

BeneVision N1

Patient Monitor

Service Manual

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WARNING

- **Federal Law (USA) restricts this device to sale by or on the order of a physician or other practitioner licensed by U.S. state law to use or order the use of this device.**

NOTE

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

Manufacturer's Responsibility

Contents of this manual are subject to changes without prior notice.

Mindray is responsible for safety, reliability and performance of this product only on the condition that:

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

Return Policy

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

1. Obtain a return authorization.

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

2. Freight policy

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

3. Return address

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

Service

Mindray maintains a network of service representatives and factory-trained distributors. Prior to requesting service, perform a complete operational check of the instrument to verify proper control settings. If operational problems continue to exist, contact Mindray service.

In North America contact the Service Department at (800) 288-2121, ext: 8116 for Technical Support or (201) 995-8000 for assistance in determining the nearest field service location.

Please include the instrument model number, the serial number, and a description of the problem with all requests for service.

Any questions regarding the warranty should be directed to your local sales or service representative.

NOTE

- **Upon request, Mindray provides circuit diagrams, component part lists, descriptions, calibration instructions, or other information which assist the user's appropriately qualified technical personnel to repair those parts of the equipment which are designated by Mindray DS USA, Inc. as repairable.**
-

Contact Information

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd.
Address:	Mindray Building, Keji 12th Road South, High-tech Industrial Park, Nanshan, Shenzhen 518057 P.R. China
Tel:	+86 755 81888998
Fax:	+86 755 26582680
Website:	www.mindray.com
Distributor:	Mindray DS USA, Inc.
Address:	800 MacArthur Boulevard, Mahwah, New Jersey 07430 USA
Tel:	1.800.288.2121, 1.201.995.8000
Website:	www.mindray.com

Preface

Manual Purpose

This manual provides detailed information about the assembly, disassembly, 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. Use of the manual is necessary for proper equipment maintenance and will help to eliminate equipment damage and personal 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.

Contact your local Mindray Service Organization for information on product courses which address service and support for this product.

Passwords

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

- User maintenance: MIN888 (User adjustable)
- Configuration mode: MIN315 (User adjustable)

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

FOR YOUR NOTES

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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.
-

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 should be 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, verify 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

NOTE

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

1.2 Equipment Symbols

See the N1 Patient Monitor Operator's Manual for information about the symbols used on this product and its packaging.

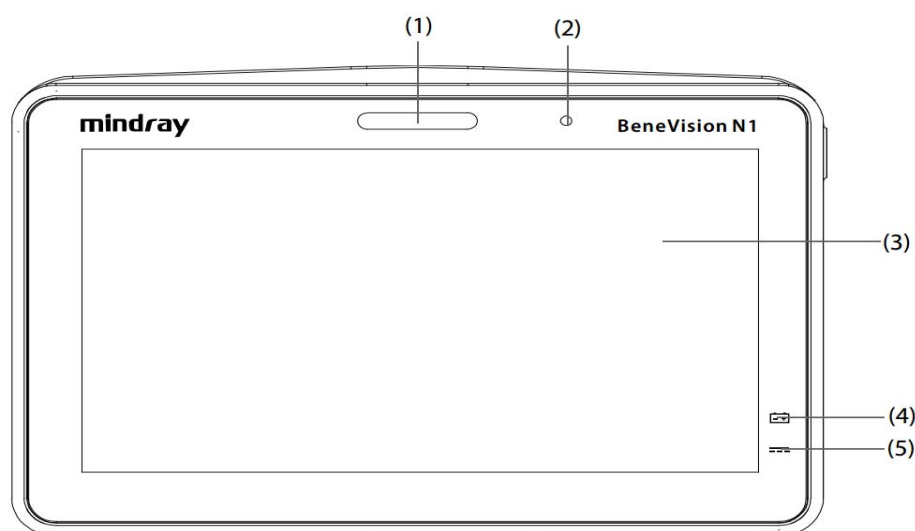
2 Theory of Operation

2.1 Overview

This monitor is intended for monitoring, displaying, reviewing, storing, alarming, and transferring of patients' physiological parameters, including electrocardiogram (ECG), respiration (RESP), temperature (TEMP), pulse oxygen saturation (SpO₂), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), carbon dioxide (CO₂), and oxygen (O₂).

The monitor is to be used in healthcare facilities. It can also be used during patient transport with road, rotary, and fixed-wing ambulances.

2.1.1 Front View



1. Alarm lamp

When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority:

- ◆ High priority alarms: the lamp quickly flashes red.
- ◆ Medium priority alarms: the lamp slowly flashes yellow.
- ◆ Low priority alarms: the lamp lights in cyan without flashing.

2. Ambient light sensor

When screen brightness is set to auto, the system automatically adjusts screen brightness according to the strength of ambient light.

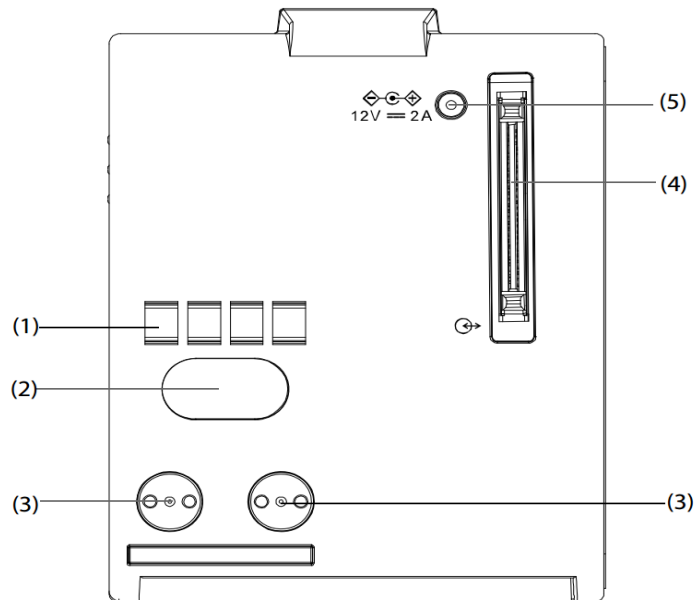
3. Display and touchscreen

4. Battery LED

- ◆ Yellow: the battery is being charged.
- ◆ Green: the battery is fully charged.
- ◆ Flashing green: the monitor runs on battery power.
- ◆ Flashing yellow: the battery is malfunctioning.

- ◆ Off: no battery is installed, or the monitor is powered off and no external power is connected.
5. External power supply indicator
- ◆ On: when external power supply is connected.
 - ◆ Off: when external power supply is not connected.

2.1.2 Left View

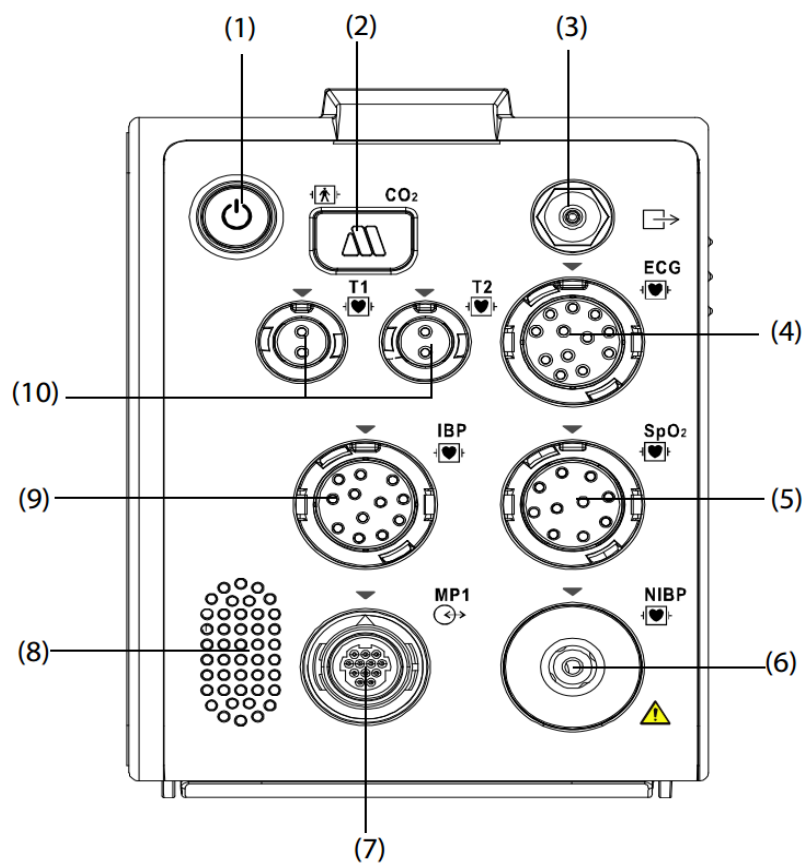


1. Communication interface: used for communication between the N1 and host monitor (BeneVision N series monitor)
2. Infrared filter: used for communication between the N1 and Passport m series monitor; used for communication between the N1 and N series monitor if the communication interface does not work.
3. Contact: used for receiving power supply from the host monitor (Passport m series monitor or BeneVision N series monitor).
4. Multi-pin connector: connects N1 to the Modular Rack or Dock.
5. External DC power input connector: connects the N1 to the AC adapter.

NOTE

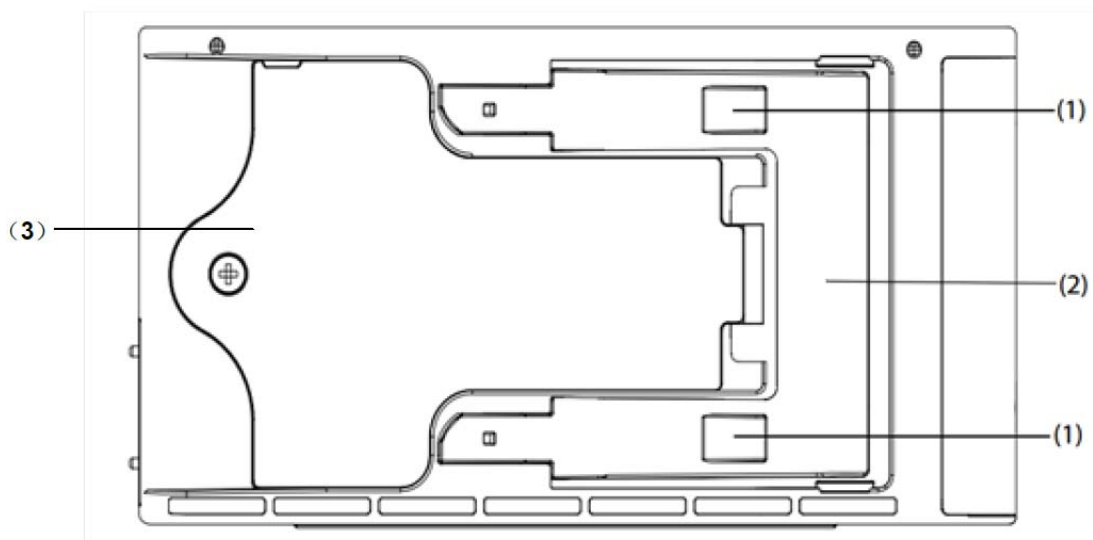
- To ensure good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. Using forceps is recommended.
- In the case of water spray, dry the Multi-pin connector of the N1 before connecting the N1 to the Modular Rack or Dock.

2.1.3 Right View



1. Power switch
2. Sample line connector for sidestream CO₂ (available when CO₂ is configured)
3. Gas outlet (available when CO₂ is configured)
4. ECG cable connector
5. SpO₂ sensor connector
6. NIBP cuff connector
7. Multifunctional connector: outputting analog and defib. synchronization signals
8. Speaker
9. IBP cable connector
10. Temperature probe connector

2.1.4 Bottom View



1. Clip: fastens N1 when N1 is in use with the host monitor, Dock or Modular Rack.
2. Latch: locks N1 when N1 is in use with the host monitor, Dock or Modular Rack. Pressing here releases the N1 so that the N1 can be removed from the host monitor, Dock or Modular Rack.
3. Battery door: secures the battery.

2.2 System Composition

The N1 monitor system consists of the N1 main unit, Dock, Modular Rack, single-slot module, external display, AC adapter, Transport Dock and the peripherals such as keyboard, mouse, scanner, and printer, as shown in the figure below:



In the figure:

- **N1 main unit:** incorporates multiple functions such as display, control, parameter measurement, printing, and communication. It is the core of the whole system and supports the following functions:
 - ◆ Integrate the basic parameter measurement module for measuring the ECG, RESP, S O₂, TEMP, NIBP, IBP, CO₂ and other parameters.
 - ◆ Connect to the Modular Rack, and to the parameter measurement modules such as the three kinds of CO₂ modules through the Modular Rack, so as to display and store module measurement results and report alarms.
 - ◆ Be directly inserted into the host monitor as a submodule.
 - ◆ Output analog (ECG and IBP) and defib. synchronization signals.
 - ◆ Be powered using the DC and smart battery.

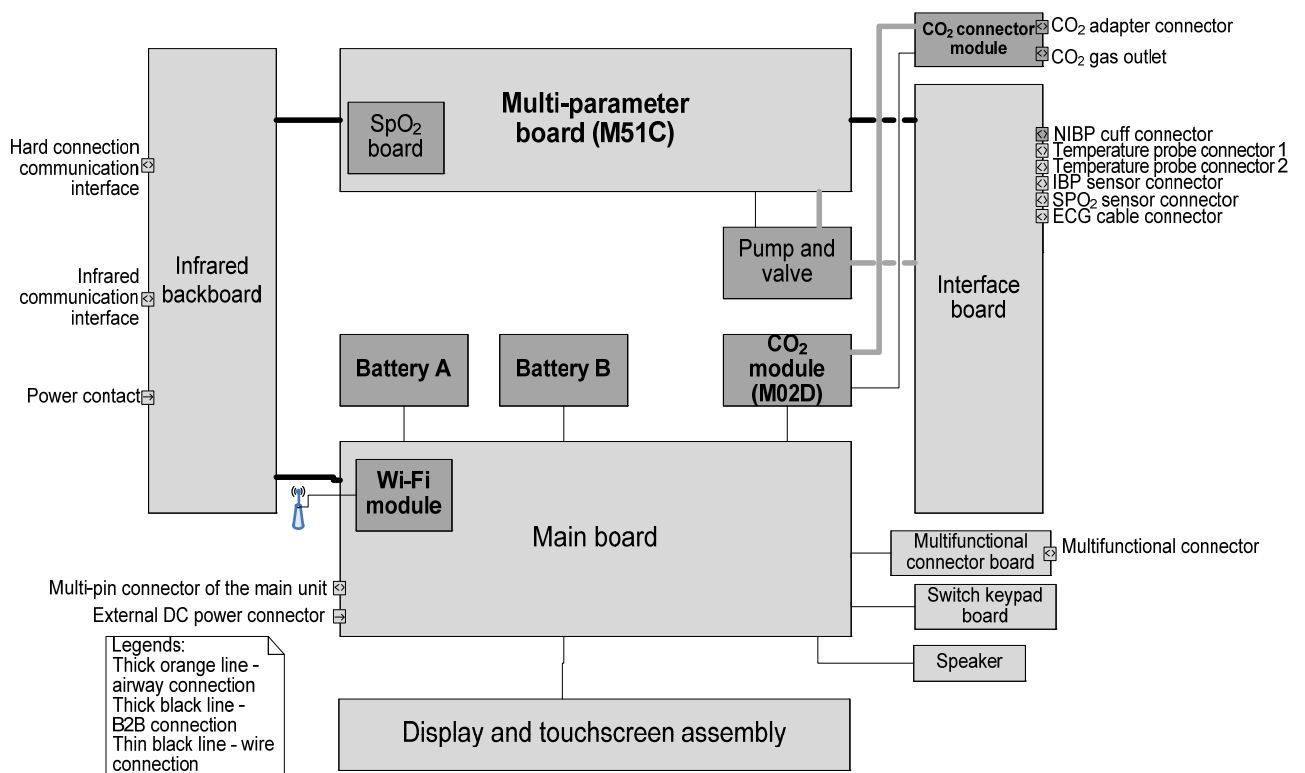
- ◆ Support Wi-Fi wireless communication.
 - ◆ Support alarm sound and light output.
 - ◆ Connect to the Dock to extend display, USB, LAN, host monitor communication, and power supply interfaces.
- **AC adapter:** provides an external power supply to the N1 main unit used separately.
 - **Dock:** secured beside the bed and connected to the N1 main unit. It can supply power to the N1 and charge the N1 battery. It can be connected to a touchscreen, mouse, keyboard, barcode scanner, USB drive, external host monitor, and wired network.
 - **Modular Rack:** enables N1 to connect to the mainstream CO₂, sidestream CO₂, microstream CO₂ and PiCCO modules.
 - **Transport Dock:** secures N1 in airplanes and ambulances and supplies power to N1.

2.2.1 Main Unit System Structure

The figure below shows the system structure of the N1 main unit. One should be selected from the battery B and CO₂ related components.

In the figure:

- Battery B exists only in the N1 main unit (without CO₂).
- The CO₂ module and its interface exist only in the N1 main unit (with CO₂).
- The Wi-Fi module is optional.
- There are three kinds of SpO₂ boards.



2.2.1.1 Main Board

The main board is the control core of the entire system. Its main functions are as follows:

- display driver and backlight control
- touchscreen driver
- external display VGA drive
- audio driver
- integrating the alarm lamp
- integrating the light sensor
- wired network communication
- wireless network communication (through the Wi-Fi module)
- USB driver
- real-time clock
- data and configuration storage
- DC/DC conversion and power switching
- power management (power-on/off, status monitoring, etc.)
- battery management (in-position detection, charge control, discharge control, status monitoring, etc.)
- integrating the external power LED and battery LED
- analog and defib. synchronization signals transfer
- communication with the Dock
- communication with the Modular Rack
- communication with the host monitor
- communication with the infrared communication board
- communication with the multi-parameter board
- communication with the CO₂ module

2.2.1.2 Multi-parameter Board

This board completes the basic parameter measurement functions, including:

- ECG and Resp parameter measurement
- SpO₂ parameter measurement (in the backboard mode, supporting Mindray, Masimo, and Nellcor SpO₂)
- NIBP parameter measurement
- 2-channel TEMP parameter measurement
- 2-channel IBP parameter measurement
- isolation of parameters except NIBP from the ground
- isolation of ECG from other parameters
- direct output of analog signals (1-channel ECG and 2-channel IBP)
- direct output of defib. synchronization signals
- data interaction with the main board through the serial port

2.2.1.3 CO₂ Module

This module completes the CO₂ parameter measurement function.

2.2.1.4 Parameter Interface Board

This board provides the following functions:

- ECG signal transfer and isolation of ECG signals from other signals
- SpO₂ signal transfer
- TEMP signal transfer
- IBP signal transfer

2.2.1.5 Multifunctional Connector Board

This board outputs analog signals and transfers defib. synchronization signals.

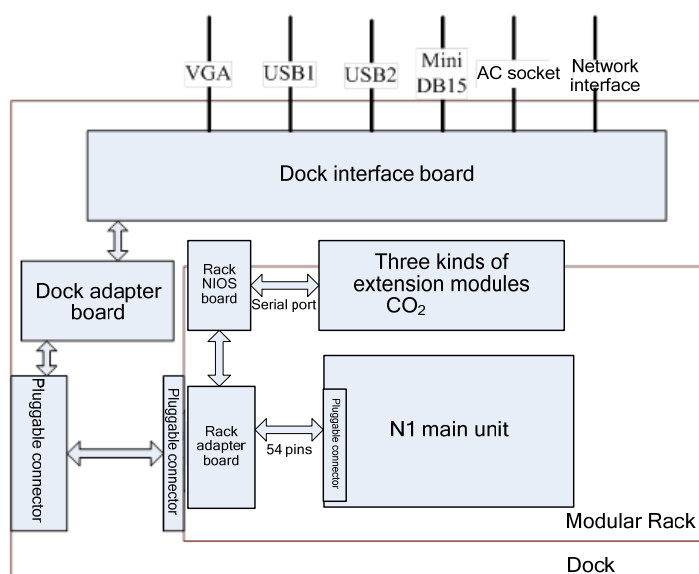
2.2.1.6 Switch Keypad Board

This board provides the power switch and power LED.

2.2.1.7 Infrared Backboard

The infrared backboard is used for infrared/contact communication between N1 and the host monitor. It receives power supply from the host monitor and connects the multi-parameter board to the main board.

2.2.2 Modular Rack and Dock System Composition



The above figure shows the connection and system composition relationships between the N1, Modular Rack, and Dock. The three can be interconnected through the pluggable 54-pin connector. N1 functions as the system core. The Modular Rack and Dock expand the functions of N1.

When N1 is separately connected to the Modular Rack, the N main unit can communicate with the parameter module. N1 can implement power supply and measurement parameter interaction with the parameter module through the Rack adapter board and Rack NIOS board. The parameter module is a one-slot parameter module.

When N1 is in use with the Dock, it can be connected to the Dock interface power board through the Dock adapter board. In this way, the Dock interface board supplies power to N1. N1 connects the USB, external device connector (Mini DB15), VGA and wired network port to the Dock response interface to implement external interface connection and extension.

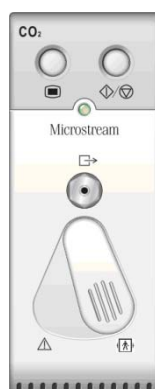
When N1, the Modular Rack, and the Dock form a whole, functions of the above two combinations are implemented at the same time.

2.2.3 Extended Parameter Module Composition

N1 can be connected to the following four external modules through the Modular Rack:

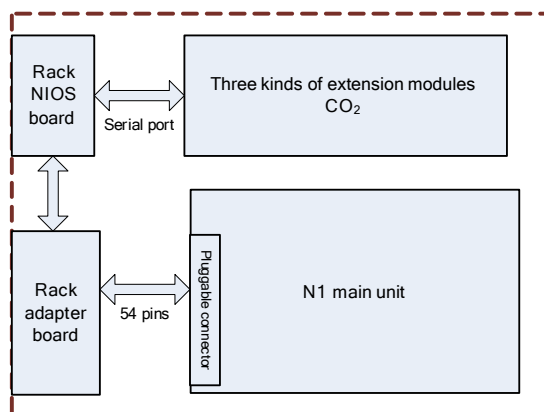


Sidestream CO₂
module



Microstream
CO₂ module

The figure below shows parameter module expansion through the Modular Rack:



In this application, N1 and the external module are inserted into the specified slots of the Modular Rack. The external module is connected to the Rack adapter board through the Rack NIOS board in the Modular Rack. The battery in the N1 main unit powers the parameter module. The Rack adapter board and N1 main unit are connected through the 54-pin pluggable connector. The Modular Rack can also be inserted into the Dock so that the Dock can supply power to it.

3 Unpacking and Installation

3.1 Unpacking

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

1. All the optional parts purchased by the customer shall also be checked.
2. Immediately contact the supplier if any item in the package is inconsistent with that listed on the packing list.
3. In case of damage during transportation, keep the packing material and immediately contact the supplier.
4. Keep the packing material until the product acceptance is completed.

3.2 Preparations for Installation

3.2.1 Installation Site Requirements

1. Ensure that the installation site meets all safety, environmental and power requirements.
2. Check that required power sockets are available.
3. Check whether a network connector is available if the monitor needs to connect to the wired network.

WARNING

- **When using the N1 Dock, use only the power cord supplied by the manufacturer to connect the AC power supply. When using the monitor alone, use only the DC adapter supplied by the manufacturer to connect the external power supply.**
-

3.2.1.1 Environmental Requirements

To avoid explosion hazard, do not use the equipment in the presence of flammable anesthetics, vapors or liquids. To avoid impact on the normal operation, the monitor shall be placed in an environment free from vibration, dust and corrosive substances.

Environmental specifications are as follows:

Main unit, adapter, and Transport Dock			
Item	Temperature (°C)	Relative Humidity (Non-condensing)	Atmospheric Pressure (kPa)
Working environment	0~40	5%~95%	57.0~107.4
Storage and transport environment	-30~70	5%~95%	16.0~107.4 (without the CO ₂ module) 50.0~107.4 (with the CO ₂ module)

Microstream CO ₂ module			
Item	Temperature (°C)	Relative Humidity (Non-condensing)	Atmospheric Pressure (kPa)
Working environment	0~40	15%~95%	57.3~105.3
Storage and transport environment	-20~60	10%~95%	57.3~105.3

Sidestream CO ₂ module			
Item	Temperature (°C)	Relative Humidity (Non-condensing)	Atmospheric Pressure (kPa)
Working environment	5~40	15%~95%	57.3~105.3
Storage and transport environment	-20~60	10%~95%	57.0~107.4

N1 Dock and N1 Modular Rack			
Item	Temperature (°C)	Relative Humidity (Non-condensing)	Atmospheric Pressure (kPa)
Working environment	0~40	15%~95%	57.0~107.4
Storage and transport environment	-20~60	10%~95%	16.0~107.4

NOTE

- Unless otherwise specified, the environmental specifications of a parameter module are the same as those of the main unit.

3.2.1.2 Electrical Requirements

The monitor can be powered by an AC power supply through the N1 Dock, or it can be directly connected to an external power supply using an adapter. The power cord must be connected only to a power socket with protective grounding.

Make sure that:

1. All cables and connectors are not damaged, and pins are not loose.
2. Patient cables and leadwires are properly insulated, and connectors are not loose.

The power input specifications of the adapter and Transport Dock are as follows:

Input voltage	100-240V~(15%, +10%)
Input current	FSP030-RCAM-G: 1.0 ~ 0.6 A
Frequency	50 Hz/60 Hz(±3Hz)

The AC power input specifications of the N1 Dock are as follows:

Input voltage	100-240V~(±10%)
Input current	0.65A ~0.35A
Frequency	50 Hz/60 Hz (±3Hz)

3.2.1.3 Turning on the Monitor

1. Check the monitor for any mechanical damage. Make sure that all external cables and accessories are properly connected.
2. For the first use, connect the monitor to the external power supply (AC adapter, Dock, powered-on host monitor, or Transport Dock) for a while and then turn on the monitor to activate the battery.
3. When using the monitor alone, connect the monitor and the DC adapter. If you run the patient monitor on battery power, ensure that the battery is sufficiently charged. If the monitor is powered using the N1 Dock, check that the power LED on the Dock is on.
4. Press the power switch to turn on the monitor.

