BeneView T6/T8/T9

Patient Monitor

Service Manual

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Revision History

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

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Preface

Manual Purpose

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

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

Intended Audience

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

Abbreviations

Abbreviations used in this manual are:

MPM	multi-parameter module
SMR	satellite module rack
CMS	central monitoring system
PCB	printed circuit board

Passwords

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

■ User maintenance: 888888 (User adjustable)

■ Factory maintenance: 332888

■ Demo mode: 2088

■ Configuration mode: 315666 (User adjustable)

■ iView login: MINDRAY

NOTE

● **When log in iView system and input the password, connect the keyboard to the special USB connector for iView system.**

FOR YOUR NOTES

Contents

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.**

⚠CAUTION

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

NOTE

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

1.1.1 DANGER

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

1.1.2 Warnings

⚠WARNING

- **All installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel.**

- **There is high voltage inside the equipment. Never disassemble the equipment before it is disconnected from the AC power source.**

- **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.**

- **Dispose of the package material, observing the applicable waste control regulations and keeping it out of children's reach.**

1.1.3 Cautions

⚠CAUTION

- **Make sure that no electromagnetic radiation interferes with the performance of the equipment when preparing to carry out performance tests. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**

- **Before connecting the 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 Notes

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
⚠	Attention: Consult accompanying documents (this manual).	(network icon)	iView network connector
⚡	Danger: High-voltage	(network icon)	Network connector
∼	Alternating current(AC)	⊣⊓⊢	Defibrillator connector
⊙/Ȯ	Power ON/OFF	(rack icon)	Connector for satellite module rack
🔋	Battery indication	⊂→	Video output
→0←	Zero key	⊕→	Auxiliary output connector
▼	Calibrate key	⟋•←	USB connector
◇/▽	Measure/Standby	⏚	Equipotential terminal
⊏⊐	Check sensor	CE 0123	CE marking
(ESD icon)	ESD warning symbol for Electrostatic sensitive devices.		
⊣♥⊢	Type CF applied part. Defibrillator-proof protection against electric shock.		
⊣👤⊢	Type BF applied part. Defibrillator-proof protection against electric shock.		
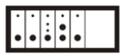
FOR YOUR NOTES

2 Theory of Operation

2.1 Introduction

This patient monitor is designed to monitor a fixed set of physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS), respiration mechanics (RM), continuous cardiac output (PiCCO), central venous oxygen saturation ($ScvO_2$), electroencephalograph (EEG), and neuromuscular transmission (NMT).

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, touchscreen, keyboard and mouse.

■ Interfaces a clinical information system or central monitoring system.

■ Enables program upgrade over the network.

■ Integrates the information of other devices, which include but are not restricted to anesthesia machine and ventilator.

2.2 System Connections

2.2.1 Mounting the Patient Monitor

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

⚠CAUTION

- **Use mounting brackets we supply or approve. If other compatible mounting bracket is used, be sure it can be safely used on the patient monitor.**

- **The mounting bracket should be installed by our qualified service personnel, or engineers who have adequate knowledge on it.**

- **If other mounting solution is used, the installation personnel and the customer should verify if it can be safely used on the patient monitor, and the customer assume the responsibility for any risk resulting from that.**

2.2.2 Connectors for Peripheral Devices

On the back of the patient monitor you will find all connectors for peripheral devices.
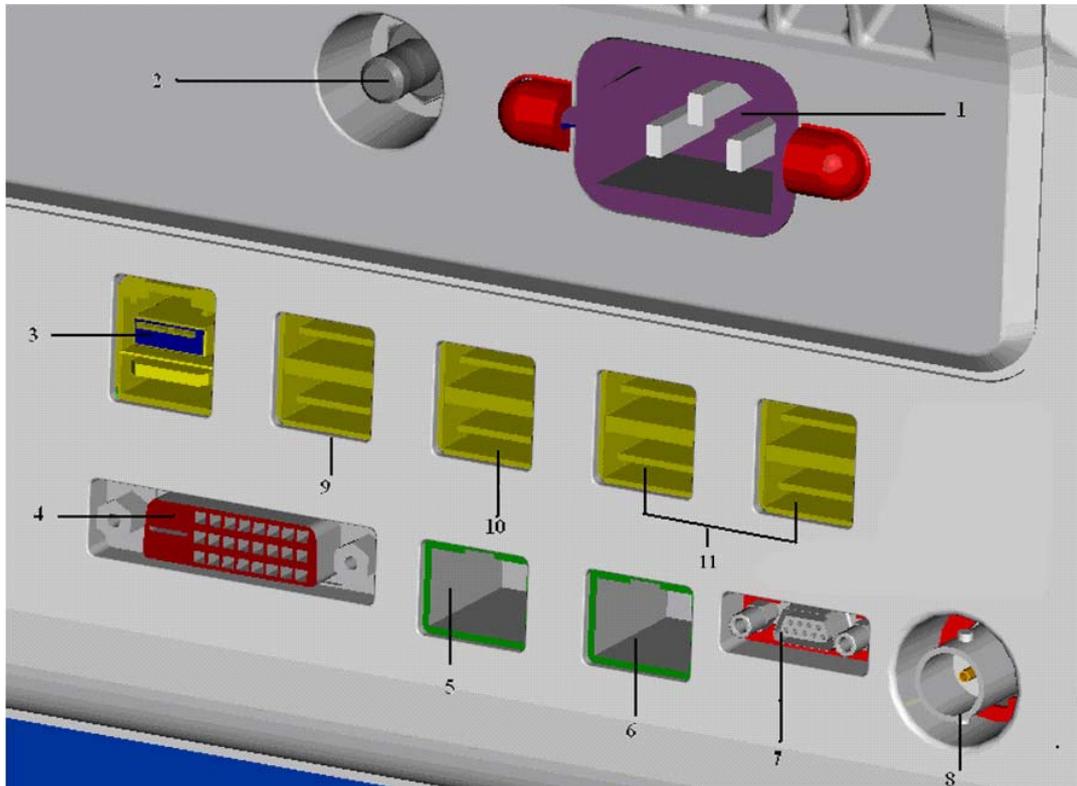
1. AC Power Connector: used to connect an AC power source (100 to 240 VAC, 50/60Hz).

2. Equipotential Terminal: used to connect the equipotential terminal of other equipment, eliminating potential difference between different pieces of equipment.

3. SMR Connector: It outputs a 12V DC, used to connect the SMR.

4. Video Output: It is a DVI-D connector used to connect a secondary display.

5. iView Network Connector: It is a RJ45 connector that connects iView system to external network.

6. Network Connector: It is a RJ45 connector used to connect an ethernet network or a PC.

7. Analog Output and Defibrillator Connector: It is a Micro-D connector used to output analog signals and defibrillator synchronization signals.

8. Auxi Output Connector: It is a BNC connector used to output nurse call signals.

9. Secondary USB Connector: used to connect the mouse and keyboard of the secondary display.

10. Special USB Connectors: used for iView maintenance and data transfer.

11. General USB Connector: used to connect any USB-compatible peripheral device.

2.3 Main Unit

The patient monitor consists of:

- Input system: button board, knob, touchscreen, power switch and LED board

- Output system: LCD panel, alarm LED board, recorder, speaker

- Processing and communications system: main board, iView assembly, integral module rack

- Power management system: battery, battery interface board, power module

- Equipment interface system: USB interface board, DVI interface board, CF card assembly and internal wireless network card.

Additionally, the patient monitor can also connect satellite module rack (SMR), parameter modules, BeneLink module, mouse, keyboard, etc.

The following diagram illustrates the structure of the patient monitor.
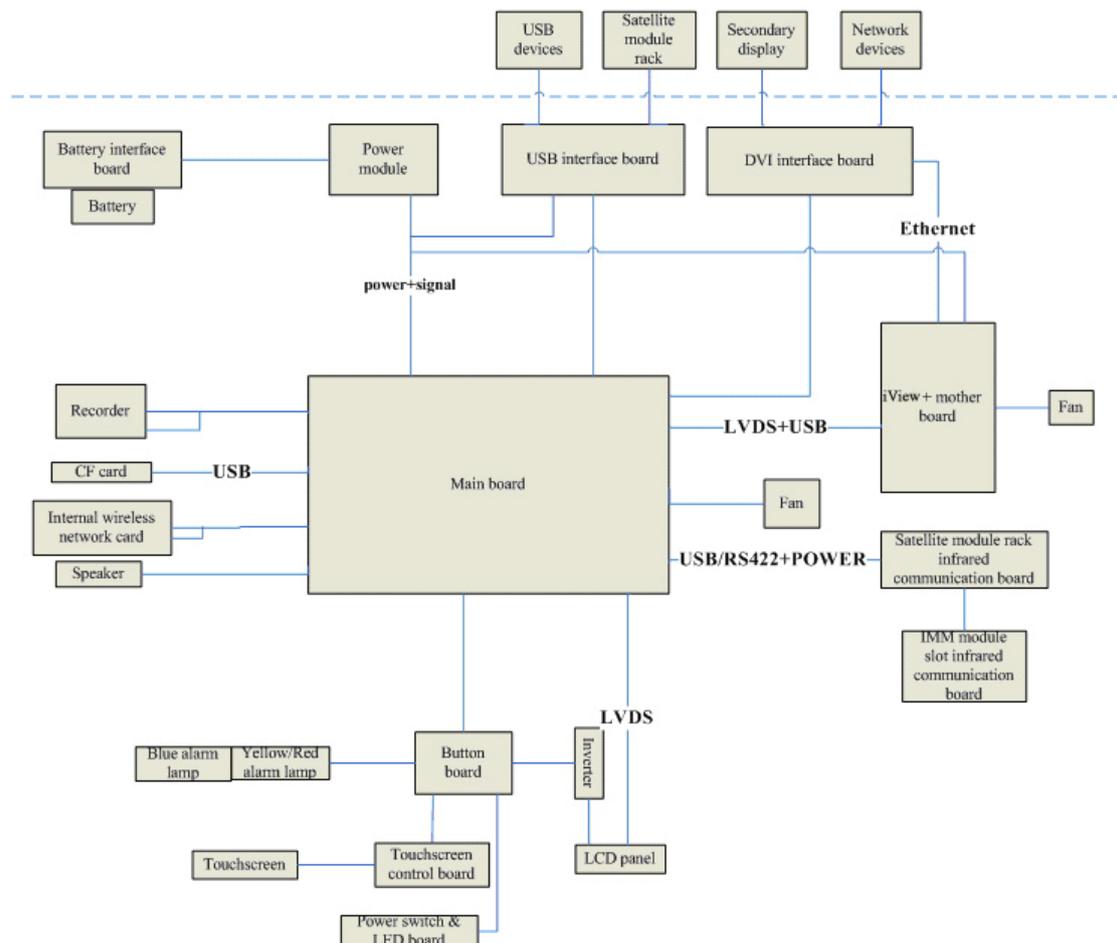
2.3.1 Input System

Button board

The button board, located at the lower part of the monitor's front panel, contains 6 keys and provides connections for the following components to the main board:

- Knob
- Power switch & LED board
- Touchscreen control board
- Backlight board/Inverter
- Alarm LED board

The following diagram shows the button board connections.
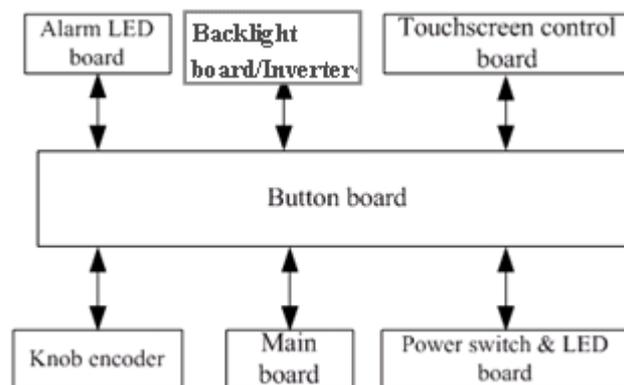
Knob

The knob can be pressed, or rotated both clockwise and counter-clockwise. It is connected with the button board.

Touchscreen

The touchscreen enables touch operations and can be calibrated. It is connected with the touchscreen control board and main board.

Power switch & LED Board

The power switch & LED board controls the power supply for the main unit. It has three LEDs, which respectively indicate the AC power status, battery status and monitor power on/off status. It is connected with the button board.

2.3.2 Output System

LCD

The patient monitor adopts a high-resolution LCD. The LCD is connected with the main board. Signals and power supply of the backlight board are transferred by the button board.

Alarm Lamp

The patient monitor has two alarm lamps: alarm lamp and technical alarm lamp. Alarm lamp lights either red or yellow whereas technical alarm lamp lights blue only. The signals from the alarm lamps are transferred by the button board and are controlled directly by the main board.

Recorder

The recorder receives data coming form the main board and then sends them to the thermal printhead for printing. The recorder has a hardkey (starting/stopping recordings) and a green LED on its front. It is connected with the main board.

The following diagram shows its operating principle.
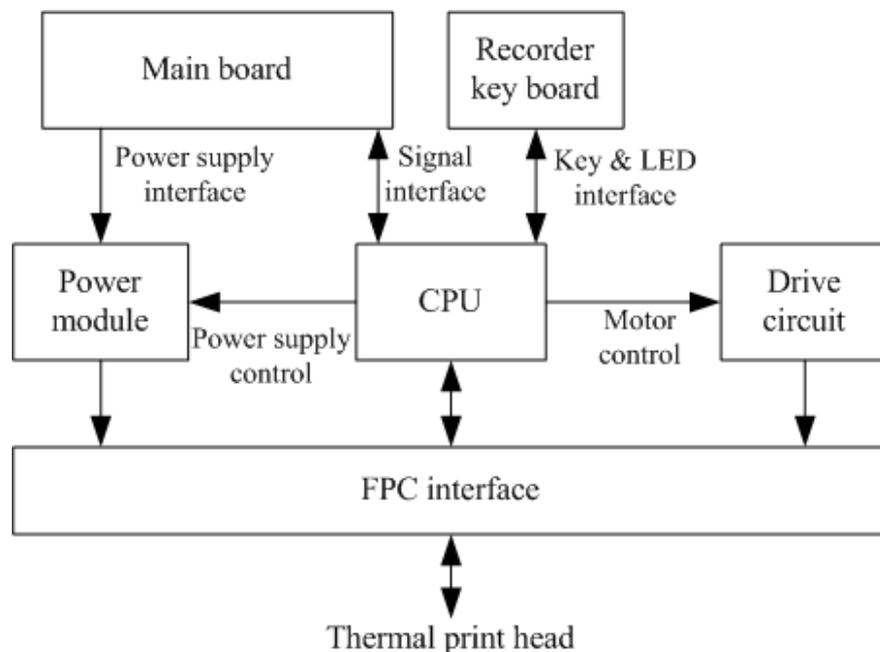
Module	Description
Power interface	Introduces a DC from the main board.
Power module	Converts the input power into voltages that fit each module and then forwards them to each module.
CPU	Control the communications between modules.
Signal interface	Control the communications between the main board and the recorder CPU.
Motor drive circuit	Receives the control signals from the CPU and then forwards them to the step engines.
Button & LED board	Includes one button and one LED which are directly controlled by the CPU.

Speaker

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

2.3.3 Processing and Communications System

Main Board

The main board is the heart of the patient monitor. It implements a series of tasks including input & output control, data storage and processing, display processing, system control, communication management, printing management and alarming, etc.

The main board comprises the CPU board and mother board. The following diagram shows interfaces to other components.

```
┌─────────────┬──────────────┬─────────────┬─────────────┬──────────────┐
│  CF card    │  Internal    │   iView     │   Power     │   Speaker    │
│  assembly   │  wireless    │  assembly   │   module    │              │
│             │ network card │             │             │              │
└─────────────┴──────────────┴─────────────┴─────────────┴──────────────┘

                          Mother board

             ┌──────────────────────────────────┐
  ┌────────┐ │                                  │          ┌────────┐
  │Recorder│ │                                  │          │  Fan   │
  └────────┘ │                                  │          └────────┘
             │            CPU board             │          ┌────────┐
             │                                  │          │Integral│
             │                                  │          │ module │
             │                                  │          │  rack  │
             └──────────────────────────────────┘          └────────┘

  ┌──────┐  ┌───────────────────────┐  ┌─────────────┐  ┌────────┐
  │ LCD  │  │        Video          │  │  USB×2+UART │  │ Button │
  └──────┘  │ output+Network+IO+IIC │  └─────────────┘  │ board  │
            └───────────────────────┘                   └────────┘

            ┌───────────────────────────────────────┐
            │              CPU board                 │
            └───────────────────────────────────────┘
                █                           █
            ┌───────────────────────────────────────┐
            │             Mother board               │
            └───────────────────────────────────────┘
```
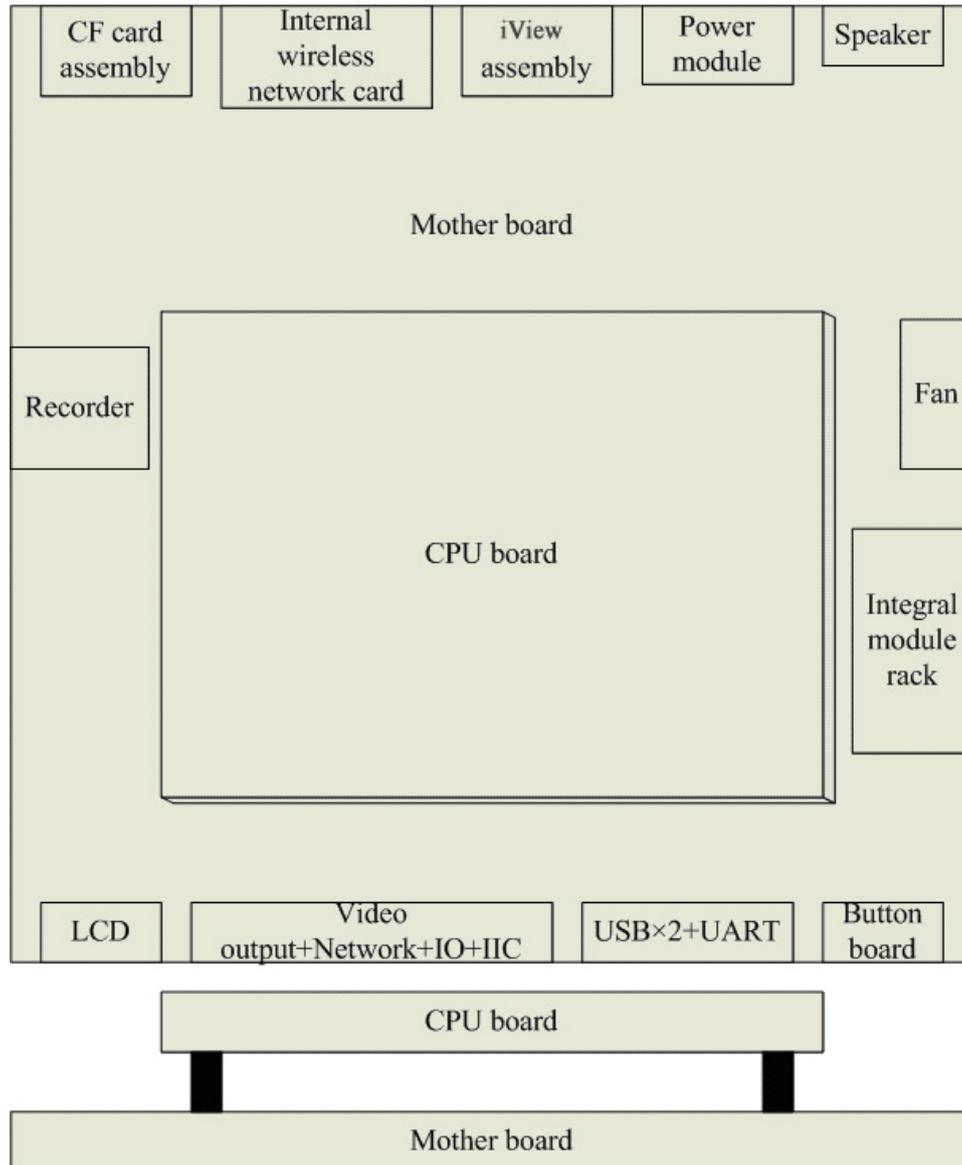
The CPU board is an essential CPU system containing the CPU, FLASH, memory, realtime clock, EEPROM, etc. It interfaces to the mother board only, which then provides interfaces to all other external devices.

The mother board is in charge of connections and communications with other components and provides the following interfaces:

■ LCD port: connects a built-in display.

■ Video output+network+IO+IIC: connects the digital video interface board.

■ USB×2+UART: connects the USB interface board.

■ Button board port: connects the button board.

■ Integral module rack port: connects integral module rack communication board.

■ Fan port: connects the fan.

- ■ Speaker port: connects the speaker.

- ■ Power module port: connects the power module.

- ■ iView port: located at the back of the mother board for connecting the iView components.

- ■ CF port: connects the CF card assembly.

- ■ Recorder port: connects the recorder.

- ■ Internal wireless network card port: connects the internal wireless network card

iView System

iView sytem includes iView mother board, computer board, hard disk and so on. iView system connects to main control board, DVI interface board and USB interface board. The iView system transmits the network signal to host network interface through DVI interface board.

Integral Module Rack

The patient monitor has two kinds of integral module rack: 2-slot and 5-slot. The control board includes a NIOS II FPGA. It implements protocol conversion and infrared communication between the main unit and the parameter modules.

The module rack communication board can be a 2-slot type or a 3-slot type. The 3-slot communication board communicates the main board directly. The 2-slot communication board is connected with and is controlled by the 3-slot communication board. The 3-slot communication board has the function of communication control. The 2-slot communication board consists of the infrared circuit and module power circuit. The RS422 drive circuit is located on the 3-slot communication board.

2.3.4 Power Management System

Battery

The patient monitor uses two chargeable lithium-ion batteries (11.1 V, 4500 mAh). The battery compartment door is located at the bottom of the patient monitor. The battery power is introduced to the power module via the battery interface board, and then processed and distributed to each component by the power module.

NOTE

- ● **Two batteries must be used simultaneously when the patient monitor operates on battery power. Otherwise, it may cause power supply protection.**

Battery Interface Board

The battery interface board connects batteries to the power module, enabling charging and discharging between the batteries and the power board.

Power Module

The power module is located at the back of the patient monitor. The main part of the power module is the power board, which contains 4 PCBs: charging & power management board, voltage drop DC inverter, voltage rise and drop DC inverter, and voltage drop 5 V CIS power board.

The power module transforms the input power into DC and then forwards them to each component of the patient monitor. The input power comes from either the batteries or an AC source. The patient monitor will run power from the AC source whenever an AC source is available. If the AC source becomes unavailable, the patient monitor will automatically switch to the battery power. This does not affect the monitor's operating status.

Power module has an AC input socket at its backside, and a socket at its front provides 4 connections to the batteries, main board, iView components and USB interface board respectively. The power module protects itself and the patient monitor by switching off AC input or DC output in case of overcurrent, short circuit and overvoltage. The power module provides 4 DC outputs:

Outputs	Description
+3.3 V	Goes to the LCD, mother board, CPU board, DVI interface board and integral module rack.
+5.0 V	Goes to the DVI interface board, recorder, CF storage card board and USB interface board.
+5.0 V CIS	Goes to the iView assembly.
+12 V	Goes to the recorder, LCD inverter, integral module rack, parameter modules and USB interface board.

The systematic principle diagram of the power module is as follows:
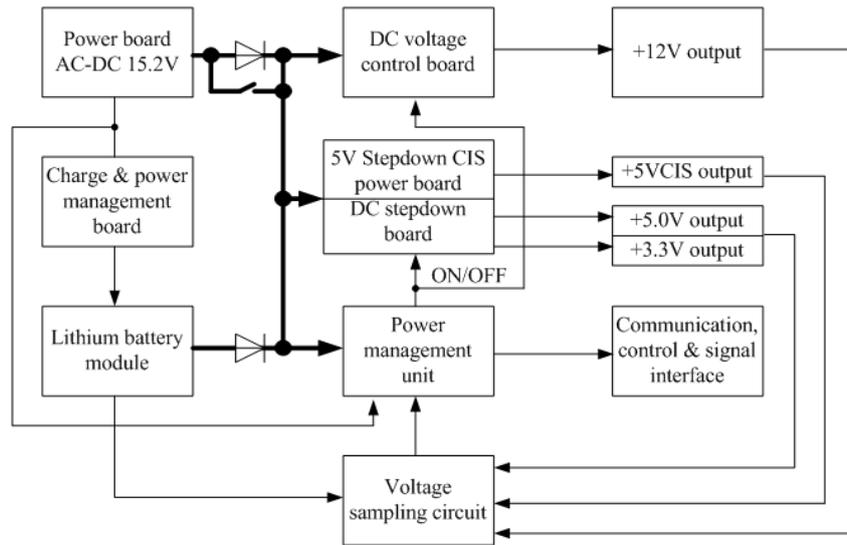
The following diagram shows the pins of the power module socket (excluding the pins of the battery power socket. On power board, pin 1 has a triangle symbol):

Pin ID	Marking	Description	Cable color
2, 4, 6, 7, 13, 15, 17	GND	The output grounding terminal of the power board.	Black
8	RXD	Receives serial communications (the main board sends).	Purple
9	TXD	Sends serial communications (the main board receives).	Brown
10	PCON	Power on/off control signal. It is a TTL pulse signal inputted from the back board. Every time when the power on/off switch is pressed (pulse of falling edge), a switch between power "on" and "off" happens. The pulse duration is no less than 0.1 s for power-on and no less than 2 s for power off.	Blue
11	LCD-EN	Backlight on/off control signal. The main board sends a backlight on/off control signal to the power board through the serial interface. The power board processes the received signal and then outputs a high or low level depending on the received signal.	Green

Pin ID	Marking	Description	Cable color
12, 1	12 V	The positive end of the 12 V DC coming from the power board.	Yellow
14, 3	5 V CIS	The positive end of the 5 V CIS coming from the power board.	Purple
16, 5	5 V	The positive end of the 5 V DC coming from the power board.	Red
18, 19	3.3 V	The positive end of the 3.3 V DC coming from the power board.	Orange
20	LED- AC	AC power status indication signal	White
21	LED- BAT	Battery status indication signal.	Grey
22	LCD-BR	Backlight brightness control voltage.	Brown

2.3.5 Equipment Interface System

USB Interface Board

The USB interface board is compatible with such USB interfaces as USB2.0, USB1.1 and USB1.0. It is connected with the main board and the power module. It receives USB differential signals coming from the main board and then distributes them to maximumly six USB interfaces via two ISP1521 chips. The USB interface board of iView system directly connects to two USB interfaces (on USB board) of host. The UART signal output by the main board is converted into RS422 signal by the USB interface board. The USB interface board receives 5 VDC and 12 VDC inputs from the power module, of which the 5 VDC goes to the USB interface board and the 12 VDC outputted to the SMR connector through a fuse.
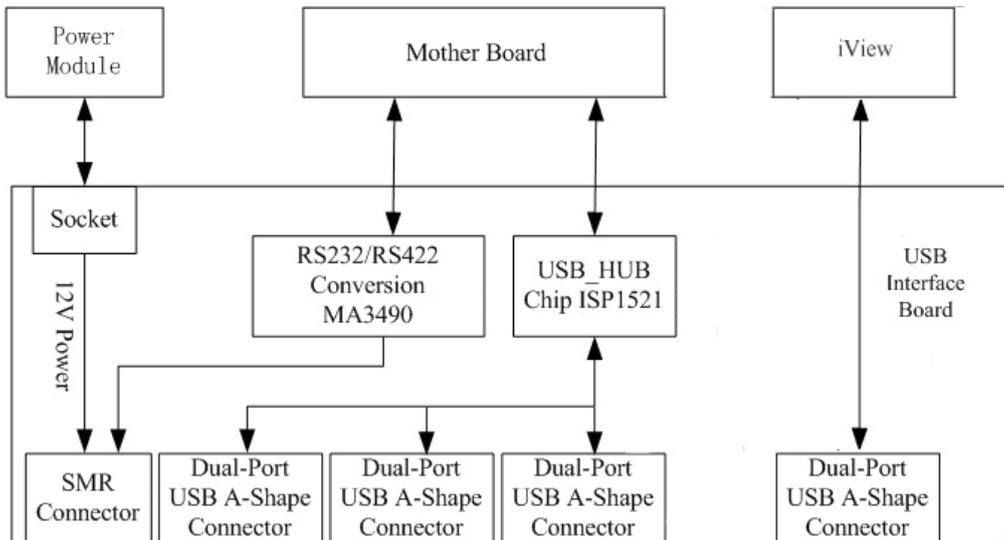
DVI Interface Board

The DVI interface board is connected with the mother board and the iView mother board. The following diagram shows its interfaces to other components.
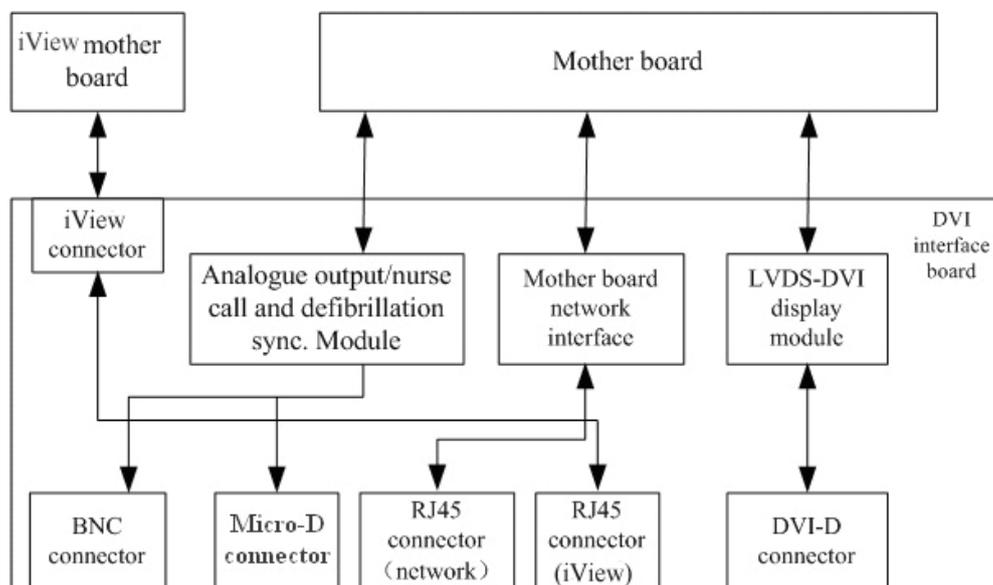
Interface	Description
iView Connector	Connects the iView mother board.
BNC connector	Outputs nurse call signals.
Micro-D connector	Outputs analog signals and defibrillator synchronization signals.
RJ 45 connector (network)	It is a standard RJ45 connector, providing 10/100 BASE-TX Ethernet communications channels. It connects an Ethernet network or a PC.
RJ 45 connector (iView)	It is a standard RJ45 connector for connecting a iView network.
DVI-D connector	Connects a secondary display.

CF Card assembly

The CF assembly serves the non-volatile CF storage card which is used for data storage and transfer. It is connected with the mother board.

Internal wireless network card

The internal wireless network card connects with the mother board. User can set network type as LAN or WLAN through user interface and can set the internal wireless network card through PC.

2.4 Parameter Module

Each parameter module consists of the module infrared communication board, module power board, module button board, parameter board, etc.

2.4.1 Module Infrared Communication Board

The module infrared communication board allows a short delay when powering up the module and adopts FPGA to enable infrared communications between the module and the module rack. An ID is integrated into the module infrared communication board. When a module is inserted in the module rack, the ID is automatically sent to the module rack.

2.4.2 Module Power Board

Some modules have no power board. There are two kinds of module power board:

1. Isolated power board: converts the 12 V DC into a 12 V isolated DC and a 5 V isolated DC.

2. Non-isolated power board: converts the 12 V DC into a 5 V DC.

2.4.3 Parameter Board

The parameter board is a parameter measurement component, which is the most important component of the parameter module.

2.5 Satellite Module Rack

The satellite module rack (SMR) is independent of the patient monitor, provides 8 slots for mounting parameter modules. It has the following features:

■ It allows a parameter module to be plugged and unplugged with the patient monitor on. This allows function extension and patient transfer.

■ It does not have its own power. It introduces 12 V DC from the patient monitor and then supplies power to each parameter module via the contact screw.

■ It accomplishes communications protocol conversions between the patient monitor and each parameter module, provides infrared communications for parameter modules, and is responsible for detecting infrared communications malfunction for each parameter module.

The following diagram shows the structure of the SMR.
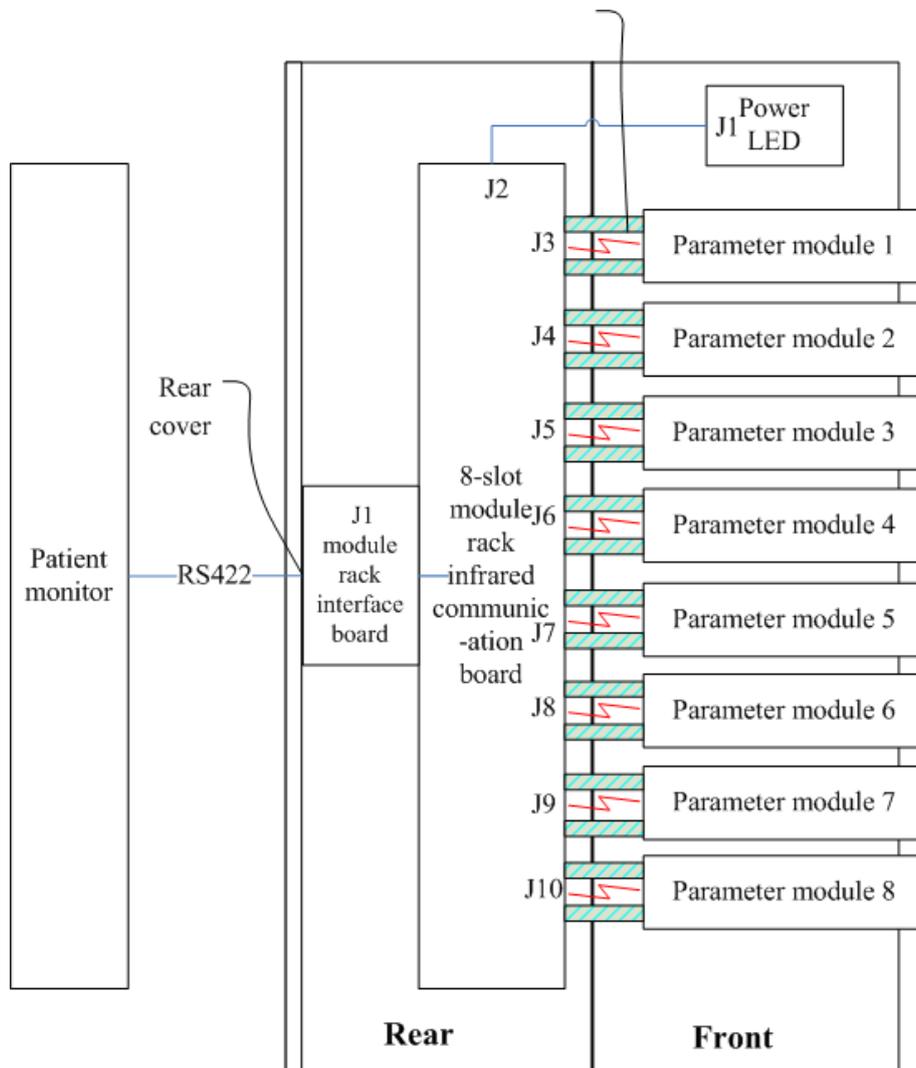
2.6 BeneLink Module

BeneLink module allows the information (patient data, alarms, etc.) from the external device to be displayed, saved, recorded, printed, or calculated through a BeneView patient monitor. If the patient monitor is connected with the CMS or gateway, information from the external device can also be transmitted to the CMS or gateway. BeneLink module connects with the external device through an ID module, which enables the information transmission between the BeneLink module and the external device. BeneLink module can be connected to many external devices such as anesthesia machine and ventilator.

The following diagram shows the structure of the BeneLink module:
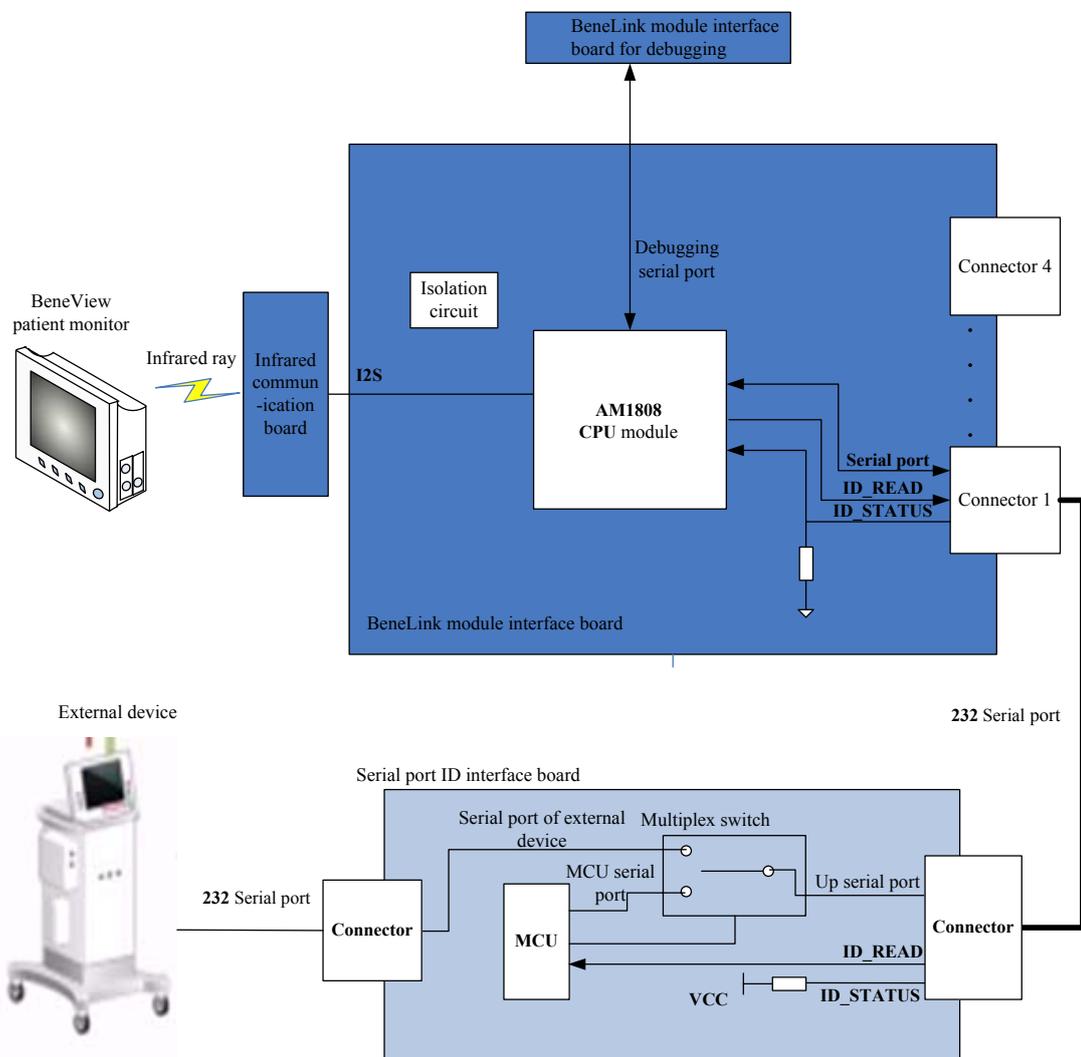
FOR YOUR NOTES

3 Testing and Maintenance

3.1 Introduction

To ensure the patient monitor always functions normally, 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 to change the settings in [User Maintenance>>] and [Factory Maintenance>>] menus to avoid loss of data.**
- **Service personnel should acquaint themselves with the test tools and make sure that test tools and cables are applicable.**

3.1.1 Test Equipment

See the following sections.

3.1.2 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.

3.1.3 Preventative Maintenance

Below are preventative maintenance tests which need to be performed on the monitor. See the following sections for detailed maintenance procedures.

- Visual inspection
- NIBP test and calibration
- Microsteam and Sidestram CO_2 test and calibration
- AG test and calibration

3.1.4 Recommended Frequency

Check/Maintenance Item		Frequency
Preventative Maintenance Tests		
Visual inspection		1. When first installed or reinstalled.
NIBP test	Pressure check	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once a year. 4. AG leakage test should be performed before AG measurement.
	Leakage test	
	Calibration	
Sidestream and Microstream CO_2 tests	Leakage test	
	Performance test	
	Calibration	
AG tests	Performance test	
	Calibration	
Performance Tests		
ECG test	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once every two years. At least once a year is recommended for NIBP, CO_2, NMT and AG. 4. AG leakage test should be performed before AG measurement.
	Calibration	
Resp performance test		
SpO$_2$ test		
NIBP test	Pressure check	
	Leakage test	
	Calibration	
Temp test		
IBP test	Performance test	

	Pressure calibration	
C.O. test		
Mainstream CO_2 test		
Sidestream and Microstream CO_2 tests	Leakage test	
	Performance test	
	Calibration	
AG tests	Leakage test	
	Performance test	
	Calibration	
ICG test		
BIS test		
RM test		
CCO/SvO_2 test	Interconnecting function	
	Output calibration	
NMT test	Performance test	
	Sensor check	
EEG test		
PiCCO test		
$ScvO_2$ test		
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 Tests		
Electrical safety tests		Refer to *A Electrical Safety Inspection*.
Other Tests		
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Touchscreen calibration		1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
Network print test		1. When first installed. 2. Whenever the printer is serviced or replaced.
Device integration check		1. When first installed. 2. Following any repair or replacement of the external device.
Battery check	Functionality test	1. When first installed. 2. Whenever a battery is replaced.

3.2 Preventative Maintenance Procedures

3.2.1 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 knob for obvious signs of damage.

■ Inspect the SMR and parameter modules for obvious signs of damage.

■ Inspect the power cord, wall-mount bracket and module 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.

3.2.2 NIBP Tests

NIBP Accuracy Test

Tools required:

- T-shape connector

- Appropriate tubing

- Balloon pump

- Rigid Vessel with volume 500 ± 25 ml

- Reference manometer (calibrated with accuracy equal to or greater than 1 mmHg)

Follow this procedure to perform the test:

1. Connect the equipment as shown below.
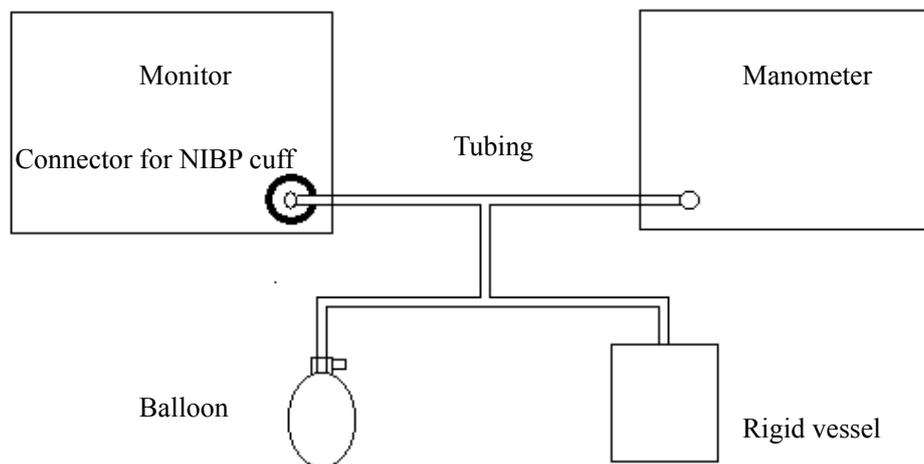
2. Before inflation, the reading of the manometer should be 0. If not, turn off the balloon pump to let the whole airway open to the atmosphere. Turn on the balloon pump after the reading is 0.

3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**NIBP Accuracy Test**].

4. Check the manometer values and the monitor values. Both should be 0mmHg.

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 manometer values with the monitor values. The difference should be 3 mmHg. If it is greater than 3 mmHg, contact your service personnel.

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 and 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.**

NIBP Leakage Test

NOTE

- **You should perform NIBP accuracy test and make sure the test result is pass prior to NIBP leakage test.**

Tools required:

- NIBP cuff for adult patient
- Appropriate tubing
- Cylinder

Follow this procedure to perform the test:

1. Set [**Patient Cat.**] to [**Adu**].
2. Connect the NIBP cuff with the NIBP connector on the monitor.
3. Apply the cuff to the cylinder as shown below.
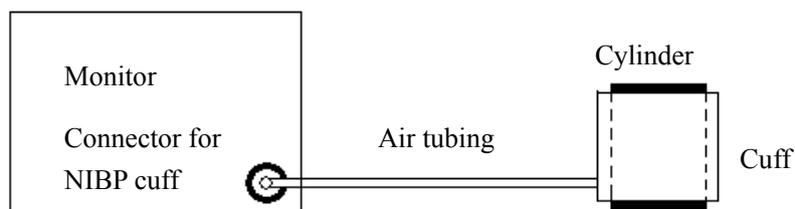
4. Select [**Main Menu**]→ [**Maintenance>>**]→ [**NIBP Leakage Test**]. The message [**Leakage Testing**…] is displayed in the NIBP parameter area.

5. The cuff automatically deflates after 20s, which means NIBP leakage test is completed.If no message is displayed in the NIBP parameter area, it indicates that the system has no leakage. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the system may have a leakage. In this case, check if all connections are good and the cuff and tubing have no leakage. Perform the test again after making sure all connections are good and the cuff and tubing have no leakage.

You can either perform a manual leakage test:

1. Perform procedures 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 to let the measured values becoming stable.

3. Record the current pressure value and meanwhile use a time counter to count time. Then, record the pressure value after counting to 60s.

