

**BeneVision TMS60**

**Telemetry Monitoring System**

**Service Manual**




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## NOTE

- **This manual describes all features and options. The equipment may not have all of them. Contact Mindray service department for any questions.**
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- The electrical installation of the relevant room complies with the applicable national and local requirements;
- The product is used in accordance with the instructions for use.

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### WARNING

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- **This manual is for biomedical engineers or technicians responsible for troubleshooting, repairing, and maintaining the telemetry monitoring system.**
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2. Freight policy

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3. Return address

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

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# 1 Safety

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## 1.1 Safety Information

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### WARNING

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- Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.
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### CAUTION

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

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

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#### WARNING

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- **There is high voltage inside the system. Never disassemble the system before it is disconnected from the AC power source.**
  - **The system 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.**
  - **To completely disconnect the power supply, unplug the power cord.**
  - **To avoid the electric shock, disassemble the central charger after the central charger is disconnected from the AC power source for five minutes later.**
  - **Dispose of the package material, observing the applicable waste control regulations and keeping it out of children's reach.**
- 

### 1.1.2 Cautions

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#### CAUTION

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- **Make sure that no electromagnetic radiation interferes with the performance of the system 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 system to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the system's label or in this manual.**
  - **Protect the system from damage caused by drop, impact, strong vibration or other mechanical force during servicing.**
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### 1.1.3 Notes

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#### NOTE

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- **Refer to Operator's Manual for detailed operation and other information.**
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## 1.2 Equipment Symbols

See ***TMS60 Telemetry Monitoring System/TM80 Telemetry Monitor Operator's Manual*** for information about the symbols used on this product and its packaging.

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## 2 Principles

### 2.1 System Operating Principle

TMS60 is a digital telemetry monitoring system consisting of the transmitter (TD60), the receiver (RC60), the antenna array. The transmitter sends the patient's physiological information to the receiver, which then transmits the information to the Central Monitoring System (CMS) for analysis, displaying, storage and printing. The transmitter is attached to the patient, whereas the receiver is used together with the CMS. TMS60 telemetry monitoring system is intended to monitor and display a fixed set of parameters including ECG, Resp, SpO<sub>2</sub>, NIBP, HR and PR under hospital environments. The Resp module, SpO<sub>2</sub> module, and NIBP module are optional.

The following is a simple illustration:

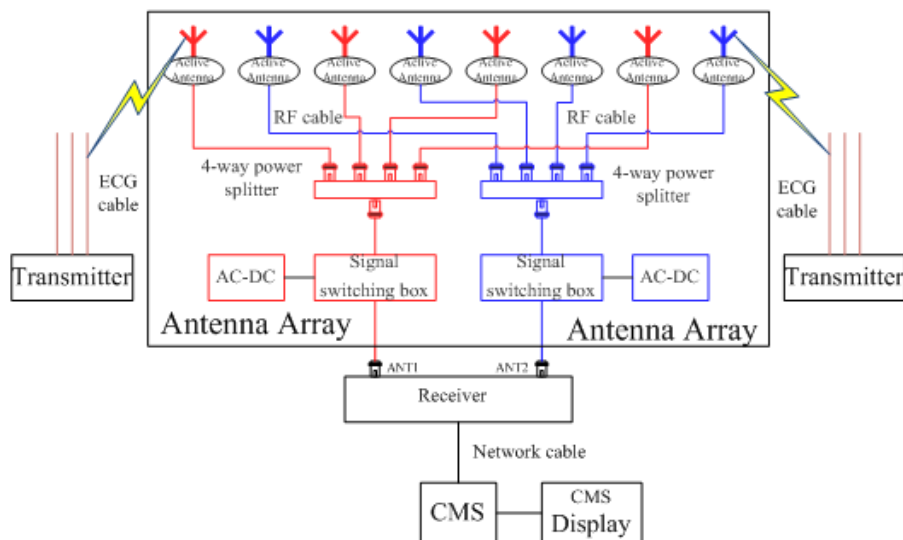


Figure 2-1 TMS60 Telemetry Monitoring System Diagram

#### NOTE

- The distance between the TD60 and the antenna should be at least one meter.



