uMEC10/uMEC12

Patient Monitor

Service Manual

Intellectual Property Statement

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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.

- Version number: 1.0
- Release time: April 2016

Preface

Manual Purpose

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

Intended Audience

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

Passwords

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

- User maintenance: 888888
- Manage Configuration: 315666
- Factory maintenance: 332888
- Demo mode: 2088

Content

FOR YOUR NOTES

1 Safety

1.1 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, could result in death or serious injury or property damage.**

⚠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.**

1.1.1 DANGER

This Manual does not involve information on level of DANGER.

1.1.2 WARNING

⚠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.**
- **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.**
- **When disposing of the package material, observe applicable local or hospital's waste control regulations and keep it out of children's reach.**

1.1.3 CAUTION

⚠CAUTION

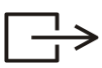
- **Make sure that no electromagnetic radiation interferes with the performance of the equipment when preparing to carry out performance tests. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before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

1.1.4 NOTE

NOTE

- **Refer to Operation Manual for detailed operation and other information.**

1.2 Equipment Symbols

	General warning sign		Refer to instruction manual/booklet
	Power ON/OFF (for a part of the equipment)		Battery indicator
	Alternating current		ALARM PAUSED
	Alarm reset		Graphical recorder
	Freeze/unfreeze waveforms		Main menu
	NIBP start/stop key		Output
	Equipotentiality		VGA output
	USB connector		Network connector
	Gas outlet	SN	Serial number
	Inserted direction	IPX1	Protection against vertically falling water drops
	Manufacturer		Date of Manufacture
CE 0123	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfils the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		
EC REP	AUTHORISED REPRESENTATIVE IN THE EUROPEAN COMMUNITY		
	Electrostatic sensitive devices		
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		
	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 Design Principle

2.1 Overview

The patient monitor is applicable to the measurement or monitoring of ECG, Resp, Temp, SpO_2, PR, NIBP, IBP, and CO_2 for patients.

The patient monitor also:

- Provides audible and visual alarm indications in case of patient or equipment problems.
- Enables displaying, reviewing, storing and transferring of real-time data.
- Incorporates multiple input devices such as buttons, knob, and touchscreen.
- Enables program upgrade over the network.
- Integrates information from other devices, including but not limited to defibrillator.

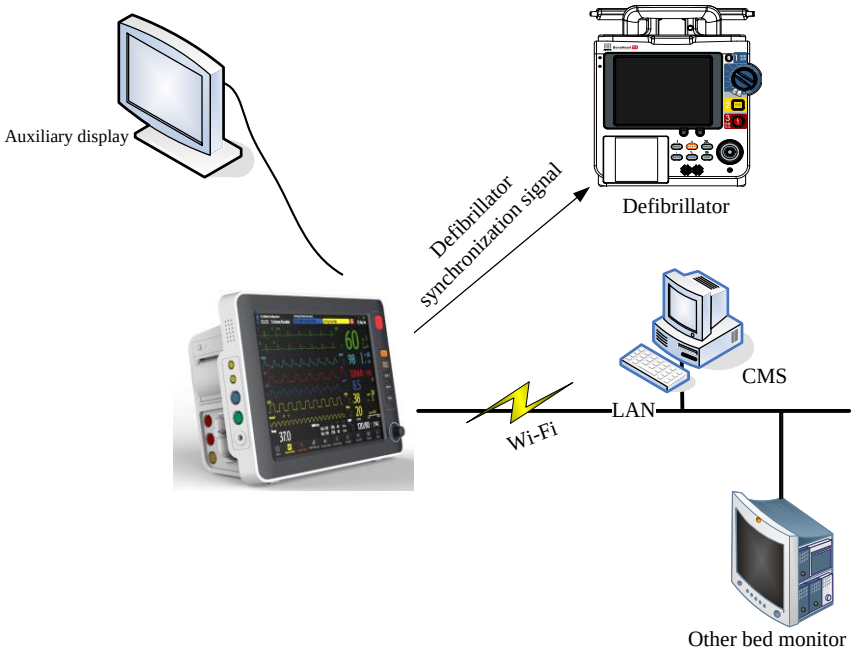


Figure 1 Peripherals

The above figure shows a system consists of the uMEC patient monitor and its peripheral devices. The uMEC patient monitor:

- Can be used for monitoring the physiological parameters, giving alarms and reviewing patient data, etc.
- Supports recorder.
- Supports nurse call signal, synchronization defibrillation signal, and analog output signal.

- Supports Wi-Fi module, wired network, remote view, and communication with the HyperVisor Central Monitoring System.
- Supports a secondary display.
- 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 System Connection

2.2.1 Mounting Bracket

The patient monitor can be mounted on a wall bracket or on a trolley bracket. The wall bracket or trolley bracket can be ordered separately. Each mounting bracket is delivered with a complete set of mounting hardware and instructions. Refer to the documentation delivered with the mounting hardware for instructions on assembling mounts.

⚠CAUTION

- **Use mounting brackets Mindray supplies or approves. If another compatible mounting bracket is used, ensure it can safely bracket the patient monitor.**
- **The mounting bracket should be installed by our qualified service personnel, or qualified personnel having a full understanding of local building codes.**
- **If a non-validated mounting solution is used, the installation personnel and the customer should verify if this mounting device can safely handle the load of the patient monitor. Customer assumes all liability if installing mounting equipment other than that recommended by Mindray.**

2.2.2 External Connectors

On the back of the patient monitor you will find all connectors for peripheral devices.

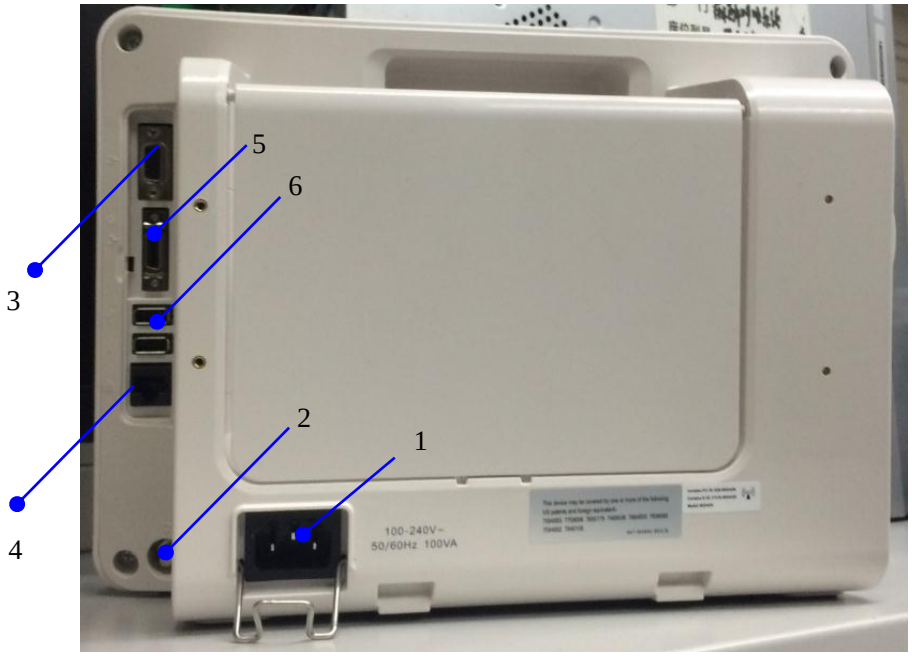


Figure 2 Rear view of uMEC patient monitor

1. AC Power Connector:	used to connect an AC power source (100 to 240 VAC, 50/60Hz).
2. Equipotential Terminal:	used to connect the equipotential terminal of other equipment, eliminating potential difference between different pieces of equipment.
3. VGA connector:	Connects a secondary display.
4. Network Connector:	It is a RJ45 connector used to connect an Ethernet network or a PC.
5. Multi-function output connector:	It is a Micro-D connector used to output analog signals and defibrillator synchronization signals.
6. General USB Connector:	It is a USB connector used to connect to an external device. The system provides two USB connectors.

2.3 Main Unit

The main unit of the patient monitor consists of two parts:

- Front housing assembly: front housing, waterproof strip, lens (touchscreen is optional), dustproof strip, display, display sheet metal, user control buttons, on/off button, knob, rotary encoder, master board, keypad, equipotential terminal, sticker antenna, speaker, AC-DC power module, balloon pump, air valve, parameter front panel assembly, and rubber foot;

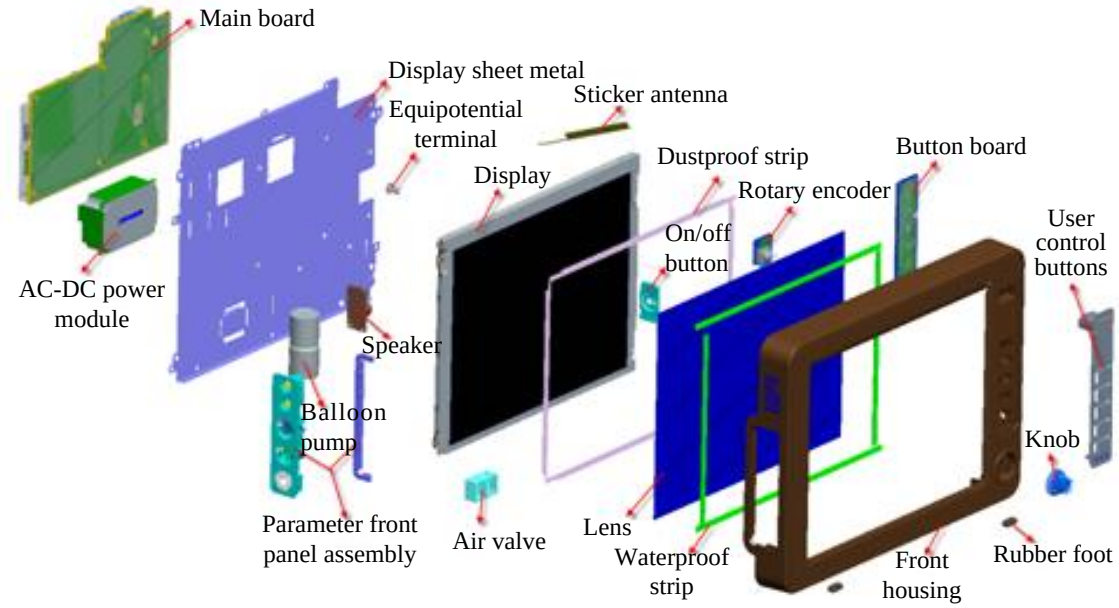


Figure 3 Layout of front housing assembly

- Rear housing assembly: rear housing, rear cover, battery and battery door, function connector cover, recorder, recorder fixing sheet metal, recorder cover, AC socket, power plug anti-pull hook, optional parameter connector assembly, optional parameter connector cover, M02D module, M03B module, module bracket, rubber foot, and speaker washer.

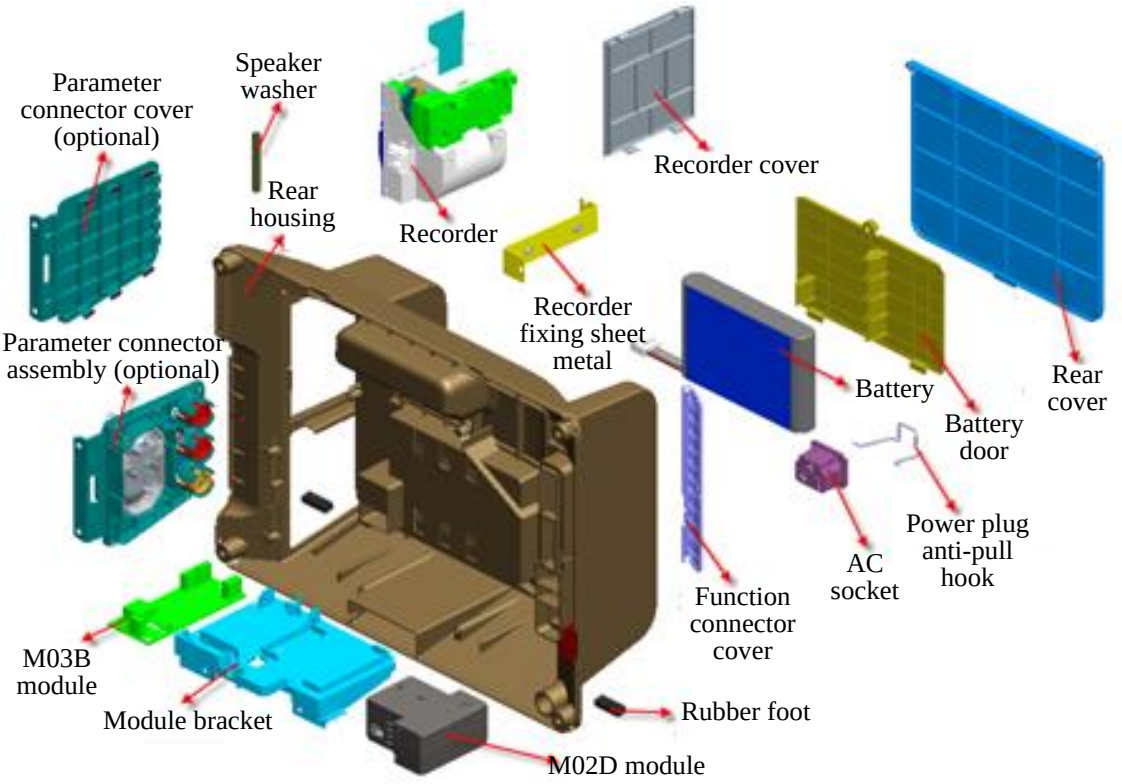


Figure 4 Layout of rear housing assembly

2.3.1 Main Board

The main board is fixed onto the center of the display sheet metal by screws. It is the core of the patient monitor. The main board of uMEC patient monitor integrates core functions such as parameter measurement (the basic five parameters), display control, data storage, network communication, and external connectors.

- 3/5/12-lead ECG, RESP, Mindray SPO_2, NIBP, and TEMP
- Display drive and backlight control
- Data storage (DDR + NOR flash)
- Wired/wireless network
- Print processing
- Connecting to touchscreen
- Audio drive
- EEPROM
- USB

The main board connects to other boards through the following connectors:

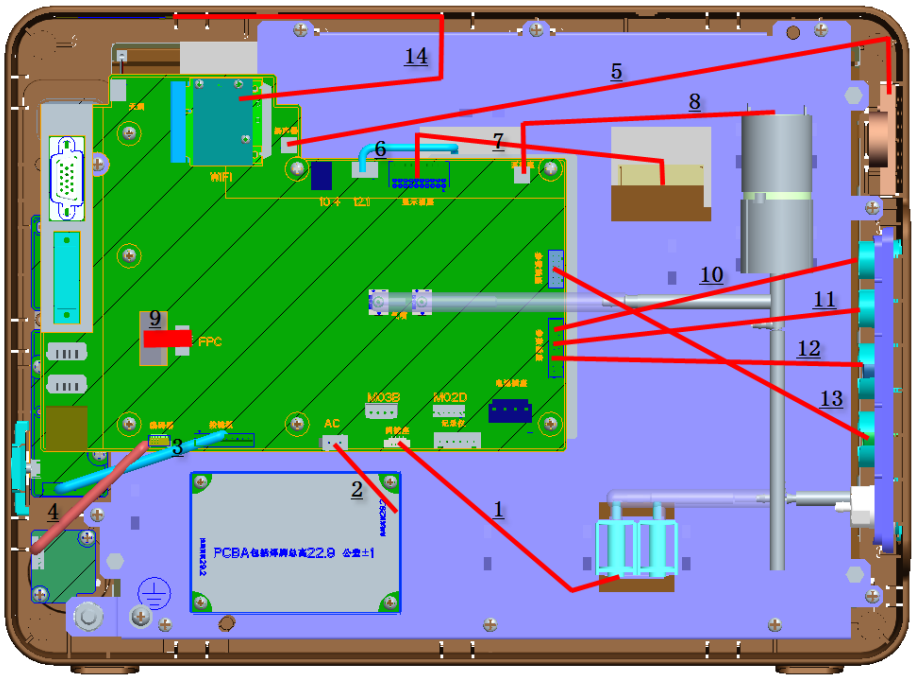


Figure 5 Front housing cabling

1. Air valve connector
2. AC/DC board connector
3. Button board connector
4. Encoder connector
5. Speaker connector

6. Screen backlight connector
7. Screen display signal connector
8. Balloon pump connector
9. Touchscreen connector
10. TEMP parameter connector 1
11. TEMP parameter connector 2
12. SPO2 parameter connector
13. ECG parameter connector
14. Wi-Fi connector

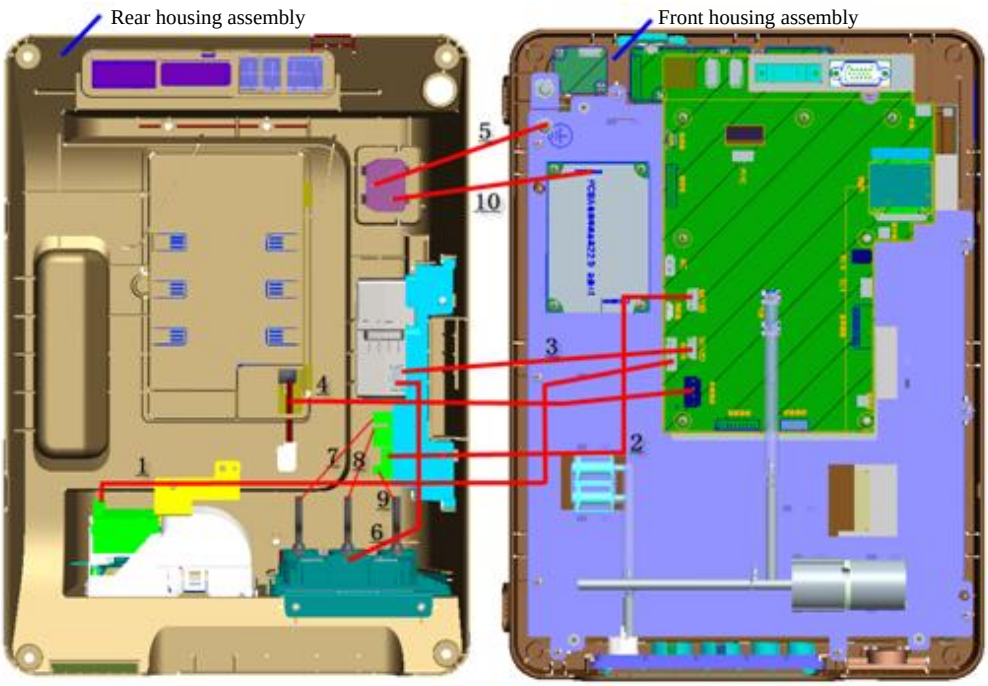


Figure 6 Front and rear housing cabling

1. Recorder connector
2. M03B connector
3. M02D connector
4. Battery connector
5. Ground cable
6. Watertrap receptacle
7. C.O. signal cable
8. IBP connector signal cable
9. IBP connector signal cable
10. AC socket

2.3.2 Button Board

The button board is installed on the left side of the front housing assembly. It connects with the main board through cables. The button board is used to implement the following functions:

- Scanning and detecting the input of five function buttons;
- Integrating the on/off button;
- Integrating the alarm indicator;
- Integrating the battery, AC, and on/off status indicators;
- Communicating with the main board through GPIO.