4. Compare the two values and make sure the difference should not be greater than 6 mmHg.

3.2.3 Sidestream and Microstream CO_2 Module Tests

Leakage test

Follow this procedure to perform the test:

1. Plug the module into the module rack.

2. Wait until CO_2 warmup is finished and then use your hand or other objects to completely block the gas inlet of the module or watertrap. The sidestream and microstream CO_2 modules will behave as follows:

   ◆ Sidestream: The alarm message [**CO₂ FilterLine Err**] is displayed on the screen after 3 seconds. Block the gas inlet for another 60 s. Select [**Main Menu**]→ [**Maintenance >>**]→[**User Maintenance >>**] → enter the required password → [**Maintain CO₂ >>**]→ [**Calibrate CO₂ >>**], and check that the flow rate is less than. 10ml/min. The module does not leak if current flow rate is less than 10ml/min and the alarm message does not disappear.

   ◆ Microstream: The alarm message [**CO₂ Purging**] is displayed on the screen after certain time. Block the gas inlet for another 30s. If alarm message [**CO₂ FilterLine Err**] is shown, it indicates that the module does not leak.

Accuracy Test

Tools required:

- A steel gas cylinder with $6\pm0.05\%$ CO_2 and balance gas N_2

- T-shape connector

- Tubing

- Flowmeter

Follow this procedure to perform the test:

1. Plug the module into the module rack.

2. Wait until the CO_2 module warmup is finished, and check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.

3. Enter [**User Maintenance**]→ [**Maintain CO_2 >>**]→ [**Calibrate CO_2>>**].

4. Connect the test system as follows:
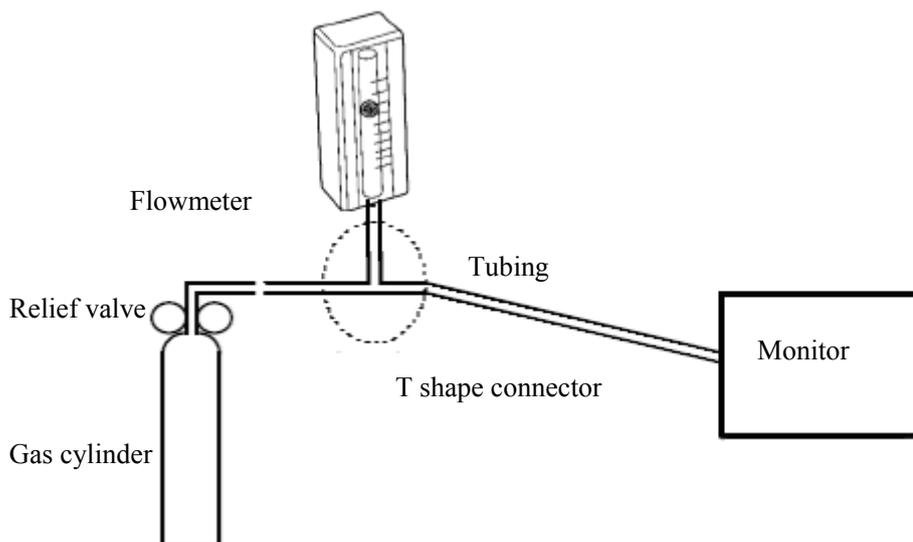
Flowmeter

Tubing

Relief valve

Monitor

T shape connector

Gas cylinder

5. Open the relief valve, and adjust it until the flowmeter has a stable reading between 10 ml/min and 50ml/min.

6. Check the realtime CO_2 value is within $6\pm0.05\%$ in the [**Calibrate CO_2**] menu.

Calibration

Tools required:

- A steel gas cylinder with $6\pm0.05\%$ CO_2 and balance gas N_2
- T-shape connector
- Tubing
- Flowmeter

Follow this procedure to perform a calibration:

1. Make sure that the sidestream or microstream CO_2 module has been warmed up or started up.

2. Check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.

3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**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:
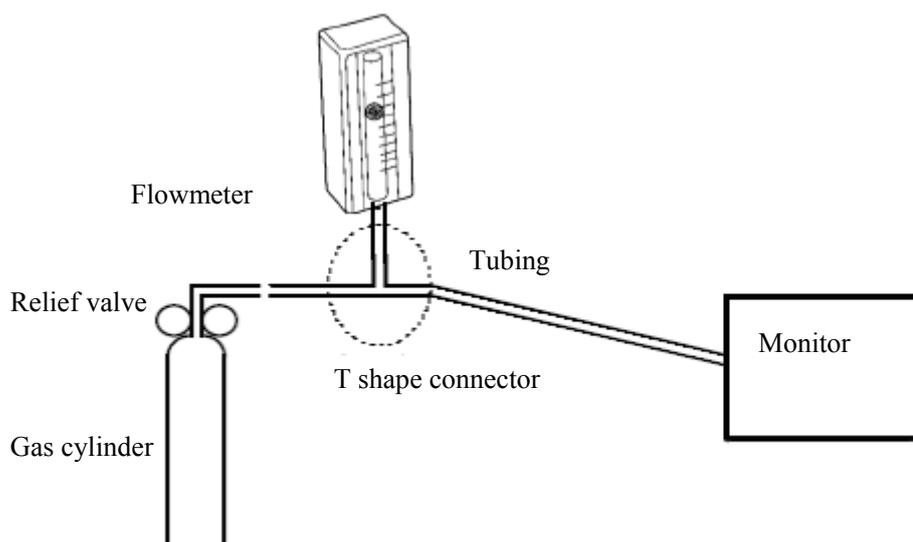
6. Open the relief valve, and adjust it until the flowmeter has a stable reading between 10 ml/min and 50ml/min.

7. In the [**Calibrate CO_2**] menu, enter 6% (the CO_2 concentration) in the [**CO_2**] field.

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

If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO$_2$**] menu. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

3.2.4 AG Tests

AG Leakage Test

The AG leakage test is required every time before the AG measurement. Follow this procedure to perform the test:

1. Plug the AG module into the module rack.

2. Wait for more than10mins until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message [**AG Airway Occluded**] will appear on the screen.

3. Block the gas inlet for another 30 s. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→**Module Maintenance >>**]→ [**Calibrate AG >>**].

Check that the current flow rate is less than 10ml/min, and the alarm message [**AG Airway Occluded**] does not disappear. This indicates that the module does not leak.

If the alarm message disappears, or the flow rate is equal to or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

AG Accuracy Test

Tools required:

- Gas cylinder with 100% O$_2$ and/or a certain standard gas (such as 6±0.05% CO$_2$, Bal N$_2$), or standard gas mixture (such as 5±0.03% CO$_2$, 1.5±0.15% ISO, 45±0.23% O$_2$ bal N$_2$O).
- Gas concentration should meet the following requirements respectively: AA≥1.5%, CO$_2$≥1.5%, N$_2$O≥40%, O$_2$≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO$_2$±0.1%, N$_2$O±1%, O$_2$±1%.
- T-shape connector
- Tubing

NOTE

- **When testing a particular gas in a mixture, only the concentration of the gas to be tested needs to meet the requirements.**
- **Handle the gas cylinder by following the instructions on the gas cylinder.**

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.

2. Wait at least 10 min and then perform a leakage test to make sure the airway has no leakage.

3. Check if the fan inside the AG module works correctly.

4. Connect the test system as follows:
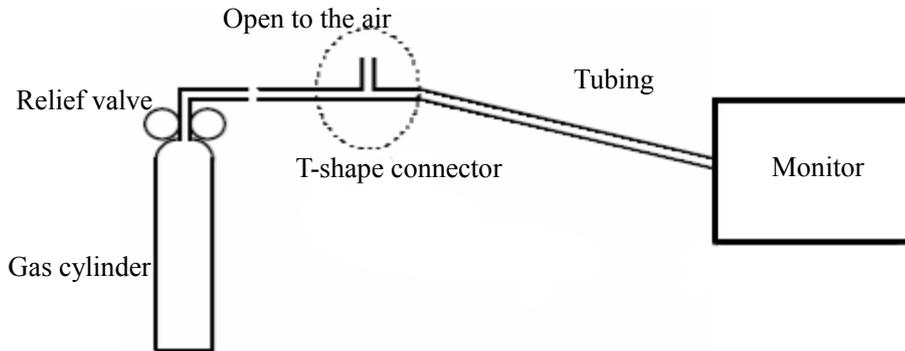
5. Open the relief valve and vent a standard gas and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.

6. Check that the concentration of each composition meets the specification stated in the Operator's Manual.

⚠WARNING

- **When performing AG accuracy test, be sure to dispose of exhaust gas properly.**

AG Calibration

Tools required:

■ Gas cylinder with a certain standard gas or standard gas mixture. Gas concentration should meet the following requirements respectively: AA≥1.5%, CO2≥1.5%, N2O≥40%, O2≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO2±0.1%, N2O±1%, O2±1%.

■ T-shape connector

■ Tubing

NOTE

● **When calibrating a particular gas in a mixture, only the concentration of the gas to be calibrated needs to meet the requirements.**

● **Handle the gas cylinder by following the instructions on the gas cylinder(s).**

Follow this procedure to perform the AG calibration:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate AG >>**]..

2. Check the airway and make sure that there are no occlusions or leaks.

   ◆ Vent the sampling tubing to the air and check if the [**Current FlowRate**] and [**SetFlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.

   ◆ Perform a leakage test to make sure that the airway has no leakage.

3. Connect the test system as follows:

Open to the air

Relief valve

T-shape connector

Tubing

Monitor

Gas cylinder
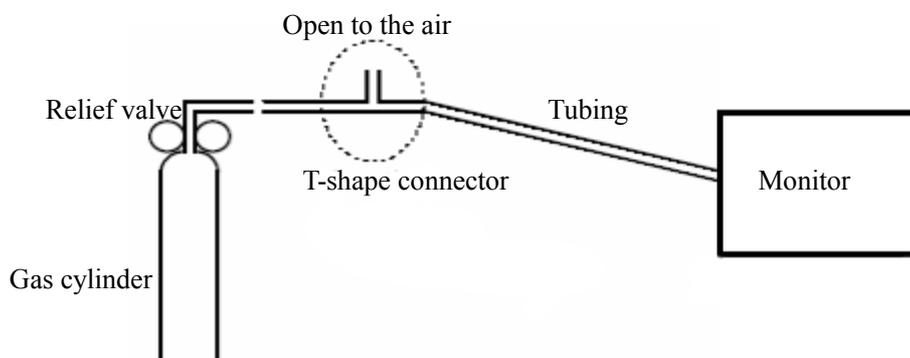
4. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.

5. In the [**Calibrate AG**] menu, the concentration of each measured gas and flow rate are displayed.

   ◆ If the difference between the measured gas concentration and the actual one is within the tolerances in the user manual, a calibration is not needed.

   ◆ If the difference for one gas composition or more gas compositions is outside of the stated tolerances, a calibration for one gas composition or more gas compositions should be performed. Select [**Calibrate >>**] to enter the calibrate menu.

6. Enter the vented gas concentration(s) for one gas composition or more gas compositions which needs calibration. If only one gas composition in gas mixture is to be calibrated i.e. CO_2 only, set the concentration of the other gases to 0.

7. Select [**Start**] to start a calibration.

8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

After the calibration finished, an accuracy test should be performed according to the Accuracy Test chapter. If one gas composition of the gas mixture is outside of the stated tolerances, please perform the calibration for the gas which reading is out of stated tolerances by using the calibration gas cylinder or another calibration gas cylinder following the instruction of Calibration chapter again.

⚠WARNING

- **When performing AG calibration, be sure to dispose of exhaust gas properly.**

⚠CAUTION

- **Calibrate the AG module, if it has been transported for a long distance or not used for a prolonged period of time.**

- **Calibrate the AG module, if the module was subject to physical impact damage i.e. dropped etc. or when the measured value(s) has a great deviation.**

NOTE

- **For measurement of O_2 concentration more than 80%, it recommends to use gas cylinder with 100% O_2 to do the O_2 calibration again.**

3.2.5 Preventative maintenance test report

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, knob, SMR, modules, 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.		
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 6mmHg/min.		
Sidestream CO$_2$ test		

Block the gas inlet of the module or watertrap. The sidestream CO_2 flowrate 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 within $6\pm0.05\%$.		
Microstream CO_2 test		
Block the gas inlet of the module or watertrap. An alarm of CO_2 Filterline Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is within $6\pm0.05\%$.		
AG test		
When AG flowrate is slower than 10ml/min, an alarm of AG Airway Occluded is given. It indicates that there is no leakage.		
The fan inside the AG module works properly.		
The measurement accuracy of CO_2, N_2O, O_2 and AA (AA represents an anaesthetic agent) meets the product specifications in the Operator's Manual.		

3.3 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:

1. Insert two batteries in the battery chamber and connect the patient monitor to the AC mains, the AC mains LED and battery LED light.

2. Press the power on/off switch to switch on the patient monitor. The operating status LED lights up, and the technical and physiological alarm lamps light blue and red respectively.

3. After the start-up screens are displayed, the system sounds a beep indicating the self test on alarm sounds is passed. At the same time, the alarm lamp turns from yellow to red, and then turns off together with the technical alarm lamp. This indicates that the self test on alarm lamps is passed.

4. The patient monitor enters the main screen and start-up is finished.

3.4 Module Performance Tests

3.4.1 ECG Tests

ECG Performance Test

Tool required:

■ Fluke Medsim 300B patient simulator recommended

Follow this procedure to perform the test:

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 1mV.

3. Check 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 that the simulator outputs paced signals and set [**Paced**] to [**Yes**] on the monitor. Check the pace pulse marks on the monitor screen.

ECG Calibration

Tool required:

■ Vernier caliper

Follow this procedure to perform a calibration:

1. Select the ECG parameter window or waveform area→ [**Filter**]→ [**Diagnostic**].

2. Select [**Main Menu**]→ [**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.

3.4.2 Resp Performance Test

Tool required:

■ Fluke Medsim 300B patient simulator recommended

Follow this procedure to perform the test:

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. Check the Resp wave is displayed without any distortion and the displayed Resp value is within 40 ± 2 rpm.

3.4.3 SpO$_2$ Test

Tool Required:

■ None.

Follow this procedure to perform the test:

1. Connect SpO$_2$ sensor to the SpO$_2$ connector of the monitor. Set [**Patient Cat**.] to [**Adu**] and [**PR Source**] to SpO2 on the monitor.

2. Measure SpO$_2$ on your finger. (Assume that you stay healthy)

3. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO$_2$ is within 95%-100%.

4. Remove the SpO$_2$ sensor from your finger and make sure that an alarm of SpO$_2$ Sensor Off is triggered.

NOTE

● **A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, it can be used to demonstrate that a particular pulse oximeter monitor reproduces a calibration curve that has been independently demonstrated to fulfill a particular accuracy specification.**

3.4.4 NIBP Tests

See section *3.2.2 NIBP Tests.*

3.4.5 Temp Test

Tool required:

■ Resistance box (with accuracy above 0.1Ω)

Follow this procedure to perform the test:

1. Connect the two pins of any Temp connector of a module to the two ends of the resistance box using 2 wires.

2. Set the resistance box to 1354.9Ω (corresponding temperature is 37ºC).

3. Verify each Temp channel of the monitor and make sure that the displayed value is within 37 ± 0.1ºC.

You can also use a patient simulator to perform the Temp test.

3.4.6 IBP Tests

IBP Performance Test

Tool required:

- Medsim300B patient simulator, MPS450, or other equivalent device
- Dedicated IBP adapter cable (300B, P/N 00-002199-00) (use P/N 00-002198-00, if the simulator is MPS450)

Follow this procedure to perform the test:

1. Connect the patient simulator with the pressure module.

2. Make the patient simulator outputs 0 to each IBP channel.

3. Press the Zero Key on the module to make a zero calibration.

4. Configure the patient simulator as P (static) = 200 mmHg.

5. The displayed value should be within 200 ± 2 mmHg.

6. If the value is outside of these tolerances, calibrate the pressure module. If the IBP module was calibrated with a dedicated reusable IBP sensor, check the calibration together with this IBP sensor.

7. Make that the patient simulator outputs 120/80 mmHg ART signals and 120/0 mmHg LV signals respectively to each IBP channel and check that the IBP wave is displayed correctly.

8. Repeat the steps above for all the IBP channels.

IBP Pressure Calibration

Method 1:
Tools required:

- Medsim300B Patient simulator, MPS450, or other equivalent device
- Dedicated IBP adapter cable (300B, P/N 00-002199-00) (use P/N 00-002198-00, if the simulator is MPS450)

Follow this procedure to perform the test:

1. Connect the patient simulator to the pressure connector on the module.

2. Set the patient simulator to 0 pressure for the desired IBP channel.

3. Press the Zero Key on the module to make a zero calibration.

4. Configure the patient simulator as P (static) = 200 mmHg.

5. Select [**Main Menu**]→ [**Maintenance >>**]→[**User 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. If the calibration is completed successfully, the message [**Calibration Completed!**] will be displayed. Otherwise, a corresponding message will be displayed.

Method 2:
Tools required:

- Standard sphygmomanometer

- Balloon pump

- Tubing

- T-shape connector

To perform a calibration:

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

2. Zero the transducer. Then open the stopcock to the sphygmomanometer.

3. Press the Main menu button on the equipment's front panel. Select [**Maintenance>>**]→ [**User Maintenance >>**]→ enter the required password→[**Cal. IBP Press. >>**]. Then configure IBP calibration value.

4. Inflate using the balloon pump until the reading of sphygmomanometer approximates the preset calibration value.
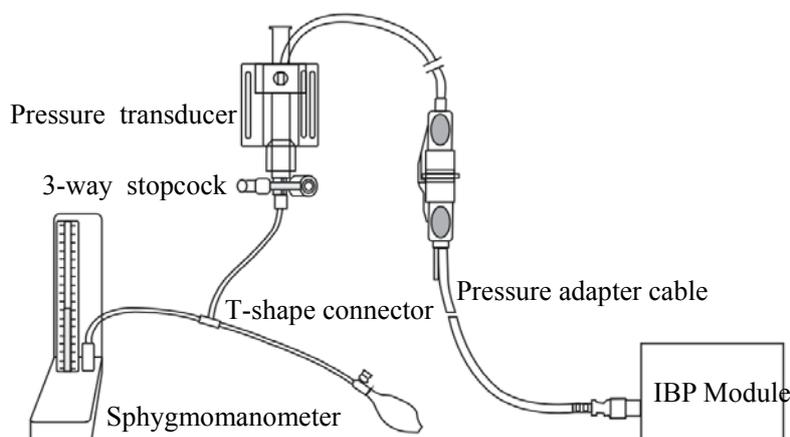
5. Adjust the calibration value in the [**Cal. IBP Press**.] menu until it is equal to the reading of sphygmomanometer

6. Select the [**Calibrate**] button to start a calibration

7. The message [**Calibration Completed!**] is displayed after a successful calibration. If the calibration failed, the prompt [**Calibration Failed!**] will be displayed.

3.4.7 C.O. Test

Tools required:

- Medsim300B Patient simulator

- C.O. adapter box

Follow this procedure to perform the test:

1. Connect the patient simulator to the C.O. module using a C.O. main cable.

2. Set the blood temperature (BT) to 37ºC on the patient simulator and check the temperature value is 37 ± 0.1ºC.

3. Set [**Auto IT**] to [**Off**] and adjust [**IT**] to 24ºC. Select [**C.O. Measure**] to enter the C.O. measurement window and set [**Comp. Const.**] to 0.595.

4. Set the injectate temperature to 24ºC and the C.O. to 5L/min on the C.O. simulator. Select [**Start**] in the C.O. measurement window to start C.O. measurements and after 3-10 seconds press the run key on the simulator.

5. Check the C.O. value is 5±0.25L/min.

3.4.8 Mainstream CO_2 Tests

NOTE

- **Make sure that the barometric pressure set in [Maintain CO_2>>] of [User Maintenance>>] accords with the local barometric pressure before performing mainstream CO_2 tests.**

Tools required:

- A steel gas cylinder with 6±0.05% CO_2

- A steel gas cylinder with compressed air or N_2 (with standard concentration)

- Two 3-way valves (power supply controlled)

- Flowmeter

- Power supply

- Tube

Follow this procedure to perform the test:

1. Wait until CO_2 warmup is finished and then select [**Start Zero Cal**.] from [**CO_2 Setup**] menu to start a zero calibration. If the zero calibration fails, the prompt message [**CO_2 Zero Failed**] is displayed. Otherwise, the baseline of waveform recovers to zero.

2. Set [**Apnea Time**] to 10 s in the [**Adjust CO_2 Limits**] menu.

3   Blow to the CO_2 sensor to generate a CO_2 waveform and then place the sensor in the air. Check if the alarm message [**CO_2 Apnea**] is displayed on the screen.

4   Connect the test system as follows
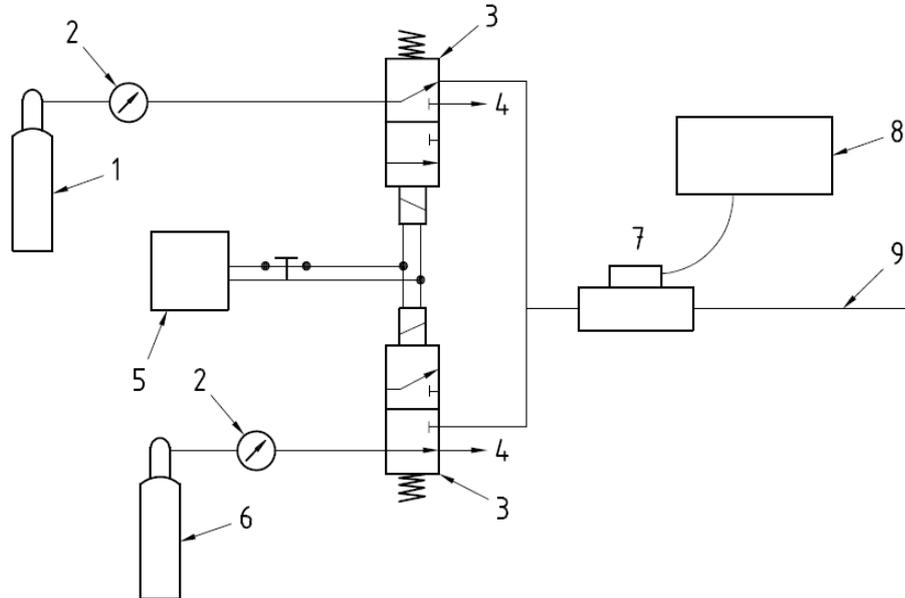
Indication of numbers in the figure above

1	A steel gas cylinder with 6±0.05% CO_2
2	Flowmeter
3	3-way valve (power supply controlled)
4	Open to air
5	Power supply (controlling two 3-way valves)
6	Compressed air or N_2 with standard concentration
7	Mainstream CO_2 sensor
8	Patient monitor
9	Tube (preventing back flow)

5   Adjust the power supply and turn on/off 3-way valves to ensure that that only one cylinder is connected to Mainstream CO_2 sensor via 3-way valves at one time and the flowmeter reading is stable and within 2-5L/min.

6   Switch between the two cylinders to connect Mainstream CO_2 sensor at intervals of 6 -10s and check if the displayed CO_2 value is within $6\pm0.05\%$.

3.4.9 Sidestream and Microstream CO$_2$ Module Tests

See section *3.2.3 Sidestream and Microstream CO$_2$ Module Tests*.

3.4.10 AG Tests

See section *3.2.4 AG Tests.*

3.4.11 ICG Test

Tool required:

■   ICG simulator (BZ-4575)

1.   Connect the ICG simulator and the patient monitor using standard ICG cable and sensor.

2.   Select [**ICG setup**]→ [**Patient Demographics >>**] and then input parameter values as follows:

Height	180 cm	CVP	6 mmHg
Weight	75 kg	PAmean	8 mmHg
PAWP	10 mmHg		

3.   Switch on the simulator and set as follows: HR=60±1 bpm, VI=61±4/1000s, TFC=32±2/kOhms. Then, start ICG monitoring.

4.   After the measurement becomes stable and check that the measured results are as follows: HR=60±2 bpm, VI=61±4/1000s, TFC=32±2/kOhms.

5.   Set on the simulator as follows: HR=70±1 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms, and then start ICG monitoring. After the measurement becomes stable and check that the measured results are as follows: HR=70±2 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms.

3.4.12 BIS Test

You can choose either of the following methods to perform the test:

Method 1:

Tools required:

■   None.

1.   Connect the BIS sensor to a healthy, wide-awake adult as directed in the Operator's Manual.

2.   Check the EEG wave and BIS numerics displayed on the screen and make sure the BIS value is within 80-100.

Method 2:

Tools required:

■   BIS simulator (with flexible cable)

1.   Connect the BIS sensor with the BIS simulator and select [**BIS Setup**]→ [**BIS Sensor Check**] to perform a cyclic impedance check.

2.   After the cyclic impedance check is finished, check that the result for each electrode is pass.

3.   Check the EEG wave and BIS numeric displayed on the screen.

3.4.13 RM Test

Tool required:

- Gas source
- Ventilator (calibrated)
- Artificial lung
- Pediatric/neonate flow sensor
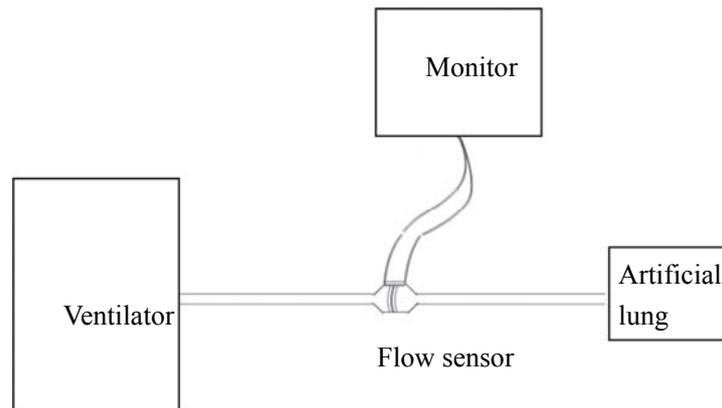
Follow this procedure to perform the test:

1. Connect the equipment as shown above. Make sure that the blue sensing tube on the flow sensor is connected with the artificial lung.

2. Set [**Patient Cat**.] to [**Adu**]. In the [**RM Setup**] menu, select [**Sensor Type**] according to the used sensor and set [**Ventilation Mode**] to [**Mechanical**].

3. Enter the [**RM Setup**] menu and select [**Calibrate >>**]. Input the constant marked on the sensor and calibrate the flow sensor.

4. Configure the ventilator as follows: TV=500 ml, RR =20 rpm, I:E=1:2.

5. Select [**Respiratory Loop**] in the [**RM Setup**] menu. Verify that the displayed TV is within 500±50ml and RR is within 20±1rpm.

3.4.14 CCO/SvO$_2$ Tests

Interconnecting Function

Tools required:

■ None.

1. Connect and set the patient monitor and Vigilance monitor per the procedures in the Operator's Manual.
2. Set the Vigilance monitor to Demo mode.
3. Check that the CCO/SvO$_2$ numerics displayed on the patient monitor and Vigilance monitor are consistent.

Output Performance

Tools required:

■ Oscillograph

1. Connect the signal output end of the connecting cables of the CCO/SvO$_2$ module to the oscillograph.
2. Make the monitor to perform an ECG calibration. Check that the ECG waves displayed on the oscillograph are consistent with the ECG calibration waves displayed on the monitor screen.
3. Select [**CCO Setup**]→ [**Signal Output Setup >>**] and then select [**Simulated High Value**] from the pop-up menu. Check that the amplitude of electrical level at the signal output port of MAP, CVP and SpO$_2$ are 5±0.25V, 5±0.25V and 10±0.5V respectively.

3.4.15 PiCCO Tests

Performance Test

Tool required:

- Medsim300B patient simulator
- PiCCO IBP test cable (6800-J87)

Follow this procedure to perform the test:

1. Connect the patient simulator, the PiCCO IBP test cable and the PiCCO module.

2. Let the patient simulator outputs 0 mmHg respectively to the pArt channel and the pCVP channel.

3. In the [**pArt Setup**] menu, select [**pArt Zero >>**]→[**Zero**].

4. In the [**pCVP Setup**] menu, select [**pCVP Zero >>**]→[**Zero**].

5. Let the patient simulator output static pressure 200 mmHg to pArt channel and 20 mmHg to pCVP channel.

6. The pArt value displayed on the monitor should be within 200 ± 4 mmHg, and pCVP value within 20 ± 1 mmHg.

7. If the pArt error is beyond ±4 mmHg or pCVP error beyond ±1 mmHg, calibrate the PiCCO module. If the module was calibrated with a dedicated reusable IBP sensor, check the calibration together with this IBP sensor.

8. Let the patient simulator output ART signal to the pArt channel and pCVP signal to the pCVP channel, verify that the pArt and pCVP waves are displayed correctly.

Pressure Calibration

Method 1

Tools required:

- Medsim300B patient simulator
- PiCCO IBP test cable (6800-J87)

Follow this procedure to perform the test:

1. Connect the patient simulator, the PiCCO IBP test cable and the PiCCO module.

2. Let the patient simulator outputs 0 mmHg respectively to the pArt channel and the pCVP channel.

3. In the [**pArt Setup**] menu, select [**pArt Zero >>**]→[**Zero**].

4. In the [**pCVP Setup**] menu, select [**pCVP Zero >>**]→[**Zero**].

5. Set static pressure to 200 mmHg on the patient simulator.

6. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→ [**Cal. IBP Press. >>**]. In the [**Cal. IBP Press**.] menu, set the calibration pressure to 200 mmHg.

7. Select the [**Calibrate**] button next to the desired IBP channel to start a calibration.

If the calibration is completed successfully, the message [**Calibration Completed!**] will be displayed. Otherwise, a corresponding message will be displayed.

Method 2

Tools required:

■ Standard sphygmomanometer

■ Balloon pump

■ Tubing

■ T-shape connector

To perform a calibration:

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

2. Vent the transducer to the atmospheric pressure by turning on the 3-way stopcock to the air. Zero the transducer, and then open the stopcock to the sphygmomanometer.

3. Select [**Main Menu**]→[**Maintenance >>**]→ [**User Maintenance >>**]→enter the required password→ [**Cal**. **IBP Press. >>**]. In the [**Cal. IBP Press.**] menu, set the calibration pressure to 200 mmHg.

4. Inflate using the balloon pump until the reading of sphygmomanometer approximates the preset calibration value.
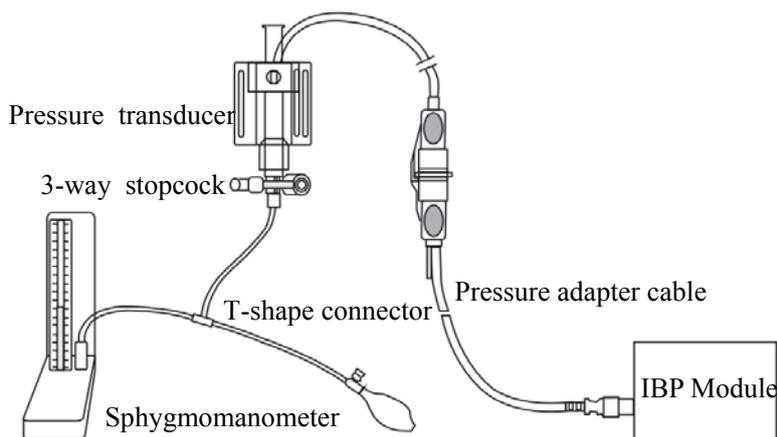
5. Adjust the calibration value in the [**Maintain IBP**] menu until it is equal to the reading of sphygmomanometer

6. In the [**Cal. IBP Press.**] menu, select the [**Calibrate**] button next to the desired IBP channel to start a calibration

The message [**Calibration Completed!**] is displayed after a successful calibration. If the calibration failed, the prompt [**Calibration Failed!**] will be displayed.

C.O. Test

Tools required:

- Medsim300B Patient simulator, or equivalent equipment
- C.O. adapter box (for 300B)
- PiCCO test cable (PN: 040-001301-00)

Follow this procedure to perform the test:

1. Connect the patient simulator and the C.O. module using a C.O. trunk cable and a C.O. adapter box.

2. Set the blood temperature (BT) to 37ºC on the patient simulator and check the temperature value displayed on the monitor is 37 ± 0.1ºC.

3. In the [**CCO Setup**] menu, select [**PiCCO Guide>>**], and check if the value for [**Cat.Type**] is [PV2015L20].

4. Turn the injectate temperature (TI) knob on the C.O. adapter box to set the TI to 20 ± 1ºC for the patient simulator and C.O. to 5L/min.

5. In the PiCCO screen, select [**Start**] to start C.O. measurement. As soon as the prompt [**Inject XXml**] is displayed, adjust TI to 4 ± 1ºC, and then quickly back to 20 ± 1ºC. Simutaneously press the button on the simulator that corresponds to 5L/min. The whole procedure shall be finished in 10 s.

6. Verify that the C.O. value displayed on the monitor is correct.

3.4.16 ScvO$_2$ Tests

You can perform ScvO$_2$ test by either of the following two methods:

Method 1:
Tools required:

■ PC (installed OM_Simulation software, G-6800-S15)

■ ScvO$_2$ test cable (6800-J68)

1. Connect the ScvO$_2$ test cable to the ScvO$_2$ module and the serial port on the PC respectively;

2. Open ScvO$_2$ test software to select the corresponding serial port from [**COM port**] menu (default serial port: COM1);

3. Select [**Start**] from the [**Replay**] menu. Then the ScvO$_2$ measurement area is displayed on the patient monitor;

4. Enter [**ScvO$_2$ Setup**] menu and set [Hb/Hct] to [Hct];

5. Set [**LED660**], [**LED800**], [**LED880**] to '1250，40000' (inching with the direction key on the keyboard if needed). Select [**Start**] from the [**Replay**] menu;

6. Enter [**ScvO$_2$ Calibration**] menu and select [**Sample drawn**] when SQI occupies four grids (80%). In the popup menu, set [**ScvO$_2$**] and [**Hct**] to 67％ and 40％ respectively, then select [**Calibrate**]. Close [**ScvO$_2$ Calibration**] menu to check that the ScvO$_2$ value is displayed as 67％ in the monitoring screen.

7. Set the value of [**LED660**] to '1250, 33600' and keep other LCD values unchanged. Check that the ScvO2 measurement is within (50±3)%.

8. Set the value of [**LED660**] to '1250, 46400' and keep other LCD values unchanged. Check that the ScvO$_2$ measurement is within (80±3)%.

Method 2:
Tools required:

■ None.

1. Connect the ScvO$_2$ sensor to the patient monitor. Check that the front end of the ScvO$_2$ sensor illuminates normally.

2. Nip the front end of the ScvO$_2$ sensor with two fingers to perform a ScvO$_2$ calibration.

3. Check that the patient monitor displays the ScvO$_2$ measurement normally.

3.4.17 NMT Tests

NMT Performance Test

Tool required:

■ Resistance box

■ Oscillograph (Agilent DSO6052A)

1. Set up the resistance box:

   a. Set the resistance value to 1kOhm.

   b. Connect the stimulation electrodes to the two wiring terminals.

2. Connect the oscillograph sensors to the NMT stimulation electrodes, making sure that each sensor and electrode connected have the same polarity.

3. Set up the monitor:

   a. Insert the NMT module into the module rack of the monitor.

   b. Set the [**Stimulation Current**] to [**Supra(60mA)**].

   c. Set the [**Pulse Width**] to 300μs.

   d. Perform an ST measurement.

4. Proceed as follows to capture the pulse signals and measure the [**PK-PK**] and [+**Width**]. The following procedures take the oscillograph of Agilent DSO6052A as an example.

   a. Power on the oscillograph by pressing the [**POWER**] button. Select the button [**1**] and verify the button light is on.

   b. Press the [**Mode/Coupling**] button, and select [**Normal**], [**Noise REJ**] and [**HF Reject**] at the lower part of the screen.

   c. Press the [**Acquire**] button, and select [**High Resolution**] from the dropdown list of [**Acq Mode**].

   d. Press the [**Quick Meas**] button. Select [**PK-PK**] from the dropdown list of [**Select**] and select [**Measure**] to confirm; select [+**Width**] from the dropdown list of [**Select**] and then select [**Measure**] to confirm.

   e. In the [**Horizontal**] area, adjust [**Delay**] to 0.0s by using the [◄►] knob, and adjust the numeric value to 100ms by using the big knob.

   f. In the [**Analog**] area, adjust the numeric value to 20.0V by using the big knob and adjust the [**Ch(1)**] to 40.0V by using the [⬍] knob.

   g. Press the [**Edge**] button. Select [**1**] from the dropdown list of [**Source**]; select [**Rising**] from the dropdown list of [**Slope**].

   h. In the [**Trigger**] area, adjust the numeric value to 40.0V by using the [**Level**] knob. Press [**Single**] to perform a measurement.

The test passes when the measurements are within the following ranges:

Test items	Measurements
【PK-PK】	54V - 66V
【+Width】	270μs - 330μs

Checking NMT Sensor

Tools required:

■   None

1.   Connect the patient monitor, NMT module, and NMT accessories.

2.   Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance** >>]→ enter the required password→ [**NMT Sensor Check >>**] from the patient monitor.

3.   Follow the on-screen instructions to check the NMT sensor in four ways.

If sensor check completes successfully, the message "Test passed. The function of NMT sensor is OK" is presented. If any of the four steps fails, check if the sensor is placed correctly as instructed, and perform the sensor check again. Replace the sensor if you cannot pass the sensor check..

NOTE

- **Stop NMT measurement or calibration before starting NMT sensor check.**
- **Take care to handle the the NMT sensor. Avoid forcefully striking the sensor.**

3.4.18 EEG tests

Method 1

Tools required:

- EEG simulator (Nannini 169/1)

1. Insert the EEG module into the module slot of the monitor.
2. Connect the EEG module to the EEG simulator through the EEG patient cable.
3. Select [**EEG Setup**]→ [**Sensor Check**] to perform a sensor check.
4. Check that the result for each electrode is pass.
5. Check that the EEG wave and numeric are displayed on the screen.

Method 2

Tools required:

- None

1. Insert the EEG module into the module slot of the monitor.
2. Connect the EEG cable and EEG electrodes to the EEG module, and short all the electrodes.
3. Select [**EEG Setup**]→ [**Sensor Check**] to perform a sensor check.
4. Check that the result for each electrode is pass.
5. Check that the EEG wave and numeric are displayed on the screen.

3.5 Nurse Call Relay Performance Test

Tools required:

- Multimeter

1. Connect the nurse call cable to the Nurse Call Connector of the patient monitor.

2. Enter Demo mode. Then, select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**Others >>**]→ [**Auxiliary Output**]→ [**Nurse Call**].

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 [**Nurse Call Setup >>**] setup menu, set [**Signal Type**] to [**Pulse**]. Make the monitor to generate an alarm and check that the output are pulses of 1s width and the relay contacts are close (can be measured with a multimeter) when there is an alarm.

5. In [**Nurse Call Setup >>**] setup menu, set [**Signal Type**] to [**Continuous**].Make the monitor to generate an alarm and check that the output is continuous high level and the relay contacts are close (can be measured with a multimeter) when there is an alarm.

3.6 Analog Output Performance Test

Tool required:

- Patient simulator
- Oscillograph

1. Connect the patient simulator to the monitor using an ECG or IBP cable and connect the oscillograph to the Auxiliary Output Connector of the patient monitor.

2. Select [**Main Menu**] → [**Analog Output Setup**]. Switch Analog Output [**On**].

3. Verify that the waves displayed on the oscillograph are identical with those displayed on the monitor.

3.7 Electrical Safety Test

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

3.8 Touchscreen Calibration

Tools required:

■ None.

1. Select the [**Cal. Screen**] QuickKey or select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**Cal. Touchscreen**].

2. The ⊕ symbol will appear at different positions of the screen.

3. Select, in turn, the central point of the ⊕ symbol.

4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

3.9 Recorder Check

Tools required:

■ None.

1. Print ECG waveforms. The recorder should print correctly and the printout should be clear.

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.

3.10 Network Print Test

Note

● **HP LaserJet 1505n, P2035n, P4015n, or 1606dn laser printer is recommended for BeneView series of patient monitors.**

Tools required:

■ Hub and network cable

3.10.1 Equipment Connection and Setup

1. Connect the patient monitor and network printer to a HUB using common network cables as follows:

```
┌──────────────┐          ┌──────────────┐
│  BeneView    │          │   Network    │
│  monitor     │          │   printer    │
└──────┬───────┘          └──────┬───────┘
       │                         │
     Cable        Cable
       │                         │
     ┌─┴─────────────────────────┴─┐
     │            HUB              │
     └────────────────────────────┘
```
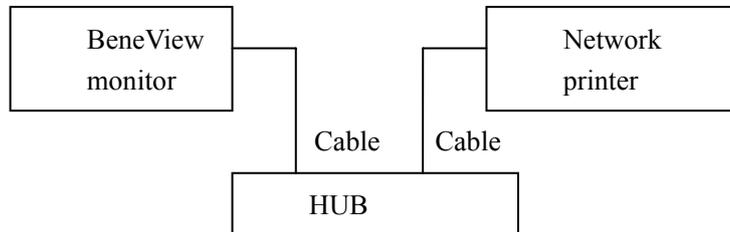
2 Set IP address as follows: Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**IP Address Setup >>**] and set the IP address of the patient monitor in the same network segment with that of the network printer. (See the instructions for use accompanying the printer)

3 Search for printer by selecting [**Main Menu**]→ [**Print Setup >>**]→ [**Printer Setup >>**]→ [**Search Printer**]. After a while, the printer's model and IP address will appear in the box beside [**Printer**].

3.10.2 Print Function Test

1 Enter the Demo mode of the patient monitor.

2 Select [**Main Menu**]→ [**Print Setup >>**]→ [**Realtime Reports >>**]→ [**Normal Report**] and then select [**Print**]. The network printer shall print out the report correctly.

3.11 BeneLink Module Check

3.11.1 Device Connection and Setup

Tools required:

- External device (anesthesia machine, ventilator)
- ID adapter that maches the external device
- RJ45 connecting cable
- Serial port adapting cable that maching the external device

Please refer to the following procedure to connect an external device:
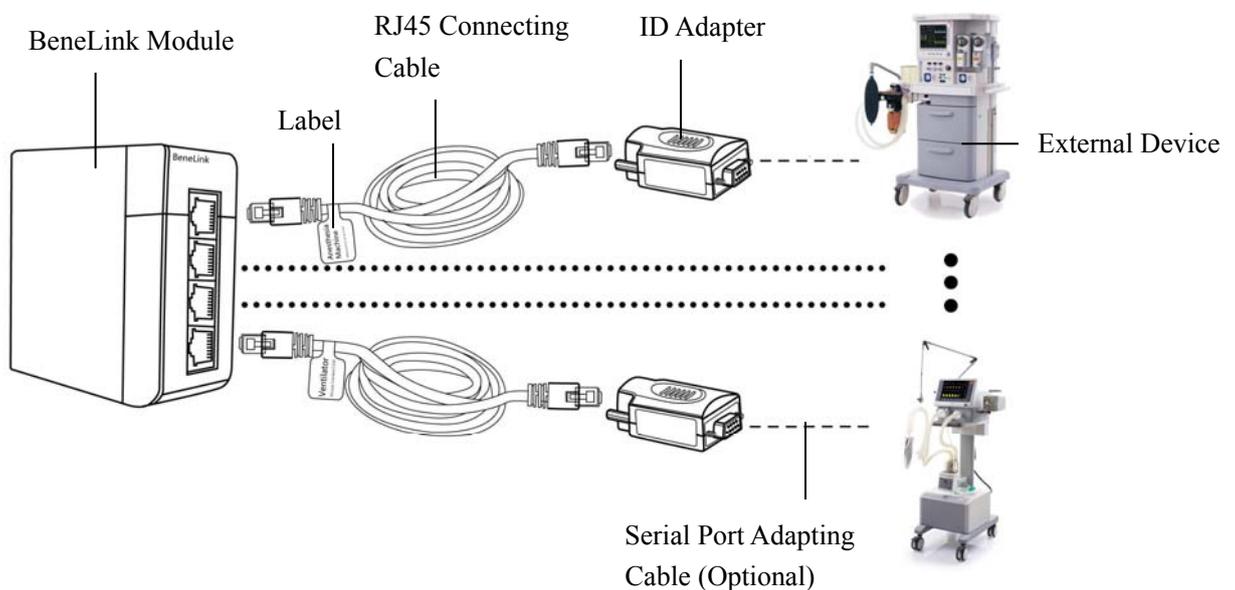
1. Insert the BeneLink module into the module slot on the BeneView patient monitor.

2. Connect the ID adapter that matches the external device to the BeneLink module with a RJ45 connecting cable.

3. Plug the ID adapter into the RS232 port on the external device. Some external devices may have ports incompatible with the ID adapter. In this case, a serial port adapting cable is required. Please be sure that you have selected the proper cable before connection.

4. Stick a label indicating device name to the RJ45 connecting cable at the end nearby the BeneLink module. When the BeneLink module is connected to several external devices, you can tell the devices apart easily with these labels.

5. Switch the external device on.

NOTE

- **Devices of the same category can not be connected to the BeneLink module simultaneously.**

- **Use the serial port adapting cable only with its matching external device. Please see the following table to select the correct adapting cable.**

- **Use the ID adapter only with the matching external device. Please see the following table for correct ID setup in [Factory Maintenance] menu.**

External Device	ID for ID adapter	Type of Serial Port Adapting Cable
Mindray Wato 20/30/55/65	4D52B2AE	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Newport E360	4E50B1B0	Type B
Puritan Bennett 840	SNDF：5042AFBE （recommended） SNDA：5031AFCF（support less parameters than protocol SNDF）	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Maquet Flow-i	4D46B2BA	Type B
Maquet Servo-i/Servo-s	4D53B2AD	Type B
Draeger Evita 2 / Evita 2 dura / Evita 4/ Evita XL	4434BBCC	Type B
Hamilton G5 (protocol Polling)	3550CAB0	Type B
Hamilton C2 (protocol Polling)	3270CD90	Type B
Hamilton Galileo (protocol Polling)	4750B8B0	Type B
Hamilton G5 (protocol Block)	3542CABE	Type B
Ohmeda Avance/Aisys	4F41B0BF	Type D
Ohmeda Aestiva 7100/7900	4F37B0C9	Type D

External Device	ID for ID adapter	Type of Serial Port Adapting Cable
Drager Fabius GS/Plus/Trio	4446BBBA	GS: no need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly. Plus: type C Trio: type C
Drager Primus	4450BBB0	Type C
TCM CombiM/TCM TOSCA	5443ABBD	Type C
TOF-Watch SX	5457ABA9	Type C
Expand Model	/	Type A

3.11.2 Device Integration Function Test

3.11.2.1 Preparation

Prepare the tools needed for function test according to the type of the external device you install. Please see the Instructions for Use of the corresponding external device for guidance. For the function test of ventilator and anesthesia machine, at least the following tools are needed:

- BeneView patient monitor with BeneLink module properly installed
- External device (anesthesia machine or ventilator) under test
- Gas source(tube or gas cylindar), including air or O_2 at least, and N_2O or other anesthesia gases are optional
- Tube that connects the patient(or test lung)
- Test lung and a matching Y-pipe, or other accessories

3.11.2.2 Procedure and Items to Be Checked

Follow the steps below:

1. Connect the BeneLink module to the ventilatior or the anesthesia machine. Plaese see Device Connection and Setup for more details.