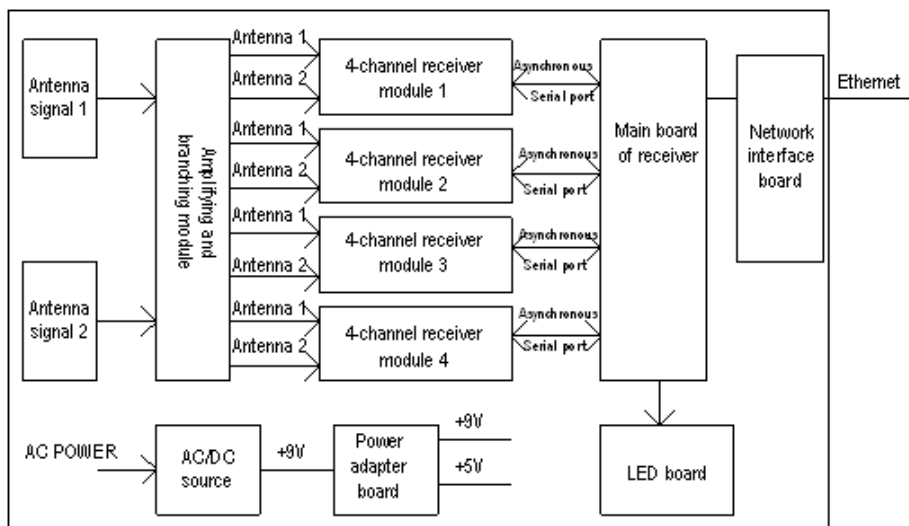


The MCU circuit is the core of the transmitter, enabling the following functions:

- Button signal detection
- SpO<sub>2</sub> connector
- Status detection, such as ECG overload detection, lead off detection, PACE detection, etc.
- ECG data processing
- MWTS circuit control and Baseband signal generation
- Bluetooth module control

## 2.2.3 Receiver

### 2.2.3.1 Principle Diagram



**Figure 2-3 Receiver Principle Diagram**

The receiver comprises the AC/DC power source, power adapter board, amplifying and branching module, 4-channel receiver, LED board, main control board and network interface board.

#### **2.2.3.2 AC/DC Source**

The AC/DC source is to convert the externally inputted AC source into a 9V DC by means of isolation. The inputted AC voltage range is from 90V to 264V, and the outputted voltage/current is 9V/6.5A.

#### **2.2.3.3 Power Adapter Board**

The power adapter board is to drop the 9V DC coming from the AC/DC source to a 5V DC and then output it with the 9V DC.

#### **2.2.3.4 Amplifying and Branching Module**

The amplifying and branching module is to amplify, filter and branch RF signals. The module allows two amplifying, filtering & branching circuits with circuit parameters in full symmetry. Each circuit amplifies, filters and branches the RF signals received by its corresponding antenna and then outputs 4 channels of RF signals. Therefore, there are a total of 8 channels of RF signals, which are then sent to the 4-channel receiver for processing. The 9V DC linearly drops down to an 8V DC, which then goes to the amplifying and branching module. The antenna array is shared by all receiving modules. Therefore, in order to compensate for the branching attenuation of the signal, a LNA (low noise amplification) is added before the branch divider. Besides, to avoid that the LNA is blocked by strong out-band signal interference, filtering circuits shall be added in front of and behind the LNA.

#### **2.2.3.5 4-Channel Receiver**

The 4-channel receiver divides the two channels of antenna signals coming from the amplifying and branching module into four channels of RF signals through the 4-channel branch divider. The MCU of the 4-channel receiving board will estimate the received signal strength (RSSI) and then select the corresponding antenna signals through the antenna switch. The selected signals will be respectively sent to the receiving modules for filtering, amplifying, mixing, filtering and demodulating. The demodulated 4-channel analog signals will then be sent to the MCU system for clock and data regenerating. The regenerated data is packed by CPU and then delivered via the asynchronous serial port to the main control board for processing. The 9V DC linearly drops down to an 8V DC, which is then stabilized into a 5V and a 3.5V supplying power for the 4-channel receiver.

#### **2.2.3.6 Main Control Board**

After receiving the data coming from the 4-channel receiving board, the main control board will pack them and then delivers them to the CMS through the Ethernet. The speaker of the main control board will give a short beep when the initialization is over, and will beep continuously when an initialization failure or a hardware fault occurs.

#### 2.2.3.7 LED Board

The LED board has two green LEDs, respectively indicating the power status and the communication status of the receiving module.