FOR YOUR NOTES

4 Testing and Maintenance

4.1 Introduction

To ensure the patient monitor always functions properly, qualified service personnel should perform regular inspection, maintenance and test. This chapter provides a checklist of the testing procedures for the patient monitor with recommended test equipment and frequency. The service personnel should perform the testing and maintenance procedures as required and use appropriate test equipment.

The testing procedures provided in this chapter are intended to verify that the patient monitor meets the performance specifications. If the patient monitor or a module fails to perform as specified in any test, repairs or replacement must be done to correct the problem. If the problem persists, contact our Customer Service Department.



CAUTION

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

4.1.1 Test Equipment

Required Test Equipment is listed in the specific test procedure.

4.1.2 Preventative Maintenance

It is recommended to verify accuracy and calibrate the patient monitor as needed at least once every two years (once a year for CO₂ modules). Preventative maintenance involves the following test items. For detailed procedures, refer to the following sections.

- Visual inspection
- NIBP tests and calibration
- CO₂ module tests and calibration

4.1.3 Recommended Frequency

Check/Maintenance Item		Frequency
Visual inspection		1. When the monitor is installed for the first time or is reinstalled.
Power-on test		1. When the monitor is installed for the first time or is reinstalled. 2. Following any repair or parts replacement.
EGG test and calibration	Performance test	1. When the user suspects that the measurement is incorrect. 2. Following any repair or replacement of the relevant module. 3. At least once every two years. Note: Perform CO ₂ module tests at least once a year.
	Module calibration	
Resp test		
SpO ₂ test		
NIBP tests and calibration	NIBP accuracy test	
	NIBP leakage test	
Temp test		
IBP test and calibration	Performance test	
	Pressure calibration	
Sidestream and microstream CO ₂ modules tests and calibration	Leakage test	
	Performance test	
	Module calibration	
Analog output test		When the user suspects that the analog output does not function properly.
Electrical safety tests	Enclosure leakage current test	1. Following any repair or replacement of the power module. 2. When the monitor is dropped. 3. At least twice a year or as required.
	Earth leakage test	
	Patient leakage current	
	Patient auxiliary current	
Battery check	Functionality test	1. When the monitor is installed for the first time. 2. After the battery is replaced.
	Performance test	Once a year or when the battery runtime reduces significantly.

4.2 Preventative Maintenance Procedures

4.2.1 Visual Inspection

Inspect the monitor for obvious damage. The test is passed if the monitor has no obvious damage. Follow these guidelines when inspecting the monitor:

- Carefully inspect the enclosure, display, buttons, and knob for obvious damage.
- Inspect the power cord and module accessories for obvious damage.
- Inspect all external connections for loose connectors, bent pins or frayed cables.
- Inspect all connectors on the monitor for loose connectors or bent pins.
- Make sure that safety labels and data plates on the monitor are clearly legible.

4.2.2 NIBP Tests

4.2.2.1 NIBP Leakage Test

NOTE

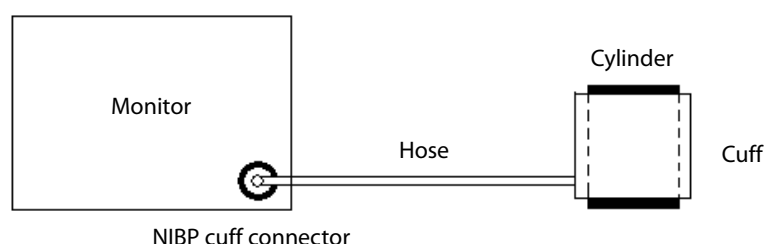
- You should perform the NIBP leakage test before any other NIBP concerned test and calibration.

Tools required:

- NIBP cuff for adult patient
- Air hose
- Cylinder

Follow this procedure to perform the test:

1. Set **Patient Category** to **Adult**.
2. Connect the NIBP cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select **Main Menu**→**System**→**Maintenance** >>→**Module**→**NIBP**→**NIBP Leakage Test**. The message "**Leakage Testing...**" is displayed in the NIBP parameter area.

After about 20s, the cuff automatically deflates, which indicates that the 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 Airway Leak**" is displayed, it indicates that the system may have a leakage. In this case, check that all connections are in good condition and the cuff and air tubing have no leakage. Then perform the test again.

You can also perform a manual leakage test:

1. Perform steps 1-4 in section **1.2.2.2 NIBP Accuracy Test**.
2. Raise the pressure in the rigid vessel to 250 mmHg using the balloon pump. Then wait for 5 seconds so that the measured values become stable.
3. Record the current pressure value, and use a timer to count time. Then record the pressure value after 60 seconds.
4. Compare the two pressure values and make sure that the difference is not greater than 6 mmHg.

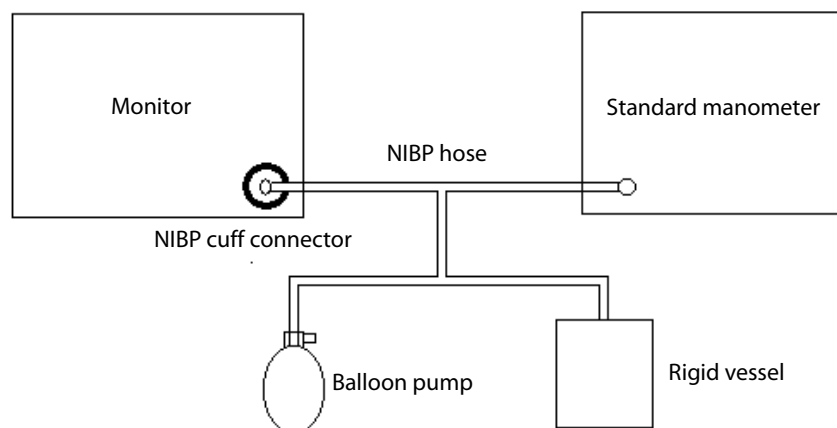
4.2.2.2 NIBP Accuracy Test

Tools required:

- T-shape connector
- NIBP hose
- Balloon pump
- Rigid vessel with 500 ± 25 ml internal volume
- Standard manometer (calibrated with accuracy greater than or equal to 1 mmHg)

Follow this procedure to perform the test:

1. Connect the monitor and the test tools as shown below.



2. Before inflation, check whether the reading on the manometer is 0. If not, open the valve of the balloon pump to let the whole airway open to the atmosphere. Close the valve after the reading becomes 0.
3. Select **Main Menu** → **Maintenance** → enter the required password → **Module** → **NIBP** → **NIBP Accuracy Test**.
4. Check that the reading of the manometer and that of the monitor are both 0 mmHg.
5. Raise the pressure in the rigid vessel to 50 mmHg using the balloon pump. Then wait for 10 seconds so that the measured values become stable.
6. Check that the difference between the reading of the manometer and that of the monitor is less than or equal to 3 mmHg or less. If the difference is greater than 3 mmHg, contact Mindray service.
7. Raise the pressure in the rigid vessel to 200 mmHg using the balloon pump. Then wait for 10 seconds so that the measured values become stable. Then repeat step 6.

NOTE

- You can use an NIBP simulator to replace the balloon pump and the standard manometer.
- You can use an appropriate cylinder and a cuff instead of the rigid vessel.

4.2.3 Sidestream and Microstream CO₂ Modules Tests

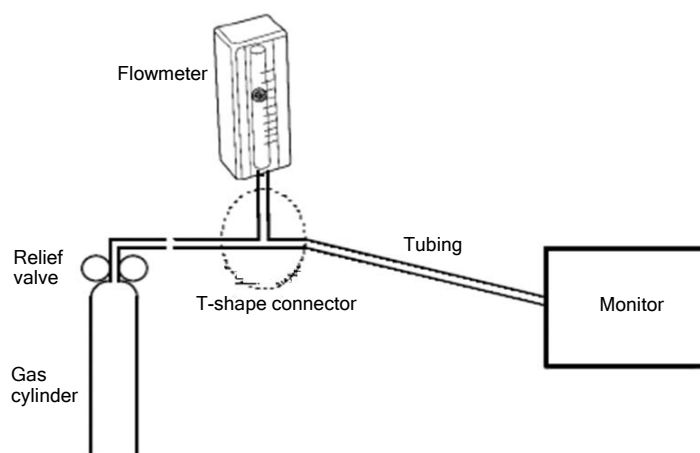
4.2.3.1 Leakage Test

1. Connect the module and the monitor.
2. Wait until CO₂ warmup is finished and then completely block the gas inlet of the module or water trap (by using your finger or a pinched sample line). The sidestream and microstream CO₂ modules will behave as follows:
 - ◆ Sidestream: After 3 seconds, the alarm message "**CO₂ Airway Occluded**" is displayed on the screen. Block the gas inlet for another 60 seconds. Select **Main Menu** → **Maintenance** → enter the required password → **Module** → **CO₂** to check that the current CO₂ flow rate is less than 10 ml/min. If the alarm message remains on the screen, it indicates that the module does not leak. If the alarm message CO₂ Airway Occluded disappears, or the flow rate is greater than or equal to 10 ml/min, it indicates that the module leaks.
 - ◆ Microstream: After 3 seconds, the alarm message "**CO₂ Purging**" is displayed on the screen. Block the gas inlet for another 30 seconds. If the alarm message "**CO₂ Airway Occluded**" is displayed, it indicates that the module does not leak.

4.2.3.2 Accuracy Test

Tools required:

- For microstream CO₂ module and sidestream CO₂ module without O₂ module, a gas cylinder with 5±0.03% CO₂, 21.0% O₂ and balance gas N₂ (P/N 0075-00-0033-01) or a steel gas cylinder with:
 - ◆ CO₂ concentration 3% - 7%
 - ◆ $a/c \leq 0.01$ (where a = absolute gas concentration accuracy, c = gas concentration)
 - ◆ balance gas N₂
 - For sidestream CO₂ module with O₂ module equipped, a steel gas cylinder (P/N 0075-00-0048-01) with 6% CO₂, 4% Desflurane, 45% N₂O, and 45% O₂,
 - T-shape connector
 - Air tubing
 - Flowmeter
1. Connect the module and the monitor.
 2. Wait until the CO₂ module warmup finishes. Check the airway for leakage and perform a leakage test as well to make sure that the airway has no leakage.
 3. Select Main Menu → Maintenance → enter the required password → Module → CO₂.
 4. Connect the test system as follows:



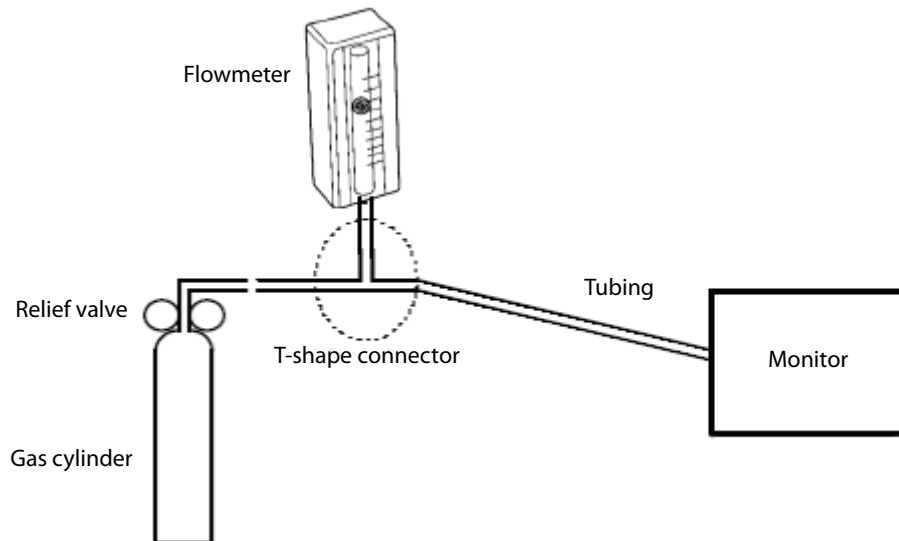
5. Open the relief valve and adjust it until the flowmeter has a stable reading between 10 ml/min and 50 ml/min.
6. Check that the real-time CO₂ value is within $6.0 \pm 0.2\%$ in the **CO2 Maintenance** menu (for microstream CO₂, the value is 45 ± 2 mmHg).
7. Replace the cylinder to the steel gas cylinder with $>40\%$ O₂ and balance gas N₂ (applicable to sidestream CO₂ module with O₂ module equipped) and verify that the real-time O₂ value error is within $\pm 2\%$ (when $O_2 \leq 80\%$) or $\pm 3\%$ ($80\% \leq O_2 \leq 100\%$).

4.2.3.3 Calibration

Tools required:

- For microstream CO₂ module and sidestream CO₂ module without O₂ module, a gas cylinder with $5 \pm 0.03\%$ CO₂, 21.0% O₂ and balance gas N₂ (P/N 0075-00-0033-01) or a steel gas cylinder with:
 - ◆ CO₂ concentration 3% - 7%
 - ◆ $a/c \leq 0.01$ (where a = absolute gas concentration accuracy, c = gas concentration)
 - ◆ balance gas N₂
- For sidestream CO₂ module with O₂ module equipped, a steel gas cylinder (P/N: 0075-00-0048-01) with 6% CO₂, 4% Desflurane, 45% N₂O, and 45% O₂,
- T-shape connector
- Air tubing
- Flowmeter

1. Make sure that the sidestream or microstream CO₂ module has been warmed up or started up.
2. Check the airway for leakage and perform a leakage test as well to make sure that the airway has no leakage.
3. Select **Main Menu** → **Maintenance** → enter the required password → **Module** → **CO₂**.
4. In the **Calibrate Maintenance** menu, select **Zero**.
5. After the zero calibration succeeds, connect the monitor and the test tools as follows:



6. Open the relief valve and adjust it until the flowmeter has a stable reading between 10 ml/min and 50 ml/min.
7. In the **CO₂ Maintenance** menu, select 6% (the CO₂ concentration) for CO₂ calibration.
8. After the measured CO₂ concentration becomes stable, select **Calibrate** to calibrate the CO₂ module.
9. Replace the cylinder to the steel gas cylinder with >40% O₂ and balance gas N₂(applicable to sidestream CO₂ module with O₂ module equipped) and calibrate O₂.

If the calibration succeeds, the message "**Calibration Completed!**" is displayed in the **Calibrate** menu. If the calibration fails, the message "**Calibration Failed!**" is displayed. In this case, check whether the operations are correct and perform another calibration. If the calibration fails several times, return the module to Mindray for repair.

4.3 Power-on Test

This test aims to verify that the monitor can power up properly.

When the monitor is powered only by the battery, follow this procedure:

1. Install the battery on the monitor.
2. Press the power switch to turn on the monitor. The battery LED flashes.

When the monitor is powered by using the adapter, follow this procedure:

1. Install the battery on the monitor. Connect the monitor and the adapter. Then connect the adapter and the AC power supply. In this case, the external power LED and the battery LED are on.
2. Press the power switch to turn on the monitor.

When the monitor is in use with the Dock, follow this procedure:

1. Install the battery on the monitor. Install the monitor on the Dock. Then connect the Dock and the AC power supply. In this case, the power LED on the Dock and the battery LED on the monitor are on.
2. Press the power switch to turn on the monitor.

The monitor automatically performs a self-test upon startup. During the self-test, you can hear the alarm tone, and the

alarm lamp glows yellow and red. This indicates that the visible and audible alarm indicators operate properly.

4.4 Module Performance Tests

4.4.1 ECG Tests

4.4.1.1 ECG Performance Test

Tools required: Medsim300B patient simulator or other equivalent simulator

1. Connect the patient simulator with the ECG module using an ECG cable.
2. Set the patient simulator as follows: ECG sinus rhythm, HR = 80 bpm, and amplitude = 1 mV.
3. Verify that the ECG waves are displayed correctly without noise and the displayed HR value is within 80 ± 1 bpm.
4. Disconnect each of the leads in turn and observe the corresponding lead off message displayed on the screen.
5. Set the output of the simulator to deliver a paced signal, and set **Paced** to **Yes** on the monitor. Check the pace pulse marks on the monitor screen.

4.4.1.2 ECG Verification

Test tool: vernier caliper

1. Select the ECG parameter window or waveform area → **Filter** → **Diagnostic**.
2. Select **Main Menu** → **Maintenance** → enter the required password → **Module**.
3. Select **Calibration**. A square wave appears on the screen and the message "**ECG Calibrating**" is displayed.
4. Compare the amplitude of the square wave with that of the scale. The difference should be less than 5%.
5. After completing the calibration, select **Stop Calibration**.

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

4.4.2 Resp Test

Tools required:

- Medsim300B patient simulator or other equivalent simulator

1. Connect the patient simulator and the monitor using a non ESU-proof cable and set lead II as the respiration lead of the monitor.
2. Configure the simulator as follows: lead II as the respiration lead, base impedance line as 500 Ω ; delta impedance as 1 Ω , respiration rate as 20 rpm.
3. Verify that the Resp wave is displayed without any distortion and the displayed Resp value is within 20 ± 1 rpm.

4.4.3 SpO₂ Test

Tools required: None

1. Connect the SpO₂ sensor to the SpO₂ connector on the monitor. Set **Patient Category** to **Adult** and **PR Source** to **SpO₂** on the monitor.
2. Apply the SpO₂ sensor to the ring finger of a healthy person.
3. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO₂ is within 95% and 100%.
4. Remove the SpO₂ sensor from your finger and check that the SpO₂ sensor off alarm is triggered.

The SpO₂ accuracy has been verified in human experiments by comparing with the arterial blood sample reference measured by a CO-oximeter. Pulse oximeter measurements are statistically distributed and about two-thirds of the measurements are expected to fall within the specified accuracy range compared to CO-oximeter measurements.

NOTE

-
- **A simulator cannot be used to assess the accuracy of a pulse oximeter monitor or a SpO₂ sensor. Instead, it can only verify that whether the monitor is functional. The accuracy of a pulse oximeter monitor or a SpO₂ sensor needs to be verified by clinical data.**
-

4.4.4 Temp Test

Tools required: Resistance box (with accuracy greater than or equal to 0.1 Ω)

1. Connect the two pins of any Temp connector of a module to the two ends of the resistance box using two wires.
2. Set the resistance box to 1354.9 Ω (the corresponding temperature is 37°C).
3. Verify that the displayed value is within 37±0.1°C.
4. Repeat steps 1 to 3 to verify each Temp channel of the monitor.

4.4.5 NIBP Tests

Refer to section **4.2.2 NIBP Tests**.

4.4.6 IBP Test and Calibration

4.4.6.1 Performance Test

Tools required:

- Patient simulator Medsim300B, MPS450, or equivalent equipment
- IBP adapter cable for test (P/N 009-002199-00 for Medsim300B; P/N 009-002198-00 for MPS450)

1. Connect the patient simulator to the IBP connector on the monitor.
2. Set the patient simulator to output 0 mmHg to an IBP channel.
3. Press the **Zero** key from the IBP Setup menu to perform a zero calibration.
4. Set static pressure to 200 mmHg on the patient simulator.
5. Check that the value displayed on the monitor is within 200 ± 2 mmHg.
6. If the error is beyond ± 2 mmHg, calibrate the IBP module. If the IBP module was calibrated with a dedicated reusable IBP sensor, check the calibration together with this IBP sensor.
7. Set the patient simulator to separately output 120/80 mmHg ART signals and 120/0 mmHg LV signals to the IBP channel and check that the IBP wave is displayed correctly.
8. Repeat the preceding steps to test all IBP channels.

4.4.6.2 Pressure Calibration

Method 1:

Tools required:

- Patient simulator Medsim300B, MPS450, or equivalent equipment
- IBP adapter cable for test (P/N 009-002199-00 for Medsim300B; P/N 009-002198-00 for MPS450)

1. Connect the patient simulator to the IBP connector on the monitor.
2. Set the patient simulator to 0 pressure for the target IBP channel.
3. Press the **Zero** key from the IBP Setup menu to perform a zero calibration.
4. Set static pressure to 200 mmHg on the patient simulator.
5. Select **Main Menu** → **Maintenance** → enter the required password → **Module** → **IBP**. Set the calibration value to 200 mmHg.
6. Select the **Calibrate** button next to the target IBP channel to start calibration.

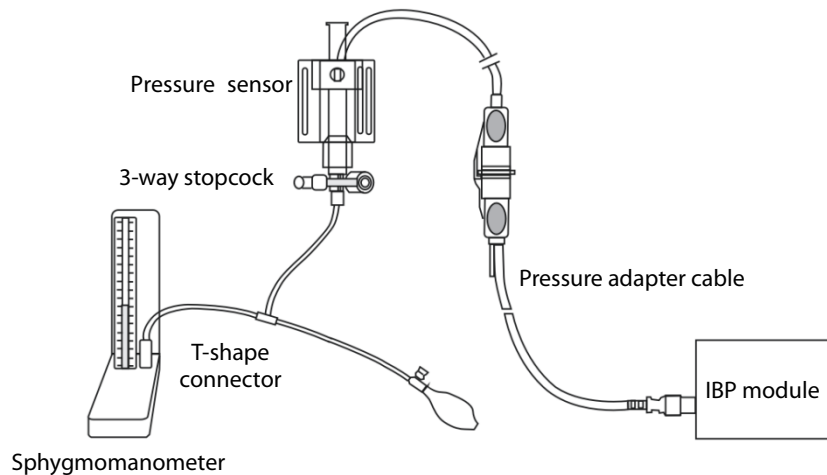
If the calibration succeeds, the message "**Calibration Completed!**" is displayed. If the calibration fails, a corresponding message is displayed.

Method 2:

Tools required:

- Standard manometer
- Balloon pump
- Air tubing
- T-shape connector

1. Connect the 3-way stopcock, the sphygmomanometer and the balloon pump using the T-shape connector, as shown below.
2. Turn on the 3-way stopcock to the air to zero the transducer. Then open the stopcock to the sphygmomanometer.



3. Select **Main Menu** → **Maintenance Maintenance** → enter the required password → **Module** → **IBP**. In the displayed interface, set the target calibration value of the target channel. Value range: 80 to 300 mmHg.
4. Use the balloon pump to inflate until the reading of the sphygmomanometer approximates to the preset calibration value.
5. Adjust the calibration value in the **IBP Maintenance** menu until it is equal to the reading of sphygmomanometer.
6. Select the **Calibrate** button next to the target IBP channel to start calibration.

If the calibration succeeds, the message "**Calibration Completed!**" is displayed. If the calibration fails, a corresponding message is displayed.

4.4.7 Sidestream and Microstream CO₂ Modules Tests and Calibration

Refer to section **4.2.3 Sidestream and Microstream CO₂ Modules Tests**.

4.5 Analog Output Test

Tools required:

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

1. Connect the patient simulator to the monitor using an ECG or IBP cable.
2. Connect the oscilloscope to the Auxiliary Output Connector on the monitor.
3. Verify that the waves displayed on the oscilloscope are identical with those displayed on the monitor.

4.6 Electrical safety tests



- **Electrical safety tests are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator.**
 - **All tests can be performed using commercially available safety analyzer test equipment. Maintenance personnel shall ensure the adaptability, functional completeness and safety of these pieces of test equipment, and be familiar with their usage.**
 - **Electrical safety tests shall comply with the following standards: IEC 60601-1 and ANSI/AAMI ES60601-1.**
 - **In case of other stipulations in local laws and regulations, implement electrical safety tests by following relevant stipulations.**
 - **All devices driven by AC power and connected to medical instruments in patient zones must comply with the IEC 60601-1 standard. And electrical safety tests on these devices must be implemented in accordance with the test interval of the patient monitor.**
 - **Use certified safety analyzer (for example, UL, CSA or AMAI) as instructed to perform relevant tests.**
-

NOTE

- **Electrical safety check shall be performed after repair or routine maintenance. Ensure that all cover boards, panels and screws are correctly installed before implementing electrical safety tests.**
 - **Electrical safety tests are used to timely detect potential electrical safety risks that might cause damage to patients, operators or maintenance personnel. Electrical safety tests must be carried out under normal environmental conditions (that is, normal temperature, humidity and barometric pressure).**
-

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

4.7 Network Print Test

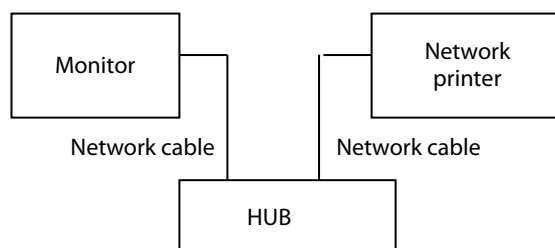
Tools required: hub and network cable

NOTE

- **HP LaserJet Pro M202dw laser printer is recommended for this monitor.**

4.7.1 Equipment Connection and Setup

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



- 2 Set the IP address:
 - a. Use the current Dock net setting: Select **Main Menu**→**Maintenance**→enter the password →**Dock Setup**. Set Net Setting Type to Use current Dock net setting.
 - b. Select the IP setup tab, and set the IP address of the monitor to one in the same network segment as that of the network printer (refer to the instructions for use of the printer).
- 3 Set the printer:
 - a. Host mode: Select **Main Menu**→**Maintenance**→**User Maintenance**→ enter the password →**Dock Setup**. Set Work Mode to Host Mode. Select the printer setup tab. Set the IP address of the printer to one in the same network segment as that of the monitor. Select **Print Test Page** to verify that the printer works properly.
 - b. Dock mode: Select **Main Menu**→**Maintenance**→**User Maintenance**→ enter the password →**Dock Setup**. Set **Work Mode** to **Dock Mode**. On the **User Maintenance** interface, select **Print**→**Printer**, and set the IP address of the printer. Select **Print Test Page** to verify that the printer works properly.