2.3.3 Encoder Board

The encoder board is used to fix the encoder. It connects with the main board through cables.

2.3.4 Display

Three models of the uMEC series patient monitors adopt the 10.4-inch, 12.1-inch and 15-inch LCD respectively. The display is connected with the main board through the display signal cable and backlight cable. The definitions of connector cables of these three models are not identical and cannot be used interchangeably. The display signal cable has a relatively low reliability. Therefore, preferably replace it in case of a display problem.

2.3.5 Touchscreen and Control

A fully-configured uMEC series patient monitor supports touchscreen. The touchscreen FPC is directly connected to the main board. Touch-based control and calibration are bracketed. A built-in touchscreen controller of the main board CPU is used to implement touchscreen functions.

2.3.6 AC/DC Power Board

The AC/DC board converts AC input voltage into 15 V DC output voltage. It connects with the main board through connection cables.

2.3.7 Battery

uMEC patient monitor supports two types of lithium-ion batteries: standard capacity battery (11.1V/2500mAh) and large capacity battery (11.1V/5000mAh). The battery connects with the main board through cables.

The fool-proofing battery cannot be installed if the insertion direction is incorrect.

2.3.8 Parameter Measurement

The basic parameter measurement circuit of uMEC patient monitor is integrated into the main board based on the latest ASIC technology.

2.3.9 CO_2 Module

The CO_2 module is installed on the rear housing of the patient monitor through the M02D module. The CO_2 module communicates with the main board over the RS232 protocol.

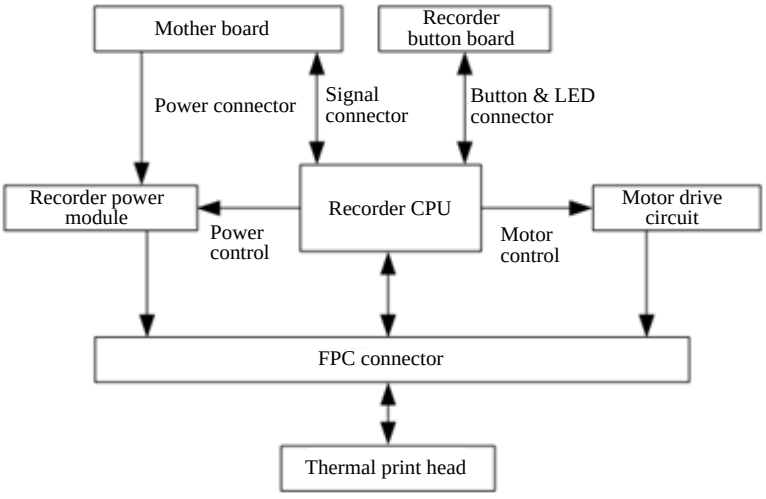
2.3.10 M03B Module

M03B module is used to implement the IBP parameter measurement function. The M03B module communicates with the main board through UART.

2.3.11 Recorder

The recorder receives data coming from the main board and then transmits it to the thermal print head for printing. The recorder has a hardkey (start/stop recordings) and a green LED on its front. The recorder communicates with the main board through UART.

The following diagram shows its operating principle.



2.3.12 Speaker

The speaker provides sound for alarms, key strokes, heart beats and pulse, and allows PITCH TONE and multi-level tone modulation. It connects with the main board through connection cables, and is directly driven by the main board.

FOR YOUR NOTES

3 Unpacking and Installation

3.1 Unpacking

Check the delivered items against the packing list after unpacking the case, and make sure that the name, quantity and specifications of all the items are consistent with those listed in the packing list. Note that:

- Optional components or other accessories (if applicable) must also be checked one by one.
- Contact immediately the supplier if any item in the package does not conform to that listed in the packing list.
- In case of damage during shipping, keep the packaging for inspection and contact immediately the supplier.
- Keep the packaging until the product acceptance is completed.

The main unit and accessories are separately packaged in the packing case, as shown in the following figure.

Unpacking the main packing case

Accessory packing case

3.2 Preparation before Installation

3.2.1 Requirement for Installation Space

1. Ensure that the installation space meets the safety, environmental and power requirements.
2. Check for available power output.
3. Check for available network connector if the patient monitor needs to connect to a wired network.

Environmental Requirement

The patient monitor cannot be used in an environment where anesthetic agents or other inflammable or explosive items are placed; otherwise, fire or explosion may occur. The patient monitor shall be placed in an environment away from vibration, dust and corrosive to prevent the normal performance of the device from being affected.

Environmental parameter specifications are listed in the following table:

Main Unit			
Item	**Temperature (℃)**	**Relative Humidity (Non-Condensing)**	**Atmospheric Pressure (kPa)**
Working environment	0~40	15%~95%	57.0~107.4
Storage and transport environment	-20~60	10%~95%	16.0~107.4

CO_2 Parameter			
Item	**Temperature (℃)**	**Relative Humidity (Non-Condensing)**	**Atmospheric Pressure (kPa)**
Working environment	5~40	15%~95%	57.0~107.4
Storage and transport environment	-20~60	10%~95%	16.0~107.4

NOTE

- **Unless expressly stated, the environmental specifications of a parameter module are the same as those of the main unit.**

3.2.2 Power Requirement

Check the cable and power cord before use.

Verify that all system cables, power plugs and power cord are intact. Ensure that the plug pin is properly fixed in the housing. Do not use the device if there is any damage.

Verify that the patient cable and lead are properly insulated, and the connector is firmly fixed at both ends.

⚠WARNING

- **The equipment must be connected to a properly installed power outlet with protective earth contacts only.**

Voltage	100~240VAC
Current	≤ 1.5A
Frequency	50/60Hz

3.2.3 Installing Patient Monitor

Refer to ***uMEC Patient Monitor User Manual***.

3.2.4 Power On

Before starting the device, check for mechanical damages and ensure that the external cables and accessories are correctly connected.

Ensure that there is sufficient charge in the battery if battery is used for power supply.

Press the power on/off switch to switch on the patient monitor.

FOR YOUR NOTES

4 Hardware and Software Upgrade

4.1 Overview

This monitor supports upgrade of the monitoring parameter function modules, upgrade of the functional assemblies, and network upgrade of software.

NOTE

- **For function upgrade involving disassembly of the monitor, eliminate static electricity before the disassembly. When removing some parts with the electrostatic sensitive mark, wear protective devices such as electrostatic ring or anti-electrostatic gloves, lest the parts would be damaged.**
- **Properly connect and route the cables and wires when reassembling the equipment to avoid pinched hoses and electrical short circuits.**
- **Use specified screws to reassemble the equipment. If the incorrect screws are forcefully tightened, the equipment may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**
- **Be sure to follow the correct sequence when disassembling the monitor.**
- **Before removing assemblies, make sure that all the connection lines have been unplugged. During removal, note to avoid breaking the connection line by pulling or damaging the connector.**
- **Place the removed screws and other parts separately by category so that they can be used in the re-installation. Do not drop, contaminate or lose them.**

4.2 Hardware Upgrade

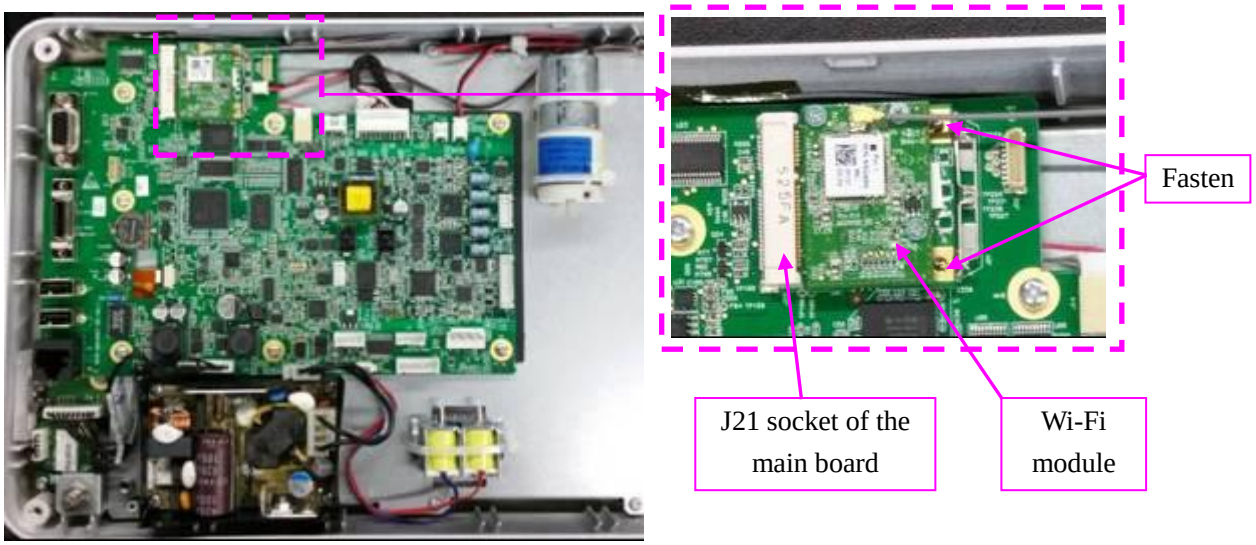
4.2.1 Wi-Fi Upgrade

4.2.1.1 Upgrade Material Package

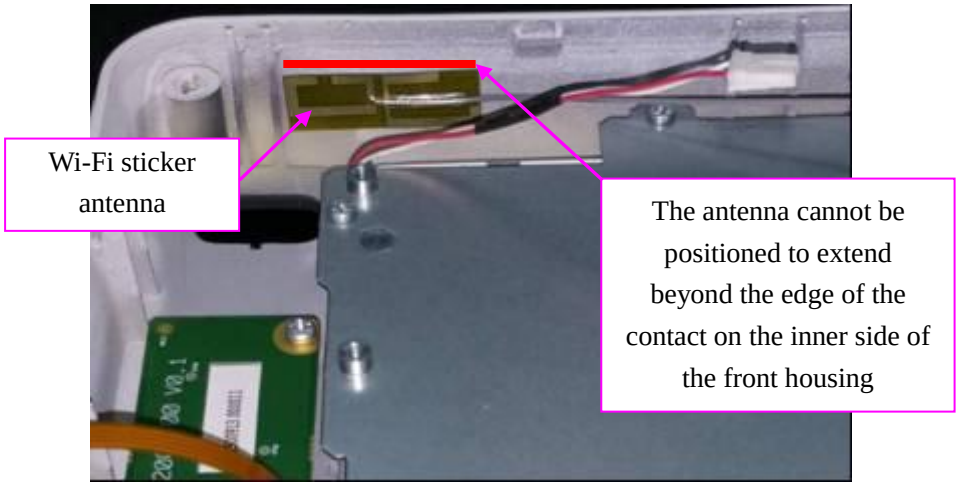
Upgrade Type	Configuration before Upgrade	Upgrade Package Description	Upgrade Package PN	Remarks
Wi-Fi upgrade	Main board	5G Wi-Fi module material package	/	The upgrade package cannot be used if there is no Wi-Fi plug on the main board. A main board of standard configuration is not configured with the Wi-Fi plug.

4.2.1.2 Upgrade Procedure

1. Split the front and rear housings as described in Section ***8.3.1 Separating the Front and Rear Half of the Monitor***.
2. Install the Wi-Fi module into the J21 socket of the main board and fasten the Wi-Fi module with clips.



3. Attach the sticker antenna onto the inner side of the front housing. The location is shown in the following figure:



Reassemble the device.

Connect the device to AC power. Start the device, and select [**Main Menu**] → [**Maintenance**] → enter the required password → [**Network Setup**] → [**Network Type**]. If the [**WLAN**] option is selectable, it indicates that the Wi-Fi upgrade is successful.

To perform a test on functions of the Wi-Fi module, refer to the methods described in ***Network Connection*** in the ***uMEC Series Patient Monitor User Manual***. Set the WLAN as required and connect the device to a nearby WLAN. Ensure that the device can be correctly connected.

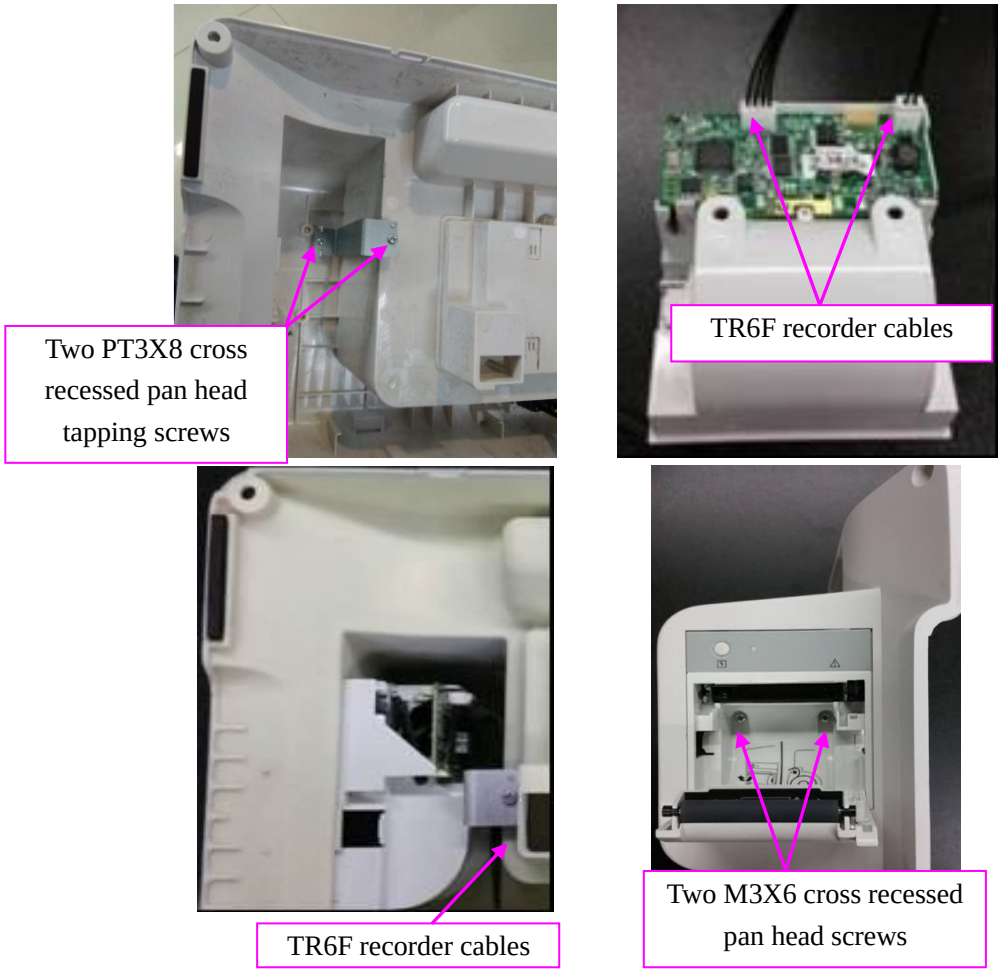
4.2.2 Recorder Upgrade

4.2.2.1 Upgrade Material Package

Upgrade Type	Configuration before Upgrade	Upgrade Package Description	Upgrade Package PN
Recorder	/	Recorder material package	/

4.2.2.2 Upgrade Procedure

1. Split the front and rear housings as described in Section ***8.3.1 Separating the Front and Rear Half of the Monitor***.
2. Fix the recorder fixing sheet metal onto the rear housing with two PT3X8 cross recessed pan head thread-cutting tapping screws (3~4kgf.cm), as shown in the following figure. Connect the TR6F recorder cables to the J2 and J6 sockets of the recorder. Then, place the recorder inside the rear housing and fix the recorder with two M3X6 cross recessed pan head screws (4~5kgf.cm).