#### 2.2.3.8 Network Interface Board

The interface between the main control board and Ethernet consists of the network isolating transformer and interface connector.

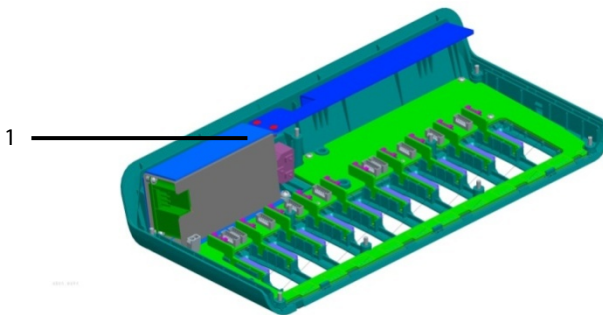
### 2.2.4 Central Monitoring System (CMS)

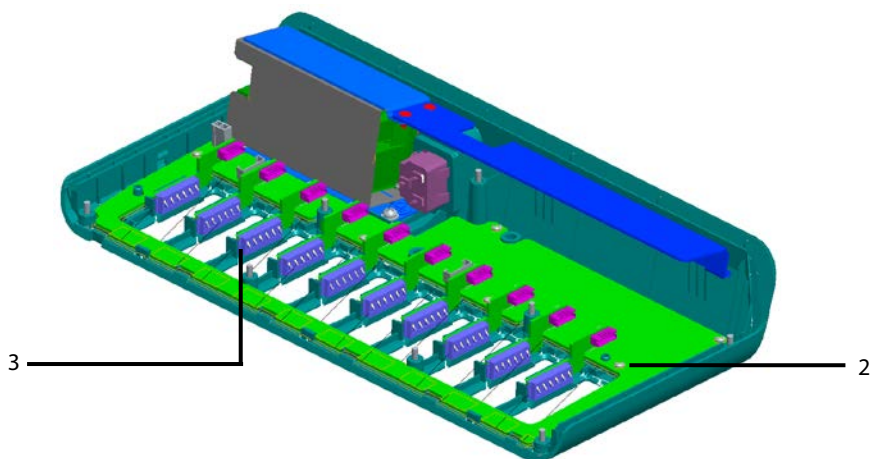
BeneVision Central Monitoring System comprises powerful system software and high-performance computer components. It constructs a monitoring network by connecting monitors and telemetry transmitters. By collecting, processing, analysing and outputting the information coming from monitors and telemetry transmitters, the CMS can achieve centralized monitoring over multiple patients so as to greatly promote the efficiency and quality of the monitoring work.

The CMS is capable of connecting up to 32 telemetry transmitters.

### 2.2.5 Central Charger

The central charger inner structure consists of three boards, as shown in Figure 2-4:



