

VS-900


Vital Signs Monitor

Service Manual

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Revision History

This manual has a revision number. This revision number changes whenever the manual is updated due to software or technical specification change. Contents of this manual are subject to change without prior notice. The version information of this manual is as follows:

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Preface

Manual Purpose

This manual provides detailed information about the assembling, disassembling, 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.

This manual is based on the maximum configuration and therefore some contents may not apply to your product. If you have any question, please contact our Customer Service Department.

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 equipments. The passwords are listed below:

- User settings: 888888 (User adjustable)
- Factory maintenance: 332888
- Demo mode: 2088
- Configuration mode: 315666 (User adjustable)

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FOR YOUR NOTES

1 Introduction

1.1 Information of This Manual

Version	Revision History
1.0	New
2.0	Change parts list according to new BOM
3.0	1. Add the related description of infrared ear thermometer module. 2. Add the description of MEWS software upgrade.
4.0	Add the description of CO ₂ and Covidien thermometer.
5.0	1. Add Exergen TemporalScanner Thermometer contents 2. Delete NIBP calibration contents

1.2 Safety Information

DANGER

- Indicates an imminent hazard that, if not avoided, will result in death or serious injury.
-
-

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 Dangers

There are no dangers that refer to the product in general. Specific “Danger” statements may be given in the respective sections of this manual.

1.2.2 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.
-

1.2.3 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.
-

1.2.4 Notes


























NOTE

- Refer to Operator's Manual for detailed operation and other information.
-

1.3 Equipment Symbols

NOTE

- Not all the symbols listed below are applied to your equipment.

	General warning sign		Power ON/OFF
	Alternating current (AC)		Battery indicator
	AUDIO PAUSED		NIBP Start/Stop key
	Alarm Paused		Record
	Admit a new patient		Insertion Direction
	DEFIBRILLATION –PROOF TYPE CF APPLIED PART		Input/Output
	Network connector		Equipotentiality
	USB connectors		Manufacturer
	Serial number		Electrostatic sensitive devices.
	DATE OF MANUFACTURE		Protection against fluid ingress
	Gas outlet		Gas sample inlet
	Refer to instruction manual/booklet		Interference may occur in the vicinity of equipment marked with this symbol
	DEFIBRILLATION-PROOF TYPE BF APPLIED PART		



The following definition of the WEEE label applies to EU member states only.

This symbol indicates that this product should not be treated as household waste. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, please consult the distributor from whom you purchased it.

* For system products, this label may be attached to the main unit only.

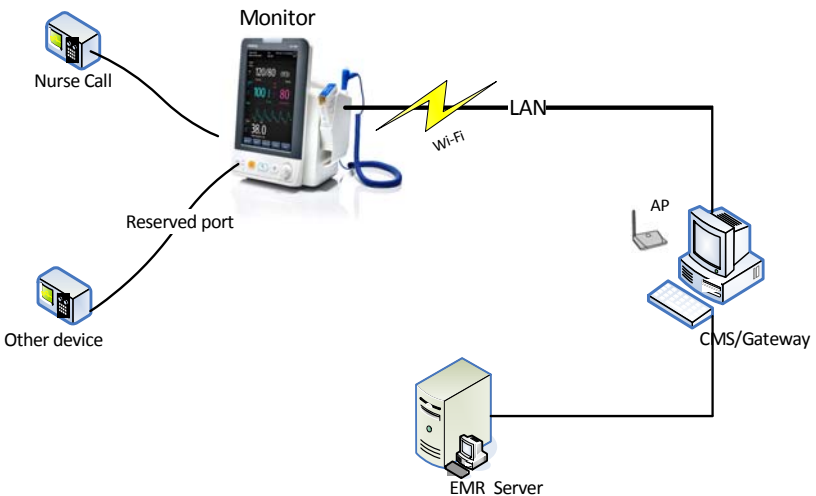
2 Theory of Operation

2.1 Overview

The Monitor is intended for monitoring physiologic parameters, including SpO₂, PR, NIBP and TEMP, on adult, pediatric, and neonatal patients in healthcare facilities by clinical physicians or appropriate medical staff under the direction of physicians.

The equipment also:

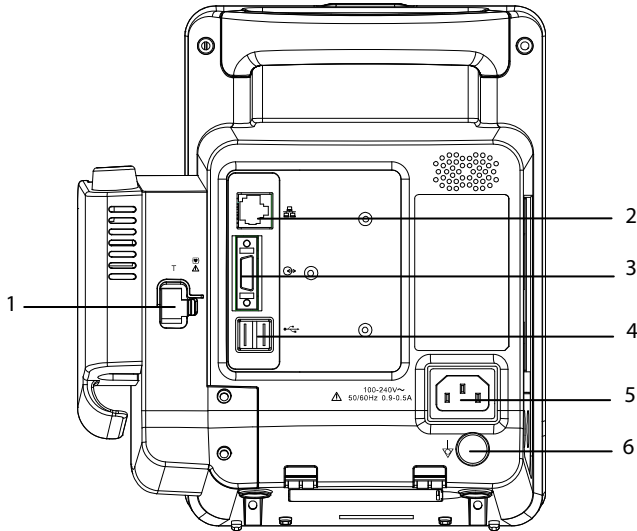
- Provides audible and visual alarm indications in case of patient or equipment problems;
- Provides display, review, storage and printing of monitored information;
- Incorporates multiple input devices such as buttons, knob, and touchscreen; and,
- Enables program upgrade over the network.



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 Central Monitoring System (hereinafter called CMS).
- Supports external AC power source and an internal battery.
- Supports clinical data acquisition, which has two ways: by SD card and by USB drive. The system software should support data output function, for SD card is a built-in device.

2.2 Connectors for Peripheral Devices



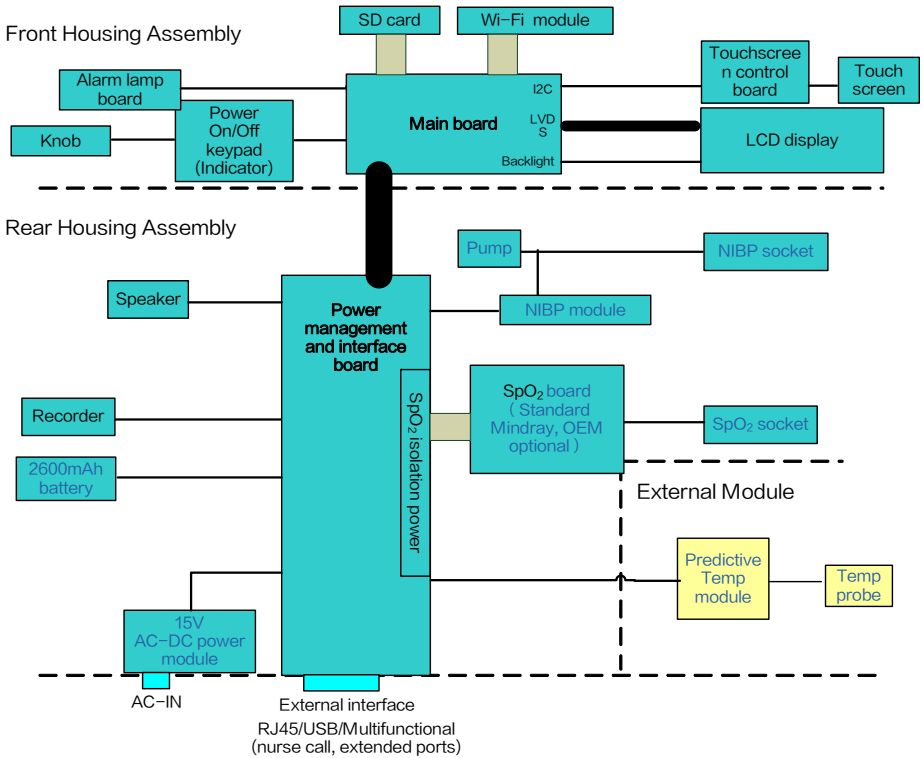
1. Connector for Temp probe
2. Network connector: It is a standard RJ45 connector used to communicate with external devices, such as central monitoring system, e-Gateway, or used to export data or upgrade the system.
3. Multi-function connector: connects to the hospital's nurse call system, or connects 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

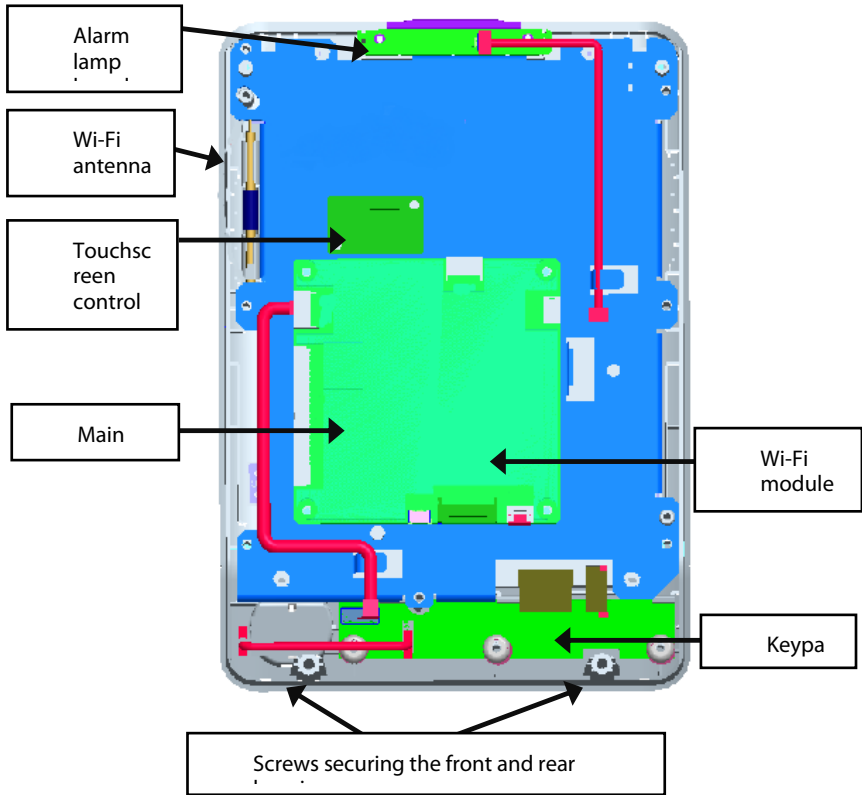
The main unit of the vital signs monitor consists of three parts:

- Front housing assembly: main board, Wi-Fi module, keypad board assembly (knob), display, touchscreen, and alarm lamp board.
- Rear housing assembly: power module (AC/DC), power management and interface board (including SpO₂ isolation power), recorder, speaker, battery, NIBP module, and SpO₂ board (including three types of configuration, i.e. Mindray, Masimo, and Nellcor).
- External module: SmarTemp™ module or Infrared Ear Thermometer module. The two modules are mutually exclusive.

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 SpO₂ board, NIBP module, and Temp 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.

Keypad

The keypad scans and detects the input of keys and knobs, 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.

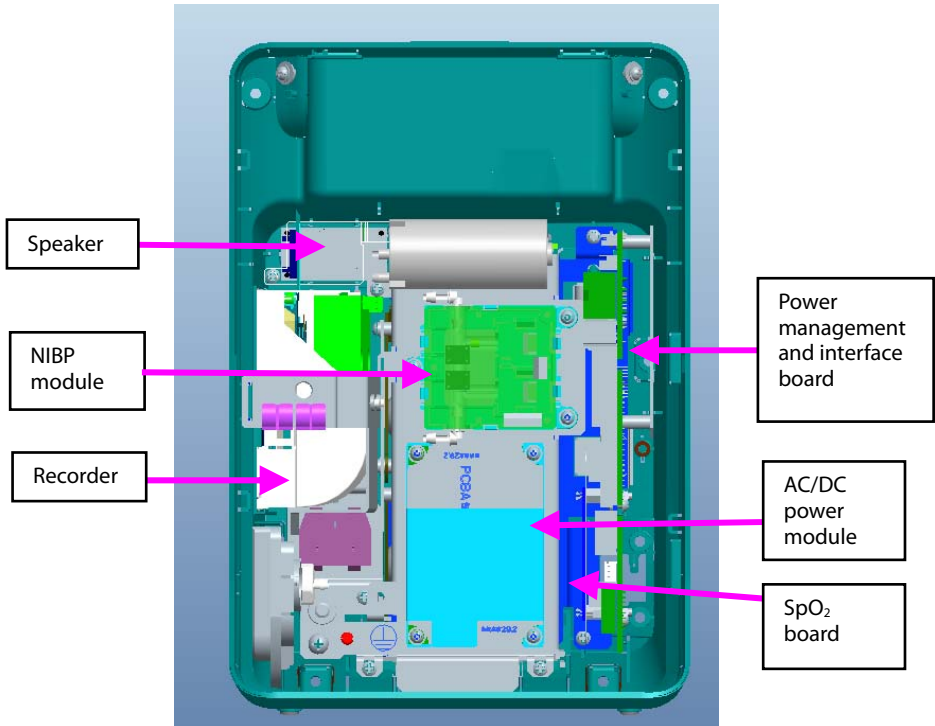
Touchscreen and Touchscreen Control Board

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

Wi-Fi Module

The Wi-Fi enable the equipment to connect to 802.11 g/n wireless network.

2.6 Rear Housing Assembly



Rear housing assembly consists of power module (AC/DC), power management and interface board (including SpO₂ isolation power), recorder, speaker, battery, NIBP module, and SpO₂ board (including three types of configuration, i.e. Mindray, Masimo, and Nellcor).

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 mainly 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 Mindray/OEM SpO₂ module; and,
- Providing external connectors, and also 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 through the serial ports.

SpO₂ Board

The independently developed Mindray SpO₂ board provides SpO₂ measurement as good as other boards but with smaller size and lower consumption. The power management and interface board is also compatible with Nellcor NELL-1 SpO₂ board and Masimo MS-2013 SpO₂ board.

The SpO₂ board collects SpO₂ signals, processes SpO₂ algorithm and sends measurement results to the main board. The power management interface board provides isolation power for it.

CO₂ Module

The CO₂ monitoring is a continuous, non-invasive technique for determining the concentration of CO₂ in the patient' airway by measuring the absorption of infrared (IR) light of specific wavelengths. The main functions of the CO₂ module are:

- Provides a CO₂ waveform, and EtCO₂, FiCO₂, awRR measurement; and
- Data exchange with the main board through the serial ports.

2.7 External Module

An external SmarTemp™ module or Infrared Ear Thermometer module can be extended on the monitor. The two modules are mutually exclusive.

The SmarTemp™ module consists of an isolation power board, Temp measurement board, and probes. The Temp measurement board collects Temp signals, processes algorithm and sends measurement results to the main board.

The Infrared Ear Thermometer module consists of an isolation power board, an infrared ear thermometer, and a communication cable. The infrared ear thermometer collects information, and displays the measurement. The measurement can be transmitted to the main board through the communication cable.

IR ear thermometers are capable of non-contact infra-red temperature measurement, and determine body temperature of a subject via thermal radiation of the ear canal and/or tympanic membrane.

FOR YOUR NOTES

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 shall also be checked.
- Notify the supplier if provided components are not correct as compared to the packing list.
- In case of damage during transportation, keep the packing material and notify the supplier immediately.
- Keep the packing material till new equipment is 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. Check that required power sockets are available.
3. Check 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 (°C)	Relative humidity (noncondensing)	Altitude (kPa)
Operating environment	0 to 40 (without Temp module) 5 to 40 (with SmarTemp module) 16 to 33 (with Genius 2 Temp module) 16 to 40 (with Exergen Temp module)	15% to 95%	57.0 to 107.4
Storage environment	-30 to 70 -25 to 55 (with Genius 2 Temp module) -20 to 50 (with Exergen Temp module)	10% to 95%	16.0 to 107.4

NOTE

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

3.2.3 Electrical Requirements

Check cables and power cords. Make sure that:

1. Check that the system cables, power cords, and power plugs are not damaged, and that the pins are not loose. In case of any damage, remove it from use.
2. The insulation of patient cables and leadwires is not damaged, and connectors are not loose.



WARNING

- **Only power sockets with protective grounding can be used.**
 - **Use the supplied power cord only!**
 - **If you doubt the completeness of the installation and cabling of the external protective cables, disconnect the equipment from the power line and operate it on battery. Otherwise, patient or operator might be shocked.**
-

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. Check the quantity of equipment and accessories as per the packing list.
2. Check for mechanical damages on the equipment and accessories.
3. Install the battery (optional). For detailed operations, please refer to the Operator's Manual of the vital signs monitor.
4. Connect AC power.
5. Connect the accessories.


Installation Support

The vital signs monitor can be mounted on a wall bracket or on a trolley support. The wall bracket or trolley support 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 mounting brackets we supply or approve. If other compatible mounting bracket is used, be sure it can be safely used on the vital signs monitor.**
 - **The mounting bracket should be installed by our qualified service personnel, or engineers who have adequate knowledge on it.**
 - **If other mounting solution is used, the installation personnel and the customer should verify if it can be safely used on the equipment, and the customer assume the responsibility for any risk resulting from that.**
-

3.3.1 Preparation for Power on

1. Before you start to make measurements, check the equipment 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

4 Testing and Maintenance

4.1 Introduction

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 Customer Service Department.



- **All tests should be performed by qualified service personnel only.**
 - **Care should be taken to change 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 applicable.**
-

4.1.1 Test Equipment

See the following sections.

4.1.2 Test Report

Upon the completion of the tests, the table of preventative maintenance test reports and the table of maintenance test reports in this chapter should be kept properly.

4.1.3 Preventative Maintenance

Below are preventative maintenance tests which need to be performed on the monitor. The recommended frequency of preventative maintenance is at least once per year. See the following sections for detailed maintenance procedures.