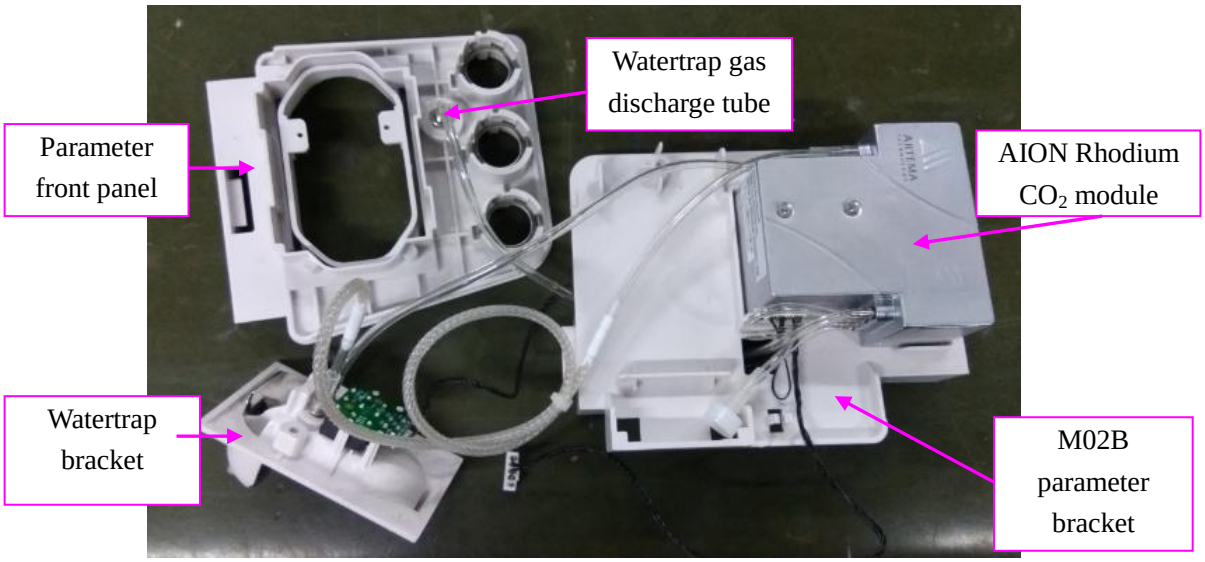
4.2.3 CO_2 Upgrade

4.2.3.1 Upgrade Material Package

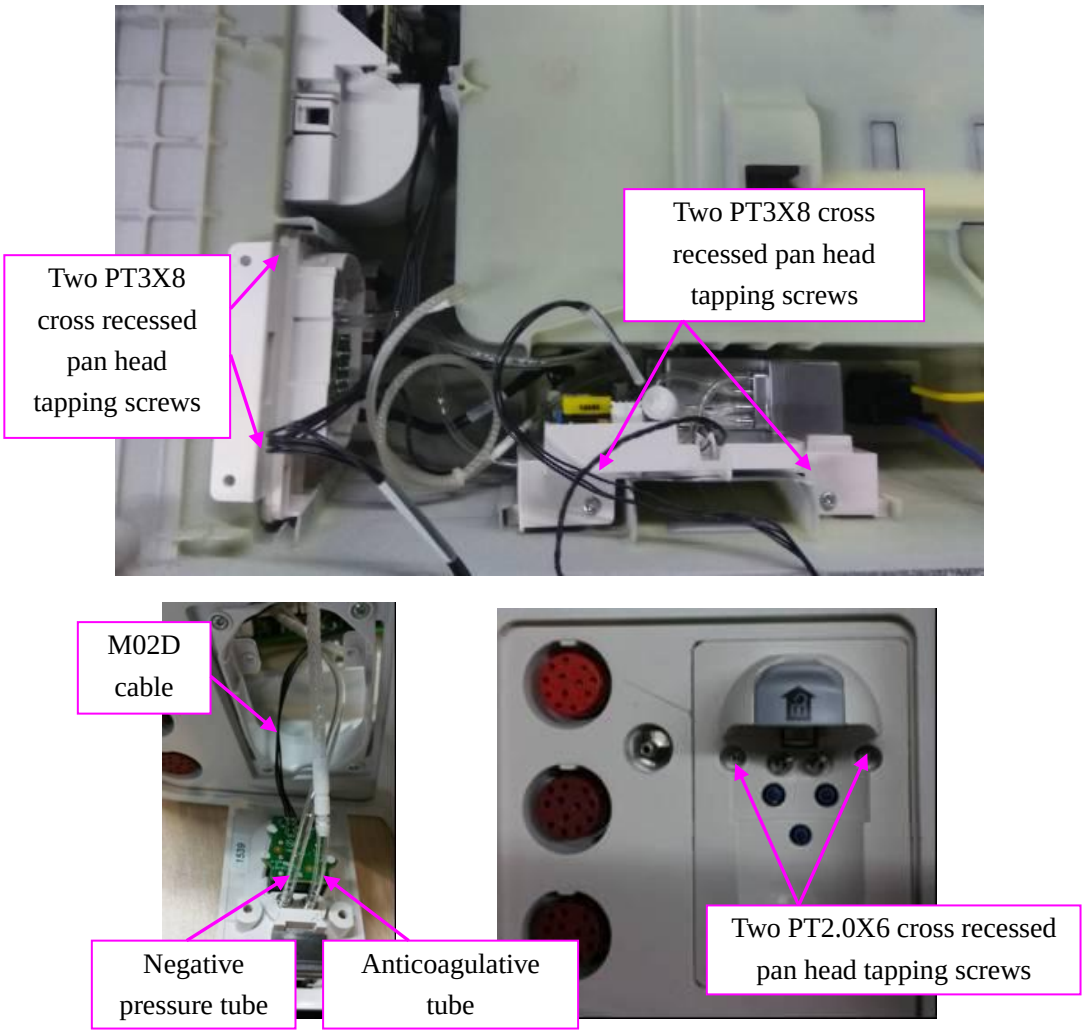
Upgrade Type	Configuration before Upgrade	Upgrade Package Description	Upgrade Package PN
CO_2	/	Mindray CO_2 (M02D) material package	/

4.2.3.2 Upgrade Procedure

1. Remove the parameter front panel assembly as described in Section ***8.3.2 Removing Parameter Front Panel Assembly, Balloon Pump, Air Valve and Speaker***, and tear off the original overlay on the parameter front panel assembly.
2. Fix the M02D CO_2 module on the parameter bracket. Connect the gas discharge tube to the nozzle on the parameter front panel (air tube on the watertrap bracket is not connected).



3. Use two PT3X8 cross recessed pan head tapping screws respectively to fix the parameter front panel and the bracket onto the rear housing, as shown in the following figure. Connect the M02D cable to the J1 socket of the watertrap bracket; connect the anticoagulative tube to the nozzle with the "X" flag on the watertrap bracket; and connect the negative pressure tube to the other nozzle. Use two PT2.0X6 cross recessed pan head tapping screws to fix the watertrap receptacle onto the parameter front panel.



4. Correctly reassemble the device.
5. Select a proper parameter overlay based on the specific configuration and attach the overlay onto the parameter front panel component.
6. Install the power plug anti-pull hook, as shown in the following figure. Be aware of the installation direction of the hook.

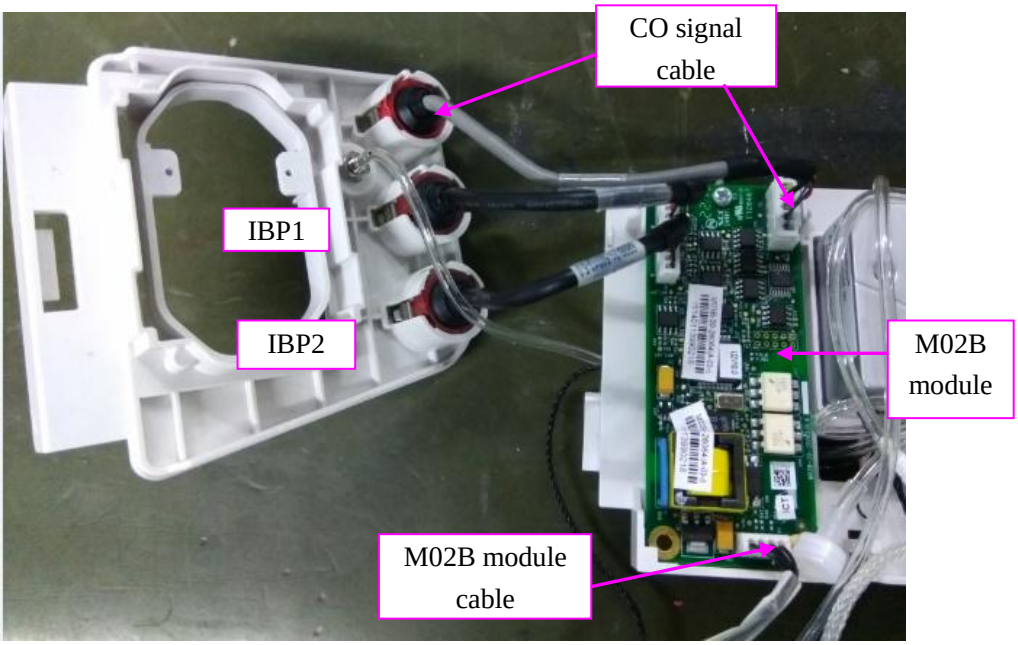
4.2.4 C.O./IBP Upgrade

4.2.4.1 Upgrade Material Package

Upgrade Type	Configuration before Upgrade	Upgrade Package Description	Upgrade Package PN
C.O./IBP upgrade	/	CO/IBP module package	/

4.2.4.2 C.O. Upgrade Procedure

1. Remove the parameter front panel assembly as described in Section ***8.3.2 Removing Parameter Front Panel Assembly, Balloon Pump, Air Valve and Speaker***, and tear off the original overlay on the parameter front panel assembly.
2. Connect the CO signal cable to the P2 socket of the M02B module, and connect the cable of M02B module to the P1 socket.
3. Connect IBP1 to the P3 socket, and IBP2 to the P4 socket.



3. Use two PT3X8 cross recessed pan head tapping screws respectively to fix the parameter front panel and the bracket onto the rear housing. Correctly reassemble the device.
4. Select a proper parameter overlay based on the specific configuration and attach the overlay onto the parameter front panel component.

Connect the device to an AC power. Start the device, and select [**Main Menu**] → [**Maintenance**] → [**Factory Maintenance**] → enter the required password → [**Device Config**]. In the [**Device Config**] menu, select the C.O. module and IBP1/IBP2 module. Then, close the [**Device Config**] menu, exit factory maintenance, and turn off the device. Restart the device and wait for a few minutes. Perform the test with the C.O./IBP module test method described in Section ***5.4.7 C.O. Test*** and ***5.4.6 IBP Test and Calibration***.

4.3 Software Upgrade

You can upgrade the software with the System Update Tool (PN: G-110-000493-00) through network. This tool can directly run on a PC. Through network or by connecting the patient monitor to a PC via a direct connection network cable, you can upgrade the following programs:

Software		**PN**	**Name and Specification**
System software package	System Software	110-004560-00	System Software
	Multilingual library	110-004556-00	Language library
	BMP resource file	110-004557-00	Icon library
		110-004558-00	Startup logo
	Linux platform software	110-004423-00	Linux kernel (including the drive)
Module software		110-004429-00	uMEC Power management board
		110-004426-00	uMEC parameter module STM32 chip-writing software
		110-003420-00	M02D functional program software
		M03B-30-86661	M03B chip-writing software (online download)

The upgrading of Linux kernel (including the drive) will remove all the original software applications except module software. Therefore, after the Linux kernel (including the drive) is upgraded, the boot software and system software must also be upgraded.

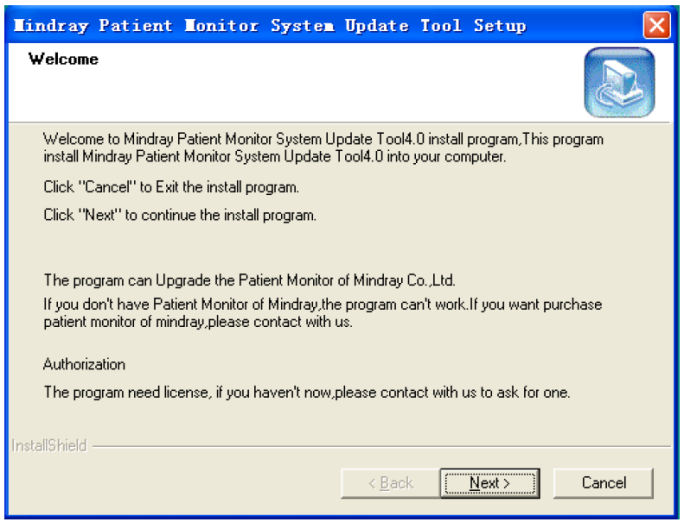
4.3.1 Installing Network Upgrade Tool (PN: G-110-000493-00)

1. Run the installation CD-ROM. Double-click the upgrade tool

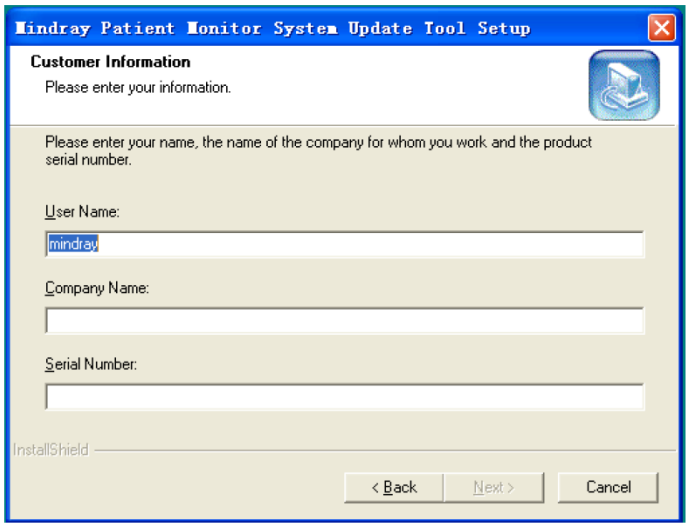
   SystemUpdateTool.exe to start installation.

2. Select the setup language.

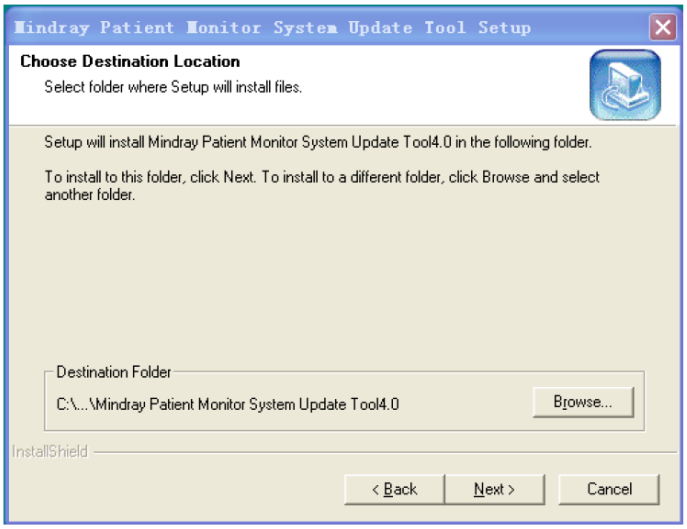
3. Select [**Ok**]. In the displayed page, click [**Next**], as shown in the following figure.



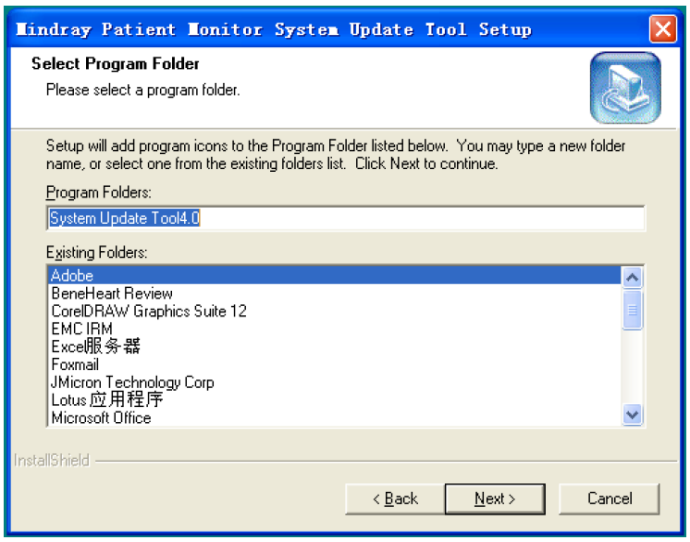
4. Enter the user name, company name and SN "26582640". Then, click [**Next**].



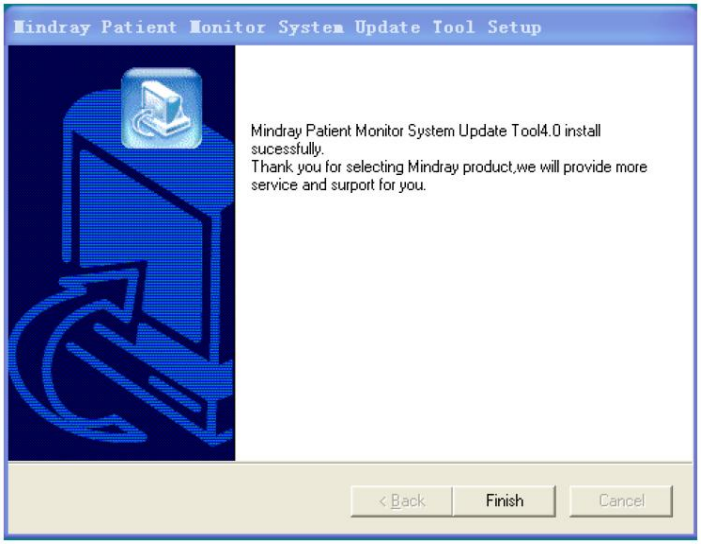
5. Select the destination folder. Then, click [**Next**].



6. Select the application folder. Then, click [**Next**].



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



4.3.2 Software Upgrade Procedure

1. Use a direct connection network cable to connect the PC and the patient monitor. On the PC, set the IP address to 77.77.1.XX, and the subnet mask to 255.255.255.0.
2. Run the System Update Tool on the PC. Select [**uMEC**] in the [**Machine Type Selection**] window and confirm.
3. Select [**Select Package**] in the main screen of the Mindray Patient Monitor Software Upgrade Tool. Choose the package you want to upgrade and click [**Start**].
4. Start up the patient monitor and press quickly the [**Silence**]+[**Main Menu**] hardkeys to enter upgrade mode. When the upgrade toolbar displays "System upgraded successfully", the upgrade is completed.

Software upgrade is usually performed in the following sequence: Linux kernel (including the drive) → System software package (including system software, multilingual library, BMP resource file and boot software) → Module software.

After software upgrade is finished, restart the patient monitor and check whether the upgraded software version is correct.

For the detailed operations of network program upgrade, refer to the help and instructions included in the System Update Tool, or consult your service personnel.

⚠CAUTION

- **Disconnect the patient monitor from the patient and make sure that important data are saved before upgrade.**
- **Do not shut down or power off the equipment when upgrading the bootstrap. Otherwise, the equipment may break down.**
- **Program upgrade should be performed by qualified service personnel only.**

NOTE

- **Make sure the version of the upgrade package is your desired one. If you want to obtain the latest upgrade package, contact Mindray Customer Service Department.**

FOR YOUR NOTES

5 Testing and Maintenance

5.1 Overview

To ensure the patient monitor always functions properly, qualified service personnel should perform regular inspection, maintenance and test. This chapter provides a checklist of the testing procedures for the patient monitor 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 patient monitor meets the performance specifications. If the patient monitor or a module fails to perform as specified in any test, repairs or replacement must be done to correct the problem. If the problem persists, contact our Customer Service Department.

⚠CAUTION

- **All tests should be performed by qualified service personnel only.**
- **Care should be taken when changing the settings in** [User Maintenance>>] **and [**Factory Maintenance>>**] menus to avoid loss of data.**
- **Service personnel should possess a working knowledge of the test tools and make sure that test equipment and cables are applicable.**

5.1.1 Test Equipment

See the following sections.