2. Connect the gas supply and test lungs to the ventilator or anesthesia machine, turn on the device, and configure as follows:

   ◆ Setup up the serial port of the external device by refering to *Serial Port Configuraion List*.

◆ Setup up the pressure control mode and check if the ventilator or anesthesia machine works normally.

3. Check the ID adapter is correctly configured, and the green indicator of corresponding port on the BeneLink module illuminates constantly.

4. Access [**Devices Integrated**] screen on the patient monitor. Check that the device type (ventilator or anesthesia machine) and ventilation mode are correctly displayed.

5. Select parameters PEEP, Pmean, VTe, MV, I:E, and f(RR) respectively on the patient monitor and check if the parameter values displayed on the patient monitor are consistent with those displayed on the ventilator or anesthesia machine.

6. Re-configure the above parameters on the ventilatior or the anesthesia machine and check if the parameter values displayed on the patient monitor change accordingly.

7. Trigger alarms [**MV Too Low**], [**Airway Pressure Too High**], [**PAW Too High**], [**Peak Too High**], and [**No Gas Supply**] (no Air or O2) on the ventilatior or the anesthesia machine. Check that these alarm messages are correctly recorded in the alarm list of the patient monitor.

8. Switch the ventilator or anesthesia machine to volume control ventilation mode. Check if the ventilation mode displayed on the patient monitor changes accordingly, and if the parameter values of PEEP, Pmean, VTe, MV, I:E, and f(RR) are correctly displayed.

Serial Port Configuration List

External Device	Setup	Remark
Mindray Wato 20/30/55/65	Not required.	If you need to view the parameters of CO2、AG、BIS module in the anesthesia machine, select [**Factory Mainenance>>**] → [**Function Configuration>>**] → [**Select Module**] in standby mode and tick the corresponding module.
Maquet Servo-i Maquet Servo-s	Not required.	The following information is for further reference: Baud Rate: 9600 bps Word Length: 8 bits Parity: even Stop Bits: 1
Draeger Evita 2	Channel A: Not required; Channel B: Protocol: Medibus Baud rate: 19200 Parity: even Stop Bits: 1	/

External Device	Setup	Remark
Draeger Evita 2 dura/ Evita 4/ Evita XL	Protocol: Medibus Baud Rate: 19200 Parity: even Stop Bits: 1 Interval: ---(Evita 2 dura)	/
Newport E360	Protocol: Newport	The following information is for further reference: Baud Rate: 38400 bps Word Length: 8 bits Parity: NONE Stop Bits: 1
Puritan Bennett 840	Baud Rate: 38400 Word Length: 8 bits Parity: NONE	/
Hamilton G5（protocol Polling）	Protocol: Polling.	The following information is for further reference: Baud Rate: 9600 bps Word Length: 7 bits Parity: even Stop Bits: 2
Hamilton C2（protocol Polling）	Protocol: Polling.	The following information is for further reference: Baud Rate: 9600 bps Word Length: 7 bits Parity: even Stop Bits: 2
Hamilton Galileo（protocol Polling）	Not required.	The following information is for further reference: Baud Rate: 9600 bps Word Length: 7 bits Parity: even Stop Bits: 2
Hamilton G5（protocol Block）	Protocol: Block.	The following information is for further reference: Baud Rate: 38400 bps Word Length: 8 bits Parity: none Stop Bits: 1

External Device	Setup	Remark
Ohmeda Avance/Aisys	Not required.	The following information is for further reference: Baud Rate: 19200 bps Word Length: 7 bits Parity: odd Stop Bits: 1
Ohmeda Aestiva 7100 /7900	Not required.	The following information is for further reference: Baud Rate: 19200 bps Word Length: 7 bits Parity: odd Stop Bits: 1
Drager Fabius GS/Plus/Tiro	Protocol: Medibus Baud Rate: 9600 Word Length: 7 bits Parity: even Stop Bits: 1	/
Drager Primus	Protocol: Medibus Baud Rate::9600 Word Length: 8 bits Parity: even Stop Bits: 1	/
TCM CombiM/TCM TOSCA	Protocol: Monlink.	The following information is for further reference: Baud Rate: 9600 bps Word Length: 8 bits Parity: even Stop Bits: 1
TOF-Watch SX	Not required.	The following information is for further reference: Baud Rate: 19200 bps Word Length: 8 bits Parity: none Stop Bits: 1

3.11.3 Installation and Test Report

Basic Information			
Hospital		Department	
Serial number of ID adapter		Name of the external device	
ID of the external device		Type of serial port adapting cable	
Software version and other information of the external device			

Checking the connection	Test Result （Yes/No）
Can the patient monitor and the external device be assembled together using designated accessories?	
Does the green indicator of corresponding port on the BeneLink module illuminate while the other indicators are not?	
Are there numerics or characters displayed on the [**Devices Integrated**] screen of the patient monitor?	
Are the device type and parameter values displayed correctly on the [**Devices Integrated**] screen of the patient monitor when the external device just enters working mode?	
Is the ventilation mode correctly displayed on the patient monitor? Does it change correctly when the ventilation mode on the external device is changed?	

Checking the parameters			
Parameters on the external device	**Value**	**Parameters on the patient monitor**	**Value**
PEEP		PEEP	
Pmean		Pmean	
VTe		VTe	
f (RR)		f (RR)	
Ppeak		Ppeak	

Checking the alarms		
Alarm	**Alarm messages displayed on the external device**	**Alarm messages displayed in the alarm list of the patient monitor**
RR Too High		
Apnea		
Patient Disconnected		

3.12 Battery Check

Tools required:

■   None.

Function Test

1.   If the patient monitor is installed with batteries, remove the batteries first.

2.   Verify that the patient monitor works correctly when running powered form an AC source.

3.   Insert two batteries per the procedures provided in the Operator's Manual.

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

5.   For T5 only: Remove one battery and verify that the patient monitor continues to work correctly. Verify that the patient monitor can also work independently from another battery.

Performance Test

Perform the test by referring to the *Battery* chapter in the Operator's Manual and verify the operating time of the battery meets the product specification.
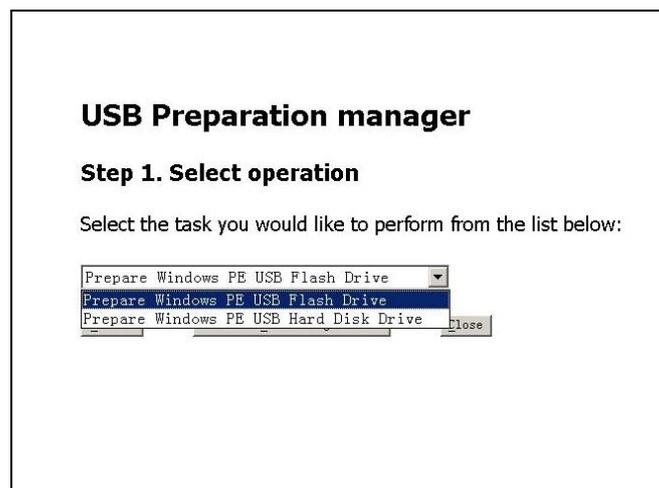
3.13 iView System Maintenance(for T8 and T9 monitors only)

3.13.1 Making USB Startup Disk

Tools required:

- MakeUSB (PN: 110-002149-00)
- USB drive with capacity greater than 4G

1. Insert the USB drive into PC.
2. Run "prepareUSB.hta" file in the folder of MakeUSB.
3. Select [**Prepare Windows PE USB Flash Drive**] in the drop-down list, and select [**Next>**].

4. Select the drive label of the USB drive in the drop-down list, and configure [**Format USB-drive？**]. [**Select Ghost Image file to use**] is unselected by default. Then select [**Next>**].

5. Select [**Prepare USB>**] to start making the startup disk. The system selects [**Full mode**] and [**Manual mode**] by default.

6. Select [**Close**] to finish.
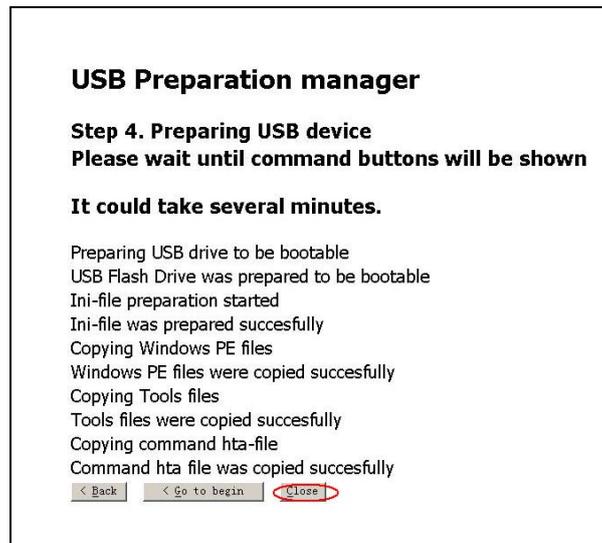
3.13.2 Restoring the System

Connecting the External USB Cable

Connect the iView maintenance USB disk which stores the system image files and keyboard to the USB connectors special for iView maintenance.

Setting BIOS Screen

1. Start up the patient monitor and press [**F2**] key repeatedly on the keyboard.

2. Select [**Main Menu**] → [**Maintenance>>**] → [**User Maintenance>>**] → enter the required password → [**iView Maintenance>>**] → [**iView Maintenance**], and when the system switches to BIOS setup screen, stop press [**F2**] key.

3. Move the cursor to [**Boot**] by pressing [←] or [→] keys on the keyboard. Then press [**Enter**] on the keyboard.

4. Move the cursor to [**1st Boot**], and press [**Enter**] on the keyboard.

5. Select [**USB**] and press [**Enter**] on the keyboard.

6. Move the cursor to [**Save&Exit**], and press [**Enter**] on the keyboard. Move the cursor to [**Yes**] and press [**Enter**] on the keyboard to save the setup.

Restoring the system

To recover the iView system, operate according to the following steps:

1. Start iView system, and press [**F2**] to enter BIOS. Select [**Maintanence>>**] → [**User Maitanence >>**] → enter the required password → [**iView Maitanence>>**]→ [**iView Setup**], and enter the following screen.
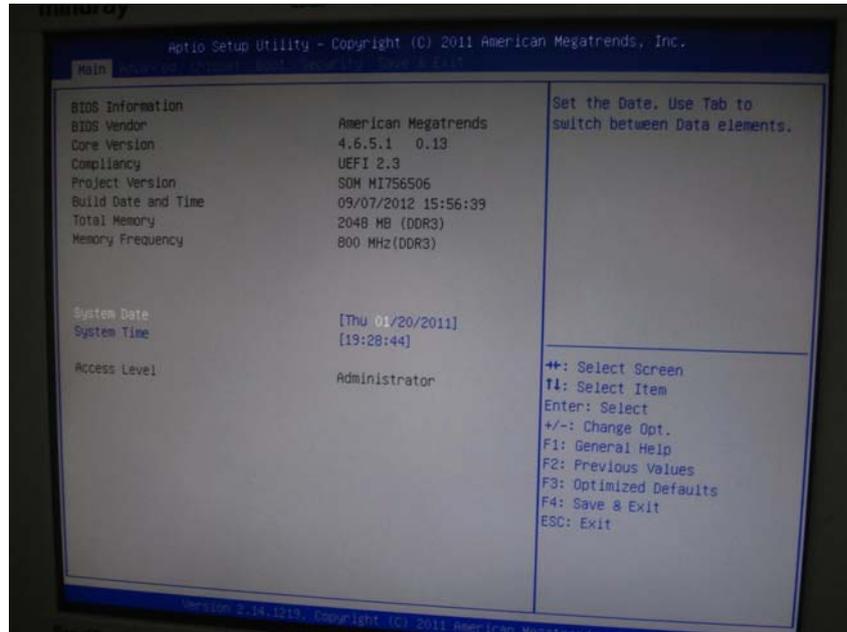
2. Select [**Boot**] in the menu bar, and then select option of [**1st Boot**] in the submenu. Press enter key, and select [**USB**] in the popup window.
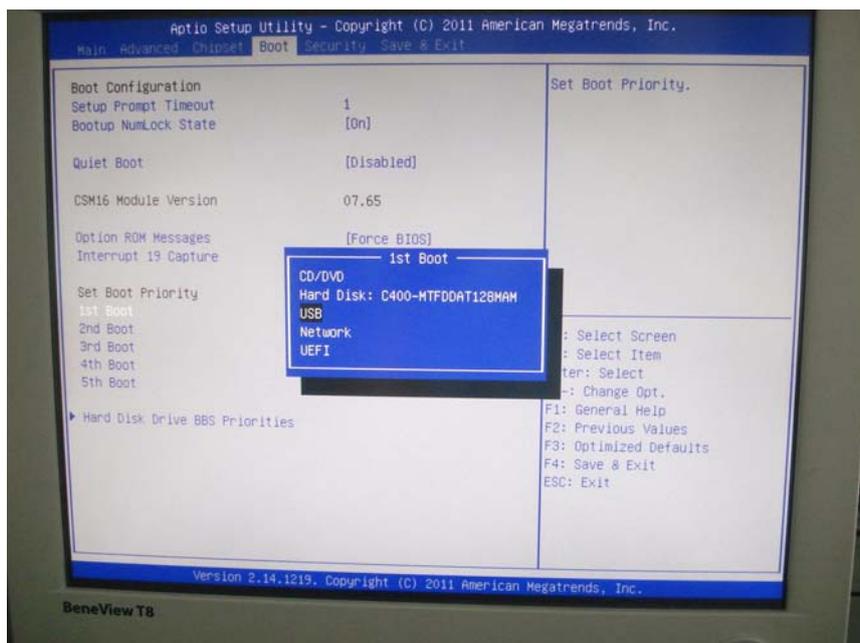
3. Select [**Save&Exit**] in the menu bar. Then select the option of [**Save Changes and Exit**] in the submenu and press [**Enter**] key. After that, select [**Yes**] to exit.
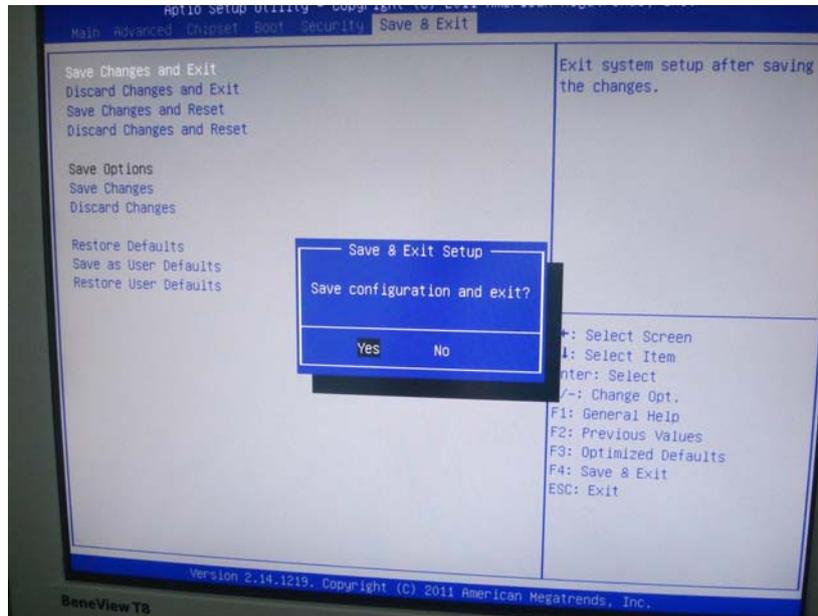
4. Insert the USB disk for iView maintanence (P/N: 115-017183-00) into the special USB connector for iView system on the back housing of BeneView T8. The following screen displays. Click the arrow, and the drop-down list will show. Select [**Ghost image to disk**] from the list. Click [**Next**].
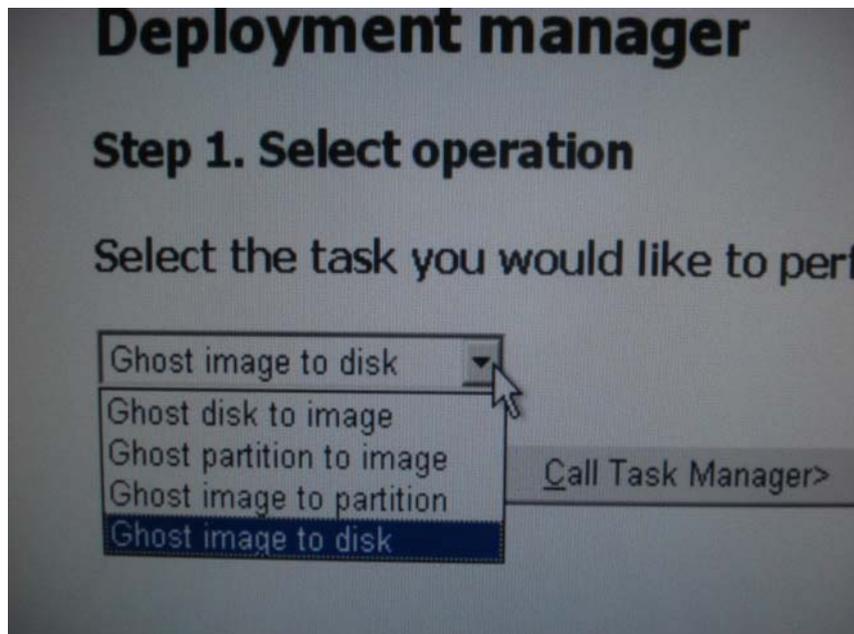
5. Click [**File**] as shown in the below figure, and then choose the image file path of the system. Click [**OK**]. Then select [**Next**].
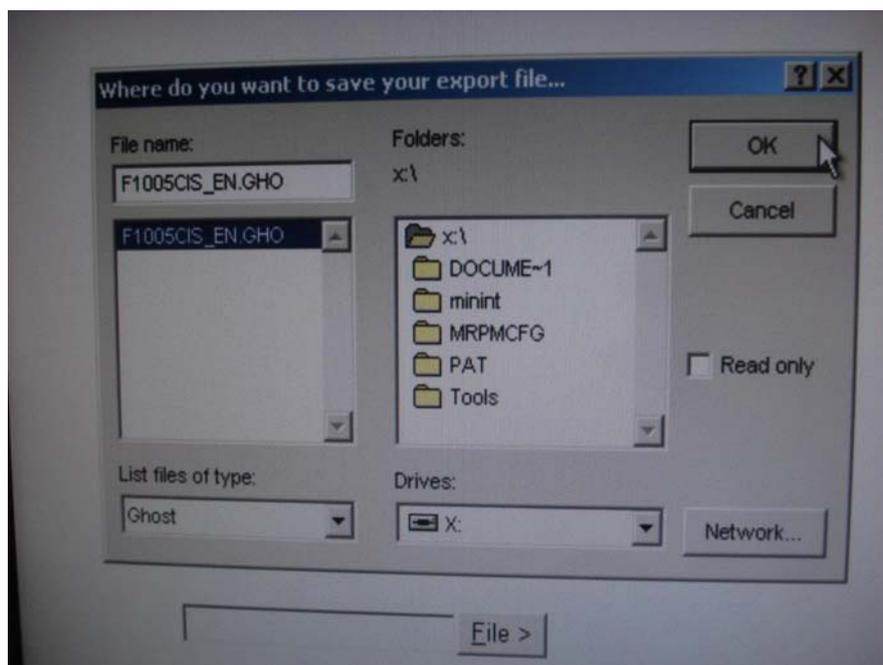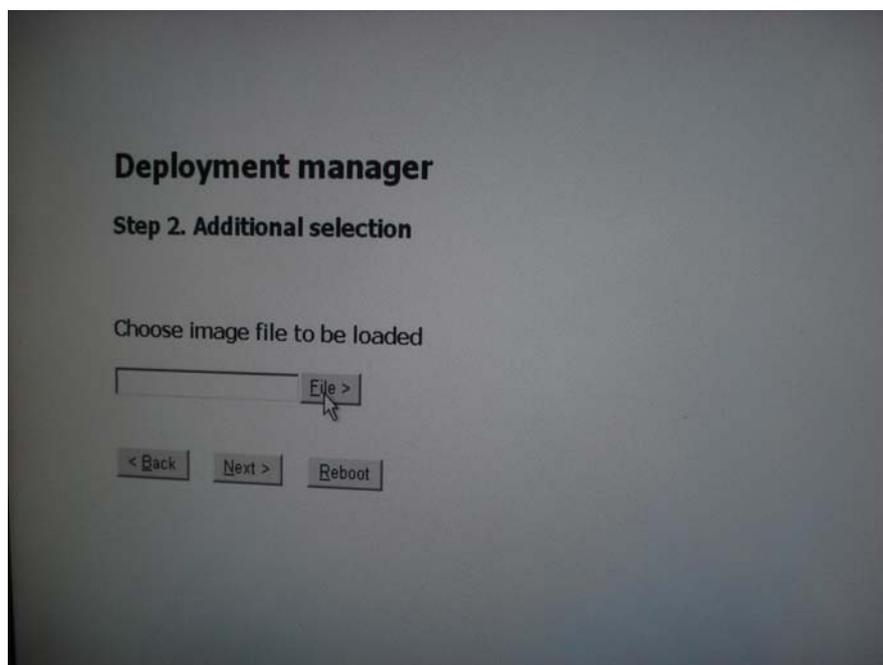
6.   Select [**Run>**], and start to recover the system with image files.
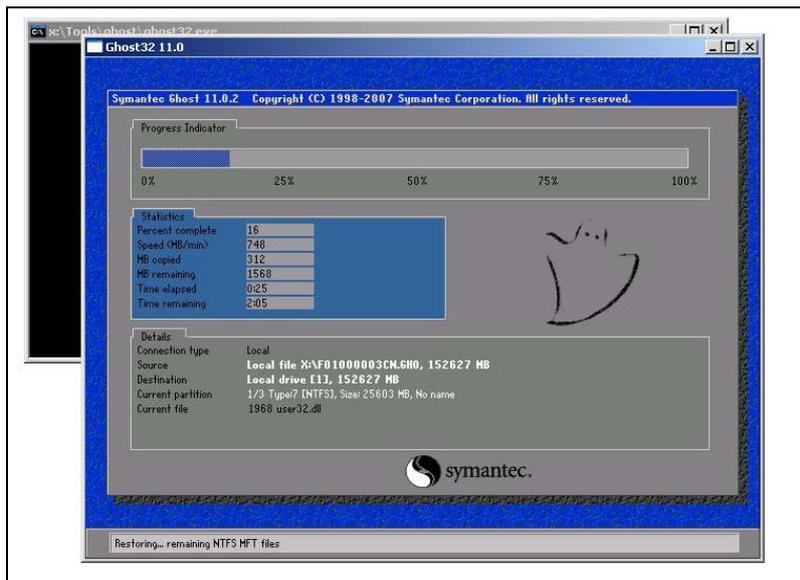
7. The system recovery finishes.

Click [**OK**], and then click [**Reboot**]. When the monitoring screen of BeneView T8 displays, remove iView maitanence USB disk. The system will restart and enter Windows 7 system. A prompt to actiavate WIN7 will display.

8. Start the activation of Windows 7 system and enter the following screen.
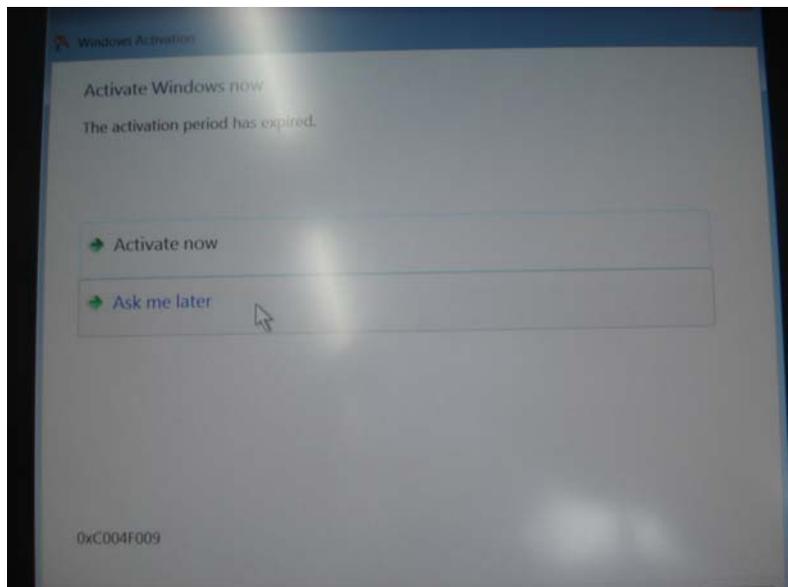
9. Input the key number.
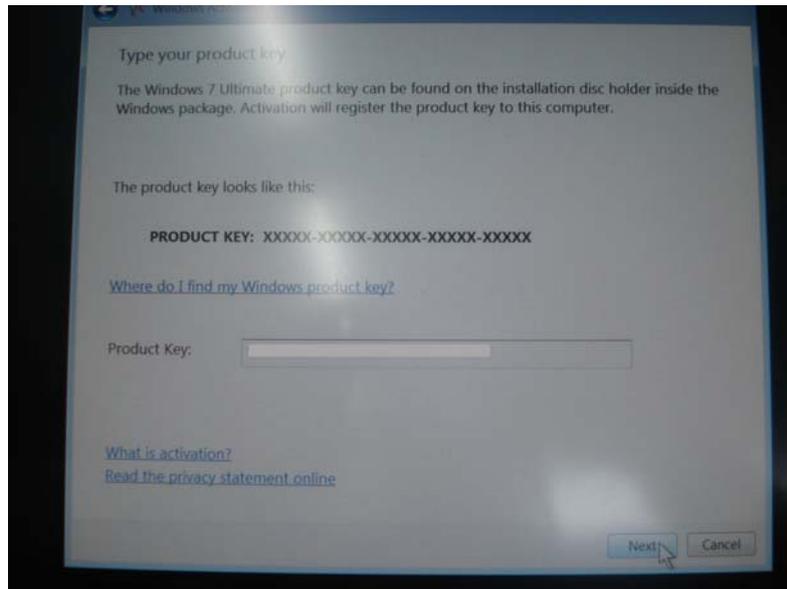
3.13.3 Setting Automatic Login

iView system is set to be automatically logged in by default. However, if the registry is modified, which leads to a manual login required, you can restore to the automatic login by doing followings:

1. Select [**Run**] in the [**Srart**] menu of Windows system.

2. Input 'regedit' command, and then click [**OK**]. The [**Registry Editor**] window will pop up.

3. In the [**Registry Editor**] window, find out the following three value entries by the path of HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon. Check and change (if necessary) the value according to what is shown below (the value is case sensitive).

    ◆ "AutoAdminLogon" = "1"

    "DefaultUserName" = "CIS"

    "DefaultPassword" = "MINDRAY"

If some value entry does not exist of the above listed three items, you have to create a corresponding one: click the right button of mouse, select [**New**] → [**String Value**], and input the string as the name of the new value entry, also input the correct value.

3.14 Factory Maintenance

3.14.1 Accessing Factory Maintenance Menu

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

The [**Factory Maintenance**] menu is shown below.
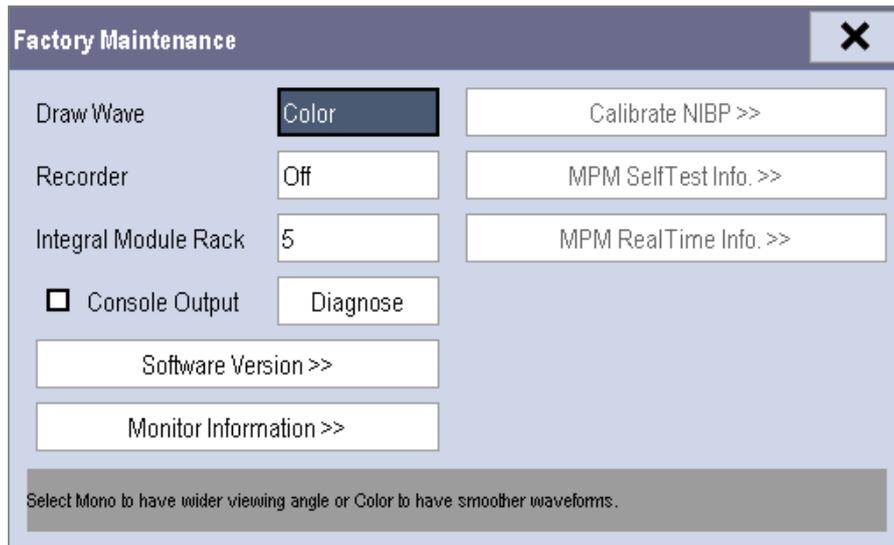
3.14.2 Drawing Waves

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

■ Color: selecting Color will have smoother waveforms.

■ Mono: selecting Mono will have a wider viewing angle.

3.14.3 Recorder

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

⚠CAUTION

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

3.14.4 Software Version

Selecting [**Software Version**] will show software version information. The [**Software Version**] menu is as follows:
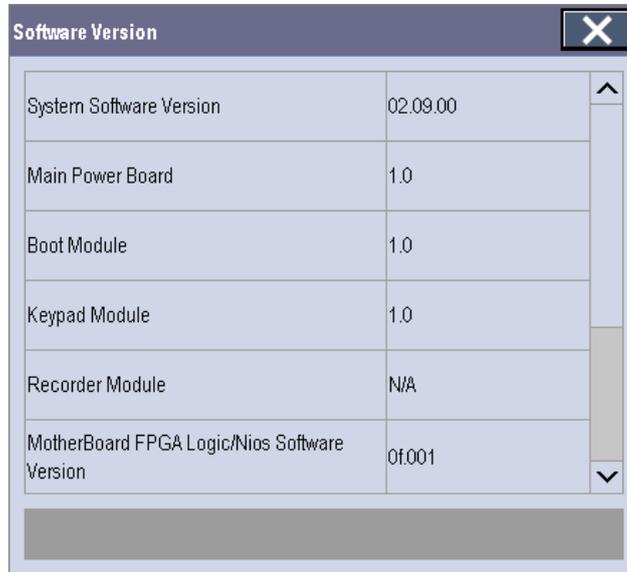
Software Version	
System Software Version	02.09.00
Main Power Board	1.0
Boot Module	1.0
Keypad Module	1.0
Recorder Module	N/A
MotherBoard FPGA Logic/Nios Software Version	0f.001

3.14.5 Monitor Information

Selecting [**Monitor Information**] will show the status of the patient monitor. Monitor information is displayed as follows:
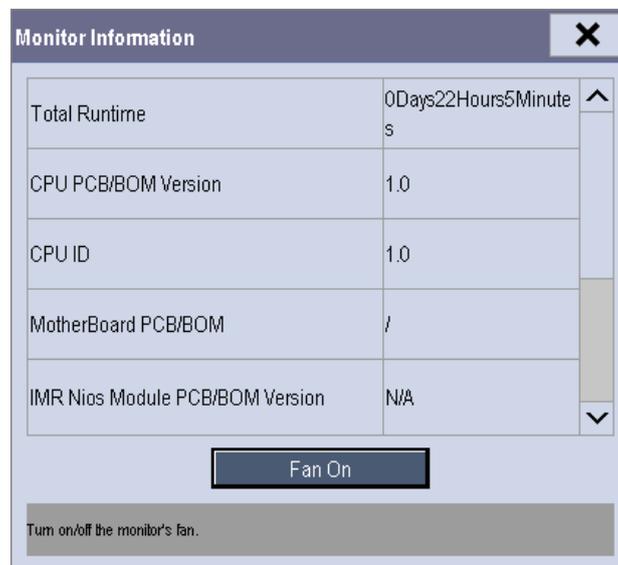
Monitor Information	
Total Runtime	0Days22Hours5Minutes
CPU PCB/BOM Version	1.0
CPU ID	1.0
MotherBoard PCB/BOM	/
IMR Nios Module PCB/BOM Version	N/A

Fan On

Turn on/off the monitor's fan.

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, knob, SMR, modules, 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 6mmHg/min.		
Temp test		
The value displayed for each Temp channel of the monitor is within 37±0.1ºC.		
IBP test		
The static pressure value displayed for each IBP channel is within 200±2 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±0.1ºC.		
The displayed C.O. value is within 5±0.25L/min.		
Mainstream CO$_2$ test		
The mainstream CO$_2$ is zeroed successfully and the waveform baseline recovers to zero.		
CO$_2$ Apnea alarm behaves correctly.		
The displayed CO$_2$ value is within $6\pm0.05\%$.		

Sidestream CO$_2$ test		
Block the gas inlet of the module or watertrap. The sidestream CO$_2$ flowrate 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 within 6 ± 0.05％.		
Miscrostream CO$_2$ test		
Block the gas inlet of the module or watertrap. An alarm of CO$_2$ Filterline Err is given. It indicates that there is no leakage.		
The displayed CO$_2$ value is within 6 ± 0.05％		
AG test		
When AG flowrate is slower than 10ml/min, an alarm of AG Airway Occluded is given. It indicates that there is no leakage.		
The fan inside the AG module works properly.		
The measurement accuracy of CO$_2$, N$_2$O, O$_2$ and AA (AA represents an anaesthetic agent) meets the product specifications in the Operator's Manual.		
ICG test		
The measured results are as follows: HR=60±2 bpm, VI=61±4/1000s, TFC=32±2/kOhms.		
The measured results are as follows: HR=70±2 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms.		
BIS test (you can select either method to perform the test)		
Method 1: The BIS value measured on healthy, wide-awake adult is within 80-100.		
Method 2: Connect to the BIS simulator to perform a cyclic impedance check. The EEG wave and BIS numeric are displayed on the monitor.		
RM test		
The displayed TV is within 500±50ml and RR is within 20±1rpm.		
CCO/SvO$_2$ test		
The CCO/SvO$_2$ numerics displayed on the patient monitor and Vigilance monitor are consistent.		
The waves (at the ECG signal output port) displayed on the oscillograph are consistent with the ECG calibration waves displayed on the monitor screen.		

The amplitude of electrical level at the signal output port of MAP, CVP and SpO_2 are 5±0.25V, 5±0.25V and 10±0.5V respectively.		
PiCCO test		
The detected catheter type accords with the setting of the Pulsion Calbox, and the measurement errors of TB and TI are within ±0.1℃.		
The displayed static pressure values of pArt and pCVP are no more than (200±2) mmHg.		
The waveforms of pArt and pCVP are displayed correctly.		
$ScvO_2$ test		
The accuracy of $ScvO_2$ measurements is (50±3)% and (80±3)%.		
NMT test		
The measurement of [**PK-PK**] is between 54V and 66V. The The measurement of [**+Width**] is between 270us to 330us.		
The message "Test passed. The function of NMT sensor is OK" is presented if sensor check completes successfully.		
EEG test		
The result of sensor check is pass, and EEG measurements are displayed on the monitor.		
Nurse call relay performance test		
The relay contacts are close when an alarm occurs.		
Analog output performance test		
The waves displayed on the oscillograph are identical with those displayed on the monitor.		
Electrical safety tests		
Refer to *A Electrical Safety Inspection*. All the electrical safety tests should be passed.		
Touchscreen calibration		
The touchscreen is calibrated successfully.		
Recorder check		
The recorder can print ECG waves correctly and the printout is clear.		

Set the recorder to some problems such as out of paper, paper jam, etc. the monitor gives corresponding prompt messages. After the problem is removed, the recorder is able to work correctly.		
Automatic alarm recording for each parameter functions correctly when parameter alarms occur.		
Network print test		
The network printer can print out ECG reports correctly.		
Device integration check		
[**Devices Integrated**] window can display the type of the external device, ventilation mode, and corresponding parameters normally.		
Battery check		
The monitor can operates correctly from battery power when an AC power failure accidentally occurs.		
T5 patient monitor can operate independently on a single battery.		
The operating time of the battery meets the product specification.		

4 Troubleshooting

4.1 Introduction

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 the troubles.

The troubles we list here are frequently arisen difficulties and the actions we recommend can correct most problems, but not all of them. For more information on troubleshooting, contact our Customer Service Department.

4.2 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 *5 Repair and Disassembly* to replace the PCB with a known good one and check that the trouble disappears or the patient monitor passes all performance tests. If the trouble remains, exchange the replacement PCB with the original suspicious PCB and continue troubleshooting as directed in this chapter. Defective PCB can be sent to us for repair.

To obtain information on replacement parts or order them, refer to *6 Parts.*

4.3 Patient Monitor Status Check

Some troubleshooting tasks may require you to identify the hardware version and status of your patient monitor.

1. To view the information on system start time, self check, etc., select [**Main Menu**]→ [**Maintenance >>**]→[**Monitor Information >>**].

2. You can also view the information on the monitor's current status by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→enter the required password →[**Monitor Information >>**].

4.4 Software Version Check

Some troubleshooting tasks may require you to identify the configuration and software version of your patient monitor.

1. To view information on the system configuration and system software version, Select [**Main Menu**]→[**Maintenance>>**]→[**Software Version>>**].

2. You can also view the information on system software version and module software version by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→ enter the required password →[**Software Version>>**].

4.5 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 message, possible cause and corrective action, refer to the patient monitor's Operation Manual.

4.6 Troubleshooting Guide

4.6.1 Power On/Off Failures

Symptoms	Possible Cause	Corrective Action
The patient monitor fails to start. AC LED or battery LED does not light	AC mains not connected or battery too low	Check that AC mains is properly connected or battery capacity is sufficient.
	Power supply protection	Refer to *4.6.9 Power Supply Failures* .
	Cables defective or poorly connected	1. Check that the cables from power switch & LED board to button board, button board to main board, and power module to main board are correctly connected. 2. Check that cables and connectors are not damaged.
	Power switch & LED board defective	Replace the power switch & LED board.
	Power module defective	Replace the power module.
	Mother board Defective	Replace the mother board.

4.6.2 Display Failures

Symptoms	Possible Cause	Corrective Action
Integrated display is blank but the patient monitor still works correctly.	Cables defective or poorly connected.	1. Check that cables from the display to the mother board and from the backlight board to the button board/display are correctly connected. 2. Check that the cables and connectors are not damaged.
	Backlight board defective	Replace the backlight board.
	Power module defective	Replace the power module.
	Display defective	Replace the display.
Secondary display does not function.	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
Secondary display displays snows or flashing specks	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
	The mother board is damaged.	Replace the mother board.
Images overlapped or distorted	FPGA error.	Update or upgrade FPGA.
	Cables defective or poorly connected.	1. Check that the cable between the display and mother board is correctly connected. 2. Check that the cables and connectors are not damaged.
Touchscreen does not response	Touchscreen disabled	Check if there is a symbol 🔒 shown above the [**Main Menu**] QuickKey. If yes, press the [**Main Menu**] QuickKey for more than 3s to enable the touchscreen.

	Cables defective or poorly connected.	1. Check that the cables from the touchscreen to the touchscreen control board, the touchscreen control board to the button board, and the button board to the mother board are correctly connected. 2. Check that the cables and connectors are properly connected
	Touchscreen control board defective	Replace the touchscreen control board
	Button board defective.	Replace the button board.
	Touchscreen defective.	Replace the touchscreen
	Mother board defective	Replace the mother board
Touch position invalid	Touchscreen not calibrated	Calibrate the touchscreen

4.6.3 Module Rack Failures

Symptoms	Possible Cause	Corrective Action
SMR		
SMR cannot identify parameter modules	Extension Cable defective or poorly connected	1. Check that the cable between SMR and main unit is properly connected 2. Check that the connecting cables and connectors are not damaged. 3. Check that contact screws on SMR are tightly screwed and properly contact the SMR.
	Defective parameter module	Replace the suspicious parameter module with a known good module. Check if the patient monitor identifies the replacement module. If yes, it means that the original one is defective.
	Wrong communication board software revision	Upgrade the program of the module or SMR.
	Module (in some slots) unrecognized	1. Replace the Nios II module. 2. Replace the 8-slot module rack communication board.

	Power supply failure	1. Check if the voltage between two contact screws in any slot reaches 12V DC. If yes and the parameter module functions, the PCB assembly in SRM might fail. 2. If there is no 12 V sent to the SMR, check that the power module output voltage to the USB interface board reaches 12V. If yes, the fuse on the USB interface board might blow. Replace the USB interface board.
	Cable defective or poorly connected	1. Check that the cable between SMR interface board and communication board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Nios II module loose or failure	1. Check that Nios II module is correctly plug ed 2. If the symptom persists, replace the Nios II module.
	SMR interface board failure	Replace the SMR interface board.
	SMR communication board failure	Replace the SMR communication board.
	USB interface board failure	Replace the USB interface board.
	Mother board failure	Replace the mother board.
Integral module rack		
Integral module rack cannot identify parameter modules	Module failure	Replace parameter module. If a new module is identified, the original one is defective.
	Cable defective or poorly connected	1. Check that the cables from 3-slot module rack communication board to MPM module rack communication board, module rack to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Wrong communication board software revision	Upgrade the program of the module or Integral module rack.
	Module (in some slots) unrecognized	Replace the corresponding module rack communication board.

	Power supply to integral module rack abnormal	1. Check if voltage between two contact screws in any slot reaches 12VDC. If yes and the parameter module functions, PCB assembly in the SMR might fail. 2. If there is no 12V sent to the integrated module rack, check that power module output voltage to mother board reaches 12V DC. If yes, mother board might fail.
	3-slot or MPM module rack communication board failure	Replace the 3-slot or MPM module rack communication board.
	Nios II module failure	Replace the Nios II module.
	Mother board failure	Replace the mother board.

4.6.4 Alarm Problems

Symptoms	Possible Cause	Corrective Action
The alarm lamp is not light or extinguished but alarm sound is issued	Cable defective or poorly connected	1. Check that cables from alarm LED board to button board and button board to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Alarm LED board failure	Replace the alarm LED board.
	Button board failure	Replace the button board.
	Mother board failure	Replace the mother board.
No alarm sound is issued but alarm lamp is light	Audio alarm disabled	Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Alarm Setup >>**], and then in the popup menu, set [**Minimum Alarm Volume**] to appropriate setting. In the [**Others**] window of the [**Alarm Setup**] menu, set [**Alm Volume**] to appropriate setting.
	Cable defective or poorly connected	1. Check that cable between speaker and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	FPGA audio logic error	Upgrade the audio logic part of the FPGA program.
	Speaker failure	Replace the speaker.
	Mother board failure	Replace the mother board.

4.6.5 Button and Knob Failures

Symptoms	Possible Cause	Corrective Action
Buttons do not work	Cable defective or poorly connected	1. Check that cable between button board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Button board failure	Replace button board.
Knob does not work	Cable defective or poorly connected	1. Check that cables from knob to button board, and button board to mother board are properly connected 2. Check that connecting cables and connectors are undamaged.
	Knob failure	Replace the knob encoder.
	Button board failure	Replace the button board

4.6.6 Recorder Failures

Symptoms	Possible Cause	Corrective Action
No printout	Recorder module disabled	1. Check if the recorder status LED lights 2. If yes, enable the module in [**Factory Maintenance>>**] menu. Otherwise, check for other possible causes.
	Paper reversed	Re-install the paper roll.
	Cable defective or poorly connected	1. Check that cable between recorder and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Recorder power supply failure	Check if the power module outputs 5 V DC and 12V DC correctly.
	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. Check the thermal print head and the paper roller for foreign matter. 2. Clean the thermal print head with an appropriate clean solution.
	Print head failure	Replace the print head.
	Recorder failure	Replace recorder.

4.6.7 Interface Failures

Symptoms	Possible Cause	Corrective Action
No analog signals or nurse call signals are issued	Respective output disabled	1. Select [**Main Menu**]→[**Analog Output Setup**]→set [**Analog Output**] to [**On**].
	DVI interface board cable loose	1. Check that cable between DVI interface board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	DVI interface board failure	Replace the DVI interface board.
	Mother board failure	Replace the mother board.
Device with USB port does not function (Assume that the peripheral devices are good)	Cable defective or poorly connected	1. Check that cable between USB interface board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	USB interface board failure	Replace the USB interface board.
	Mother board failure	Replace the mother board.

4.6.8 CF Card Problems

Symptoms	Possible Cause	Corrective Action
CF card malfunctions	Wrong CF card or small memory space	Use only SanDisk-manufactured CF storage cards. Those with 4GB memory space are recommended.
	CF card full; data error; CF card error	Format CF card on PC.
	CF card failure	Replace the CF card.
	Cable defective or poorly connected	1. Check that the cable between CF card board and mother board is correctly connected. 2. Check that connecting cables and connectors not damaged.
	CF card board failure	Replace the CF card board.
	Mother board failure	Replace the mother board.

4.6.9 Power Supply Failures

Symptoms	Possible Cause	Corrective Action
Different battery voltages	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable between battery interface board and power module is correctly connected. 2. Check that cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery capacity is too low	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable is correctly connected. 2. Check that connecting cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery cannot be recharged	Battery failure	Replace battery and recharge the replacement battery. If the replacement battery can be recharged, the original one fails.

	Cable defective or poorly connected	1. Check that cable between battery interface board and power module is correctly connected.
		2. Check that cables and connectors are not damaged.
	Power board failure	Replace power board
No +3.3 V output	Power supply protection	1. Turn off the monitor then restart it.
No +5.0 V output	Power board failure	2. If the problem remains, disconnect the AC mains for 5 s and reconnect it, then restart the patient monitor.
No +5.0 V CIS output		
No +12 V output		3. If the problem still remains, replace power board.