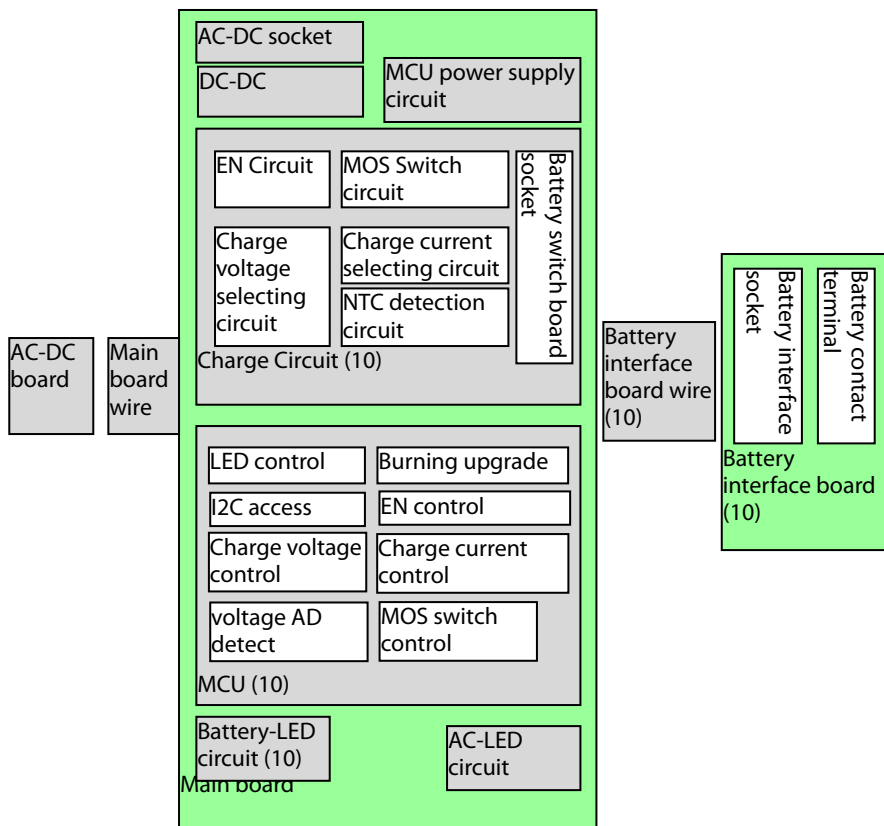


**Figure 2-4 Central Charger Inner Structure**

1. AC-DC board (one)  
Switching the AC circuit to the DC circuit.
2. Main board (one)  
Including the charge circuit, MCU, and LED indicator.
3. Battery interface board (10)  
Switching the circuit from the battery contact terminal to the main board.

Three kinds of wires connect with those boards:

- AC-DC socket + wire (P/N 0651-20-76879)  
The wire connects the AC socket and the AC-DC board.
- Main board wire (P/N 009-003327-00)  
The wire connects the AC-DC board and the main board.
- Battery interface board wires (10) (P/N 009-003325-00)  
The wires connect the main board and the battery interface boards.

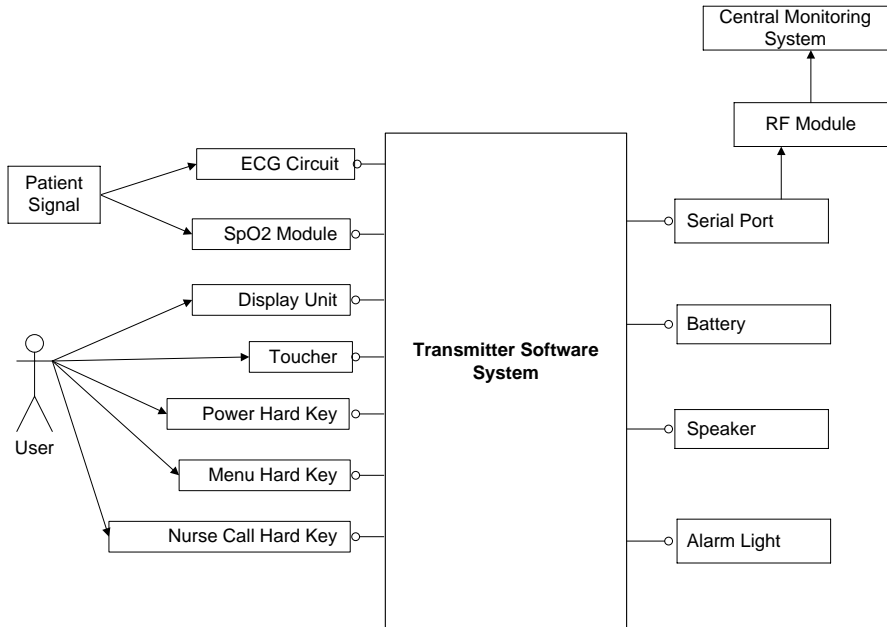


**Figure 2-5 Central Charger Hardware Boards and Wires**

## 2.3 Software Principles

### 2.3.1 Transmitter Software System

#### 2.3.1.1 Overview



**Figure 2-6 Interfacing Diagram between the Transmitter Single-Chip Software and Peripherals**

Inside the solid frame is the transmitter software system (hereinafter called the software system), and outside the solid frame are the inputs and outputs of the software system. The patient's ECG data are inputted into the software system by means of sampling.




The external SpO<sub>2</sub> module communicates with the transmitter through the serial port, and the collected SpO<sub>2</sub> data are inputted into the software system via the serial port. The CMS and external SpO<sub>2</sub> module communicate with the transmitter through the same serial port. The user commands and online upgrade files of the transmitter software are inputted into the software system through this serial port.