- Visual inspection
- NIBP test

4.1.4 Recommended Frequency

Check/Maintenance Item		Frequency
Visual inspection		1. When first installed or reinstalled.
Power-on test		1. When first installed or reinstalled. 2. Following any repairs or replacement of any main unit parts.
SpO ₂ test		1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once every two years. Note: At least once a year is recommended for NIBP and CO ₂ .
NIBP test	Pressure check	
	Leakage test	
CO ₂ test	Performance test	
	Calibration	
TEMP test	Infrared ear thermometer	
	Exergen TemporalScanner thermometer	
	SmarTemp™ module	
Nurse call function test		If the user suspects that the nurse call function does not work well.
Electric Safety Tests	Refer to Appendix A Electrical Safety Inspection.	1. Following any repair or replacement of power module 2. After the monitor drops. 3. At least once every two years.
Touchscreen Calibration		1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
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.

4.2 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.

4.3 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 is passed.
4. The welcome screen passes and the main interface is displayed. Now the equipment is correctly started.

4.4 Module Performance Tests

4.4.1 SpO₂ test

Test Method 1

Tool required:

- None

1. Connect SpO₂ sensor for adult to the SpO₂ connector of the monitor. Set [**Patient Cat.**] to [**Adu**].
2. Apply the SpO₂ sensor to your ring finger (assume that you stay healthy).
3. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO₂ is within 95% and 100%.
4. Remove the SpO₂ sensor from your finger and make sure that an alarm of SpO₂ Sensor Off is triggered.

Measurement validation

The SpO₂ 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:

- SpO₂ simulator, Index-2 recommended

1. Connect the SpO₂ sensor to the SpO₂ simulator.
2. Selected the model and manufacturer of the SpO₂ module to be tested on the simulator, and set the simulator as follows: SpO₂ to 96% and PR to 80 bpm.
3. Set the patient type to **[Adu]**, **[Ped]**, and **[Neo]** respectively. Observe the monitor and make sure the displayed SpO₂ and PR value fall in the following range.

Manufacturer	SpO ₂	PR
Mindray	96% ± 2% (Adult, pediatric) 96% ± 3% (Neonate)	80 ± 3 bpm
Nellcor	96% ± 2% (Adult, pediatric) 96% ± 3% (Neonate)	80 ± 3 bpm
Masimo	96% ± 2% (Adult, pediatric) 96% ± 3% (Neonate)	80 ± 3 bpm

4.4.2 NIBP Test

Leakage Test

NOTE

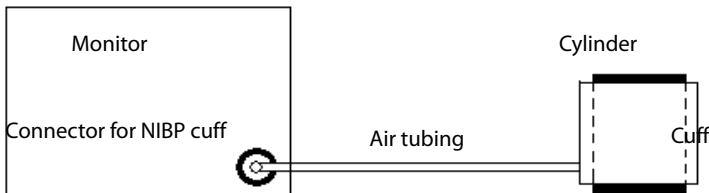
- **Perform NIBP leakage test before any other NIBP concerned test and calibration.**
-

Tools required:

- NIBP cuff for adult patient
- Air tubing
- Cylinder

Follow this procedure to perform the leakage test:

1. In the [**Patient Demographics**] menu, set [**Patient Cat.**] to [**Adu.**].
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 >>**]→[**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 completed. 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 leakage. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again. If the problem persists, contact your service personnel.

You can either 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 balloon pump. Then, wait for 5 s to let the measured values becoming stable.
3. Record the current pressure value, and meanwhile use a time counter to count the time. Then, record the pressure value after 60 s.
4. Compare the two pressure values and make sure the difference should not be greater than 6 mmHg.

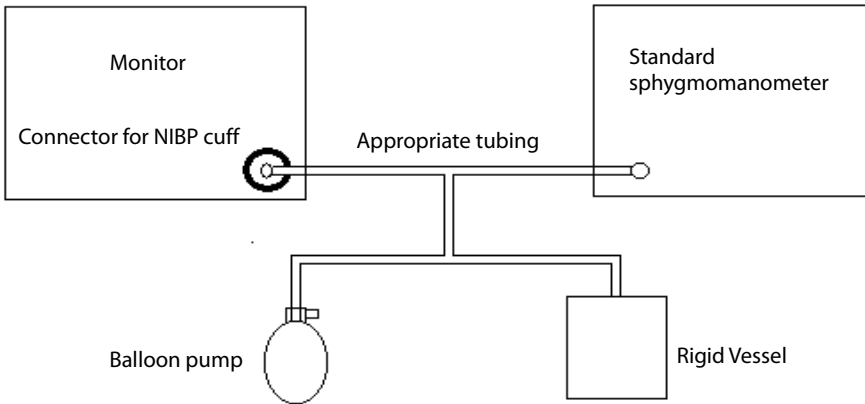
NIBP Accuracy Test

Tool required:

- T-shape connector
- Appropriate tubing
- Balloon pump
- 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 equipments as shown below.



2. Before inflation, check that the reading of the manometer is 0. If not, turn off the balloon pump to let the whole airway open to the atmosphere. Turn on the balloon pump after the reading is 0.
3. Select **[Main]**→**[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 balloon pump. 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, calibrate the monitor as described in .
7. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. 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 balloon pump and the reference manometer to perform the test.
- You can use an appropriate cylinder and a cuff instead of the rigid vessel.

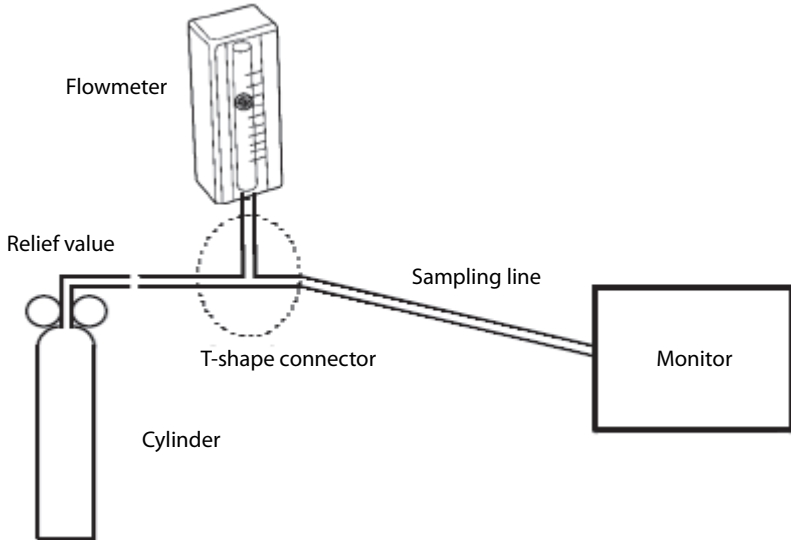
4.4.3 CO₂ Test

Accuracy test

Tool required:

- A steel gas cylinder with $5 \pm 0.03\%$ CO₂ and balance gas N₂ (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:



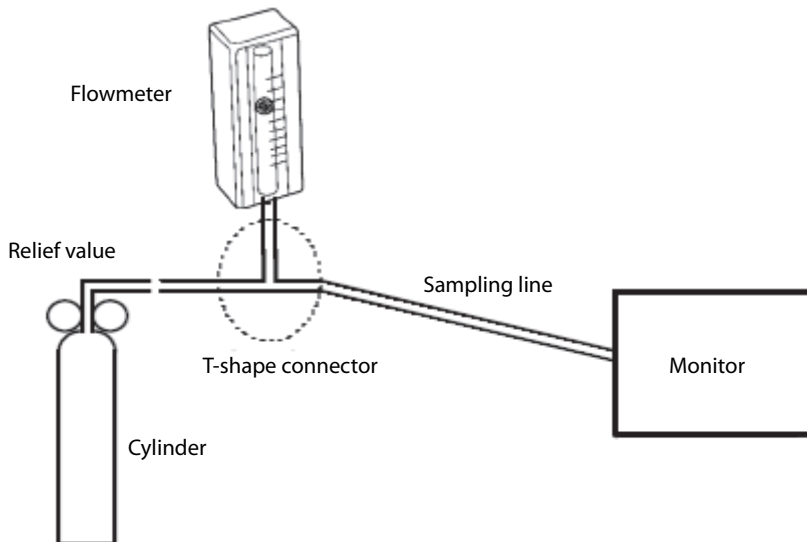
3. Open the valve to flow CO₂ and make sure that there is flow sufficient to vent to atmosphere.
4. Verify the realtime CO₂ value is within $5.0 \pm 0.3\%$ in the **[Calibrate CO₂]** menu.

CO₂ calibration

Tool required:

- A steel gas cylinder with $5 \pm 0.03\%$ CO₂ and balance gas N₂ (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 flow CO₂ and make sure that there is flow sufficient to vent to atmosphere.
5. In the **[Calibrate CO₂]** menu, enter the CO₂ concentration in the **[CO₂]** field.
6. In the **[Calibrate CO₂]**, the measured CO₂ concentration is displayed. After the measured CO₂ concentration becomes stable, select **[Calibrate CO₂]** to calibrate the CO₂ module.

If the calibration is finished successfully, the message **[Calibration Completed!]** is displayed in the **[Calibrate CO₂]** menu. If the calibration failed, the message **[Calibration Failed]** is displayed. In this case, perform another calibration.

4.4.4 Infrared Ear Thermometer/Exergen TemporalScanner Thermometer Test

Tool required:

- Water bath
 - Blackbody as specified in EN 12470-5-2003
 - Four-channel thermometer
1. Put the probe of four-channel thermometer into water bath, and then put the blackbody into water bath, set the water bath to 37.0°C. allow the water bath sufficient time to equilibrate.
 2. Set the infrared ear thermometer (THP79JU Infrared ear thermometer or Convidien Genius 2 Tethered Tympanic Thermometer or Exergen TemporalScanner Themometer) to EAR mode and "°C".
 3. Install a new probe cover. Measure and record the target temperature of blackbody with infrared ear thermometer and four-channel thermometer.

4. Verify accuracy of temperature on monitor(subtract temperature value on four-channel thermometer from temperature value on monitor) is within $\pm 0.2^{\circ}\text{C}$ for THP79JU Infrared ear thermometer or $\pm 0.1^{\circ}\text{C}$ for Covidien Genius 2 Tethered Tympanic Thermometer or $\pm 0.1^{\circ}\text{C}$ for Exergen TemporalScanner Thermometer.
5. Repeat sections 1 to 4. For water bath set to 42.0°C .
6. Verify accuracy of temperature on monitor is within $\pm 0.2^{\circ}\text{C}$ for both types of infrared ear thermometer.

Please contact our service personnel if the Temp test fails.

4.4.5 SmarTemp™ Module Test

Method 1

Tool required:

- Resistance box (with accuracy above $0.1\ \Omega$)

1. Connect the Temperature probe to Monitor. Connect the two wires (orange wires) of Temp probe connector to the two ends of the resistance box.
2. Set the resistance box to $9882.0\ \Omega$ (corresponding temperature is 25.3°C).
3. Verify displayed temperature value on monitor is within $25.3 \pm 0.1^{\circ}\text{C}$.
4. Set the resistance box to $6037.1\ \Omega$ (corresponding temperature is 37.0°C).
5. Verify displayed temperature value on monitor is within $37.0 \pm 0.1^{\circ}\text{C}$.
6. Set the resistance box to $4619.2\ \Omega$ (corresponding temperature is 43.7°C).
7. Verify displayed temperature value on monitor is within $43.7 \pm 0.1^{\circ}\text{C}$.

Please contact our service personnel if the Temp 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°C may exist in predictive Temp measurement by liquid bath techniques.**
-

Method 2

Tool required:

- Thermostatic oil tank (HART 7102 is recommended)

1. Set the temperature of the oil tank to 37°C and conduct the test after the temperature stabilizes.
2. Set the Temp type of the monitor to **[Monitor]**.
3. Remove the Temp probe from the probe sheath and put it into the oil tank.


4. Wait till the Temp value displayed on the monitor stabilizes. Verify that the displayed value is $37\pm 0.1^{\circ}\text{C}$.

Please contact our service personnel if the Temp test fails.

4.4.6 Nurse Call Reply Performance Test

Tool required:

- Oscilloscope

1. Connect the nurse call cable to the Multifunctional Connector of the equipment.
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 oscillograph 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. Make the monitor to generate an alarm and check that the oscillograph displays positive pulses of 1s width when there is an alarm.

4.4.7 Bar Code Scanner Test

Tool required:

- None

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.



4.5 Electric Safety Tests

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

4.6 Touchscreen Calibration

Tool required:

- None

1. Select [**Main**]→[**Maintenance >>**]→[**Touchscreen Calibration**].
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.

4.7 Recorder check

Tool required:

- None

1. Print SpO₂ Pleth waveform. The recorder should print correctly and the printout should be clear.
2. Set the recorder to some problems such as out of paper, etc., and then the equipment should give corresponding prompt messages. After the problem is removed, the recorder should be able to work correctly.
3. Set the recorder to print trend data. Check that the recorder can give printouts accordingly.

Please contact our service personnel if the recorder test fails.

4.8 Battery Check

Tool required:

- None

Functional Test

1. If the equipment is installed with a battery, remove the battery first.
2. Verify that the equipment works correctly when running powered form an AC source.
3. Insert the battery per the procedures provided in the Operator's Manual.
4. Remove the AC power cord and verify that the equipment still works correctly.

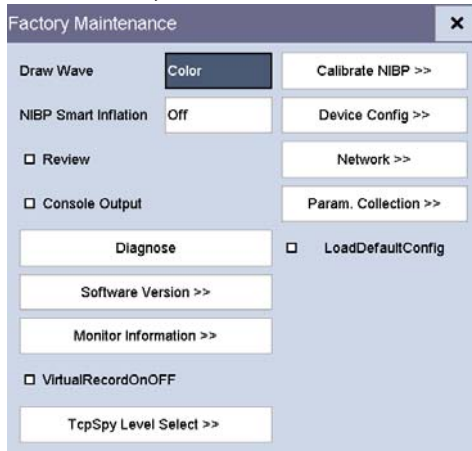
Performance Test

Perform the test by referring to the **Battery** chapter in the **Operator's Manual** (P/N: H-046-004882-00) and verify the operating time of the battery meets the product specification.

4.9 Factory Maintenance

4.9.1 Accessing Factory Maintenance Menu

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



4.9.2 Drawing Waves

There are two methods to draw waves: **[Color]** and **[Mono]**.

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

4.9.3 Software Version

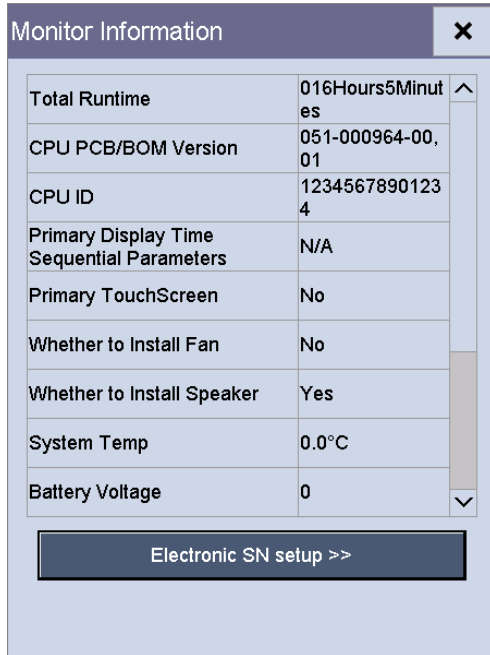
Selecting the **[Software Version >>]** will show software version information, as shown below:

Software Version:	
System Software Version:	03.00.00
Power Software Version	N/A
UBoot	11.22.33
Kernel	00.11.22
Keypad Module	N/A
Recorder Module	N/A
NIBP Module Software Version:	N/A
Mindray SpO2 Module Software Version:	N/A
Fast Temp Module Software Version:	N/A
Language Library Version	01.00.00
Icon Library Version	01.00.00

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

4.9.4 Monitor Information

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



The screenshot shows a dialog box titled "Monitor Information" with a close button (X) in the top right corner. The dialog contains a table of system parameters and a button at the bottom.

Total Runtime	016Hours5Minutes	^
CPU PCB/BOM Version	051-000964-00, 01	
CPU ID	12345678901234	
Primary Display Time Sequential Parameters	N/A	
Primary TouchScreen	No	
Whether to Install Fan	No	
Whether to Install Speaker	Yes	
System Temp	0.0°C	
Battery Voltage	0	v

Electronic SN setup >>

NOTE

- **If the main board is replaced, you need to check the label on the main unit and reconfigure the serial number of the monitor.**

If you need the calibration methods of Covidien Genius infrared ear module and Exergen TemporalScanner Thermometer module, please contact the manufacturer factory.