NOTE

- **When the power module has a failure, it may cause problems to other components, e.g. the monitor suddenly breaks down during start-up, as the power module may have a power supply protection. In this case, troubleshoot the power module per the procedure described in the table above.**

- **Components of the main unit, SMR and parameter modules are powered by the power module. In the event that a component malfunctions, check if the operating voltage is correct. Refer to 2 Theory of Operation for the operating voltage and measurement points of each component.**

4.6.10 Network Related Problems

Symptoms	Possible Cause	Corrective Action
The patient monitor cannot be connected to iView system.	No connection to LAN	1. Check that the cables and connectors are in good condition and that the network is correctly connected. 2. Check that the hub or switch is correctly configured.
	iView assembly failure	1. Restart the patient monitor; check that a beep is heard. 2. After starting, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**] → enter the password required→[**iView Maintenance>>**]. The [**iView Setup**] option shall be enabled and switching between normal monitor screen and iView screen is possible. 3. If step 1 and 2 fail, check if the power supply to the iView assembly is correct. If the power supply works correctly, replace the iView assembly.
	DVI interface board failure	Replace DVI interface board.
Frequent dropouts and network disconnects	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 m.
	Incorrect IP address configuration	Check for IP address conflict. Reconfigure IP address.
The patient monitor is connected to a LAN but cannot view other patients under the View Others mode	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50m.
	Excessive requests for viewing the patient monitor at the same time	A patient monitor can only be viewed by 4 other patient monitors at the same time under the View Others mode. The excessive view requests system will be ignored.
	Incorrect IP configuration	Check for IP address conflict. Reconfigure IP address.
	iView assembly failure	Replace iView assembly.

4.6.11 Software Upgrade Problems

Symptoms	Possible Cause	Corrective Action
Boot file upgrade fails	Power failure or unintended power off during boot file upgrade	Return the CPU board to factory for repair.
Program upgrade fails	Incorrect network connection	1. Check that network connector, not iView network connector, on the patient monitor is used. 2. Make sure that the hub or switch run normally. Check that net twines are of the right type and have been connected correctly.
	Wrong upgrade package has been downloaded	Upgrade package shall be .pkg files. Select package according to system requirement.
	Incorrect IP address configuration	Configure a fixed IP address in range C as specified for the patient monitor. We recommend not to upgrade a program when the patient monitor is connected to a network with multiple PCs.

4.6.12 Technical Alarm Messages

Please refer to the Operator's manual.

4.6.13 M51A Self Test Information

New MPM module applies the integrative parameter board (ECG ASIC).

MPM Selftest Item	Test Value	Test Value (New MPM module)	Corrective Action
DSP selftest information	Not F		
7024 selftest information	Not 7F		
2131 selftest information	Not 1F	Not FF	Replace the module
ECG module selftest information	Normal value：7 for 3/5 lead module; FF for 12-lead module		

4.6.14 Device Integration Failures

Symptoms	Possible Cause	Corrective Action
The [**Devices Integrated**] window displays nothing after connection.	The ID adapter is not compatible with the external device.	1. Replace the ID adapter. 2. Upgrade the ID adapter in [**Factory Maintenance**] menu to make the ID adapter match the corresponding external device. See *3.11.1 Device Connection and Setup* for more about the setup of the ID.
	The serial port adapting cable is not compatible with the external device.	Replace the serial port adapting cable.
	Wrong software version or wrong protocol version of the external device.	Make sure the protocol version and software version are supported by the BeneLink module.
Generate the alarm: [**BeneLink Comm Stop**].	The application of the BeneLink module is damaged.	Update or upgrade the application of the BeneLink module with the network upgrading tool.
The patient monitor has no response when loading the ID adapter.	The application of the BeneLink module is damaged.	Update or upgrade the application of the BeneLink module with the network upgrading tool.
	The kernel or the document system of the BeneLink module is damaged.	Return the BeneLink module to factory for repair.

FOR YOUR NOTES

5 Repair and Disassembly

5.1 Tools

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

- Phillips screwdrivers
- Small flat-bladed screwdrivers
- Contact spanner
- Tweezers
- Sharp nose pliers
- Sleeve

5.2 Preparations for Disassembly

Before disassembling the monitor, finish the following preparations:

- Stop monitoring the patient, turn off the monitor and disconnect all the accessories and peripheral devices.
- Disconnect the AC power source and take out both of the batteries.
- Pull off all the modules in the integral module rack. If the SMR is connected, disconnect the SMR from the monitor and then remove all the modules in it.

⚠WARNING

- **Before disassembling the monitor, be sure to eliminate the static charges first. When disassembling the parts labeled with static-sensitive symbols, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**
- **Put the cables or wires in place when reassemble the monitor to avoid short circuit.**
- **When assembling the monitor, be sure to select proper screws. If an unfit screw is tightened by force, the monitor may be damaged and the screw or the part may fall off during use to cause unpredictable damage or human injury.**
- **Be sure to follow the correct sequence to disassembly the monitor. Otherwise, the monitor may be damaged permanently.**
- **Be sure to disconnect all the cables before disassembling any parts. Be sure not to damage any cables or connectors.**
- **Be sure to place the monitor face up when disassembling it. Otherwise, the screen or the knob may be scratched or damaged.**

5.3 Basic Disassembly

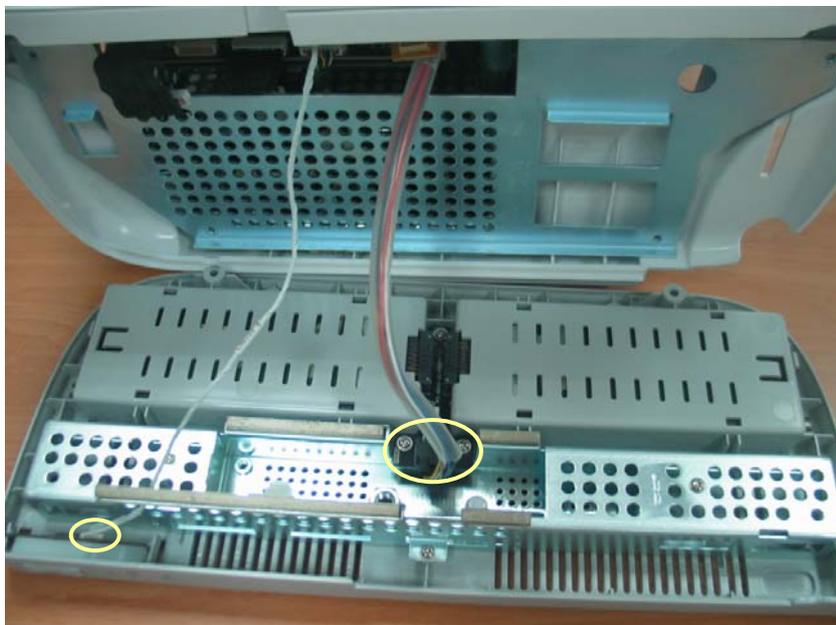## 5.3.1 Disconnecting the Base

NOTE

- **Be sure to disassemble the base first before proceeding with other parts.**

- **Be sure to place the monitor face up when disassembling it. If lay the monitor face down, be sure the surface is non-abrasive and static-free. Otherwise, the screen or the knob may be scratched or damaged.**

1. The hook that prevents the power plug off is located beside the AC port in the rear case of the monitor. Remove this hook and then place the monitor face up and unscrew the four M4×12 screws, as shown in the figure below.

2. Pull out the base and then unplug the two cables marked in the picture, one connecting the Power Switch & LED board and the button board, and the other connecting the battery interface board and the power supply assembly.

NOTE

● **Exercise care when pulling the base out. Be sure not to damage the cables and connectors.**

5.3.2 Separating the Front and Rear Half of the Monitor

1. Keep the monitor (without the base) face up. Disconnect the cables marked in the picture, one connecting the LCD panel and the mother board, and the other connecting the button board and the mother board.
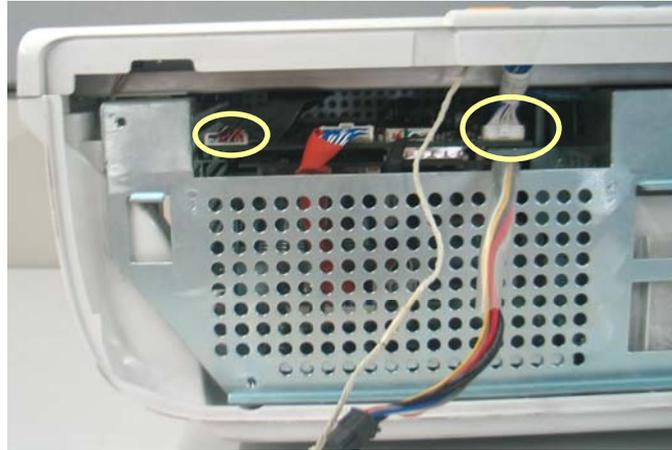
NOTE

● **Release the clip before disconnecting the cable between the button board and the mother board.**

2. Carefully place the monitor face down. Pry up the four screw covers with a small flat-bladed screwdriver and unscrew the four M3×12 screws exposed. Then unscrew the M3×12 screw in the handle.

Avoid pressing the knob on the table.

NOTE

- **Press the cover with a thumb when prying it.**
- **Avoid pressing the knob on the table.**

3. Lift the rear cover assembly to separate it from the front cover assembly.

（T6/T8 front housing assembly） 　　　　（T9 front housing assembly）

(Rear housing assembly)

4. For T9 monitor, unscrew the four M3×6 screws and lift the middle frame upward to separate the front housing assembly from the middle frame.
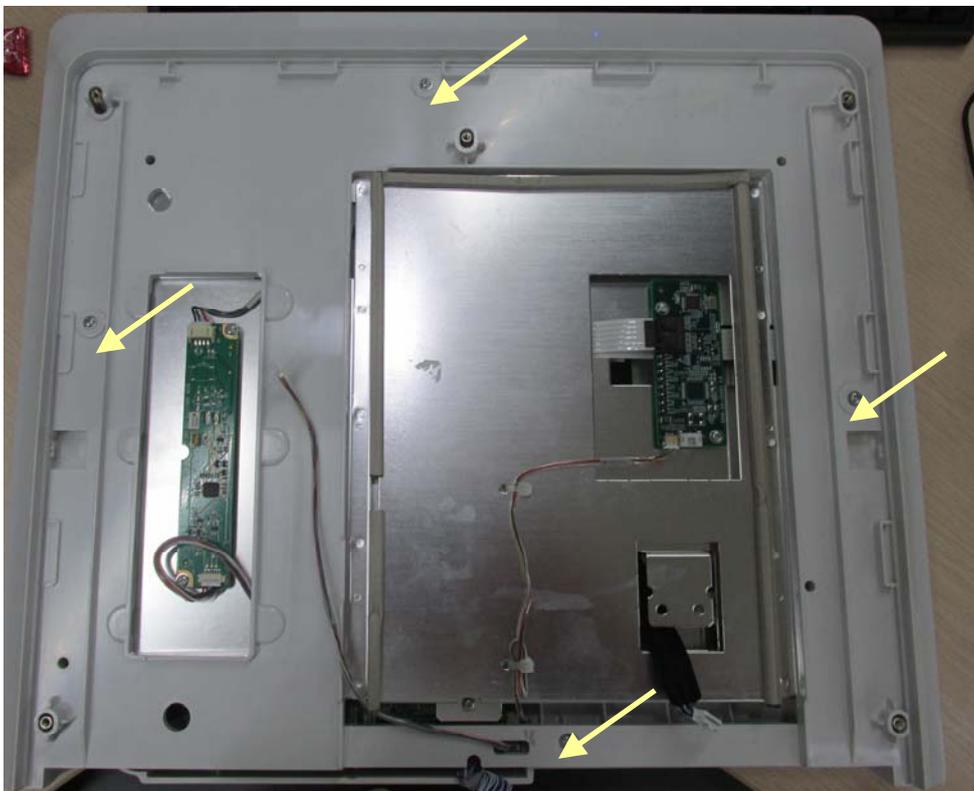
5.4 Further Disassembly

5.4.1 Removing the Power Switch & LED Board

1. Locate the cable marked in the picture and disconnect it from the power switch & LED board.

Left Clip

Right Clip

2. Release the clips with fingers. At the same time pinch the power switch & LED board, push it to the left and take it out along with the power switch.

NOTE

- **Exercise care whe releasing the clips.**

- **When installing the LED board along with the power switch, put it on the left clip, unclench the right clip to the right direction slightly, and then press it down.**

5.4.2 Disconnecting the Encoder Assembly

Disconnect the cable that connects the knob encoder and the button board. Then unscrew the two M3×6 screws and take out the encoder assembly.
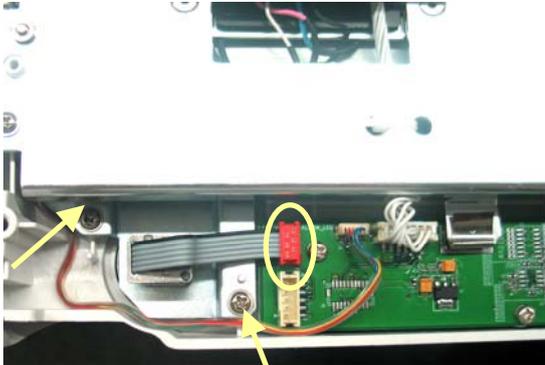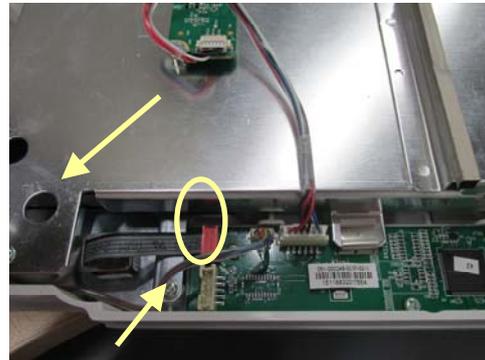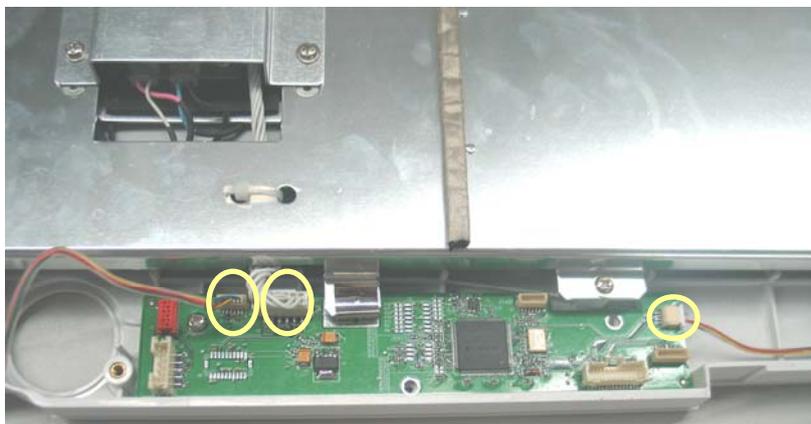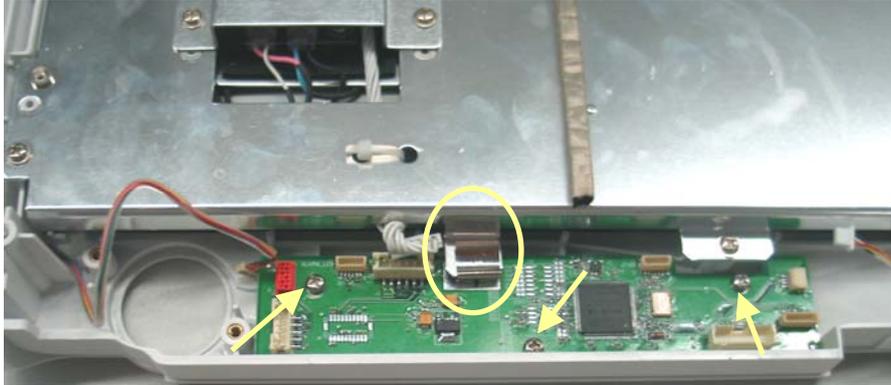

| (T6/T8) | (T9) |

5.4.3 Removing the Button Board

1. Disconnect the cables from the button board to the power switch & LED board, knob encoder, alarm LED board, backlight board and, touchscreen control board and the mother board.

2. Remove the grounding spring and then unscrew the three PT3×8 screws and take out the button board.

NOTE

- **Do not forget the grounding spring when reassembling.**

5.4.4 Removing the Touchscreen Control Board

Unplug the touchscreen cable and the cable from the button board to the touchscreen control board. Then, unscrew the two M3×6 screws and remove the touchscreen control board.
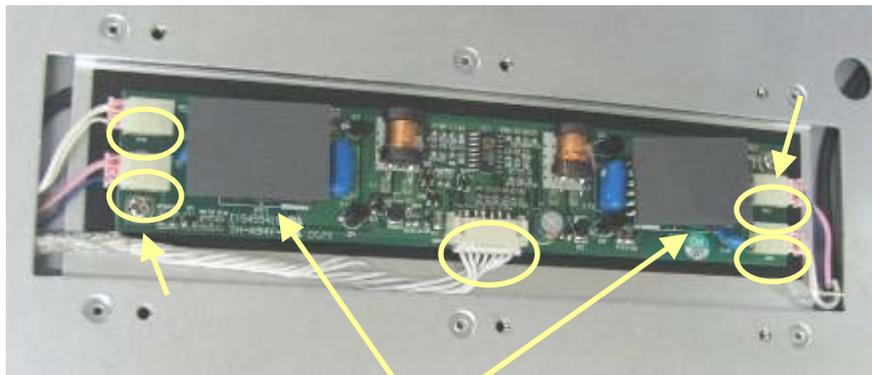
5.4.5 Removing the Inverter of T6 and T8

1. Unscrew the six M3×6 screws and remove the inverter shield.
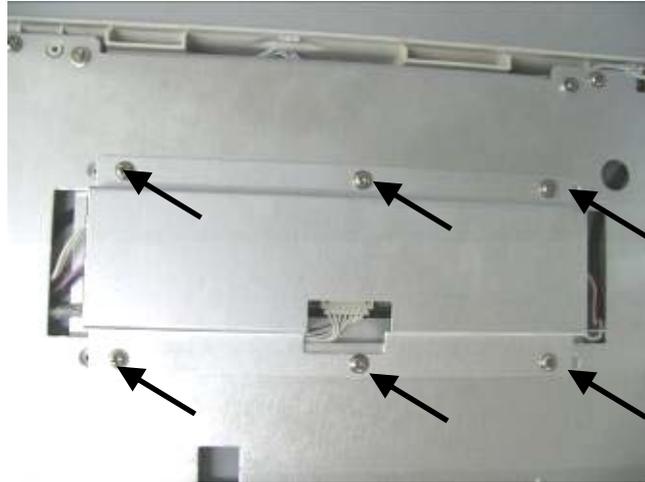
2. Unplug the cables respectively from the button board and the LCD to the inverter. Then, unscrew the two M3×6 screws to remove the inverter.

Heat-conductive insulator

NOTE

- Release the clip (if any) before disconnecting the cable between the LCD and the inverter.

- When reassembling, check whether the two heat-conductive insulators are in place.

5.4.6 Removing the Backlight Board of T9

Disconnect the cable between the backlight board and the LCD screen. Unscrew the two M3 ×6 screws to remove the backlight board.
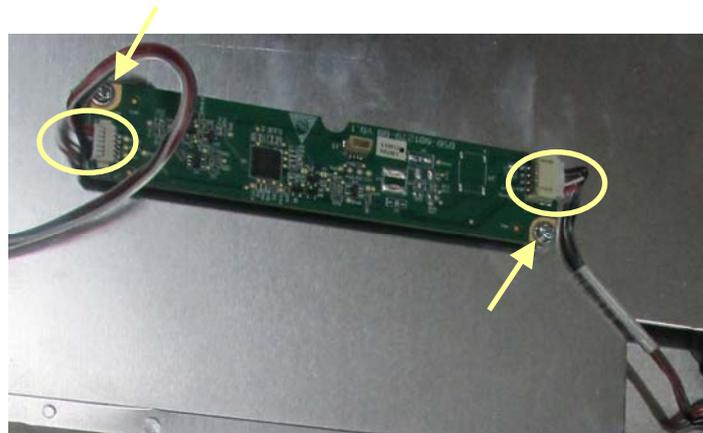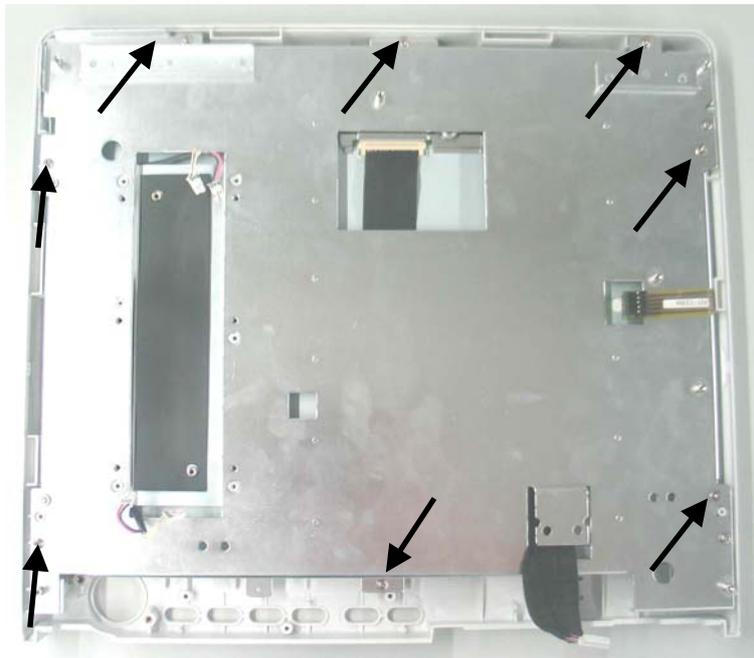
5.4.7 Removing the LCD Screen

⚠**CAUTION**

- **Do not touch the LCD screen.**

- **Disassemble the LCD screen in an environment as dust-free as possible.**

1.   Unscrew the eight M3×6 screws of T6 or T8 monitor and take the screen assembly out carefully. To prevent the screen from being contaminated by dust, do not touch the screen.

Unscrew the twelve M3×6 screws of T9 monitor and take the screen assembly out carefully. To prevent the screen from being contaminated by dust, do not touch the screen.
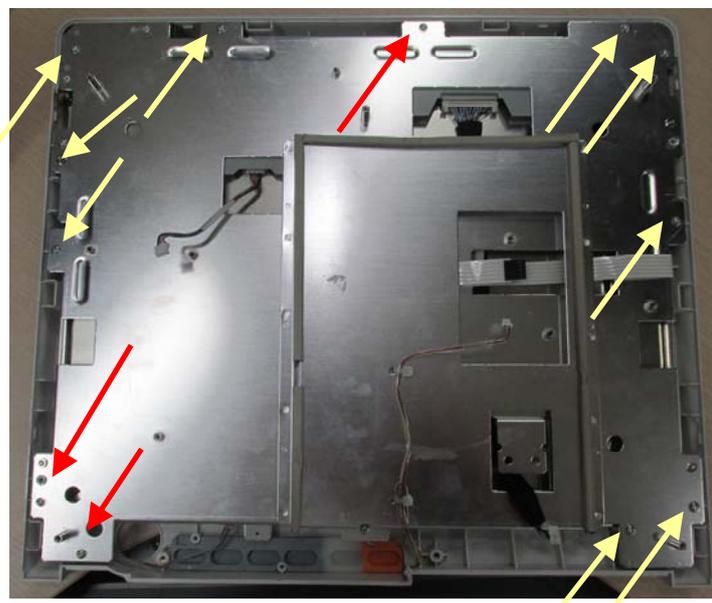
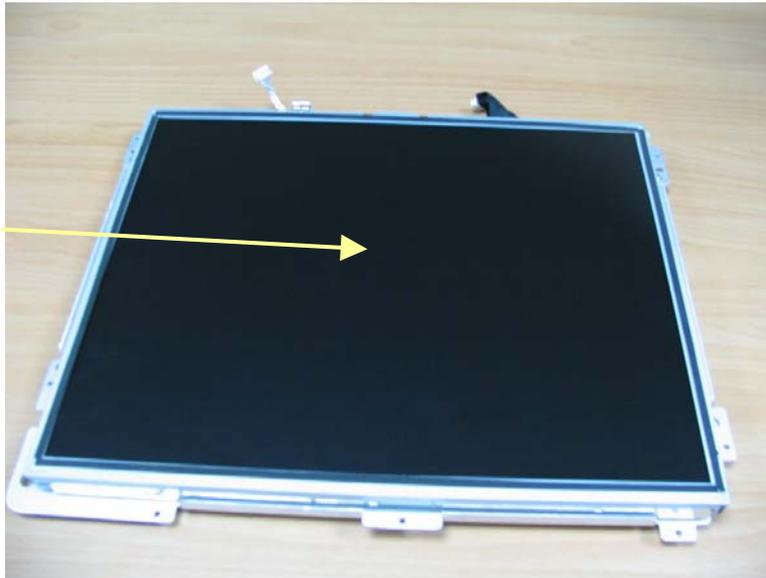Do not touch the
LCD panel

2.   Unscrew the four M3×6 screws and take out the LCD screen.
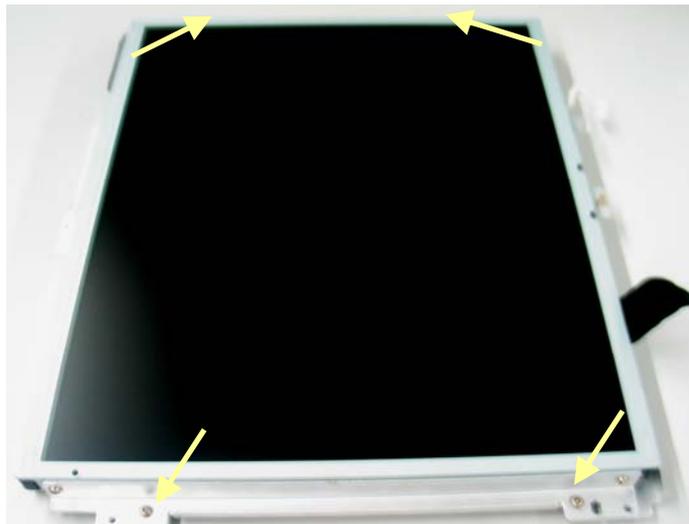
3.   Unscrew the four M3×6 screws and separate the LCD screen from the two supporters.
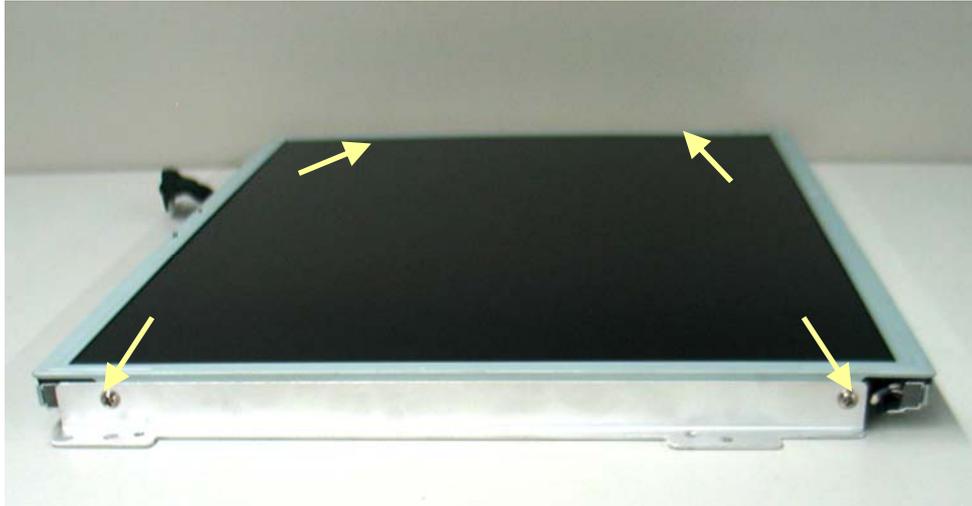
5.4.8 Removing the Alarm Lamp Board

After removing the LCD panel, disconnect the cable that connects the alarm lamp board and the button board, and then remove the alarm lamp board on which there is no screw.

NOTE

- **Exercise care when removing the alarm lamp board because it may be adhered to the LCD assembly (as shown in the above figure).**

5.4.9 Removing the Wireless AP

5.4.9.1 Removing the Internal Wireless AP

1. Unplug the wireless AP cable from the main board. Then unscrew the three M3×6 screws and take out the wireless AP assembly.
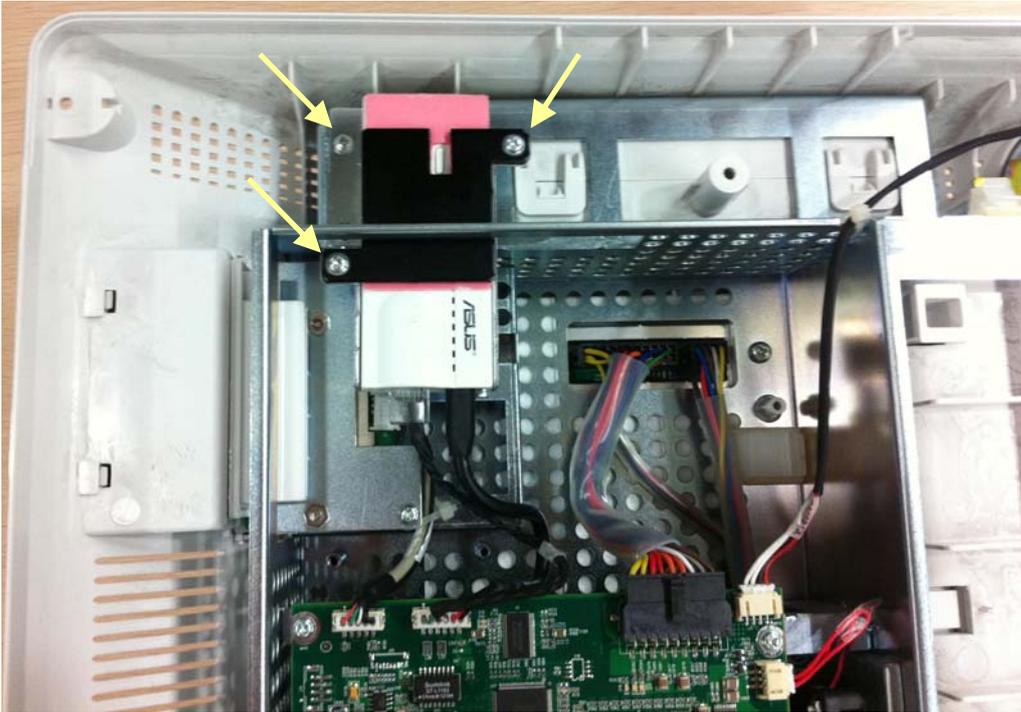
2. Unscrew the two M3×6 screws and then remove the wireless AP.

5.4.9.2 Removing the External Wireless AP

1. Disconnect the network cable and the power cord

2. Press the leaf on the fix board with forceps; push the AP and installation board upwards. Then remove the AP and installation board.

Press the leaf with a forceps

Installation board
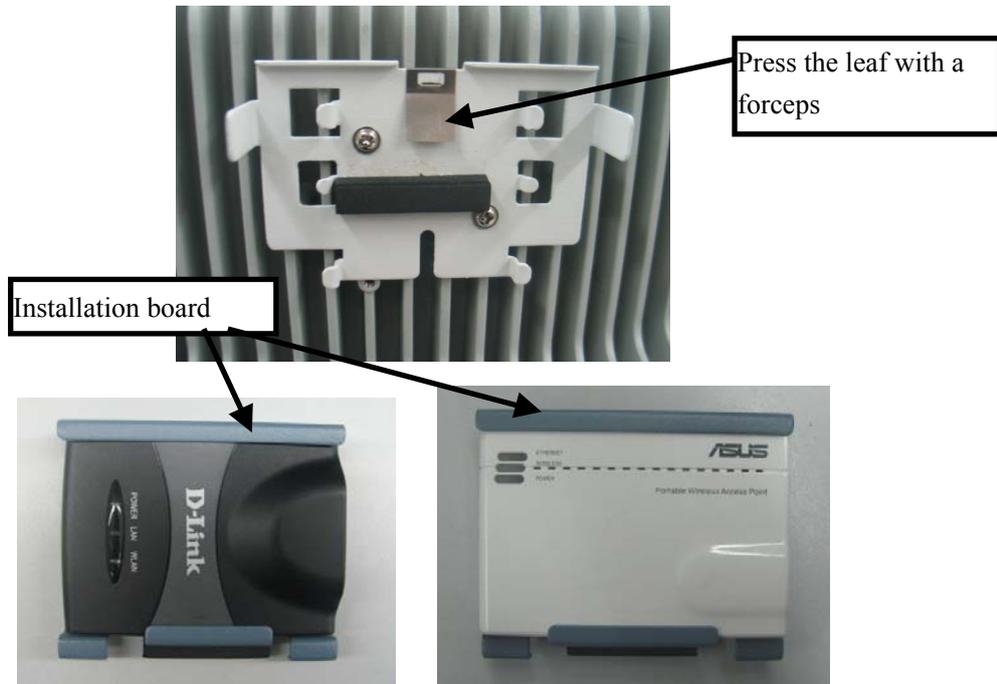
3. Unscrew the two M3×8 screws and take out the fix board.

5.4.10 Removing the CF Assembly

1. Disconnect the cable between the CF driving board and main board. Unscrew the two M3×6 screws and take out the CF assembly.
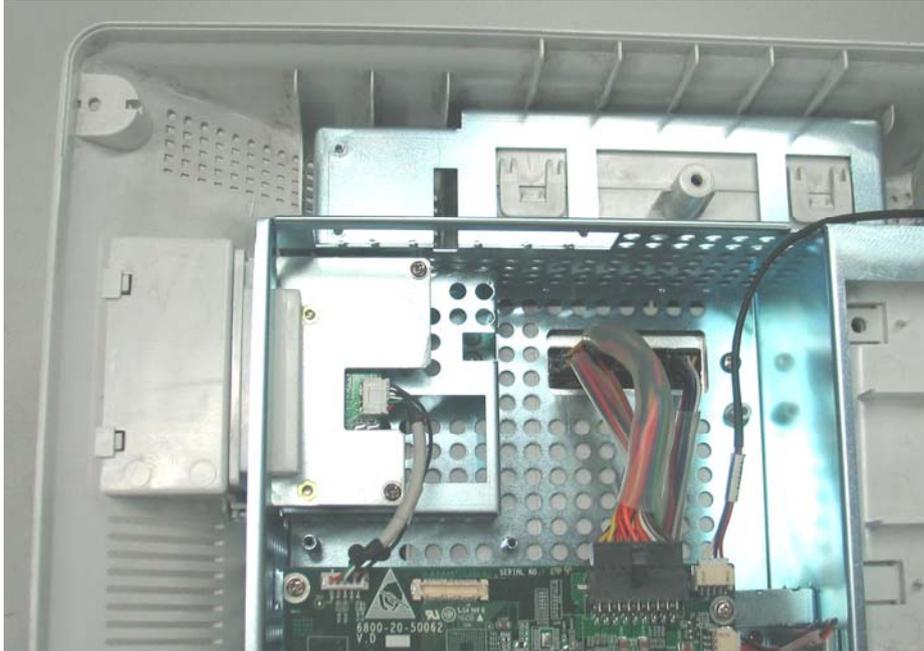
2. Unscrew the two M3×6 screws and take out the CF driving board.
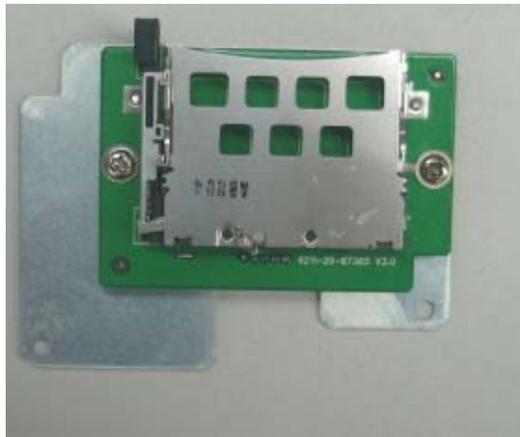
5.4.11 Removing the Main Board

1. Pull out all the connectors on the mother board. There are numbers beside the connectors, which are listed below.

Number	Connected to
J1	Power module
J2	Speaker
J3	Fan
J4	Integral module rack
J5	Button board
J6	DVI interface board
J7	LCD panel
J8	Recorder
J16	Wireless AP
J10	iView assembly
J11	USB interface board
J12	CF assembly
J22/J23	CPU board, which is connected to the mother board with a socket
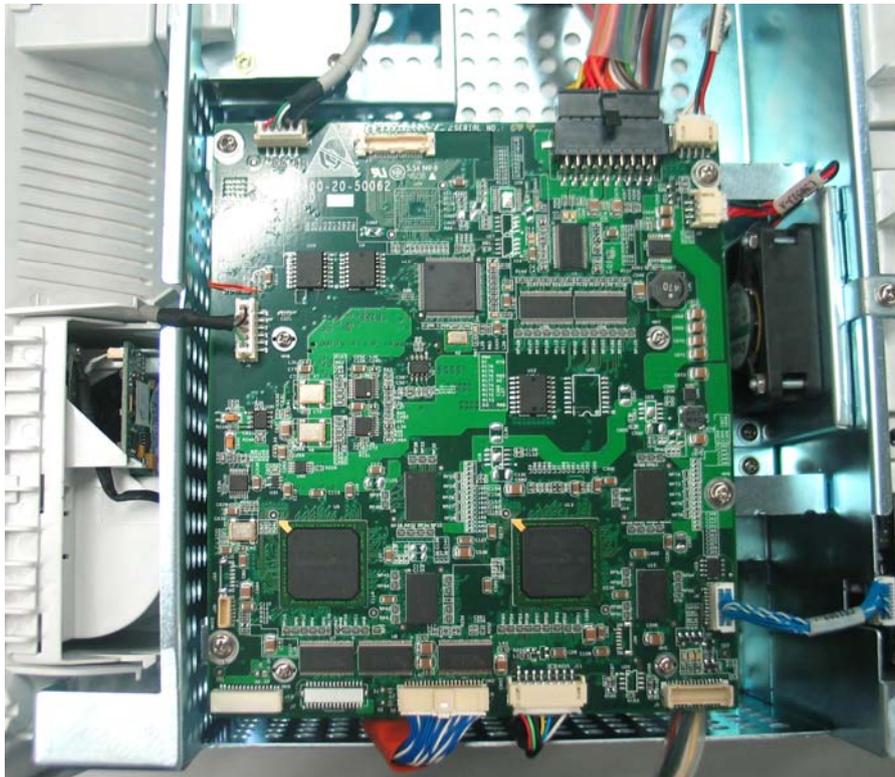
2. Unscrew the four M3×6 screws as shown in the figure above and take out the main board that includes the mother board and the CPU board.

3. Unscrew the four M2.5×6 screws and separate the mother board from the CPU board. Be sure not to damage the socket that connects the two boards. There is a battery on the CPU board.

Battery
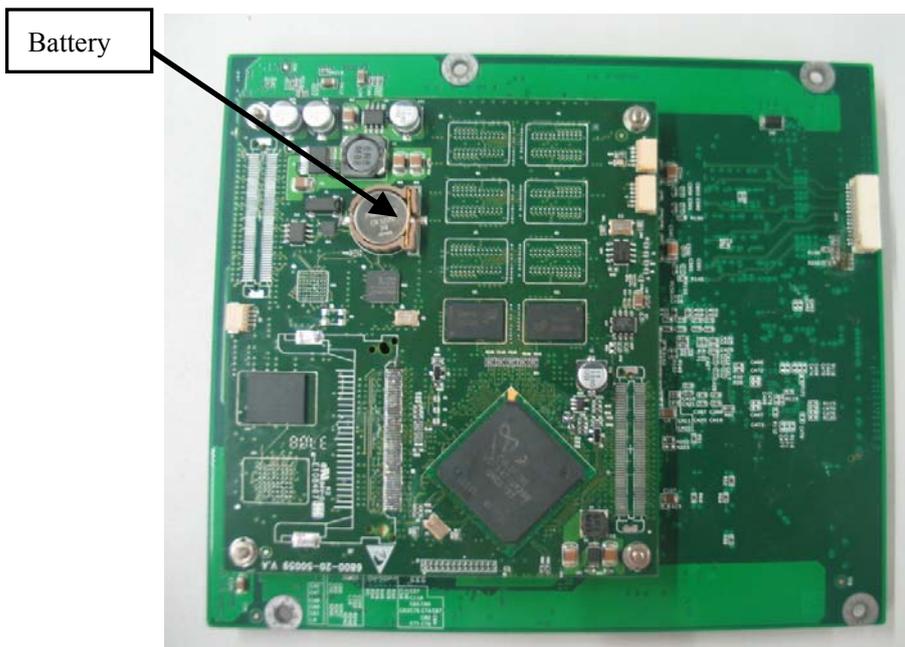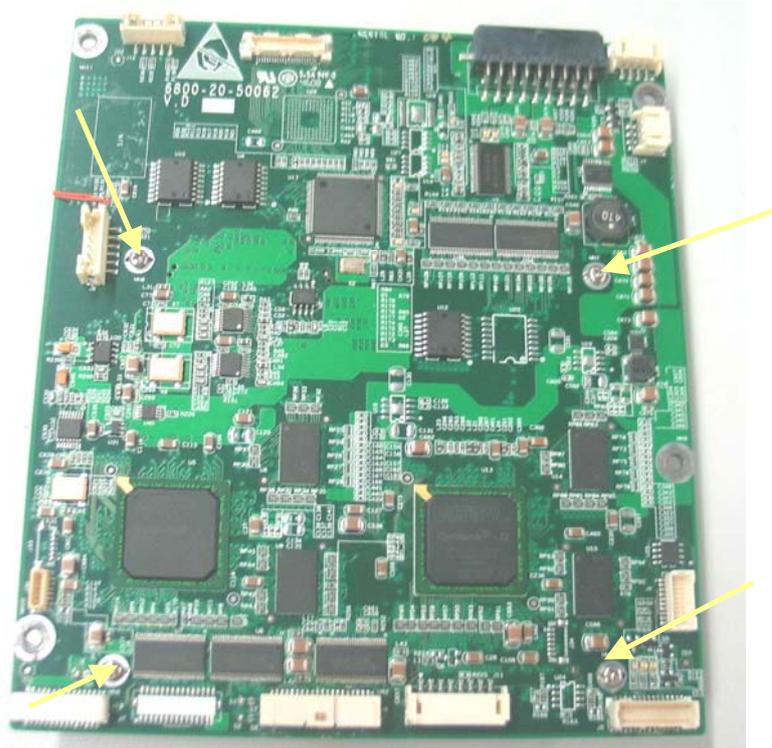
5.4.12 Removing the Fan

Disconnect the connector that connects the fan and the mother board. Then unscrew the three M3×6 screws and remove the fan.
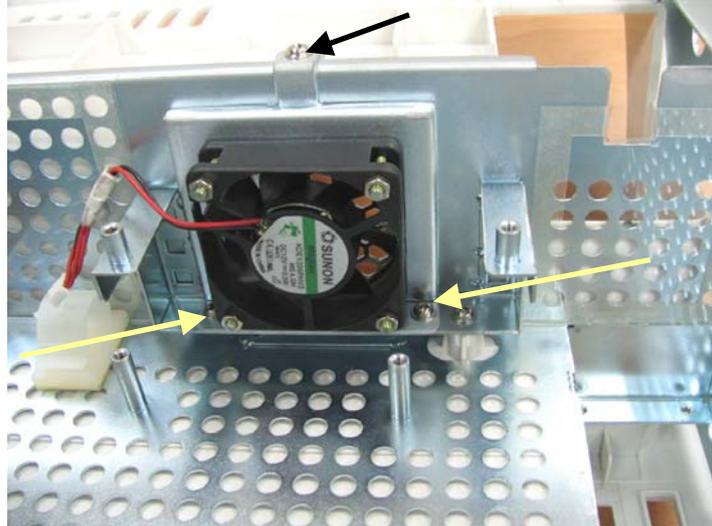
5.4.13 Removing the Speaker

Disconnect the connector that connects the speaker and the mother board. Then unscrew the two M3×6 screws and remove the speaker.