4.7.2 Print Function Test

- 1 Enter the Demo mode of the monitor.
- 2 Select **Main Menu**→**Report** column →**Normal Report**→**Realtime Report**. Click Print. The network printer prints the real-time report.

4.8 Battery Check

4.8.1 Functionality Test

1. Remove the battery from the monitor.
2. Check that the monitor works properly when being powered by the external DC power supply or by the AC power supply through the Dock.
3. Install the battery according to the procedures described in the Operator's Manual.
4. Disconnect the external DC power supply or the AC power supply on the Dock. Check whether the monitor still works properly.

4.8.2 Performance Test

Refer to the related content in the Battery chapter in BeneVision N1 Patient Monitor Operator's Manual.

5 Troubleshooting

5.1 Overview

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

The recommended solutions given in this chapter address most of the equipment problems you encounter, but do not include any problems that may arise. Contact us if you have a problem that is not covered in this section.

5.2 Part Replacement

Printed circuit boards (PCBs) and other major parts and components in the monitor are replaceable. Once you have located the faulty PCB, follow the steps in 6 **Repair and Disassembly** to replace it and check if the failure is eliminated or if the monitor passes the relevant tests. If the failure is eliminated, it indicates that the original PCB is damaged. In this case, send the defective PCB to us for repair. If the failure persists, reinstall the original PCB and continue troubleshooting as directed in this chapter.

To learn about and get the parts you need to replace, refer to **7 Parts**.

5.3 Software Version Check

In troubleshooting that involves software version compatibility, you need to know the monitor configuration and software version information. For detailed information about version compatibility, contact our after-sales service department. To check the software version, follow this procedure:

1. Select **Main Menu**→**System** >>→**Version** >>. In the displayed menu, you can check the system software version and monitor configuration.



2. Select **Main Menu**→**Maintenance**>>→ enter the user maintenance password →**Version** >>. In the displayed menu, you can check the version information of the system software and modules.

Maintenance	
Other	Authorization Setup
Version	Battery Information << >>
System Software Version	02.01.00.15 85469
Kernel	02.05.00.05
MPM Version	N/A
MPM Type	ARR-ST-12L
ECG Algorithm Type	Mindray.ArrExtend.ST12.Analyze.Glasgow

5.4 Technical Alarm Check

Before troubleshooting the monitor, check whether the monitor displays technical alarm information. If yes, eliminate the technical alarm first.

For technical alarm information, causes and solutions, refer to the Operator's Manual of the monitor.

5.5 Troubleshooting Guide



5.5.1 Power-On/Off Failures

Failure Description	Possible Cause	Troubleshooting
You cannot turn on the monitor powered only by the battery.	The battery is not activated.	Use the AC adapter or Dock to supply external power to activate the battery.
	The battery is low or the battery is damaged.	Use the AC adapter or Dock to supply external power to the monitor. Then turn on the monitor to check the battery level and battery status. If the battery LED flashes yellow or the system generates the battery error alarm, the battery is damaged. In this case, replace the battery.
You cannot turn on the monitor connected to the AC adapter (when the battery is not available or the battery is low or faulty).	The AC power supply is not connected.	Verify that the AC power supply is properly connected.
	The AC adapter is faulty.	If the monitor can work properly when being connected to the main monitor or the Dock, replace the AC adapter.
	The main board power supply is faulty.	If the external power LED is off, replace the main board.
	The power button PCBA is faulty.	If you can turn on the monitor after connecting it to the powered-on main monitor, replace the power button PCBA.
	The main board display circuit is faulty.	If the power LED is on but the display is off, replace the main board.

5.5.2 Display Failures

Failure Description	Possible Cause	Troubleshooting
The monitor displays a black, white, or flower screen or displays horizontal or vertical lines.	The screen cable is loose.	Check whether the screen cable is connected properly. If no, reconnect it.
	The display assembly is faulty.	Replace the display assembly.
	The main board is faulty.	Replace the main board.
The touchscreen does not respond.	The screen cable is loose.	Check whether the screen cable is connected properly. If no, reconnect it.
	The display assembly is faulty.	Replace the display assembly.
	The main board is faulty.	Replace the main board.
The touchscreen fails to respond accurately.	The touchscreen is faulty.	Replace the display assembly.

5.5.3 Alarm Failures

Failure Description	Possible Cause	Troubleshooting
The alarm lamp is off or cannot be turned off while the monitor sounds audible alarms.	The main board is faulty.	Replace the main board.
You cannot hear the alarm.	The alarm is muted.	1. Check whether the  icon is displayed in the alarm status icon area. If yes, the alarm is muted. 2. Check whether the  icon is displayed in the alarm status icon area. If yes, the alarm is paused or disabled.
	The speaker connection cable is faulty.	Verify that the cable connecting the speaker to the main board is properly connected.
	The speaker is faulty.	Replace the speaker.
	The main board is faulty.	Replace the main board.

5.5.4 Dock or Modular Rack Failures

Failure Description	Possible Cause	Troubleshooting
The parameter module cannot be identified.	The Rack NIOS board is faulty.	Replace the NIOS board.
	The RACK connector board is faulty.	Verify that the RACK connector board is securely connected to the NIOS board, or replace the connector board.
	The main board is faulty.	Replace the main board.
The monitor provides no video output, the USB device or network cannot be used, or the	The Dock interface board is faulty.	Replace the Dock interface board.
	The Dock transfer board is faulty.	Replace the Dock transfer board.

Failure Description	Possible Cause	Troubleshooting
monitor cannot be connected to the main monitor.	The main board is faulty.	Replace the Dock main board.
The Dock provides no power output.	The Dock power board is faulty.	Replace the Dock power board.
After the monitor is installed on the Dock, the external display is black.	An abnormality occurs due to hot plug.	Reinstall N1.
	The connection sequence is incorrect.	Connect the display and the Dock first, and then install or start N1.
The touchscreen of the external display cannot be used.	The USB connection is abnormal.	Reinstall or restart N1.

5.5.5 Operation Failures

Failure Description	Possible Cause	Troubleshooting
The monitor crashes.	The system program is faulty.	Refresh the system software.
	The main board is faulty.	Replace the main board.
The monitor is not identified after being connected to the main monitor.	The infrared communication board is faulty.	Replace the infrared communication board.
After being connected to the main monitor, the monitor is identified but displays no parameter waveform.	The main board is faulty.	Replace the main board.
The time is reset.	The battery is faulty.	Replace the battery.
	The battery charging circuit is faulty.	Replace the main board.
	The main board is faulty.	Replace the main board.

5.5.6 Storage Failures

Failure Description	Possible Cause	Troubleshooting
Historical data and holographic waveforms cannot be stored.	The data storage device is faulty.	Restart N1. If the failure persists, enter the EMMC tab in the Factory Maintenance menu to format the data storage device or replace the main board.
	The main board is faulty.	Replace the main board.
N1 reports "Storage Card Error".	The data storage device is faulty.	Restart N1. If the failure persists, enter the EMMC tab in the Factory Maintenance menu to format the data storage device or replace the main board.

5.5.7 Power Supply Failures

Failure Description	Possible Cause	Troubleshooting
The battery cannot be fully charged.	The battery is damaged.	Replace the battery.
	The main board is faulty.	Replace the main board.
The battery cannot be charged or a battery charging error is reported.	The battery is damaged.	Replace the battery.
	The main board is faulty.	Replace the main board.
The battery cannot supply power.	The battery is damaged.	Replace the battery.
	The battery connection cable is faulty.	Verify that the battery connection cable is properly connected and the plug is not damaged.
	The main board is faulty.	Replace the main board.
The system reports that the DC power is too high or too low.	The power supply is faulty.	1. Turn off the monitor and then restart it. 2. If the failure persists, replace the main board.
The system reports a battery communication error.	The battery connection cable is faulty.	Verify that the battery connection cable is properly connected and the plug is not damaged.
	The power supply is faulty.	Replace the main board.
The system reports that the battery is aged.	The battery is aged.	Replace the battery.
The system reports a battery error.	The battery is faulty.	Replace the battery.
The system reports a high battery temperature alarm.	The ambient temperature is too high.	Check whether the ambient temperature is too high. If yes, reduce the ambient temperature.
The system reports a battery off alarm.	The battery connection cable is faulty.	Verify that the battery connection cable is properly connected and the plug is not damaged.

NOTE

- When the power module is faulty, it may cause damage to other components, for example, the monitor suddenly crashes during startup, due to power supply protection. In this case, troubleshoot the power module as per the procedure described in the table above.
- Components of the main unit are powered by the power module. When a component malfunctions, verify the operating voltage is correct.
- If the device has two batteries, replace both batteries if required.

5.5.8 Wi-Fi Failures

Failure Description	Possible Cause	Troubleshooting
Wi-Fi connection is unavailable.	The Wi-Fi module is faulty.	Reinstall or replace the module.
	The main board is faulty.	Replace the main board.
The Wi-Fi connection is disconnected frequently.	The Wi-Fi antenna falls off or is not securely connected to the module.	Disassemble the monitor and secure the Wi-Fi antenna.
	The Wi-Fi module is faulty.	Replace the Wi-Fi module.
	Wi-Fi signals in the region are unstable.	Check the Wi-Fi connection of the hospital.
The monitor fails to connect Wi-Fi.	The IP address is incorrect.	Check whether an IP address conflict exists in the network. If yes, reset the IP address.
	Wi-Fi signals in the region are unstable.	Check the Wi-Fi connection of the hospital.
	The Wi-Fi antenna falls off or is disconnected from the Wi-Fi module.	Secure the Wi-Fi antenna.
	The main board is faulty.	Replace the main board.

5.5.9 Wired Network Failures

Failure Description	Possible Cause	Troubleshooting
The monitor fails to connect to a wired network.	The network cable fails to be connected properly.	Make sure that the network cable is properly connected and is not close to the power cord of high power equipment, and the length of the network cable is less than or equal to 50 m.
	The IP address is incorrect.	Check whether an IP address conflict exists in the network. If yes, reset the IP address.
	The network cable is faulty.	Replace the network cable.
	The main board is faulty.	Replace the main board.
The network connection is disconnected frequently.	The network cable fails to be connected properly.	Make sure that the network cable is properly connected and is not close to the power cord of high power equipment, and the length of the network cable is less than or equal to 50 m.
	The IP address is incorrect.	Check whether an IP address conflict exists in the network. If yes, reset the IP address.
The monitor is connected to a network, but the Remote View function is unavailable.	The network cable fails to be connected properly.	Make sure that the network cable is properly connected and is not close to the power cord of high power equipment, and the length of the network cable is less than or equal to 50 m.
	There are too many monitors to be viewed.	Confirm the maximum number of simultaneously connected monitors according to the Operator's Manual.
	The network setting is incorrect.	Check whether an IP address conflict exists in the network. If yes, reset the network.

5.5.10 Software Upgrade Failures

Failure Description	Possible Cause	Troubleshooting
The program cannot be upgraded.	The connection is faulty.	<ol style="list-style-type: none">1. Check that the network cable is connected to the network interface on the monitor.2. Ensure the normal operation of the network hub or switch, and verify the hub cable or crossover cable is properly connected.
	The program upgrade package is incorrect.	Ensure that the upgrade package is a .pkg file corresponding to the program to be upgraded.
	The IP address of the PC is incorrect.	Configure a fixed IP address in range C as specified for the monitor. You are not advised to upgrade a program t to when the monitor is connected to a network with multiple PCs.
	The main board is faulty.	Replace the main board.

FOR YOUR NOTES

6 Repair and Disassembly

6.1 Tools

During disassembly and part replacement, the following tools may be required:

- Small Phillips screwdriver (used to remove and install M2 screws; the head model is PH0)
- Phillips screwdriver (used to remove and install M3 screws; when the N1 main unit face plate needs to be removed, the rod length of the screwdriver must be greater than or equal to 115 mm)
- Tweezers
- Terminal screw dismounting tool (the 898-000417-00 N1 terminal assembly fixture is recommended)
- Needle nose pliers
- Hexagon spanner (used to remove M6 hex socket screws)

6.2 Preparations for Disassembly

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



WARNING

- **Before disassembly, be sure to eliminate static electricity. When removing some parts with the electrostatic sensitive marks, wear protective devices such as antistatic wristband or gloves to avoid damaging the parts.**
 - **Properly connect and route the cables and wires when reassembling the monitor to avoid short circuits.**
 - **Use specified screws to reassemble the monitor. If unfit screws are tightened by force, the monitor may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**
 - **Follow the correct sequence to disassemble the monitor.**
 - **Place the removed parts by category to facilitate reassembly. Do not drop, contaminate or lose them.**
 - **To reassemble the monitor, first install the assemblies, and then the main unit. Carefully route the cables.**
 - **Make sure that the waterproof materials are properly applied during reassembly.**
-

6.3 Disassembling the N1 Main Unit with the CO₂ Module

6.3.1 Removing the Battery Door and Battery

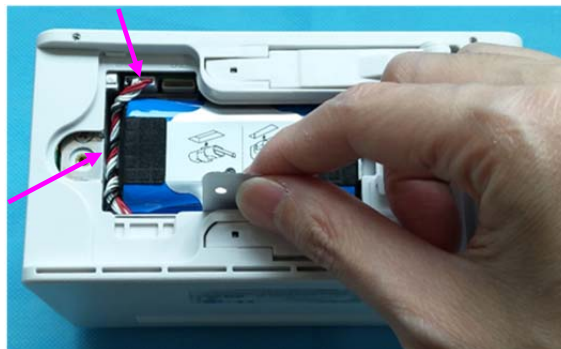
1. Remove the screw cover and loosen the screw.



2. Hold the screw with your hand and open the battery door.
3. Pull out the battery connection cable and remove the battery.

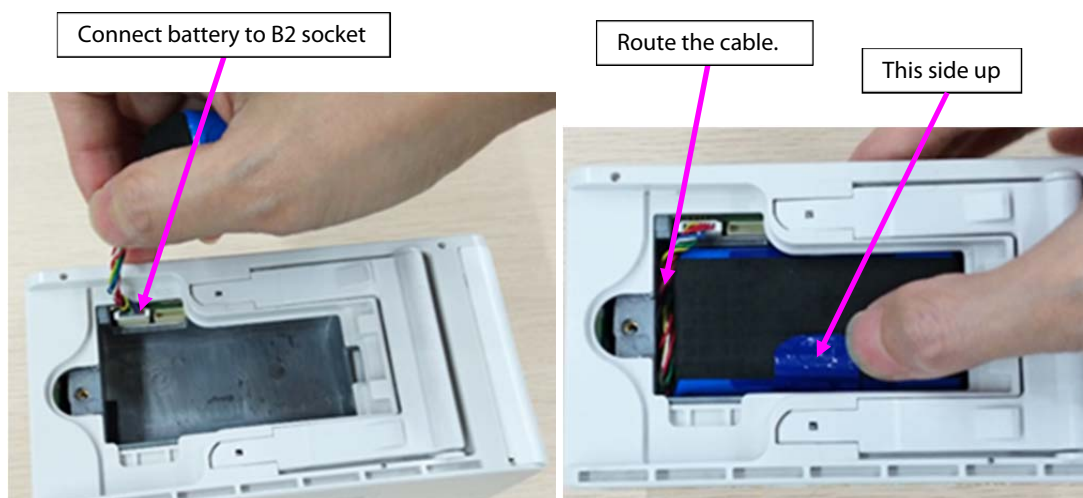
NOTE

- When disassembling the main unit, be sure to pull out the battery connection cable herein and remove the battery to avoid electricity in subsequent disassembly steps.
- When reinstalling the battery, place the battery connection cable into the left B1 socket as shown below. The battery connection cable is routed as follows. When inserting the connection cable into the socket, align the connector to avoid damage to connector pins.

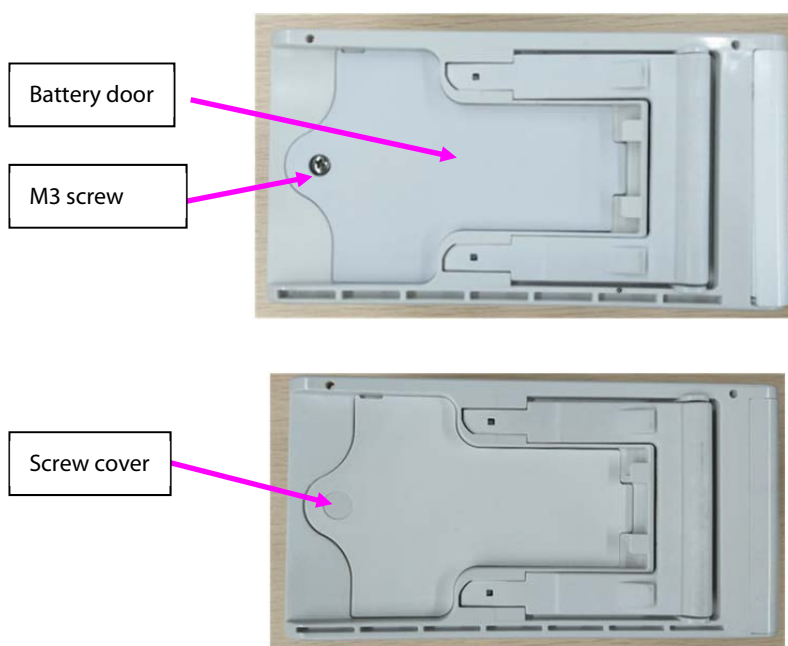


6.3.2 Installing the Battery and Battery Door

1. Connect the battery to the B1 socket on the main unit through the battery connection cable.
2. Insert the battery into the battery housing with the cable facing up.
3. Route the battery connection cable. Do not squeeze the cable.



3. Secure the battery door using a M3 screw.
4. Use a screw cover to cover the screw hole.



6.3.3 Removing the Display Assembly

1. Use the small Phillips screwdriver to remove the two screen pins fixing the display assembly.

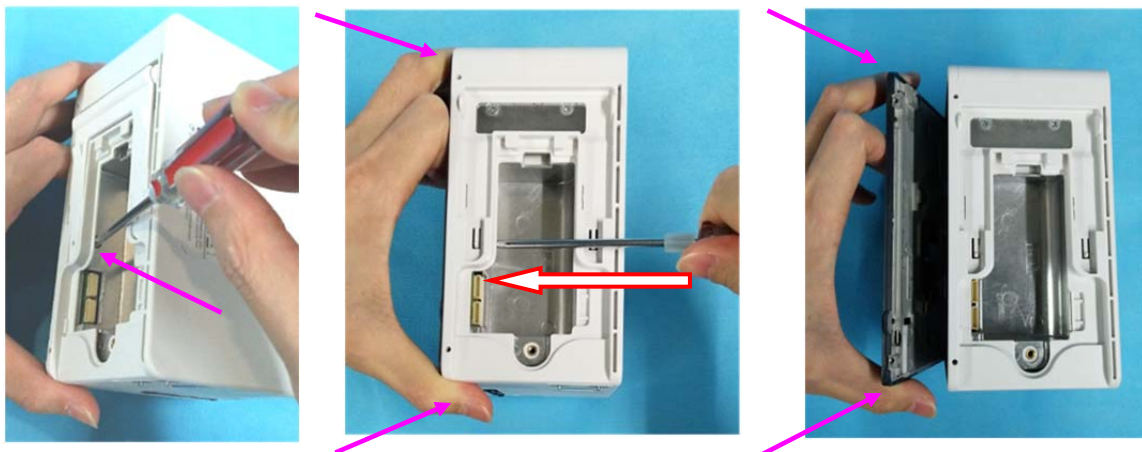


2. Use one hand to support the display assembly, and use the screwdriver to press the hole in the battery housing and push out the display assembly, as shown below.

NOTE

- Use one hand to support the display assembly as shown below. Otherwise, the FPC plug wire of the display assembly will be damaged.

3. Use your hand to hold the display assembly after it is pushed out.

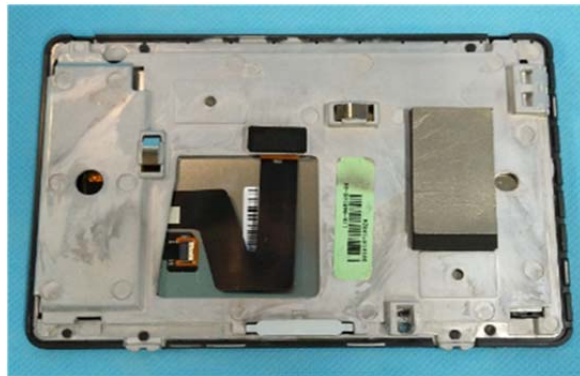


4. Use one hand to hold the display assembly as shown below, and the other to loosen the FPC plug wire on the display assembly, and remove the display assembly.



NOTE

- If the light pipe of the indicator is released after the display assembly is removed, install the light pipe at the position shown in the figure below.



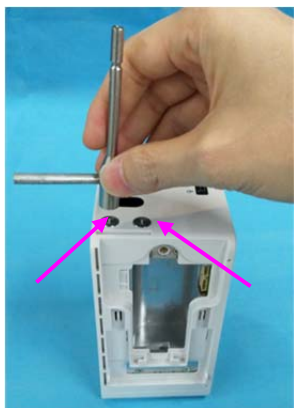
NOTE

- When assembling the display assembly, press the two corners shown in the figure below, and press the display assembly into the rear housing.



6.3.4 Removing the Rear Housing

1. Use the terminal screw dismounting tool to remove the two terminal screws fixing the rear housing.
2. Remove the four M3×5 screws fixing the rear housing.



NOTE

- To ensure flat assembly of the face plate, when fixing the four screws on the rear housing, do as follows: lay the N1 main unit flatwise, and turn the four screws by 2-3 circles for preliminary fixing; place the N1 main unit vertically, and use one hand to press the main unit and the other to tighten the screws.



NOTE

- After assembly, check that the silicon cover shown in the figure below is assembled properly.

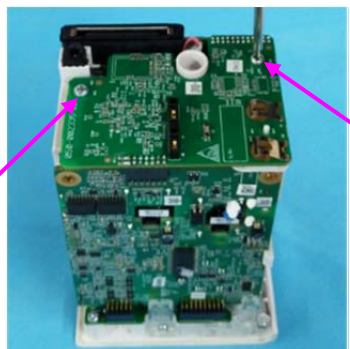


3. Use your hand to press the battery housing to separate the main frame, and then remove the rear housing.



6.3.5 Removing the Infrared Backboard

1. Loosen the two M3×5 screws fixing the infrared backboard.
2. Remove the infrared backboard.



3. Tilt the N1 main unit as shown below, and remove the two terminal nuts shown in the figure below.

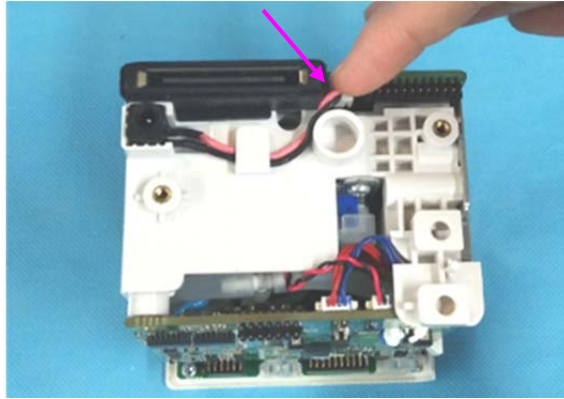


6.3.6 Removing the Main Board

1. Remove the four M3×5 screws fixing the main board.

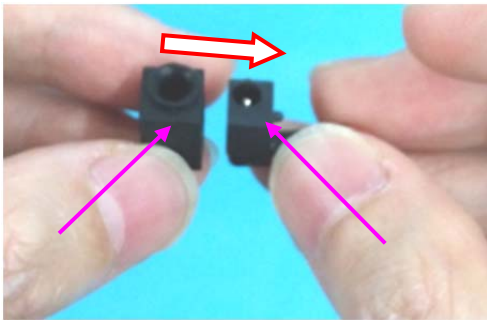


2. Remove the DC-in connection cable.

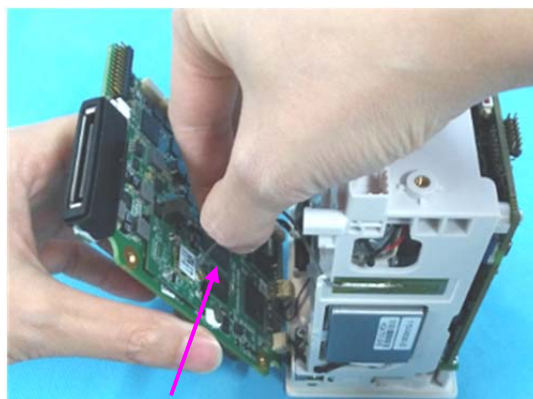


NOTE

- Check that the waterproof jacket and connection cable are installed properly when reassembling the DC-in connection cable.