Maintenance and Test Report

(See the above sections for detailed test procedures and contents)

Customer name		
Customer address		
Servicing person		
Servicing company		
Equipment under test (EUT)		
Model of EUT		
SN of EUT		
Hardware version		
Software Version		
Test equipment	Model/No.	Effective date of calibration
Test Contents	Test Record	Test Result (Pass/Fail)
Visual Inspection		
The case, display screen, buttons, knob, power cord, wall mount, and accessories have no obvious signs of damage.		
The external connecting cables are not frayed and the connector pins are not loose and bent.		
The external connectors are not loose or their pins are not bent.		
The safety labels and data plate are clearly legible.		
Power-on test		
The power-on test is passed. The power indicator and alarm system work correctly and the monitor start up properly.		
Performance test		
SpO₂ test		
Measure SpO ₂ on a healthy person's finger and a Pleth wave and PR value are displayed. The displayed SpO ₂ value is within 95% and 100%.		
NIBP test		

The difference is within ± 3 mm when 0, 50 or 200 mmHg is set for NIBP accuracy test.		
There is no leakage with NIBP, or the manual leakage test result does not exceed 6 mmHg/min.		
CO₂ test		
The difference is within $\pm 0.3\%$ when gas level 5% is set for CO ₂ accuracy test.		
Temp test		
The accuracy of temperature on monitor is within $\pm 0.2^{\circ}\text{C}$ with THP79JU Infrared ear thermometer when the target temperatures are 37.0°C and 42.0°C.		
The accuracy of temperature on monitor is within $\pm 0.1^{\circ}\text{C}$ with Covidien Genius 2 Tethered Tympanic Thermometer when the target temperature is 37.0°C. The accuracy of temperature on monitor is within $\pm 0.2^{\circ}\text{C}$ with Covidien Genius 2 Tethered Tympanic Thermometer when the target temperature is 42.0°C.		
The accuracy of temperature on monitor is within $\pm 0.1^{\circ}\text{C}$ with Exergen TemporalScanner Thermometer when the target temperatures are 16.0°C and 43.0°C.		
The displayed Temp value on the monitor is within $37 \pm 0.1^{\circ}\text{C}$ with SmarTemp™ module.		
Nurse Call Reply Performance Test		
When an alarm is reported on the monitor, a nurse call is sent out through the cable.		
Barcode Scanner Test		
The indicator turns green and scanned characters are displayed on the monitor.		
Electric Safety Tests		
Refer to . All the electrical safety tests should be passed.		
Touchscreen Calibration		
The touchscreen is calibrated successfully.		
Recorder check		
The recorder can print correctly and the printout is clear.		
Set the recorder to some problems such as out of paper, etc. the monitor gives corresponding prompt messages. After the problem is removed, the recorder is able to work correctly.		
Automatic alarm recording for each parameter functions correctly when parameter alarms occur.		
Battery check		

The monitor can operate correctly from battery power when an AC power failure accidentally occurs.		
The monitor can operate independently on a single battery.		

Test conclusion

Tested by:

Test date:

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 eliminate the troubles.

The troubles we list here are frequently arisen difficulties and the actions we recommend can correct most problems, but not all of them. For more information on troubleshooting, contact our Customer Service 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 **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. Defective PCB can be sent to us for repair. If the trouble remains, exchange the replacement PCB with the original suspicious PCB and continue troubleshooting as directed in this chapter.

To obtain information on replacement parts or order them, refer to **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, self check, 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.

5.5 Checking Technical Alarms

Before troubleshooting the monitor, check for technical alarm messages. If an alarm message is presented, eliminate the technical alarm first.

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	1. Check if the cable between the display and main board and the backlight cable are correctly connected.

Symptoms	Possible Cause	Troubleshooting
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 is not light or extinguished, or the alarm lamp illuminates abnormally.	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 Knob 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.
Knob 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 knob encoder.
	Keypad board failure	Replace the keypad board.

5.6.5 Sound Failures

Symptoms	Possible Cause	Troubleshooting
No hardkey or knob sound, or hardkey or knob 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

- **When the battery module has a failure, it may cause problems to other components. In this case, troubleshoot the battery module per the procedure described in the table above.**
- **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	1. 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 clean solution.
	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 >>] → [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 garbage patient data, remove 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.

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 m.
	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 m.
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 m.
	Excessive requests for viewing the monitor at the same time	A monitor can only be viewed by 4 other monitors at the same time under the View Others mode. The excessive view requests system will be ignored.

Symptoms	Possible Cause	Troubleshooting
	Incorrect IP address configuration	Check for IP address conflict. If yes, reconfigure the IP address.

5.6.11 Wi-Fi Related Problems

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 hospital Wi-Fi network.
	The monitor's Wi-Fi antenna is detached or not properly connect 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 hospital Wi-Fi network.
	The monitor's Wi-Fi antenna is detached or not connect 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 stopped" is reported	Cable defective inside the module	Check the cables connecting the converter board and corresponding parameter module.
	Parameter module defective	Replace the corresponding module.

or some parameters cannot be used	Converter board defective inside the module	Replace corresponding converter board.
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"XX" indicates the configured modules, such as NIBP, SpO₂ and Temp.

5.6.13 THJ79JU Infrared Ear Thermometer Module Problems

Symptoms	Possible Cause	Troubleshooting
Er	Error 5~9, the system is not functioning properly.	Unload the battery, wait for 1 minute and repower it. If the message reappears, contact the retailer for service.
Er 1	A measurement is taken before device stabilizes.	Wait until all the icons stop flashing.
Er 3	The ambient temperature is beyond the range of 10°C - 40°C (50°F - 104°F).	Keep the thermometer from operating for at least 30 minutes at a temperature of 10°C - 40°C (50°F - 104°F).
H _i	Temperature taken is higher than +42.2°C (108°F).	Check the integrity of the probe cover and take a new temperature measurement.
Lo	Temperature taken is lower than +32°C (89.6°F).	Make sure the probe cover is clean and take a new temperature measurement.

5.6.14 Genius™ 2 Infrared Ear Thermometer Module Problems

Symptoms	Possible Cause	Troubleshooting
Temperature reading unusually high	The installed probe cover is with non-smooth membrane on the thermometer.	Check the probe cover for tears or gaps.
Temperature reading unusually low	Cerumen plugs or impactions containing debris can lower the temperature measurement by several tenths of a degree.	Check the probe cover and thermometer tip for obstructions. Check the patient ear canal for obstructions.
Display blank	Poor contact.	Check tethered connectivity.

<p>Site mode corruption error displayed.</p> 	<p>Site mode corruption</p>	<p>If system error “12”, power off the thermometer. Enter Biotech mode to reset the site mode. Save the Biotech settings and let the thermometer power off. For all other system errors, reset the thermometer by installing a probe cover. If the system error does not clear, contact the factory for available service options.</p>
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5.6.15 Exergen TemporalScanner Thermometer Module Problems

Symptoms	Possible cause	Troubleshooting
<p>Abnormally low Temperature</p>	<p>Dirty Lens</p>	<p>Clean lens of scanner every two weeks.</p>
	<p>Releasing the button before finished measuring</p>	<p>Release the button after finished measuring.</p>
	<p>Measuring when an ice pack or wet compress is on the forehead</p>	<p>Remove ice pack or wet compress, wait 2 minutes, and re-take temperature.</p>
	<p>Measuring a completely diaphoretic patient</p>	<p>Complete diaphoresis includes diaphoresis of area behind the ear and suggests that the temperature is rapidly dropping. Use an alternative method of temperature measurement in these cases until the patient is dry and the temporal artery measurement can be repeated.</p>
<p>Abnormally high temperature</p>	<p>Anything covering the area to be measured would insulate and prevent heat from dissipating, resulting in false high readings.</p>	<p>Confirm measurement site has not recently been in contact with heat insulators such as hats, blankets, and hair. Scan the area not covered or wait about 30 seconds for the previously covered area to equilibrate to the environment.</p>
<p>Processing Error</p>	<p>Error</p>	<p>Restart. Return for repair if error message persists</p>

5.6.16 CO₂ Module Problems

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 fail. Change the CO ₂ module.
CO ₂ Zero Failed	The zeroing failed.	Wait for 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 the time.

5.6.17 Software Upgrade Problems

Symptoms	Possible Cause	Troubleshooting
Boot file upgrade fails	Power failure or unintended power off during boot file upgrade	Replace the main board.
Program upgrade fails	Incorrect network connection	1. Check the network connector on the monitor. 2. Make sure that the hub or switch runs normally. Check that net twines are of the right type and have been connected correctly.
	Wrong upgrade package has been downloaded	Select package according to system requirement. Upgrade package shall be .pkg files.
	Incorrect IP address configuration	Configure a fixed IP address for the monitor. We recommend not to upgrade a program when the monitor is connected to a network with multiple PCs.
Battery abnormal after upgrading the power management program	Fails to power cycle the monitor after upgrading the power management program	Upgrade the power management software again and then power cycle the monitor.

5.6.18 Technical Alarm Messages

Please refer to the Operator's Manual.

FOR YOUR NOTES

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.**
 - **Select appropriate screws to assemble the equipment. If unfit screws are tightened by force, the equipment may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**
 - **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.**
 - **Be sure to place removed screws and disassembled parts properly, preventing them from being lost or contaminated.**
 - **Place the screws and parts from the same module together to facilitate reassembling.**
 - **To reassemble the equipment, first assemble the assemblies, and then the main unit. Carefully route the cables.**
 - **Make sure that the waterproof material is properly applied during reassembling.**
-
-

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 the operations should be performed by qualified service personnel only. Make sure to put on the insulating gloves during service operations.
- Operations relating to optional parts may not apply to your equipment.

6.3.1 Disassembling the SmarTemp™ Module (Optional)

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



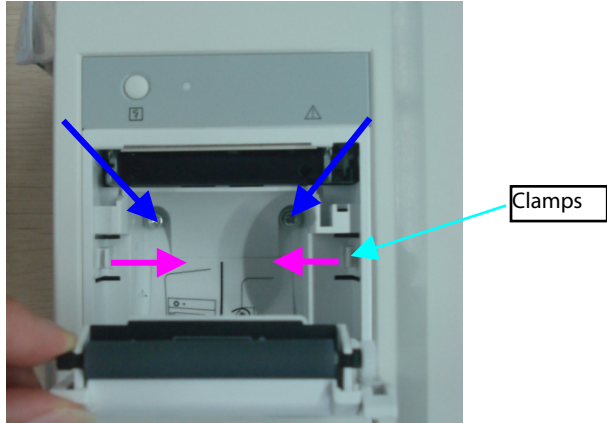
6.3.2 Disassembling the Infrared Ear Thermometer Module (Optional)

Lay the monitor on a table as shown below. Unscrew the three M3×6 screws, pull the Infrared Ear Thermometer module up, and disconnect the infrared ear temperature cable.



6.3.3 Removing the Recorder

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



NOTE

- The recorder can be disassembled separately.

6.3.4 Separating the Front and Rear Half of the Monitor

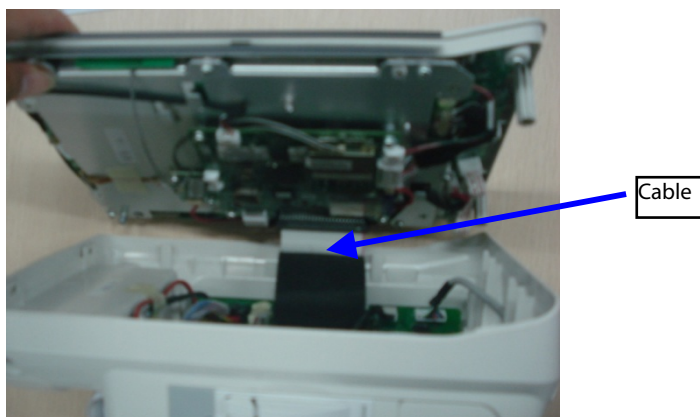
1. Lay the monitor on a table as shown below. Unscrew the four M3 screws.



2. Remove the recorder or recorder cover, and pull the rear housing out as indicated below to separate the fastener that are fixing 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.

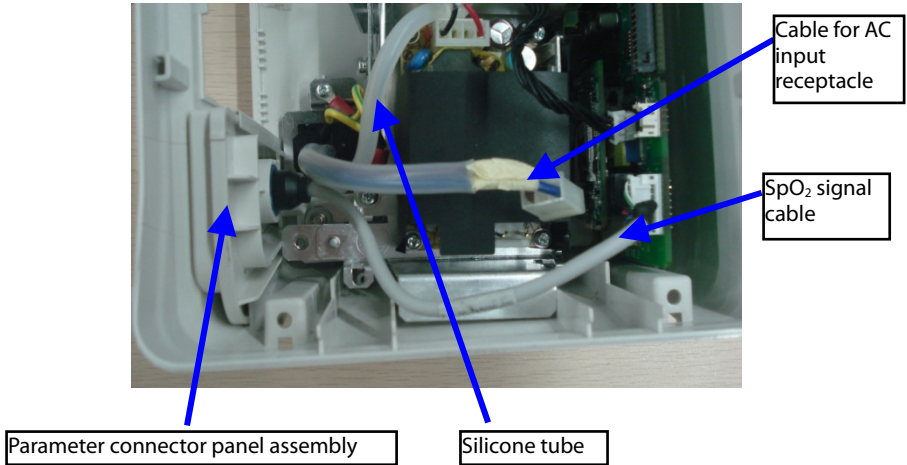


NOTE

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

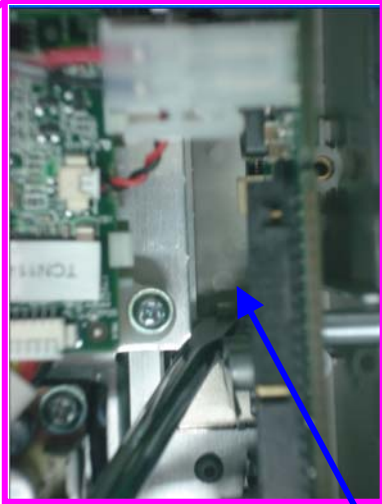
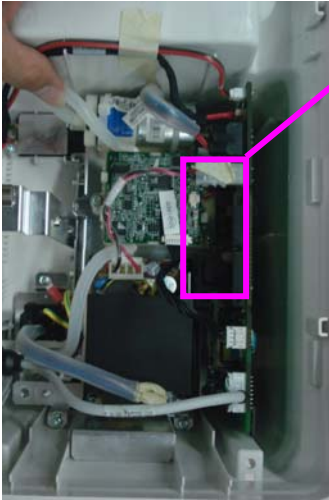
6.3.5 Removing the Parameter Connector Panel Assembly

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

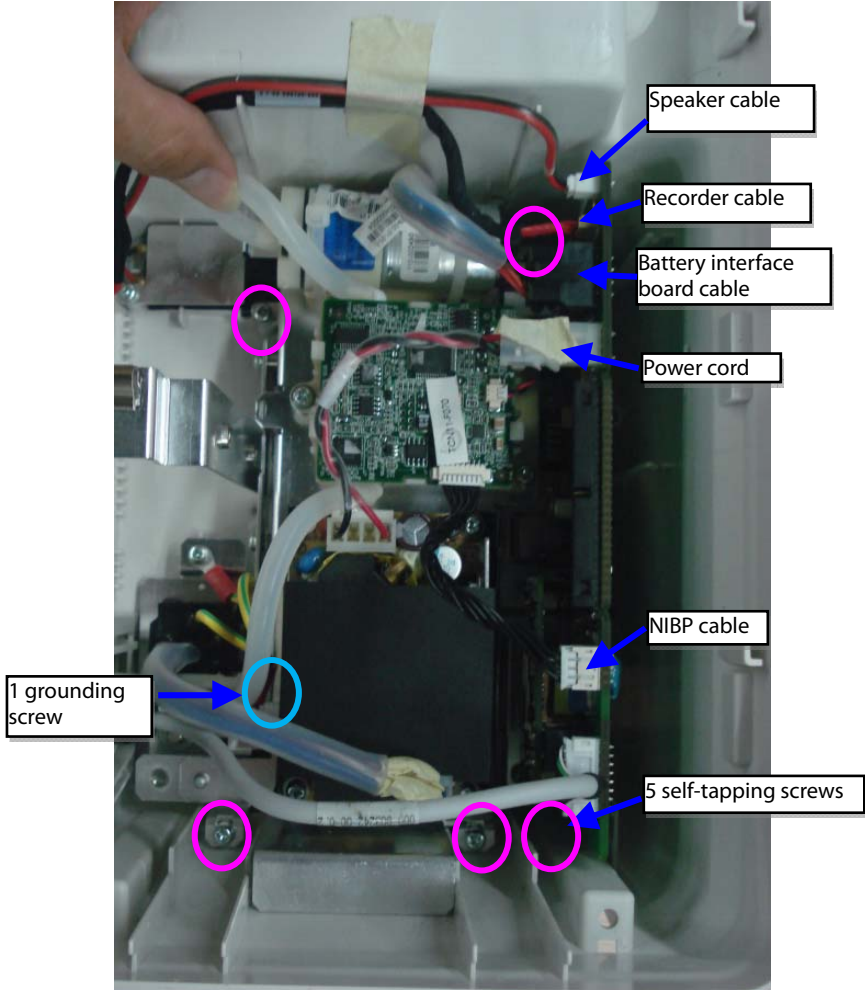


6.3.6 Disassembling the Main Bracket Assembly

For monitors without multi-function connector, you need to prize the cover from the inside of the monitor with a slot-type screwdriver, and then take out the cover.

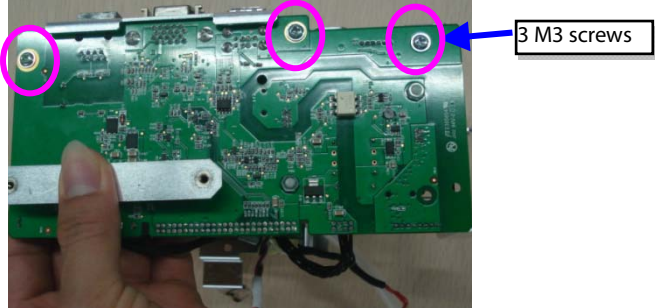


Disconnect the speaker cable, recorder cable, power cable, battery interface board cable, and NIBP cable. Unscrew the five PT3×8 screws and a M4 screw. Then take out the main bracket assembly.