5.1.2 Preventative Maintenance Procedures

The following sections provide a list of recommended preventative maintenance procedures. The following sections provide a list of recommended preventative maintenance procedures and their recommended frequencies.

Visual Inspection

NIBP test

CO_2 test and calibration

5.1.3 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 maintenance or the replacement of any main unit parts.
ECG Tests	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repair or replacement of relevant module. 3. At least once every two years. Note: For CO_2 module, at least once a year.
	Calibration	
Resp performance test		
SpO_2 test		
NIBP test	Pressure check	
	Leakage Test	
Temp Test		
IBP test	Performance test	
	Pressure Calibration	
C.O. test		
CO_2 test	Leakage Test	
	Performance test	
	Calibration	
Nurse call relay performance test		If the user suspects that the nurse call or analog output does not work well.
Analog output performance test		
Electrical safety test	Enclosure leakage current test	1. Following any repair or replacement of the power module. 2. When the patient monitor is dropped. 3. At least twice a year or as required.
	Earth leakage test	
	Patient leakage current	
	Patient auxiliary current	
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	Function Test	1. When first installed. 2. Whenever a battery is replaced.
	Performance Test	Once every six months or when the battery run time is reduced significantly.

5.2 Visual Inspection

Inspect the equipment for obvious signs of damage. 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 rotary encoder for obvious signs of damage.
Inspect the power cord, wall-mount bracket and accessories 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.

5.3 Power on Test

This test is to verify that the patient monitor can power up correctly. The test is passed if the patient monitor starts up by following this procedure: Follow this procedure to perform the test:

1. Install the battery into the patient monitor, and connect the patient monitor to an AC power. The AC mains LED and battery LED light up.
2. Press the power on/off switch to switch on the patient monitor.

The patient monitor will automatically implement self test upon start-up. During the self test, the alarm lamps light yellow and red respectively, and the system sounds a beep, indicating that the audible and visual alarm indicator has already start operating normally.

5.4 Module Performance Tests

5.4.1 ECG Test and Calibration

ECG Performance Test

Tools required:

- Medsim300B patient simulator

1. Connect the patient simulator with the ECG module using an ECG cable.
2. Set the patient simulator as follows: ECG sinus rhythm, HR = 80 bpm with the amplitude as 1 mV.
3. Verify that the ECG waves are displayed correctly without noise and the displayed HR value is within 80 ±1 bpm.
4. Disconnect each of the leads in turn and observe the corresponding lead off message displayed on the screen.

5. Set the output of the simulator to deliver a paced signal and set [**Paced**] to [**Yes**] on the monitor. Check the pace pulse marks on the monitor screen.

ECG Calibration

Tools required:

- Vernier caliper

1. Select the ECG parameter window or waveform area→ [**Filter**]→ [**Diagnostic**]
2. Select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → [**Module Maintenance >>**].
3. Select [**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
4. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
5. After completing the calibration, select [**Stop Calibrating ECG**].

If necessary, you can print out the square wave and wave scale through the recorder and then measure the difference.

5.4.2 Resp Performance Test

Tools required:

- Medsim300B patient simulator

1. Connect the patient simulator to the module using a non ESU-proof cable and set lead II as the respiration lead.
2. Configure the simulator as follows: lead II as the respiration lead, base impedance line as 1500 Ω; delta impedance as 0.5 Ω, respiration rate as 40 rpm.
3. Verify that the Resp wave is displayed without any distortion and the displayed Resp value is within 40 ±2 rpm.

5.4.3 SpO_2 Test

Tools required:

- None.

1. Connect SpO_2 sensor to the SpO_2 connector of the monitor. Set [**Patient Cat.**] to [**Adu**] and [**PR Source**] to [**SpO_2**] on the monitor.

2. Apply the SpO_2 sensor to the ring finger of a healthy person.
3. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO_2 is within 95% and100%.
4. Remove the SpO_2 sensor from your finger and make sure that an alarm of SpO_2 Sensor Off is triggered.

Measurement accuracy verification:
The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.

NOTE

- **A simulator cannot be used to assess the accuracy of a pulse oximeter monitor or a SpO_2 sensor. Instead, it can only verify that whether the monitor is functional. The accuracy of a pulse oximeter monitor or a SpO_2 sensor needs to be verified by clinical data.**

5.4.4 NIBP Test

Leakage Test

NOTE

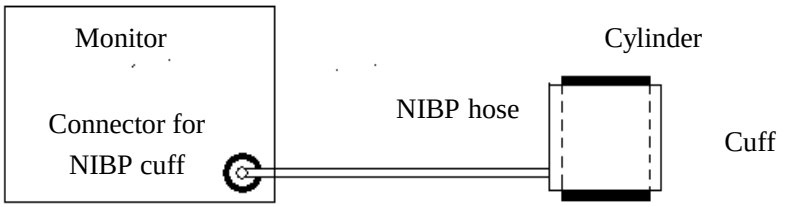
- **Leakage test must be performed before carrying out other NIBP tests.**

Tools required:

- NIBP cuff for adult patient
- Tubing
- Cylinder

Follow this procedure to perform the test:

1. Set [**Patient Cat.**] to [**Adu**].
2. Connect the NIBP cuff to the NIBP connector on the patient monitor.
3. Wrap the cuff around the rigid cylinder as shown below.



4. Select [**Main Menu**] → [**Maintenance**] → enter the required password → [**Module**] → [**NIBP**] → [**NIBP Leakage Test**]. The message [**NIBP Leakage Test**] is displayed in the NIBP parameter area.
5. The cuff automatically deflates after 20s, which means NIBP leakage test is completed.
6. If no message is displayed in the NIBP parameter area, it indicates that the system has no leak. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the system may have a leak.In this case, verify the connections and make sure that the NIBP cuff, hose, and connectors are not leaking. Then, perform the test again.

You can also perform a manual leakage test:

1. Perform steps 1-4 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 seconds until the measured values become stable.
3. Record the current pressure value and meanwhile count time with a timer. Then, record the pressure value after counting to 60 seconds.
4. Compare the two values and make sure the difference is not greater than 6 mmHg.

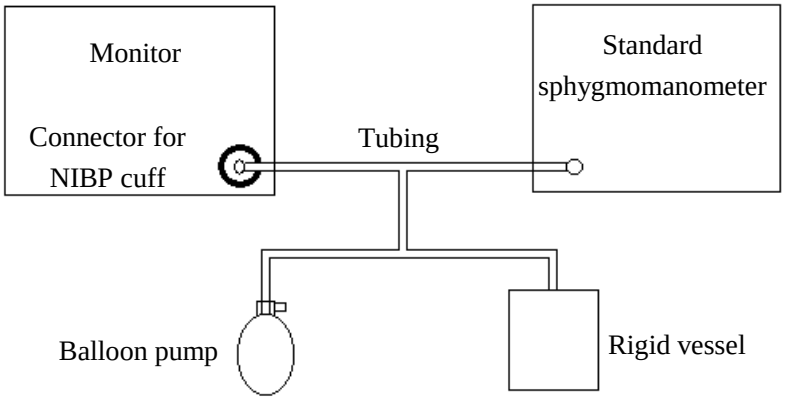
Pressure Check

Tools required:

- T-shape connector
- Tubing
- Balloon pump
- Rigid vessel with volume 500±25 ml
- Reference manometer (calibrated with accuracy equal to or greater than 0.75 mmHg)

Follow this procedure to perform the test:

1. Connect the equipment as shown below.



2. Before inflation, the reading on the manometer should be zero. If not, open the valve of the balloon pump to let the whole airway open to the atmosphere. Close the valve after the reading turns to zero.
3. Select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → [M**odule Maintenance >>**] → [**NIBP Accuracy Test**].
4. Check the reading of the manometer and the reading of the patient monitor. 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 until the measured values become stable.
6. Compare the reading of the manometer with the reading of the patient monitor. The difference should be within ±3 mmHg.
7. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until 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.**

5.4.5 Temp Test

Tools required:

- Resistance box (with accuracy above 0.1 Ω)

1. Connect the two pins of any Temp connector of the patient monitor to the two ends of the resistance box using two wires.
2. Set the resistance box to 1354.9 Ω (corresponding temperature is 37ºC).

3. Verify that the displayed value is within 37±0.1℃.
4. Repeat steps 1 to 3 to verify each Temp channel of the monitor.

5.4.6 IBP Test and Calibration

Performance Test

Tools required:

- Medsim300 patient simulator, MPS450, or other equivalent equipment
- Dedicated IBP adapter cable (use P/N 00-002199-00, if the simulator is Medsim300B; use P/N 00-002198-00, if the simulator is MPS450)

1. Connect the patient simulator to the monitor's IBP connector.
2. Set the patient simulator output to a certain IBP channel to 0 mmHg.
3. Make a zero calibration on the parameter module.
4. Set static pressure to 200 mmHg on the patient simulator.
5. The displayed value should be within 200±4 mmHg.
6. If the value is outside of these tolerances, calibrate the IBP module. If the IBP module was calibrated with a dedicated reusable IBP sensor, check the calibration together with this IBP sensor.
7. Make the patient simulator outputs 120/80 mmHg ART signals and 120/0 mmHg LV signals respectively to the IBP channel and check that the IBP wave is displayed correctly.
8. Repeat the preceding steps to test every IBP channel.

Pressure Calibration

Method 1:
Tools required:

- Medsim300B patient simulator, MPS450, or other equivalent equipment
- Dedicated IBP adapter cable (use P/N 00-002199-00, if the simulator is Medsim300B; use P/N 00-002198-00, if the simulator is MPS450)

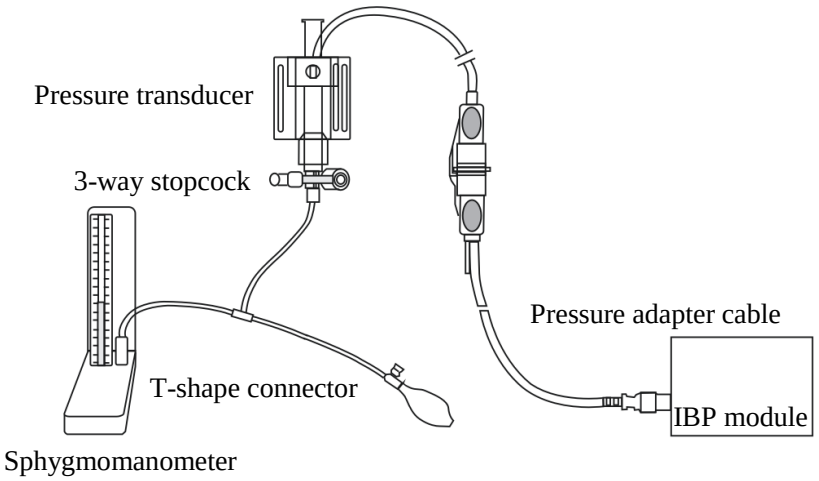
1. Connect the patient simulator to the monitor's IBP connector.
2. Set the patient simulator to 0 pressure for the desired IBP channel.
3. Make a zero calibration on the parameter module.
4. Set static pressure to 200 mmHg on the patient simulator.

5. Select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → [**Module Maintenance >>**] → [**Cal. IBP Press. >>**]. In the [**Cal. IBP Press.**] menu, set the calibration value to 200 mmHg.
6. Select the [**Calibrate**] button next to the desired IBP channel to start a calibration.
7. The message [**Calibration Completed!**] is displayed after a successful calibration. Otherwise, a corresponding message will be displayed.

Method 2:
Tools required:

- Standard sphygmomanometer
- Balloon pump
- Tubing
- T-shape connector

1. Connect the 3-way stopcock, the sphygmomanometer and the balloon pump through a T-shape connector, as shown below.



2. Turn on the 3-way stopcock to the air to zero the transducer, and then open the stopcock to the sphygmomanometer.
3. Select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → [**Module Maintenance >>**] → [**Cal. IBP Press. >>**]. In the [**Cal. IBP Press.**] menu, set the target pressure calibration value of the target channel.
4. Inflate using the balloon pump until the reading of sphygmomanometer approximates the preset calibration value.
5. Adjust the calibration value in the [**Maintain IBP**] menu until it is equal to the reading of sphygmomanometer
6. Select the [**Calibrate**] button next to the desired IBP channel to start a calibration.

The message [**Calibration Completed!**] is displayed after a successful calibration. Otherwise, a corresponding message will be displayed.

5.4.7 C.O. Test

Tools required:

- Medsim300B Patient simulator, MPS450, or equivalent equipment
- C.O. adapter box (for 300B, use CI-3, P/N 3010-0289; for MPS450, use P/N 5180500)
- C.O. main cable (P/N: 0010-21-42716)

1. Connect the patient simulator to the C.O. connector using the C.O. main cable through the adapter box.
2. Set the blood temperature (BT) to 37℃ on the patient simulator and check the temperature value is 37±0.1℃.
3. In the [**C.O. Setup**] menu, set [**Auto IT**] to [**Off**], set [**Manual TI(℃)**] to [**2℃**], and set [**Comp. Const**] to [**0.542**]. Select [**Enter C.O. Screen**] to open the C.O. Screen.
4. Click [**Start**] to start C.O. measurement.
5. On the C.O. simulator, set the C.O. to 5 L/min. Wait for 3 to 10 seconds.
6. Verify that the C.O. value is 5±0.25 L/min.

5.4.8 CO_2 (M02D) Test and Calibration

Leakage Test

1. Connect CO_2 measurement assembly.
2. Wait for 10 minutes until the CO_2 module warm-up is finished. Use your finger or other object to occlude the port. The CO_2 module will behave as follows:

The alarm message [**CO_2 Filter Line Occluded**] is displayed on the screen after 3 seconds. Block the gas inlet for another 60 seconds. Select [**User Maintenance >>**] → enter the required password → [**Module Maintenance >>**] → [**Maintain CO_2 >>**] → [**Calibrate CO_2 >>**]. If the flow rate is less than 10 ml/min and the alarm message continues, it indicates that the module does not leak.

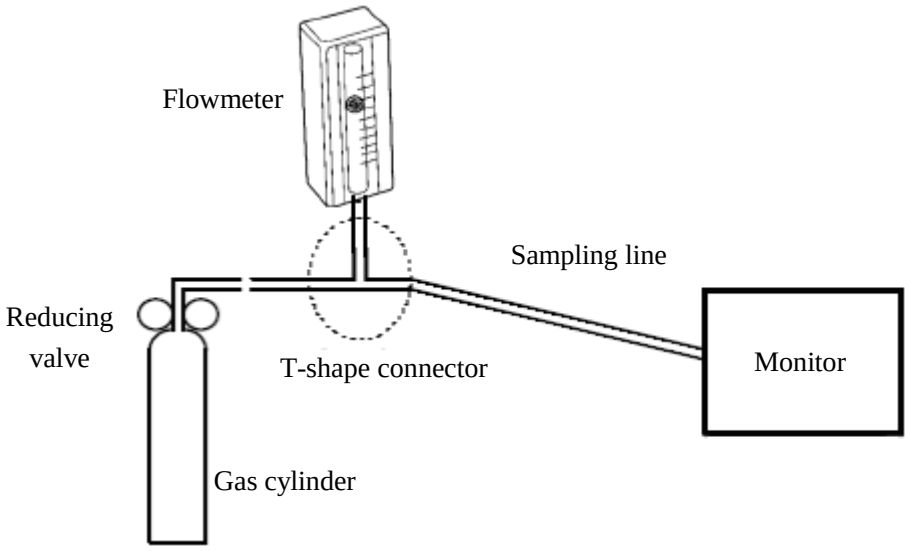
Accuracy Test

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2

- T-shape connector
- Tubing
- Flowmeter

1. Connect CO_2 measurement assembly.
2. Wait until the CO_2 module warm-up is finished. Check the airway for leak and perform a leakage test as well to make sure that the airway has no leak.
3. Select [**User Maintenance** >>] → enter the required password → [**Module Maintenance** >>] → [**Maintain CO_2** >>] → [**Calibrate CO_2** >>].
4. Connect the test system as follows:



5. Open the relief valve, and adjust it until the flowmeter has a stable reading between 10 ml/min and 50 ml/min.
6. Check the real-time CO_2 value is within 6±0.3% in the [**Calibrate CO_2**] menu.

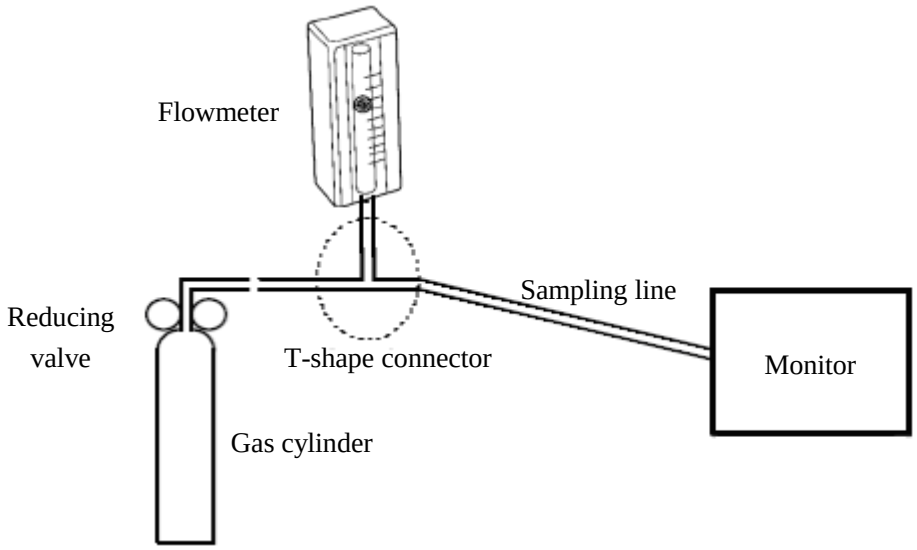
Calibration

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

1. Make sure that the CO_2 module has been warmed up or started up.
2. Check the airway for leaks and perform a leakage test as well to make sure that the airway has no leak.

3. In the [**Calibrate CO_2**] menu, select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → enter the required password → [**Module Maintenance >>**] → [**Maintain CO_2 >>**] → [**Calibrate CO_2 >>**].
4. In the [**Calibrate CO_2**] menu, select [**Zero**].
5. After the zero calibration is finished successfully, connect the equipment as follows:



6. Open the relief valve, and adjust it until the flowmeter has a stable reading between 10 ml/min and 50 ml/min.
7. In the text box on the upper right corner of the [**Calibrate CO_2**] menu, enter the vented gas concentration.
8. In the [**Calibrate CO_2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate**] to calibrate the CO_2 module.
9. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

5.5 Nurse Call Relay Performance Test

Tools required:

- Oscilloscope

1. Connect the nurse call cable to the multifunction output connector of the patient monitor.
2. Enter Demo mode. Then, select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → enter the required password → [**Others >>**].