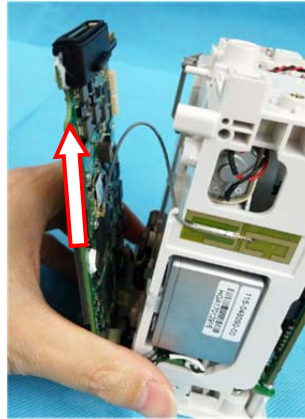


3. Loosen the Wi-Fi antenna (when the N1 main unit is configured with the Wi-Fi function).

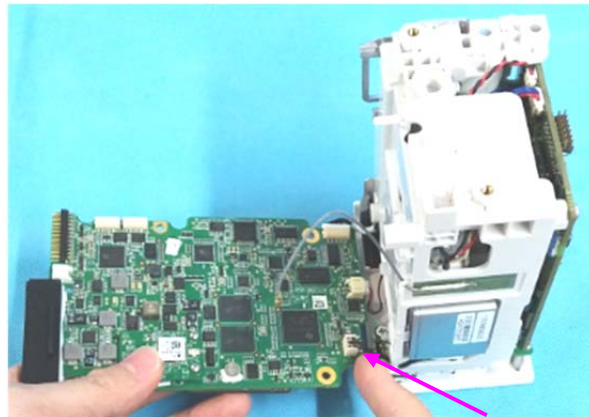


NOTE

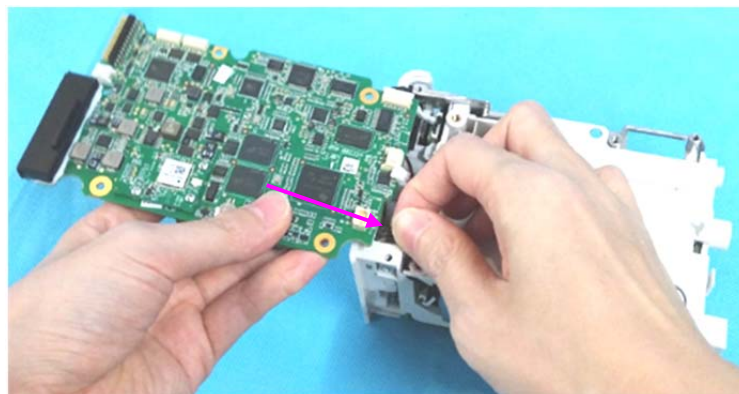
- To prevent the board from crushing the Wi-Fi antenna, route the Wi-Fi antenna according to the direction shown in the figure when reassembling the Wi-Fi antenna.



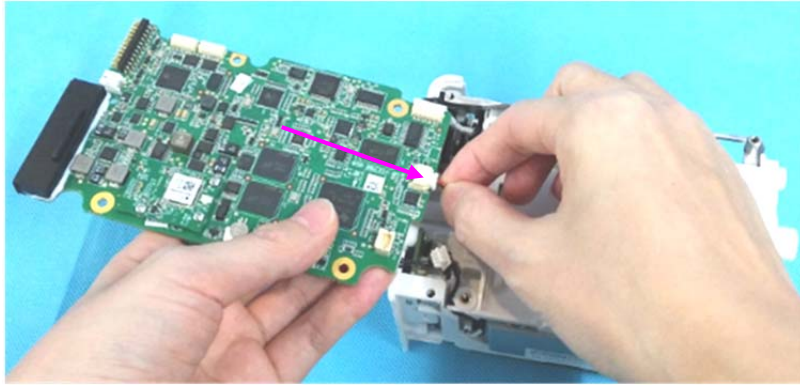
4. Loosen the connection cable of the CO₂ module.



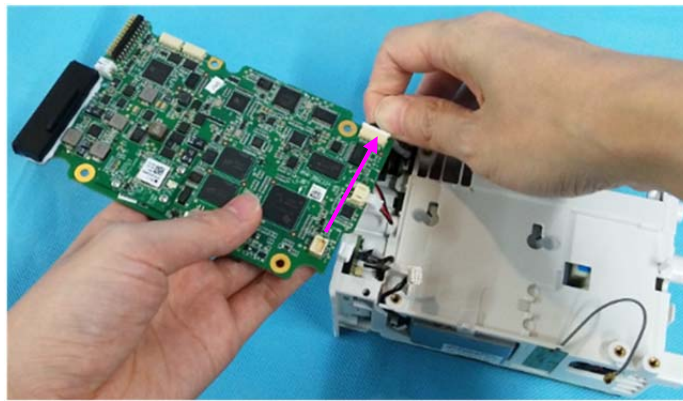
5. Loosen the connection cable of the power switch on the main unit.



6. Loosen the connection cable of the speaker.

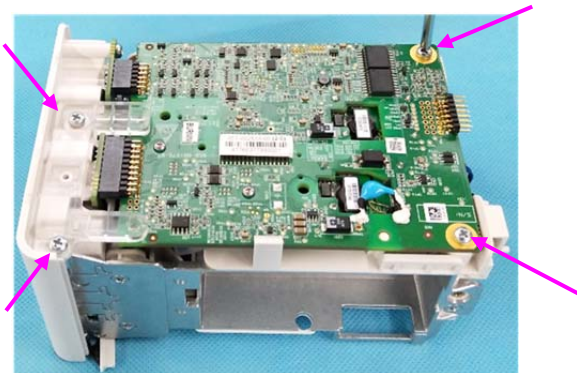


7. Loosen the connection cable of the analog output (when the N1 main unit is configured with analog output), and remove the main board.



6.3.7 Removing the Parameter Board

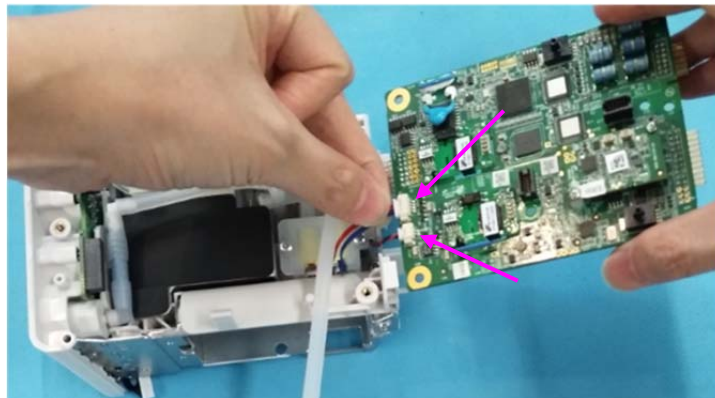
1. Loosen the four M3×5 screws fixing the main board.
2. Remove the block fixing the parameter board.



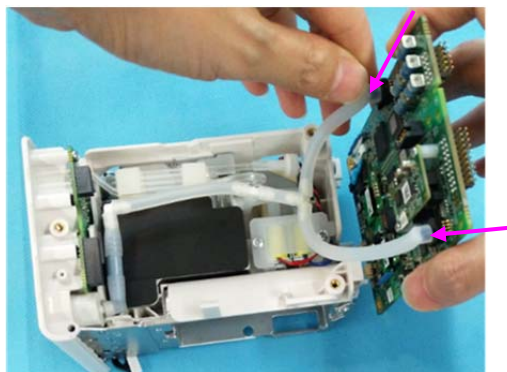
3. Use one hand to loosen the latch and the other to take the parameter board.



4. Loosen the NIBP pump connection cable and NIBP valve connection cable.

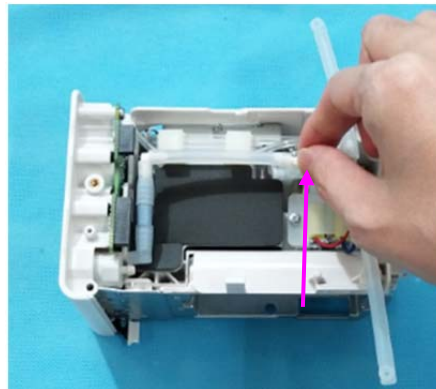
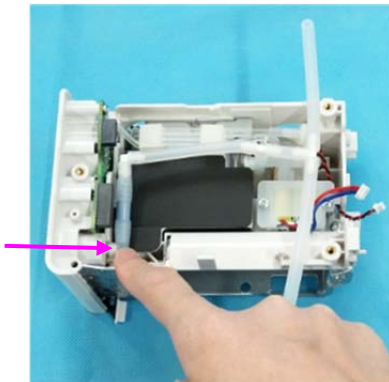


5. Loosen the NIBP air tubing on the parameter board, and remove the parameter board.

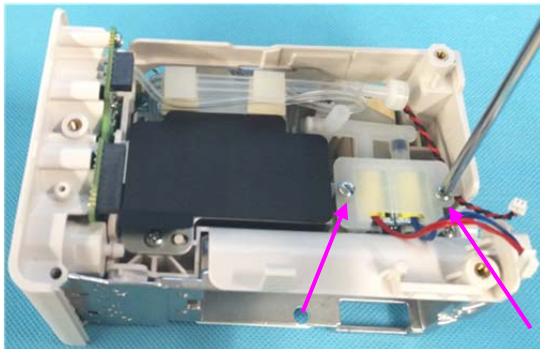


6.3.8 Removing the NIBP Gas Circuit and NIBP Valve

1. Loosen the connection between the NIBP gas circuit and interface board.
2. Loosen the connection between the NIBP gas circuit and integrated pump pipe.

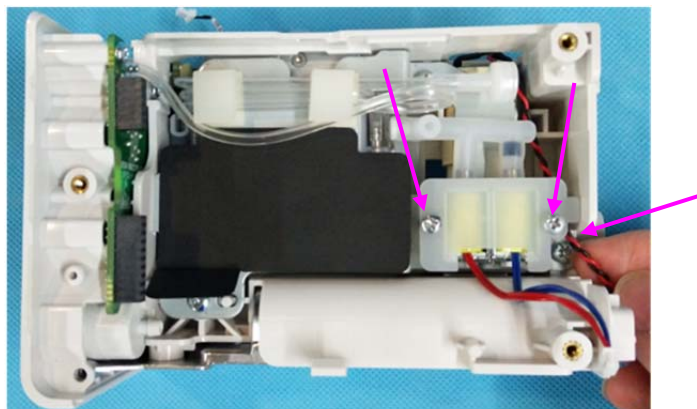


3. Loosen the two M3×5 screws fixing the valve frame.
4. Remove the NIBP valve.



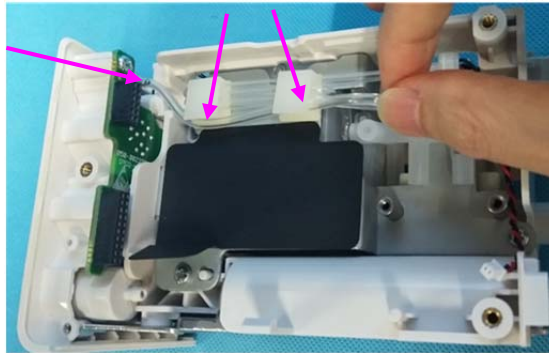
NOTE

- When installing the NIBP valve, place the cables upwards with the quick release valve of the red cable on the left and the slow release valve of the blue cable on the right. Lead the NIBP pump connection cable through under the valve plate.

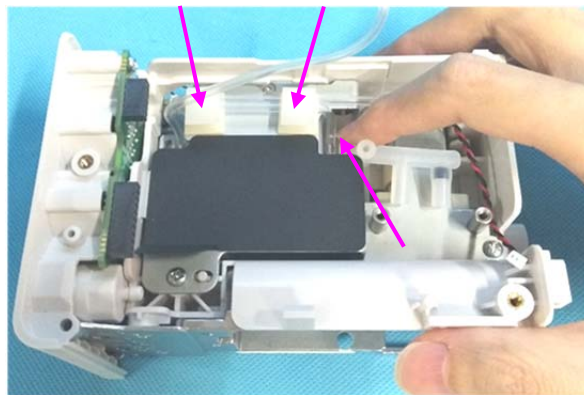


6.3.9 Removing the NIBP Pump

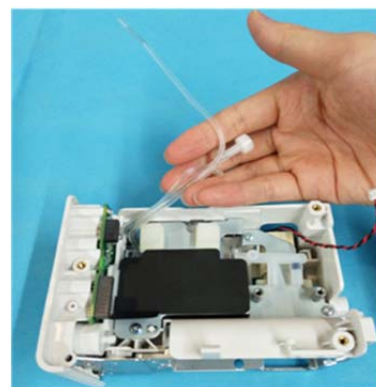
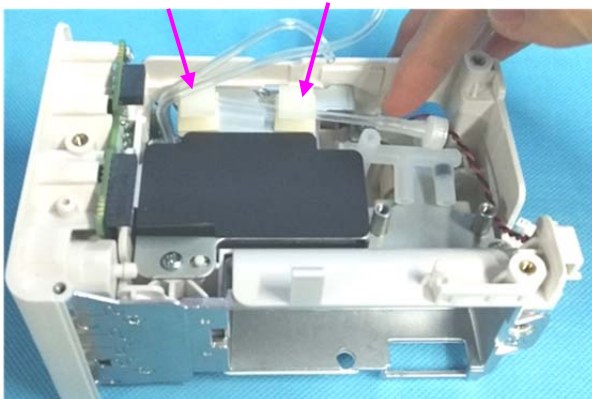
1. Loosen the exhaust pipe of the CO₂ module.



2. Loosen the air inlet pipe of the CO₂ module.

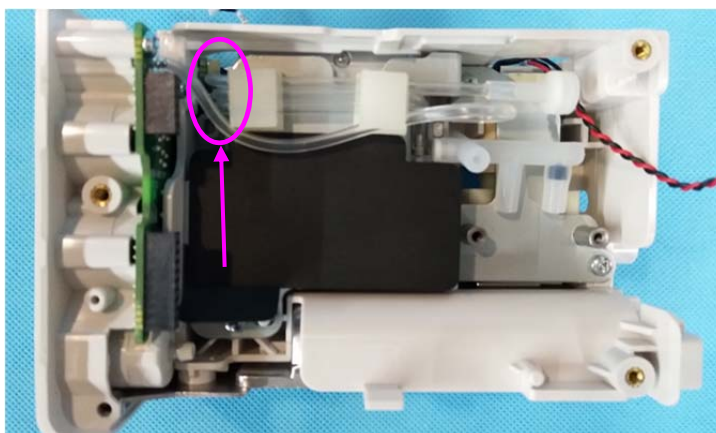


3. Loosen the zero calibration pipe of the CO₂ module.

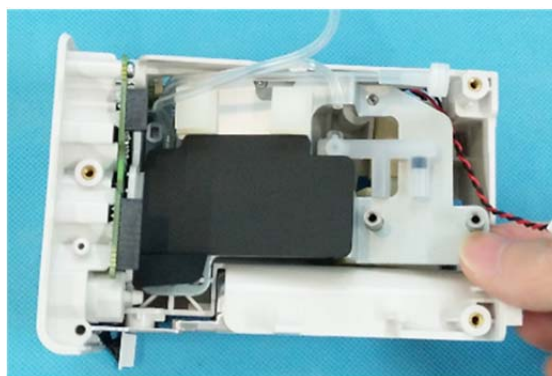
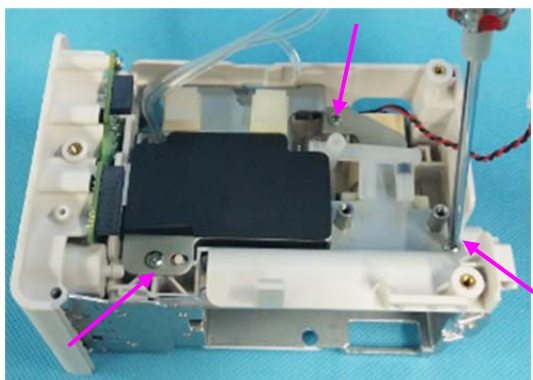


NOTE

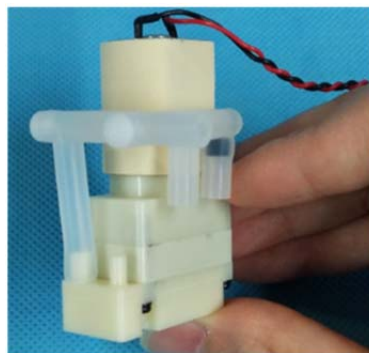
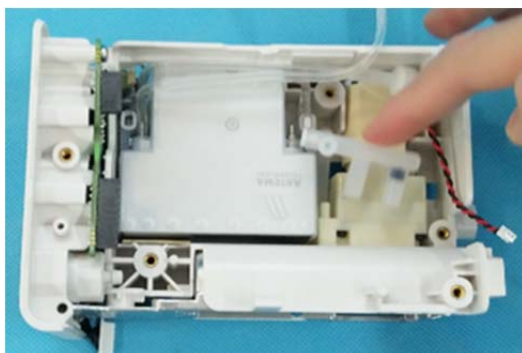
- After reassembling the exhaust pipe, air inlet pipe and zero calibration pipe, clamp them in the tie mount according to the sequence shown in the figure, and arrange them in order.



4. Loosen the four M3×5 screws fixing the CO₂ module sheet.
5. Remove the CO₂ module sheet.

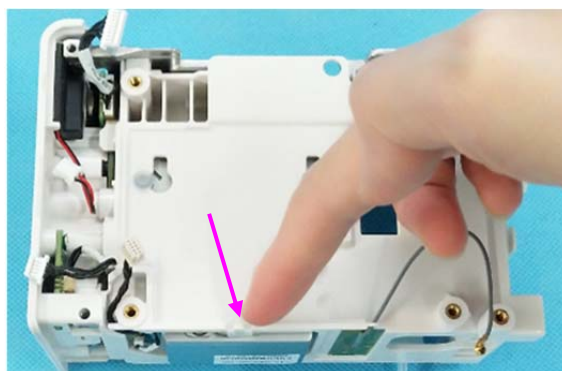
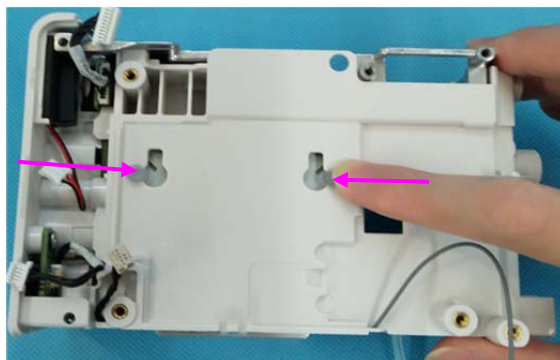


6. Remove the NIBP pump.



6.3.10 Removing the CO₂ Module

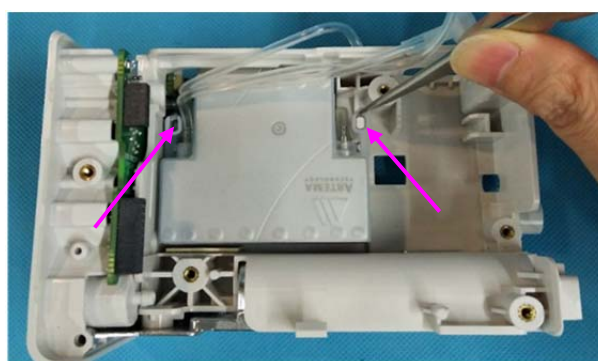
1. Loosen the mushroom head with a silicone cover on the CO₂ module.
2. Loosen the silicone cover head on the CO₂ module.



3. Loosen the connection cable between the CO₂ module and water trap.
4. Loosen the slot position of the connection cable.

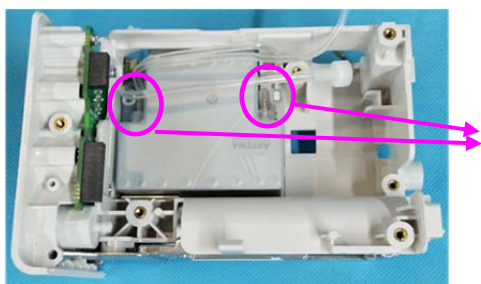


5. Use a pair of tweezers to remove the two CO₂ module rings.

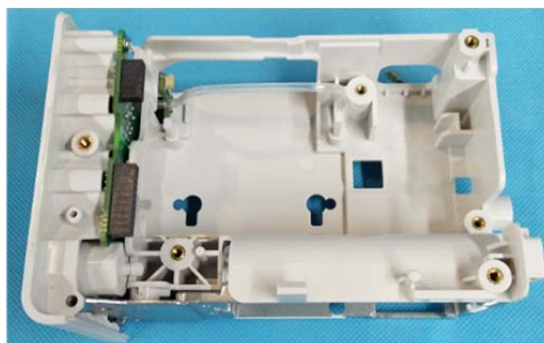


NOTE

- When reinstalling the module rings, keep the ring side with a gap upward, and clamp the inverted fastener of the ring into the hole in the silicone cover.

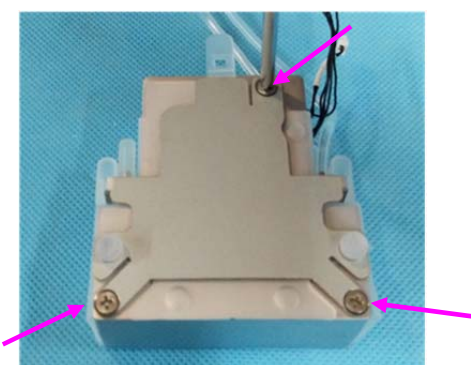


6. Remove the CO₂ module.



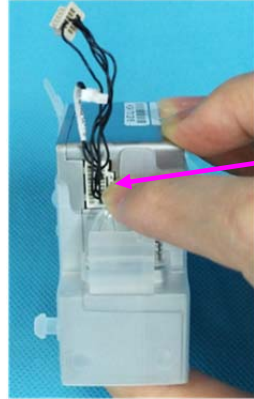
6.3.11 Removing the CO₂ Module Assembly

1. Loosen the three M2.5×4 countersunk head screws on the cover plate of the CO₂ module.
2. Remove the cover plate of the CO₂ module.

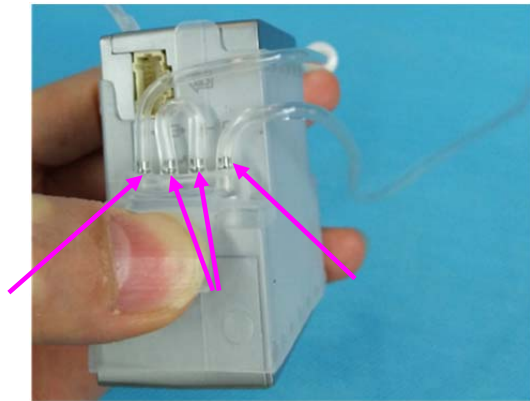


3. Remove the end cap of the CO₂ module gas circuit.

4. Press the latch of the CO₂ module connection cable, and remove the connection cable.

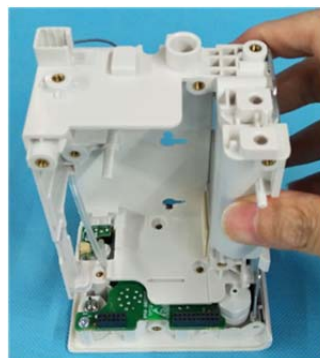
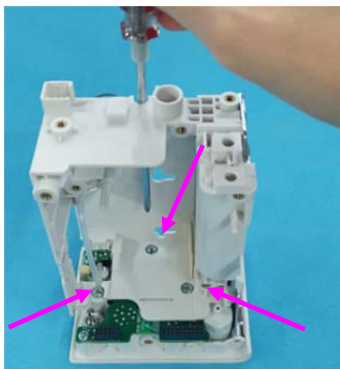


5. Remove the zero calibration pipe, short circuit pipe and exhaust pipe on the CO₂ module.
6. Remove the silicone cover.



6.3.12 Removing the Interface Board

1. Loosen the three M3×5 screws fixing the main frame.
2. Remove the main frame.

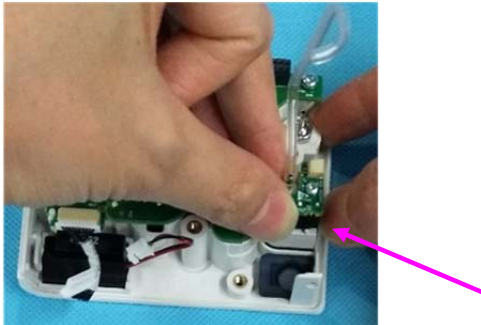


3. Loosen the M3×5 countersunk head screw fixing the power button.

4. Remove the power keypad.



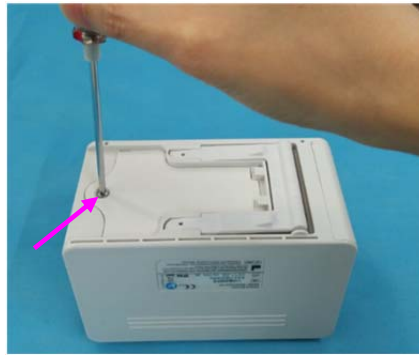
5. Use one hand to loosen the latch fixing the CO₂ water trap and the other to remove the CO₂ water trap.



6.4 Disassembling the N1 Main Unit with Two Batteries

6.4.1 Removing the Battery Door and Battery

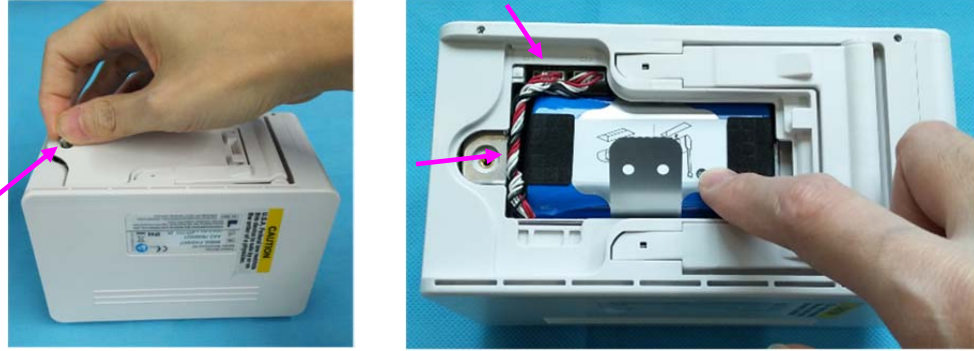
1. Remove the screw cover and loosen the screw.



2. Remove the screw, and then remove the battery door.
3. Remove the battery from the primary battery housing, and remove the battery connection cable.

NOTE

- When disassembling the main unit, be sure to pull out the battery connection cable herein and remove the battery to avoid electricity in subsequent disassembly steps.
- When reinstalling the battery, install the battery connection cable of the primary battery housing into the left B1 socket. Route the battery connection cable as shown below. When inserting the connection cable into the socket, align the connector to avoid damage to connector pins.