⚠CAUTION

- **When installing a speaker, be sure to keep the cable from the press bar. Otherwise, the speaker may be short-circuited.**

5.4.14 Removing the Interface Board Assembly

1. Unscrew the four M3×6 screws and remove the interface board assembly.
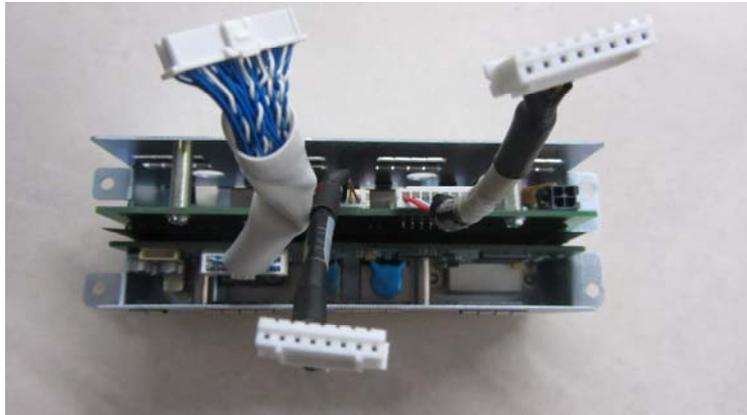
2. Unscrew the screws beside the DVI socket and micro-D socket. Then unscrew the two M3×6 screws in the holes. After that, pull out the DVI interface board.
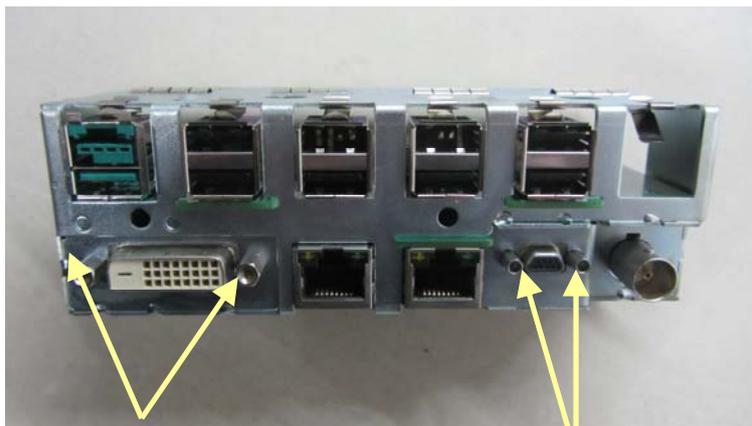
Screws beside DVI socket   Screws beside micro-D socket

Two M3×6 Screws in Holes

3. Unscrew the two M3×6 screws and take out the USB interface board upwards.
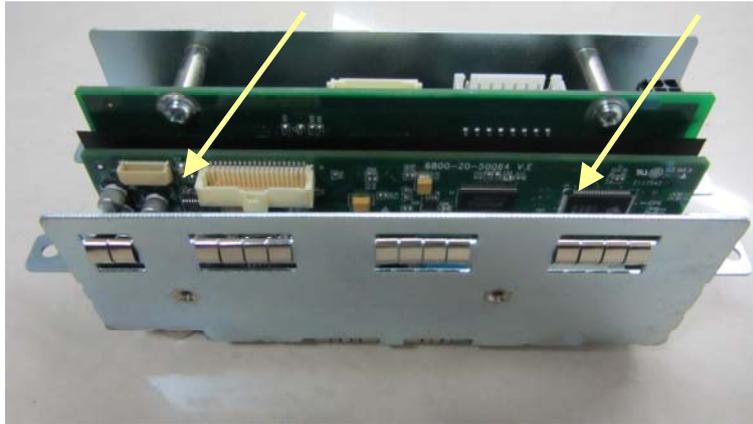
NOTE

- **Before removing the USB interface board, the DVI interface board must be removed first.**

- **Be careful not to damage the insulation between the DVI interface board and the USB interface board. If it is damaged, stick a new one.**

5.4.15 Removing the iView Assembly (for T8 and T9 monitor only)

1. Pull out all the connecting cables between the iView mother board and power board, USB interface board, mother board, DVI interface board. Unscrew the four M3×6 screws, and remove the iView assembly.
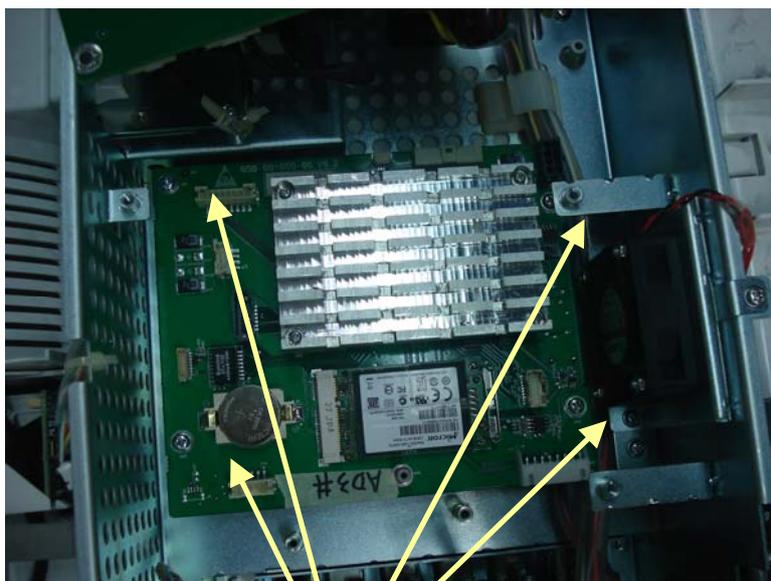
M3× 6 screws

2. Remove the SSD hard disk and battery from assembly

3. Unscrew the four pan head cross recessed screws and remove the cooling fin in the industrial control board.
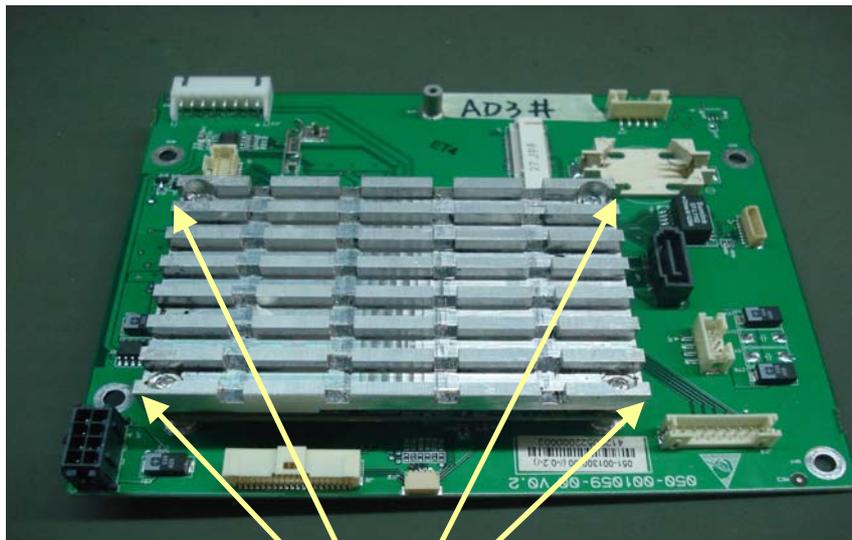
Pan head cross recessed

4. Seperate industrial control board from mother board. Remove the heat conductive glue on the mother board.
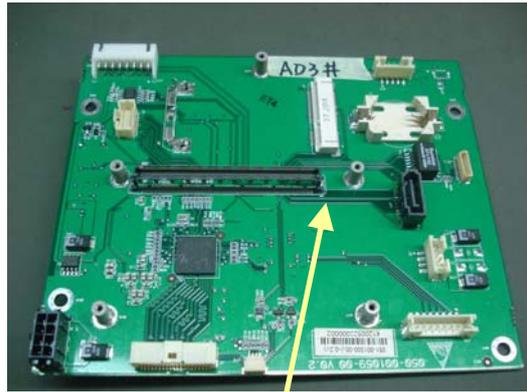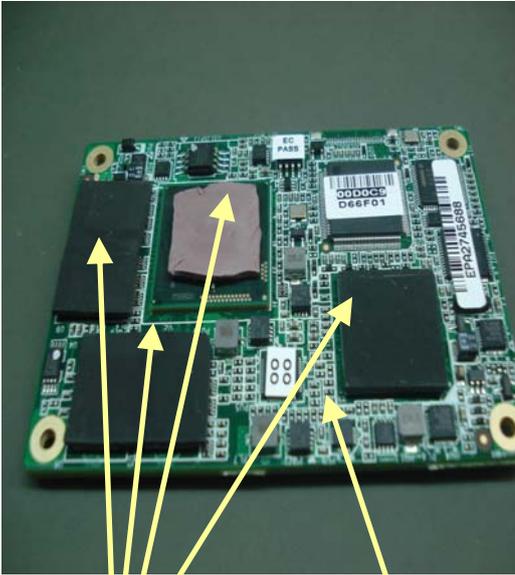
Heat-conductive glue   Industrial control board   Mother board

NOTE

- **Take care of the heat-conductive glue which lies between the industrial control board and the CIS mother board. Make sure the heat-conductive glue is coated before reinstallation. Remember to install the separation pillar to the CIS mother board whan reinstallation.**

5.4.16 Removing the Power Supply Assembly

1. Disconnect the four cables which connect to main control board, iView assembly, DVI interface board and battery interface board from the socket of the power supply assembly.

NOTE

- **For some cables, you have to release the clips on it before disconnecting them.**

2. Unscrew the two M4×20 screws. Be sure to hold the power supply assembly to prevent it from falling when unscrewing the screws.
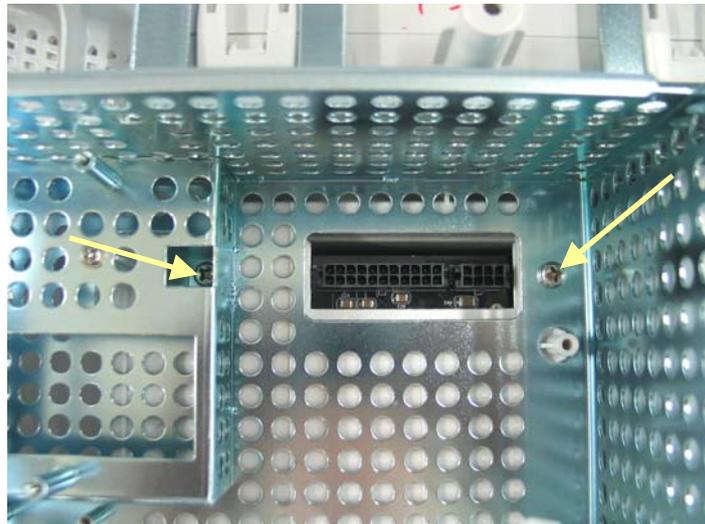
3. Lift the power supply assembly slightly to separate it from the two shafts on the rear cover and then remove the assembly.

Shafts

4. Unscrew the two M3×12 screws and remove the cover of the power supply.

5. Unscrew the two M3×6 screws. pry out the board with a small flat-bladed screwdriver in the gap between the power supply board and the housing. Then turn the board over and unplug the cables from it.

Insulator

Equipotential Pillar
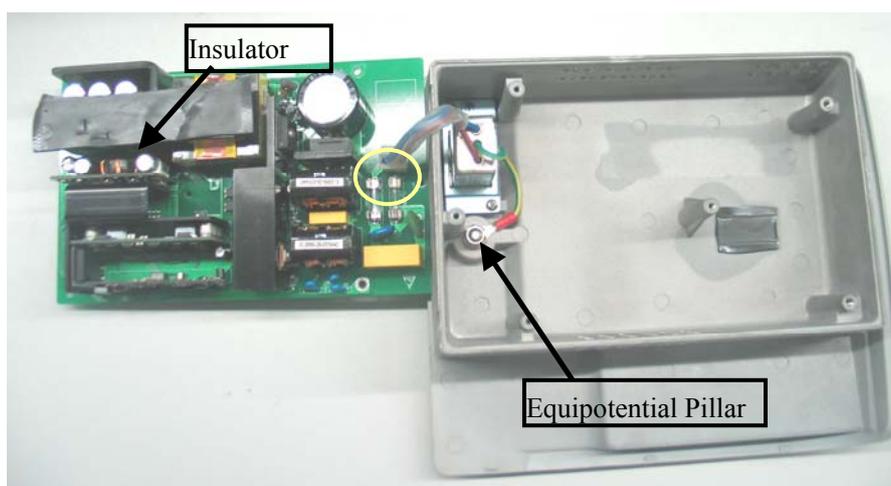
NOTE

● **Because the power supply board may be adhered to the insulator, be careful not to damage the parts, connector and cables when prizing it.**

5.4.17 Removing the Integral Module Rack

The following disassembling procedure takes the 5-slot module rack as an example. You can disassemble other types of module rack by referring to this procedure.

1. Disconnect the cable that connects the integral module rack and the mother board. Remove the two bolts and unscrew the M3×6 screw.
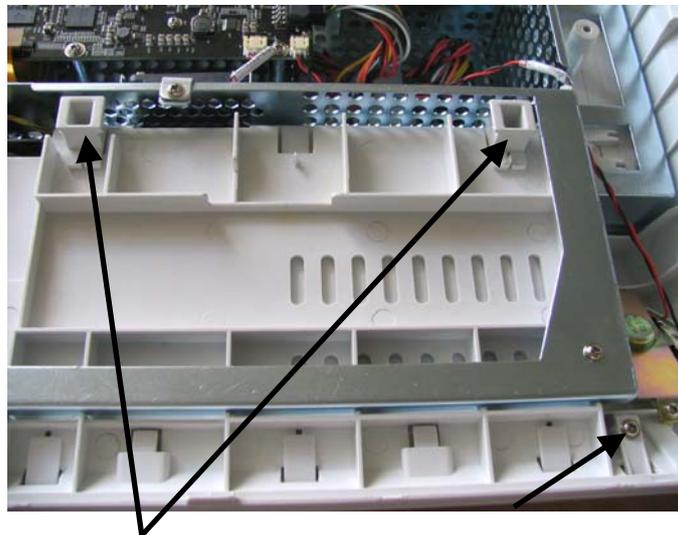
Bolts

2. Pry the snaps out about 1mm away with a small flat-bladed screwdriver. Then insert the small flat-bladed screwdriver into the position marked in the picture and pry it out about 1mm so that the module rack becomes disengaged from the back cover.

3. If the module rack still engages with the back cover, insert a small flat-bladed screwdriver into the position marked in the picture and pry it out about 1mm to release the hidden snap between the integral module rack and the back cover. Then pull out the module rack.
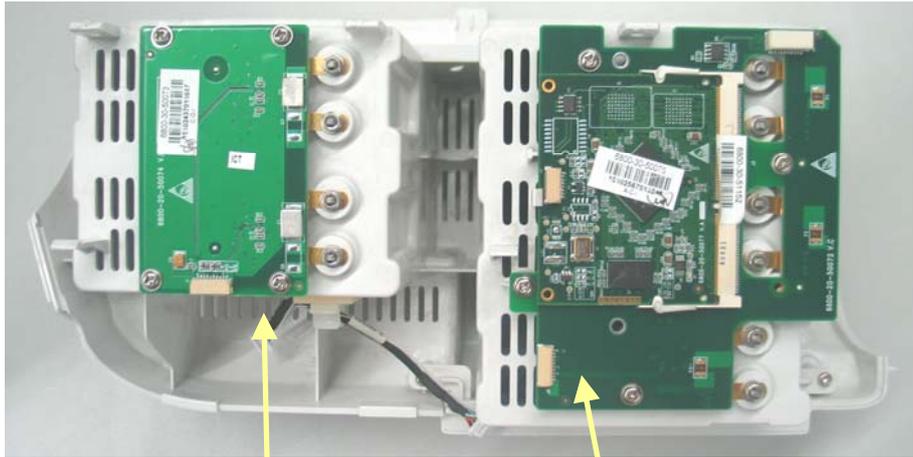
MPM Communication Board   3-slot module Rack Communication Board

⚠CAUTION

- **Be sure to release the hidden snaps first when removing the integral module rack. Otherwise, the monitor will be damaged.**

4. Release the three clips on the 3-slot module rack communication board and remove the Nios II module.

Nios II module
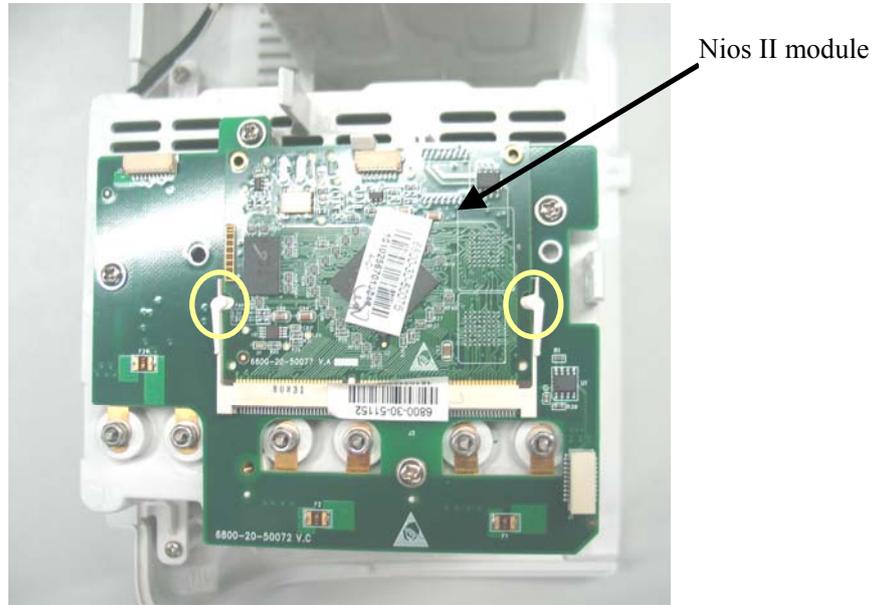
5. Unscrew the four M3×6 screws and take out the 3-slot module rack communication board. Unscrew the four M3×6 screws and take out the MPM Communication Board.
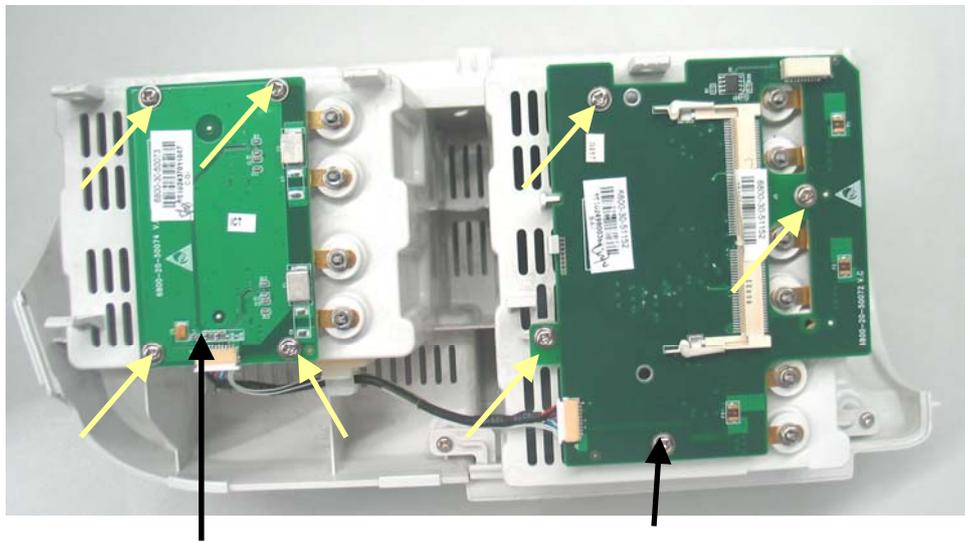
MPM Communication Board   3-slot module Rack Communication Board

6. Unscrew the hex nut assy using the sleeve. Then separate the washer, spring and contact screw from each other.

Leaf

Contact screw

M3 nut

Φ 3 flat washer

Φ 3 flexible washer
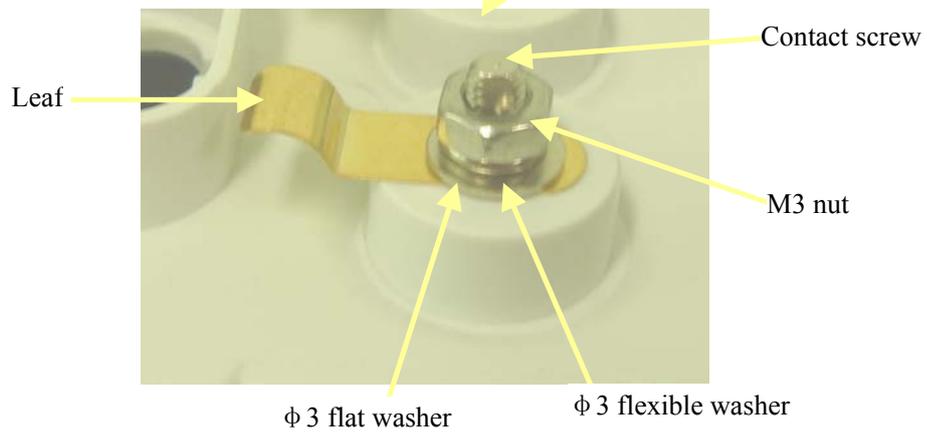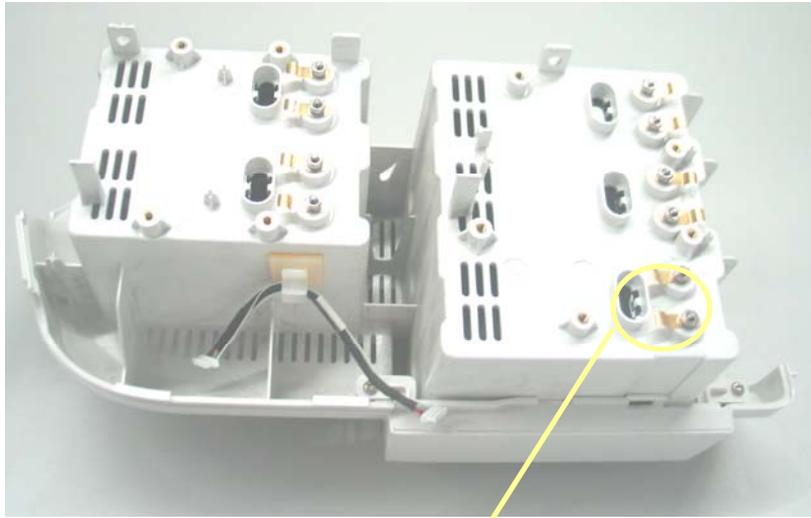
5.4.18 Removing the Recorder

1. Open the recorder door and unscrew the two M3×6 screws.
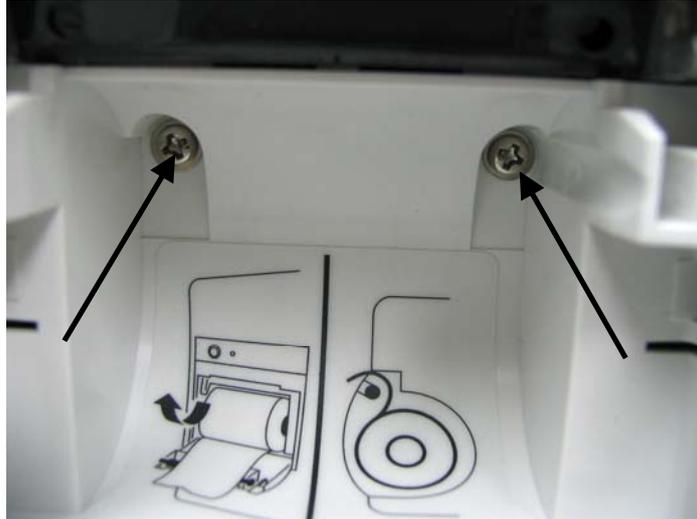
2. Pull the two clips in the directions as indicated and meanwhile pull out the recorder.
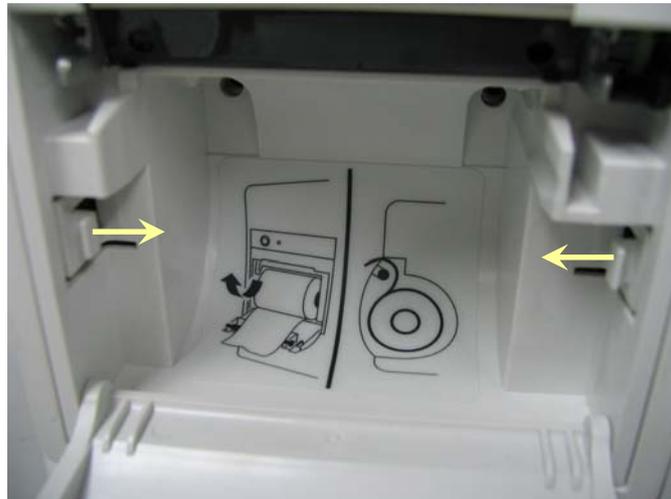
NOTE

● **Be sure not to damage the connecting cables or connectors when pulling out the recorder.**

3. Unscrew the M3×6 screw and remove the cables marked in the picture.

4. Unclench the two clips and meanwhile take out the recorder drive board. Pay attention to the snap in the front.

Snap
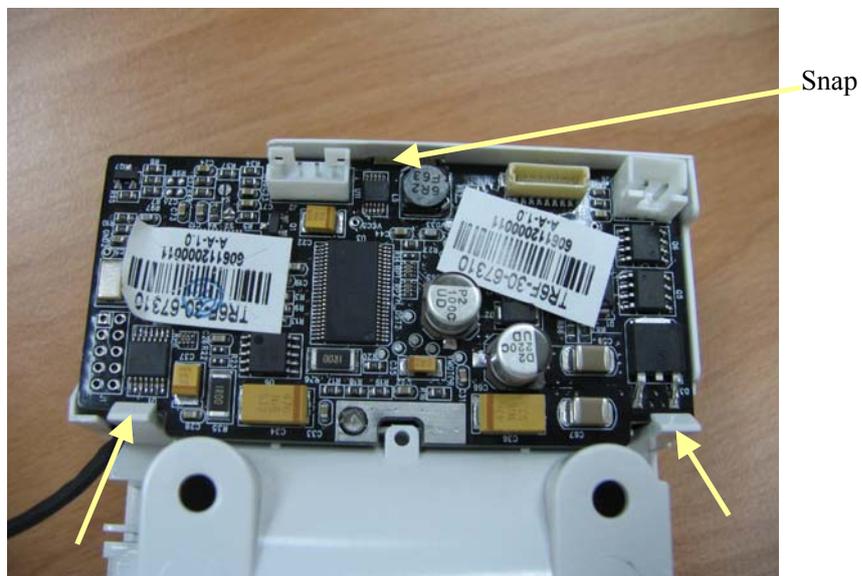
5. Pull out the press bar upwards about 1mm and then pull off the flexible cable. Remove the cable that connects the drive board and the button board. Unscrew the PT2×6 screw and remove the drive board's grounding cable. Then take out the recorder drive board.
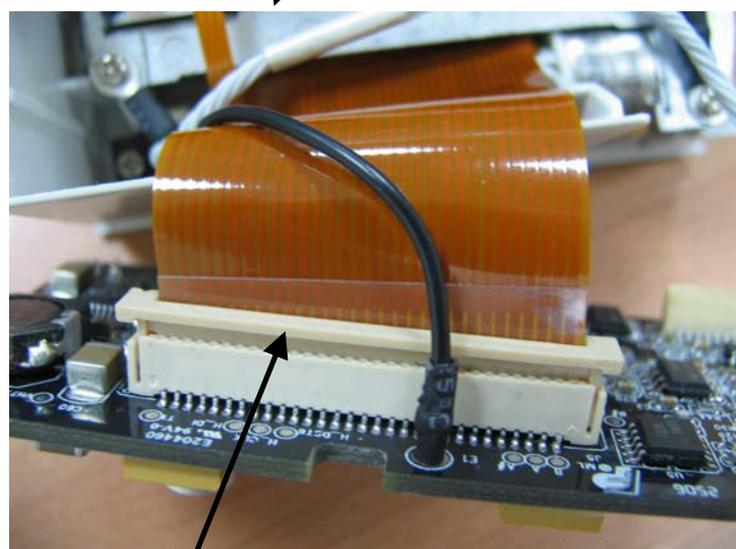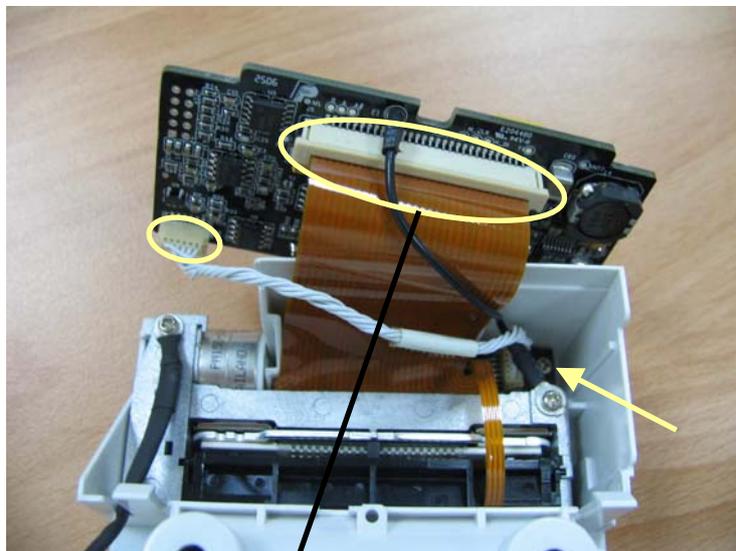
Press bar

6.   Unscrew the two PT2×6 screws and take out the thermal printhead. Then unscrew the two PT2×6 screws and remove the recorder's button board.
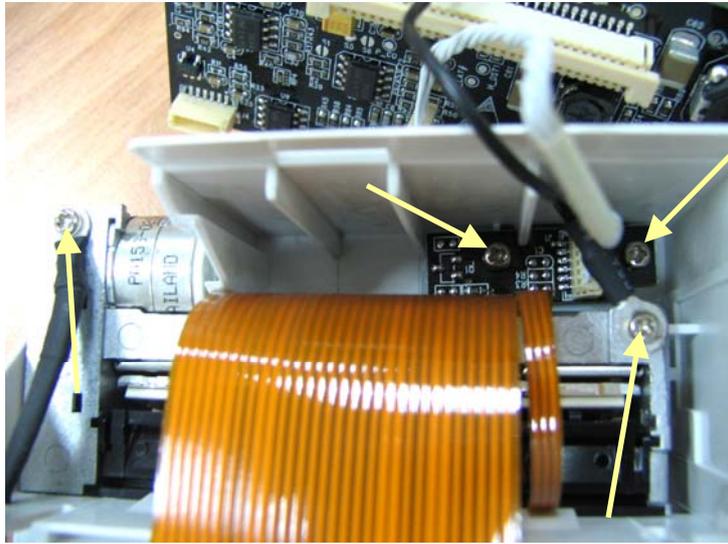
7.   Remove the recorder mounting bracket by pulling out the recorder mounting bracket from the right side first.
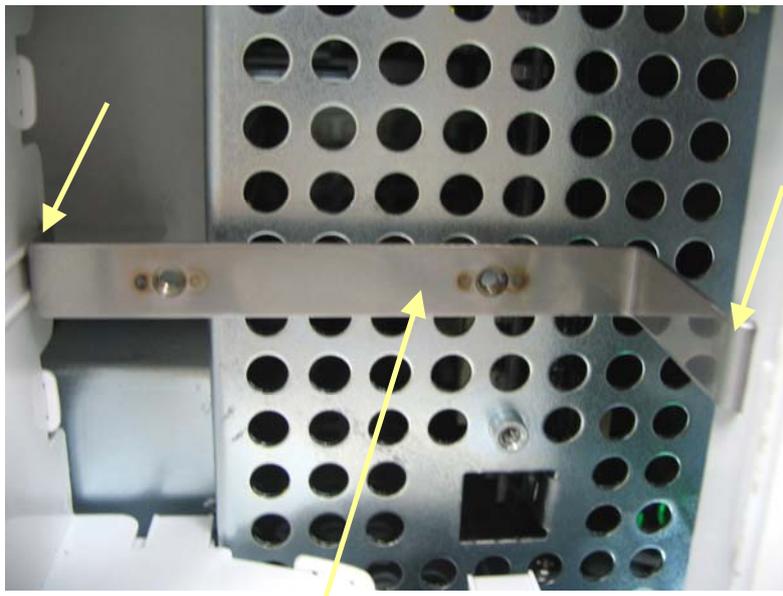
Recorder mounting bracket

8. Hold and then pinch the recorder housing so that the recorder housing becomes disengaged from the monitor housing. Then take out the recorder housing.

NOTE

- **When pinching the recorder housing, take care not to damage the recorder housing.**

- **When reassembling the recorder housing and the recorder mounting bracket, install the recorder mounting bracket first and meanwhile be sure the two clips are in right position. Otherwise, the recorder cannot be installed correctly.**

5.5 Removing the SMR Assembly

1. First remove the 4 screw covers and then unscrew the 4 M3×8 screws.

Right-side board
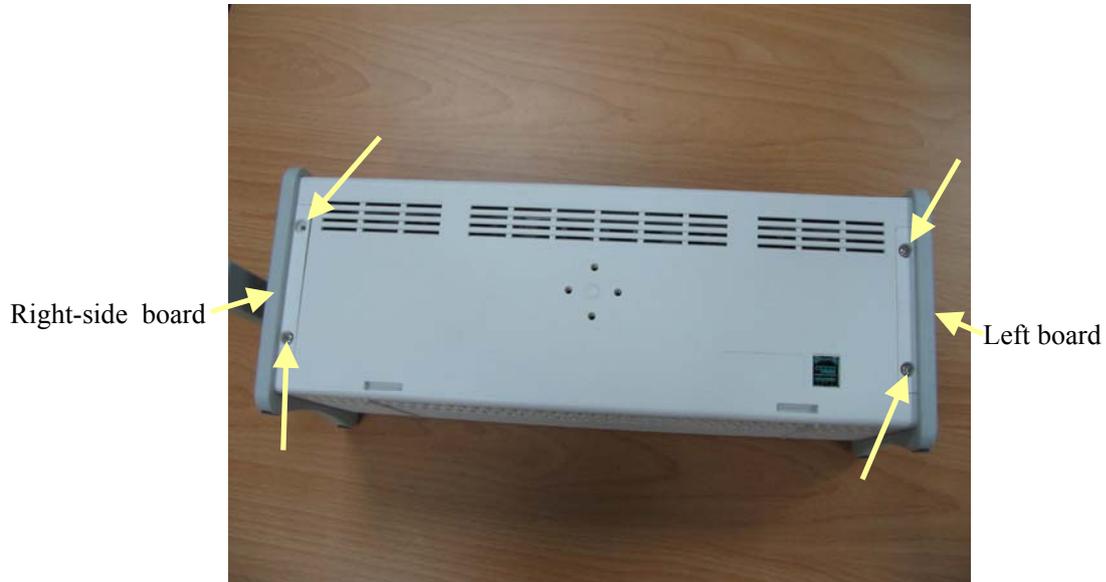
Left board

2. Pull off the left- and right-side boards. Be sure to place the rubber loop in position when reassembling the right board.

3. From the left side, remove the cable that connects the module rack interface board and the 8-slot module rack communication board. Then take off the SMR cover.

4. Unclench the two clips and take out the module rack interface board. Be sure not to damage the snap slot on the left side.

5. Remove the cable that connects the 8-slot communication board and the LED board, the LED indicator and the light tube.

6. Unclench the clips and take out the Nios II module. Then unscrew the six M3×6 screws and remove the 8-slot module rack communication board.
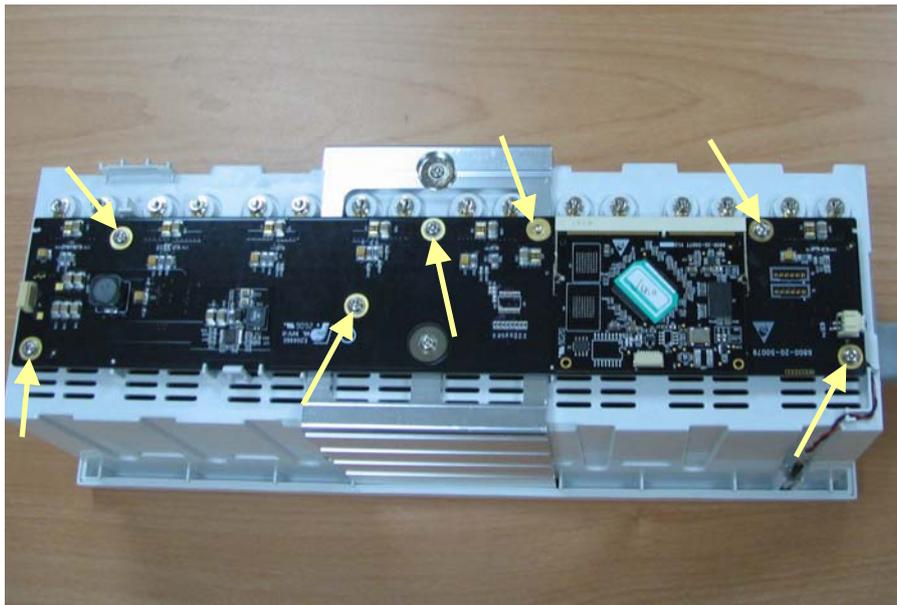
7. Use the sleeve to unscrew the hexagon nut and countersunk external toothed lock washer assembly which can be further separated into the washer, springlet and contact screw.

Washer

Springlet

Hexagon nut and countersunk external toothed lock washer assembly

Contact screw
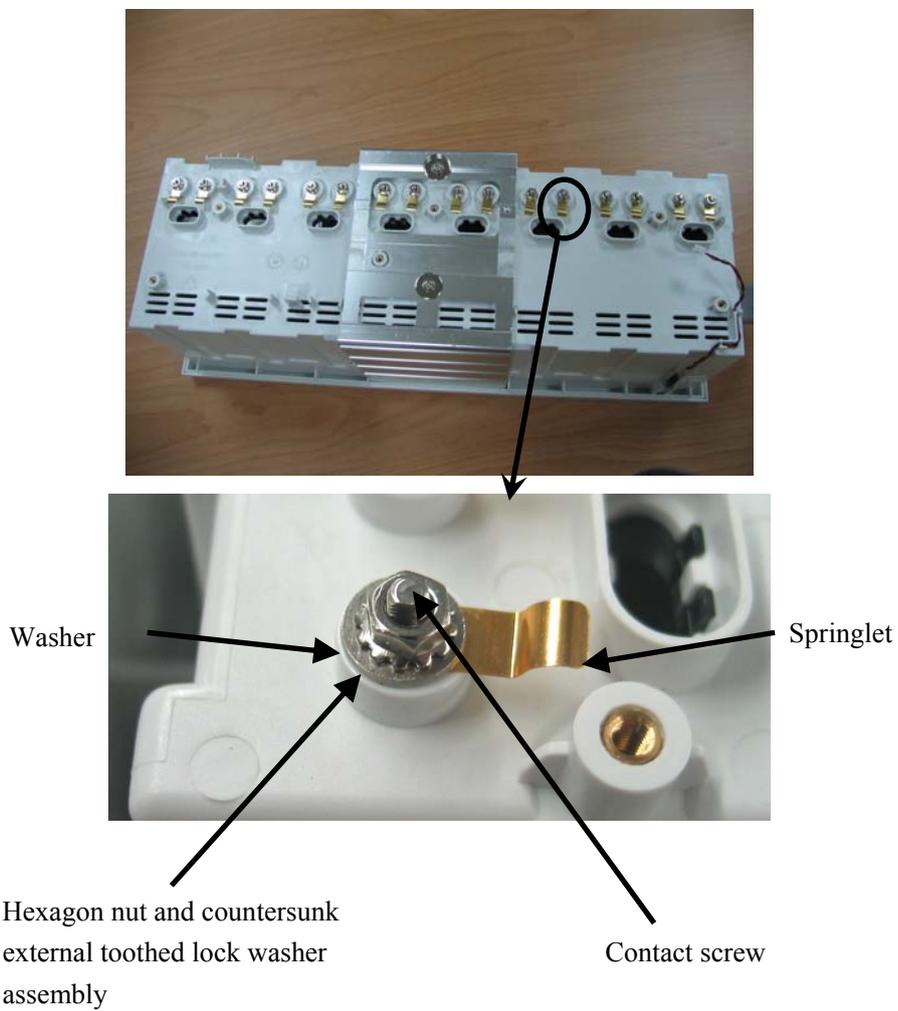
5.6 Disassembling Modules

⚠WARNING

- **For a reassembled module, a patient leakage current test must be performed before it is used again for patient monitoring.**
- **Make sure the monitor is off before disassembling the modules.**

The monitor supports three types of modules, single-slot modules, 2-slot modules and 3-slot modules. The following part describes two typical disassembling procedures.

5.6.1 Disassembling the ICG Module

1. Unscrew the two contact screws and Φ3 spring washer on the back with a sharp nose pliers.
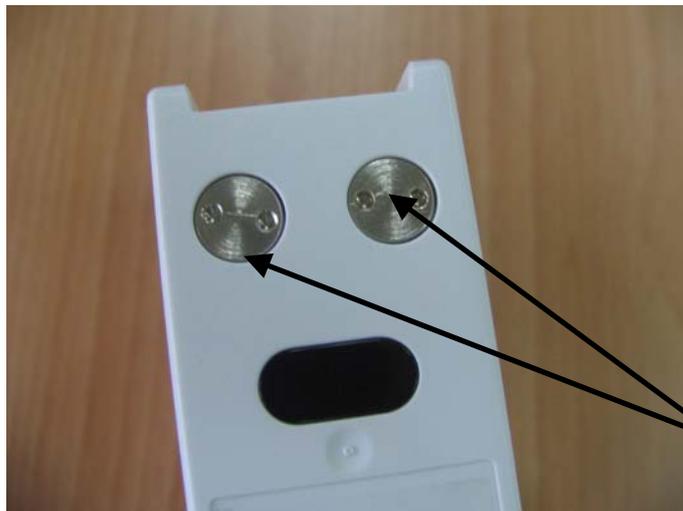
Contact Screw

2. Move the snap lock in front of the contact spanner to the unlocking position. Insert a small flat-bladed screwdriver into the hole on the snap lock and press the snap down about 1mm. At the same time, push the snap lock forwards with a thumb until the snap lock and its counterpart separate. Then release the snap lock with a screwdriver.
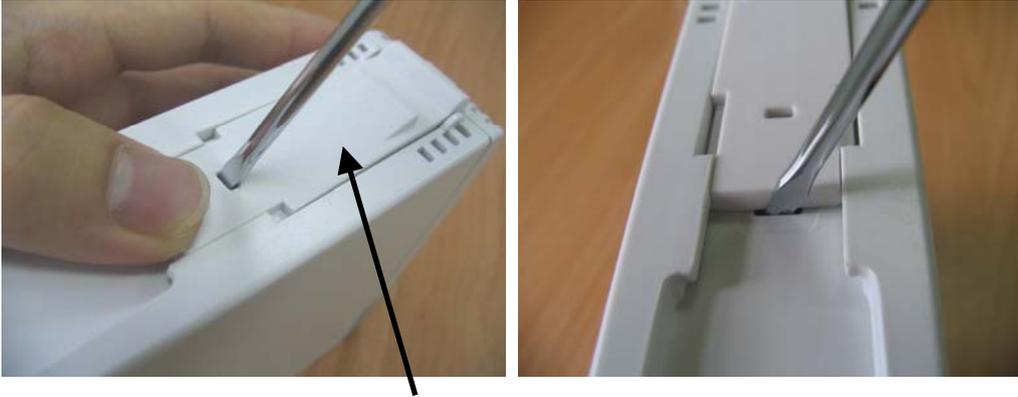
Snap Lock

3. Unscrew the M3×6 screw. Then press down, in turn, the two clips that engage the front cover. At the same time, pull off the front cover carefully to avoid damaging the cables.

4. Press the two clips about 1mm and take off the housing.
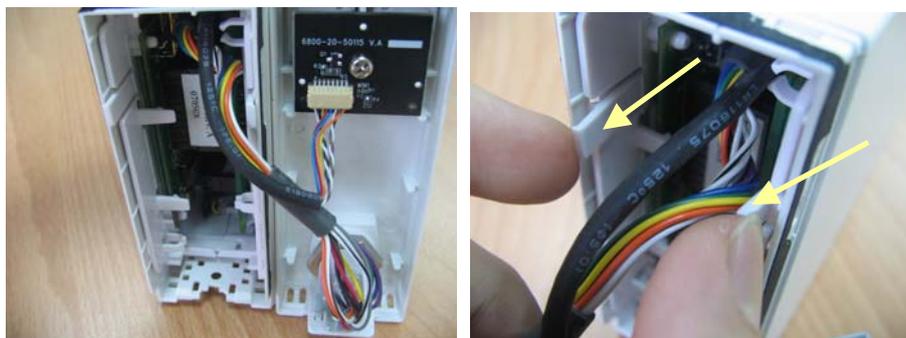
5. The side cover of the module without the housing is composed of two halves. Release the three snaps to separate the two halves.
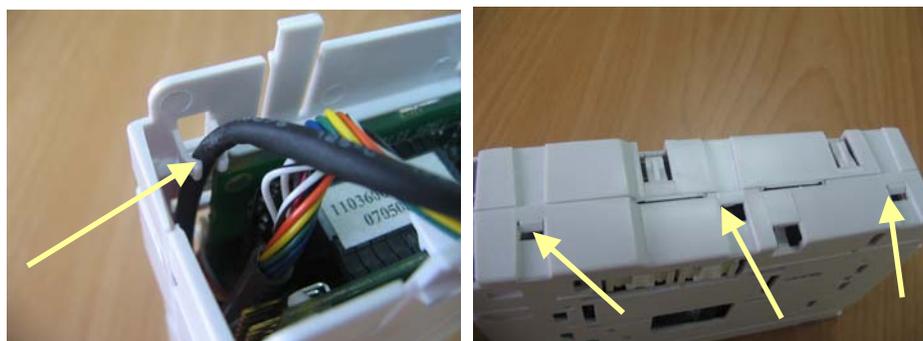
6.   Take out the non-insulated power board and disconnect all the cables from it.

7.   Take out the infrared communication board and disconnect all the cables from it.
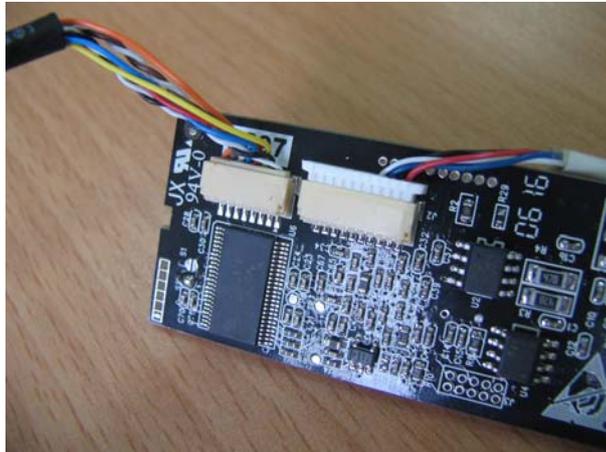
8.   Disconnect all the cables on the ICG board and take off it with the front cover.

5.6.2 Disassembling CO$_2$ Module

1. Remove the four contact screws on the back and two snap locks on the bottom and then unscrew the two M3×6 screws by referring to the procedure as described in **5.6.1 Disassembling the ICG Module** .