3. In the [**Others**] menu, select [**Nurse Call Setup >>**] and then select all options of [**Alm Lev**] and [**Alarm Cat.**] and set [**Contact Type**] to [**Normally Open**]
4. In the [**Nurse Call Setup >>**] menu, set [**Signal Type**] to [**Pulse**].Cause the monitor to generate an alarm and verify the output are pulses of 1s width when there is an alarm.
5. In the [**Nurse Call Setup >>**] menu, set [**Signal Type**] to [**Continuous**].Cause the monitor to generate an alarm and verify the output is continuous high level when there is an alarm.

5.6 Analog Output Performance Test

Tools required:

- Medsim300B Patient simulator, MPS450, or equivalent equipment
- Oscilloscope

Connect the patient simulator to the monitor using an ECG or IBP cable and connect the oscilloscope to the multifunction output connector of the patient monitor. Verify that the waves displayed on the oscilloscope are identical with those displayed on the monitor.

5.7 Electrical Safety Test

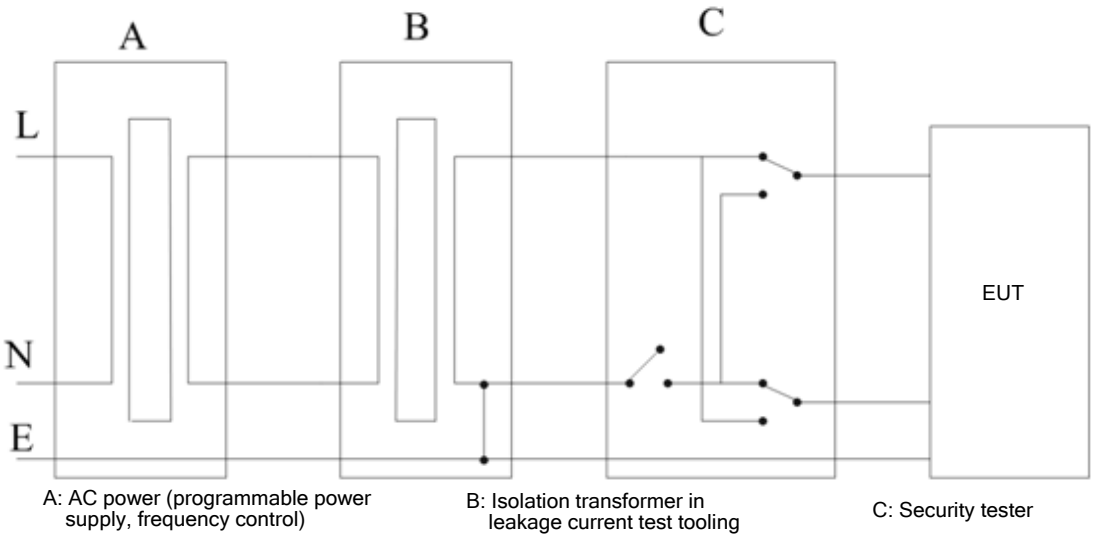
⚠WARNING

- **Electrical safety tests are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator.**
- **All tests can be performed using commercially available safety analyzer test equipment. Maintenance personnel shall ensure the adaptability, functional completeness and safety of these pieces of test equipment, and be familiar with their usage.**
- **Electrical safety tests shall comply with the following standards: EN 60601-1 and UL60601.**
- **In case of other stipulations in local laws and regulations, implement electrical safety tests by following relevant stipulations.**
- **All devices driven by AC power and connected to medical instruments in patient zones must comply with the IEC 60601-1 standard. And electrical safety tests on these devices must be implemented in accordance with the test interval of the patient monitor.**

Electrical safety tests are used to timely detect potential electrical safety risks that might cause damage to patients, operators or maintenance personnel. Electrical safety tests must be carried out under normal environmental conditions (that is, normal temperature, humidity and barometric pressure).

The electrical safety tests described in this chapter take 601 safety analyzer as an example. The safety analyzer used in different regions may vary. Make sure that the electrical safety test scheme you adopted is applicable.

Device connection is shown in the following figure.



Tools required:

- Safety analyzer (601 PROXL)
- Isolation transformer

5.7.1 Enclosure Leakage Current Test

1. Connect 601 PROXL safety analyzer to a 264 VAC 60 Hz power supply.
2. Use power cord to connect the equipment under test (EUT) to the auxiliary power output connector of 601 PROXL safety analyzer.
3. Connect one end of the red lead to the "Red input terminal" of the safety analyzer, and clip the other end on the metal foil attached on the surface of the outer housing of the EUT.
4. Power on 601 PROXL safety analyzer. Press "5-Enclosure leakage" on the panel to access the test interface for enclosure leakage current test.
5. The enclosure leakage current is not greater than 100 μA in normal condition and is not greater than 300 μA in single fault condition.

5.7.2 Earth Leakage Current Test

1. Connect 601 PROXL safety analyzer to a 264 VAC 60 Hz power supply.
2. Connect the application part of the EUT to the RA terminal of the safety analyzer.
3. Use power cord to connect the EUT to the auxiliary power output connector of 601 PROXL safety analyzer.
4. Power on 601 PROXL safety analyzer. Press "4-Earth leakage" on the panel to access the test interface for earth leakage current test.
5. The earth leakage current is not greater than 300 μA in normal condition and is not greater than 1000 μA in single fault condition.

5.7.3 Patient Leakage Current Test

1. Connect 601 PROXL safety analyzer to a 264 VAC 60 Hz power supply.
2. Connect the application part of the EUT to the RA terminal of the safety analyzer.
3. Use power cord to connect the EUT to the auxiliary power output connector of 601 PROXL safety analyzer.
4. Power on 601 PROXL safety analyzer. Press "6-Patient leakage" on the panel.
5. Press the "APPLIED PART" button repeatedly to select AC and DC measurement. When DC is selected, the "DC" text is displayed next to the limit.
6. The patient leakage current is not greater than 10 μA in normal condition and is not greater than 50 μA in single fault condition.

5.7.4 Patient Auxiliary Current Test

1. Connect 601 PROXL safety analyzer to a 264 VAC 60 Hz power supply.
2. Use power cord to connect the EUT to the auxiliary power output connector of 601 PROXL safety analyzer.
3. Connect the ECG cable of the EUT to the RA terminal of the safety analyzer.
4. Power on 601 PROXL safety analyzer. Press "8-Patient Auxiliary Current Test" on the panel to access the test interface for patient auxiliary current test.
5. Press the "APPLIED PART" button repeatedly to select AC and DC measurement. When DC is selected, the "DC" text is displayed next to the limit.
6. The patient auxiliary current is not greater than 10 μA in normal condition and is not greater than 50 μA in single fault condition.

5.8 Touchscreen Calibration

Tools required:

- None.

1. Select [**Main Menu**] → [**Maintenance >>**] → [**Cal. Touchscreen**].
2. The  symbol will appear at different positions on the screen.
3. Touch, in turn, the central point of the  symbol.
4. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

5.9 Recorder Check

Tools required:

- None.

1. Print ECG waveforms. The recorder should print correctly and the printout should be clear and correct.
2. Set the recorder to some problems such as out of paper, etc. the patient monitor should give corresponding prompt messages. After the problem is removed, the recorder should be able to work correctly.
3. Switch automatic alarm recording for each parameter ON and then set each parameter's limit outside set alarm limits. Corresponding alarm recordings should be triggered when parameter alarms occur.

5.10 Battery check

Tools required:

- None.

Function Test

1. Remove any batteries that are installed in the patient monitor.
2. Verify that the patient monitor works properly when running on AC power.
3. Insert batteries according to the procedures provided in the Operator's Manual.

4. Remove the AC power cord and verify that the patient monitor still works properly.

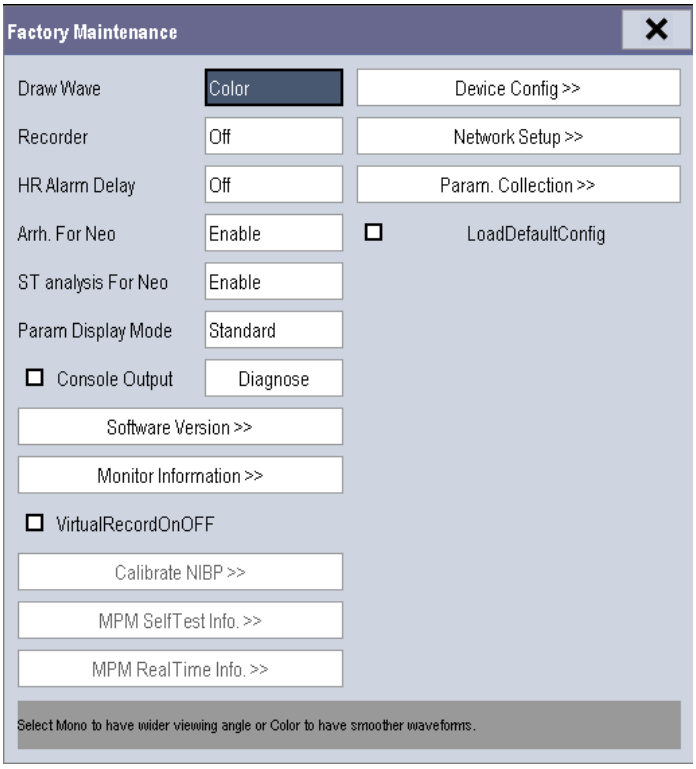
Performance Test

Perform the test procedure in the ***Battery*** section in the Operator's Manual and verify the operating time of the battery meets the product specification.

5.11 Factory Maintenance

5.11.1 Accessing Factory Maintenance

To access the [**Factory Maintenance**] menu, select [**Main Menu**] → [**Maintenance >>**] → [**Factory Maintenance >>**] → enter the required password.



5.11.2 Draw Wave

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.

5.11.3 Recorder

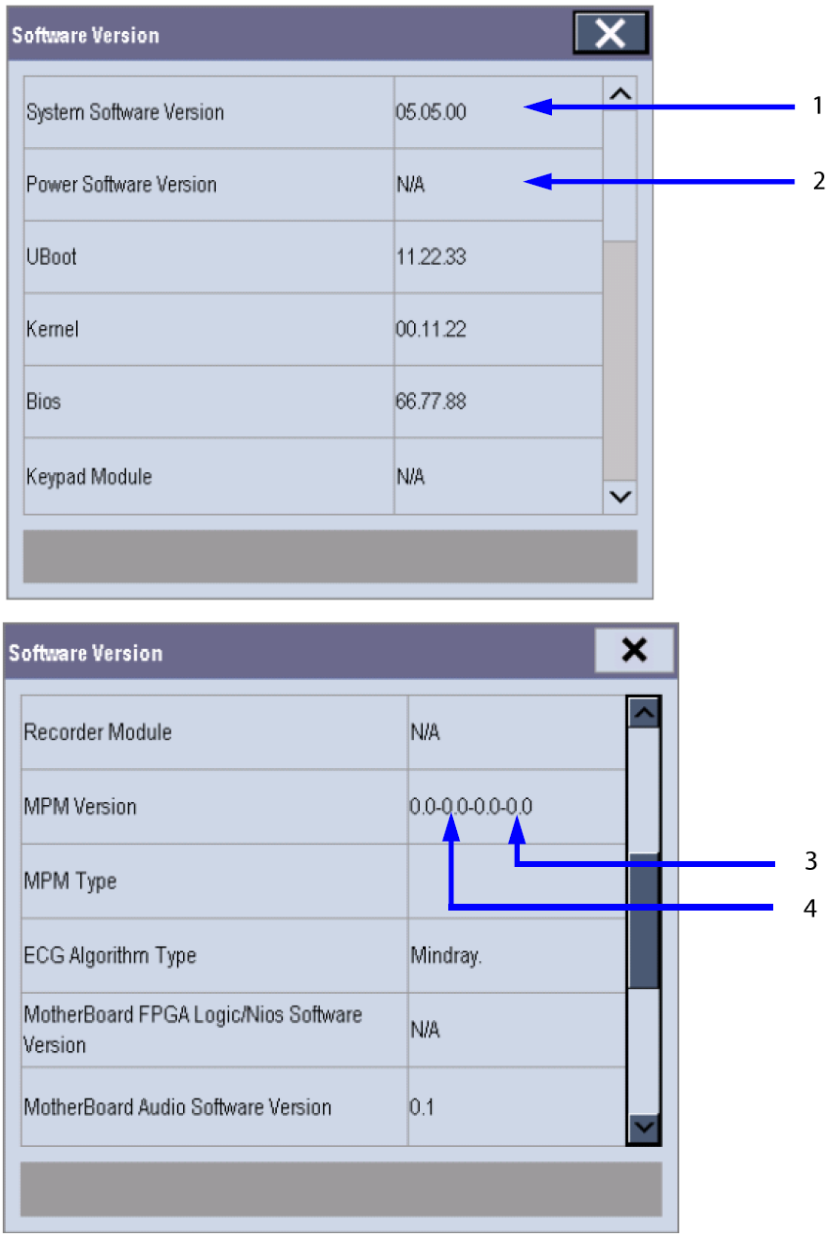
To enable/disable the recorder, select [**Recorder**] and toggle between [**On**] and [**Off**].

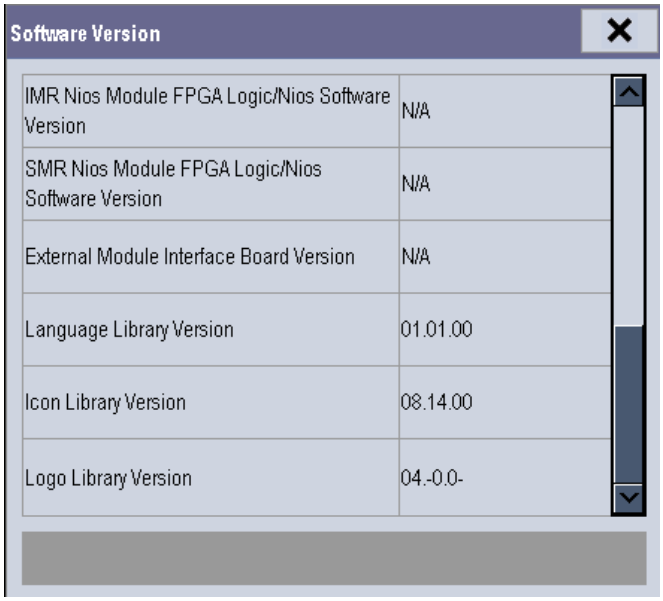
NOTE

- **The recorder is disabled if [**Recorder] **is switched off in the [**Factory Maintenance] **menu.**

5.11.4 Software Version

In the [**Factory Maintenance**] menu, select [**Software Version**] to show software version information. The [**Software Version**] menu is as follows:



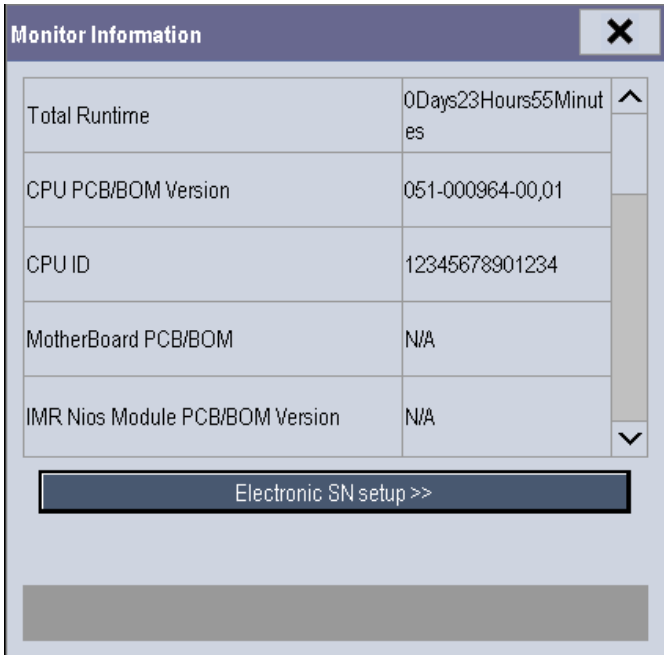


In the above figures,

1. System software version
2. Power management software version
3. Blood oxygen board software version (for the patient monitor with Nellcor or Masimo blood oxygen board configured, the value is 0.0)
4. Multi-parameter module software version

5.11.5 Monitor Information

In the [**Factory Maintenance**] menu, select [**Monitor Information**] to show the status of the patient monitor. Monitor information is displayed as follows:



NOTE

- **After the main board is changed, the ESN of the patient monitor needs to be reset based on the main unit label.**

5.11.6 Test Report

Upon 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.

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 items	**Test records**	**Test results (Pass/Fail)**
Visual Inspection		
The case, display screen, buttons, rotary encoder, power cord, wall-mount bracket 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		
ECG performance test		
ECG waves are displayed correctly without noise and the HR value is within 80±1 bpm.		
ECG Lead Off alarm behaves correctly.		
Paced signals are detected and pace pulse marks are displayed when Paced is set to Yes.		
The difference between the amplitude of the ECG calibration square wave and that of the wave scale is not greater than 5%.		
Resp test		
The Resp wave is not distorted and the Resp value is within 40±2 rpm.		
SpO_2 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%-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.		
Temp test		
The value displayed for each Temp channel of the monitor is within 37±0.1 ℃.		
IBP test		
The static pressure value displayed for each IBP channel is within 200±4 mmHg.		
The ART and LV waves for each IBP channel are displayed correctly.		

C.O. test		
The TB value displayed on the monitor is within 37±0.2℃.		
The displayed C.O. value is within 5±0.25 L/min.		
Sidestream CO_2 test		
Block the gas inlet of the module or watertrap. The sidestream CO_2 flow rate is slower than 10ml/min and an alarm of CO_2 FilterLine Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is 6.0±0.3%.		
Nurse call relay performance test		
The relay contacts are close when an alarm occurs.		
Analog output performance test		
The waves displayed on the oscilloscope are identical with those displayed on the monitor.		
Electrical safety test		
The enclosure leakage current is not greater than 100 μA in normal condition and is not greater than 300 μA in single fault condition.		
The earth leakage current is not greater than 300 μA in normal condition and is not greater than 1000 μA in single fault condition.		
The patient leakage current is not greater than 10 μA in normal condition and is not greater than 50 μA in single fault condition.		
The patient auxiliary current is not greater than 10 μA in normal condition and is not greater than 50 μA in single fault condition.		
Touchscreen calibration		
The touchscreen is calibrated successfully.		
Recorder check		
The recorder can print ECG waves correctly and the printout is clear and correct.		
Set the recorder to some problems such as out of paper, etc. the patient monitor should give corresponding prompt messages. After the problem is removed, the recorder should be able to work correctly.		
Automatic alarm recording for each parameter functions correctly when parameter alarms occur.		
Battery check		

The monitor can operates correctly from battery power when an AC power failure accidentally occurs.		
The operating time of the battery meets the product specification.		