4. Remove the battery from the secondary battery housing. Remove the battery connection cable.

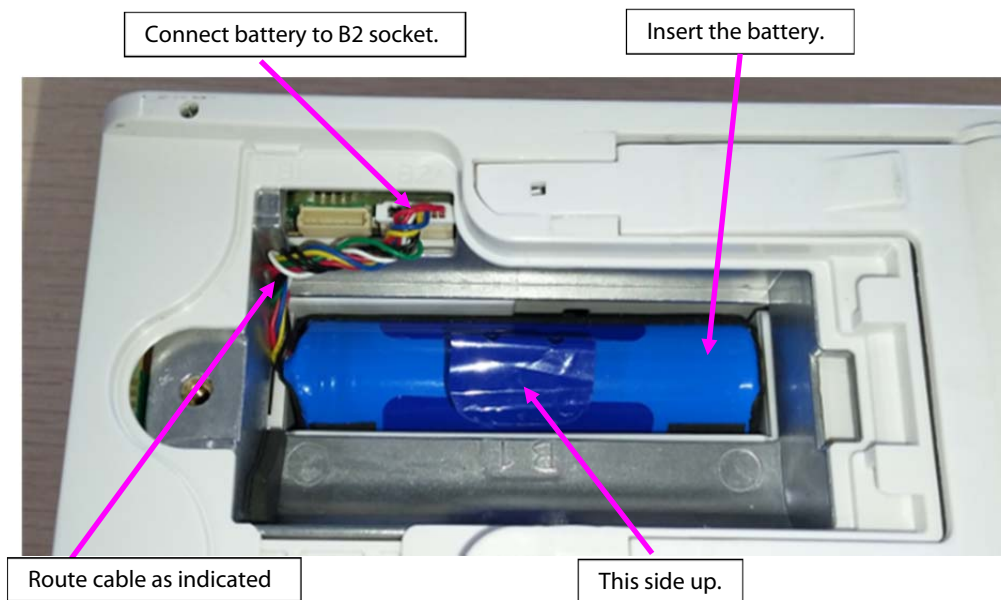
NOTE

- When disassembling the main unit, be sure to pull out the battery connection cable herein and remove the battery to avoid electricity in subsequent disassembly steps.
- When reinstalling the battery, install the battery connection cable of the secondary battery housing into the right B2 socket. Route the battery connection cable as shown below. When inserting the connection cable into the socket, align the connector to avoid damage to connector pins.

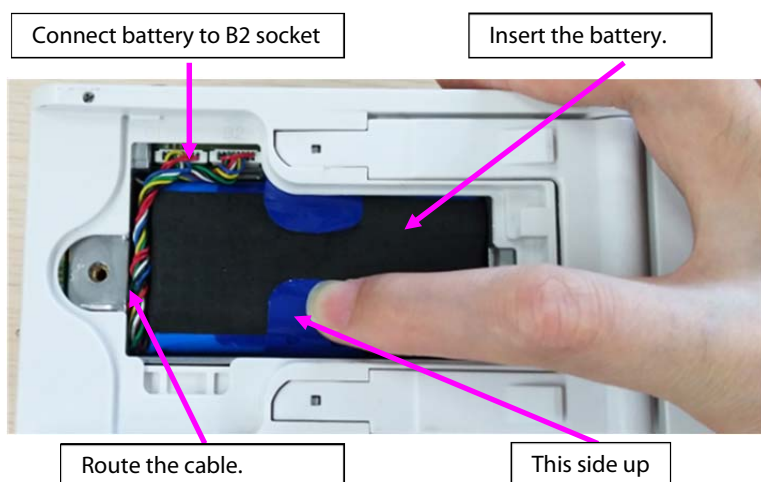


6.4.2 Installing the Battery and Battery Door

1. Installing the secondary battery.
 - a. Connect the battery to the B2 socket on the main unit through the battery connection cable.
 - b. Insert the battery into the secondary battery housing with the cable facing up.
 - c. Route the battery connection cable.

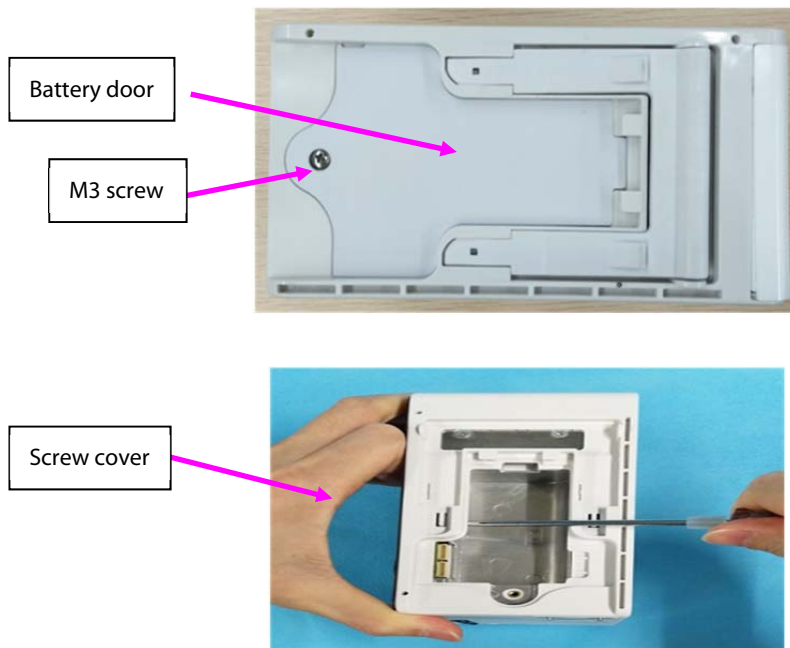


2. Installing the primary battery.
 - a. Connect the battery to the B1 socket on the main unit through the battery connection cable.
 - b. Insert the battery into the primary battery housing with the cable facing up.
 - c. Route the battery connection cable. Do not squeeze the cable.



3. Secure the battery door using a M3 screw.

4. Use a screw cover to cover the screw hole.



6.4.3 Removing the Display Assembly

1. Use the small Phillips screwdriver to remove the two screen pins fixing the display assembly.

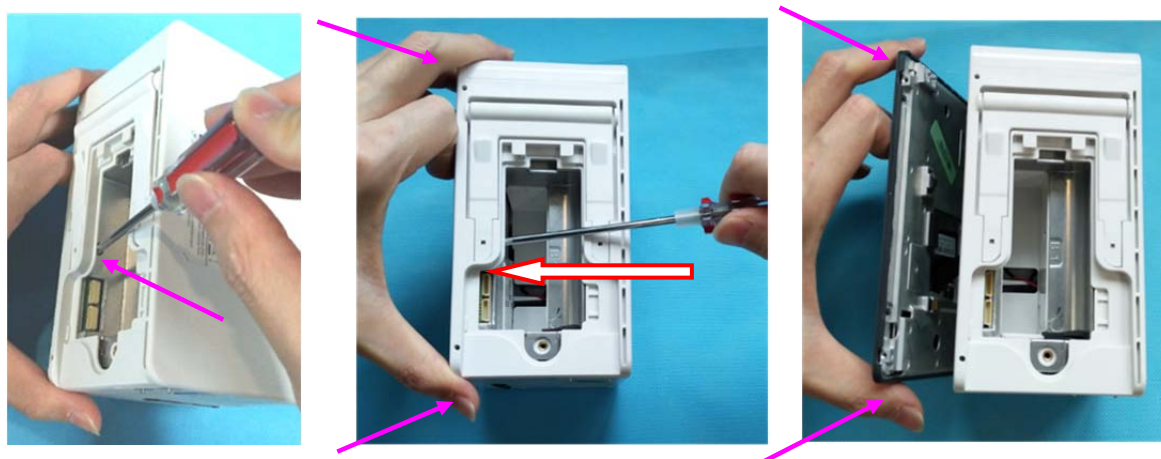


2. Use one hand to support the display assembly, and use the screwdriver to press the hole in the battery housing and push out the display assembly, as shown below.

NOTE

- Use one hand to support the display assembly as shown below. Otherwise, the FPC plug wire of the display assembly will be damaged.

3. Use your hand to hold the display assembly after it is pushed out.

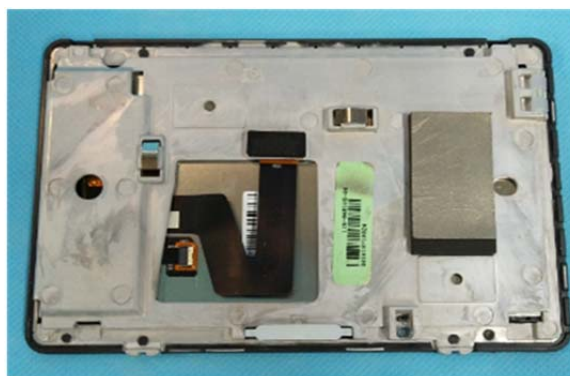


4. Use one hand to hold the display assembly as shown below, and the other to loosen the FPC plug wire on the display assembly, and remove the display assembly.



NOTE

- If the light pipe of the indicator is released after the display assembly is removed, install the light pipe at the position shown in the figure below.



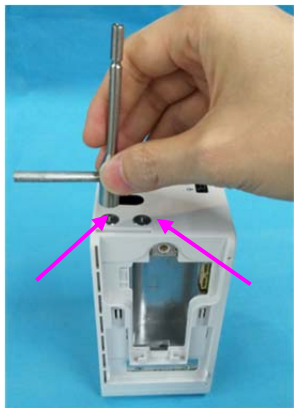
NOTE

- When assembling the display assembly, press the two corners shown in the figure below, and press the display assembly into the rear housing.



6.4.4 Removing the Rear Housing

1. Use the terminal screw dismounting tool to remove the two terminal screws fixing the rear housing.
2. Remove the four M3×5 screws fixing the rear housing.



NOTE

- To ensure flat assembly of the face plate, when fixing the four screws on the rear housing, do as follows: lay the N1 main unit flatwise, and turn the four screws by 2-3 circles for preliminary fixing; place the N1 main unit vertically, and use one hand to press the main unit and the other to tighten the screws.

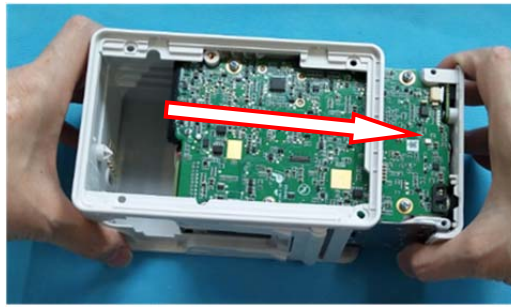


NOTE

- After assembly, check that the silicon cover shown in the figure below is assembled properly.



3. Use your hand to press the battery housing to separate the main frame, and then remove the rear housing.

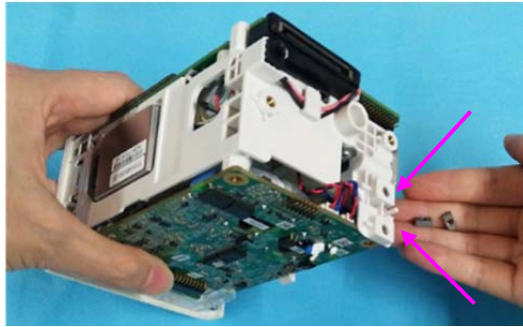


6.4.5 Removing the Infrared Backboard

1. Loosen the two M3×5 screws fixing the infrared backboard.
2. Remove the infrared backboard.

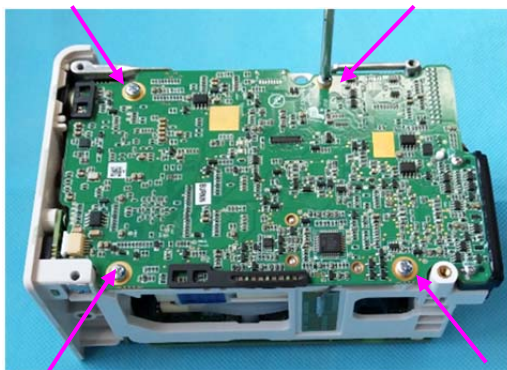


3. Tilt the N1 main unit as shown below, and remove the two terminal nuts shown in the figure below.

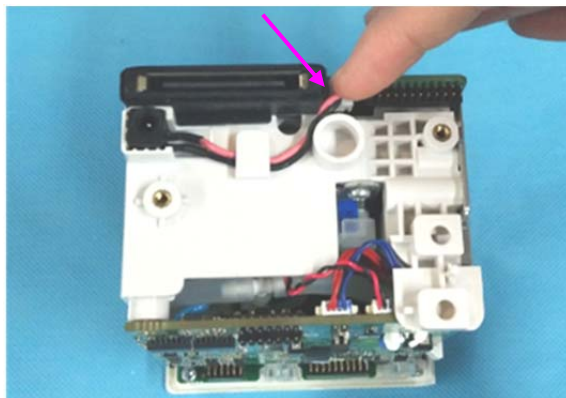


6.4.6 Removing the Main Board

1. Remove the four M3x5 screws fixing the main board.

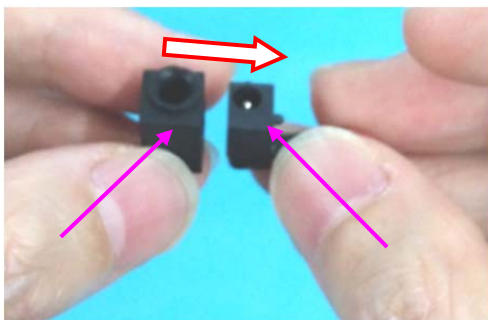


2. Remove the DC-in connection cable.

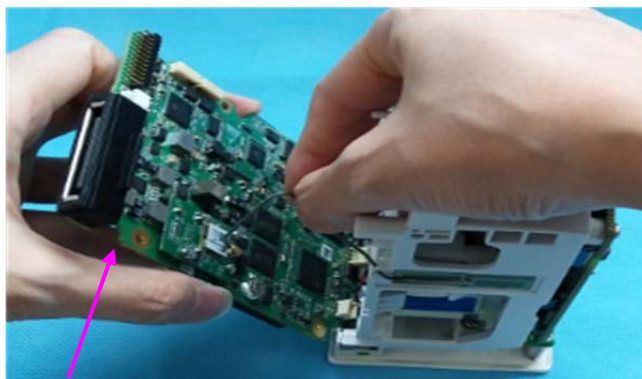


NOTE

- Check that the waterproof jacket and connection cable are installed properly when reassembling the DC-in connection cable.

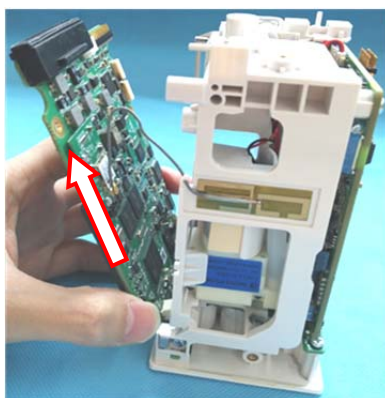


3. Loosen the Wi-Fi antenna (when the N1 main unit is configured with the Wi-Fi function).

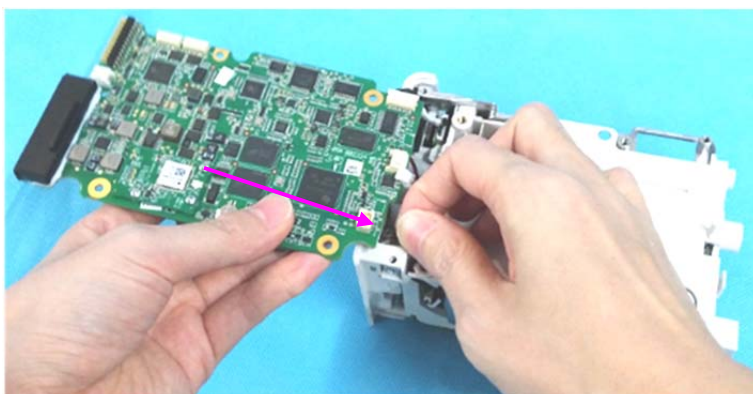


NOTE

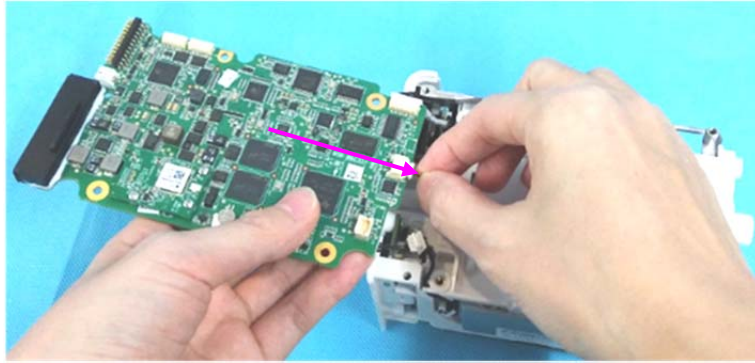
- To prevent the board from crushing the Wi-Fi antenna, route the Wi-Fi antenna according to the direction shown in the figure when reassembling the Wi-Fi antenna.



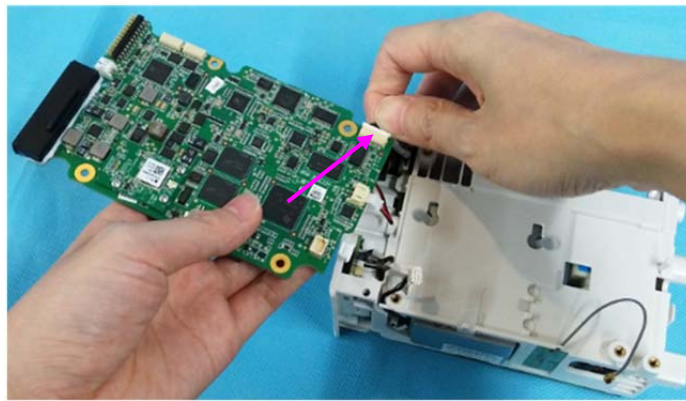
4. Loosen the connection cable of the power switch on the main unit.



5. Loosen the connection cable of the speaker.



6. Loosen the connection cable of the analog output (when the N1 main unit is configured with analog output), and remove the main board.



6.4.7 Removing the Parameter Board

1. Loosen the four M3×5 screws fixing the main board.
2. Remove the block fixing the parameter board.

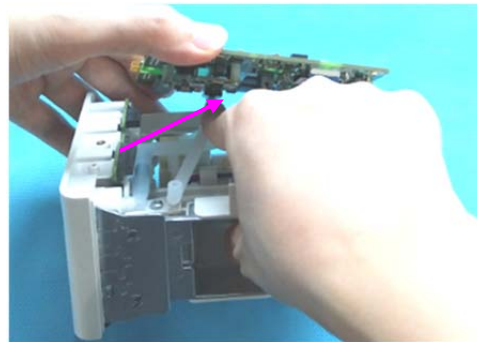
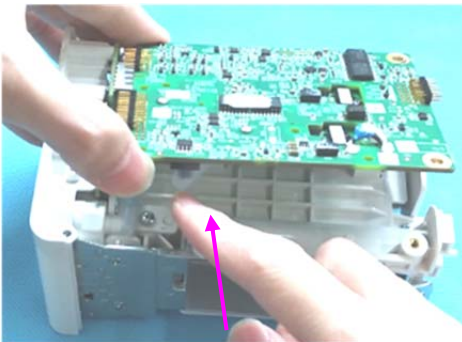


3. Use one hand to loosen the latch and the other to take the parameter board.

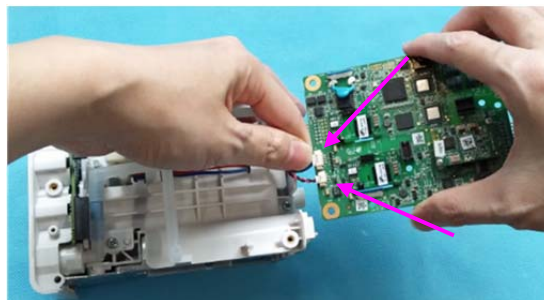


4. Loosen the connection between the NIBP gas circuit and parameter board U26 sensor.

5. Loosen the connection between the NIBP gas circuit and parameter board U23 sensor.



6. Loosen the NIBP pump connection cable and NIBP valve connection cable, and remove the parameter board.

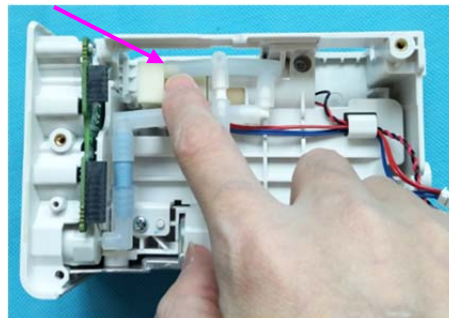
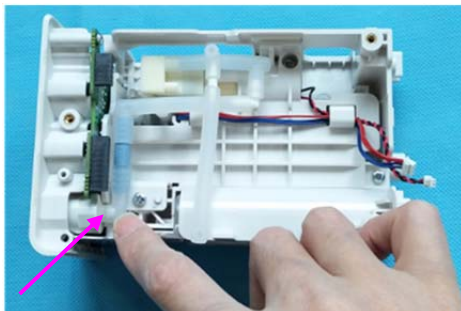


6.4.8 Removing the NIBP Gas Circuit and Secondary Battery housing

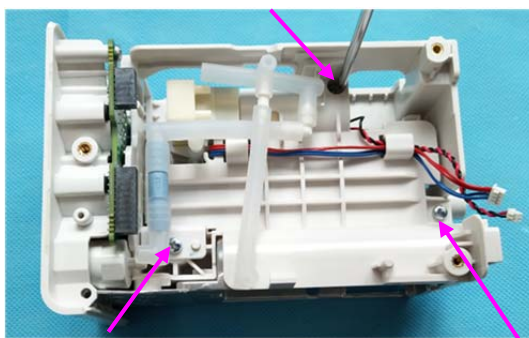
1. Loosen the connection between the NIBP gas circuit and interface board.
2. Loosen the connection between the NIBP gas circuit and pump.

NOTE

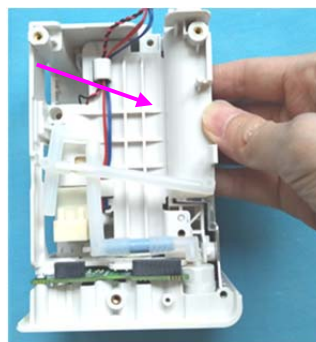
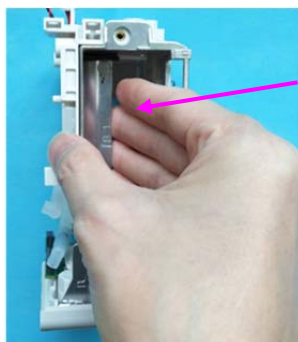
- During reassembly, the NIBP gas circuit should be connected to the outermost gas outlet.



3. Loosen the three M3x5 screws fixing the secondary battery housing.

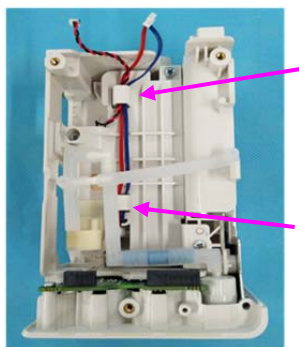


4. Use your hand to push the secondary battery housing to remove it from the latch.

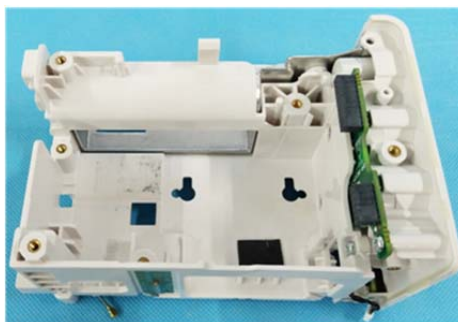
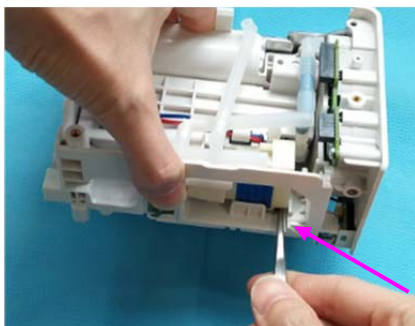


NOTE

- After reassembling the secondary battery housing, confirm that the pump connection cable and valve connection cable have been placed in the latch.

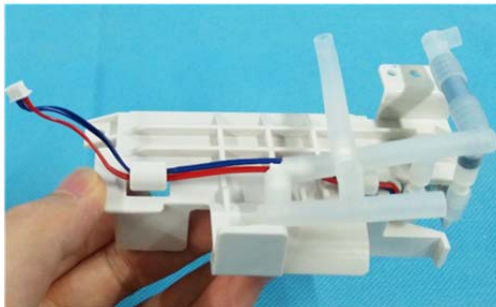
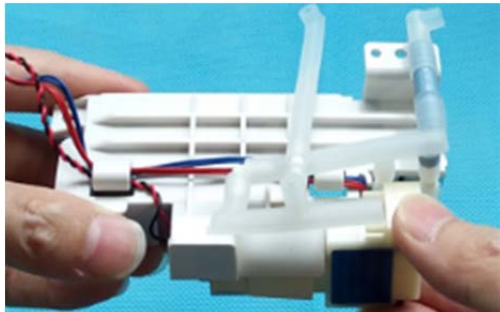


5. Use a pair of tweezers to press the pump head, and remove the secondary battery housing.



6.4.9 Removing the NIBP Pump and Valve

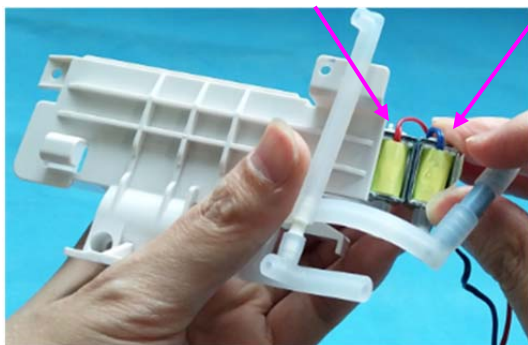
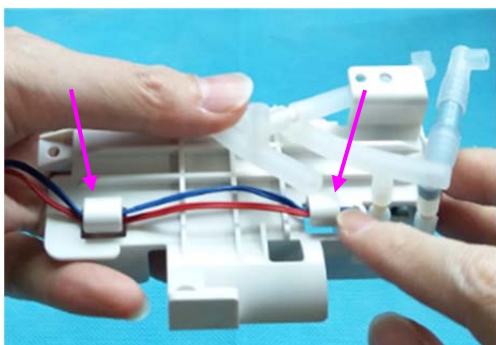
1. Remove the NIBP pump.