2. Take off the front cover of the CO$_2$ module by referring to the procedure as described in **5.6.1 Disassembling the ICG Module**. Then press the two clips about 1mm and take off the housing.
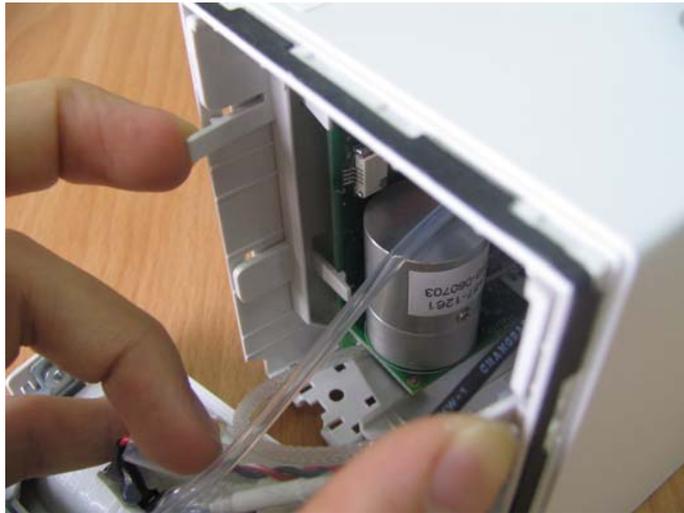
3. Hold the housing with both hands. Press the snap side with the thumb and move the other side with the index finger and the middle finger to separate the housing into two halves.
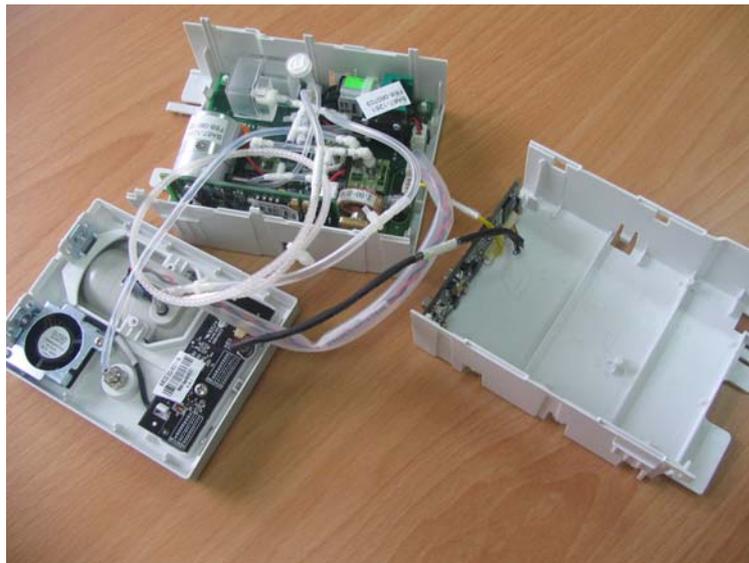
4. Take out the infrared communication board and disconnect all the cables from it.

5. Disconnect the cables from the button board and unscrew the PT3×8 screw. Then release the two clips and take out the board. After that, disconnect the cable to the fan and remove the button board.
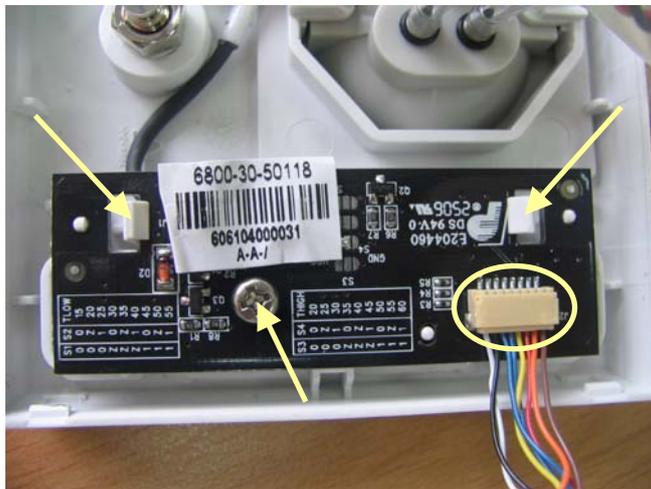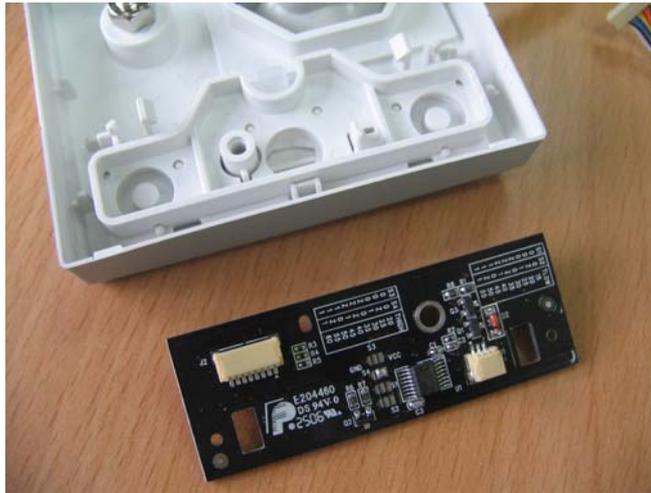
6. Unscrew the two screws on the front panel. Disconnect the tubing between the watertrap assembly and CO_2 parameter board. Disconnect the cable between the watertrap and CO_2 parameter board. Then take out the watertrap connector assembly.

7. Disconnect the tubing between the CO_2 parameter board and the front panel. Then release the four clips and remove the CO_2 parameter board.
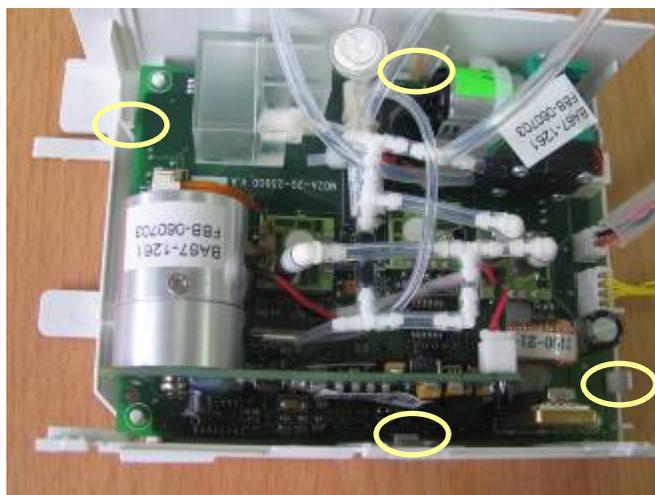
NOTE

- **When reinstalling, do not fold the tubings.**

5.6.3 Disassembling the BeneLink Module

1. Remove the contact screws, the spanner, and the front cover by referring to steps 1 to 3 as described in *5.6.1Disassembling the ICG Module* .

2. Take off the small cover board on one side of the rear cover. Then press the two clips about 1mm and take off the housing.
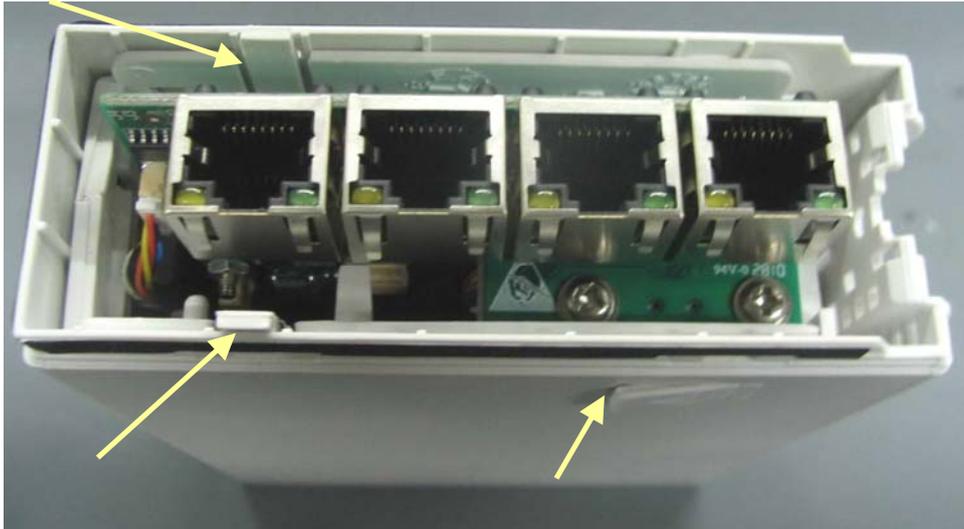
3. Release the three snaps to separate the two halves of the module side cover.
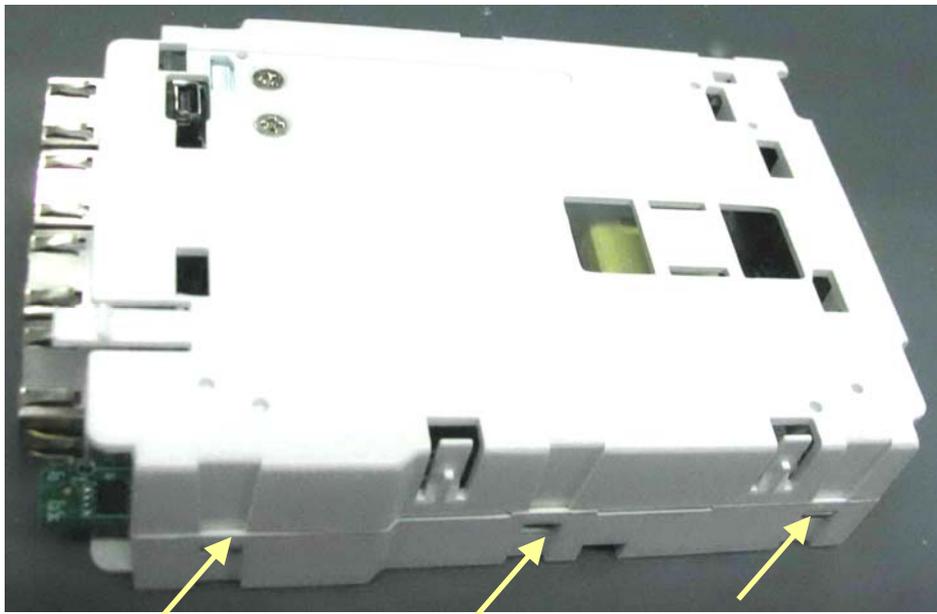
4. Take off the cable between the USB board and the interface board.

5. Take off the cable between the infrared communication board and the interface board to remove the infrared board.

6. Unclench the four clips with a tweezer to remove the interface board.

5.6.4 Disassembling the New MPM Module

1. Remove the contact screws and the spanner by referring to steps 1 to 3 as described in *5.6.1 Disassembling the ICG Module* .

2. Unscrew the two M3×6 screws. Then press down, in turn, the four clips that engage the front cover with a small flat-bladed screwdriver. At the same time, pull off the rear cover.
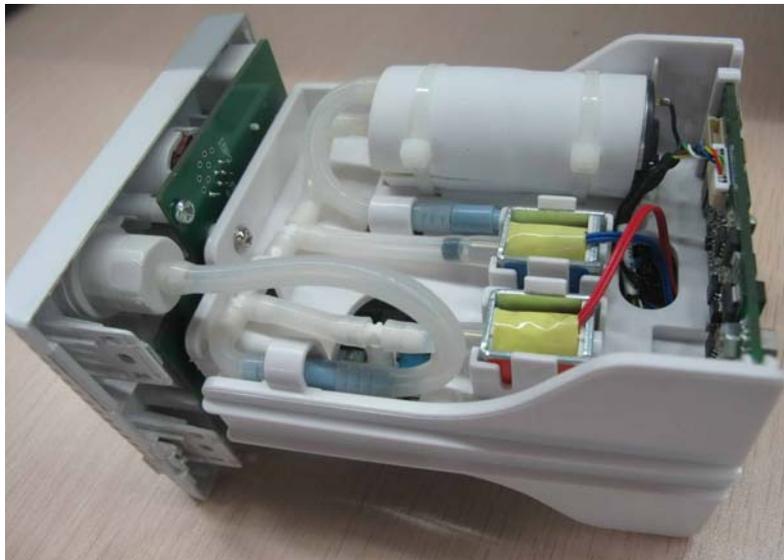
3. Disconnect the cable of the infrared communication board, and release the snap lock to remove the infrared communication board.

4. Disconnect the cables of the NIBP inflation pump and the relief valves from the parameter board. Snip off the cable ties to remove the pump. Release the snap locks to remove the valves.
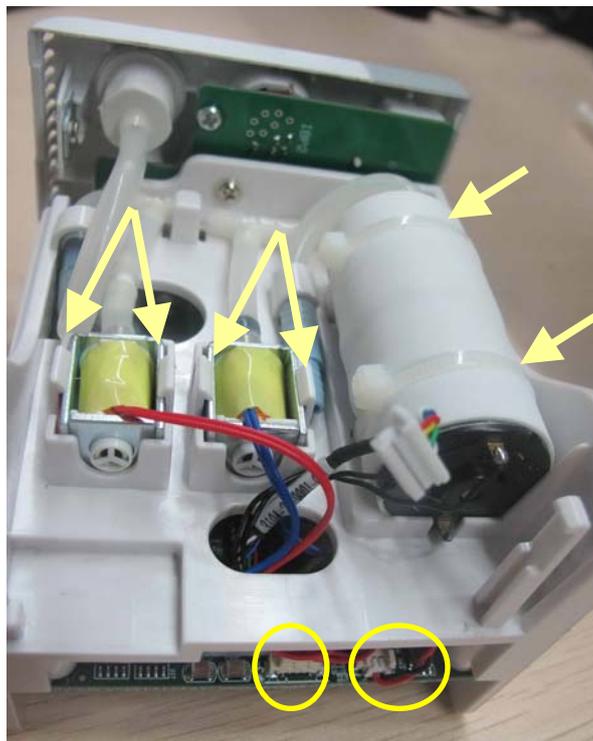
5. Unscrew the two M3×8 screws on the parameter board. Then pull off the parameter board rightward as shown below.

6. Unscrew the two M3×4 screws on the SpO$_2$ board to separate the SpO$_2$ board and the parameter board.

7. Unscrew the three M3×8 screws to separate the front panel assembly and the holder.
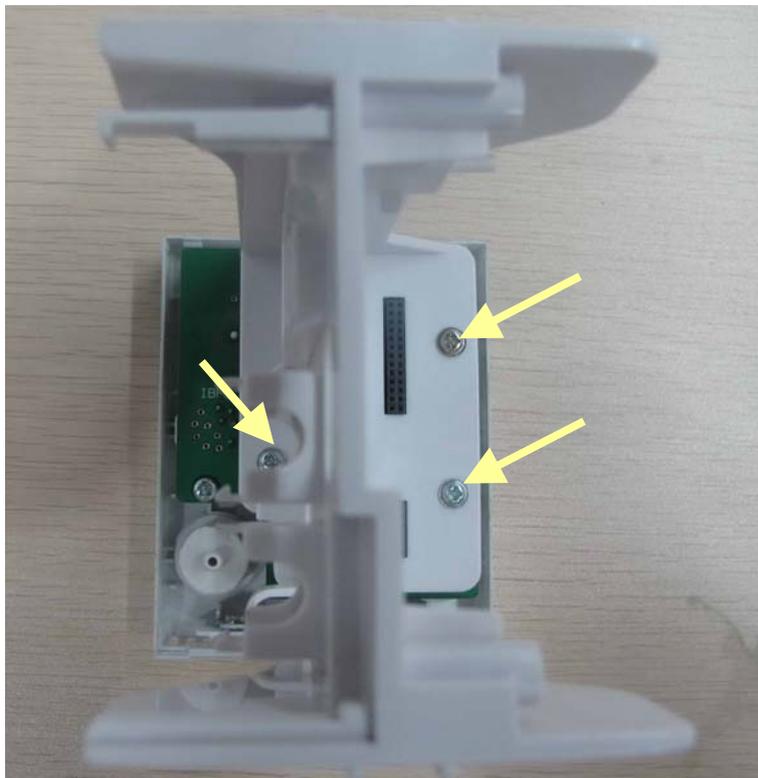
6 Parts

6.1 Introduction

This section contains the exploded views and parts lists of the main unit, satellite module rack and parameter modules of the patient monitor. It helps the engineer to identify the parts during disassembling the patient monitor and replacing the parts.

Hardware architecture of the main unit is shown below:
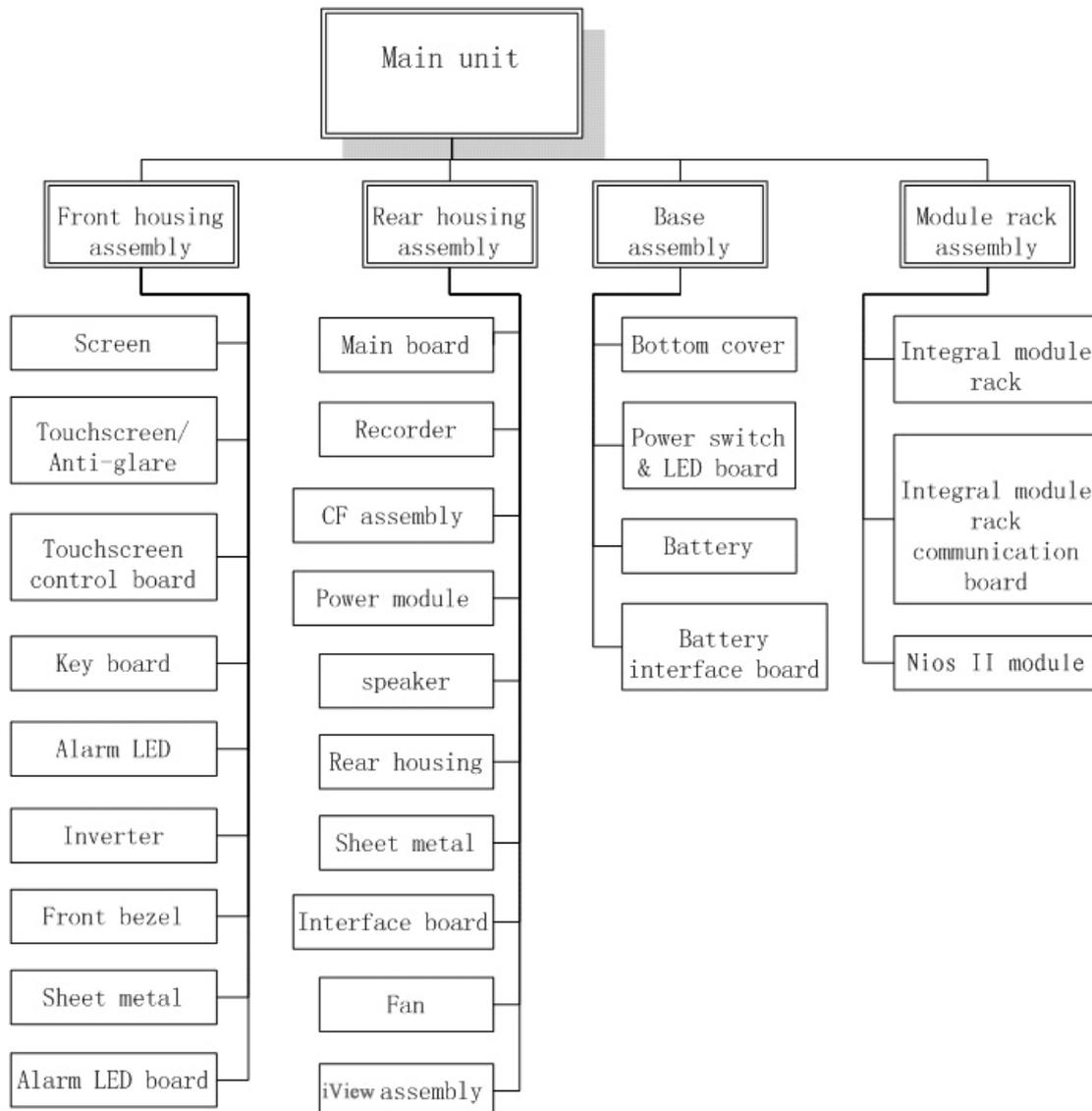
6.2 Main Unit (T6/T8）

Exploded View
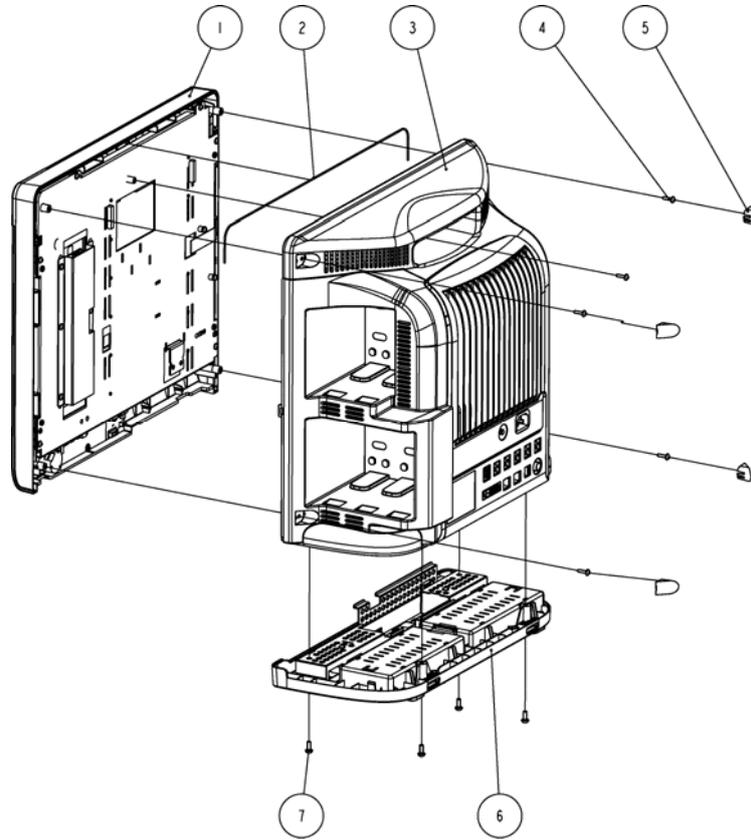
Parts List

SN	P/N	Description	Qty
1	6800-30-50479 or 6800-30-50480	Front housing assembly(17" LCD, anti-glare screen,T8） Front housing assembly（17" LCD, touchscreen,T8)	1
1	6800-30-50936 or 6800-30-50937	Front housing assembly(15"LCD, touch screen, T6) Front housing assembly(15"LCD, Anti-glare Screen, T6)	1
2	M6G-020015---	Hose, 0.47 m	1
3	6800-30-50637	Rear housing assembly	1
4	M04-004017---	Crosshead screw M3×12	5
5	6800-20-50189 or 043-004044-00	Screw cap	4
6	6800-20-50468	Base assembly	1
7	M04-051001---	Screw, M4×12	4

6.3 Main Unit (T9)

Exploded View
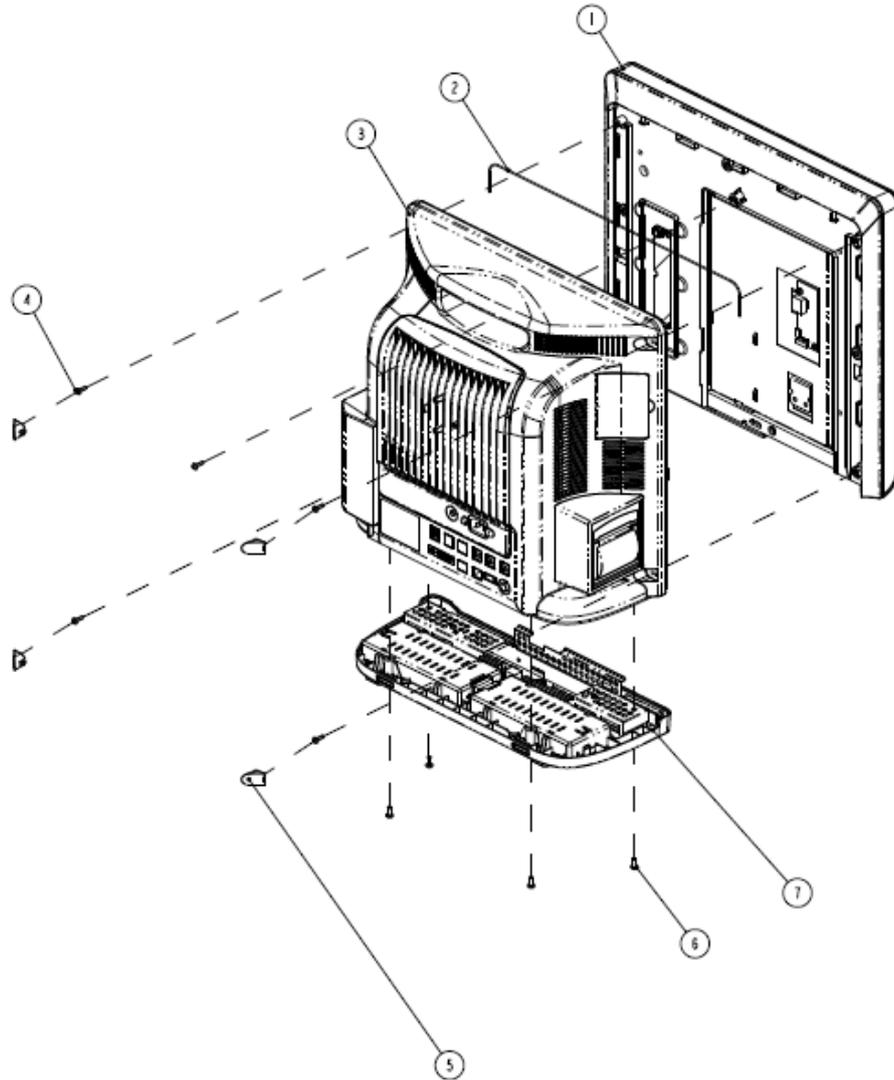
Parts List

SN	P/N	Description	Qty
1	115-022476-00	Front housing assembly (T9)	1
2	M6G-020015---	Hose, 0.47 m	1
3	6800-30-50637	Rear housing assembly	1
4	M04-004017---	Crosshead screw M3×12	5
5	043-004044-00	Screw cap	4
6	M04-005405---	Crosshead screw	4
7	6800-30-50468	Base assembly	1

6.4 Base Assembly

Exploded View
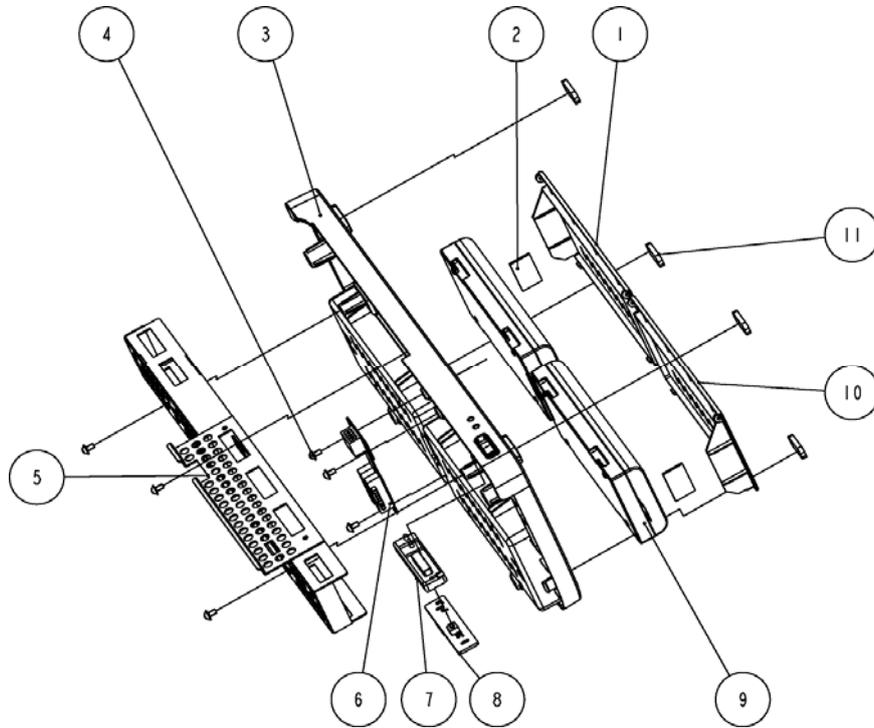
Parts List

SN	P/N	Description	Qty
1	6800-20-50183 or 043-004072-00	Battery cover L	1
2	6800-20-50386	Battery cover spacer	2
3	6800-20-50181-51 or 043-004135-00	Bottom cover (T8)	1
4	M04-004012---	Crosshead screw M3×6	6
5	6800-20-50212	Base support	1
6	6800-30-50108	Battery interface board	1
7	6800-20-50201-51	Power switch (T8)	1
8	6800-30-50088	Power switch board	1
9	M05-010002-06	Lithium battery, 1.1 V, 4500 mAh	2
10	6800-20-50182 or 043-004071-00	Battery cover L	1
11	6800-20-50233	Cushion	4

6.5 Front housing Assembly

6.5.1 17" LCD with Anti-glare Screen

Exploded View
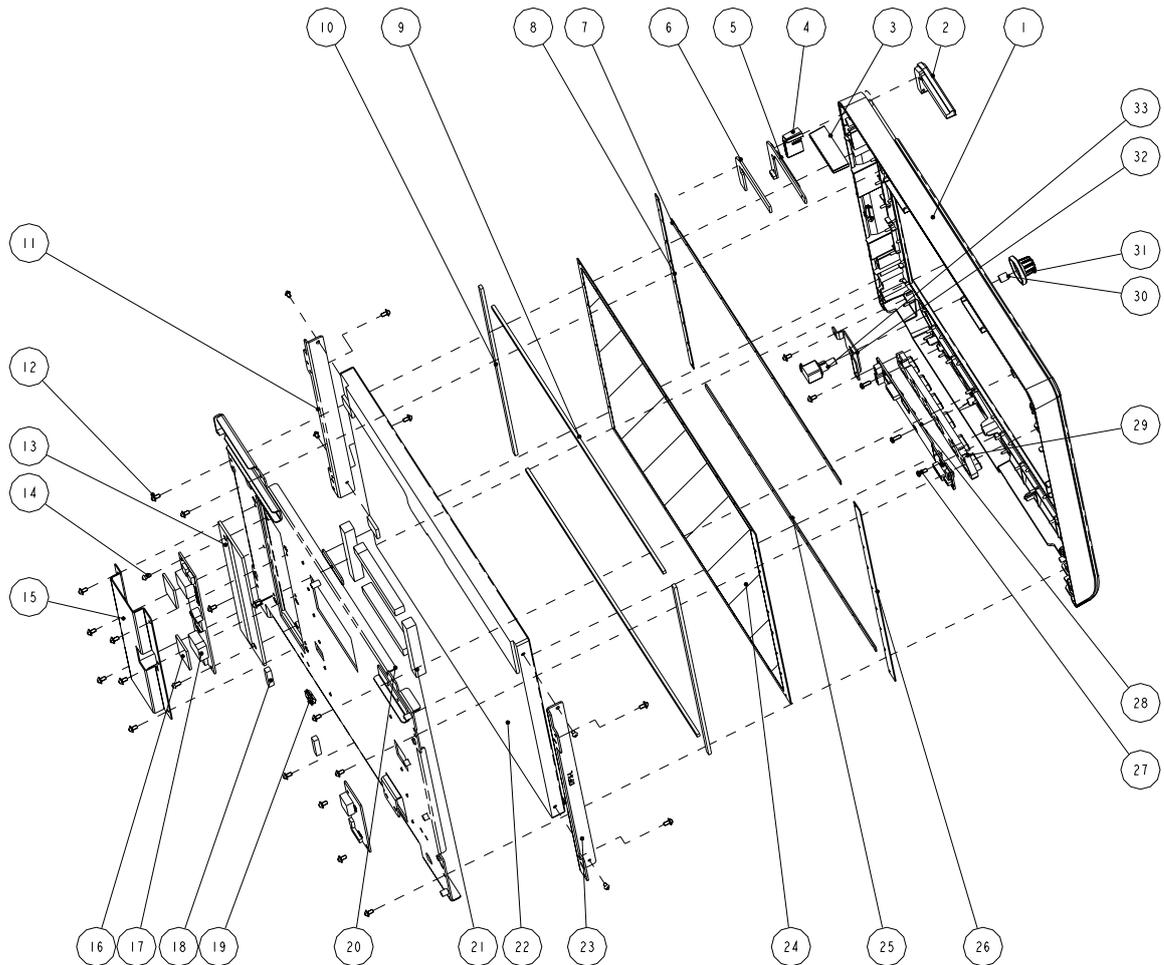
Parts List

SN	P/N	Description	Qty
1	043-000484-00 or 043-000484-01	Front housing (T8)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conduction block 2	1
4	6800-20-50389	Light conduction block 1	1
5	6800-30-50086	Alarm LED board	1
6	6800-20-50691	Insulating strip for alarm LED board	1

SN	P/N	Description	Qty
7	6800-20-50220	PC cusion 1	1
8	6800-20-50221	PC cusion 2	1
9	6800-20-50228	Dust-proof pad 7	2
10	6800-20-50227	Dust-proof pad 6	2
11	6800-20-50207	Screen support 4(for 17" anit-glare screen)	1
12	M04-004012---	Crosshead screw M3×6	22
13	6800-20-50232	Backlight board insulating sheet	1
14	M04-002505---	Crosshead screw M3×6	2
15	6800-20-50671	Backlight board shielded cover	1
16	6800-20-50692	Backlight board insulating sheet	2
17	0000-10-11072	Converter DC-AC12VDC/700Vrms	1
18	9901-10-23920	Conducting foam 0501080	0.8
19	0000-10-10996	Leaf 92-047	1
20	042-000575-00	Screen mounting plate	1
21	M6T-030003---	Conducting foam, 4105AB51K	4
22	021-000043-00 or 0000-10-11069 (optional)	17"LCD screen	1
23	6800-20-50206	Screen support 3(for 17" anit-glare screen)	1
24	6800-20-50336	Anti-glare screen	1
25	6800-20-50392	PC cusion 4	1
26	6800-20-50391	PC cusion 3	1
27	M04-003105---	Tapping screw PT3×8	3
28	115-001326-01	T8 button board (anti-glare/optical encoder) (without shank)	1
29	6800-20-50198	Silicon buttons	1
30	M6T-040001---	Clamp spring.1707P	1
31	0651-20-76735	Knob (mould MR76734)	1
32	042-000693-00	Knob mounting plate	1
33	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1

6.5.2 15" LCD with Anti-glare Screen

Exploded View

Parts List

SN	P/N	Description	Qty
1	043-000483-00 or 043-000483-01	Front bezel (T6)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conduction block 2	1
4	6800-20-50389	Light conduction block 1	1
5	6800-30-50086	Alarm LED board	1
6	6800-20-50691	Insulating strip for alarm LED board	1
7	6800-20-50220	PC cusion 1	1
8	6800-20-50221	PC cusion 2	1
9	6800-20-50686	Dust-proof pad 9	1

SN	P/N	Description	Qty
10	6800-20-50687	Dust-proof pad 10	1
11	6800-20-50211	Screen support 8	1
12	M04-004012---	Crosshead screw M3×6	22
13	6800-20-50232	Backlight board insulator	1
14	M04-002505---	Crosshead screw M3×6	2
15	6800-20-50671	Backlight board shield	1
16	6800-20-50692	Backlight board insulating sheet	2
17	0000-10-10750 or 0000-10-11073 (Optional)	Backlight board	1
18	9901-10-23920	Conducting foam.0501080	0.8
19	0000-10-10996	Berylium & bronze leaf 92-047	1
20	042-000575-00	Screen mounting plate	1
21	M6T-030004---	Conducting foam	1
22	0000-10-10753 or 0000-10-11068 (optional)	LCD Display （0000-10-11068 only used together with optional inverter 0000-10-11073）	1
23	6800-20-50210	Screen support 7	1
24	6800-20-50239	Light shield	1
25	6800-20-50688	Dust-proof pad 11	1
26	6800-20-50689	Dust-proof pad 12	1
27	6800-20-50336	Anti-glare screen	1
28	6800-20-50392	Anti-glare waterproof strip	1
29	6800-20-50391	PC cusion 3	1
30	M04-003105---	Tapping screw PT3×8	3
31	115-004217-00	Button board (anti-glare screen/optical encoder) (without shank)	1
32	6800-20-50198	Key pad	1
33	M6T-040001---	Clamp spring.1707P	1
34	0651-20-76735	Knob (mould MR76734)	1
35	042-000693-00	Knob encoder mounting board	1
36	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1

6.5.3 19" LCD Touchscreen

Exploded View
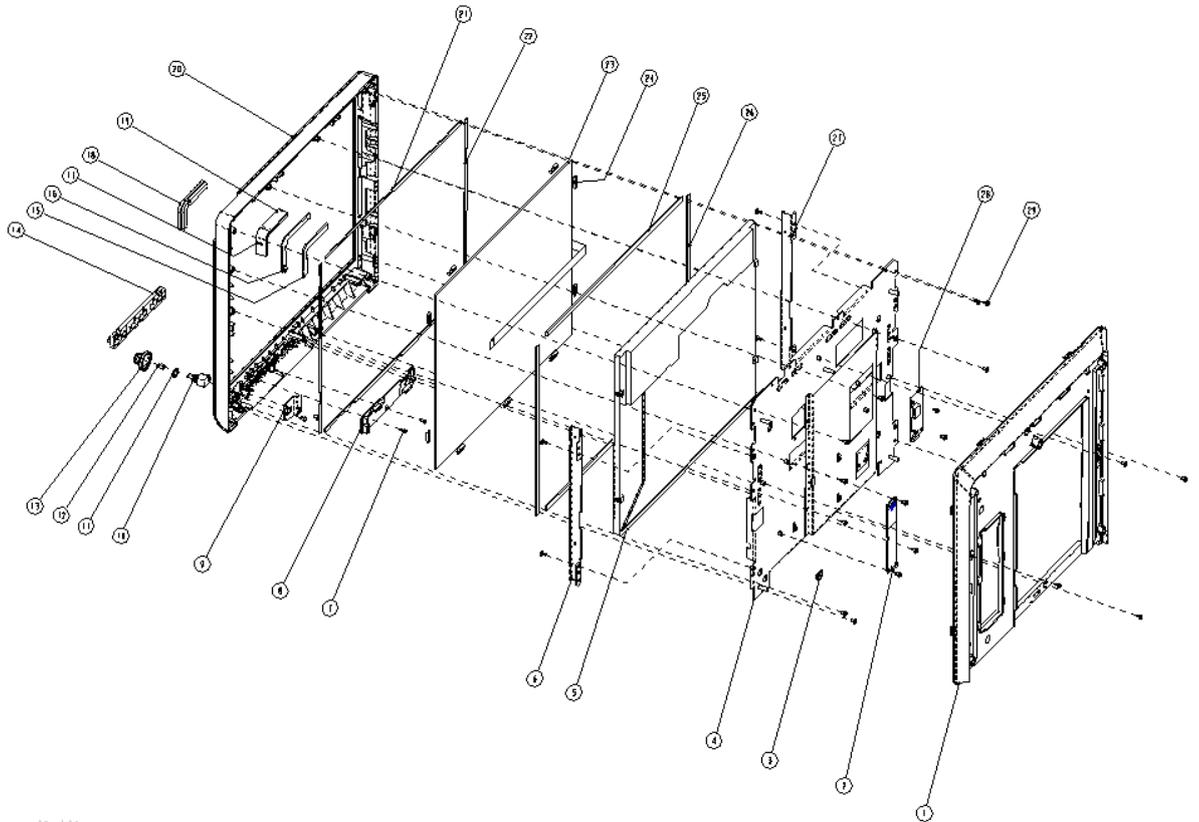
Parts List

SN	P/N	Description	Qty
1	043-003550-00	Middle frame(T9)	1
2	051-001516-00	LED backlight adapter board	1
3	0000-10-10996	Leaf, 92-047	1
4	042-009881-00	Bracket (19")	1
5	021-000137-00	LCD screen, TFT, 19″	1
6	042-009883-00	19"right fixing bracket	1
7	M04-003105---	Tapping screw PT3×8	3
8	6800-30-50084	Button board	1
9	042-000693-00	Knob mounting plate	1
10	0000-10-10789	Optical encoder	1
11	0651-20-76773	Waterproof strip for encoder	1
12	M6T-040001---	Clamp spring, 1707P	1
13	0651-20-76735	Knob (mould MR76734)	1
14	6800-20-50198	Silicon buttons	1

SN	P/N	Description	Qty
15	6800-20-50691	Insulating strip for alarm LED board	1
16	6800-30-50086	Alarm LED board	1
17	6800-20-50389	Light conduction block 1	1
18	6800-20-50199	Alarm LED cover	1
19	6800-20-50390	Light conduction block 2	1
20	043-003871-00	Front bezel (T9)	1
21	048-003353-00	Touchscreen waterproof strip 2	2
22	048-003352-00	Touchscreen waterproof strip 1	2
23	021-000135-00	Touchscreen, resistance-type, 19″	1
24	049-000346-00	Touchscreen, location block, 12″	9
25	048-003351-00	19" touchscreen underlay 2	2
26	048-003350-00	19" touchscreen underlay 1	2
27	042-009882-00	19"right fixing bracket	1
28	6800-30-50082	Touchscreen control board	1
29	M04-004012---	Crosshead screw M3×6	32
30	009-003866-00	Cable for alarm lamp board	1
31	009-003867-00	Flat wire (T9)	1
32	009-003868-00	Cable for backlight board	1
33	6800-20-50450	Cable for connecting button board and main board	1
34	009-000248-00	Cable for connecting new backlight board and button board (AU)	1
35	6800-20-50157	Touchscreen control board cable	1
36	6800-20-50159	Power switch & LED board cable	1
37	M6G-020015---	Hose, 0.47 m	550mm
38	9901-10-23920	Conducting foam	870mm
39	M6T-030003---	Conducting foam, 4105AB51K	80mm

6.5.4 17" LCD Touchscreen

Exploded View
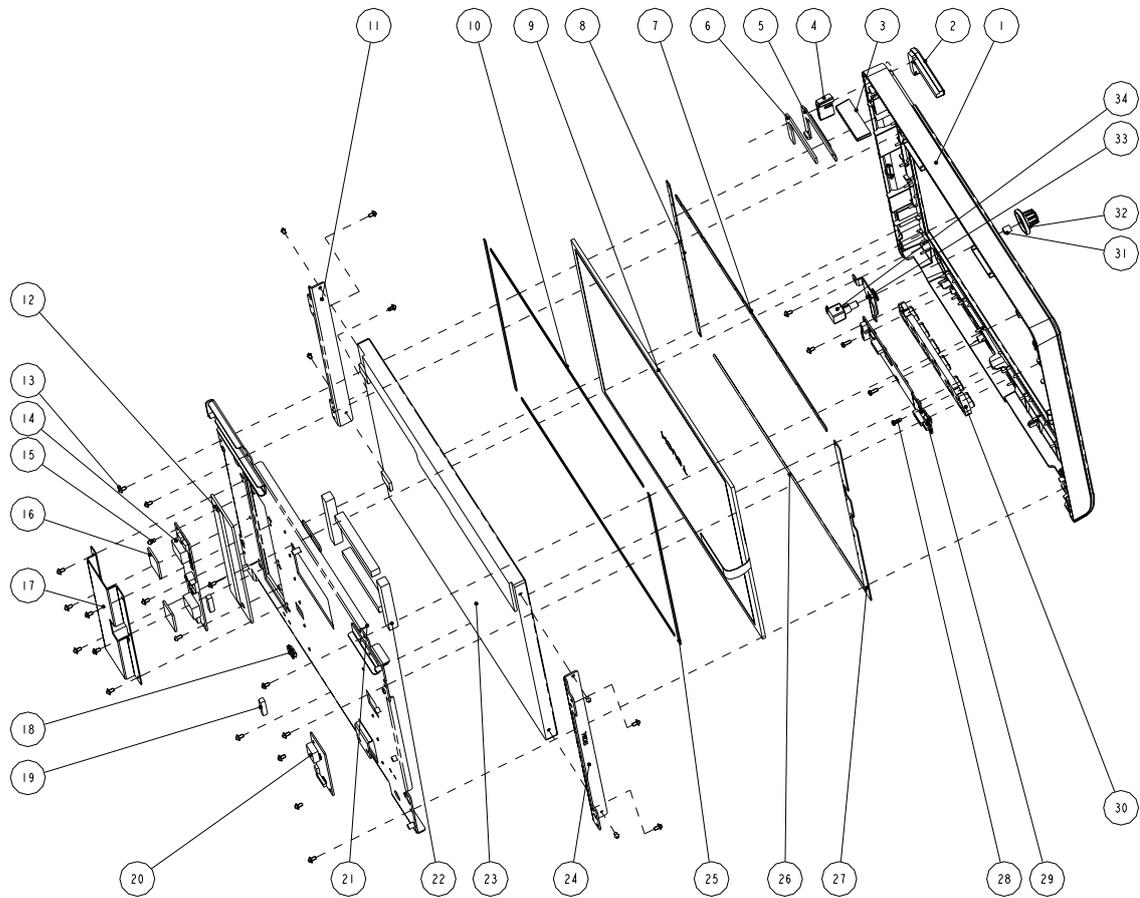
Parts List

SN	P/N	Description	Qty
1	043-000484-00 or 043-000484-01	Front bezel (T8)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conducting block2	1
4	6800-20-50389	Light conducting block1	1
5	6800-30-50086	Indicator board	1
6	6800-20-50691	Insulating strip for alarm LED board	1
7	6800-20-50222	Dust-proof pad 1	1
8	6800-20-50223	Dust-proof pad 2	1
9	0000-10-11071 or 0000-10-10748 (optional)	Touchscreen, resistance, 17.1″	1