Conclusion:

Qualified or not: (Yes No)

Signature of tester: Date:

FOR YOUR NOTES

6 Troubleshooting

6.1 Overview

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

For more information on troubleshooting, contact Mindray After-sales Service.

6.2 Part Replacement

Printed circuit boards (PCBs), major parts and components in the patient monitor are replaceable. Once you isolate a PCB you suspect defective, follow the instructions in 8 ***Disassembly*** and Repair
to replace the PCB with a known good one. Verify proper operation and that the patient monitor passes all performance tests. If the fault is cleared, it indicates that the original PCB was damaged. Send the defective PCB 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 8 ***Disassembly*** and Repair
.

6.3 Patient Monitor Status Check

Some troubleshooting tasks may require you to identify the hardware version and status of your patient monitor. To check the status of your patient monitor, follow this procedure:

1. Select [**Main Menu**] → [**Maintenance >>**] → [**Monitor Information >>**]. In the displayed menu, you can check the system start time, self test error and other status information.
2. Select [**Main Menu**] → [**Maintenance >>**] → [**Factory Maintenance >>**] → enter the required password → [**Monitor Information >>**]. In the displayed menu, you can check the monitor's current status.

6.4 Software Version Check

Some troubleshooting tasks may involve software version compatibility. For information about the configuration and software version of your patient monitor, contact Mindray After-sales Service. To check the software version, do as follows:

1. Select [**Main Menu**] → [**Maintenance** >>] → [**Software Version** >>]. In the displayed menu, you can check the system software version and monitor configuration.
2. Select [**Main Menu**] → [**Maintenance** >>] → [**Factory Maintenance** >>] → enter the required password → [**Software Version** >>]. In the displayed menu, you can check the version information of the system software and modules.

6.5 Technical Alarm Check

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

For detailed information on technical alarm messages, possible causes and countermeasures, refer to the patient monitor's Operation Manual.

6.6 Troubleshooting Guide

6.6.1 Power On/Off Failures

Fault Symptom	Possible Cause	Countermeasure
Power on failure, AC LED, battery LED, or start up display LED does not light	AC mains not connected or insufficient battery power	Verify the AC mains is properly connected or battery capacity is sufficient.
	Power supply protection	Refer to 6.6.6 Power Failures.
	Cable defective or improperly connected	Verify the cable connecting the main board to the button board is correctly connected. Verify the connecting cables and connectors are not damaged.
	Power switch & LED defective	Replace the button board
	AC/DC board defective	Replace the AC/DC board
	Main board failure	Replace the main board.

6.6.2 Display Failures

Fault Symptom	Possible Cause	Countermeasure
Blank screen	Cable defective or improperly connected	1. Verify the signal cable and backlight cable connecting the display to the main board are correctly connected. 2. Verify the connecting cables and connectors are not damaged.
	Main board defective	Replace the main board.
	LCD defective	Replace the LCD.
Images overlapped or distorted	Main board error	Replace the main board or use the downloaded upgrade software to upgrade the main board
	Cable defective or improperly connected	1. Verify the signal cable and backlight cable connecting the display to the main board are correctly connected. 2. Verify the cables and connectors are not damaged.
Secondary display shows snow or flashing specks Secondary display does not function	Cable defective or improperly connected	1. Verify the cable connecting the display and the patient monitor is correctly connected. 2. Verify the cables and connectors are not damaged.
	Main board failure	Replace the main board.
Touchscreen does not respond	Cable defective or improperly connected	1. Verify the cable connecting the touchscreen to the main board is properly connected. 2. Verify the cables and connectors are properly connected
	Touchscreen defective	Replace the touchscreen.
	Main board failure	Replace the main board.
Touchscreen response is not accurate	Touchscreen not calibrated	Calibrate the touchscreen.

6.6.3 Alarm LED Failures

Fault Symptom	Possible Cause	Countermeasure
Alarm LED off or cannot be turned off, or alarm LED displays abnormally	Cable defective or improperly connected	1. Verify the cable connecting the button board to the main board is properly connected. 2. Verify the cables and connectors are not damaged.
	Button board failure	Replace the button board
	Main board failure	Replace the main board.

6.6.4 Button and Knob Failures

Fault Symptom	Possible Cause	Countermeasure
Buttons do not work	Cable defective or improperly connected	1. Verify the cable connecting the button board to the main board is properly connected. 2. Verify the cables and connectors are not damaged.
	Button board failure	Replace the button board
Knob does not work	Cable defective or improperly connected	1. Verify the cable connecting the knob to the main board is properly connected. 2. Verify the cables and connectors are not damaged.
	Knob failure	Replace the rotary encoder.

6.6.5 Audio Failures

Fault Symptom	Possible Cause	Countermeasure
No sound or abnormal sound while the button or rotary encoder is normal	Key volume set to 0	Choose [**Main Menu**] → [**Screen Setup** >>] → [**Key Volume** >>] to adjust the key volume.
	Cable defective or improperly connected	1. Verify the cable connecting the speaker to the main board is properly connected. 2. Verify the cables and connectors are not damaged.
	Speaker failure	Replace the speaker.
	Main board failure	Replace the main board.

Fault Symptom	Possible Cause	Countermeasure
No audible alarm sounds emitted or abnormal alarm sounds	Alarm sound set to 0	Select [**Main Menu**] → [**Maintenance** >>] → [**User Maintenance** >>] → enter the required password → [**Alarm Setup** >>], and then in the popup menu, set [**Minimum Alarm Volume**] to a proper value. In the Others window of the [**Alarm Setup**] menu, set the alarm volume to a proper value.
	Cable defective or improperly connected	1. Verify the cable connecting the speaker to the main board is properly connected. 2. Verify the cables and connectors are not damaged.
	Speaker failure	Replace the speaker.
	Main board failure	Replace the main board.

6.6.6 Power Failures

Fault Symptom	Possible Cause	Countermeasure
Battery voltage is too low Battery capacity is too low Battery cannot be recharged Battery availability test error	Battery damaged	Replace the battery.
	Cable defective or improperly connected	1. Verify the cable connecting the Li-ion battery and main board is properly connected. 2. Verify the cables and connectors are not damaged.
No output or abnormal output of bus bar voltage VIN	Cable defective or improperly connected	1. Verify the cable connecting the AC/DC board and main board is properly connected, and the cable connecting AC input and AC/DC board is properly connected. 2. Verify the cables and connectors are not damaged.
	AC/DC board defective	Replace the AC/DC board
No +12 V output	1. Power supply protected 2. Power board failure	1. Turn off the patient monitor then restart it. 2. If the problem persists, disconnect the AC mains for 5s and reconnect it, and then restart the patient monitor. 3. If the problem still remains, replace the AC/DC board.
No +5.0 V output		

NOTE

- **When the power module fails, it may cause damage to other components. In this case, troubleshoot the power module by following 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, verify the operating voltage is correct.**

6.6.7 Recorder Failures

Fault Symptom	Possible Cause	Countermeasure
No printout	Recorder module disabled	Verify the recorder status LED is lit. If not, check whether it is disabled. Method: In the [**Factory Maintenance**] menu, enable the recorder function. Then, check whether the recorder function is normal. If the LED still not lit after the recorder is enabled, it indicates that other type of failure occurs.
	Paper is installed upside down	Remove and reinstall the paper roll properly.
	Cable defective or improperly connected	1. Verify the cable connecting the recorder and the control board is properly connected. 2. Verify the cables and connectors are not damaged.
	Recorder power supply failure	Verify the power module's 5 VDC and 12VDC outputs are present.
	Recorder failure	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. Verify the thermal print head and the paper roller for foreign matter. 2. Clean the thermal print head with an appropriate cleaning solution.
	Print head failure	Replace the recorder.
	Recorder failure	Replace the recorder.

6.6.8 Output Connector Failures

Fault Symptom	Possible Cause	Countermeasure
No analog signal output	Main board failure	Replace the main board.
Connected USB devices not working (it is assumed these devices are working properly when connected elsewhere) Data cannot be exported to USB devices Patient data cannot be transferred in or out	Main board failure	Replace the main board.
	Incorrect settings	Select [**Main Menu**] → [**Maintenance >>**] → [**User Maintenance >>**] → enter the required password → [**Others >>**]. Set [**Data Transfer Method**] to [**USB Drive**].

6.6.9 Wired Network Failures

Fault Symptom	Possible Cause	Countermeasure
Failure to connect to a wired network	Improper network cable connection	Check LAN cable connection. LAN cable should not be longer than 50 m.
	Incorrect IP configuration	Check for IP conflict in the network and reset the IP address.
	Main board failure	Replace the main board.
Frequent dropouts or network disconnects	Improper network cable connection	Check LAN cable connection. LAN cable should not be longer than 50 m.
The patient monitor is connected to a network but cannot view other patients in the View Others mode	Improper network cable connection	Check LAN cable connection. LAN cable should not be longer than 50 m.
	Too many simultaneous requests for viewing the patient monitor	One monitor could only be observed by four monitors simultaneously, and the observing requests not within the range would not be handled.
	Incorrect IP configuration	Check for IP conflict in the network and reset the IP address.

6.6.10 Wi-Fi Network Failure

Fault Symptom	Possible Cause	Countermeasure
Frequent dropouts or network disconnects	Unstable Wi-Fi connection in the region	Check the Wi-Fi connection of the hospital
	Wi-Fi- antenna falls off or not well fixed to the module	Disassemble the monitor and fix the Wi-Fi antenna properly.
Failed to connect to Wi-Fi	Incorrect IP configuration	Check for IP conflict in the network and reset the IP address.
	Unstable Wi-Fi connection in the region	Check the Wi-Fi connection of the hospital
	Wi-Fi- antenna falls off or disconnected from the Wi-Fi module	Properly fix the Wi-Fi antenna.
	Main board defective	Replace the main board.

6.6.11 Software Upgrade Failures

Fault Symptom	Possible Cause	Countermeasure
Bootstrap upgrade fails	Power failure or unintended power-off during bootstrap upgrade	Return the main board to Mindray for repair.
Program upgrade fails	Incorrect connection	1. Verify the PC is correctly connected to the network interface of the monitor through network cables. 2. Ensure the normal operation of the network hub or switch, and verify the hub cable or crossover cable is properly connected.
	Wrong upgrade package has been downloaded	Select package according to system requirement. Upgrade package should be .pkg files.
	Incorrect IP address configuration for the PC	Set a fixed IP address for the monitor to be upgraded. We recommend not to upgrade a program when the patient monitor is connected to a network with multiple PCs.

Fault Symptom	Possible Cause	Countermeasure
Abnormal battery display after power management program upgrade	No power-off after power board software upgrade	Upgrade the power management software again, and then power off the entire system before restart.

6.6.12 Technical Alarm Messages

Please refer to the Operator's manual.

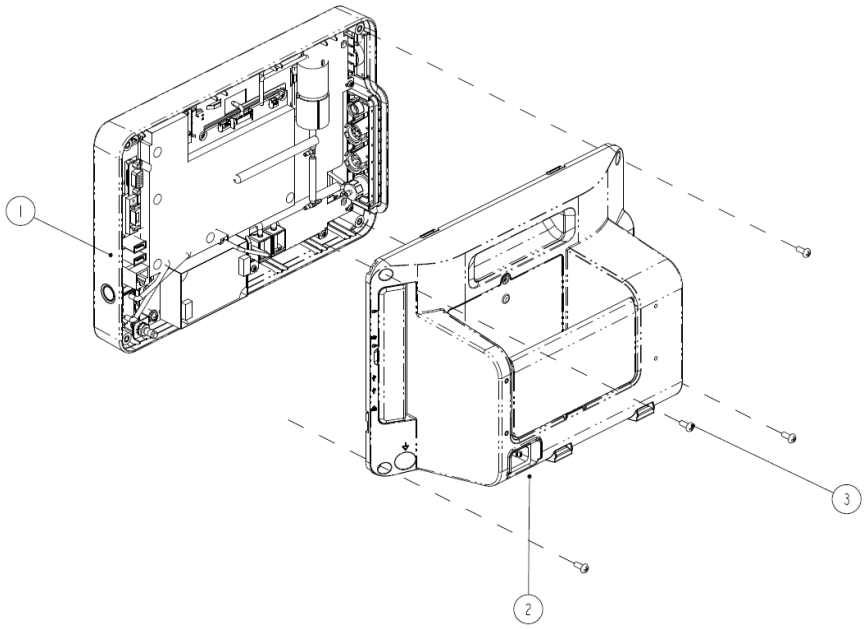
FOR YOUR NOTES

7 Parts

7.1 uMEC10

7.1.1 Main Unit

7.1.1.1 Exploded View

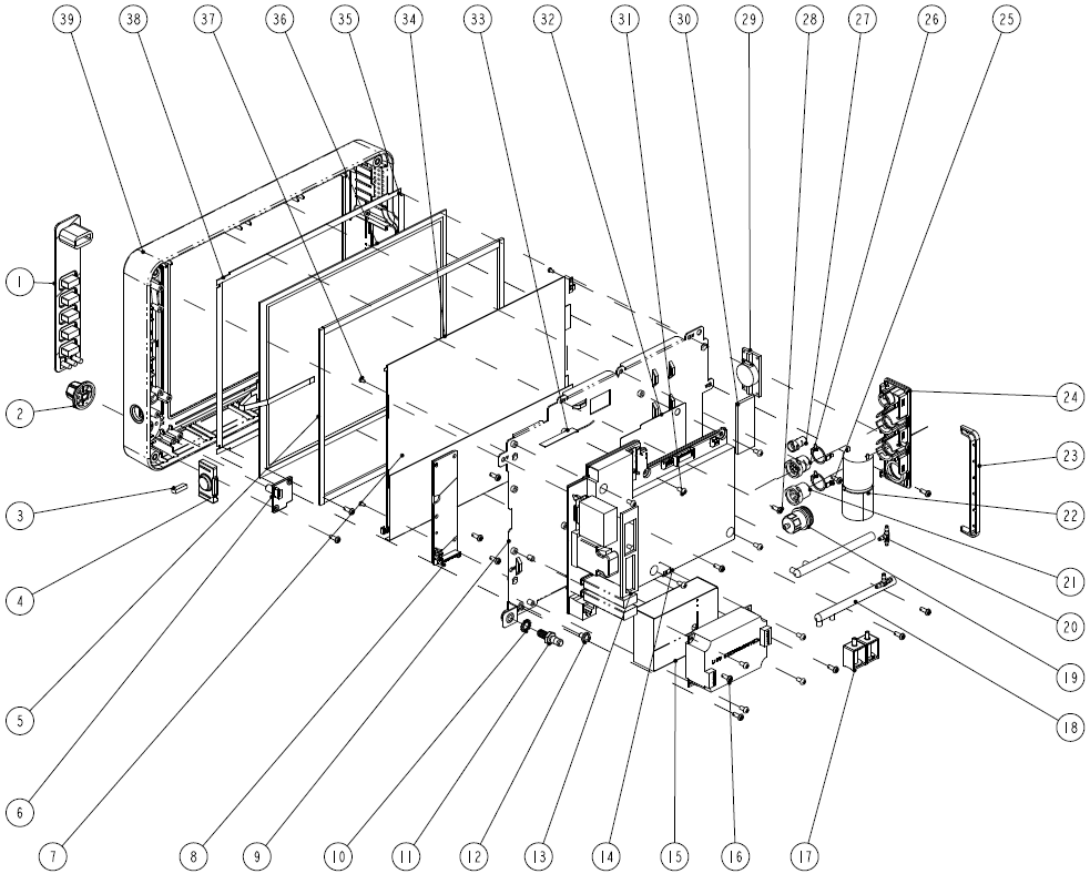


7.1.1.2 Parts List

No.	P/N	Description	Remarks
1.	/	uMEC10 front housing assembly (touchscreen)	/
2.	115-036696-00	uMEC10 rear housing assembly	/

7.1.2 Front Housing Assembly

7.1.2.1 Exploded View



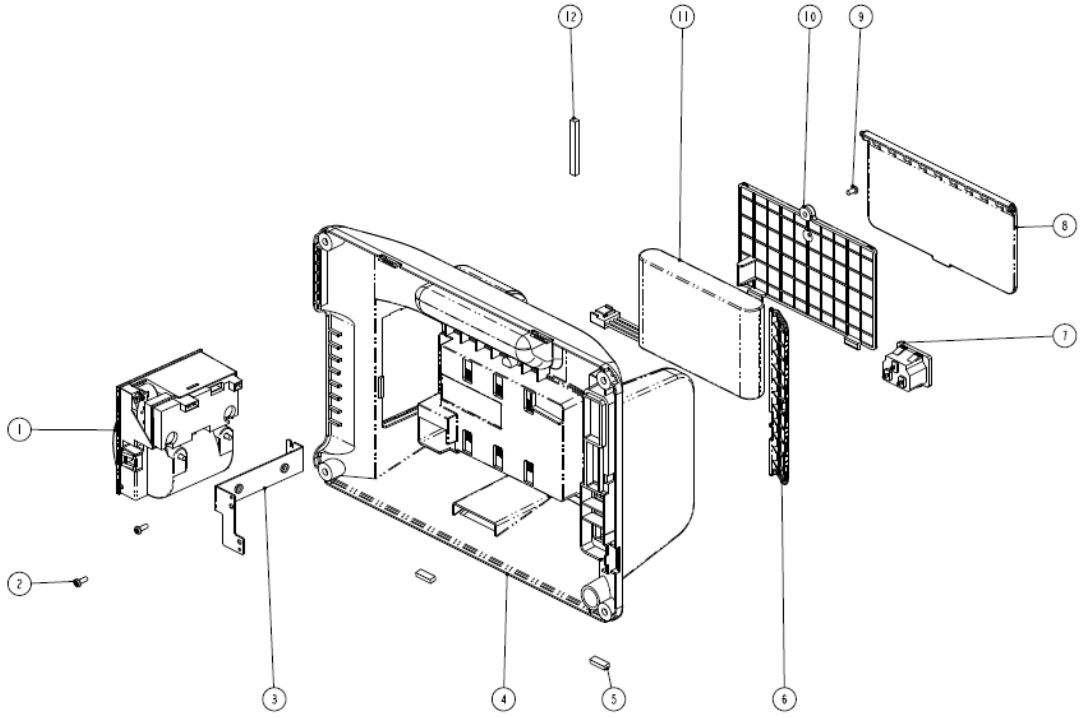
7.1.2.2 Parts List

No.	P/N	Description	Remarks
1.	049-001142-00	MECS Silicone keypad (M1K6 icon black)	/
2.	043-007142-00	Knob (black)	/
3.	6800-20-50263	Rubber foot	/
4	049-001148-00	MECS power button (M1K6)	/
6	051-002401-00	Encoder board PCBA	/
8	051-002390-00	Button board PCBA	/
11	0509-20-00098	GndLug,VS8,PM7,8,8E,9E,MEC12v	/
14	115-039016-00	M1K6 Integrated Board PCBA（standard）	/
	115-039017-00	M1K6 Integrated Board PCBA（1GB NAND）	/
	115-039018-00	M1K6 Integrated Board PCBA（without	/