Patient calls can be inputted into the software system through the nurse call button. The patient's ECG and SpO<sub>2</sub> parameter signals and the transmitter's status data are processed by the software system and then transmitted to the RF module. In addition, the indicator and speaker are also controlled by the software system.

### 2.3.1.2 Transmitter System Task

The transmitter collects the patient's ECG and SpO<sub>2</sub> signals, and then detects the pace pulse, SpO<sub>2</sub> and other status information in them by amplifying and digitalizing them, and finally sends the detected information to the receiver through wireless channels.

The transmitter supports the auto detection of 3-lead or 5-lead leadwire, lead off detection and PACE detection. It also supports the external SpO<sub>2</sub> module through the SpO<sub>2</sub> connector, through which the CMS can perform the parameter configuration and online software upgrade to the transmitter.

The transmitter also enables these functions including battery voltage detection, hardware button detection including the Power On/Off and Display On/Off button , Nurse Call button , Main menu/Main screen button . Besides, it supports audible and visual alarms and enables the standby mode, sleep mode, and lock screen mode.

## 2.3.2 Receiver System Software

### 2.3.2.1 Overview

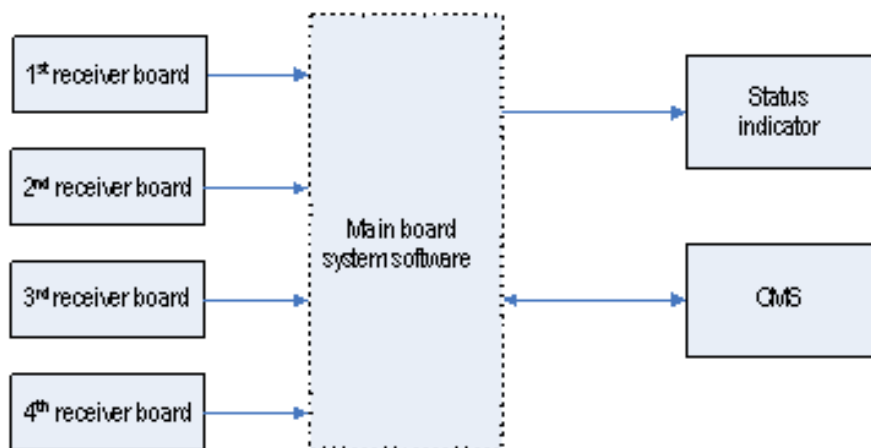


Figure 2-7 Receiver system software diagram

Inside the dashed frame is the system software of the main control board (hereinafter called the software system), and outside the dashed frame is the inputs and outputs of the software system. The data coming from the 4-channel receiver are sent to the software system through the serial port.

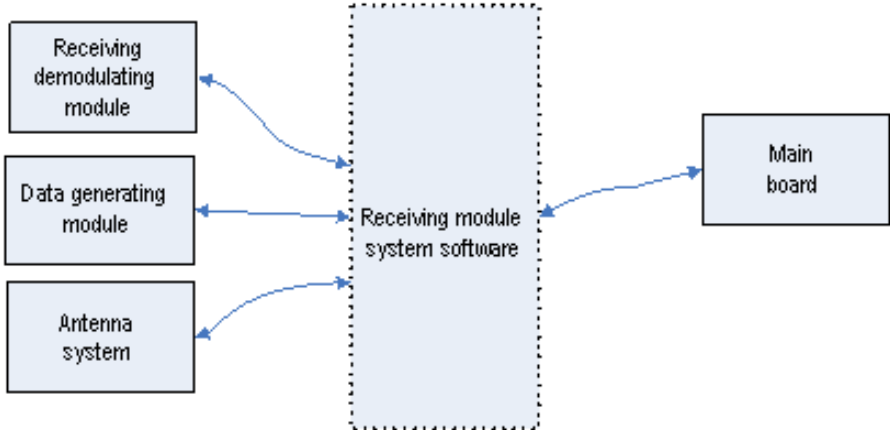
The main control board and receiver controller communicate through the serial port. The main control board directly controls the LED indicator through the I/O port and communicates with the CMS through the Ethernet.

### 2.3.2.2 Receiver System Task

The receiver receives data from boards, descrambles data, analyses the integrity of data, generates relevant alarm messages and sends them together with data to the CMS.

Through the receiving controller, the receiver obtains and controls the operating status of the receiving demodulator, including the operating frequency and signal strength of the demodulator. After detecting the operating status, the receiver will give prompt information through the communication status indicator.

