head	M04-051001-01	N/A
6	SpO_2 board	100-000106-00	Nellcor SpO_2 board (MDU)
		040-000109-01	SpO_2 board, Masimo MS-2013
7	Screw, Pan head w/washer	M04-004012---	N/A

7.8 Parameter Connector Panel Assembly (without CO_2 module, CO_2 Only Available for Accutorr 7)

7.8.1 Exploded View



7.8.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Parameter panel	115-017711-00/ 115-048908-00	without SpO_2
2	NIBP fitting		
1	Parameter panel	115-017706-00/ 115-048906-00	Masimo SpO_2
2	NIBP fitting		
1	Parameter panel	115-017707-00/ 115-048907-00	Nellcor SpO_2
2	NIBP fitting		
3	SpO_2 signal cable	009-003243-00	Masimo SpO_2 module
		009-003244-00	Nellcor SpO_2 module
/	Decorative NIBP socket	043-003304-01	N/A
/	Decorative IBP socket	043-001893-01/ 043-008498-00	N/A

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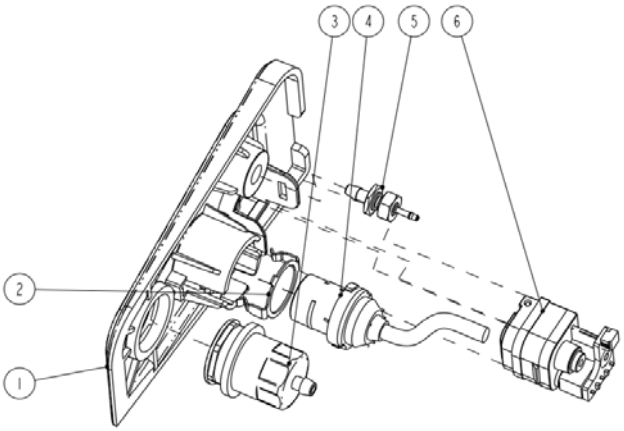
To Purchase, Visit Avobus.com or call 1-800-674-3655

7.9 Parameter Connector Panel Assembly (with CO_2 module, Only Available for Accutorr 7)

7.9.1 Exploded View

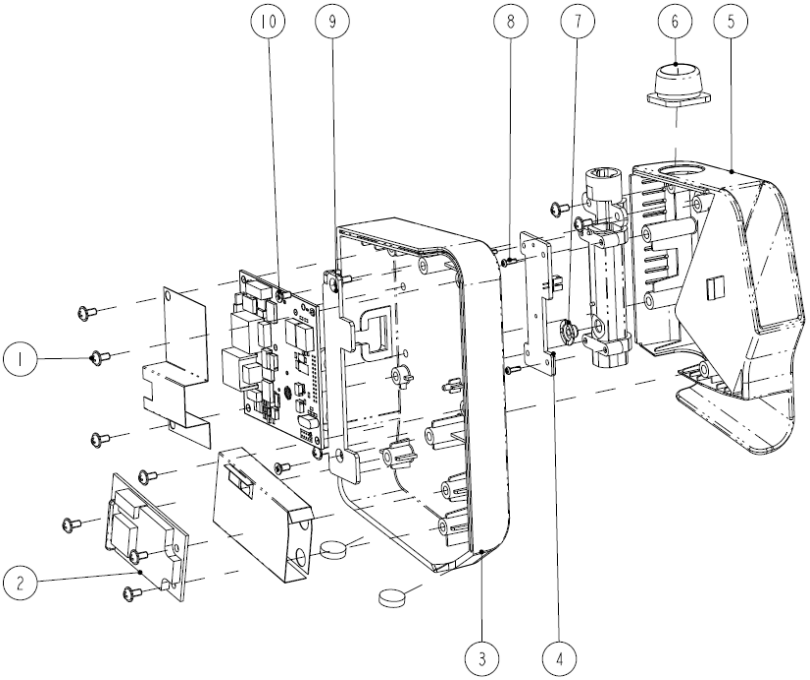


7.9.2 Parts List

Item No.	Description	FRU part number	Remarks
1	Parameter panel	043-006643-00	Applicable for Nellcor or Masimo SpO_2 module
2	Hand feel spring	042-013555-00	N/A
3	NIBP fitting	115-010541-00/ 115-046902-00	N/A
4	SpO_2 signal cable	009-003243-00	Masimo SpO_2 module
		009-003244-00	Nellcor SpO_2 module
5	1 slot CO_2+O_2 outlet nipple	041-017255-00	N/A
6	DRYLINE PRIME Receptacle with no panel	115-036134-00	N/A
/	Decorative NIBP socket	043-003304-01	N/A
/	Decorative IBP socket	043-001893-01/ 043-008498-00	N/A

7.10 Predictive Temperature Assembly

7.10.1 Exploded View



7.10.2 Parts List

Item No.	Description	FRU part number
1	Screw, Pan head w/washer	M04-004012---
2	Predictive Temperature module power board PCBA	801-6006-00043-00
3	Predictive Temperature housing	043-003326-01/ 043-008862-00
4	Temperature on-position detection board PCBA	051-001419-00
5	External compartment for Temperature module	043-003312-01/ 043-008842-00
6	Temperature cover	049-000547-01
7	Silicon buttons	M09A-20-62064
8	Screw, Pan head Self-Tapping PT2X6	M04-051003---