No.	P/N	Description	Remarks
		NAND）	
15	047-010840-00	Power board insulating sheet (M501)	/
16	022-000125-00	Power board	/
17	082-002237-00	Air valve. Dual air valve 6VDC 300 mmHg 125 mm long line (custom)	/
18	115-039011-00	NIBP tube kit FRU	/
19	/	NIBP nozzle assembly	/
20	/	Connector. Tee, 200Barb, 3/32"ID, White Nylon	/
21	/	Multi-parameter Module ECG socket	/
22	082-001351-00	Inflator pump 6VDC 300 mmHg P2.0 terminal (custom)	/
23	043-006527-00	Parameter support of general monitor	/
24	115-039019-00	Umec-10-inch standard configuration parameter front panel (M1K6)	/
25		Spring	/
26		All-in-one parameter SPO2 socket (Mindray)	/
27		Multi-parameter Module TEMP socket (mold MR50554)	/
29	020-000027-00	Speaker 2W 4ohm 500Hz	/
30	047-005212-01	PUMP SHOCK A BSORPTION	/
32	/	All-in-one parameter insulating sheet	/
33	024-000751-00	Embedded Wireless Antenna	/
34	115-039021-00	10 " LCD screen kit FRU（touch）	/
36	021-000005-00	Touch screen 10.4"	With Touch
	047-016311-00	lens for 10inch	Without Touch
39	115-039022-00	uMEC10 Front shell kit（touch/no key）	/

7.1.3 Rear Housing Assembly

7.1.3.1 Exploded View



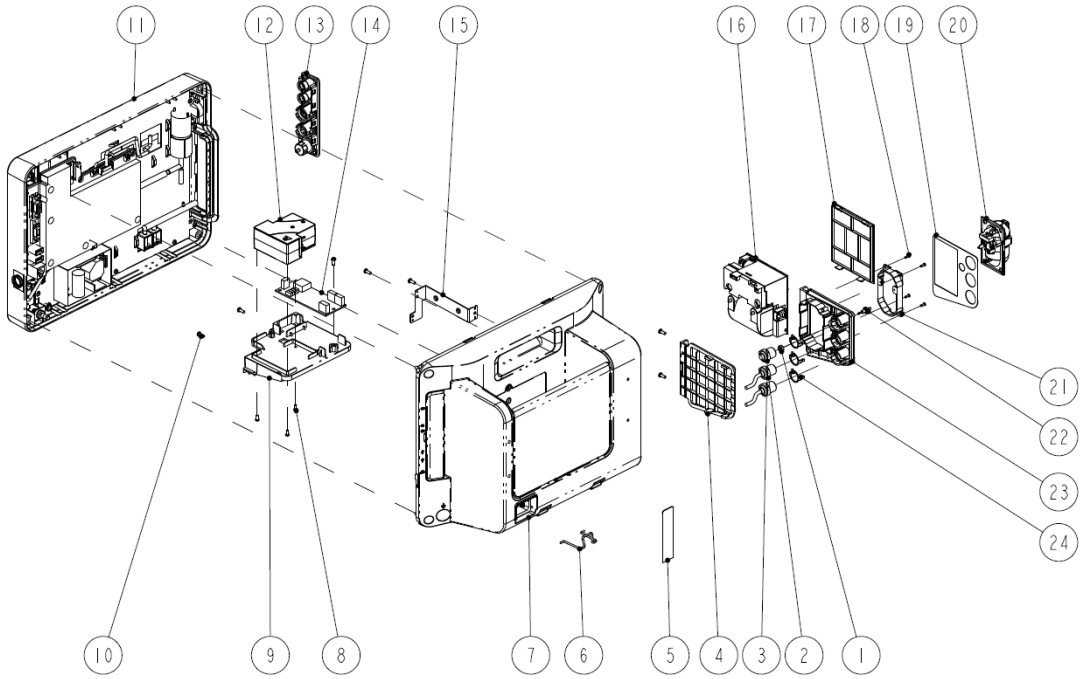
7.1.3.2 Parts List

No.	P/N	Description	Remarks
1.	801-6800-00080-00	TR6F Recorder	/
4	115-036696-00	Rear cover subassembly	/
5	6800-20-50263	Rubber foot	/
6	043-006911-00	uMEC function connector cover	/
7	009-006354-00	Cable for AC input receptacle	/
8	043-006912-00	10-inch rear cover	/
10	043-006940-00	alternative battery door	With high capacity battery
	043-006910-00	normal battery door	With standard battery
11	115-037896-00	Li-ion battery 11.1V 5000mAh LI23S005A	
	022-000122-00	Li-ion battery 11.1V 2500mAh LI13S001A	/

7.2 uMEC12

7.2.1 Main Unit

7.2.1.1 Exploded View



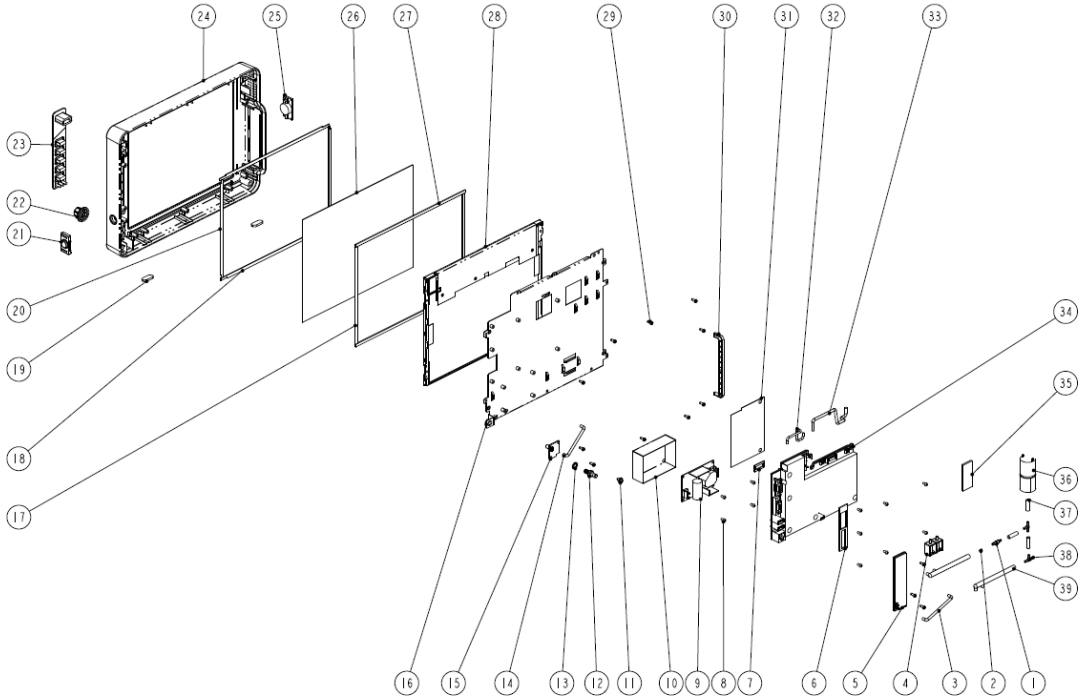
7.2.1.2 Parts List

No.	P/N	Description	Remarks
2.	/	IBP connector signal cable	/
4	/	Parameter connector cover (optional)	/
5	/	Connector overlay (standard configuration)	/
7	115-036714-00	uMEC12 rear housing assembly	/
11	115-039007-00	uMEC12 Front shell kit（touch/no key）	/
12	/	AION Rhodium CO_2 module main unit	/
13	115-036715-00	Parameter Panel（3,5ECG/TEMP/SPO2/NIBP）	/
	115-036716-00	Parameter Panel（12 ECG/TEMP/SPO2/NIBP）	/
14	/	CO/IBP modified module (M03B) PCBA	/
16	801-6800-00080-00	TR6F Recorder	/
17	043-000184-00	Recorder cover	/

No.	P/N	Description	Remarks
19	/	Parameter connector overlay (IBP+CO+CO_2)	/
20	/	DRYLINE II water trap for adult patient	/
23	/	Parameter connector front panel (optional)	/
24	/	Spring	/

7.2.2 Front Housing Assembly

7.2.2.1 Exploded View



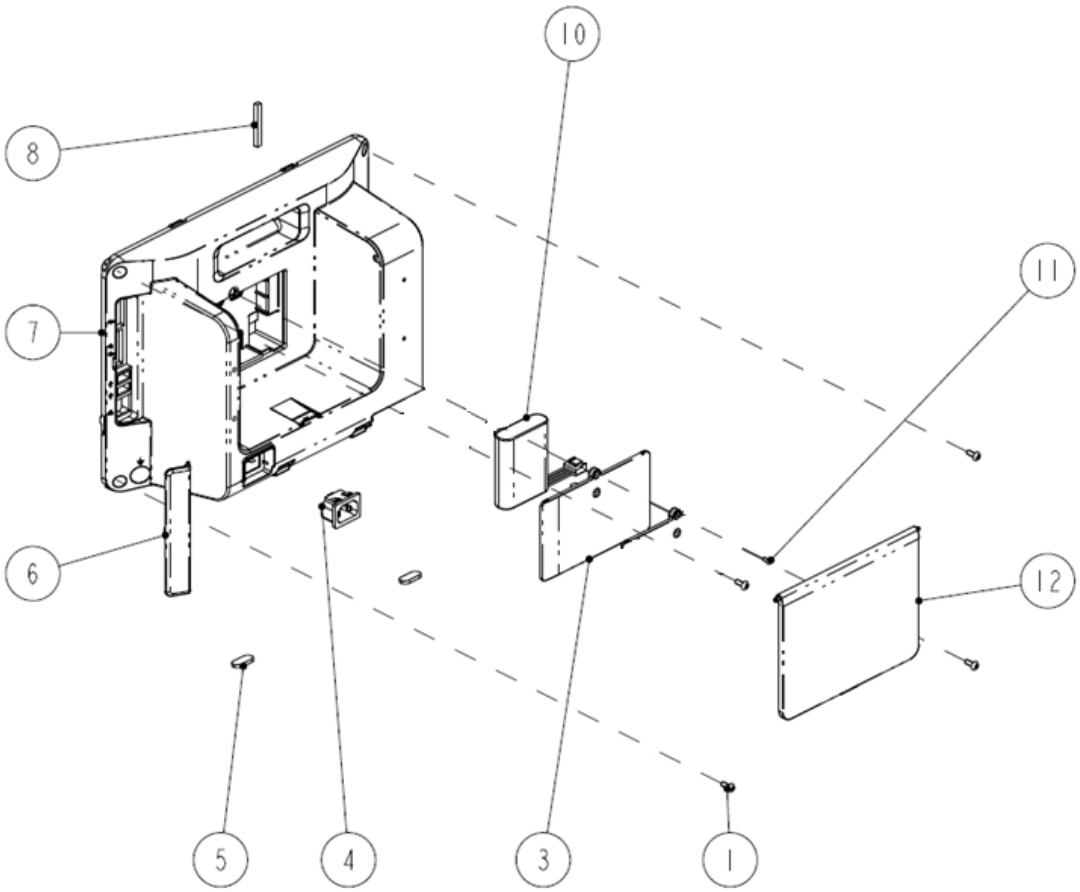
7.2.2.2 Parts List

No.	P/N	Description	Remarks
1.	/	Plastic connector	/
2.	/	630F flow restrictor	/
3.	009-006346-00	Button board cable	/
4	082-002237-00	Valve 6VDC 300mmHg Wire length 125mm	/
5	051-002390-00	Button board PCBA	/
9	022-000125-00	POWER SUPPLY BOARD 15V 40W	/
10	047-010840-00	Power board insulating sheet (M501)	/
12	0509-20-00098	GndLug,VS8,PM7,8,8E,9E,MEC12v	/
14	009-006355-00	Encoder cable	/

No.	P/N	Description	Remarks
15	051-002401-00	Encoder board PCBA	/
19	DA8K-20-14420	Rubber foot	/
21	049-001148-00	MECS Power button(M1K6)	/
22	043-007142-00	Knob (black)	/
23	049-001142-00	MECS keyboard(M1K6 ICON Black)	/
24	115-039007-00	uMEC12 Front shell kit（touch/no key）	/
25	020-000054-00	Speaker 4Ω 2W 5000hz with wire	/
26	047-016312-00	12-inch lens	Without Touch
	021-000059-00	Touch screen 12.1"	With Touch
28	115-039005-00	12 " LCD screen kit FRU（non-touch）	/
	115-039006-00	12 " LCD screen kit FRU（touch）	/
30	043-006916-00	12-inch parameter fixing frame (standard configuration)	/
32	009-006349-00	Display backlight cable (12.1')	/
33	009-006348-00	Display signal cable (12.1')	/
34	115-039012-00	12 " Integrated PCBA kit FRU（standard）	/
	115-039013-00	12 " Integrated PCBA FRU（3, 5lead、1GB）	/
	115-039014-00	12 " Integrated PCBA kit FRU（3, 5lead）	/
	115-039015-00	12 " Integrated PCBA FRU（12lead、1GB）	/
35	047-005212-01	PUMP SHOCK A BSORPTION	/
36	082-002338-00	Pump CJP37-C06B33	/
37	115-039011-00	Pipe. Silicone,3/32"X7/32"X100ft	/
38		Connector. Tee, 200Barb, 3/32"ID, White Nylon	/
39		All-in-one NIBP air tube	/

7.2.3 Rear Housing Assembly

7.2.3.1 Exploded View



7.2.3.2 Parts List

No.	P/N	Description	Remarks
3	043-006940-00	alternative battery door	With high capacity battery
	043-006910-00	normal battery door	With standard battery
4	009-006354-00	Cable for AC input receptacle	/
5	DA8K-20-14420	Rubber foot	/
6	043-006911-00	uMEC function connector cover	/
7	115-036714-00	Rear cover subassembly	/
10	115-037896-00	Li-ion battery 11.1V 5000mAh LI23S005A	/
	022-000122-00	Li-ion battery 11.1V 2500mAh LI13S001A	/

No.	P/N	Description	Remarks
12	043-006917-00	12-inch rear cover	/

7.3 Others

No.	P/N	Description	Remarks
1.	009-006348-00	Display signal cable (12.1')	/
2.	009-006349-00	Display backlight cable (12.1')	/
3.	009-006346-00	Button board cable	/
4	009-006353-00	ACDC module cable	/
5	009-006355-00	Encoder cable	/
6	009-006352-00	TR6F recorder cables	/
7	009-006346-00	Button board cable	/
8	009-006347-00	Display signal cable (10.4')	/

FOR YOUR NOTES

8 Disassembly and Repair

8.1 Tools

During disassembly and repair, the following tools may be required:

- Phillips screwdrivers
- Allen wrench
- Needle nose pliers
- Cutting pliers

8.2 Preparations for Disassembly

Before disassembling the monitor,
Stop monitoring the patient, turn off the monitor and disconnect all the accessories and peripheral devices.

Disconnect the AC power supply and take out the battery.

⚠WARNING

- **Eliminate static electricity before the disassembly. When removing some parts with the electrostatic sensitive mark, wear protective devices such as electrostatic ring or anti-electrostatic gloves, lest the parts would be damaged.**
- **Properly connect and route the cables and wires when reassembling the equipment to avoid pinched hoses and electrical short circuits.**
- **Use specified screws to reassemble the equipment. If the incorrect screws are forcefully tightened, the equipment may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**
- **Be sure to follow the correct sequence when disassembling the monitor.**
- **Disconnect all cables before disassembling any parts. Be careful not to damage any cables or connectors.**
- **Place the removed screws and other parts separately by category so that they can be used in the reinstallation. Do not drop, contaminate or lose them.**
- **Place materials by module; otherwise, incorrect material may be used or corresponding material cannot be founding during reassembly.**

- **Install assemblies before the installation of the main unit. Properly connect cables and pay attention to the positions where wires are placed.**
- **Make sure that waterproof strips and other waterproof auxiliary materials are properly assembled.**

8.3 Main Unit Disassembly

⚠WARNING

- **The recorder can be disassembled without disassembling other components.**
- **Before disassembly, make sure that the point for placement is smooth and free of unrelated things; otherwise, the screen or the knob may be scratched or damaged. Prevent the two clips at the front end of the rear housing from being damaged.**
- **All the operations must be performed by professionals. Be sure to wear insulating gloves during the repair.**
- **When optional functions are indicated, the related operations may be involved if this function is selected for the machine; otherwise, the related operations are not involved.**

8.3.1 Separating the Front and Rear Half of the Monitor

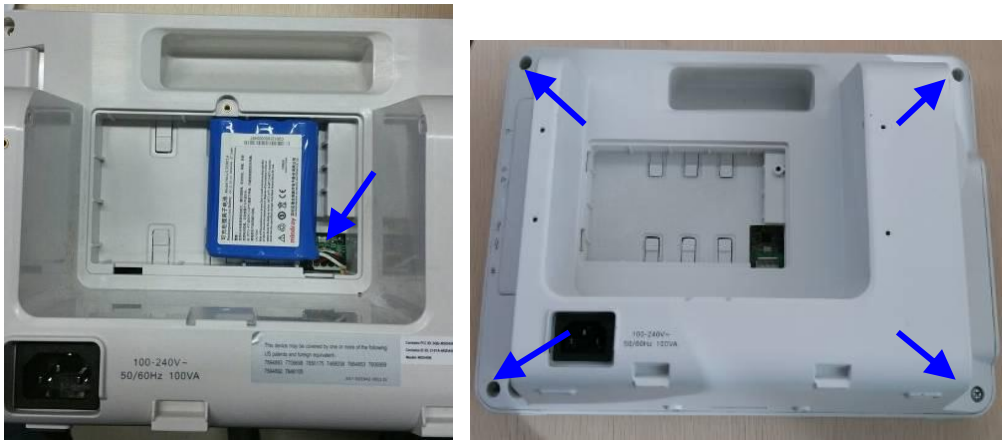
1. As shown in the following figure, loosen and remove the one M3×6 cross recessed pan head screw with a screwdriver, and take out the battery cover.

uMEC10 model

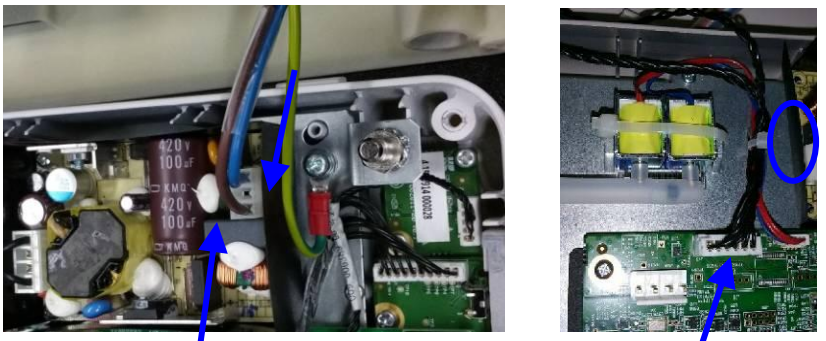
uMEC12 model

Remove the rear cover (pull the rear cover in the direction as indicated by the blue arrow, and take out the left cover clip)

2. Loosen the battery cable clip and take out the Li-ion battery. Loosen and remove the four 4×10 cross recessed pan head screws with a screwdriver.