2. Loosen the two clamping positions of the NIBP valve cable, and remove the valve.

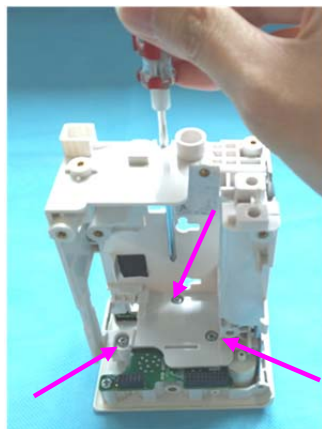
NOTE

- When reassembling the valve, place the quick release valve of the red cable on the left and the slow release valve of the blue cable on the right. See the figure below for the specific placement positions.

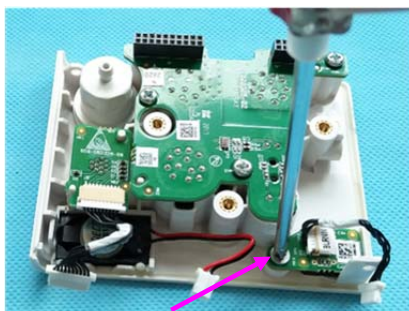


6.4.10 Removing the Interface Board

1. Loosen the three M3×5 screws fixing the main frame.
2. Remove the main frame.



3. Loosen the M3×5 countersunk head screw fixing the power button.
4. Remove the power keypad.



6.5 Removing the N1 Dock

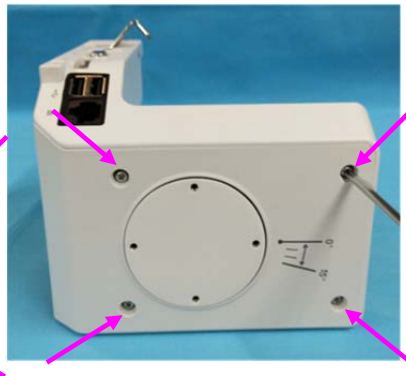
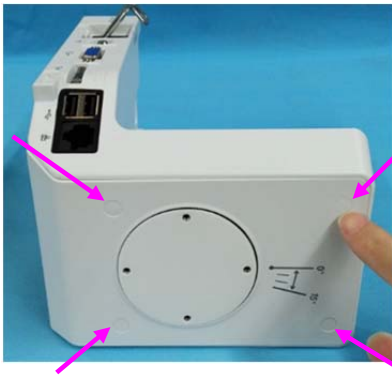
6.5.1 Removing the Bottom Housing

1. Remove the four M3×8 screws from the bottom housing.
2. Remove the bottom housing.



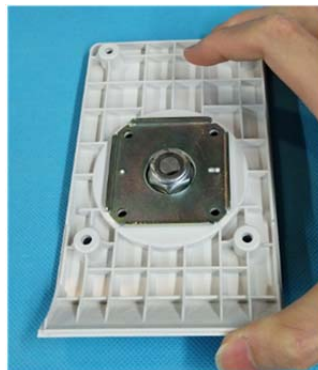
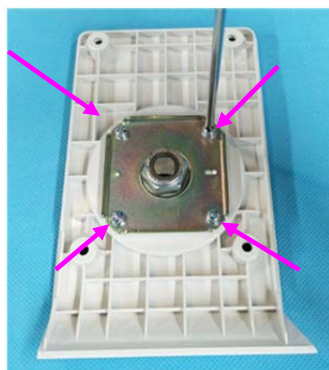
6.5.2 Removing the Right Shell Assembly

1. Remove the four screw covers from the right shell.
2. Remove the four M3×8 screws from the right shell.
3. Remove the right shell module.



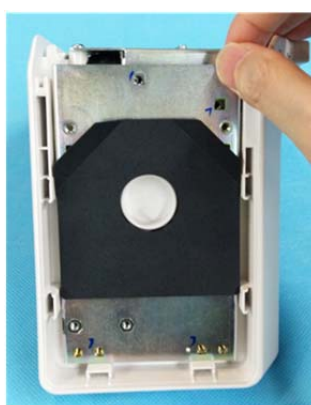
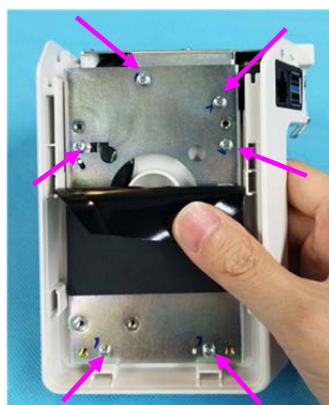
6.5.3 Removing the Rotatable Plate

1. Remove the four M3×8 screws with pad from the rotatable plate.
2. Remove the rotatable plate.

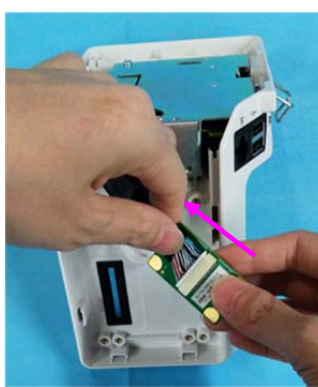


6.5.4 Removing the Transition Board

1. Remove the six M3×6 screws from the transition board.
2. Remove the transition board plate.



3. Remove the transition board, and loosen the connection cable.



NOTE

- During reassembly, route the connection cable as shown below. Do not press any cables.

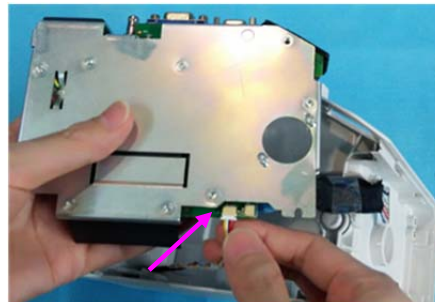
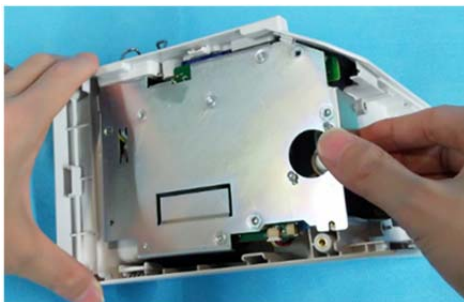


6.5.5 Removing the Port Module

1. Remove the two M3×6 screws from the port module.



2. Remove the port module, and loosen the indicator connection cable.



NOTE

- During reassembly, the sheet metal of the port module is clamped on the latch as shown below. Be sure to properly assemble the silicone cover of the network cable connector.



6.5.6 Removing the Interface Board and Power Board

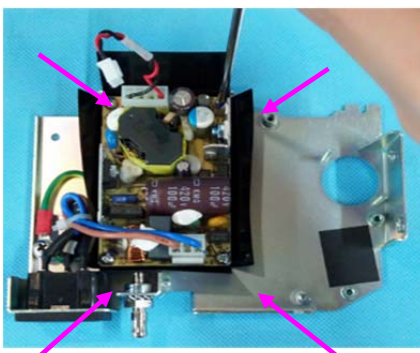
1. Remove the plug wire from the interface board.



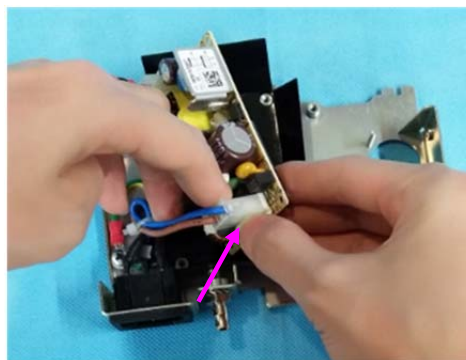
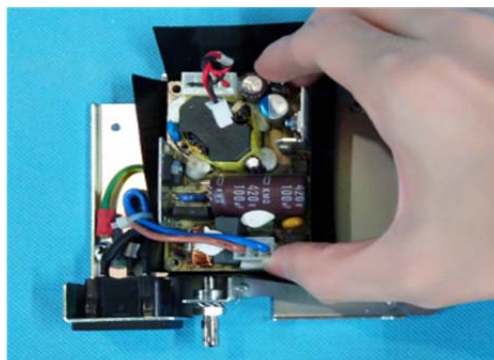
2. Loosen the two M3×6 screws from the interface board.
3. Remove the interface board.



4. Remove the four M3×6 screws from the power board.



5. Remove the power board.
6. Loosen the latch on the power outlet, and remove the power connection cable.

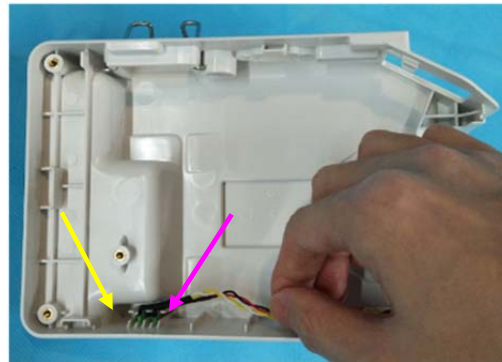
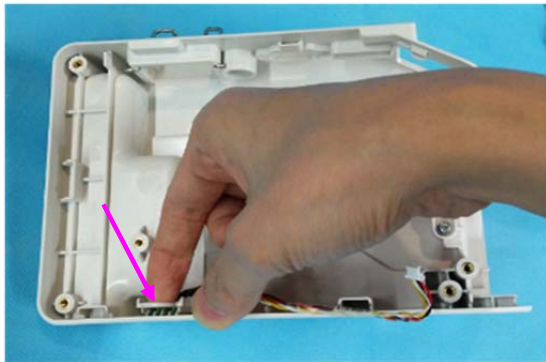


6.5.7 Removing the LED Indicator

1. Remove the LED bracket.
2. Remove the LED indicator.

NOTE

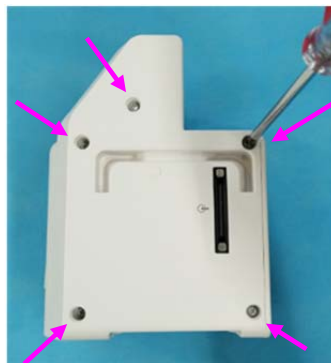
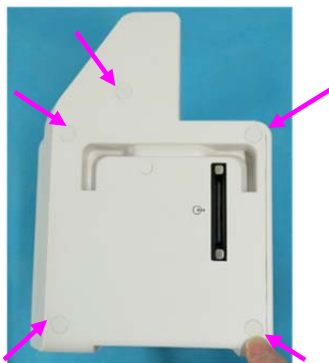
- During reassembly, the indicator with the yellow cable is installed on the left, and the indicator with the red cable is installed on the right.



6.6 Removing the N1 Modular Rack

6.6.1 Removing the Rear Housing

1. Remove the five screw covers from the rear housing.
2. Loosen the five M3×8 screws on the rear housing.
3. Remove the rear housing.



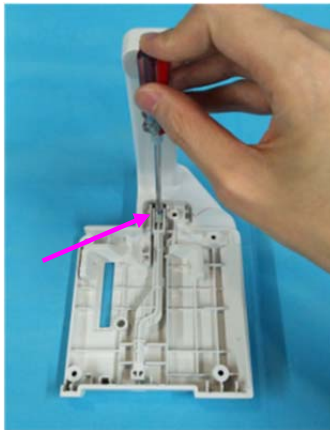
NOTE

- After reinstalling the rear housing, check that the unlocking button works well.



6.6.2 Removing the Unlock Rod

1. Loosen the M2.5×8 screw on the unlock rod.
2. Remove the unlock rod.
3. Remove the unlocking button and spring.



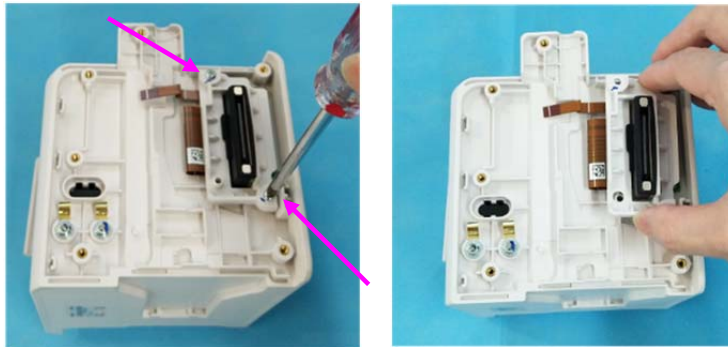
6.6.3 Removing the Infrared Backboard

1. Loosen the connection cable on the infrared backboard.
2. Loosen the M3×8 screw on the infrared backboard.
3. Remove the infrared backboard.

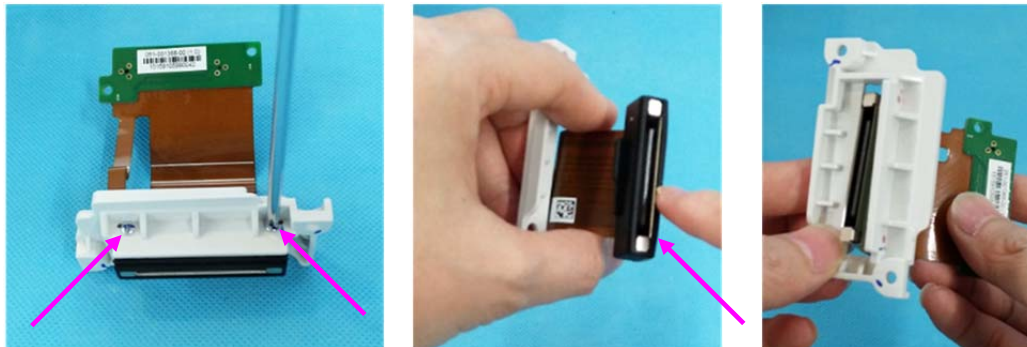


6.6.4 Removing the Transition Board

1. Loosen the two PT3×10 self-tapping screws on the transition board.
2. Remove the transition board assembly.

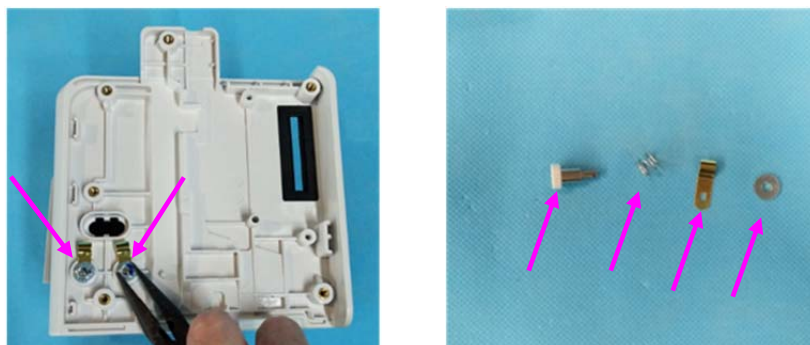


3. Loosen the two M2×8 screws fixing the transition board.
4. Remove the waterproof jacket from the transition board socket.
5. Remove the transition board.



6.6.5 Removing the Contact Screws

1. Loosen the M3 self-locking nuts from the contact screws, and then remove the contact screws, contact springs and spring plates.



6.7 Removing N1 Transport Dock

6.7.1 Removing the Transition Board

1. Loosen and remove the four M3×5 countersunk head screws from the bottom of bottom plate.
2. Loosen and remove the two M3×5 countersunk head screws from the left side of bottom plate.

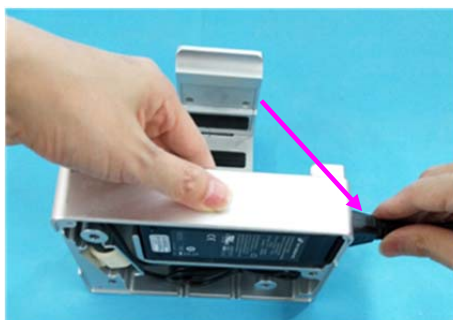


3. Remove the bottom plate.



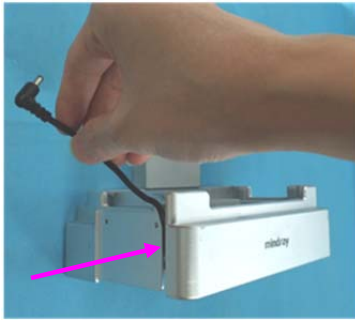
6.7.2 Removing the Power Adapter

1. Remove the power cable from the power adapter.



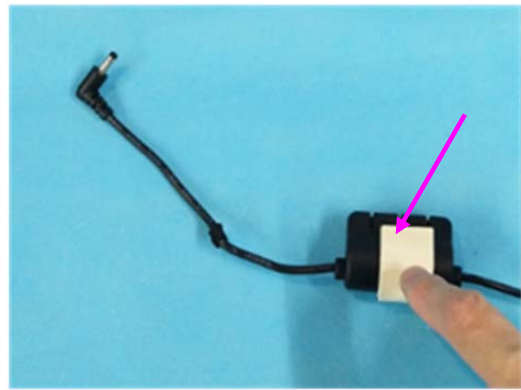
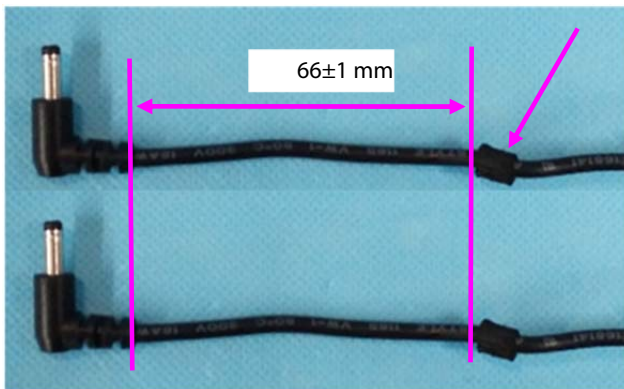
2. Loosen the plug on the power adapter.

3. Remove the power adapter.



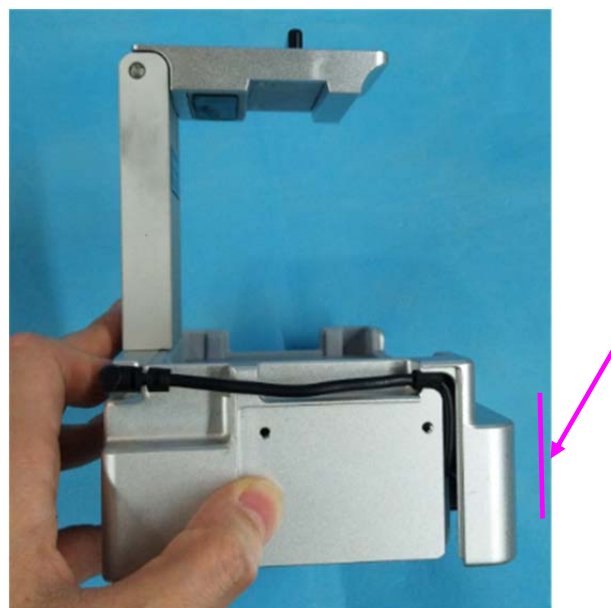
NOTE

- Before reassembling the adapter, use a ruler to measure the position or refer to the position of the original adapter, and attach a piece of black foam to the cable. In addition, attach a shockproof pad to the magnet ring.



NOTE

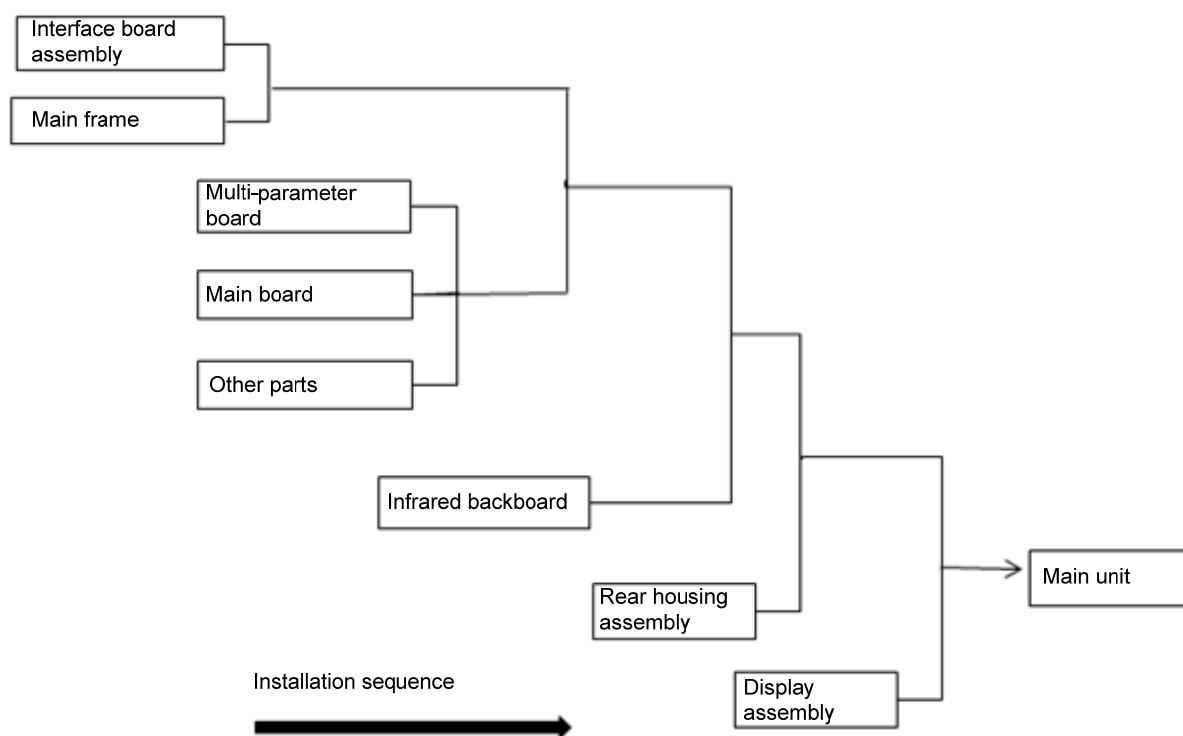
- When placing the cable into the Transport Dock, align the left edge of the foam with the position shown in the figure below.



7 Parts

7.1 Introduction

This chapter lists the exploded views of the main unit and all the parts and part numbers of the repairable parts. It helps the maintenance personnel to identify the parts during disassembly and part replacement. The part numbers listed in the "Part Number" columns of all parts lists are used only to assist the maintenance personnel in searching for the corresponding FRU part numbers. Please provide the FRU parts numbers if you want to purchase the spare parts. The figure below shows the hardware architecture of the N1 main unit:

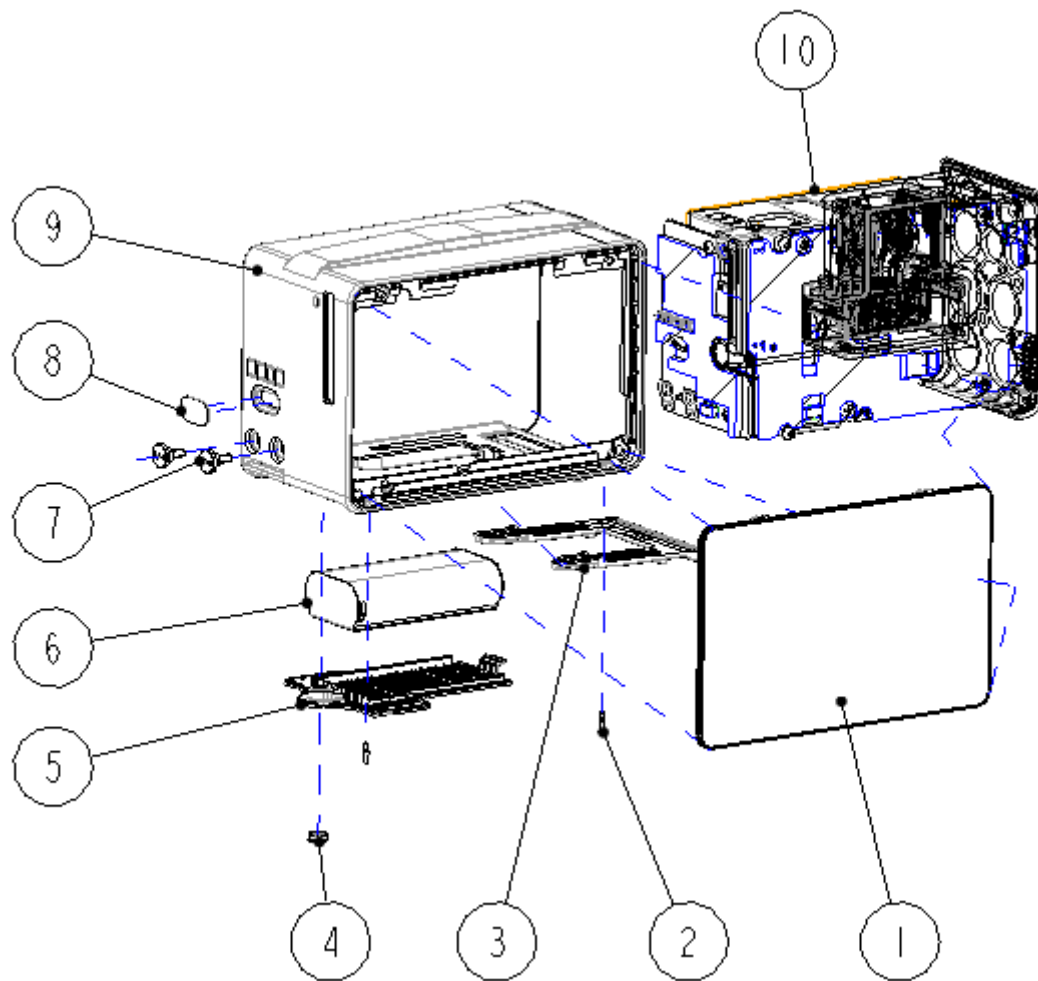


NOTE

- The part numbers listed in the "Part Number" columns of all parts lists are used only to assist the maintenance personnel in searching for the corresponding FRU part numbers. Please provide the FRU parts numbers if you want to purchase the spare parts.