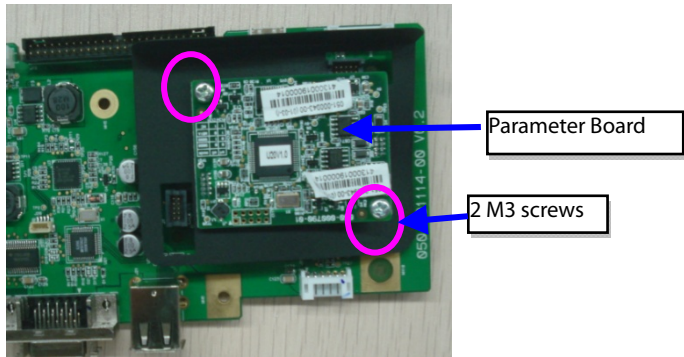


6.3.7 Removing the Parameter Board (SpO₂ Optional) and Power Management Board

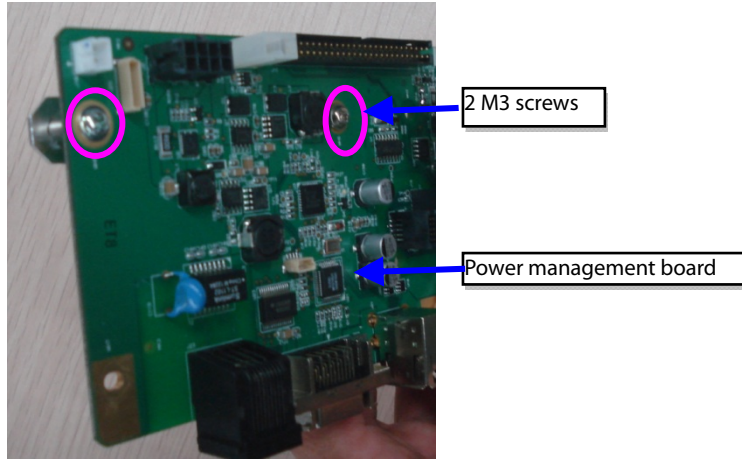
1. Unscrew the three M3×6 screws and take the power management board assembly from the main bracket assembly.



2. Unscrew the two M3×4 screws and take the parameter board out from the power management board assembly.

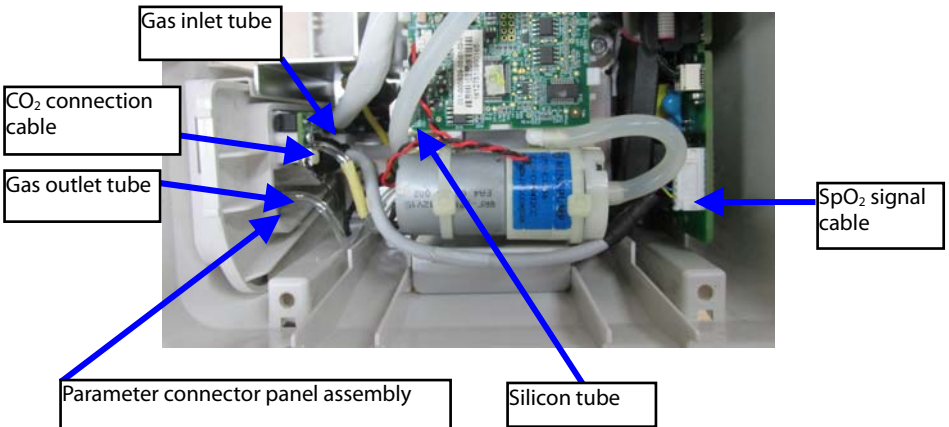


3. Unscrew the two M3×6 screws and take out the power management board assembly.



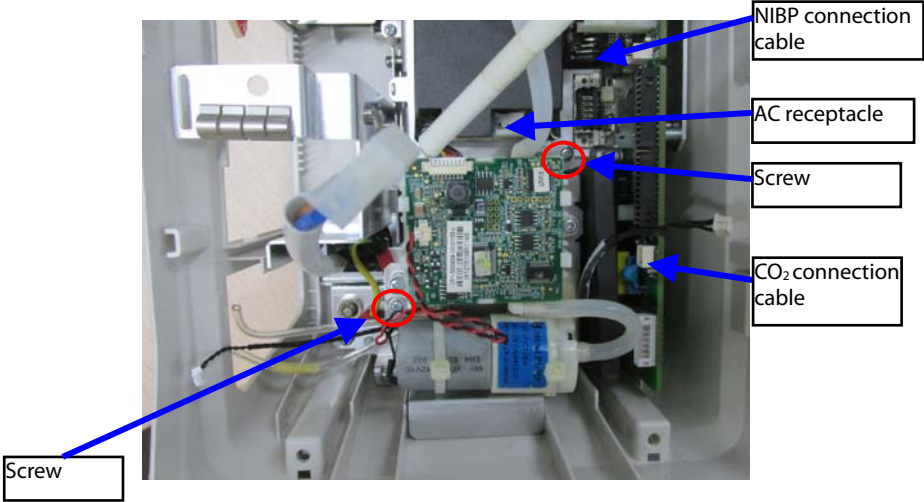
6.3.8 Removing the Parameter Connector Panel Assembly (With CO₂)

1. Lay the rear housing assembly of the equipment on a table.
2. Pull out the AC receptacle, SpO₂ cable, and then the silicon tube, gas inlet tube, gas outlet tube and CO₂ connection cable.



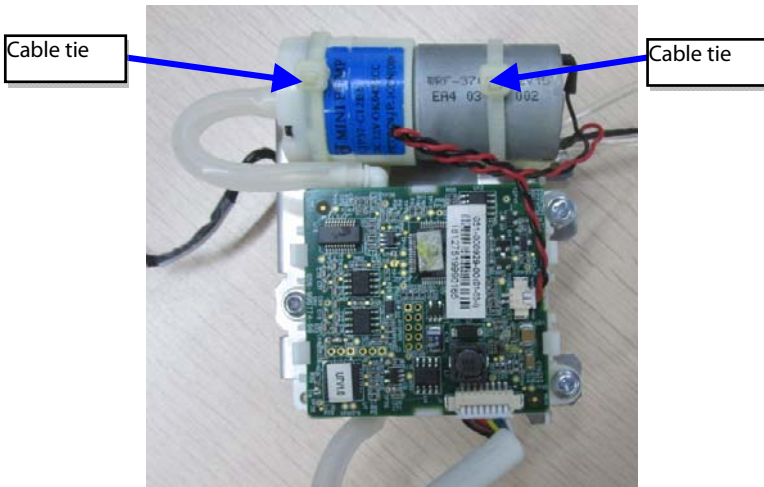
6.3.9 Disassembling the CO₂ Module Assembly

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

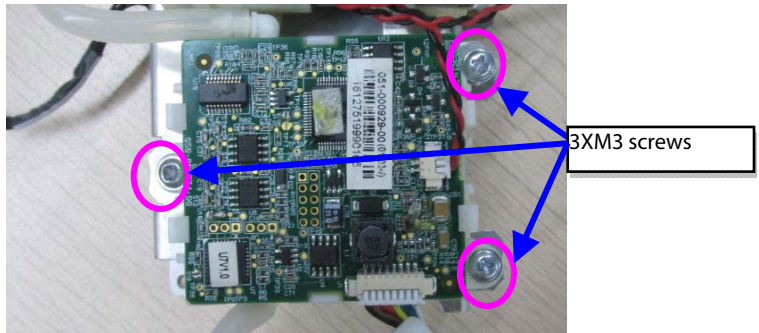


6.3.10 Disassembling Pumps and Valves (NIBP optional)

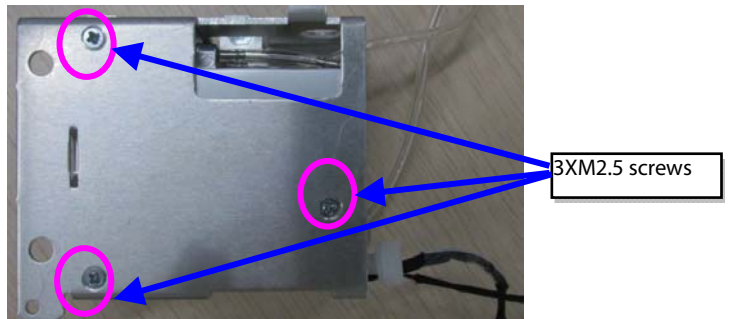
1. Cut the two cable ties and take out the gas pump.



2. Unscrew the three M3×6 screws as indicated and take out the valve.

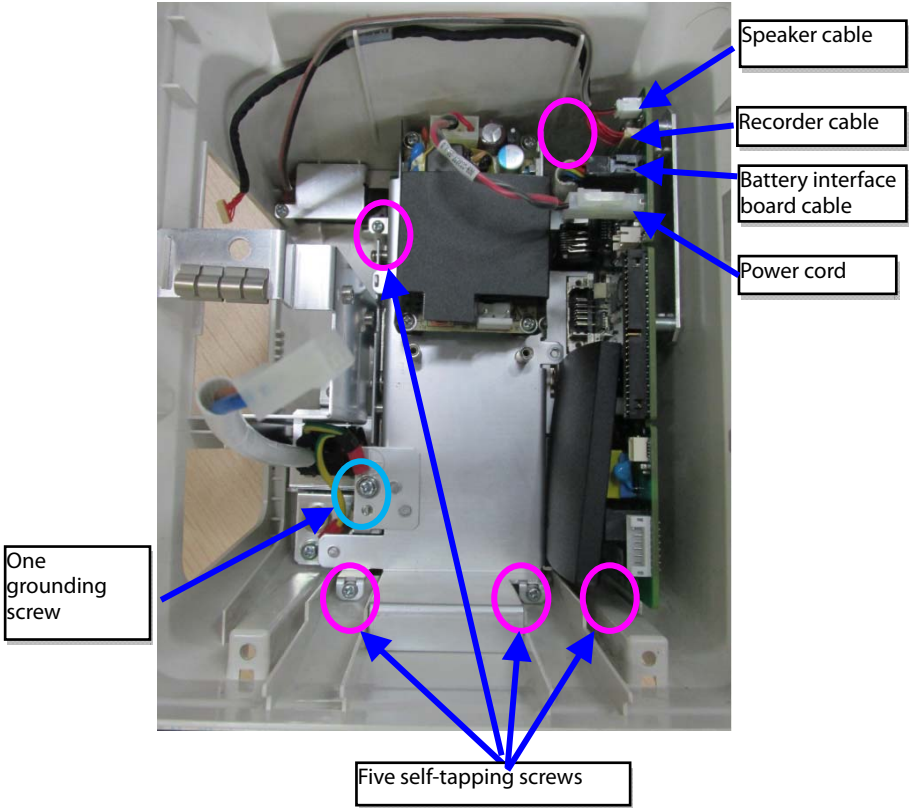


6.3.11 Disassembling CO2 main Module



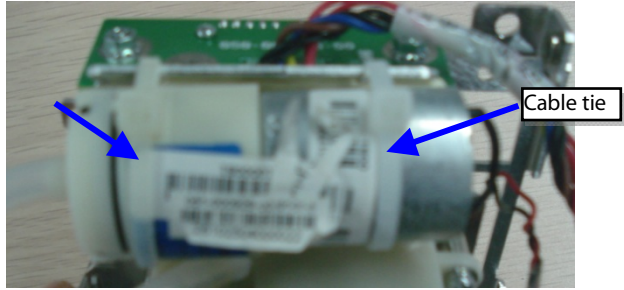
6.3.12 Disassembling the Main Bracket Assembly (With CO₂)

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

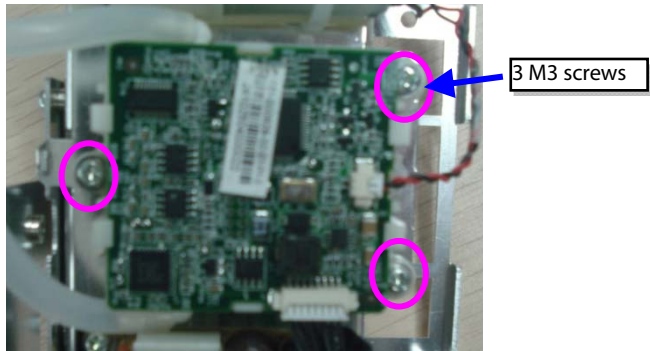


6.3.13 Disassembling Pumps and Valves (NIBP optional)

1. Cut the two cable ties and take out the gas pump.

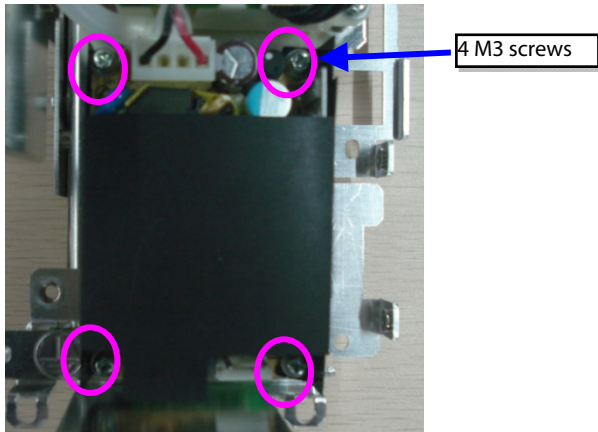


2. Unscrew the three M3x6 screws as indicated and take out the valve.

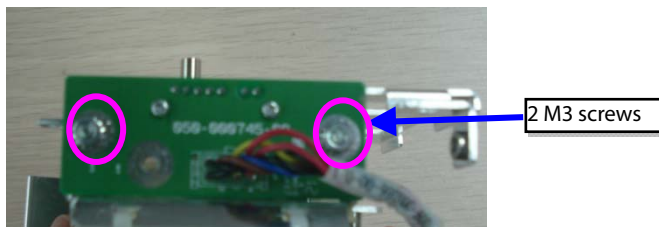


6.3.14 Disassembling AC/DC Power Board and Battery Converter Board

1. Unscrew the four M3x6 screws as indicated and take out the AC/DC power board.



2. Unscrew the two M3 nuts to take out the battery interface board.



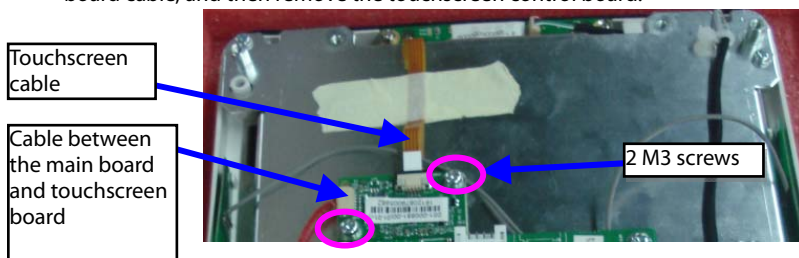
6.4 Disassembling the Front Housing Assembly

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.

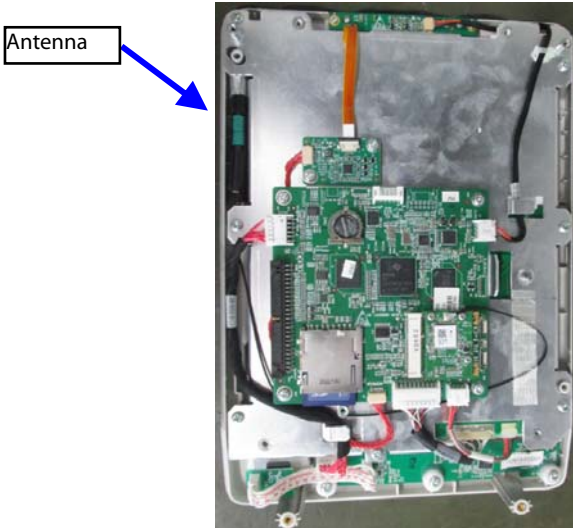
6.4.1 Removing the Touchscreen Control Board (Optional)

Loose and unscrew the two M3×6 screws as shown below. Disconnect the cable between main board and touchscreen board, the touchscreen board, and the touchscreen control board cable, and then remove the touchscreen control board.

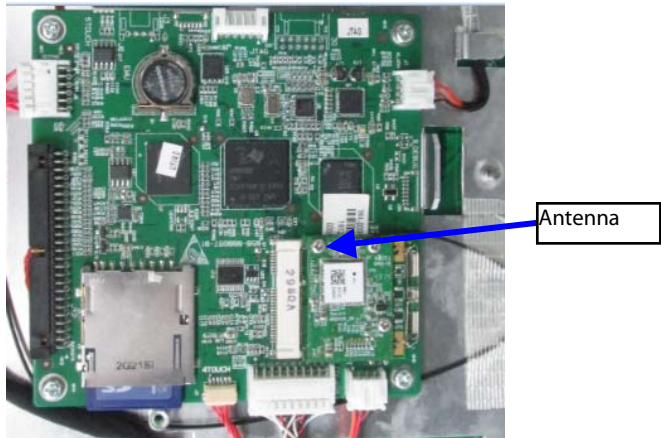


6.4.2 Removing the Wi-Fi Module (Optional)

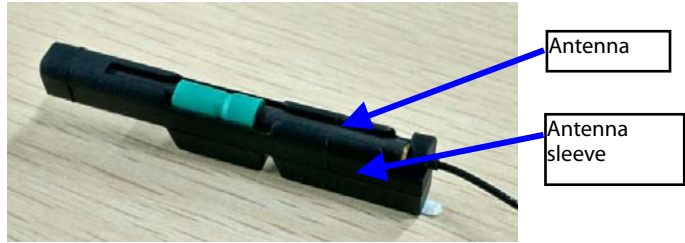
1. Remove the antennas on the front panel from the slots as shown below:



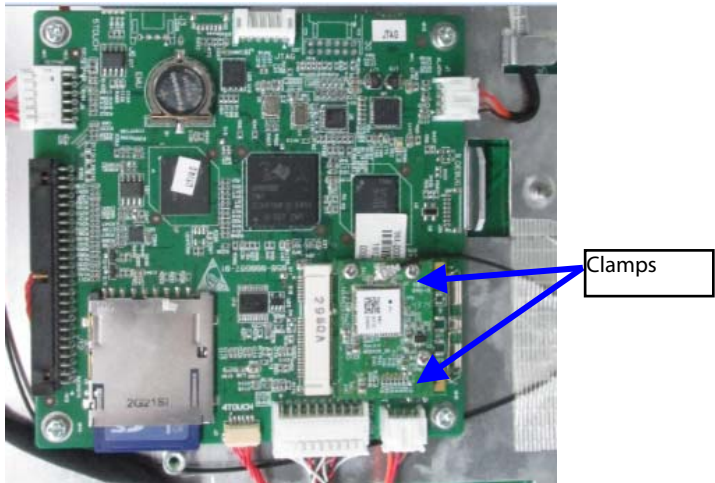
2. Remove the antennas from the Wi-Fi module PCBA.