SN	P/N	Description	Qty
10	6800-20-50226	Dust-proof pad 5	2
11	6800-20-50205	Screen support 2(for 17" touchscreen)	1
12	6800-20-50232	Backlight board	1
13	M04-004012---	Crosshead screw M3×6	22
14	0000-10-11072	Backlight board	1
15	M04-002505---	Crosshead screw M3×6	2
16	6800-20-50692	Backlight board insulating sheet	2
17	6800-20-50671	Backlight board shield	1
18	0000-10-10996	Berylium-bronze leaf 92-047	1
19	9901-10-23920	Conducting foam0501080	2
20	6800-30-50082 or 6800-30-51095 (optional)	Touchscreen control board （6800-30-51095 only used together with the optional touchscreen 0000-10-10748）	1
21	042-000575-00	Screen mounting plate	1
22	M6T-030003---	Conducting foam, 4105AB51K	4
23	021-000043-00 or 0000-10-11069 (optional)	LCD screen	1
24	6800-20-50204	Screen support 1(for 17' touchscreen)	1
25	6800-20-50225	Dust-proof pad 4	2
26	6800-20-50224	Dust-proof pad 3	1
27	6800-20-50142	Touchscreen waterproof strip	1
28	M04-003105---	Tapping screw PT3×8	3
29	115-004216-00	T8 button board (touchscreen/optical encoder) (without shank)	1
30	6800-20-50198	Silicon buttons	1
31	M6T-040001---	Clamp spring.1707P	1
32	0651-20-76735	Knob (mould MR76734)	1
33	042-000693-00	Knob mounting plate	1
34	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1

6.5.5 15" LCD Touchscreen

Exploded View

Parts List

SN	P/N	Description	Qty
1	043-000483-00 or 043-000483-01	Front bezel (T6)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conducting block2	1
4	6800-20-50389	Light conducting block1	1
5	6800-30-50086	Alarm LED board	1
6	6800-20-50198	Silicon buttons	1
7	6800-20-50691	Insulating strip for alarm LED board	1
8	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1
9	6800-20-50222	Dust-proof pad 1	1
10	6800-20-50223	Dust-proof pad 2	1
11	0000-10-11071 or 0000-10-10748 (Optional)	Touchscreen, resistance, 17.1″ five lines	1
12	6800-20-50178 or 043-004068-00	LCD fixed plate 1	4

SN	P/N	Description	Qty
13	6800-20-50686	Dust-proof pad 9	1
14	6800-20-50687	Dust-proof pad 10	1
15	6800-20-50239	Light shield	1
16	6800-20-50209	Screen support 6	1
17	M04-051001-01	Crosshead screw M3×4	4
18	6800-20-50232	Backlight board	1
19	M04-004012---	Crosshead screw M3×6	26
20	6800-20-50692	Backlight board insulating sheet	2
21	6800-20-50671	Backlight board shield	1
22	M04-002505---	Crosshead screw M3×6	2
23	0000-10-10750 or 0000-10-11073（optional ）	Backlight board	1
24	0000-10-10996	Berylium leaf 92-047	1
25	9901-10-23920	Conducting foam.0501080	2
26	6800-30-50082 or 6800-30-51095 (optional)	Touchscreen control board （6800-30-51095 only used together with optional touchscreen 0000-10-10748）	1
27	042-000575-00	Screen mounting plate	1
28	M6T-030004---	Conducting foam	4
29	0000-10-10753 or 0000-10-11068 (optional)	15" LCD （0000-10-11068 only used together with optional inverter 0000-10-11073）	1
30	6800-20-50208	Screen support 5	1
31	6800-20-50688	Dust-proof pad 11	1
32	6800-20-50689	Dust-proof pad 12	1
33	6800-20-50179 or 043-004069-00	LCD fixed plate 2	6
34	6800-20-50142	Touchscreen waterproof strip	1
35	6800-20-50224	Dust-proof pad 3	1
36	M04-003105---	Tapping screw PT3×8	3
37	115-004218-00	T6 button board(touchscreen/optical encoder) (without shank)	1
38	042-000693-00	Knob encoder mounting board	1
39	M6T-040001---	Clamp spring.1707P	1
40	0651-20-76735	Knob (mould MR76734)	1

6.6 Rear Housing Assembly

6.6.1 Rear Housing Assembly

Exploded View
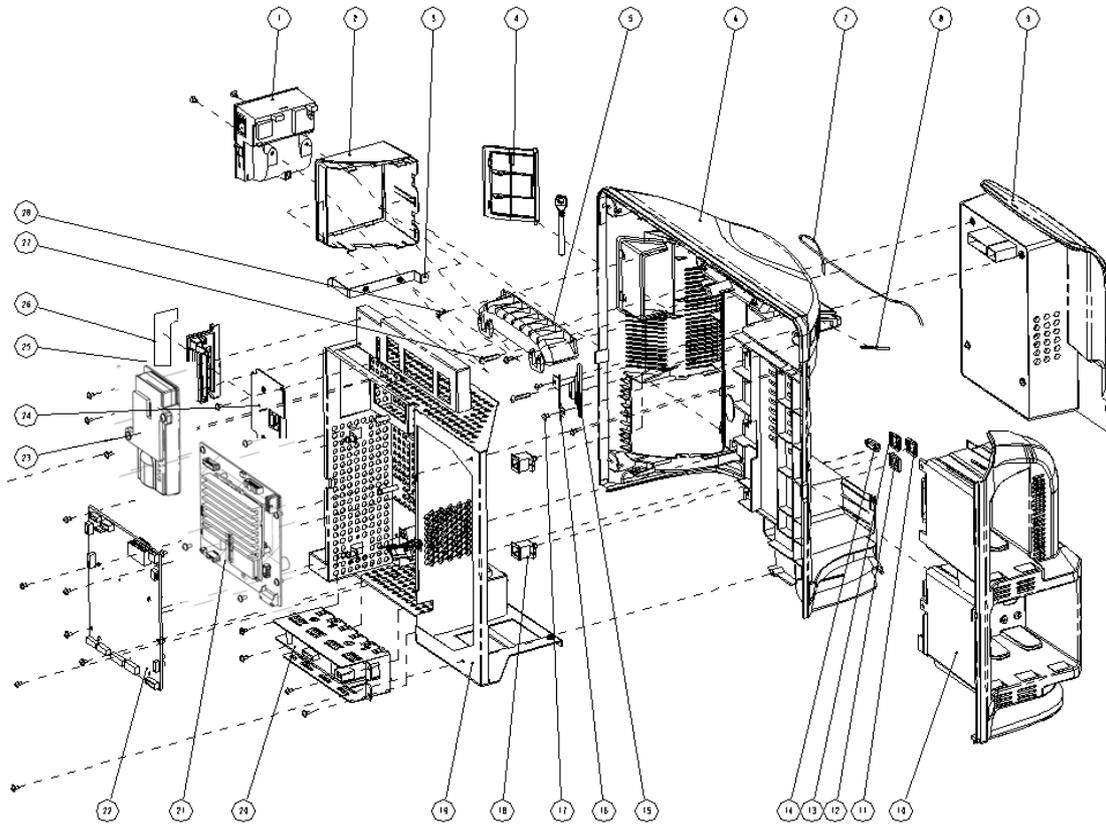
Parts List

SN	P/N	Description	Qty
1	TR6F-30-67306 or 115-001290-00	TR6F recorder	1
2	6800-20-50193 or 043-004046-00	Recorder chamber	1
3	6800-20-50213	Recorder support rack	1
4	6800-20-50196 or 043-004075-00	CF card door	1
5	6800-20-50185 or 043-004073-00	Handle cover	1
6	043-000060-00 or 043-000060-01	Rear housing (new connector)	1

SN	P/N	Description	Qty
7	M6G-020015---	Hose, 0.3m	1
8	6800-20-50234	Waterproof strip I	1
9	6800-30-50475	Power module assembly	1
10	6800-30-50469	Module rack (maximum configuration)	1
11	043-000561-00 or 043-000561-01	Grey USB cover	1
12	043-000471-00 or 043-000471-01	CIS network port cover	1
13	043-000470-00 or 043-000470-01	USB cover	1
14	043-000469-00 or 043-000469-01	MiniDB9 cover (T8)	1
15	6200-21-11629	Speaker	1
16	6800-20-50195	Speaker pad	1
17	M04-004012---	Crosshead screw M3×6	27
18	6800-20-50187 or 043-004076-00	plug	2
19	6800-30-50533 or 115-003226-00	Main support assembly	1
20	6800-30-50476 or 115-003227-00	Interface board assembly	1
21	115-016498-00	iView assembly (SSD hard drive)	1
22	6800-30-50532 or 115-003232-00	Main board assembly	1
23	115-015188-00	6800 wireless AP kit (ASUS)	1
24	115-001868-00	6800 CF card assembly (9211 driving board)	1
25	6800-20-50395 or 043-004074-00	WLAN tray	1
26	6800-20-50143 or 047-011878-00	WLAN overlay	1
27	M04-051054---	Crosshead screw M4×20	2
28	M04-004015---	Crosshead screw M3×8	2

6.6.2 Power module

Exploded View
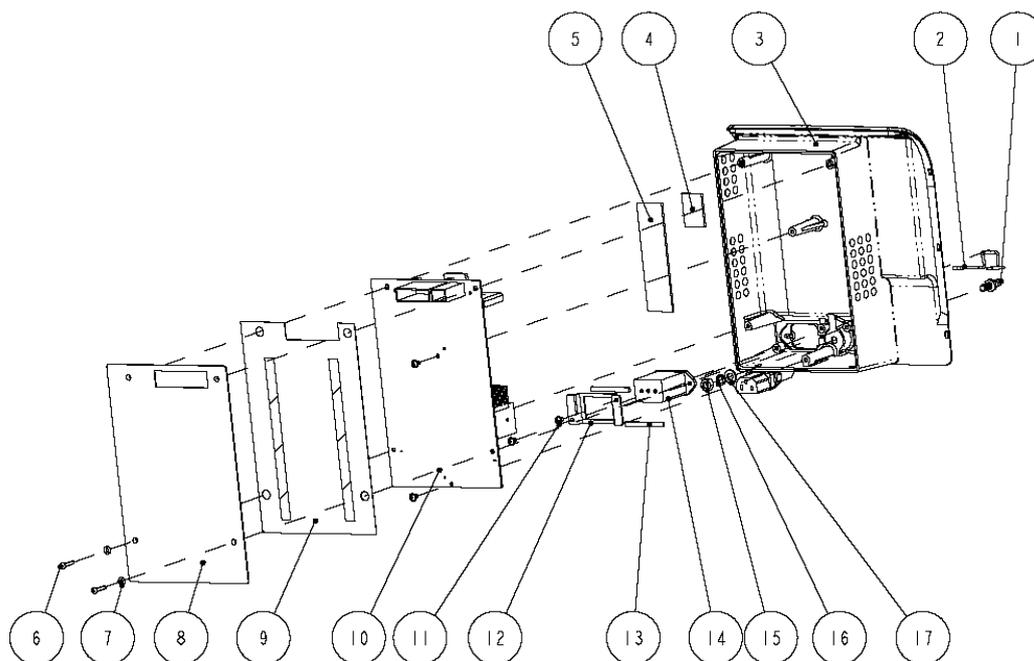
Parts List

SN	P/N	Description	Qty
1	0509-20-00098	Grounding terminal	1
2	9211-20-87369	Pothook for power supply plugs	1
3	6800-20-50197-51 or 044-000447-00	Power module chamber (T8)	1
4	6800-20-50692	Backlight board insulating sheet	1
5	6800-20-50693	Backlight board insulating plate I, 100×27 mm	1
6	M04-004017---	Philips pan head screw GB9074.5-88 M3×12	2
7	M04-021024---	Large washer class A GB/T96.1-2002 3	2
8	6800-20-50219	Sheet metal	1
9	6800-20-50465	Power board insulating sheet	1
10	6800-30-50050 or 051-000193-00	6800 power board 6800 power board PCBA (No voltage decrease, 5V CIS power board)	1
11	M04-004012---	Crosshead screw M3×6	4
12	6800-20-50218	power socket fixture	1
13	6800-20-50636	Waterproof strip for power socket	2

SN	P/N	Description	Qty
14	009-000255-00	AC input connector and cable	1
15	M04-004401---	Stainless steel nut, hexagon GB/T6170-2000 M6 polished	1
16	M04-004504---	Spring washer	1
17	M04-021003---	Flat washer	1

6.6.3 Integral Module Rack

Exploded View
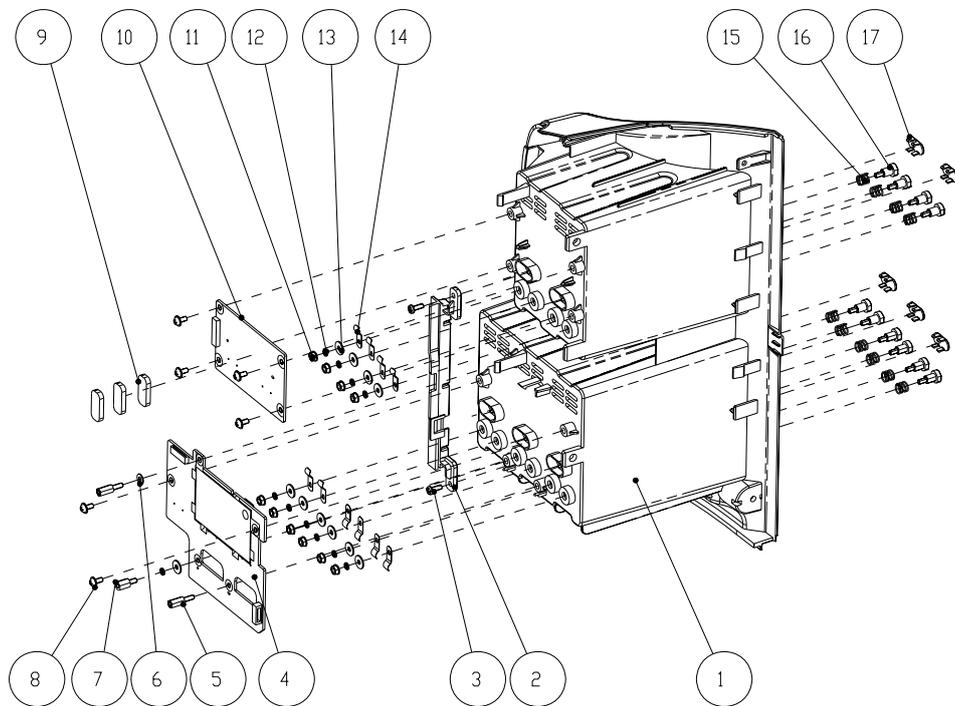
Parts List

SN	P/N	Description	Qty
1	6800-20-50190 or 043-004078-00	Side plate, rear housing-ALL	1
2	6800-20-50191 or 043-004042-00	Side plate small cover, rear housing -ALL	1
3	M04-003105---	Tapping screw PT3×8	2
4	051-000243-00	6800 three-slot module rack communication board	1
5	M04-000306---	stud screw M3X10+8-8, coated with antirust nickel	2
6	M04-021024---	Large Flat Washer, GB96 3	1
7	M04-030035---	plastic stud screw M3X8+6-6	1

SN	P/N	Description	Qty
8	M04-004012---	Philips pan head screw M3×6	6
9	6800-20-50233	Rubber feet	3
10	6800-30-50073	MPM module rack communication board	1
11	M04-000301---	Stainless steel hexagon nut GB/T6170-2000 M3 polished	10
12	M04-000802---	Flat washer-grade A GB/T97.1-20023 nickel plated to resist rust	11
13	M04-000104---	Standard spring washerGB/T93-1987 3 nickel plated to resist rust	11
14	6800-20-50388	Leaf	10
15	6800-20-50261	Contact spring	10
16	6800-21-51100	Contact screw	10
17	6800-20-50279	Infrared lens	5

6.6.4 Interface Board Assembly

Exploded View (6800-30-50476)
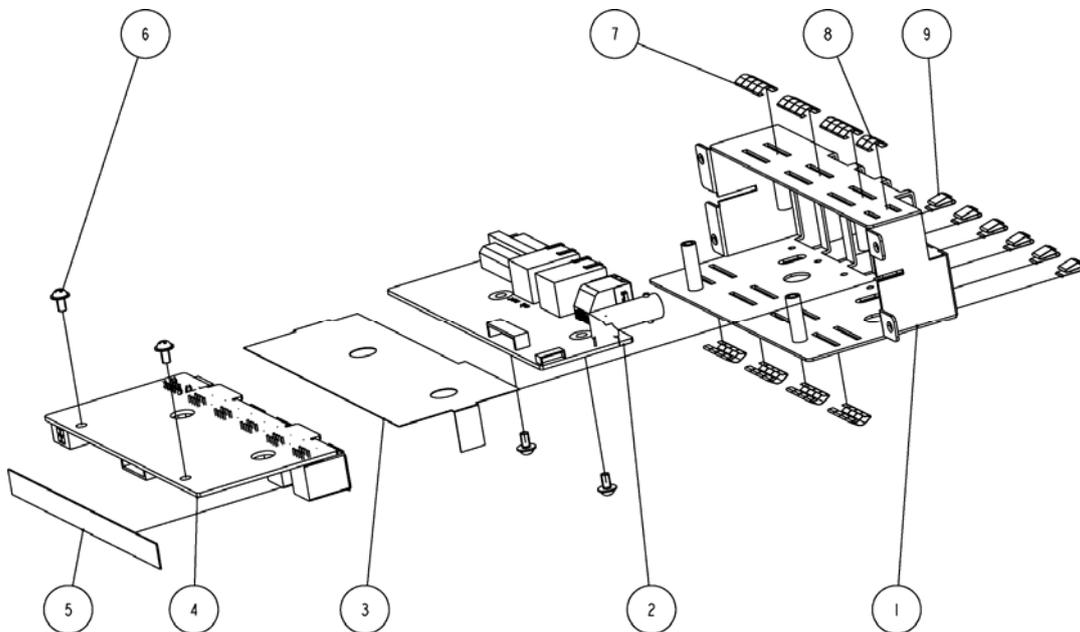
Parts List

SN	P/N	Description	Qty
1	042-000055-00	T8 interface support (new interface)	1
2	051-000221-00	6800 DVI interface board (full configuration)	1
3	6800-20-50241	Interface board insulating plate	1
4	051-000222-00	6800 USB interface board (full configuration)	1
5	6800-20-50745	Waterproof strip	1
6	M04-004012---	Screw, M3×6	4
7	M6T-030005---	Berilium & bronze leaf 187S30（4 leaves）	7
8	M6T-030005---	Berilium & bronze leaf 187S30（2 leaves）	1
9	M6T-030006---	Berilium & bronze leaf 92-106 nickel plated	6

Exploded View (115-003227-00)
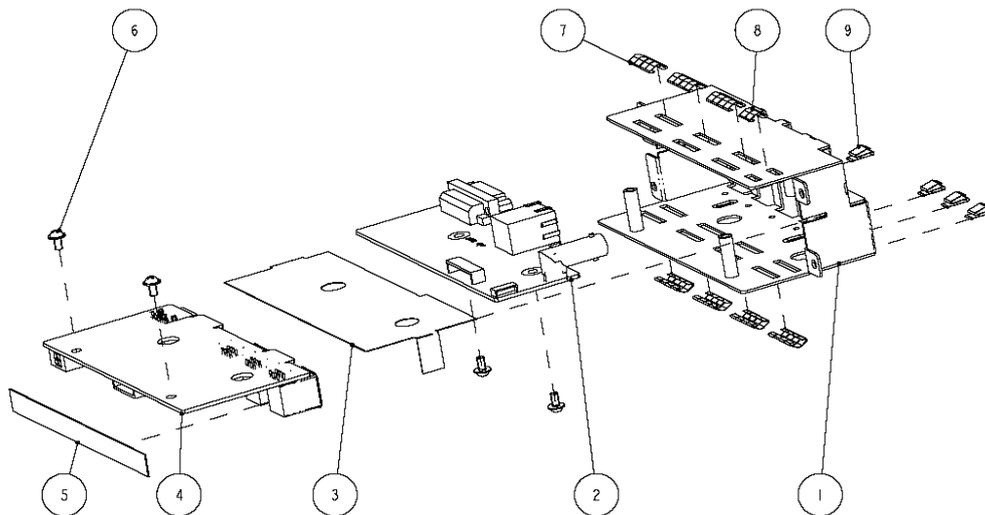
Parts List

SN	P/N	Description	Qty
1	042-000055-00	T8 interface support (new interface)	1
2	051-000221-01	6800 DVI interface board (standard configuration)	1
3	6800-20-50241	Interface board insulating plate	1
4	051-000222-01	6800 USB interface board (standard configuration)	1
5	6800-20-50745	Waterproof strip	1
6	M04-004012---	Screw, M3×6	4
7	M6T-030005---	Berilium & bronze leaf 187S30	7
8	M6T-030005---	Berilium & bronze leaf 187S30	1
9	M6T-030006---	Berilium & bronze leaf 92-106 , nickel plated	6

6.6.5 Main Support Assembly (T8/T9)

Exploded View
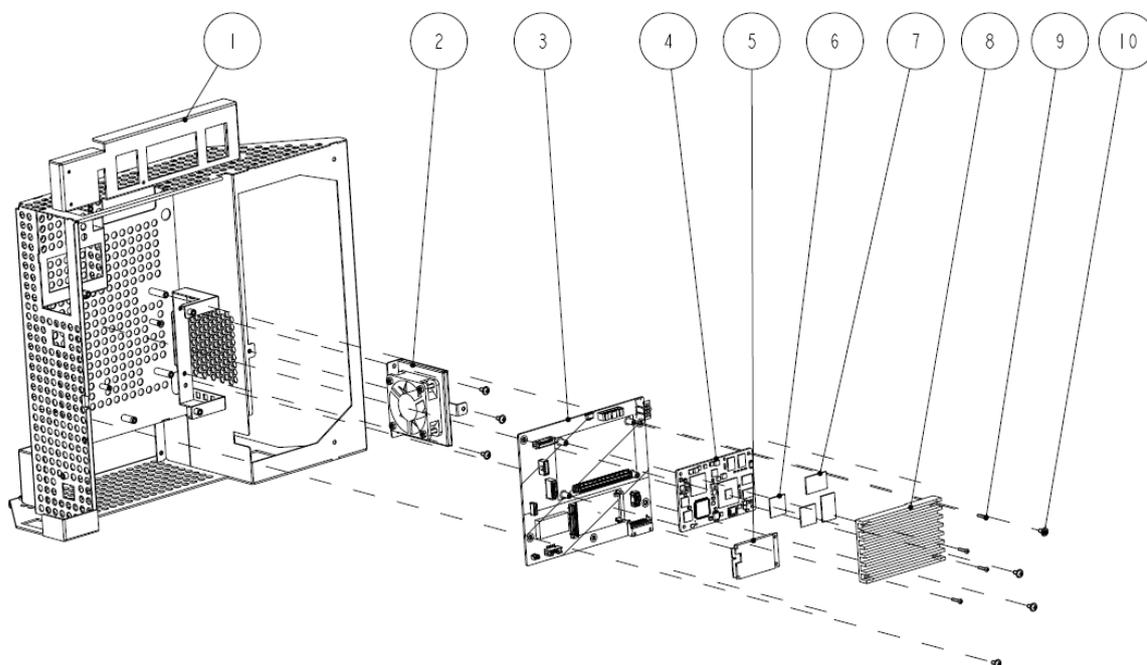
Parts List

SN	P/N	Description	Qty
1	6800-20-50215	Main support	1
2	6800-30-50509	Fan assembly	1
3	051-001300-00	6800 COME CIS Motherboard PCBA	1
4	023-000570-00	COM N2600 NM10 DDR3 onboard 2GB	1
5	023-000544-00	SSD 128GB MLC mSATA	1 (Optional)
6	047-009148-00	Thermal Pad/Chomerics/3.0/17*17*1	2
7	047-009104-00	Thermal Pad/Chomerics/3.0/23*15*1	2
8	045-000781-00	PC heatsink of iView	1
9	M04-051020---	Countersunk flat head screw, M2×10	4
10	M04-004012---	Pan head screw with washer, M3×6	7

6.6.6 Main Support Assembly (T6)

Exploded View
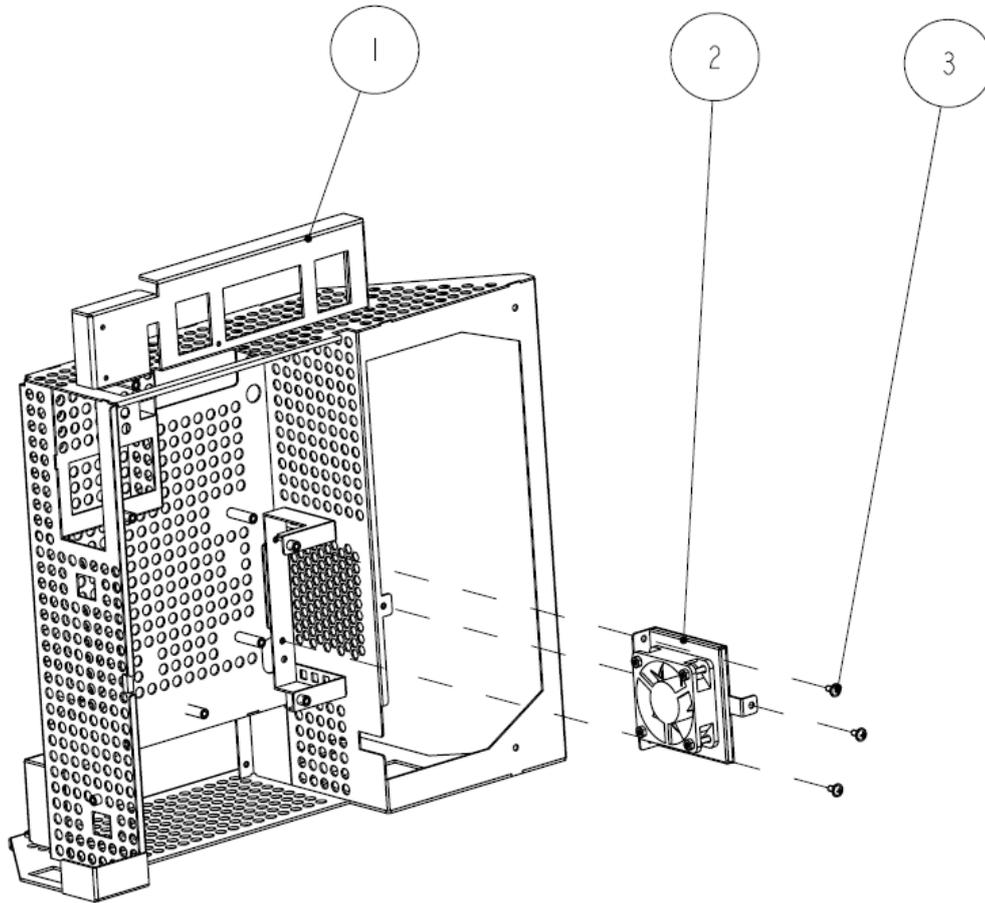
Parts List

SN	P/N	Description	Qty
1	6800-20-50215	Main support	1
2	6800-30-50509	Fan assembly	1
3	M04-004012---	Pan head screw with washer, M3×6	3

6.6.7 Main Control Board Assembly

Exploded View
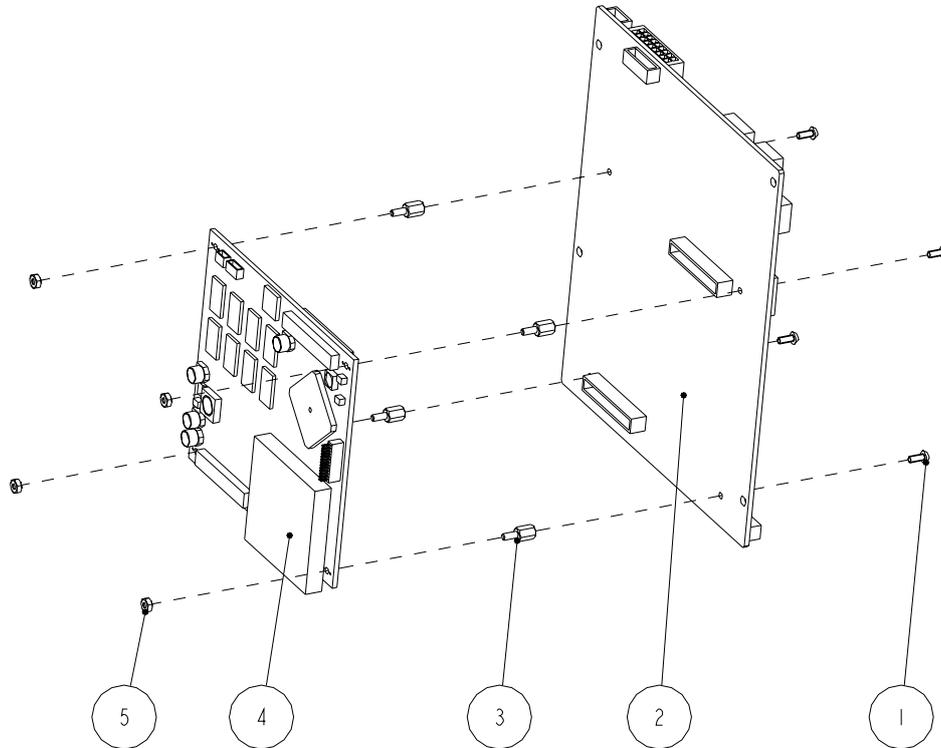
Parts List

SN	P/N	Description	Qty
1	M04-051045---	Cross head screw M2.5×6	4
2	051-000220-00 or 051-000220-01	6800 mother board (full configuration) 6800 mother board (standard configuration)	1
3	M04-060021---	Stud M2.5x7+6-6	4
4	6800-30-50058 or 6812-30-66989	MCF547x CPU module (basic configuration/lead-free)	1
5	M04-011001---	Nut GB6170 M2.5	4

6.6.8 6800 Wireless AP Kit (ASUS)

Exploded View
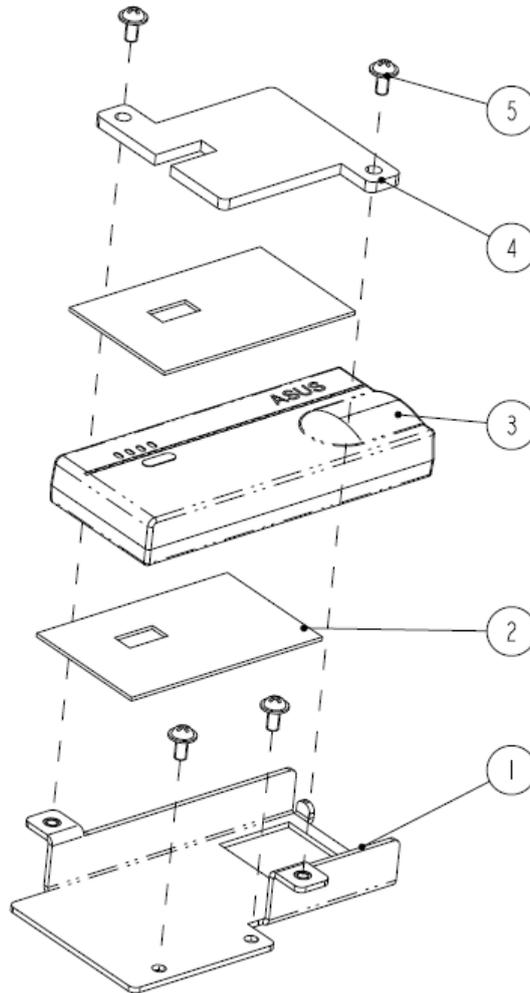
Parts List

SN	P/N	Description	Qty
1	042-000599-00	T8 wireless AP mounting support	1
2	047-008023-00	Thermal pad for wireless card	2
3	023-000505-00	Wireless router 150Mbps Wi-Fi	1
4	042-007523-00	Cover for wireless LAN (T8)	1
5	M04-004012---	Cross pan head screw with washer M3×6	4
6	009-002895-00	Cable for AP wireless (6100)	1

6.6.9 Others

P/N	Description	Qty
iView assembly －115-016498-00		
6800-20-50304	Ethernet cable for DVI interface board	1
051-001300-00	6800 COME iView Motherboard PCBA	1
023-000570-00	COM N2600 NM10 DDR3 onboard 2GB	1
023-000544-00	SSD 128GB MLC mSATA	1
047-009148-00	Thermal Pad /Chomerics/3.0/17*17*1	2
047-009104-00	Thermal Pad/Chomerics/3.0/23*15*1	2
045-000781-00	PC Heatsink of iView	1
M04-051020---	Countersunk flat head screw, M2×10	4
M04-004012---	Pan head screw with washer, M3×6	4
M04-051045-00	Stainless steel crosshead screw	4
009-003228-00	iView flat signal wire	1
TR6F recorder－TR6F-30-67306		
0000-10-11079	Thermal print head	1
9201-20-36007	Grounding wire	1
M04-051003---	Crosshead tapping screw PT2×6	6
TR6F-20-67300	Recorder chamber	1
TR6F-20-67301	Recorder door	1
TR6F-20-67302	Spanner	1
TR6F-20-67303	Internal adapter	1
TR6F-20-67304	Back spring	1
TR6F-20-67305	Silicon button	1
TR6F-20-67307	Overlay	1
TR6F-20-67314	Cable from recorder drive board to recorder button board	1
TR6F-30-67308	Recorder button board	1
TR6F-30-67310	Recorder drive board	1
TR6F recorder (Datascope)－115-001290-00		
0000-10-11079	Thermal print head	1
M04-051003---	Crosshead tapping screw PT2×6	5
PR1A-20-13639	Sensor cable label	1
043-000072-00	Recorder door (DPM)	1
TR6F-20-67304	Back spring	1

TR6F-20-67305	Silicon button	1
TR6F-20-67307	Overlay	1
TR6F-20-67314	Cable from recorder drive board to recorder button board	1
TR6F-20-67319	Overlay	1
TR6F-30-67308	Recorder button board	1
TR6F-30-67310	Recorder drive board	1
6101-20-46746	Grounding wire (6101)	1
043-001269-00	Recorder chamber (DPM)	1
043-001273-00	Spanner (DPM)	1

6.7 SMR Assembly

6.7.1 SMR Assembly

Exploded View
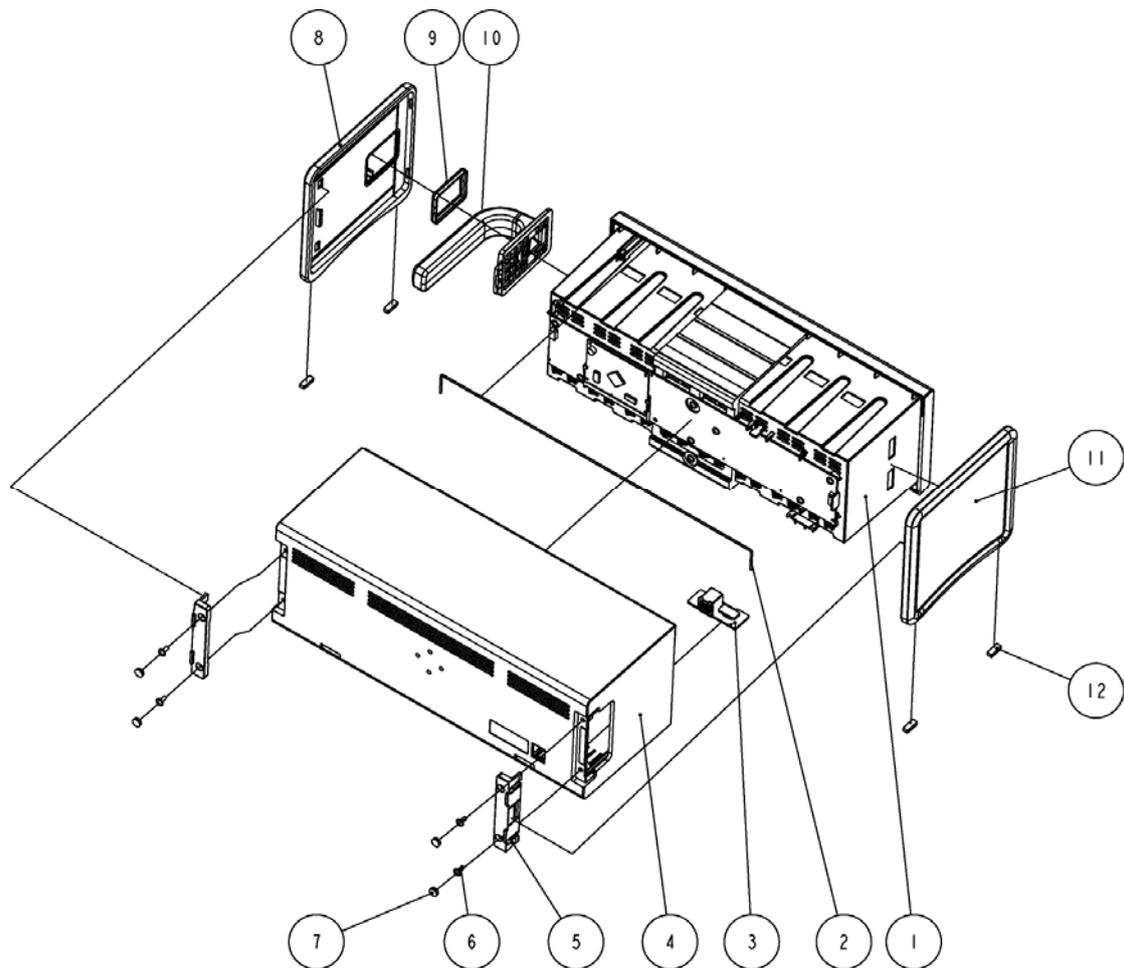
Parts List

SN	P/N	Description	Qty
1	6800-20-50249-51 or 6800-20-50249-52 or 043-004118-00 or 043-004119-00	Inside assembly	1
2	M6G-020015---	Hose	1
3	6800-30-51154	Interface board	1
4	6800-20-50250 or 043-004120-00	Rear housing	1
5	6800-20-50254 or 043-004054-00	Side plate fixture	2
6	M04-004015---	Crosshead screw M3×8	4
7	6800-20-50308 or 049-000650-00	Screw cap 2	4
8	6800-20-50253 or 043-004053-00	Side plate, right	1
9	6800-20-50262 or 049-000651-00	Rubber washer	1
10	6800-20-50251 or 043-004051-00	Handle	1
11	6800-20-50252 or 043-004052-00	Side plate, left	1
12	6800-20-50263	Cushion	4

6.7.2 SMR Inside Assembly

Exploded View
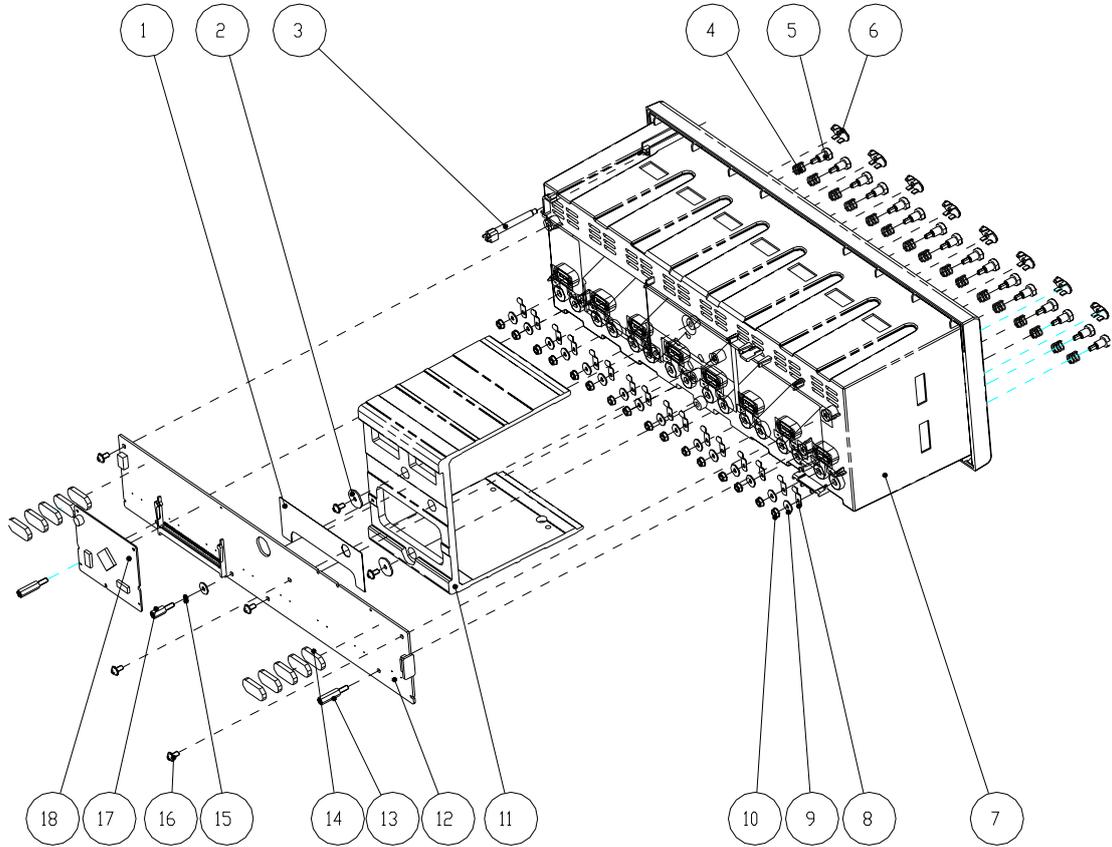
Parts List

SN	P/N	Description	Qty
1	6800-20-50519	Insulating plate	1
2	9201-20-36010	Torsion spring washer	2
3	6800-20-50256	Light conducting pole	1
4	6800-20-50261	Contact spring	16
5	6800-21-51100	Contact screw	16
6	6800-20-50279	Infrared light filter	8
7	6800-20-50249 or 043-004118-00	SMR inside assembly	1
8	6800-20-50388	Leaf	16
9	M04-021024---	Washer	16
10	M04-011002---	Hex nut assy	16

SN	P/N	Description	Qty
11	6800-20-50257-51	Reinforced section steel	1
12	6800-30-51153	8-slot module rack communication board	1
13	M04-004306---	stub screw M3X16+8-8	2
14	6800-20-50233	Rubber feet	10
15	M04-000104---	spring washer GB93 3	1
16	M04-004012---	Crosshead screw M3×6	6
17	M04-000306---	stud screw M3X10+8-8, coated with antirust nickel	1
18	6800-30-50075	Nios II module	1

6.8 Parameter Modules

6.8.1 MPM Module

Exploded View
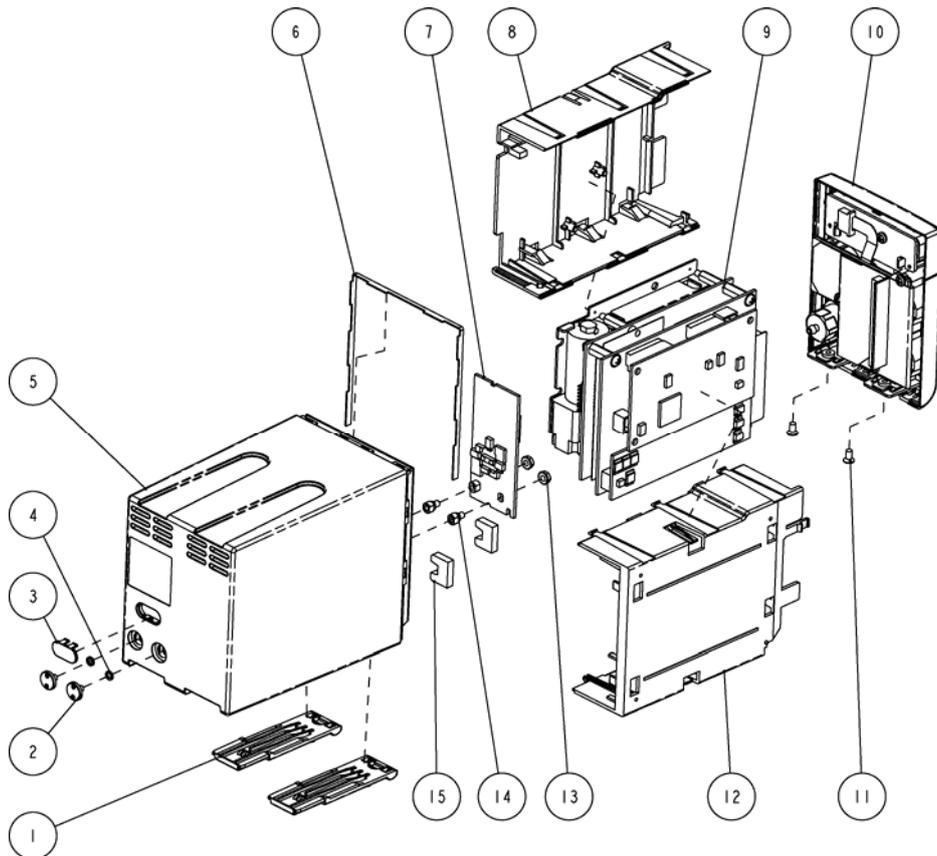
Parts List

SN	P/N	Description	Qty
1	6800-20-50278 or 043-004037-00	Spanner	2
2	6800-20-50293	Screw	2
3	6800-20-50279	Infrared light filter	1
4	M04-000104---	Spring washer	2
5	6800-20-50273 or 043-004031-00	Rear cover	1
6	6800-20-50339	Waterproof seal 02	1
7	6800-30-50684	MPM module infrared communication backboard	1
8	6800-20-50275 or 043-004033-00	Right cover	1
9	M51A-30-80924	NIBP&MPM analog module	1
10	M51A-30-80870	MPM front panel assembly	1
11	M04-005005---	Crosshead screw M3×6	2
12	6800-20-50274 or 043-004032-00	Left cover	1
13	M04-011002---	M3 nut with spring washer	2
14	6800-20-50292	Fixer	2
15	6800-20-50870	Cushion	2

6.8.2 New MPM Module

New MPM module applies the integrative parameter board (ECG ASIC).