### 2.3.2.3 Overview of the 4-Channel Receiver Software



**Figure 2-8 Diagram for the 4-Channel Receiver Software**

Inside the dashed frame is the receiving module control software (hereinafter call software system), and outside the dashed frame are the inputs and outputs of the software system. Through the serial port and signal line, the software system communicates with the receiving demodulator, resolves the data coming from the data-generating module and controls the antenna system via switch. Besides, it also communicates with the main control board via the serial port.



#### **2.3.2.4 4-Channel Receiver Software Task**

The 4-channel receiver mainly undertakes the following tasks:

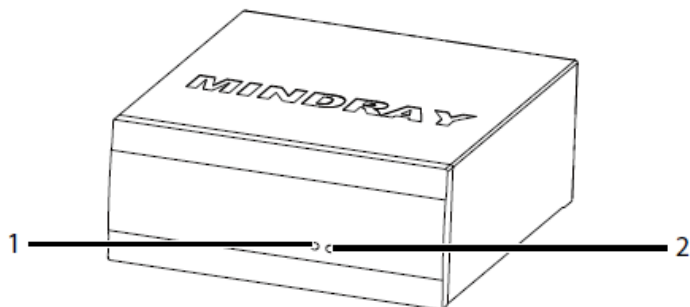
- Recover and resolve the wireless transmission space protocol;
- Configure frequency for the 4-channel receiver on the receiving board;
- Collect the RSSI from the 4-channel receiver on the receiving board;
- Select antenna according to the received signal strength;
- Collect the status information of the 4-channel receiver on the receiving board;
- Carry out the communication with the main control board.

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## 3 Receiver Physical Views

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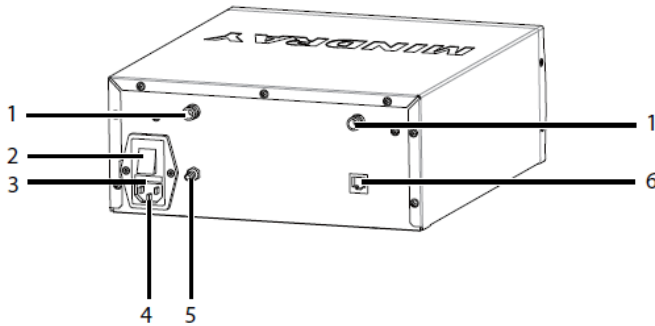
### 3.1 Front View



**Figure 3-1 Receiver Front View**

1. Communications indicator
  - ◆ Flashes periodically: communications is occurring.
  - ◆ On: communications is not occurring.
  - ◆ Off: there is a startup failure or hardware failure.
2. Power indicator
  - ◆ On: the receiver is powered on.
  - ◆ Off: the receiver is powered off.

## 3.2 Rear View



**Figure 3-2 Receiver Rear View**

1. Antenna connectors  
The receiver has two antenna connectors. Each connector connects an antenna cable.
2. Power switch  
Place the switch to “|” to turn the receiver on. Place the switch to “○” to turn the receiver off.
3. Fuse holder  
You can open the cover to replace the fuse.
4. AC power input connector
5. Equipotential grounding terminal  
When the receiver and other device are to be used together, their equipotential grounding terminals should be connected together to eliminate the potential difference.
6. Network connector  
A standard RJ45 connector that connects the receiver to the central monitoring system.

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**WARNING**

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- **Only use the approved power cord with the grounded mains plug to firmly connect the receiver to a grounded AC mains socket. Never refit the mains plug to fit an ungrounded AC mains socket.**
  - **Do not use the Multiple Portable Socket Outlets (MPSO) or AC mains extension cords. Use an IEC 60601-1 approved isolation / separation transformer, otherwise, it may result in leakage current. Insure that the sum of the individual ground leakage currents does not exceed the allowable limits.**
- 

### **3.3 Restoring Latest Configuration Automatically**

To prevent the changes from losing in case of a sudden power failure, the device, such as the receiver or the BeneVision CMS, stores the configuration in real time. The saved configuration is the latest configuration.