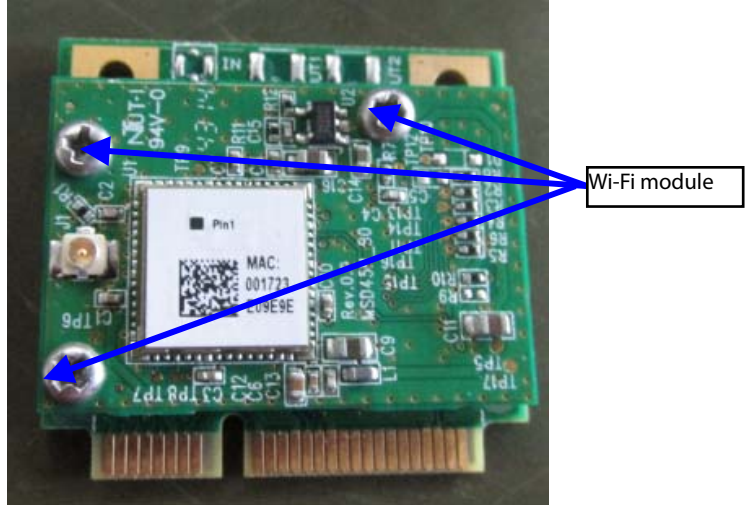
3. Remove the antennas from antenna sleeve.



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

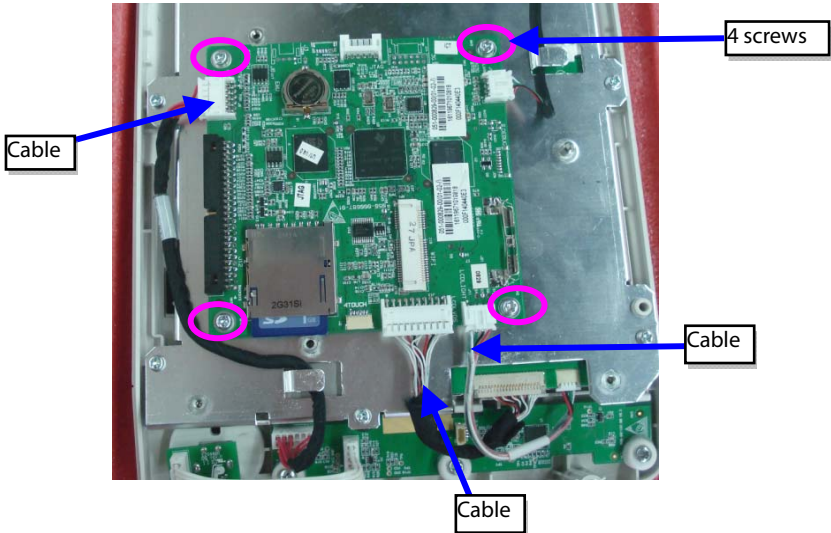


5. Remove the Wi-Fi module.



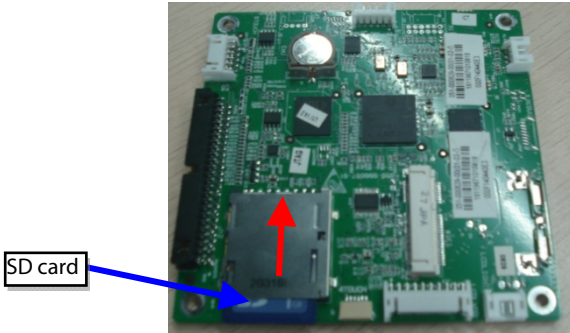
6.4.3 Removing the Main Control Board

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 M3x8 screws and take out the main board, as shown below:



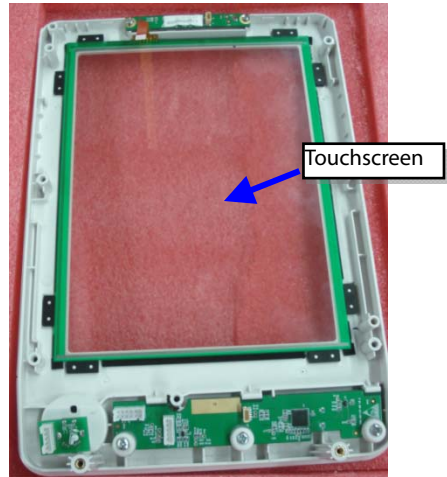
6.4.4 Removing SD Card (Optional)

Take out the main board for VS-900, and push the SD card as indicated below to take out the SD card.



6.4.5 Removing the Touchscreen (Optional)

Unscrew the seven PT3x8 screws as indicated below. Take out the touchscreen assembly and then the touchscreen.



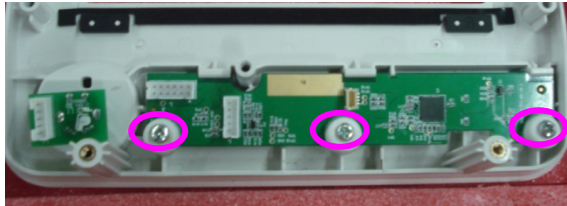
6.4.6 Disassembling the Display

Unscrew the four M3x6 screws indicated below to remove the screen.



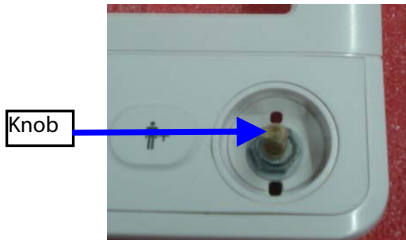
6.4.7 Removing the Keypad

Unplug the encoder cable and unscrew the three PT3x8 screws indicated below. Take out the keypad.



6.4.8 Removing the Encoder

Poke the encoder knob out from the slot and loose the nut with a sharp nose plier. Take out the encoder.



6.4.9 Removing the Alarm Lamp

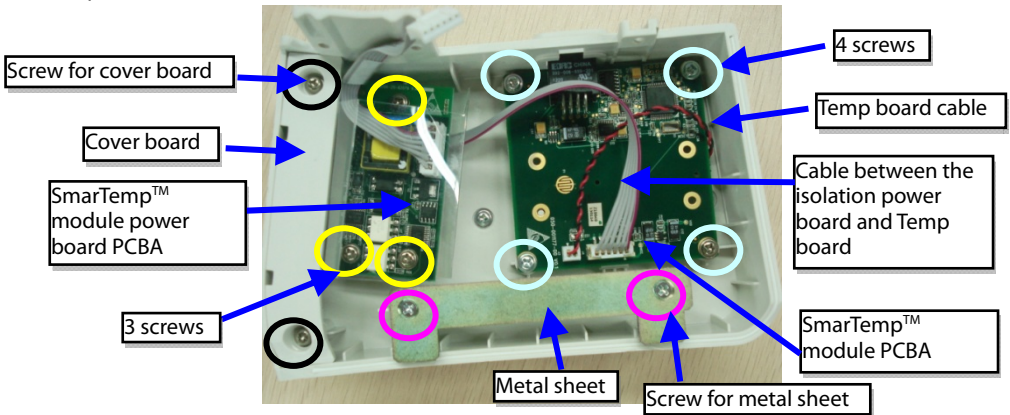
Unscrew the four PT2×6 screws indicated below and take out the alarm lamp board and alarm lamp.



6.5 Disassembling the SmarTemp™ Module (Optional)

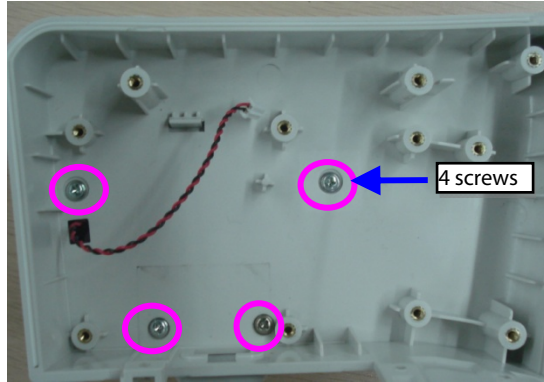
6.5.1 Removing the SmarTemp™ Module PCBA and SmarTemp™ Module Power Board PCBA

Unscrew the two M3×6 screws and the two M3 screws. Remove the cover board and metal sheet. Disconnect the Temp board cable and the cable between Temp isolation power board and Temp board. Unscrew the four M3×6 screws, you can take out the SmarTemp™ module PCBA. Then unscrew the three M3×6 screws, you can take out the SmarTemp™ module power board PCBA.

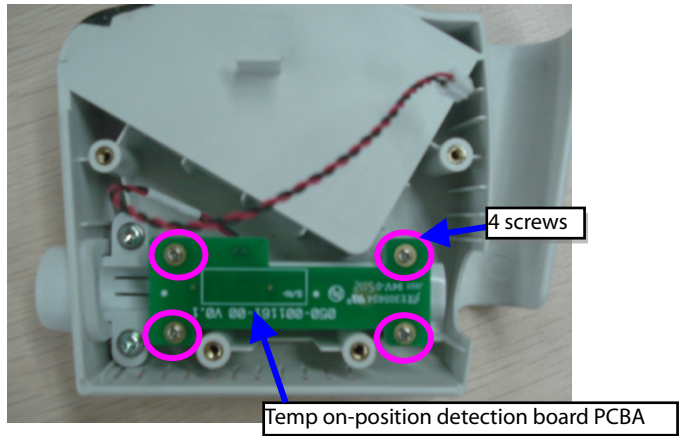


6.5.2 Disassembling the Temp On-Position Detection Board PCBA

1. Unscrew the four M3×6 screws as indicated and take out the SmarTemp™ module housing.



2. Unscrew the four M2 screws as indicated below and take out the Temp on-position detection board PCBA.



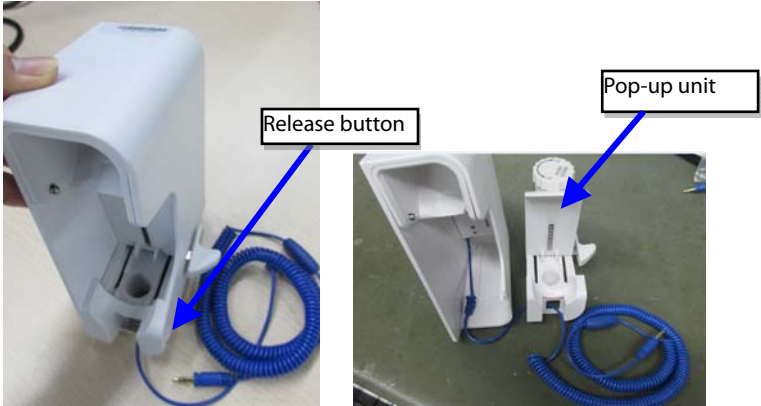
NOTE

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

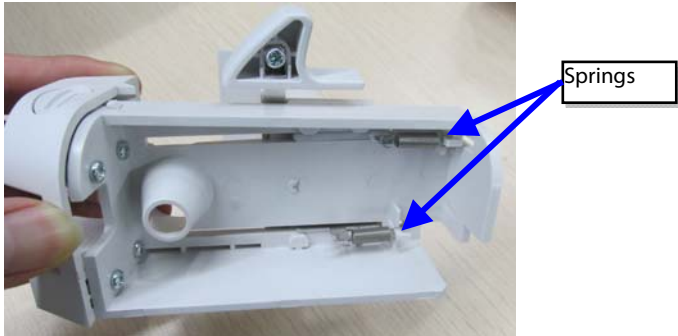
6.6 Disassembling the Infrared Ear Thermometer Module (Optional)

6.6.1 Disassembling the Pop-up Unit

1. Press the release button, and pull the pop-up unit out of the infrared ear thermometer module.

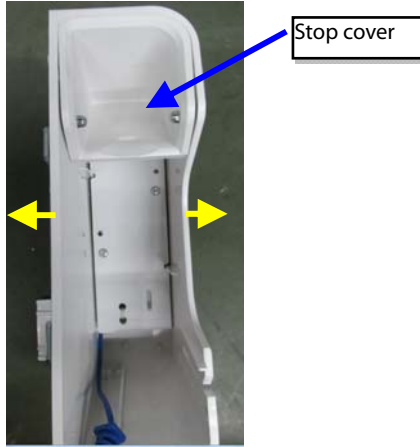


2. Remove the two springs under the pop-up unit.

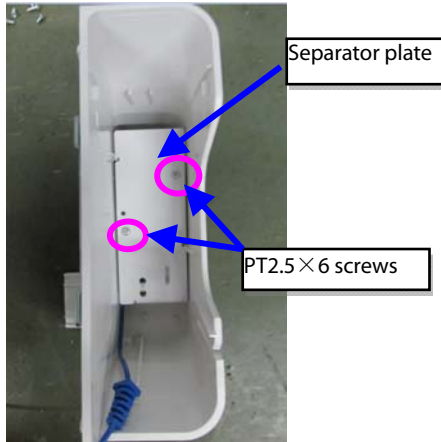


6.6.2 Disassembling the Separator Plate PCBA

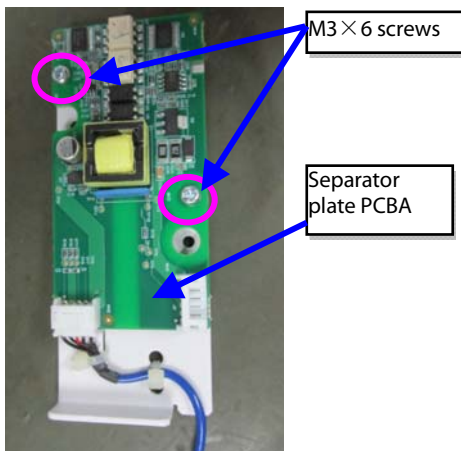
1. As indicated in the figure below, pull both sides of the pop-up unit open, and take out the stop cover.



2. Unscrew the two PT2.5×6 screws to take out the separator plate.

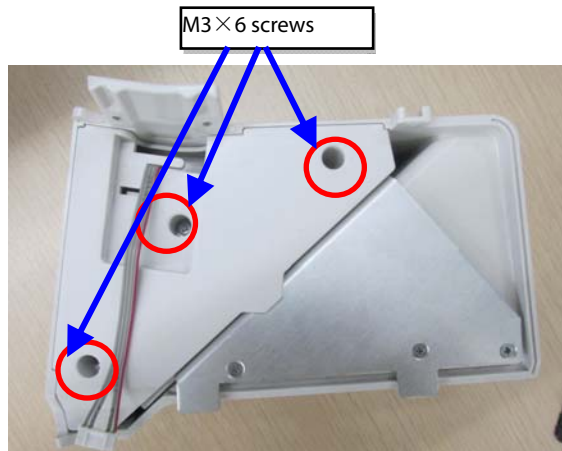


3. Unscrew the two M3×6 screws to take out the separator plate PCBA.

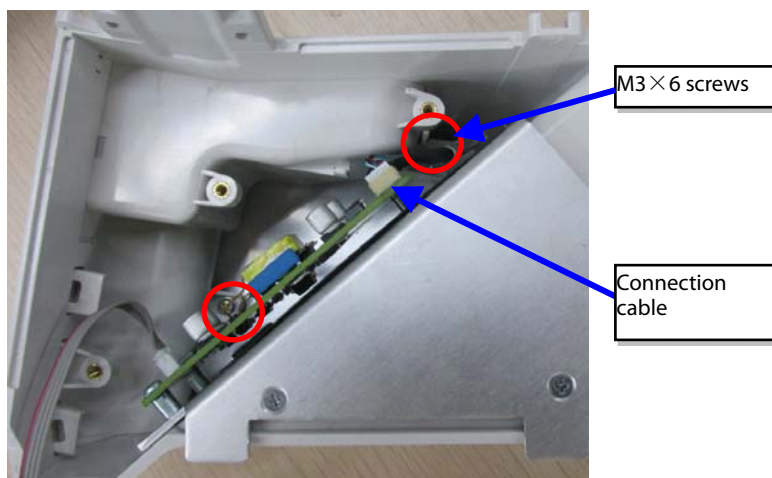


6.6.3 Disassembling the Covidien Infrared Ear Thermometer Module or Exergen TemporalScanner Thermometer Module (Optional)

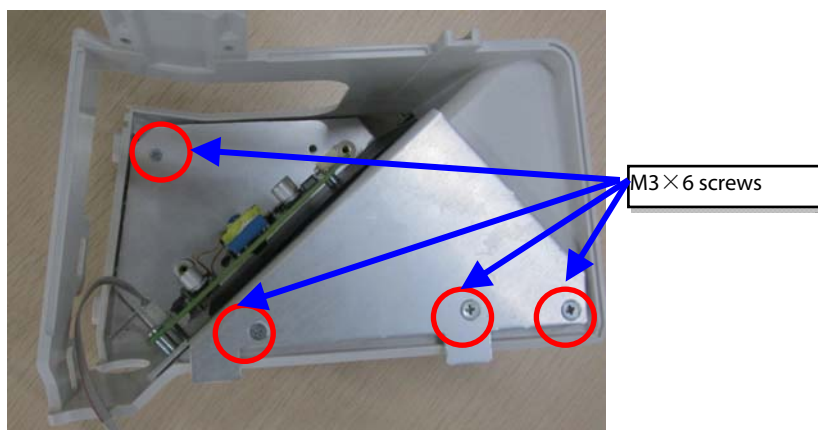
1. Unscrew three M3×6 screws, and then remove the panel.