Exploded View
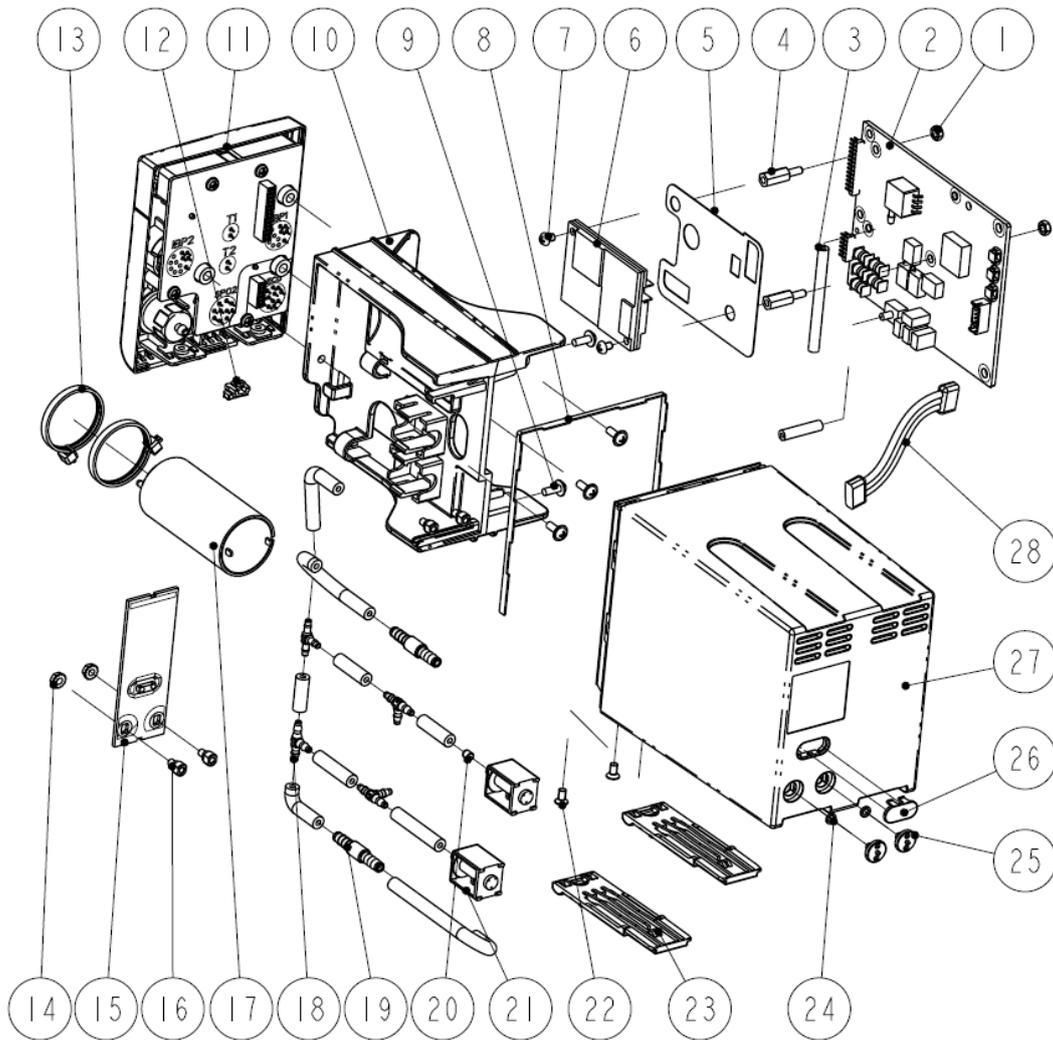
Parts List

SN	P/N	Description	Qty
1	M90-000156---	Plastic hex nut M3	2
2	051-000976-00	M51A Multi-parameter module, 5-lead, standard	1 As configured
	051-000977-00	M51A Multi-parameter module, 5-lead, full	
	051-000978-00	M51A Multi-parameter module, 12-lead, full	
	051-001037-00	M51A Multi-parameter module, 5-lead, full, IBP, Masimo	
3	A21-000007---	Silicone tube	1.65 inch
4	M90-000155---	Plastic hex stud screw, M3×12	2
5	047-006240-00	Insulation sheet for SpO₂ board	1
6	051-000943-00	9008 V2.0 SpO₂ board	1 As configured
	0671-00-0102-01	Nellcor SpO₂ board	
	040-001149-00	Masimo, MS-2013, SpO₂ board	
7	M04-051001-01	Crosshead screw M3×4	2
8	6800-20-50339	Waterproof seal 02	1
9	M04-004015---	Cross pan head screw with washer M3×8	5
10	043-001964-00 or 043-001964-01	Holder	1
11	115-011209-00	New MPM front panel assembly, Mindray SpO₂	1 As configured
	115-011210-00	New MPM front panel assembly, Nellcor SpO₂	
	15-011211-00	New MPM front panel assembly, Masimo2013 SpO₂	
	115-011212-00	New MPM front panel assembly, Mindray SpO₂, no IBP	
	115-011213-00	New MPM front panel assembly, Nellcor SpO₂, no IBP	
	115-011214-00	New MPM front panel assembly, Masimo SpO₂, no IBP	
12	6800-20-50394 or 043-004039-00	Snap close	1
13	A90-000031---	Cable tie, CHS-4×150mm	2
14	M04-011002---	M3 nut with washer	2
15	115-011562-00	New M51A Infrared communication board	1

SN	P/N	Description	Qty
	115-011563-00	New M51A Infrared communication board, no IBP	As configured
16	6800-20-50292	Fixer	2
17	801-6800-00211-00	NIBP pump for M51A and iPM	1
18	S1-0103-00-0511	Tee connector, White, Nylon	4
19	0010-10-12408	Inline Filter	2
20	082-000098-00	630F Reducer	1
21	082-000864-00	Valve	1
22	M04-005005---	Flat head screw, Phillips M3×6	2
23	6800-20-50278 or 043-004037-00	Spanner	2
24	M04-000104---	Spring Washer	2
25	6800-20-50293	Screw	2
26	6800-20-50279	Infrared light filter	1
27	6800-20-50273 or 043-004031-00	Rear cover	1
28	009-002220-00	Cable for infrared Communication board	1

6.9 Remote Display Box

Exploded View
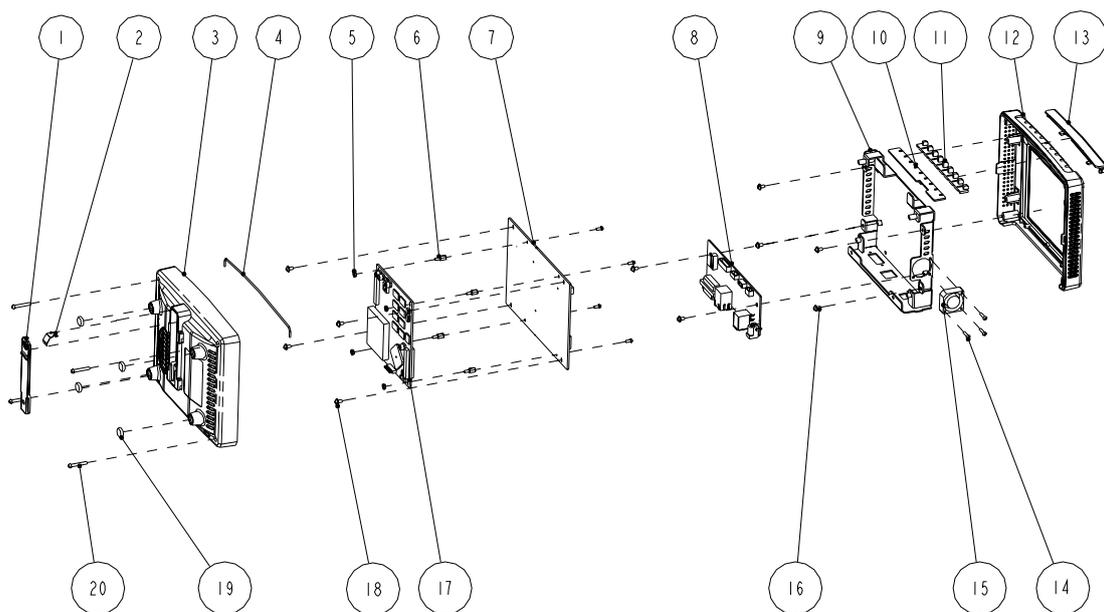
Parts List

SN	P/N	Description	Qty
1	M12A-20-75103	CIS lock catch	1
2	M12A-20-75107	Lock catch spring	1
3	M12A-21-75110	CIS bottom housing	1
4	M6G-020015---	Silicone tube	1
5	M04-011001---	Hex nut GB/T6170-2000M2.5	4
6	M04-060021---	Stud screw M2.5×7+6-6	4
7	M11A-30-75026	Remote display mother board	1
8	M11A-30-75000	Equipment interface board	1
9	M11A-20-75004-51	Remote display box rack	1
10	M12A-30-75002	Indicator board	1
11	M12A-20-75106	Light block	1
12	M12A-20-75101-51	CIS top housing	1
13	M12A-20-75102-52	Remote display box light cover	1
14	M04-004705---	Cross pan head screw M2.5×12	3
15	6800-20-50164	Module fan and cable	1
16	M04-004012---	Cross pan head screw with washer M3×6	10
17	6800-30-50058	MCF547x CPU module (basic configuration/lead-free process)	1
18	M04-051045---	Cross pan head screw M2.5×6	4
19	M12A-20-75105	CIS box cushion	4
20	M04-000505---	Cross pan head screw M3×20	4

6.10 New Wireless AP Package for 6800/6802

The new MPM module uses intergral parameter board (ECG ASIC).

Exploded View
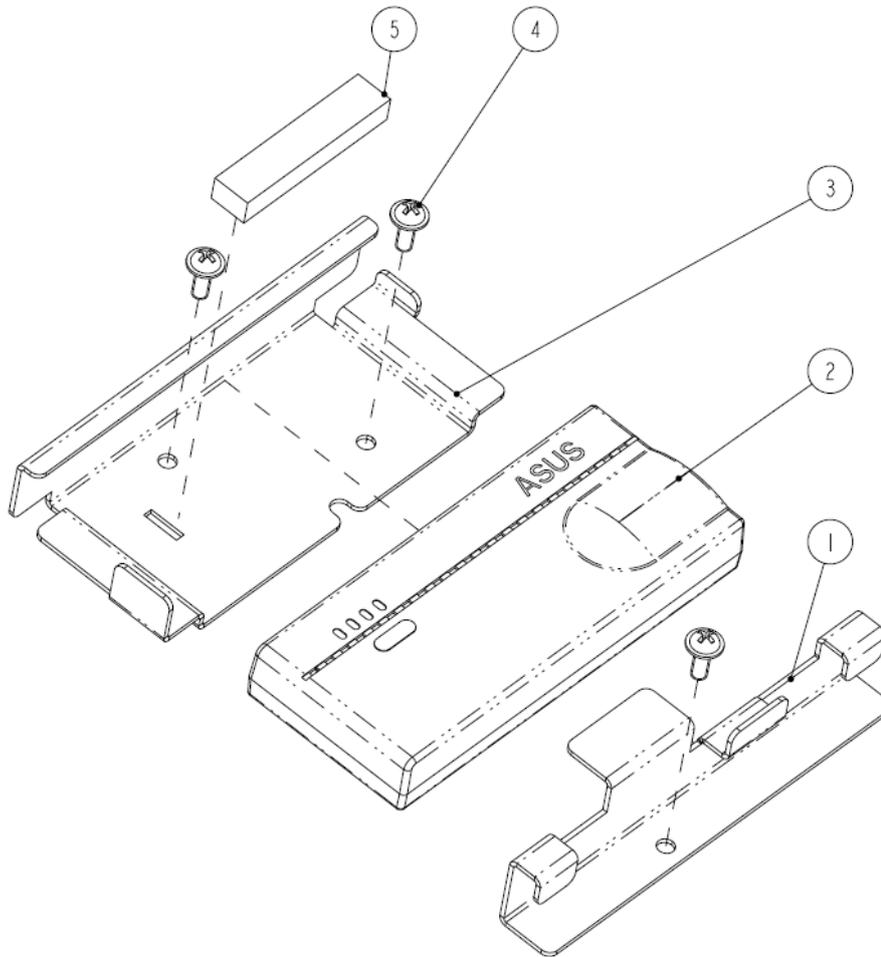
Part List

SN	P/N	Description	Qty
1	042-007507-00	Wireless AP/CF card mount	1
2	023-000505-00	Wireless router 150Mbps Wi-Fi	1
3	042-007506-00	Mounting plate for wireless LAN (ASUS)	1
4	M04-004015-	Cross recessed small pan head screw with washer M3X8	3
5	9201-20-36109	Wireless network card spacer	1
6	9201-20-53698	Network cable	1

6.11 Replaceable Parts

To replace the parts, please refer to *5 Repair and Disassembly* and the exploded views above.

NOTE

- **Here we list most replaceable parts. If you need more parts, please contact our Customer Service Department.**

6.11.1 Main Unit

P/N	Description	Qty
Rear housing assembly		
6800-20-50194 or 043-004045-00	Recorder cover	1
TR6F-30-67306 or 115-001290-00	TR6F recorder	1
6800-20-50301	Recorder to main board cable	1
6800-20-50197-51 or 044-000447-00	Mains container	1
6800-20-50298	Cable, power board to battery interface board	1
6800-20-50155	Cable, main unit to infrared communication board	1
051-000243-00	6800 3-slot module rack communication board	1
6800-30-50073	MPM module rack communication board	1
6800-30-50075	NiosII module	1
0000-10-11063	CF card	1
6800-20-50198-51	Key pad	1
043-000060-00 or 043-000060-01	Rear housing (new interface)	1
6800-20-50672	Cable, main board to DIV interface board	1
6800-20-50673	Cable, main board to USB interface board	1
6800-30-50532 or 115-003232-00	Main board assembly	1
6800-30-50401	WLAN&CF card flexible cable	1
115-001868-00	6800 CF assembly (9211 driving board)	1
6800-30-50476 or	Interface board assembly	1

115-003227-00		
6800-30-50509	Fan assembly	1
6800-20-50681	Speaker & cable	1
115-016498-00	iView assembly	1
Front housing assembly (T9)		
043-003550-00	Middle frame(T9)	1
051-001516-00	LED backlight adapter board	1
021-000137-00	LCD screen, TFT, 19 "	1
6800-30-50084	Button board	1
043-003871-00	Front bezel(T9)	1
021-000135-00	Touchscreen, resistance-type, 19″	1
6800-30-50082	Touchscreen control board	1
115-003711-00	Encoder assembly (Optical encoder)	1
6800-30-50086	Alarm LED board	1
Front housing assembly (T8)		
0000-10-10750 or 0000-10-11073(optional)	Inverter	1
021-000043-00 or 0000-10-11069 (optional)	LCD screen （only used together with optional inverter 0000-10-11073）	1
043-000484-00 or 043-000484-01	Front bezel (T8)	1
0000-10-11071 or 0000-10-10748 (optional)	Touchscreen	1
6800-30-50082	Touchscreen control board	1
6800-30-51095(optional)	Touchscreen control board (only used together with optional touchscreen 0000-10-10748)	1
115-001328-01	Button board(1280x1024-1+anti-glare) (without shank)	1
115-001327-01	Button board (1280x1024-1+touchscreen) (without shank)	1
6800-30-50086	Alarm LED board	1
6800-30-51132	Encoder assembly (without shank)	1
Front housing assembly (T6)		
0000-10-10750 or 0000-10-11073(optional)	Inverter	1
0000-10-10753 or 0000-10-11068 (optional)	LCD screen （only used together with optional inverter 0000-10-11073）	1

P/N	Description	Qty
043-000483-00 or 043-000483-01	Front bezel (T6)	1
0000-10-11071 or 0000-10-10748 (optional)	Touchscreen	1
6800-30-50082	Touchscreen control board	1
6800-30-51095(optional)	Touchscreen control board（only used together with optional touchscreen 0000-10-10748）	1
115-004217-00	T6 button board(anti-glare/optical encoder) (without shank)	1
115-004218-00	T6 button board (touchscreen/optical encoder) (without shank)	1
6800-30-50086	Alarm LED board	1
115-003711-00	Encoder assembly (Optical encoder)	1
Base assembly		
6800-20-50181-51 or 043-004135-00	Bottom cover	1
6800-30-50108	Battery interface board	1
6800-30-50088	Power switch board	1

6.11.2 SMR

P/N	Description	Qty
6800-30-50075	NiosII module	1
6800-30-50078	SMR communication board	1
6800-30-50080	SMR interface board	1
6800-30-50667	SMR indicating lamp assembly	1
6800-20-50249-51 or 043-004118-00	SMR inside assembly (BeneView)	1
6800-20-50250-51 or 043-004120-00	SMR rear housing (BeneView)	1
6800-20-50251 or 043-004051-00	Handle	1

6.11.3 Parameter Modules

P/N	Description	Qty
6800-30-50486	BIS Module	1
6800-30-50488	RM module	1
6800-30-50487	CAPNOSTAT CO_2 module	1
6800-30-50559	ORIDION CO_2 module	1
6800-30-50500	Mindray sidestream CO_2 module (M02B)	1
115-020189-00	Mindray sidestream CO_2 module (M02C)	1
6800-30-50491	ICG module	1
6800-30-50501	AG module (with O_2/BIS)	1
6800-30-50502	AG module (with O_2)	1
6800-30-50503	AG module (without O_2/BIS)	1
6800-30-50504	AG module (without O_2)	1
6800-30-50505	Manual AG module (with O_2/BIS)	1
6800-30-50506	Manual AG module (with O_2)	1
6800-30-50507	Manual AG module (without O_2/BIS)	1
6800-30-50508	Manual AG module (without O_2)	1
6800-30-50484	C.O. module	1
6800-30-50485	IBP module	1
115-007270-00	PiCCO module	1
115-007273-00	$ScvO_2$ module	1
115-007276-00	BeneLink module	1
115-007277-00	BeneLink ID adapter	1
115-018152-00	EEG module	1
115-018518-00	NMT module	1
M51A-30-80873	MPM-1 module(Mindray SpO_2/3/5 lead)	1
115-004900-00	MPM-2 module(MasimoSpO_2/3/5 lead)	1
M51A-30-80879	MPM-3 module(NellcorSpO_2/3/5 lead)	1
M51A-30-80880	MPM-4 module (MindraySpO_2/12 lead)	1
115-004904-00	MPM-5 module(MasimoSpO_2/12 lead)	1
M51A-30-80886	MPM-6 module(NellcorSpO_2/12 lead)	1
M51A-30-80900	MPM-7 module main unit(MindraySpO_2/3/5 lead/without IBP)	1
115-004909-00	MPM-8 module(Masimo SpO_2/3/5 lead/without IBP)	1

P/N	Description	Qty
M51A-30-80906	MPM-9 module(Nellcor SpO$_2$/3/5 lead/without IBP)	1
M51A-30-80907	MPM-10 module main unit (MindraySpO$_2$/12 lead/without IBP)	1
115-004912-00	MPM-11 module (Masi SpO$_2$/12 lead /without IBP)	1
M51A-30-80913	MPM-12 module (Nell SpO$_2$/12 lead/without IBP)	1
115-010731-00	New MPM2 module(Masimo SpO$_2$/3/5lead)	1
115-010734-00	New MPM5 module(Masimo SpO$_2$/12lead)	1
115-010738-00	New MPM8 module(Masimo SpO$_2$/3/5lead/no IBP)	1
115-010740-00	New MPM11 module(Masimo SpO$_2$/12lead/no IBP)	1
115-010744-00	New MPM3 module(Nellcor SpO$_2$/3/5lead)	1
115-010747-00	New MPM6 module(Nellcor SpO$_2$/12lead)	1
115-010750-00	New MPM9 module(Nellcor SpO$_2$/3/5lead/no IBP)	1
115-010753-00	New MPM12 module(Nellcor SpO$_2$/12 lead)	1
115-010755-00	New MPM1 module(Mindray SpO$_2$/3/5lead)	1
115-010758-00	New MPM4 module(Mindray SpO$_2$/12lead)	1
115-010761-00	New MPM7 module(Mindray SpO$_2$/3/5lead/no IBP)	1
115-010764-00	New MPM10 module(Mindray SpO$_2$/12lead/no IBP)	1

6.11.4 Cables

P/N	Description	Remarks
Main unit		
6800-20-50156	Alarm LED board cable	/
6800-20-50157	Touchscreen control board cable	/
6800-20-50159	Power switch & LED board cable	/
6800-20-50298	Cable from power board to battery interface board	/
6800-20-50301	Cable from recorder to main board	/
6800-20-50304	DVI interface board signal wire	DVI interface board to CIS assembly
6800-20-50305	power board DC output cable	/
009-003228-00	iView flat wire	/
009-003229-00	USB cable	/
6800-20-50334	17" LCD flat wire (T8)	Mother board to LCD
6800-20-50512	15-inch screen, flat cables (only used together with optional screen 0000-10-11068）(T6)	6800-20-50512
6801-20-50973	15-inch AU screen cables (T6)	6801-20-50973

6800-21-50337	AC input filter cable	/
6800-20-50513	Main unit Fan cable	/
6800-20-50672	Cable from mother board to DVI interface board	/
6800-20-50673	Cable from mother board to USB interface board	/
6800-20-50681	Speaker & cables	/
6800-30-50124	Integral module rack flexible cable (T8)	Mother board to integral module rack
6800-30-50126	Button board flexible cable (T8)	Mother board to button board
6800-20-51103	Cable, mother board to integral module rack (T6)	/
6800-20-51102	Cable, mother board to button board (T6)	/
6800-20-50401	WLAN card flexible cable	Mother board to CF&WLAN assembly
SMR and parameter modules		
6800-20-50155	Main unit infrared communication board cable (integral module rack)	/
6800-20-50160	Button board cable	/
6800-20-50161	Cable from infrared communication board to RS232 connector	/
6800-20-50162	Infrared communication board TTL cable	/
6800-20-50164	Module fan & cable	/
6800-20-50167	SMR LED cable	/
6800-20-50170	Cable from inverter to button board	from inverter to button board
6800-20-50306	AG cable	/
6800-20-50309	ICG communication cable	/
6800-21-50310	BIS interface cable	/
6800-21-50311	CO interface cable	/
6800-21-50312	IBP interface cable	/
6800-21-50313	Mainstream CO_2 interface cable	/
6800-20-50315	ICG power cord	/
6800-20-50316	RM infrared detection board cable	/
6800-20-50319	Cable from SMR to main unit	/
6800-20-50662	gas pump cable	NIBP pump to parameter board
6800-20-50663	Fast-release valve cable	Fast-release valve to parameter board

6800-20-50664	Slow-release valve cable	Slow-release valve to parameter board
6800-20-50674	Cable from ICG module to infrared communication board	/
6800-20-50683	Mindray CO_2 infrared communication cable	/
6800-30-50128	Mindray SpO_2 flexible cable kit	/
6800-30-50132	Nellcor SpO_2 flexible cable kit	/
6800-30-50130	Masimo SpO_2 flexible cable kit	/
040-000125-00	Patient Interface Cable (BIS module service part)	/
040-000674-00	For service only, BISx Kit (186-0199-MR)	/
040-000675-00	For service only, BISx4 Kit (186-1030-MR)	/
040-000676-00	For service only, BISx Host Cable (186-0201-MR)	/
009-001770-00	RJ45 connecting cable	/
009-001767-00	Serial port adapting cable, type A	/
009-001768-00	Serial port adapting cable, type B	/
009-001769-00	Serial port adapting cable, type C	/
009-001765-00	Cable, Infrared Board to Interface Board	/
009-001254-00	AP&CVP socket with signal cable	/
009-001253-00	PiCCO socket with signal cable	/
009-001255-00	$ScvO_2$ socket with signal cable	/
009-002220-00	Cable for infrared Communication board	/
009-003211-00	NMT signal cable	/
100-000070-00	EEG signal cable	/

7 Upgrade

7.1 Introduction

You can upgrade parameter modules, functional assemblies and software by connecting the patient monitor to a PC running the System Update Tool.

NOTE

- **If you have to disassemble the patient monitor for software upgrade, be sure to eliminate the static charges before disassembling the equipment. When disassembling the part labeled with a ESD warning symbol, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**

- **Properly connect and route the cables and wires when reassembling the equipment to avoid short circuit.**

- **Select appropriate screws to assemble the equipment. If unfit screws are tightened by force, the equipment may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**

- **Follow correct sequence to disassembly the equipment. Otherwise, the equipment may be damaged permanently.**

- **Disconnect all the cables before disassembling any parts. Be careful not to damage any cables or connectors.**

- **Properly place removed screws and disassembled parts, preventing them from being lost or contaminated.**

7.2 Upgrading Parameter Modules

You can upgrade the following parameter modules:

Parameter module	PN	Description	Remark
MPM module	M51A-30-80873	MPM-1Module(Mindray SpO$_2$, 3/5lead)	/
	115-004900-00	MPM-2 Module (Masimo MS-2011, 3/5lead)	
	M51A-30-80879	MPM-3 Module (Nellcor SpO$_2$, 3/5 lead)	
	M51A-30-80880	MPM-4 Module (Mindray SpO$_2$, 12 lead)	
	115-004904-00	MPM-5 Module (Masimo MS-2011, 12 lead)	
	M51A-30-80886	MPM-6 Module (Nellcor SpO$_2$, 12 lead)	
	M51A-30-80900	MPM-7Module(Mindray SpO$_2$, 3/5 lead, no IBP)	
	115-004909-00	MPM-8Module(Masimo MS-2011, 3/5 lead, no IBP)	
	M51A-30-80906	MPM-9Module(Nellcor SpO$_2$, 3/5 lead, no IBP)	
	M51A-30-80907	MPM-10Module(Mindray SpO$_2$, 12 lead, no IBP)	
	115-004912-00	MPM-11Module(Masimo MS-2011, 12 lead, no IBP)	
	M51A-30-80913	MPM-12Module(Nellcor SpO$_2$, 12 lead, no IBP)	
New MPM module	115-010731-00	MPM2 module(Masimo SpO$_2$, 3/5lead)	/
	115-010734-00	MPM5 module(Masimo SpO$_2$, 12lead)	
	115-010738-00	MPM8 module(Masimo SpO$_2$, 3/5lead, no IBP)	
	115-010740-00	MPM11 module(Masimo SpO$_2$, 12lead, no IBP)	
	115-010744-00	MPM3 module(Nellcor SpO$_2$, 3/5lead)	
	115-010747-00	MPM6 module(Nellcor SpO$_2$, 12lead)	
	115-010750-00	MPM9 module(Nellcor SpO$_2$, 3/5lead, no IBP)	
	115-010753-00	MPM12 module(Nellcor SpO$_2$, 12 lead)	
	115-010755-00	MPM1 module(Mindray SpO$_2$, 3/5lead)	
	115-010758-00	MPM4 module(Mindray SpO$_2$, 12lead)	
	115-010761-00	MPM7 module(Mindray SpO$_2$, 3/5lead, no IBP)	
	115-010764-00	MPM10 module(Mindray SpO$_2$, 12lead, no IBP)	
IBP module	6800-30-50850	IBP module upgrade package (without accessories)	/
C.O. module	6800-30-50849	C.O. module upgrade package (without accessories)	/
CO$_2$ module	6800-30-50139	M02B CO$_2$ module upgrade package (for adult and pediatric patients, with accessories)	Sidestream (2 slots)

	6800-30-50141	M02B CO_2 module upgrade package (for neonatal patient, with accessories)	Sidestream (2 slots)
	115-020189-00	CO_2 module	Sidestream (1 slot)
	6800-30-50820	Oridion CO_2 module upgrade package (with accessories)	Microstream
	6800-30-50852	Capnostat CO_2 module upgrade package (with accessories)	Mainstream
AG module	6800-30-50841	AG module upgrade package (with O_2, BIS, and accessories	/
	6800-30-50842	AG module upgrade package (with O_2 and accessories	/
	6800-30-50843	AG module upgrade package (without O_2, with BIS and accessories	/
	6800-30-50844	AG module upgrade package (without O_2, with accessories	/
ICG module	6800-30-50854	ICG module upgrade package (with accessories)	/
BIS module	6800-30-50427	BIS module upgrade package (for pediatric patients, with accessories)	/
	6800-30-50880	BIS module upgrade package (with accessories)	/
RM module	6800-30-50853	RM module upgrade package (with accessories)	/
CCO/SvO_2 module	801-6800-00104 -00	CCO/SvO_2 module upgrade package	/
PiCCO Module	115-007589-00	PiCCO function upgrade kit	/
$ScvO_2$ Module	115-007590-00	$ScvO_2$ function upgrade kit	/
EEG module	115-018152-00	EEG module	/
NMT module	115-018518-00	NMT module	/

You can plug and unplug parameter modules during patient monitoring. Refer to the Operator's Manual for the use of parameter modules.

7.3 Upgrading Functional Assemblies

You can upgrade the following functional assemblies:

Functional assembly	PN	Description	Remark
SMR	6800-30-50641	SMR kit	/
Wireless network	801-6800-00108-00	6800 wireless network upgrade kit	Internal AP, for standard- configured patient monitor
	801-6800-00109-00	6800 wireless network upgrade kit	Internal AP, for fully configured patient monitor
	801-6800-00002-00	Wireless network adaptor kit	External AP
Recorder	6800-30-50856	Recorder upgrade kit	/
Analog output	801-6800-00093-00	DVI interface board (FRU)	/
iView assembly	115-016498-00	iView assembly (SSD hard drive)	/

The patient monitor can be connected to network through wireless AP. Authorized personnel are required to connect and set up the wireless network, and then carry out the performance test.

7.3.1 Upgrading SMR

The SMR can be connected to the patient monitor through SMR connector via a SMR cable. Refer to the Operator's Manual for detail.

7.3.2 Upgrading Wireless Network Function

Refer to the conrresponding section to install the wireless network assembly in your patient monitor.
Refer to the Operator's Manual for the use of wireless network.

7.3.3 Upgrading Recorder

Refer to the conrresponding section to install the recorder in your patient monitor.

Refer to the Operator's Manual for the use of recorder.

7.3.4 Upgrading Analog Output

Refer to the conrresponding section to replace the interface board assembly and DVI interface board.

Refer to the Operator's Manual for use of the analog output.

7.3.5 Upgrading iView System

Refer to the conrresponding section to install iView kit in your patient monitor.

Refer to the Operator's Manual for the use of iView system

NOTE

- **When upgrading wireless network, analog output and CIS function for a patient monitor with standard configuration, you have to replace old PCBAs in the patient monitor with corresponding PCBAs included in the upgrade kit and remove the covers of related connectors.**

7.4 Upgrading Software

You can upgrade the software with the System Update Tool (PN: 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 crossover network cable, you can upgrade the following programs:

Software	PN	Description	Remark
Boot program	6800-30-50770	BIOS program	Bootstrap program for monitor main control unit, implementing hardware drive and initialization For CE
	110-001594-00	BIOS program	For FDA
System software	110-000414-00	System software	CE
	6800-30-50701	System software	FDA
Multilingual library	110-000421-00	Language library	CE
	6800-30-50702	Language library	FDA
iView system	110-002455-00	System image files of iView platform	Use the iView maintanence disk during upgrading iView system
BMP resource file	110-000422-00	Icon library	CE
	6800-30-50767	Icon library	FDA
	110-000810-00	Startup Logo(T8)	CE
	110-000809-00	Startup Logo(T6)	CE
	6800-30-50704	Startup Logo(T8)	FDA
	6801-30-50961	Startup Logo(T6)	FDA
FPGA program	6800-30-50706	FPGA configuration chip software for mother board (MDDR)(T8)	FDA
	110-000813-00	6800FPGA configuration chip software for mother board (MDDR)	CE
Audio data file	110-001423-00	Audio data software for mother board	CE
	6800-30-50872	Audio data software for mother board	FDA
Module rack program	6800-30-50863	FPGA configuration chip software for Module rack NIOS board	/

Software	PN	Description	Remark
MPM module program	0010-30-43083	BIOS program for parameter module(BF531)	The System Update Tool for MPM
	M51A-30-80950	DSP board M25P16 software for M51A module	
	M51A-30-80951	DSP board LPC2131 software for M51A module	
	M51A-30-80952	7024 software for M51A module ECG board	
	110-000539-00	SpO_2 module software for 9008	
	M51A-30-80953	7024 software for M51A module SpO_2 board	
	M51A-30-80956	M25P16 software for M51A module DSP board, Mortara algorithm	
New MPM module program	110-001979-00	BIOS program for parameter module(BF512)	The System Update Tool for M51A_2
	110-001839-00	M51A V2.0 DSP(BF512) software	
	110-001978-00	M51A V2.0 DSP(Mortara) software	
	110-001842-00	9008 V2.0 SpO_2 software	

7.4.1 How to Upgrade Software

Before software upgrade, check software version by selecting [**Main Menu**] →
[**Maintenance>>**] → [**Factory Maintenance>>**] → enter the required password →
[**Software Version>>**]. If your BIOS program has a version prior to 2.0, upgrade it to version
2.0 or greater before upgrading other programs. If you use System Update Tool (PN:
110-000493-00) version 2.0 or greater, make sure that BIOS program version is 2.0 or greater
before upgrade. Please refer to the following procedure to upgrade the software:

1. Connect the patient monitor to a PC through a crossover network cable. Set the IP to
   77.77.1.XX, the subnet mask to 255.255.255.0.

2. Run the System Update Tool in the PC. Select [**BeneView**] 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. Determine if the software is upgraded successfully according to the
   prompt message of the patient monitor when finishing upgrading the software.

If your BIOS program has a version prior to 5.0(CE) or 4.2.0(FDA), you should press
[**Silence**] hardkey before you start the patient monitor, and do not release it until you enter
the upgrade screen.

Software upgrade is taken in the sequence of BIOS program → system software package
(including system software, language library, and BMP resource files) → FPGA package
(including mother board FPGA software and audio data files) → module rack FPGA package
→ MPM module software.

7.4.1.1 Upgrading BIOS program

If your BIOS program is version 1.2 or prior, the patient monitor has a blank screen during software upgrade. For BIOS program version greater than 1.2, the patient monitor enters the upgrade screen and presents related prompts during software upgrade.

For example, to upgrade BIOS program from version 2.0 to 3.0 or greater,

1. Run the System Update Tool, version 3.0.

2. Download the BIOS upgrade program (110-000296-00). Create a system package using the BIOS upgrade program and download it to the patient monitor. Turn off the patient monitor after you finish downloading the package.

3. Select BIOS package version 3.0 or greater, and then select the "Start" button on the System Update Tool screen. Turn on the patient monitor by pressing the power switch (you are not allowed to press other buttons at same time). Thus you can upgrade the BIOS program to version 3.0.

It should be noted that the patient monitor shows a blank screen for about 20 seconds when you turn on the patient monitor for the first time after successful software upgrade. This is because the new BIOS program is restoring the master boot from backup BIOS program.

7.4.1.2 Upgrading System Software

To upgrade system software version 02.02.00 or prior, BIOS program version 2.0 or greater and System Update Tool version 2.0 or greater are required.
The language library and icon library shall be upgraded at same time when system software is upgraded.

7.4.1.3 iView System Software

Refer to *3.13.2 Restoring the System* for more information of software actiavation.

7.4.1.4 Upgrading FPGA Program

If your FPGA program is version 1.0, first you have to upgrade it to version 2.0 using the System Update Tool version 1.4, and then upgrade it to the latest version using the System Update Tool version 2.0 or greater.

Because two display memory models are available for the mother board, there are two mother board FGPA programs. The two FGPA programs can be created into one package to upgrade the FPGA programs for mother boards equipped with different display memories.

The audio data file shall be upgraded at same time when FPGA program is upgraded.

For details, refer to the help and instructions included in the System Update Tool, or consult your service personnel.

⚠CAUTION

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

NOTE

- **After upgrading the BIOS program, you have to upgrade system program and other programs to ensure compatibility.**
- **Make sure the version of the upgrade package is you desired one. If you want to obtain the latest upgrade package, contact Mindray Customer Service Department.**
- **To upgrade the MPM module from Mindray ECG algorithm to Mortara ECG algorithm, you have to send the MPM module to manufacture.**

A Electrical Safety Inspection

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

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

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

A.1 Power Cord Plug

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

A.2 Device Enclosure and Accessories

A.2.1 Visual Inspection

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

A.2.2 Contextual Inspection

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

A.3 Device Labeling

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

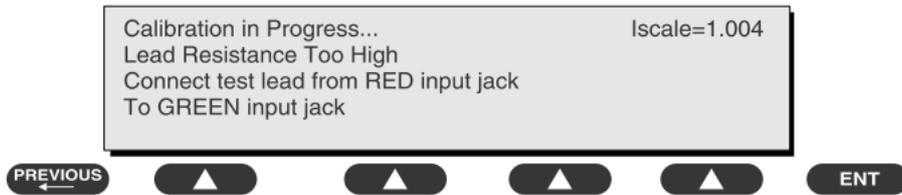- Main unit label
- Integrated warning labels

A.4 Protective Earth Resistance

Protective Earth Resistance is measured using the RED test lead attached to the DUT Protective Earth terminal or enclosure. Select the test current (25 amp) by pressing SOFT KEY 3. The front panel outlet power is turned off for this test.

The following conditions apply: L1 and L2 Open.

Preparation

1. First select the test current that will be used for performing the Protective Earth Resistance test by pressing AMPERES (SOFT KEY 3).

2. Connect the test lead(s) between the RED input jack and the GREEN input jack.

3. Press CAL LEADS. The 601PRO will measure the lead resistance, and if less than 0.150 Ohms, it will store the reading and subtract it from all earth resistance readings taken at the calibrated current.
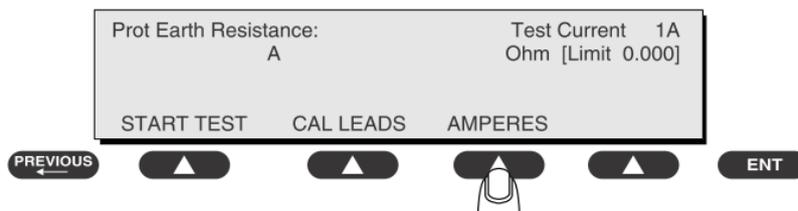
```
Calibration in Progress...                         Iscale=1.004
Lead Resistance Too High
Connect test lead from RED input jack
To GREEN input jack
```

PREVIOUS   ▲   ▲   ▲   ▲   ENT

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

⚠WARNING

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

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet.

2. Attach the 601PRO RED input lead to the device's Protective Earth terminal or an exposed metal area.

3. Press shortcut key 3. The Protective Earth Resistance test is displayed.

4. Press SOFT KEY 3 to select a test current (25 amp). The selected test current is displayed in the upper right corner of the display.

```
Prot Earth Resistance:                    Test Current   1A
                    A                     Ohm  [Limit  0.000]


       START TEST      CAL LEADS      AMPERES
```

PREVIOUS   ▲   ▲   ▲   ▲   ENT

5. Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.

6. Press the print data key at any time to generate a printout of the latest measurement(s).

NOTE

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

In Case of Failure

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

LIMITS

ALL COUNTRIES R = 0.2 Ω Maximum

A.5 Earth Leakage Test

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

Leakage current is measured the following ways:

- Earth Leakage Current, leakage current measured through DUT outlet Earth

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

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

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.

2. Attach the device's applied parts to the 601PRO applied part terminals if applicable.

3. Press shortcut key 4. The Earth Leakage test appears on the display, and the test begins immediately:
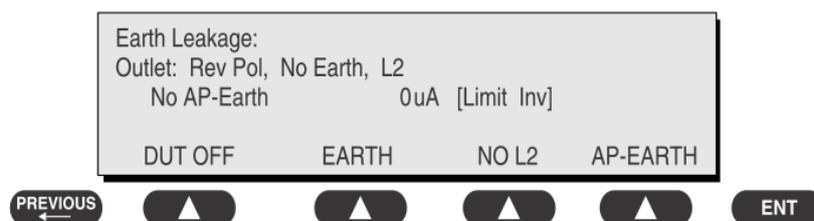
- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.

- SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.

- SOFT KEY 3 toggles the DUT outlet from L2 to No L2.

- SOFT KEY 4 toggles the AP to Earth to No AP to Earth.

4. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.

- Inspect wiring for bad crimps, poor connections, or damage.

- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

- Change another probe to confirm if the fail is caused by console.

- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For UL60601-1,

- ◆ 300 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

For IEC60601-1,

- ◆ 500 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

A.6 Patient Leakage Current

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

Preparation

Perform a calibration from the Mains on Applied Part menu.

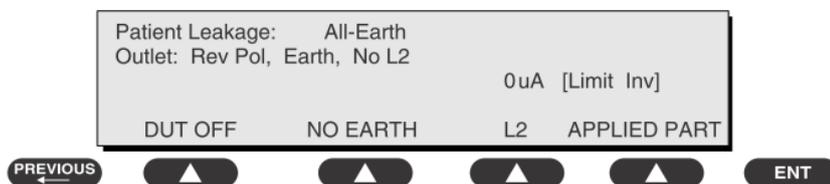The following outlet conditions apply when performing this test:

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

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

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

⚠WARNING

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

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.

2. Attach the applied parts to the 601PRO's applied part terminals.

3. Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.

```
Patient Leakage:       All-Earth
Outlet: Rev Pol,  Earth,  No L2
                                      0uA   [Limit  Inv]

     DUT OFF          NO EARTH      L2     APPLIED PART
```
PREVIOUS ◀ ▲ ▲ ▲ ▲ ENT

4. Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.

5. Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.

6. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

■ Check any broken of the enclosure. Replace any defective part.

■ Inspect wiring for bad crimps, poor connections, or damage.

■ Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

■ Change another probe to confirm if the fail is caused by console.

■ If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

■ If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

For CF ♥ applied parts

◆ 10μA in Normal Condition

◆ 50μA in Single Fault Condition

For BF ⊼ applied parts

◆ 100μA in Normal Condition

◆ 500μA in Single Fault Condition

A.7 Mains on Applied Part Leakage

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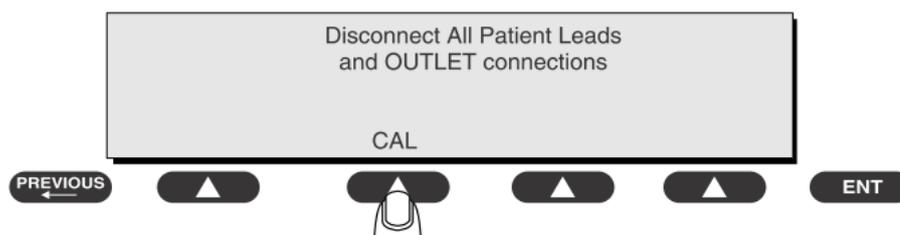
The following outlet conditions apply when performing the Mains on Applied Part test.

■ Normal Polarity;

■ Reversed Polarity

Preparation

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

1. Disconnect ALL patient leads, test leads, and DUT outlet connections.

2. Press CAL to begin calibration, as shown:

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

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

⚠WARNING

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

- **High voltage is present at applied part terminals while measurements are being taken.**

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601

2. Attach the applied parts to the 601PRO applied part terminals.

3. Attach the red terminal lead to a conductive part on the DUT enclosure.

4. Press shortcut key 7. The Mains on Applied Part test is displayed.

5. Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:

6. Press START TEST (SOFT KEY 1) to begin the test.

7. Press the print data key to generate a printout of the latest measurement.

NOTE

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

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.

- Inspect wiring for bad crimps, poor connections, or damage.

- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

- Change another probe to confirm if the fail is caused by console.

- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

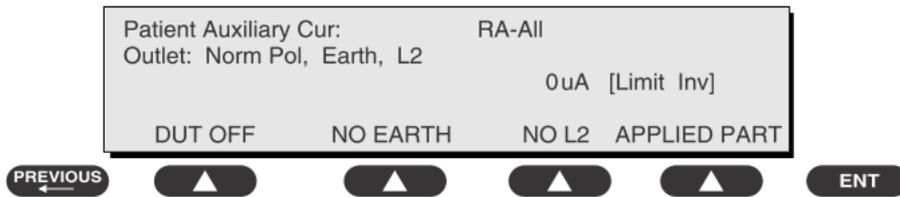- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

- For CF ♥ applied parts: 50 μA
- For BF 🖈 applied parts: 5000 μA

A.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected ECG jack and the remaining selected ECG jacks. All measurements may have a true RMS only response.

Preparation

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.

2. Attach the patient leads to the 601PRO ECG jacks.

3. Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).

4. Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.

```
Patient Auxiliary Cur:              RA-All
Outlet: Norm Pol,  Earth,  L2
                                    0uA  [Limit  Inv]

     DUT OFF        NO EARTH        NO L2   APPLIED PART
```
PREVIOUS   △   △   △   △   ENT

5. Press SOFT KEYS 1-4 to select leakage tests

6. Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part
    leakage current:

7. Modify the configuration of the front panel outlet by pressing the appropriate SOFT
    KEY on the 601PRO:

8. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

■ Check any broken of the enclosure. Replace any defective part.

■ Inspect wiring for bad crimps, poor connections, or damage.

■ Test the wall outlet; verify it is grounded and is free of other wiring abnormalities.
   Notify the user or owner to correct any deviations. As a work around, check the other
   outlets to see if they could be used instead.

■ Change another probe to confirm if the fail is caused by console.

■ If the leakage current measurement tests fail on a new unit and if situation can not be
   corrected, submit a Safety Failure Report to document the system problem. Remove unit
   from operation.

■ If all else fails, stop using and inform the Customer Service Engineer for analysis and
   disposal.

LIMITS

For CF ♥ applied parts,
   ◆   10μA in Normal Condition
   ◆   50μA in Single Fault Condition

For BF 🛧 applied parts,
   ◆   100μA in Normal Condition
   ◆   500μA in Single Fault Condition

A.9 Scheduled Electrical Safety Inspection

For scheduled electrical safety inspection, test items 1, 2, 3, 4, 5, 6, 7, and 8 included in the *ELECTRICAL SAFETY INSPECTION FORM* shall be performed.

◆ **ELECTRICAL SAFETY INSPECTION FORM**

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

Note: The equipment sold to the United States shall comply with the requirement of UL60601-1; others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____ Date:_____

A.10 Electrical Safety Inspection after Repair

The following table specifies test items to be performed after the equipment is repaired.

Repair with main unit not disassembled		Test items: 1, 2, 3
Repair with main unit disassembled	When neither power supply PCBA nor patient electrically-connected PCBA is repaired or replaced	Test items: 1, 2, 3, 4
	When power supply PCBA is repaired or replaced	Test items: 1, 2, 3, 4, 5
	When patient electrically-connected PCBA is repaired or replaced	Test items: 1, 2, 3, 4, 6, 7, 8
	When both power supply PCBA and patient electrically-connected PCBA are repaired or replaced	Test items: 1, 2, 3, 4, 5, 6, 7, 8

ELECTRICAL SAFETY INSPECTION FORM

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

Note: The equipment sold to the United States shall comply with the requirement of UL60601-1; others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____ Date:_____

FOR YOUR NOTES