7.2 Main Unit

7.2.1 Exploded View

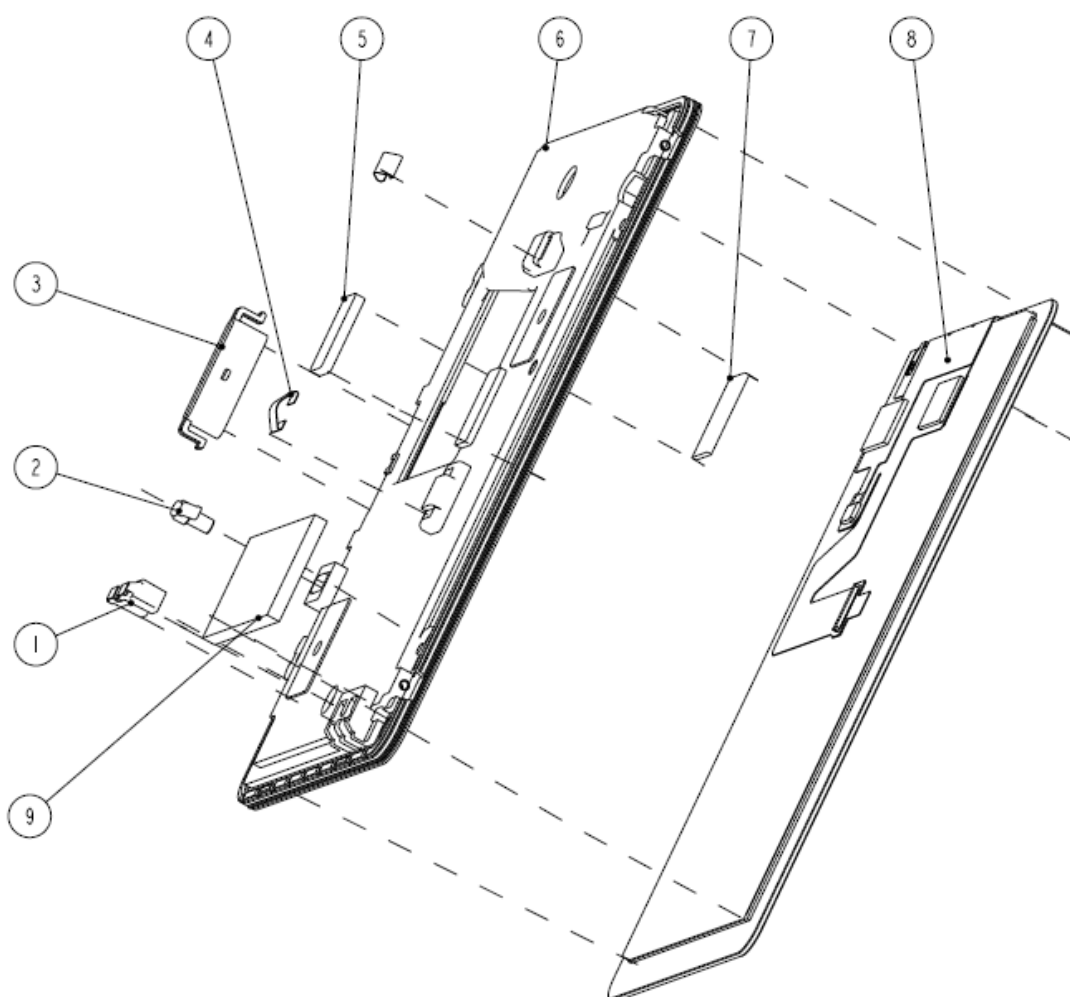


7.2.2 Parts List

No.	Description	FRU Part Number	Remark
1	Display assembly (TRULY)	115-049058-00	Two kinds of screens compatible with each other
	Display assembly (TIANMA)	115-049059-00	
2	Pin for screen	041-026193-00	/
3	T1 spanner (POM)	/	/
4	Screw cover 2 (T8)	049-000650-00	/
5	Battery door (rubber)	043-007866-00	/
6	N1 Li-ion battery	115-049427-00	/
7	N1 terminal screw	041-026393-00	/
8	T1 infrared lens (ESM)	/	/
9	N1 back cover silkscreen	/	/
10	Main frame assembly	/	/

7.3 Display assembly

7.3.1 Exploded View

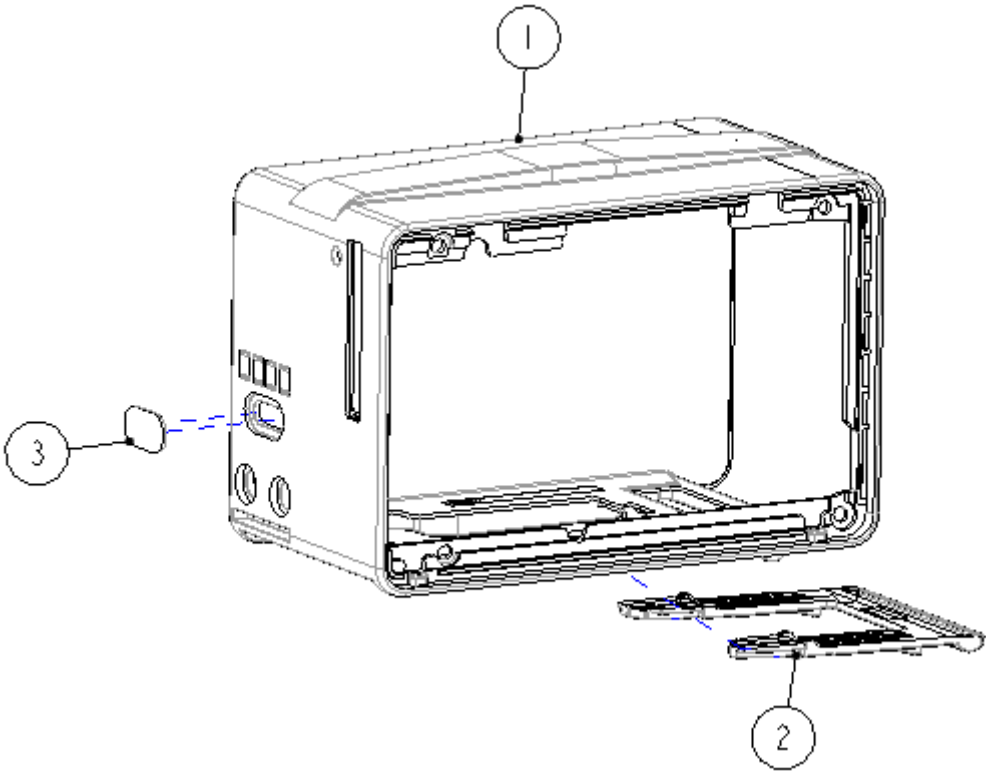


7.3.2 Parts List

No.	Description	FRU Part Number	Remark
1	Refraction to light for instruction	115-049058-00 (with TRULY display or 115-049059-00 (with TIANMA display))	/
2	Light guild pillar		/
3	Refraction to light of alarm		/
4	Beryllium copper spring, slot type, plated with nickel, 16"		M6T-030009---
5	EVA FOR screen		/
6	Screen of skete		/
7	Conductive fabric gasket		/
8	5.5" display touchscreen		/
9	Sponge and shielding sheet		/

7.4 Rear Housing Assembly

7.4.1 Exploded View

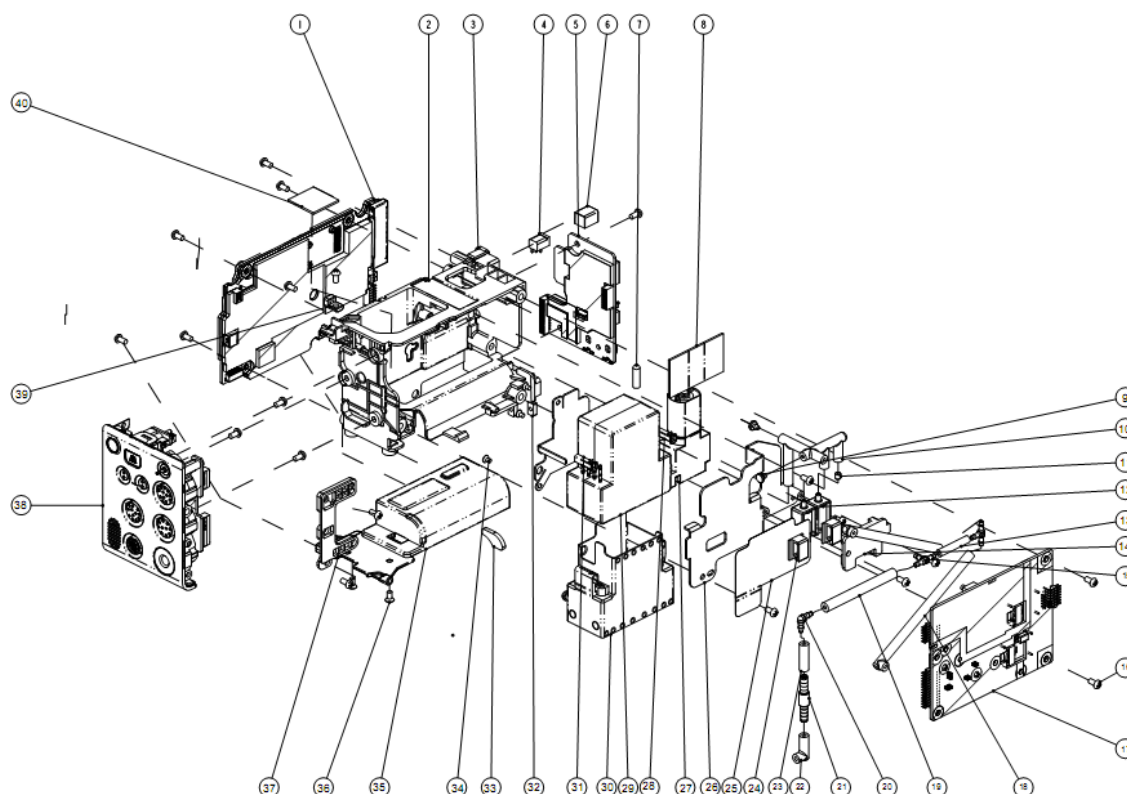


7.4.2 Parts List

No.	Description	FRU Part Number	Remark
1	N1 backcover silkscreen	115-050694-00	/
2	T1 spanner (POM)		043-008495-00
3	T1 infrared lens (ESM)		043-008505-00

7.5 Main Unit Assembly

7.5.1 Exploded View (for CO2 Module Configuraiton)

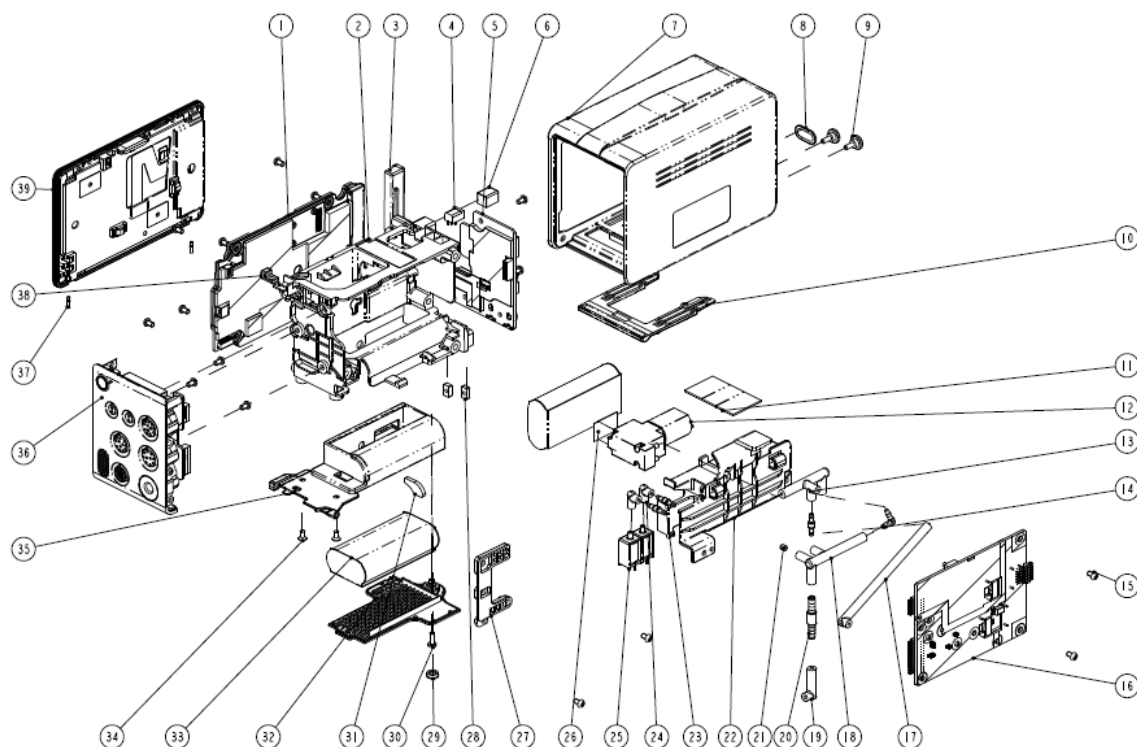


7.5.2 Parts List

No.	Description	FRU Part Number	Remark
1	Main board	115-048114-00	/
3	Rack female plug cover		/
2	Main frame (M02D)	043-008180-00	For the monitor with the CO ₂ module.
4	DC-in cable	009-008383-00	/
5	Infrared backboard PCBA	051-002742-01	/
6	DC water-proof silicon	/	/
7	M02D end cup	115-049056-00	
/	CO ₂ pipe		
8	Pump shock-absorbing pad	115-049054-00	/
27	Pump, DC12V, 300mmHg with wire and connector		/
9	Pipeline end cap	115-049055-00	/
10	Gas circuit whole pipe		/
13	Rubber tube		/
15	Plastic connector		
22	Air cock pipe (M02D)		/
18	Sensor interface tube		/

No.	Description	FRU Part Number	Remark
20	Connector, elbow		
21	Filter		/
11	630F reducer	082-000098-00	/
12	Valve, 2-way, DC12V, 50mm wire	082-002751-00	It is used for the monitor with the CO ₂ module.
14	M02D valve frame	/	/
16	Crosshead pan screw	/	/
17	M51C5L-FE,3-SPO ₂ , IBP, AO (N1)	051-002832-00	3/5-lead ECG
	M51C12L-FE,3-SPO ₂ , IBP, AO (N1)	051-002833-00	
24	Tie mount, 3.6X10.2, square, 94V-2	009-007779-00	/
25	M02D insulating trip	/	/
26	M02D module sheet	/	/
28	M02D module ring	043-007926-00	It is used for the monitor with the CO ₂ module.
29	CO ₂ module main unit, AION Rhodium	115-048090-00	It is used for the monitor with the CO ₂ module.
30	CO ₂ model shock absorption silica gel	049-001261-00	It is used for the monitor with the CO ₂ module.
31	M02D module sheet	/	/
32	Post movable nut	041-027293-00	/
33	N1 Battery shock-absorbing sponge	/	/
—	Screw, M2.5×4		
35	Battery compartment	/	/
36	Screw, M3×5, ,	/	/
37	PCBA press block	/	/
38	Parameter interface board (CO ₂) assembly	/	Refer to 7.6 Parameter Interface Board Assembly
39	N1 main frame connect nut	/	/
40	CO ₂ support pad	/	/

7.5.3 Exploded View (for 2-battery Configuration)



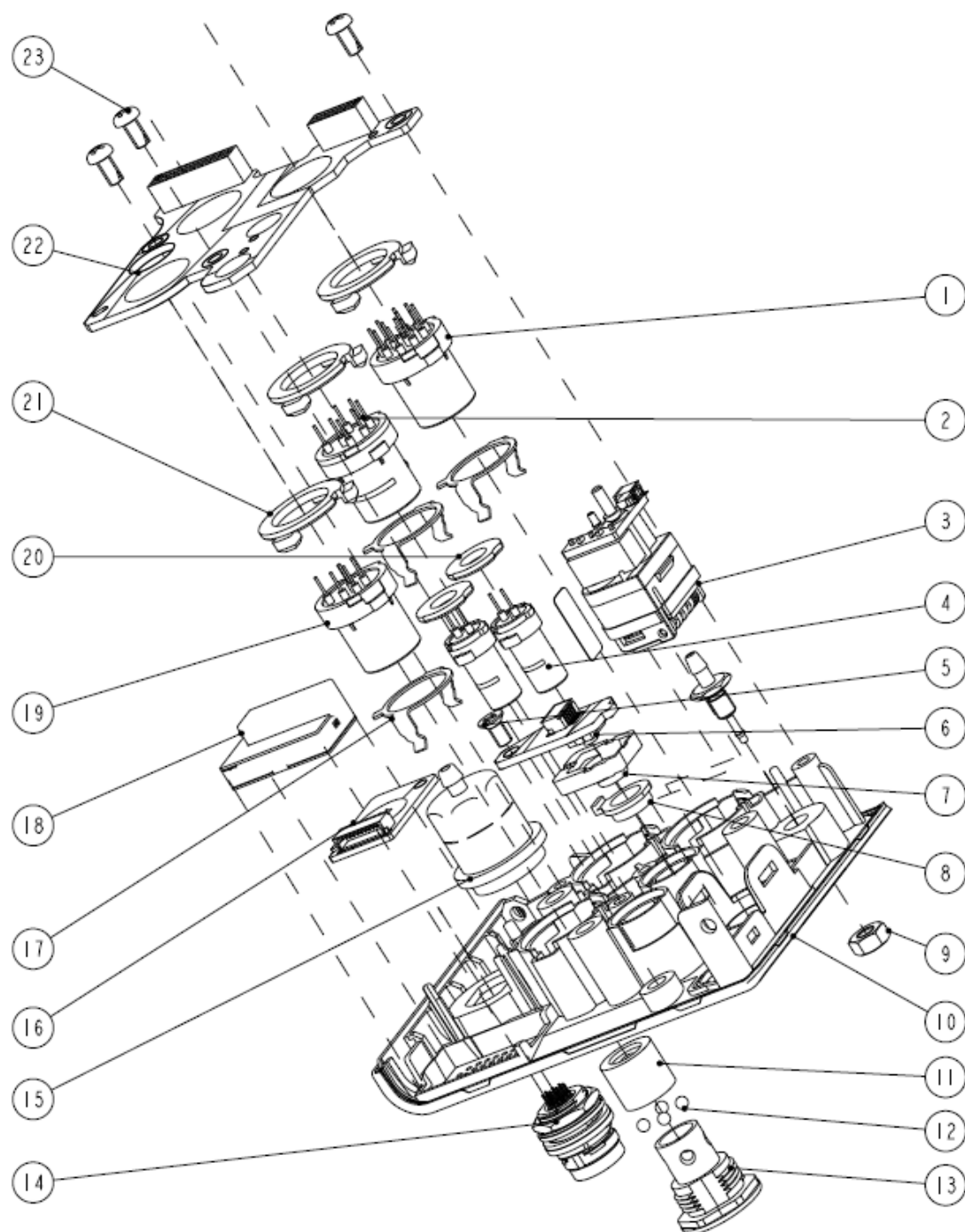
7.5.4 Parts List

No.	Description	FRU Part Number	Remark
1	Main board	115-048114-00	/
3	Rack female plug cover		
2	Main frame	043-007704-00	/
4	DC-in cable	009-008383-00	/
5	Infrared backboard PCBA	051-002742-01	
6	DC water-proof silicon	/	/
7	Housing	115-050780-00	/
8	Infrared lens, ESM		043-008505-00
10	T1 spanner (POM)		043-008495-00
9	Terminal screw	041-026393-00	
11	Pump shock-absorbing pad	115-049054-00	/
12	Pump		/
26	Adhesive pad for the pump		
13	Pump exit tube, for 2-battery configuration	115-049057-00	/
14	Connector, elbow		/
17	Sensor interface tube		/
18	Axis tube, for 2-battery configuration		/
19	Air cock connecting tube, for 2-battery configuration		/
20	Filter		/

No.	Description	FRU Part Number	Remark
23	Plastic connector, straight		/
24	Tube, L-type		/
15	Screw, pan head, Philips, M3X5	030-000962-00	/
16	M51C module,	051-002833-00 (12-lead ECG) or 051-002832-00 (3/5-lead ECG)	/
21	630F reducer	082-000098-00	/
22	Secondary battery compartment	/	/
25	Valve, 2-way, DC12V, 50mm wire	082-002707-00	/
27	PCBA press plate	/	/
28	Post moveable nut	041-027293-00	/
29	Screw cover	049-000650-00	/
30	Screw, M3	043-007866-00	/
32	Battery compartment door		/
31	N1 Battery shock-absorbing sponge	/	/
33	Li-ion battery, 2500mAh	115-049427-00	/
34	Screw, flat head Philips M3X6	/	/
35	Battery compartment	/	/
36	Parameter interface board (without CO ₂) assembly	/	/
37	Pin for screen	041-026193-00	/
38	Main frame connection nut	/	/
39	Screen assembly	115-049058-00 (TRULY)/ 115-049059-00 (TIANMA)	/

7.6 Parameter Interface Board Assembly

7.6.1 Exploded View (with the CO₂ module)

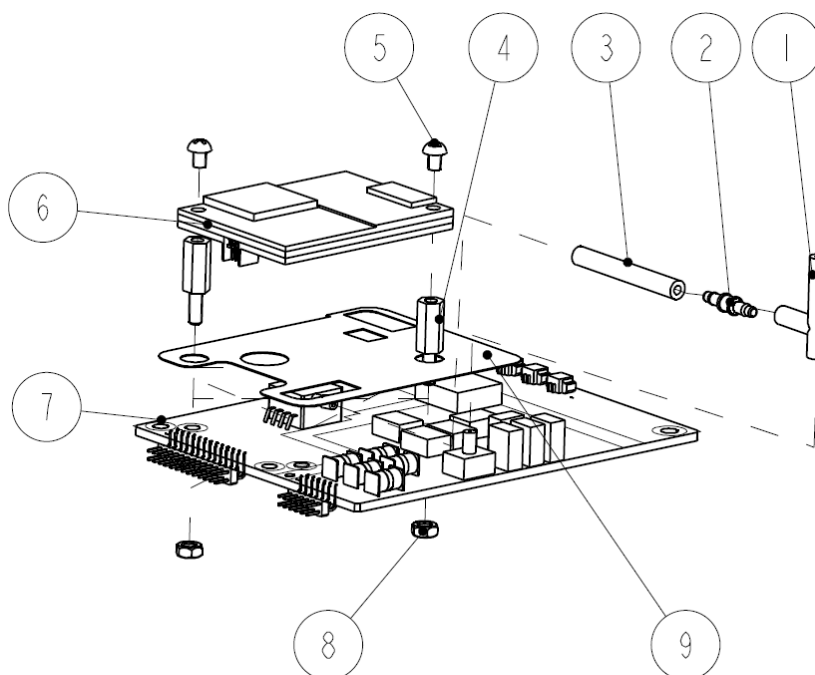


7.6.2 Parts List

No.	Description	FRU Part Number	Remark
1	ECG socket of parameter module	051-002825-00 (12 lead ECG, Masimo SpO2, CO2), 051-002824-00 (5/12 lead ECG, Nellcor SpO2, CO2), 051-002821-00 5/(12 lead ECG, Nellcor SpO2, CO2), 051-002818-00 (12 lead ECG, Masimo SpO2)	Select the corresponding FRU part number according to the parameter module configuration of the monitor.
2	SpO2 socket of parameter module		
4	Multi-parameter module TEMP socket		
5	SCREW,FLAT-HD,CROSS,M3X6,NI-P		
10	Parameter interface board (CO2 rubber)		
17	Spring		
19	IBP socket of parameter module		
20	Waterproof for temp socket		
21	Rainproof rubber		
22	N1 interface board		
16	Pin board for N1 analog output		
23	Screw self-tapping, M3X6		
6	6660 Power Button PCBA	051-002808-00	/
3	DRYLINE PRIME receptacle with no panel	115-036134-00	
7	Rubber button	/	/
8	N1 power key silkscreen	043-007946-00	/
9	1 slot CO2+O2 outlet nipple	/	/
11	Rubber sleeve socket	/	/
12	Steel ball.GB308-89 2.5 stainless steel polishing	/	/
13	Hexagon NIBP pedestal (POM)	/	/
14	MPM module analog output interface socket	/	/
15	NIBP outer seat	/	/
18	Speaker, 8 ohm, 1 W	020-000065-00	/