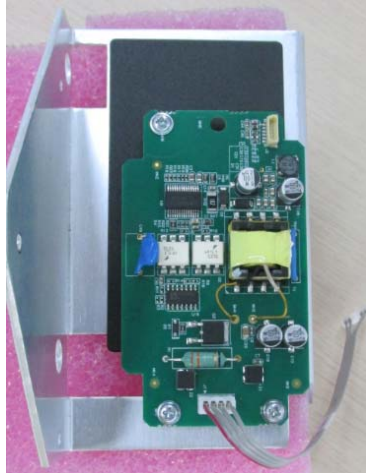
2. Pull out the thermometer cable, unscrew two M3X6 screws, and then take out the bottom panel.



3. Unscrew four M3X6 screws, and then take out the metal bracket.



4. Unscrew three M3X6 screws, and then take out the power isolation board.



7 Parts

7.1 Introduction

This section contains the exploded views and parts lists of the main unit. It helps the engineer to identify the parts during disassembling the monitor and replacing the parts.

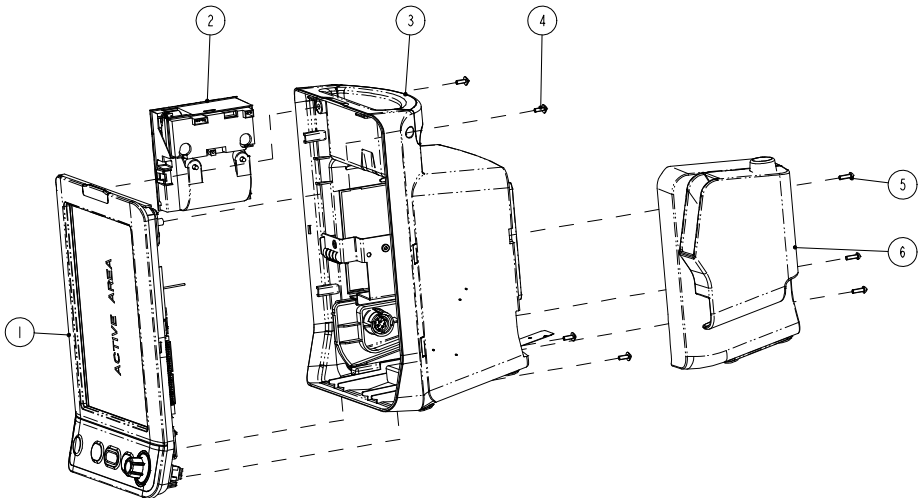
This manual is based on the maximum configuration. Your equipment may not have same parts and the quantity of the screws or stacking sleeves etc. may be different with those included in the parts lists.

NOTE

- The part number listed in the Parts List is only for checking the FRU part number which is also included in the Parts List. Please provide the FRU parts number if you want to purchase the spare parts.
-

7.2 Main Unit

7.2.1 Exploded View

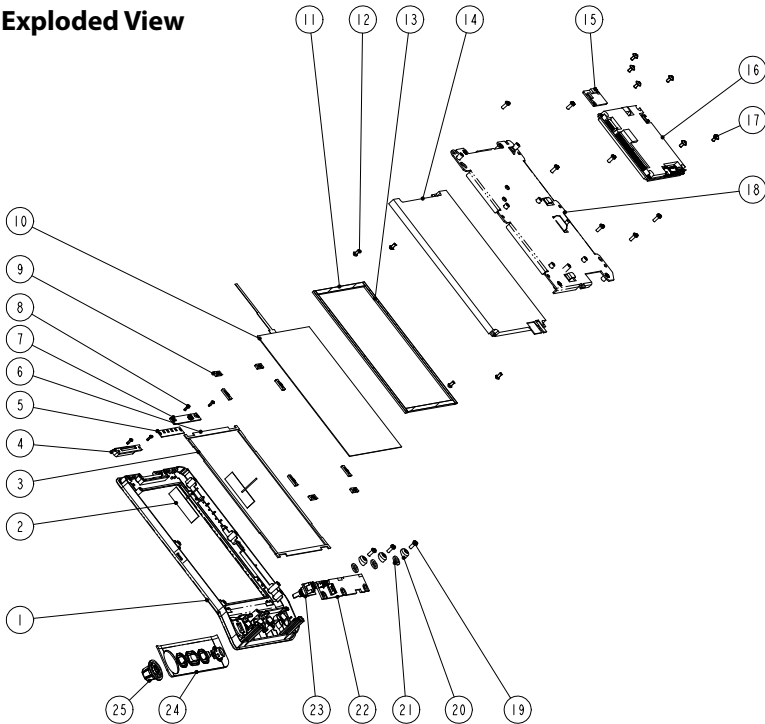


7.2.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Front Housing Assembly for VS-900	115-059373-00	Touch screen
			115-059387-00	Non-touch screen
2	115-046892-00	TR6F recorder (Datascope)	115-046892-00	/
3	/	Rear Housing Assembly for VS-900	115-048904-00	Cover assembly
4	/	Screw, Pan head with washer, Phillips M3×8	/	/
5	/	Screw, pan head Phillips, M3×10	/	/
6	115-048910-00	VS-900 Temp module	115-048910-00	/

7.3 Front Housing Subassembly (Touchscreen)

7.3.1 Exploded View



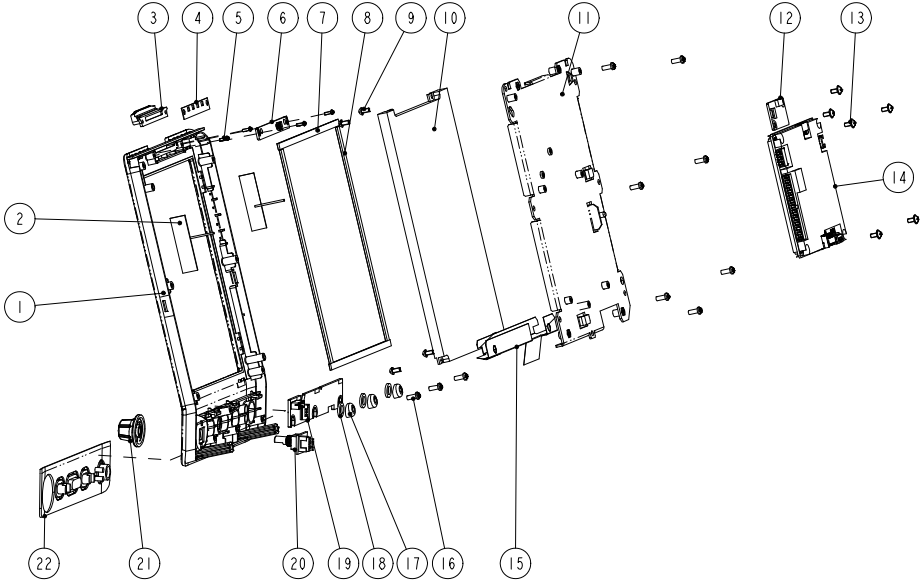
7.3.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Font housing for VS-900	115-059373-00	/
3	/	Silicon water-proof strip		
4	/	Alarm lamp for VS-900		
6	/	Silicon water-proof strip		
9	/	Touchscreen position pad (8")		
2	0012-00-1730-01	Antenna cable	115-048914-00	
5	/	Alarm lamp pad for VS-900	/	/
7	051-001362-00	Alarm Lamp Board	051-001362-00	/
8	/	Cross recessed pan head self-tapping screw PT2X6	/	/
10	021-000271-00	Touch-panel, resistive-type, 8.4"	021-000271-00	/
11	/	8" display-short	115-018259-00	/
13	/	8" display-long		
14	/	LCD TFT 8.4"		
12	/	Screw, pan head Phillips, M3×6	/	/
15	051-000881-00	Touchscreen control board PCBA-6301	051-000881-00	/
16	/	Main board PCBA (6301)	115-018264-00	/
17	/	Screw, Pan head w/washer	/	/
18	/	Plate, mounting display (VS-900, touchscreen)	/	/
19	/	Screw, pan head	/	/
20	/	Keypad board adjusting sleeve	043-003153-00	/
21	/	Keypad board cushion	047-010363-00	/
22	051-001359-00	VS-900 keypad PCBA	051-001359-00	/
23	0010-30-43089	Encoder	801-0010-00010-00	/
24	049-001679-00	VS-900 silicon buttons	049-001679-00	/

SN	PN	Description	FRU part number	Remarks
25	043-010368-00	Knob	043-010368-00	/

7.4 Front Housing Subassembly (Non-Touchscreen)

7.4.1 Exploded View



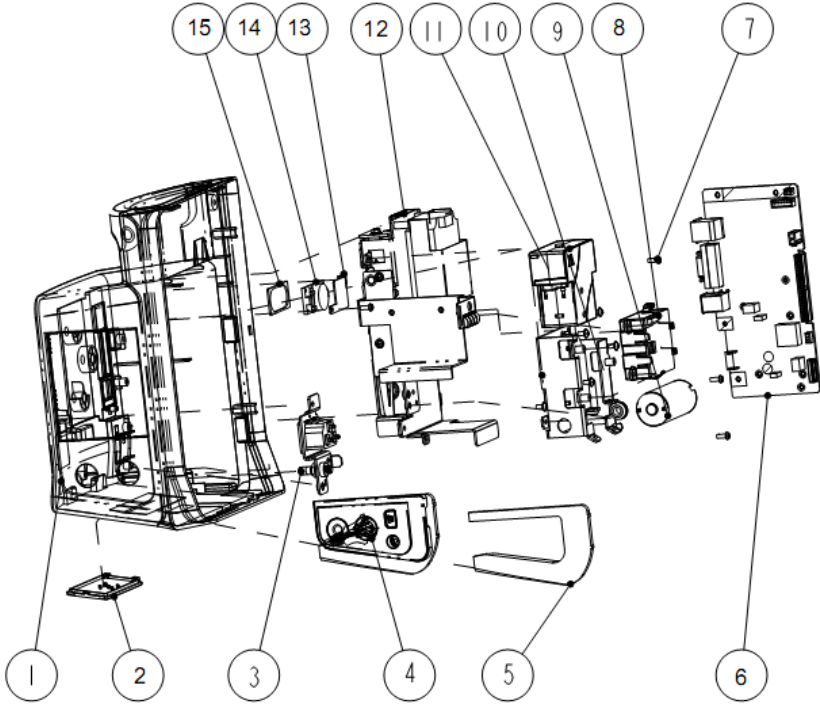
7.4.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Font housing for VS-900	115-059387-00	VS-900 front housing service kit
3	/	Alarm lamp for VS-900		
7	/	Water-proof strip, 144.2X1.5mm poron		
8	/	Water-proof strip, 173.2X1.5mm poron		
2	0012-00-1730-01	Antenna cable	0012-00-1730-01	/
4	/	Alarm lamp pad for VS-900	/	/
5	/	Cross recessed pan head self-tapping screw PT2X6	/	/
6	051-001362-00	Alarm Lamp Board	051-001362-00	/

SN	PN	Description	FRU part number	Remarks
9	/	Screw, pan head Phillips, M3×6	/	/
10	/	LCD TFT 8.4"	115-018259-00	/
11	/	Plate, mounting display (VS-900, touchscreen)	/	/
12	051-000881-00	Touchscreen control board PCBA-6301	051-000881-00	/
13	/	Screw, Pan head with washer, M3×6	/	/
14	/	Main board PCBA (6301)	115-018264-00	/
15	/	Naked screen water-proof plate for VS-900	/	/
16	/	Self-tapping screw	/	/
17	/	Keypad board adjusting sleeve	043-003153-00	/
18	/	Keypad board cushion	047-010363-00	/
19	051-001359-00	VS-900 keypad PCBA	051-001359-00	/
20	0010-30-43089	Encoder	801-0010-00010-00	/
21	043-010368-00	Knob	043-010368-00	/
22	049-001679-00	VS-900 silicon buttons	049-001679-00	/
/	9200-21-10460	Encoder cable	9200-21-10460	/
/	009-003232-00	Cable between main board and display	009-003232-00	/
/	009-003234-00	Cable between main board and keypad board (6012)	009-003234-00	/
/	009-003233-00	Cable between the main board and display backlight board (VS-900)	009-003233-00	/
/	009-003235-00	Cable between alarm lamp board and main board (VS-900)	009-003235-00	/

7.5 Rear Housing Assembly

7.5.1 Exploded View



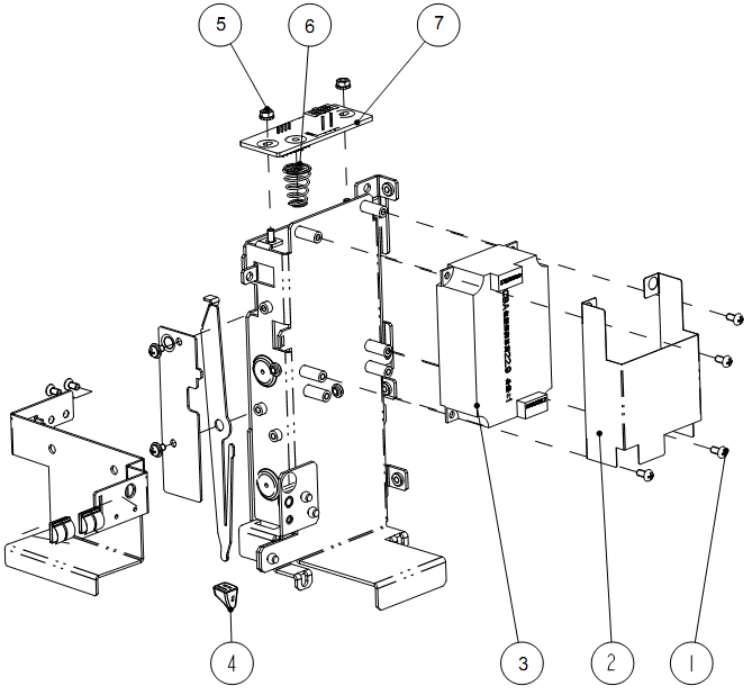
7.5.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	115-048904-00	Rear Housing Subassembly for VS-900	115-048904-00	/
2	/	Battery door assembly for VS-900	043-008878-00	/
3	115-017699-00	AC socket assembly for VS-900	115-017699-00	/
4	115-017705-00	Parameter connector panel assembly for VS-900	115-059370-00	Mindray SpO ₂ , with no NIBP
			115-048908-00	With no SpO ₂
5	043-003168-00	Parameter connector board support for VS-900	043-003168-00	/

SN	PN	Description	FRU part number	Remarks
6	/	Power management board for VS-900	115-018262-00	With multi-IO
			115-018263-00	Without multi-IO
7	/	Screw, Pan head w/washer, Phillips M3X6	/	/
8	115-017679-00	Valve assembly for VS-900	115-017679-00	/
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	/
13		Speaker bolster plate	042-008296-00	/
14	/	Speaker	020-000027-00	/
15	/	Speaker pad		
/	009-003237-00	Cable between the power management board and power board	009-003237-00	/
/	9211-20-87225	Cable between the interface board and main board	9211-20-87225	/
/	009-003238-00	Cable between NIBP module and power management board	009-003238-00	/
/	009-001969-00	Recorder cable	009-001969-00	/
/	043-003311-00	multifunctional connector cap	043-003311-01	/

7.6 Main Bracket Assembly

7.6.1 Exploded View

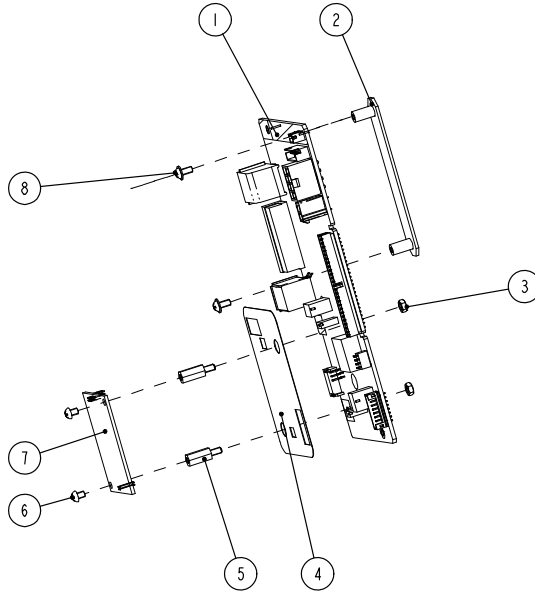


7.6.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Screw, Pan head w/washer	/	/
2	047-010575-00	Power board insulator	047-010575-00	/
3	022-000125-00	Power board	022-000125-00	/
4	0380-00-0593	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