3. Separate the front and rear covers. Loosen and remove the four 4×8 cross recessed pan head screws with a screwdriver. Loosen the ground cable. Separately remove the AC input socket cable and recorder cable, and cut the cable tie.



AC input socket cable

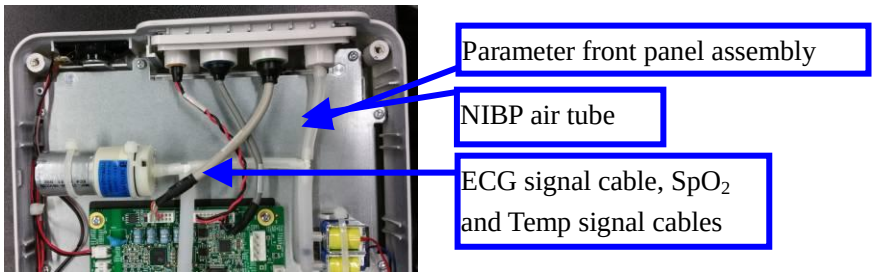
Recorder cable\cable tie

NOTE

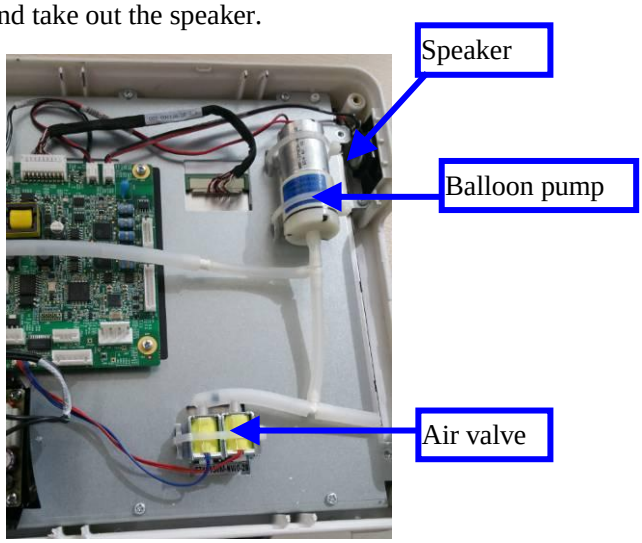
- **Before reassembly, fasten the recorder cable and valve cable onto the fixing sheet metal with cable ties.**

8.3.2 Removing Parameter Front Panel Assembly, Balloon Pump, Air Valve and Speaker

1. As shown in the following figure, remove the parameter fixing frame on the parameter front panel assembly. Unplug the SPO_2 and Temp signal cables, NIBP air tube, and ECG signal cable. Take out the parameter front panel assembly upwards along the rear cover.

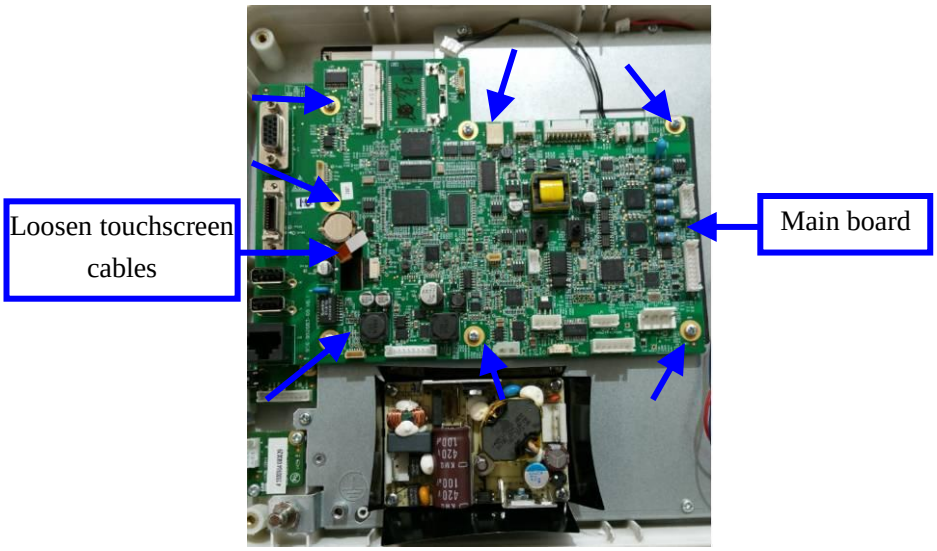


2. As shown in the following figure, cut the cable ties on the balloon pump and air valve. Remove the balloon pump and air valve. Unplug the connector connecting the speaker and the main board, and take out the speaker.

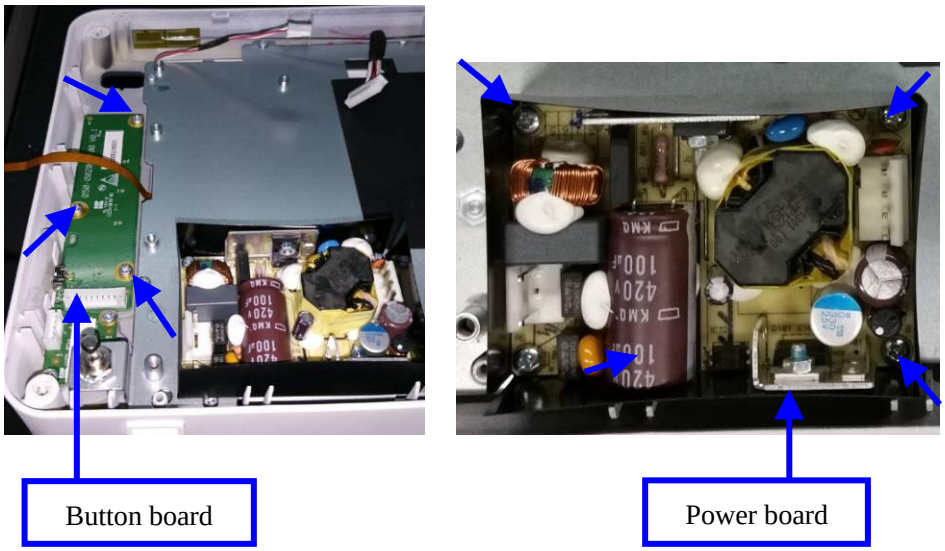


8.3.3 Removing Main Board, Power Board and Button Board

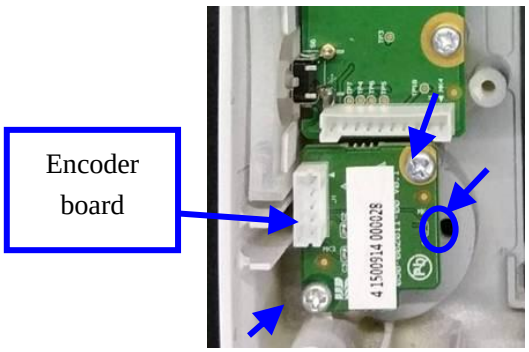
1. As shown in the following figure, loosen the touchscreen cable (for equipment configured with touchscreen). Unplug all cables on the main board. Then, use a screwdriver to loosen and remove the seven M3×6 cross recessed pan head screws. Take out the main board.



2. As shown in the following figure, unplug all cables on the button board and power board. Then, use a screwdriver to loosen and remove the three PT3X8 cross recessed pan head tapping screws from the button board and take out the button board; and loosen and remove the four M3×6 cross recessed pan head screws from the power board and take out the power board.



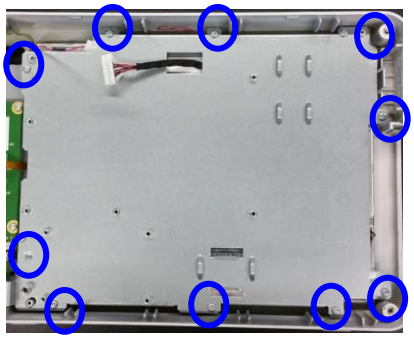
3. As shown in the following figure, use a No.7 hex key to push out the knob from the round hole of the front cover. Then, use a screwdriver to loosen and remove the two PT3X8 cross recessed pan head tapping screws from the encoder board, and take out the encoder board.



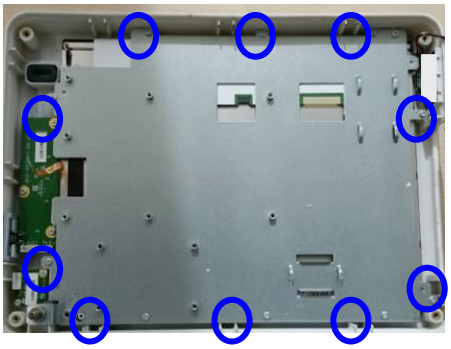
8.3.4 Removing Display and Touchscreen

1. As shown in the following figure, use a screwdriver to loosen and remove the 10 PT3X8 cross recessed pan head tapping screws (identified with the "A" character) from the display sheet metal, and take out the display sheet metal assembly.

uMEC10 model

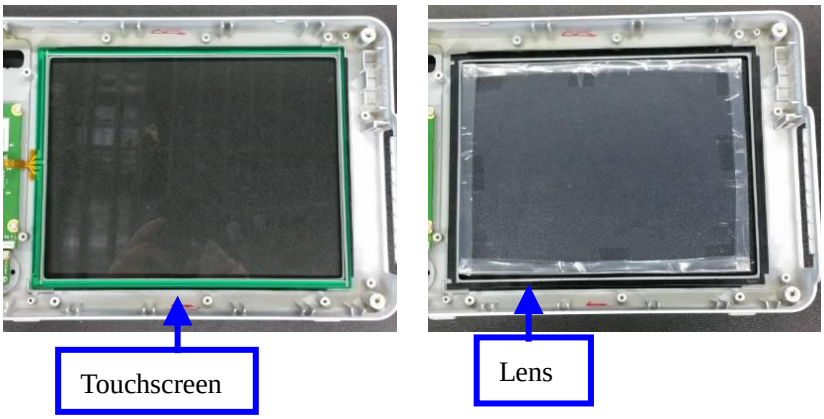


uMEC12 model



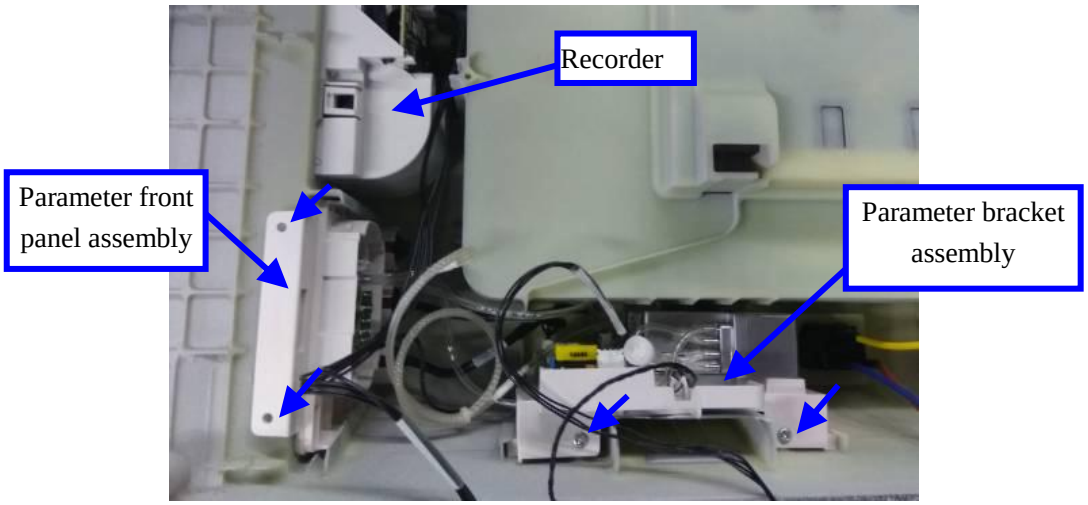
2. As shown in the following figure, use a screwdriver to loosen and remove the four M3X6 cross recessed pan head screws, and take out the display.

3. As shown in the following figure, take out the touchscreen or lens.

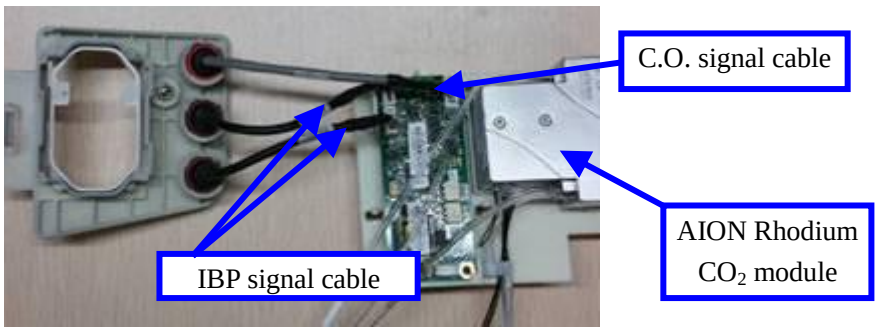


8.3.5 Removing Parameter Front Panel Assembly

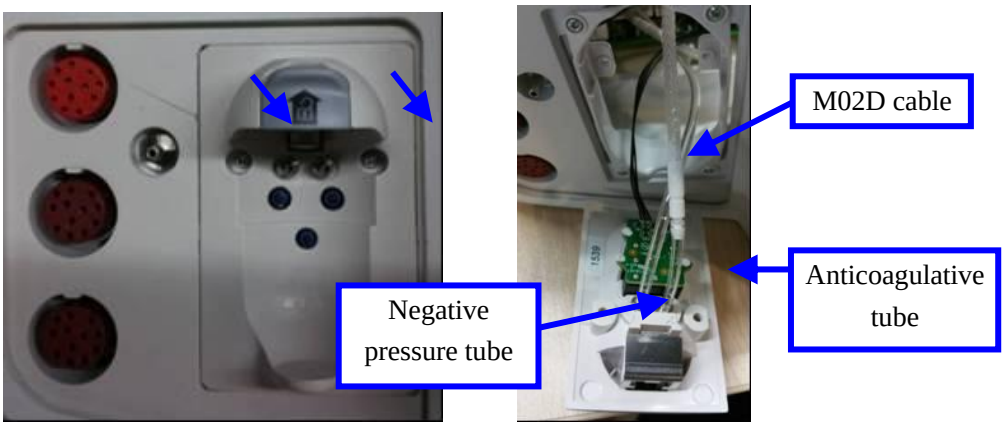
For the equipment with non-standard configuration, take out the parameter front panel assembly and the parameter bracket assembly together from the rear housing. Then, separate the assemblies based on the configuration.



If the optional IBP/C.O. function is adopted: the parameter front panel assembly and parameter module assembly can be separately removed by unplugging the IBP/C.O. signal cable.

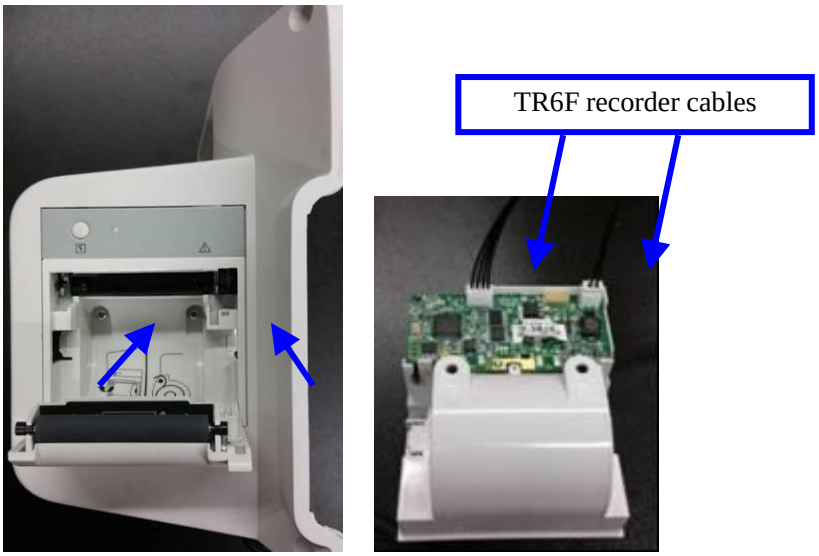


If the optional microstream CO_2 is adopted: the parameter front panel assembly and parameter module assembly can be separately removed by unplugging the microstream CO_2 signal cable.



8.3.6 Removing Recorder (Optional)

Use a screwdriver to loosen and remove the two M3×6 cross recessed pan head screws with pad. Unplug the recorder cable and take out the recorder.



NOTE

- **The recorder can be disassembled without disassembling other components.**