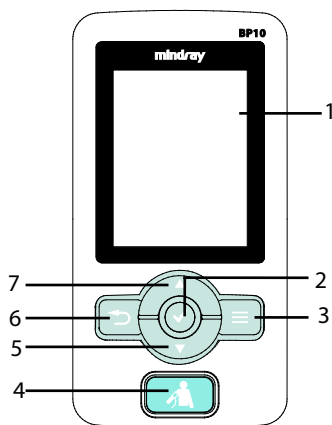
The device restores the latest configuration if it restarts within 60 seconds after the power failure. And the device will restore the default configuration rather than the latest configuration if it restarts 120 seconds after the power failure. The device may load either the latest configuration or the default configuration if it restarts from 60-120 seconds after the power failure.

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## 4 BP10 Physical Views

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### 4.1 Front View

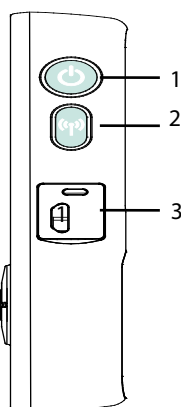


1. Display
2. Confirmation key  
When the desired option is highlighted, press this key to select or activate the corresponding function.
3. Main menu key  
Press this key to turn to the main menu.
4. NIBP start/stop key
  - ◆ When NIBP measurement is in process, press this key to stop the proceeding NIBP measurement.
  - ◆ When NIBP measurement is not performed, press this key to start an NIBP measurement.
5. Down key  
Press this key to move down along the column of menu options or configuration choices.

6. Return key
  - ◆ Press this key to return to the previous menu and save the settings.
  - ◆ Press this key to switch between two main screens.
7. Up key

Press this key to move up along the column of menu options or configuration choices.

## 4.2 Side View



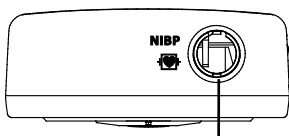
1. Power On/Off key
  - ◆ When BP10 is powered off, press this key to turn BP10 on.
  - ◆ When BP10 is powered on, press and hold this key to display the power off confirmation menu.
  - ◆ If the screen display is on, press this key to turn the display off.
2. Mindray Patient Area Network (MPAN) key
  - ◆ When BP10 is disconnected from the MPAN, press this key to begin the bluetooth pairing process.
  - ◆ When BP10 is connected with the MPAN, press this key to unpair any connected bluetooth devices.

You can also set up the MPAN communication in the main menu.
3. USB port

This port is used for software upgrade.



### 4.3 Top View



NIBP cuff connector: connect the NIBP hose.

For further details about the BP10 NIBP module, refer to the ***BP10 NIBP Module Operator's Manual (P/N 046-011008-00)***.

**FOR YOUR NOTES**

## 5 Central Charger Physical Views

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### 5.1 Front View

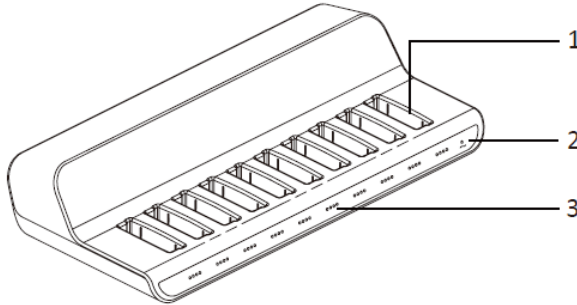


Figure 4-1 Central Charger Front View

1. Charging slot
2. AC power indicator
  - ◆ Off: No AC power supply connected, or the AC-DC board is abnormal.
  - ◆ Green: AC power supply is connected.
3. LED indicators: indicates the charging status for the corresponding charging slot.

### 5.2 Rear View

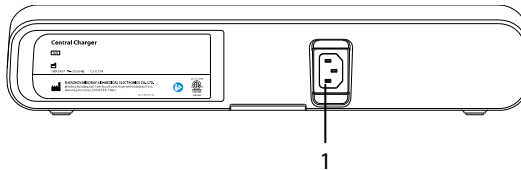


Figure 4-2 Central Charger Rear View

1. AC power socket

For further details about the central charger such as how to mount the central charger and how to charge and remove batteries, refer to the **BeneVision Central Charger Operator's Manual (P/N 046-007059-00)**.