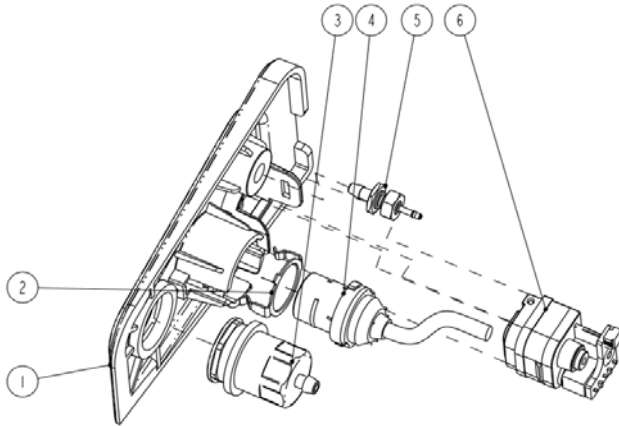
7.7.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Power management board service kit for VS-900	115-018262-00	with multifunctional connector
			115-018263-00	without multifunctional connector
2	/	Interface board support for VS-900	/	/
3	M90-000156---	Plastic hexagon nut	M90-000156---	/
4	047-010576-00	SpO ₂ shield	047-010576-00	/
5	099-000129-00	Plastic hexagon bolt	099-000129-00	/
6	/	Screw, pan head	/	/
7	/	SpO ₂ board	115-018383-00	Mindray SpO ₂ board service kit, 9008 V2.0
			0671-00-0102-01	Nellcor SpO ₂ board

SN	PN	Description	FRU part number	Remarks
				(MDU)
			040-001149-00	SpO ₂ board, Masimo MS-2013
8	/	Screw, Pan head w/washer	/	/

7.8 Parameter Connector Panel Assembly

7.8.1 Exploded View



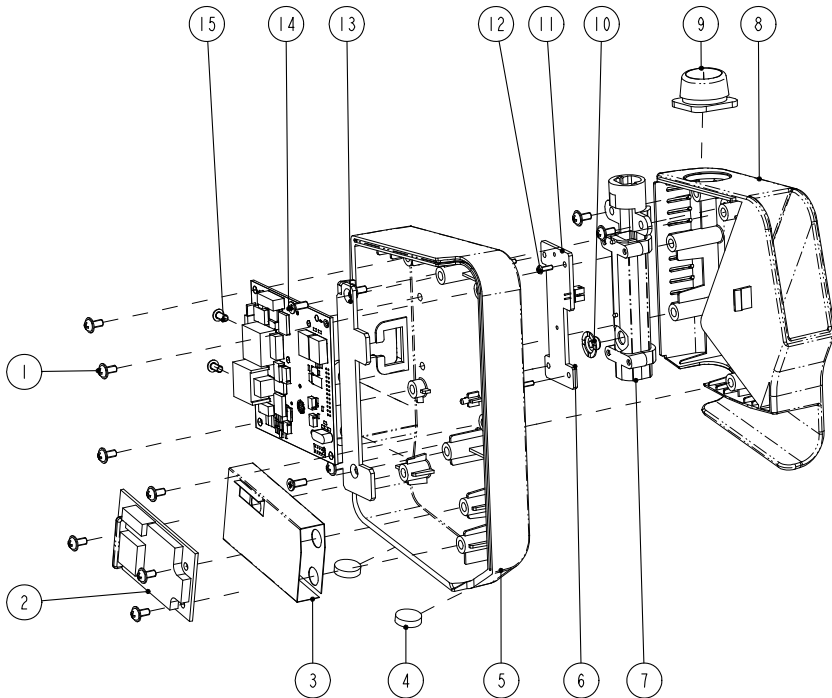
7.8.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Parameter panel for VS-900	043-008871-00	/
2	/	Hand feel spring	042-013555-00	/
3	/	NIBP fitting	115-010541-00	/
4	/	SpO ₂ signal cable	009-003242-00	Mindray SpO ₂ module
			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	/
6	/	DRYLINE PRIME	115-036134-00	/

SN	PN	Description	FRU part number	Remarks
		Receptacle with no panel		
/	/	NIBP air cock	115-046902-00	/
/	/	Decorative IBP socket	043-008498-00	/

7.9 Predictive Temp Assembly

7.9.1 Exploded View



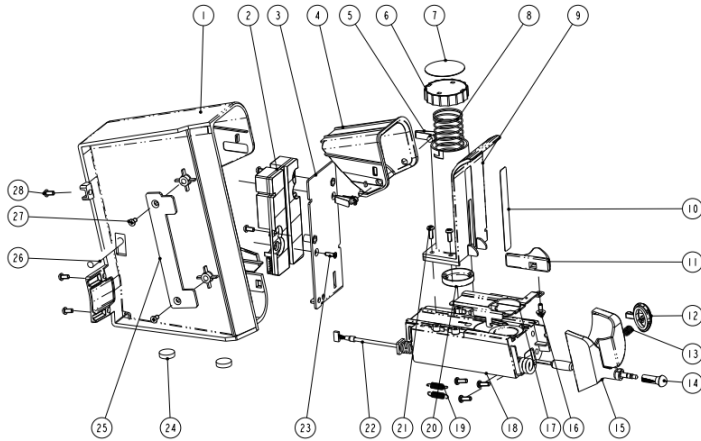
7.9.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	/	Screw, Pan head w/washer	/	/
2	M09A-30-62080	Predictive Temp module power board PCBA	801-6006-00043-00	/
3	/	Temp module insulator	/	/
4	/	FOOT, "ENDEAVOUR"		/

SN	PN	Description	FRU part number	Remarks
5	043-008862-00	VS900 TEMP BOX	043-008862-00	/
6	051-001419-00	Temp on-position detection board PCBA	051-001419-00	/
7	/	Chassis	/	/
8	043-008842-00	External compartment for Temp module (VS)	043-008842-00	/
9	049-000547-01	Temp cover for VS-600	049-000547-01	/
10	M09A-20-62064	Silicon buttons	M09A-20-62064	/
11	051-001435-00	Predictive Temp module PCBA	051-001435-00	/
12	/	Screw, pan head cross recessed M2X6	/	/
13	/	Temp module support for VS-600	/	/
14	/	Screw, Flat Head Phillips, M3X8	/	/
15	/	Screw, pan head cross recessed M3X6	/	/
/	/	Silicone tube	/	/
/	009-003368-00	VS-900 predictive Temp board cable	009-003368-00	/
/	009-003239-00	VS-900 Cable between the Temp module and power management board	009-003239-00	/
/	009-003240-00	VS-900 Cable between the isolation power board and Temp board	009-003240-00	/

7.10 THJ79JU Infrared Ear Thermometer Assembly

7.10.1 Exploded View



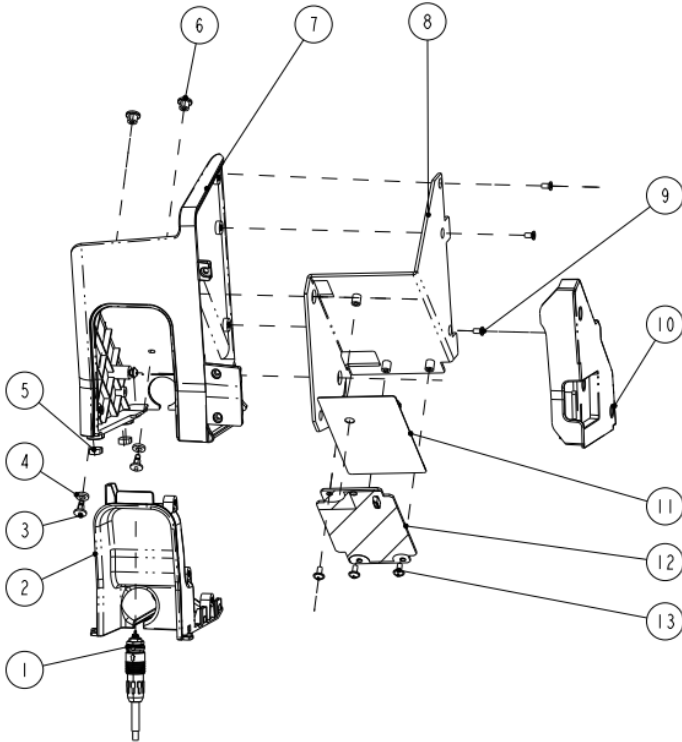
7.10.2 Parts List

SN	PN	Description	FRU part number	Remarks
1	043-004299-00	Cover, infrared ear thermometer(VS)	115-030318-00	/
22	009-004499-00	Infrared ear temperature cable		
24	0348-00-0223	Foot, "ENDEAVOUR"		
2	051-001957-00	VS temp Interface Board PCBA	051-001957-00	/
3	/	Separator PCB plate of ear temp	/	/
4	043-004300-00	Stop cover, infrared ear thermometer	043-004300-00	/
5	042-011143-00	V-shaped elastic buckle	042-011143-00	/
6	043-004306-00	Sealing cover, infrared ear thermometer	043-004306-00	/
7	047-012161-00	Cover label, infrared ear thermometer(VS)	047-012161-00	/
8	033-000322-00	Push spring, infrared ear thermometer(VS)	033-000322-00	/
9	043-004305-00	Sleeve, infrared ear thermometer(VS)	043-004305-00	/

SN	PN	Description	FRU part number	Remarks
10	047-012162-00	Sleeve label, infrared ear thermometer VS	047-012162-00	/
11	043-004303-00	Ejector pad, infrared ear thermometer(VS)	043-004303-00	/
12	043-004302-00	Button, infrared ear thermometer(VS)	043-004302-00	/
13	0601-20-78919	Spring	0601-20-7891	/
14	049-000783-00	Silicone cover of earphone	049-000783-00	/
15	043-004301-00	Lower cover, infrared ear thermometer(VS)	043-004301-00	/
16	/	M3X8 combined screw	/	/
17	042-011763-00	Transition Plate (encapsulation), VS ear	042-011763-00	/
18	043-004304-00	Base, infrared ear thermometer(VS)	043-004304-00	/
19	3100-20-49121	Spring	3100-20-49121	/
20	043-004307-00	Binder plate, infrared ear thermometer VS	043-004307-00	/
21	/	Screw, Self-Tapping PT3X8	/	/
23	/	Cross sunk self-threading screw GB/T846-1985 ST2.6X10 C-type, coated with antirust nickel	/	/
25	/	VS900 Temp holder	/	/
26	009-005234-00	Infra Ear Thermometer Cable	009-005234-00	/
27	/	GB/T819.1-2000 Screw, Flat Head Phillips M3X6	/	/
28	/	GB/T818-2000 Screw, Pan Head Cross Recessed M3X6	/	/

7.11 Genius™ 2 Tympanic Thermometer or Exergen TemporalScanner Thermometer Assembly

7.11.1 Exploded View



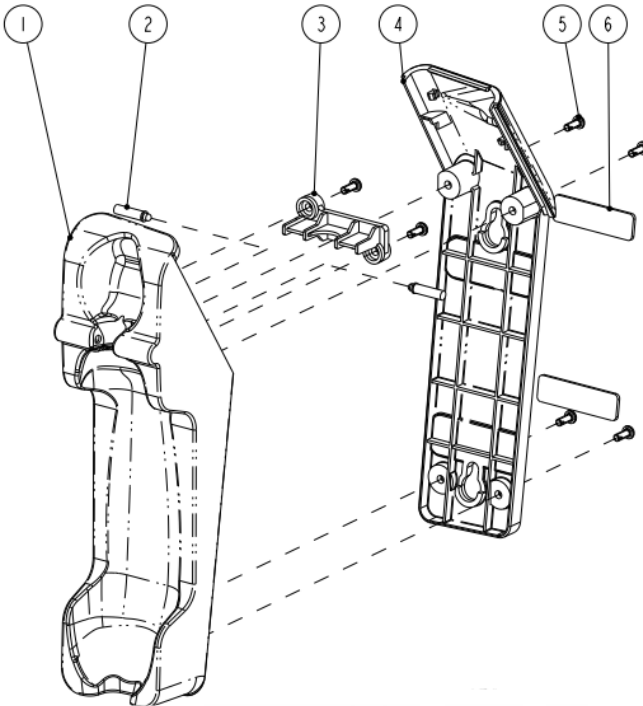
7.11.2 Parts List

SN	Description	FRU part number	Remarks
1	Temp connection cable, Genius™ 2	009-006361-00	/
2	Lower cover, Genius™ 2	043-008823-00	/
3	Fixed screw, Genius™ 2	041-023435-00	/
4	Spacer gasket	047-016529-00	/
5	7 X 12 Base, Genius™ 2	047-010577-00	/
6	Pin buckle, Genius™ 2	041-022395-00	/
7	Cover, Genius™ 2	115-038403-00	/

SN	Description	FRU part number	Remarks
8	Temp holder, Genius™ 2	042-016758-00	/
9	Screw, flat head Philips M3 X 6	M04-005005---	/
10	Stop cover, Genius™ 2	043-006888-00	/
11	Insulated sheet	047-017159-00	/
12	Insulated sheet connection cable, Genius™ 2	009-006362-00	/
13	Screw, pan head W/Washer Philips M3 X 6	M04-004012---	/

7.12 Exergen frame Assembly

7.12.1 Exploded View



7.12.2 Parts List

SN	Description	FRU part number	Remarks
1	Exergen frame cover	045-003420-00	/
2	Lower cover, Genius™ 2		/
3	spring holder		/
4	Exergen frame base		/
5	7 X 12 Base, Genius™ 2		/
6	tail bed antiskid pad		/

FOR YOUR NOTES

8 Hardware and Software Upgrade

8.1 Hardware Upgrade

The monitor supports upgrade of the following functions:

- NIBP measurement;
- SpO₂ measurement;
- Temp measurement;
- Wireless network (Wi-Fi);
- Touchscreen; and,
- Recorder.

8.1.1 Upgrade Package

Upgrade package	Description of upgrade package	PN of upgrade package	Remarks
SpO ₂	VS-900 Mindray SpO ₂ upgrade kit	115-059650-00	/
	VS-900 Masimo SpO ₂ upgrade kit	115-059651-00	/
	VS-900 Nellcor SpO ₂ upgrade kit	115-050362-00	/
NIBP	VS-900 NIBP module upgrade kit	115-018382-00	/
Temp (SmarTemp™ module)	VS-900 SmarTemp™ module	115-048910-00	/
Temp (Infrared Ear Thermometer module)	Infrared ear thermometer module (THJ79TU)	115-023226-00	/
Temp (Infrared Ear Thermometer module)	Infrared ear thermometer module (Covidien)	115-038401-00	/
Wireless Network (Wi-Fi)	iPM Wi-Fi module kit	115-048914-00	/
Touchscreen	Front housing assembly service kit for VS-900 (Touchscreen, without main board)	115-059372-00	/
Recorder	Recorder subassembly	115-061679-00	/
Nurse call function and DIAP protocol port	Power management board service kit (with multifunctional connector)	115-018262-00	Upgrading multifunctional

Upgrade package	Description of upgrade package	PN of upgrade package	Remarks
			connector

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

8.1.2 Upgrading Parameter Modules

8.1.2.1 Upgrading Mindray SpO₂ and Nellcor SpO₂

List of upgrade package:

- A Mindray SpO₂ board or Nellcor SpO₂ board;
- An SpO₂ insulator;
- A connector panel assembly for Mindray SpO₂ board or Nellcor SpO₂ board; and,
- Two M3×6 screws

1. Remove the power management board and connector panel assembly as described in **6.3 Disassembling the Main Unit**.
2. Assemble the SpO₂ board and insulator onto the power management board as described in **6.3.7 Removing the Parameter Board (SpO₂ Optional) and Power Management Board**.
3. 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 **6.3 Disassembling the Main Unit**.

8.1.2.2 Upgrading Masimo SpO₂

List of upgrade package:

- A power management board assembly with Masimo SpO₂; and,
- A Masimo SpO₂ 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 **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 **6.3 Disassembling the Main Unit**.

8.1.3 Upgrading NIBP

List of upgrade package:

- An NIBP valve;
- A pump;
- Two cable ties;
- A cable between NIBP module and power management board;
- A parameter connector panel assembly; and,
- Two M3×6 screws

Disassemble the main bracket assembly and parameter connector panel assembly as described in **6.3 Disassembling the Main Unit**, assemble the NIBP valve and pump onto the main bracket assembly, and then assemble the new connector panel assembly, cables, and tubes together into the main unit.

8.1.4 Upgrading Temp

List of upgrade package:

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

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

8.1.5 Enabling Parameter Functions

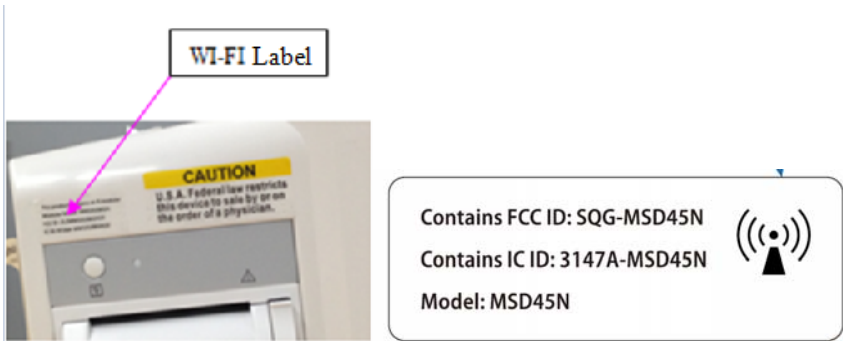
1. Select **[Main]**→**[Maintenance >>]**→**[Factory Maintenance >>]**→enter the required password→**[Ok]**→**[Device Config. >>]**.
2. In the prompt menu, check the upgraded functions.
3. Click **✕** to save the changes and quit the menu.
4. Restart the monitor and the software for upgraded parameters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

8.1.6 Upgrading Wireless Network Function

List 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

1. Install the Wi-Fi module onto the main board and then connect the Wi-Fi antennas as described in *错误未找到引用源。 错误未找到引用源。*.
2. Paste the Wi-Fi label.