Item No.	Description	FRU part number
9	Screw, Flat Head Phillips, M3X6	M04-005005---
10	Predictive Temperature module PCBA	051-001435-00
/	Predictive Temperature board cable	009-003368-00
/	Cable between the Temperature module and power management board	009-003239-00
/	Cable between the isolation power board and Temperature board	009-003240-00

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8 Hardware and Software Upgrade

8.1 Hardware Upgrade

The monitor supports upgrade of the following functions:

- SpO_2 measurement
- Temperature measurement

8.1.1 Upgrade Package

Upgrade package	Description of upgrade package	PN of upgrade package
SpO_2	Masimo SpO_2 upgrade kit	115-027698-00
	Nellcor SpO_2 upgrade kit	115-027699-00
Temperature	Temperature module	115-027700-00

Note: measurement accessories are not included in the above upgrade packages.

8.1.2 Upgrading Parameter Modules

8.1.2.1 Upgrading Nellcor SpO_2

Contents of upgrade package:

- A Nellcor SpO_2 board;
- An SpO_2 insulator;
- A connector panel assembly for Nellcor SpO_2 board; and,
- Two M3×6 screws

1. Remove the power management board and connector panel assembly as described in section ***6.3*** Disassembling the Main Unit.
2. Assemble the SpO_2 board and insulator onto the power management board as described in section ***6.3.6*** Removing the Parameter Board (SpO2 Optional) and Power Management Board.
3. Install the power management board assembly with the SpO_2 board and the connector panel assembly in the service kit into the main unit as described in section ***6.3*** Disassembling the Main Unit.

8.1.2.2 Upgrading Masimo SpO_2

Contents of upgrade package:

- A power management board assembly with Masimo SpO_2; and,
- A Masimo SpO_2 connector panel assembly.

1. Remove the power management board, connector panel assembly and the stopple of multifunctional connector (if there is one) as described in section ***6.3*** Disassembling the Main Unit.
2. Install the power management board assembly with the SpO2 board and the connector panel assembly in the service kit into the main unit as described in section ***6.3*** Disassembling the Main Unit.

8.1.3 Upgrading Temperature

Contents of upgrade package:

- A Temperature module with cables; and,
- Two M3×6 screws.

Remove the decorative cover from the Temperature module connector. Install the Temperature module onto the main unit as described in section ***6.5*** Disassembling the Temperature Module (Optional).

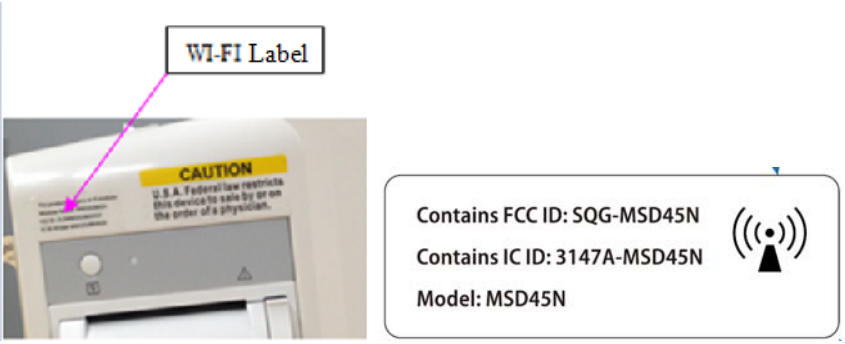
8.1.4 Upgrading Wi-Fi (Only Available for Accutorr 7)

Contents of upgrade package:

- Antenna sleeve
- Wi-Fi antenna
- Carrier board of wireless module (PCBA)
- Radio module support IEEE 802.11a/b/g/n
- Wi-Fi label
- Three cross pan head screw M2X4

Follow this procedure to upgrade:

1. Install the Wi-Fi module onto the main unit as described in section ***6.4*** Disassembling the Front Housing Assembly**.**
2. Paste the Wi-Fi label.



3. Upgrade software.
4. Test that the wireless network can be connected. Refer to the operator's manual for wireless network connection.

8.1.5 Enabling Parameter Functions

1. Select [**Main**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Ok**]→[**Device Config. >>**].
2. In the prompt menu, check the upgraded functions.
3. Click × to save the changes and quit the menu.
4. Restart the monitor and the software for upgraded parameters are enabled.

8.2 Software Upgrade

Software upgrades must be performed by Mindray, NA authorized service personnel. Call Service Dispatch 1 800 288-2121 ext: 7875.

NOTE

- **The software upgrading could result in clearing the historical patient data. It is recommended to export patient data before upgrading software.**

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FOR YOUR NOTES

A Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

A.1 Power Cord Plug

A.1.1 The Power Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

A.2 Device Enclosure and Accessories

A.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No indication of exposure to fluid spills (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

A.2.2 Physical Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

A.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facility are present and legible.

- Main unit label
- Integrated warning labels

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