7.7 Parameter Assembly

7.7.1 Exploded View

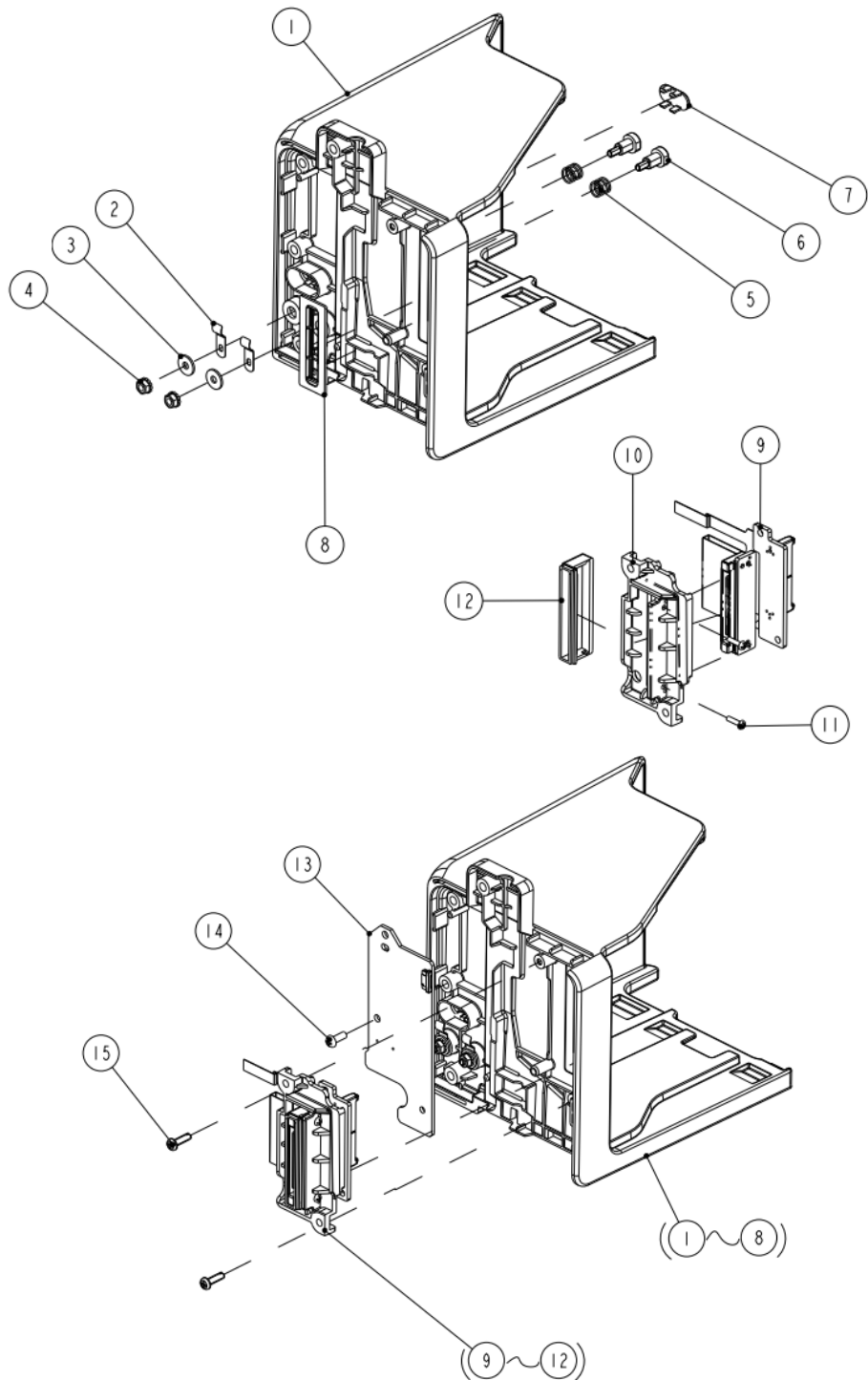


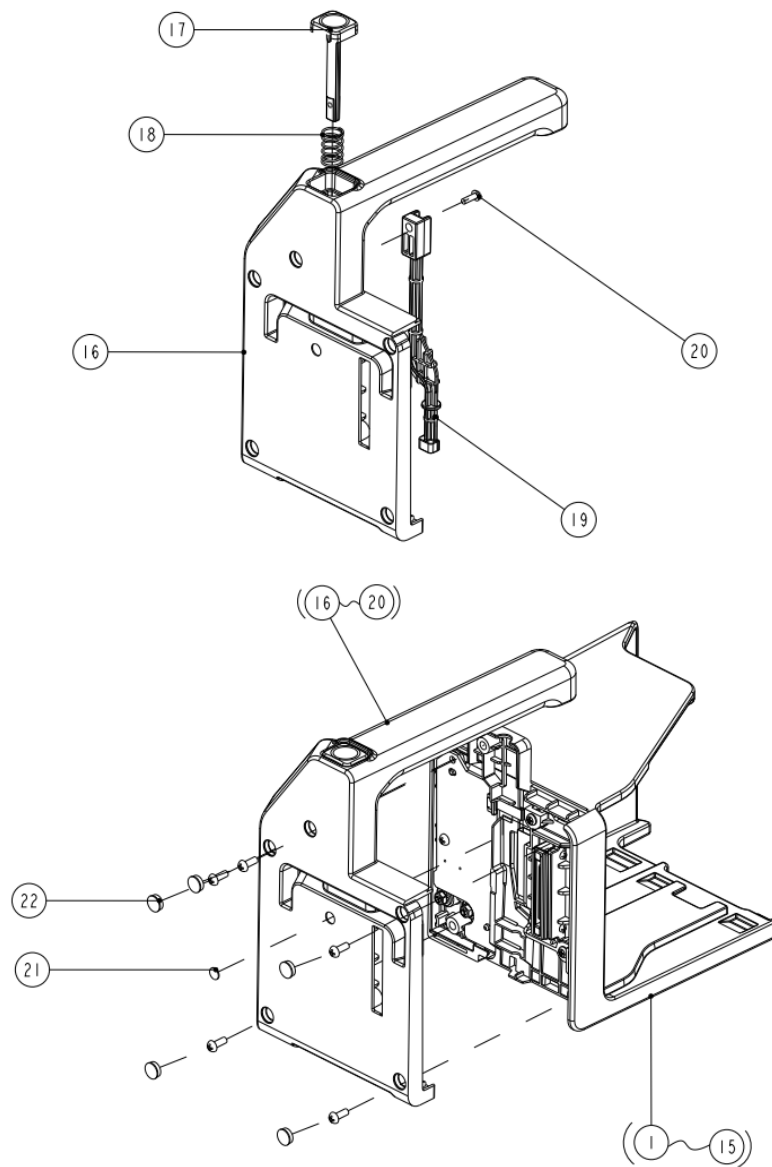
7.7.2 Parts List

No.	Description	FRU Part Number	Remark
1	Rubber tube	115-049055-00 (for CO2 module) or 115-049057-00 (for 2-battery configuration)	Part of the pump assembly
2	Plastic connector		
3	Rubber tube		
4	Threaded spacer	/	/
5	Crosshead pan screw M3×4		/
6	SPO ₂ module	040-003371-00	Masimo SpO ₂
		101-000469-00	Nellcor SpO ₂
8	Threaded spacer M3×0.5	/	/
9	Blood oxygen board insulating sheet	/	/
7	M51C5L-FE, 3-SPO ₂ , IBP, AO (N1)	051-002832-00	3/5-lead ECG
	M51C12L-FE, 3-SPO ₂ , IBP, AO (N1)	051-002833-00	12-lead ECG

7.8 Modular Rack

7.8.1 Exploded View





7.8.2 Parts List

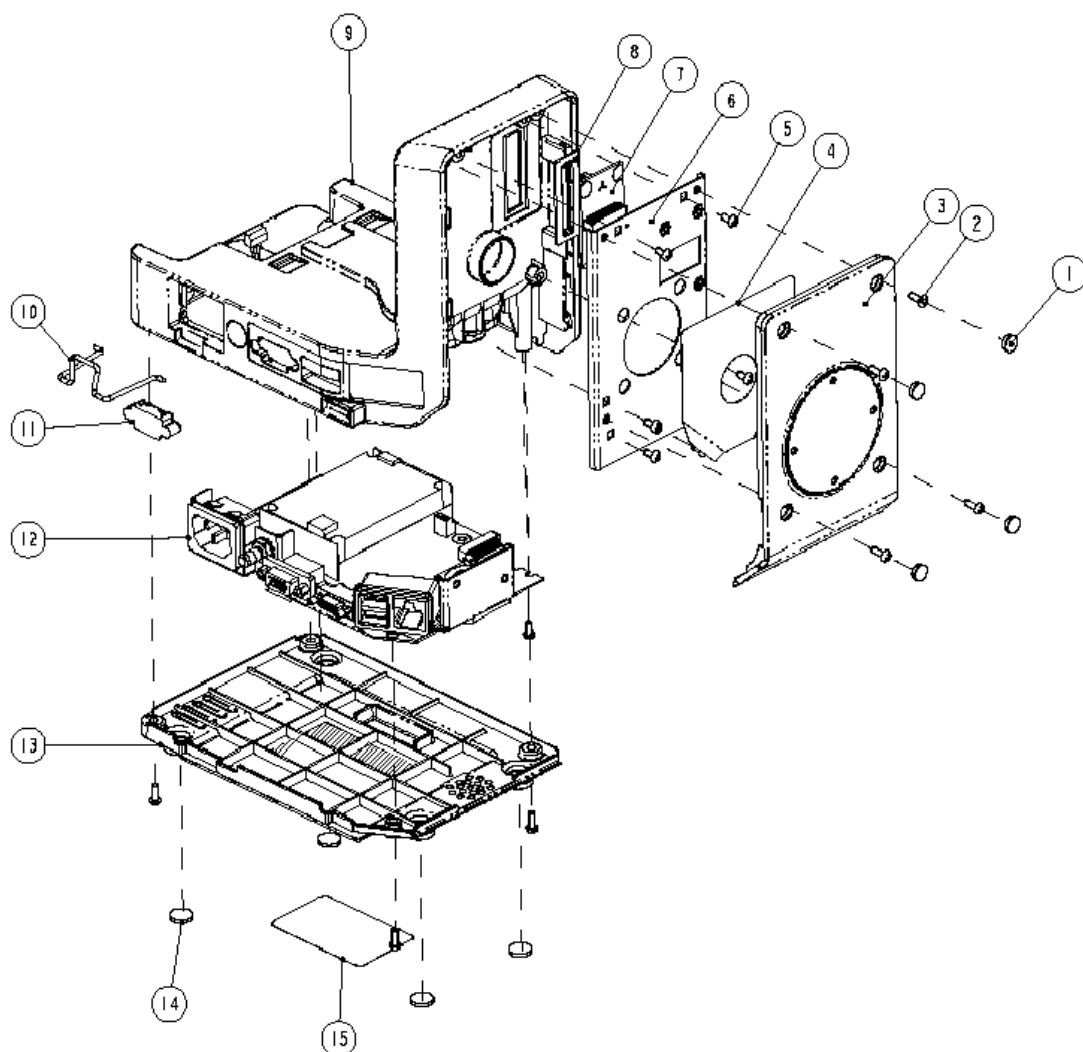
No.	Description	FRU Part Number	Remark
1	Rack up housing	/	/
2	Spring	/	/
3	Contact screw	/	/
4	Large flat washer, A GB/T96.1-2002	/	/
5	Hex nut and taper lock washer	/	/
6	Infrared lens	/	/
7	Contact spring	/	/
8	Rack male plug cover	/	/
9	Rack connector board PCBA	051-001366-00	/
10	Rack connector fix bracket	/	/
11	Crosshead pan screw GB/T818-2000 M2×8	/	/
12	Rack female receptacle waterproof jacket	/	/
13	Rack NIOS board	051-001367-00	/

No.	Description	FRU Part Number	Remark
14	Stainless steel cross recessed pan head tapping screw, PT3×10	/	/
15	Crosshead pan screw GB/T818-2000, M3×8	/	/
16	Rack handle assembly	115-050763-00	/
17	Key, A MODULE	/	/
18	Spring, compression	/	/
19	Rack unlock rod	/	/
20	Crosshead pan screw GB/T818-2000, M2.5×8	/	/
21	Decorating label	/	/
22	Screw cover	/	/

7.9 Dock

7.9.1 Main Unit

7.9.1.1 Exploded View

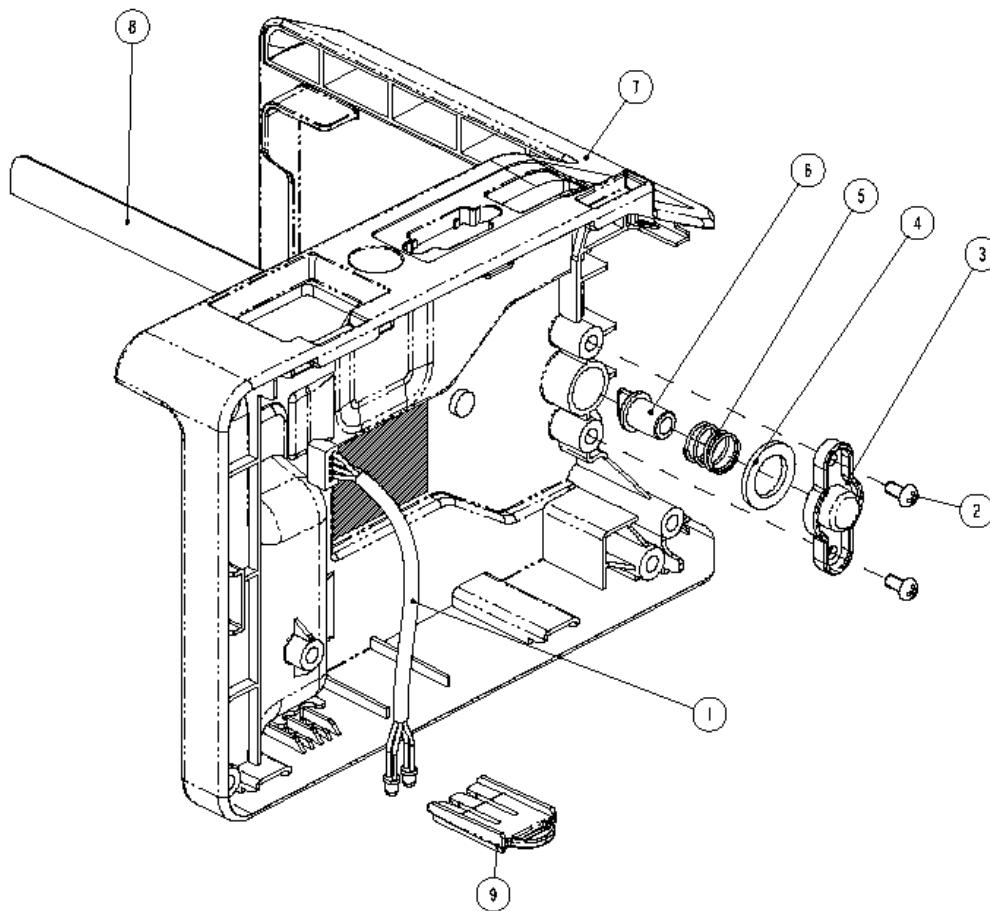


7.9.1.2 Parts List

No.	Description	FRU Part Number	Remark
1	Screw cover 2	/	/
2	Crosshead pan screw, M3×8, NI-P	/	/
3	DOCK right housing	/	/
4	ESD Insulation	/	/
5	Crosshead pan screw, M3×6, NI-P	/	/
6	Dock Transition Board Plate	/	/
7	N1 DOCK connector Board PCBA	051-001368-00	/
8	Rack Male plug Cover	/	/
9	Top shell module of DOCK	115-050764-00	/
10	Power Cable Hook	/	/
11	VGA hole cover	/	/
12	Dock port module	/	/
13	Dock Bottom Housing		/
14	Handle pad	/	/
15	N1 Dock part label	/	/

7.9.2 Top Shell Module of Dock

7.9.2.1 Exploded View

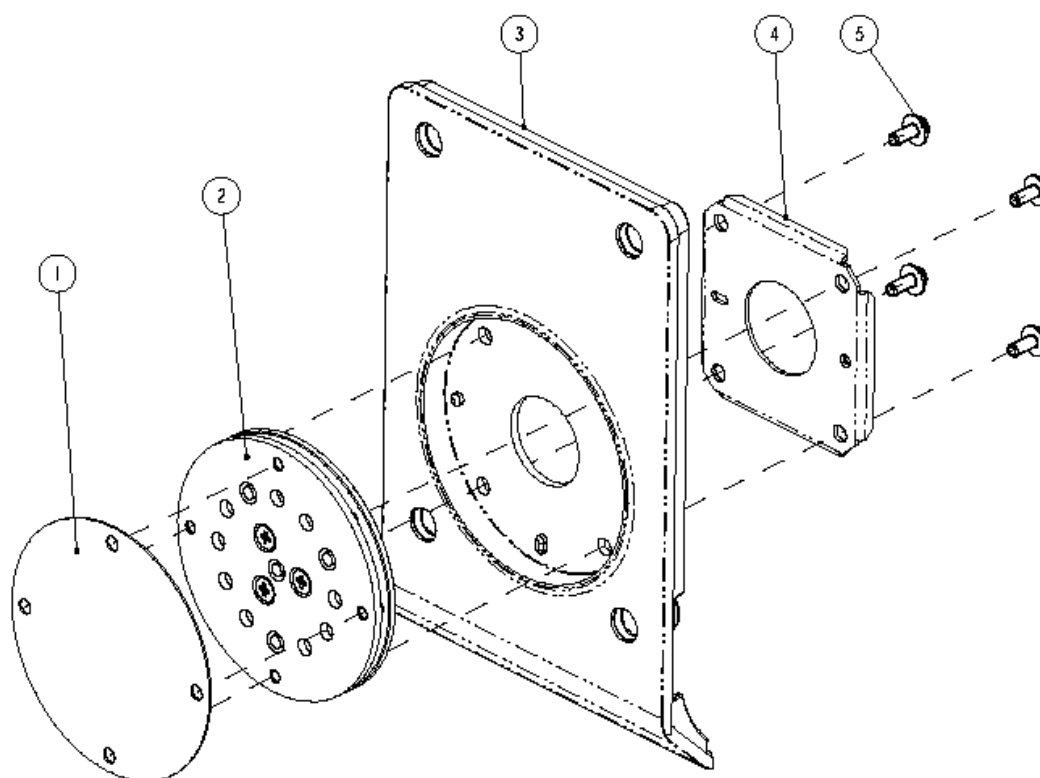


7.9.2.2 Parts List

No.	Description	FRU Part Number	Remark
1	Dock indicator connection cable	009-003299-00	/
2	Crosshead pan screw, M3×6, NI-P	/	/
3	Rack Latch Plate	/	/
4	Rack Latch Waterproof Pad	/	/
5	Pin spring	/	/
6	Rack Latch	043-003181-00	/
7	Dock Top Housing	/	/
8	Dock Decoration Label	/	/
9	LED bracket	/	/

7.9.3 Right Shell Module of Dock

7.9.3.1 Exploded View

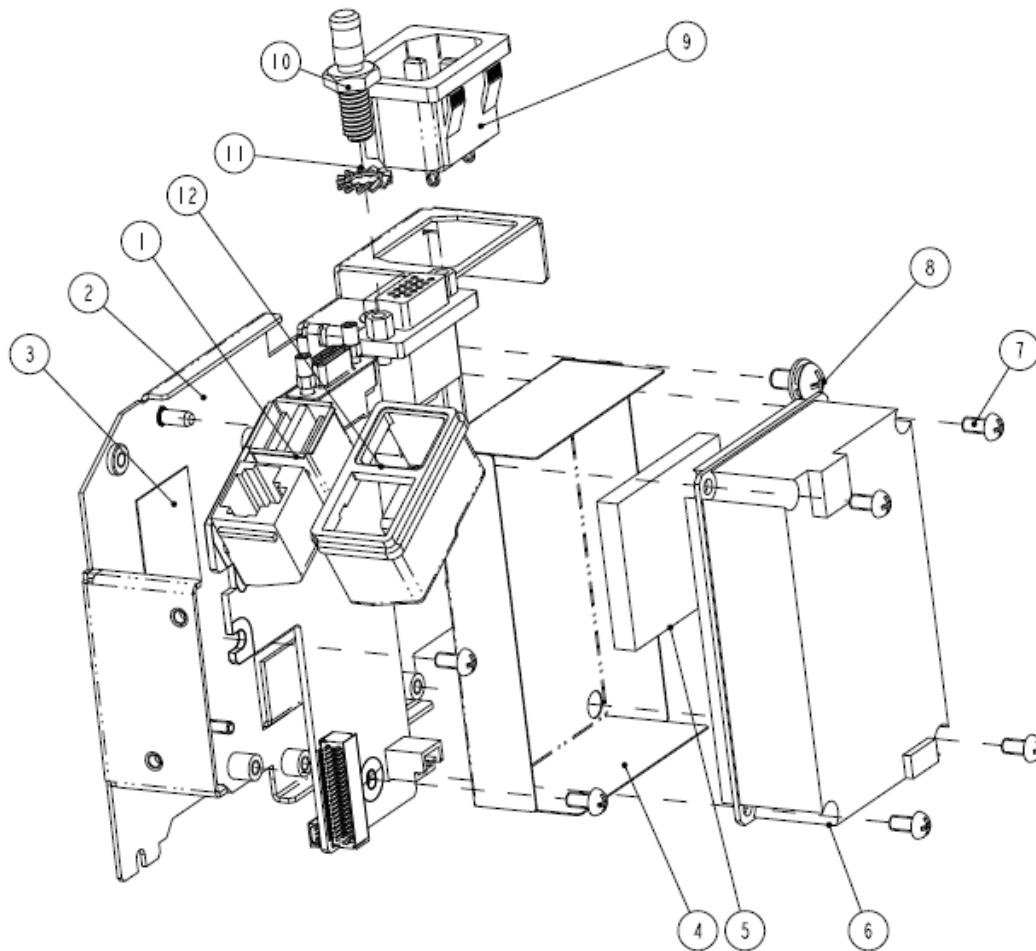


7.9.3.2 Parts List

No.	Description	FRU Part Number	Remark
1	Dock Plate Label	/	/
2	Dock Rotatable Plate	/	/
3	Dock Right Housing	/	/
4	Dock right shell frame	/	/
5	Assembling bolt, M3×8	/	/

7.9.4 Dock Port Module

7.9.4.1 Exploded View



7.9.4.2 Parts List

No.	Description	FRU Part Number	Remark
1	Dock interface board PCBA	051-001369-00	With VGA
2	Dock interface board frame	/	/
3	Network port insulating sheet	/	/
4	Power board insulation	/	/
5	Thermal pad	/	/
6	Power board, 12V 40W	022-000137-00	/
7	Crosshead pan screw, M3x6, NI-P	/	/
8	Stainless steel pan head screw assembly, M4x8	/	/
9	Cable for AC input receptacle	009-003698-00	/
10	Grounding pillar	/	/
11	Lock washer, external tooth #6	/	/
12	Socket waterproof cushion	/	/

7.10 Other Maintenance and Repair Parts

No.	Description	FRU Part Number
1	Network upgrade tool component	115-020584-00
2	6660 mainboard to M02D module wire	009-007325-00
3	6660 mainboard multifunction wire	009-007326-00
E	6660 mainboard to Key board wire	009-007365-00
5	DC-in wire for N1	009-008383-00
6	Power adapter FRU kit	115-049060-00
7	Wi-Fi upgrade package (for N1)	115-049130-00
8	Insulated sheet	115-051478-00
9	Wi-Fi module, 2.4 GHz amd 5GHz, 802.11a/b/g/n	024-000707-00
10	Wi-Fi antenna, 2.4 - 2.5G and 4.9 - 5.87G	024-000941-00
11	Dock board power cable	009-003301-00
12	Dock transfer board to Interface board cable	009-003300-00

FOR YOUR NOTES

8 Terminology

- **AC adapter:** developed for this project and used to supply power to the N1 main unit.
- **Bedside monitor:** general designation of the N series, T series and Papssport series.
- **Central station:** abbreviated as CS.
- **Dock:** secures and extends T1/N1 accessories and supplies power to them. Its model is Dock. The online T1 Dock is used.
- **Modular Rack:** used to carry T1/N1 accessories. Its model is Rack. A one-slot module can be inserted in it. The online T1 Handle is used.
- **Monitor handle:** used to carry T1/N1. The online T1 monitor handle is used.
- **N series:** BeneVision series bedside multi-parameter modular monitors, including BeneVision N22/N19/N17/N15/N12.
- **N1 Accessories Storage Box:** a cable storage accessory developed for this project and used together with the N1 Transport Dock.
- **N1 docking solution (NDS):** It has no model and includes N1, Dock and Modular Rack.
- **N1 Transport Dock:** accessory developed for this project and used to secure and supply power to T1/N1. Its model is Dock-T.
- **N1:** BeneVision N1, the main unit of the transport multi-parameter patient monitor developed for this project.
- **Satellite Module Rack (SMR):** external device used to extend module slots for the bedside monitor.
- **System:** includes the N1, Modular Rack, Dock and N1 Transport Dock.

FOR YOUR NOTES

A Electrical Safety Inspection

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

All tests can be performed using commercially available safety analyzer test equipment. 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 also.
		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 Labelling

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

- Main unit label
- Integrated warning labels

A.4 Scheduled Electrical Safety Inspection

For scheduled electrical safety inspection, perform all the test items listed in **A.6 Electrical Safety Inspection Test**.

A.5 Electrical Safety Inspection after Repair

The following table specifies test items to be performed after the equipment is repaired. Refer to **A.6 Electrical Safety Inspection for the description of the test items**.

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

A.6 Electrical Safety Inspection Test

Inspection and Testing			Limit
1	Power Cord Plug		
2	Device Enclosure and Accessories		/
3	Device Labeling		/
4	Protective Earth Resistance		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	Max: NC: 300 μ A(refer to UL60601-1)
		Single Fault condition(SFC)	SFC: 1000 μ A
6	Patient Leakage Current	Normal condition(NC)	Max: CF applied part: NC:10 μ A, SFC: 50 μ A
		Single Fault condition(SFC)	BF applied part: NC:100 μ A, SFC: 500 μ A
7	Mains on Applied Part Leakage		Max: CF applied part: 50 μ A BF applied part: 5000 μ A
8	Patient Auxiliary Current	Normal condition(NC)	Max: CF applied part: NC:10 μ A, SFC: 50 μ A BF applied part: NC:100 μ A, SFC: 500 μ A

FOR YOUR NOTES