3. Select **[Main]** → **[Maintenance >>]** → **[User Settings >>]** → enter the required password → **[Ok]** → **[Network >>]**.
4. In the Network Setup menu, set **[Network Type]** to **[WLAN]**. Set the wireless network as described in the **Network** section in the Operator's Manual.
5. Try to connect the equipment to a nearby wireless network and see if the connection succeeds.

8.1.7 Upgrading Touchscreen

List of upgrade package:

- A front housing assembly service kit for VS-900 (Touchscreen, without main board)
1. Disassemble the main board and cables from the front housing, and install them to the front housing with touchscreen as described in **6.4 Disassembling the Front Housing Assembly**.
 2. Assemble the front housing assembly and rear housing assembly as described in **6.3 Disassembling the Main Unit**.
 3. Select **[Main]** → **[Maintenance >>]** → **[Factory Maintenance >>]** → enter the required password → **[Ok]** → **[Device Config. >>]**. Check the touchscreen function in the menu to enable the software. Then restart the equipment.

8.1.8 Upgrading Recorder Function

1. Pry the recorder cover on the left side of the monitor with a little screwdriver, and take out the metal sheet used to seal the recorder as described in **6.3.3 Removing the Recorder**. Then install the recorder assembly.
2. When the recorder is installed, select **[Main]** → **[Maintenance >>]** → **[Factory Maintenance >>]** → enter the required password → **[Ok]** → **[Device Config >>]**. Check the recorder option in the menu to enable the software. Then restart the equipment.

8.1.9 Upgrading Nurse Call Function and DIAP Protocol Port

Remove the power management board, and the stopple of multifunctional connector on the rear panel of the equipment (if there is one) as described in **6.3 Disassembling the Main Unit**. Then assemble the power management board with multifunctional connector. Then reassemble the main unit.

Once the above functions are successfully upgraded, perform related tests on the equipment as described in **4.4 Module Performance Tests**, **4.6 Touchscreen Calibration**, and **4.7 Recorder check**.

8.2 Software Upgrade

You can upgrade system software and module software by installing and running the Mindray Patient Monitor Software Upgrade Tool on a PC with Windows operating system.

Connect the monitor to be upgraded and a PC running the upgrade tool to the same network, or directly connect the monitor and the PC via a crossover network cable. Then configure the IP address of the PC. You can upgrade the following software:


No.	Type	PN	Description
1	System software package	110-002646-00	System software package
2	Module software	110-000889-00	Mindray NIBP function software
3		110-001842-00	Mindray SpO ₂ function software
4		110-002027-00	Temp function software
5	Power Management Software	110-002525-00	Power Management Software
6	MEWS	115-030317-00	MEWS

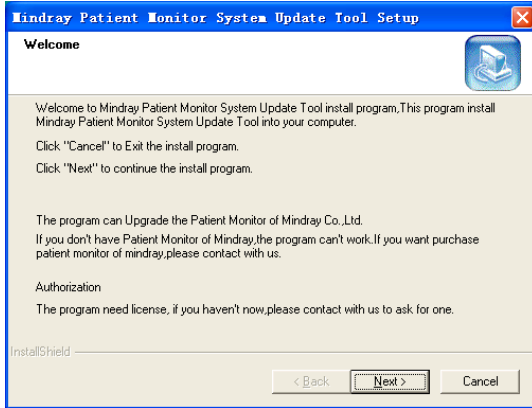
Note: No specific sequence is required for the upgrading of above software. For detailed information, please refer to **8.2.2 Software Upgrade Procedure**.

NOTE

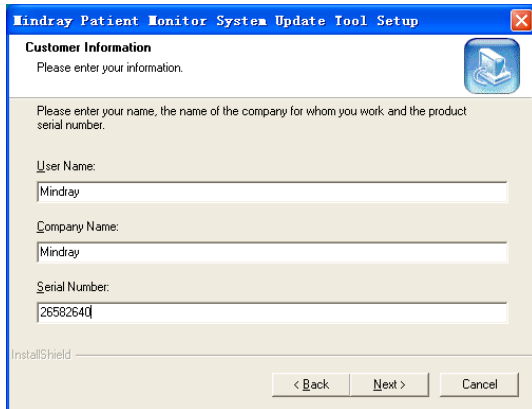
- **The software upgrading could result in clearing the historic patient data. It is recommended to export patient data before software upgrading.**

8.2.1 Installing Mindray Patient Monitor Software Upgrade Tool

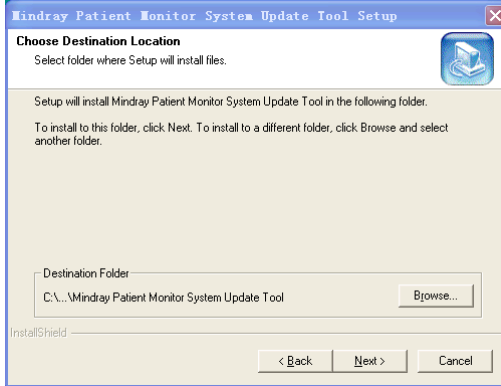
1. Find the installation program  `SystemUpdateTool.exe` and double click it to start installation.
2. Select language.
3. Click **[Ok]** and the following screen is displayed. Click **[Next]** to go to the next step.



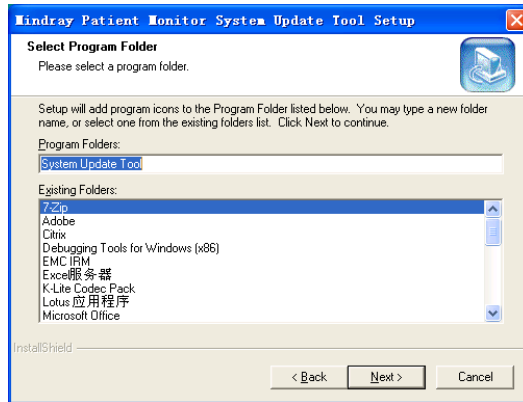
4. Enter User Name, Company name, and Serial Number "26582640". Then click **[Next]**.



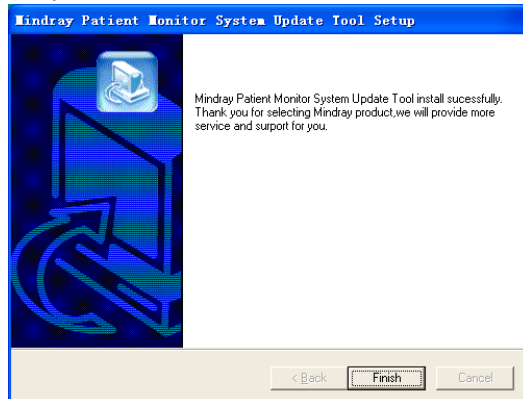
5. Specify the destination folder for installing this program. Then select **[Next]**.



6. Select Program Folder. Then select **[Next]**.



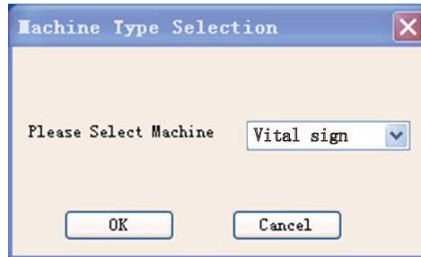
7. Click **[Finish]** to complete installation.





8.2.2 Software Upgrade Procedure

Check the version of the software to be upgraded as described in **4.9.3 Software Version** before upgrade.

1. Connect the monitor to be upgraded and a PC running the upgrade tool to the same network, or directly connect the monitor and the PC via a crossover network cable.
2. Set the IP address of the PC to "77.77.1.XX" and subnet mask to "255.255.255.0".
3. Run Mindray Patient Monitor Software Upgrade Tool on the PC and set Machine to **[Vital sign]**.



4. On the Mindray Patient Monitor Software Upgrade Tool screen, select **[Select Package]** and then the packages you want to upgrade. Then select **[Start]**.
5. Turn on the monitor to be upgrade. Press and hold  (Silence) and  (Admit Patient) buttons for 2 to 3 seconds, the monitor enters upgrade mode and starts software upgrade automatically, and corresponding prompt messages are displayed on both the monitor and PC.

When software upgrade is finished, restart the monitor and check if the software is correctly upgrade.

For details of software upgrade, please refer to **help and instructions for use of Mindray Patient Monitor Software Upgrade Tool**.

CAUTION

- **Disconnect the equipment from the patient and make sure the important data are saved before upgrade.**
- **Do not shut down or power off the equipment when upgrading the system software. Otherwise, it may cause the equipment to break down.**
- **Software upgrade should be performed by qualified service personnel only.**
- **Crossover network cable is recommended when a PC is connected for software upgrade.**

NOTE

- **Make sure the version of the upgrade package is what you desired. To obtain the latest upgrade package, please contact Mindray Customer Service Department.**

8.2.3 Upgrading the Scoring

Upgrading the Scoring Software

Refer to **8.2.2 Software Upgrade Procedure** for more information.

Importing a Scoring

Refer to **H-046-007126-00 Mindray Clinical Scoring Config Tool Instructions for Use** and **H-046-004883-00 VS-900 Vital Signs Monitor Operator's Manual** for more information.

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. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Fluke, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years. 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 residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

A.2.2 Contextual 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

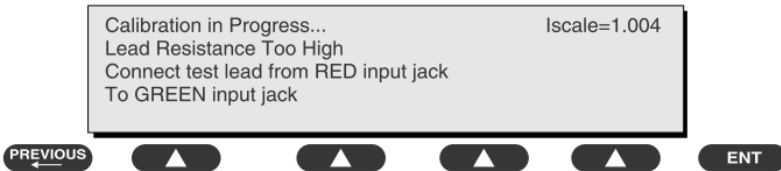
A.4 Protective Earth Resistance

Protective Earth Resistance is measured using the RED test lead attached to the DUT Protective Earth terminal or enclosure. Select the test current by pressing SOFT KEY 3 to toggle between 1AMP, 10AMP, and 25AMP. The front panel outlet power is turned off for this test.

The following conditions apply: L1 and L2 Open.

Preparation

1. First select the test current that will be used for performing the Protective Earth Resistance test by pressing AMPERES (SOFT KEY 3).
2. Connect the test lead(s) between the RED input jack and the GREEN input jack.
3. Press CAL LEADS. The 601PRO will measure the lead resistance, and if less than 0.150 Ohms, it will store the reading and subtract it from all earth resistance readings taken at the calibrated current.



If the calibration fails, the previously stored readings will be used until a passing calibration has occurred.:

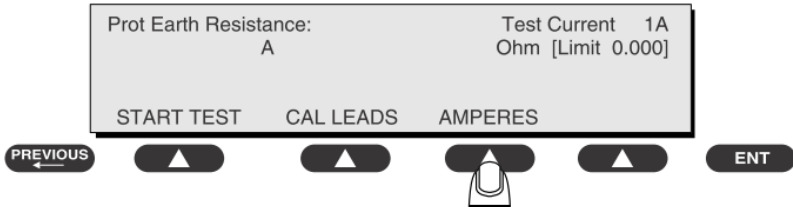
WARNING

- **During Earth Resistance testing, the DUT must be plugged into the 601PRO front outlet. If the DUT fails Earth Resistance, discontinue tests and label the device**

defective.

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet.
2. Attach the 601PRO RED input lead to the device's Protective Earth terminal or an exposed metal area.
3. Press shortcut key 3. The Protective Earth Resistance test is displayed.
4. Press SOFT KEY 3 to select a test current (1AMP, 10AMP, or 25AMP). The selected test current is displayed in the upper right corner of the display.



5. Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.
6. Press the print data key at any time to generate a printout of the latest measurement(s).

NOTE

- **When "Over" is displayed for Ohms, this signifies that a valid measurement was not obtained because either an open connection was detected or that the measurement was not within range. Readings greater than 9.999 Ohms will be displayed as Over.**

In Case of Failure

Once it reaches the limitation, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

ALL COUNTRIES R = 0.2 Ω Maximum

A.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

Leakage current is measured the following ways:

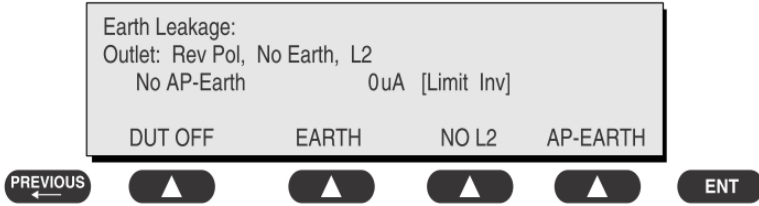
- Earth Leakage Current, leakage current measured through DUT outlet Earth
- Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

There is no need to attach a test lead; the 601PRO automatically connects the measuring

device internally.

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2. Attach the device's applied parts to the 601PRO applied part terminals if applicable.
3. Press shortcut key 4. The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
 - SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
 - SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
 - SOFT KEY 4 toggles the AP to Earth to No AP to Earth.
4. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.
- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For UL60601-1,

- ◆ **300 μ A in Normal Condition**
- ◆ **1000 μ A in Single Fault Condition**

For IEC60601-1,

- ◆ **500 μ A in Normal Condition**
- ◆ **1000 μ A in Single Fault Condition**

A.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only response.

Preparation

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

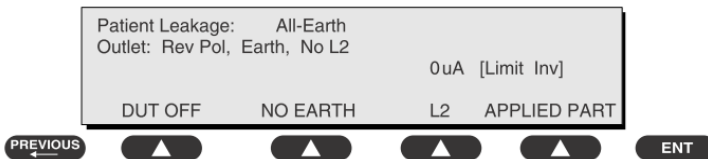
- Normal Polarity, Earth Open, Outlet ON Normal Polarity, Outlet ON
- Normal Polarity, L2 Open, Outlet ON Reversed Polarity, Outlet ON
- Reversed Polarity, Earth Open, Outlet ON Reversed Polarity, L2 Open, Outlet ON

**WARNING**

- **If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.**
-

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2. Attach the applied parts to the 601PRO's applied part terminals.
3. Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.



4. Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.
5. Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.
6. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.

- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For CF  applied parts

- ◆ **10 μ A in Normal Condition**
- ◆ **50 μ A in Single Fault Condition**

For BF  applied parts

- ◆ **100 μ A in Normal Condition**
- ◆ **500 μ A in Single Fault Condition**

A.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions as indicated on the display.

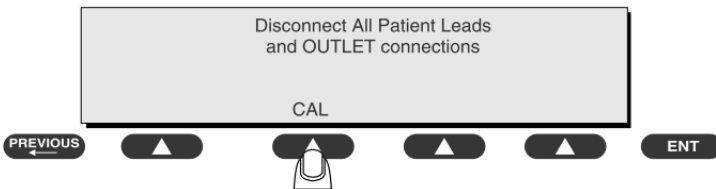
The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

Preparation

To perform a calibration from the Mains on Applied Part test, press CAL (SOFT KEY 2).

1. Disconnect ALL patient leads, test leads, and DUT outlet connections.
2. Press CAL to begin calibration, as shown:



If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

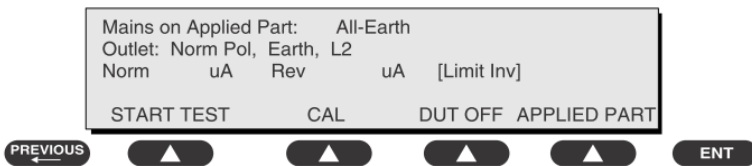
- When the calibration is finished, the Mains on Applied Part test will reappear.

 **WARNING**

- A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.
 - High voltage is present at applied part terminals while measurements are being taken.
-

To Perform the Test

- From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601
- Attach the applied parts to the 601PRO applied part terminals.
- Attach the red terminal lead to a conductive part on the DUT enclosure.
- Press shortcut key 7. The Mains on Applied Part test is displayed.



- Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:
- Press START TEST (SOFT KEY 1) to begin the test.
- Press the print data key to generate a printout of the latest measurement.

NOTE

- **If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.**
-

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
 - Inspect wiring for bad crimps, poor connections, or damage.
 - Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
 - Change another probe to confirm if the fail is caused by console.
 - If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
 - If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.
-

LIMITS

- For CF  applied parts: 50 μ A
- For BF  applied parts: 5000 μ A

ELECTRICAL SAFETY INSPECTION FORM

Overall assessment

Scheduled inspection	Test item: 1, 2, 3, 4, 5, 6, 7
Unopened repair type	Test item: 1, 2, 3
Opened repair type, not replace the power part including transformer or patient circuit board	Test item: 1, 2, 3, 4
Opened repair type, replace the power part including transformer	Test item: 1, 2, 3, 4, 5
Opened repair type, replace patient circuit board	Test item: 1, 2, 3, 4, 6, 7

Location:			Technician:		
Equipment:			Control Number:		
Manufacturer:		Model:		SN:	
Measurement equipment /SN:			Date of Calibration:		
INSPECTION AND TESTING				Pass/Fail	Limit
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	___μA		Max: NC: 300μA(refer to UL60601-1) * NC: 500μA(refer to IEC60601-1) * SFC: 1000μA
		Single Fault condition(SFC)	___μA		
6	Patient Leakage Current	Normal condition(NC)	<input type="checkbox"/> BF ___μA		Max: CF applied part: NC:10μA, SFC: 50μA BF applied part: NC:100μA, SFC: 500μA
			<input type="checkbox"/> CF ___μA		
		Single Fault condition(SFC)	<input type="checkbox"/> BF ___μA		
			<input type="checkbox"/> CF ___μA		
7	Mains on Applied Part Leakage	<input type="checkbox"/> BF ___μA		Max: CF applied part: 50μA BF applied part: 5000μA	
		<input type="checkbox"/> CF ___μA			

Note: The equipment which sell to America shall comply with the requirement of UL60601-1, others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____ Date: _____