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## 6 Maintenance

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



### CAUTION

- **All tests should be performed by qualified service personnel only.**
  - **Care should be taken to change the settings in the Maintenance menu to avoid loss of data.**
  - **Service personnel should acquaint themselves with the test tools and make sure that test tools and cables are applicable.**
-

## 6.1 Recommended Maintenance and Test Frequency

Check/Maintenance Item		Frequency
Visual inspection		When first installed or reinstalled.
Power-on test		1. When first installed or reinstalled 2. Following any repairs or replacement of transmitter components
ECG test	Performance test	1. If the user suspects that the measurement is incorrect. 2. Following any repairs or replacement of relevant module. 3. At least once every two years. Note: NIBP test should be performed at least once a year.
	Calibration	
Resp test	Performance test	
SpO <sub>2</sub> test		
NIBP test	Pressure check	
	Leakage test	
Nurse call test		If the user suspects that the measurement is incorrect.
Electrical safety tests		1. After the transmitter or central charger falls off. 2. Performed at least once every two years or as needed
Network print test		1. When first installed. 2. Whenever the printer is serviced or replaced.
Battery check	Functionality test	1. When first installed. 2. Whenever a battery is replaced.
	Performance test	Once every two months or when the lithium-ion battery's run time becomes noticeably shorter.

## 6.2 Parameter Tests

### 6.2.1 ECG Tests

#### 6.2.1.1 ECG Performance Test

Tool required:

- Medsim 300B patient simulator recommended

Follow this procedure to perform the test:

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

#### 6.2.1.2 ECG Calibration

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller.

Tool required:

- Vernier caliper


To verify the ECG waveform amplitude:

1. In the main menu, select **Parameter Setup**.
2. Select **ECG**.
3. Set **Filter** to **Monitor**.
4. Return to the main menu and select **Maintenance**.
5. Input the maintenance passcode.
6. Tap **Accept**.
7. In the **Maintenance** menu, select **General**.
8. Enable **Calibrate ECG**. A square wave appears on the screen and the message **ECG Calibrating** is displayed in the technical alarm area of the transmitter's screen. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
9. After completing the verification, disable **Calibrate ECG**. If necessary, you can print out the square wave and wave scale through the recorder and then measure the difference.

## 6.2.2 Resp Test

### 6.2.2.1 Enabling Resp Functionality

Before performing the Resp performance test, you need to enable the Resp functionality. Follow this procedure to enable the Resp functionality:

1. After powering on the TD60, press  to enter the main menu of the transmitter.
2. Select **Maintenance**→input the maintenance passcode→tap **Accept**→select **Service**.
3. Input the passcode.
4. Tap **Accept**.
5. Enable **Support Resp**.
6. Return to the main menu.
7. Select **Maintenance**→input the maintenance passcode→tap **Accept**→select **General**.
8. Enable **Resp**.

### 6.2.2.2 Resp Performance Test

Tools required:

- Medsim300B patient simulator
1. Connect the patient simulator to the TD60 using an ECG cable and set lead II as the respiration lead.
  2. Configure the simulator as follows: lead II as the respiration lead, base impedance line as 500  $\Omega$ ; delta impedance as 1  $\Omega$ , respiration rate as 20 rpm.
  3. Verify that the Resp wave is displayed without any distortion and the displayed Resp value is within  $20 \pm 1$  rpm.

#### NOTE

- 
- **The Resp functionality for the TMS60 telemetry monitoring system is supported by the CMS whose version is 03.00 or above.**
-



## 6.2.3 SpO<sub>2</sub> Test

Tool required:

- None

Follow this procedure to perform the test:

1. Connect an adult SpO<sub>2</sub> sensor to the SpO<sub>2</sub> connector of the transmitter.
2. In the main menu, select **Patient Info** and set **Patient Category** to **Adult** on the transmitter
3. Measure SpO<sub>2</sub> on your finger. (Assume that you stay healthy)
4. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO<sub>2</sub> is within 95%-100%.
5. Remove the SpO<sub>2</sub> sensor from your finger and make sure that an alarm of SpO<sub>2</sub> Sensor Off is triggered.

Measurement accuracy verification:

The accuracy of Masimo and Nonin SpO<sub>2</sub> modules has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.

### NOTE

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

## 6.2.4 NIBP Tests

Perform NIBP accuracy test and leakage test at the BP10.

### NOTE

- **The NIBP functionality for the TMS60 telemetry monitoring system is supported by the CMS whose version is 03.00 or above.**

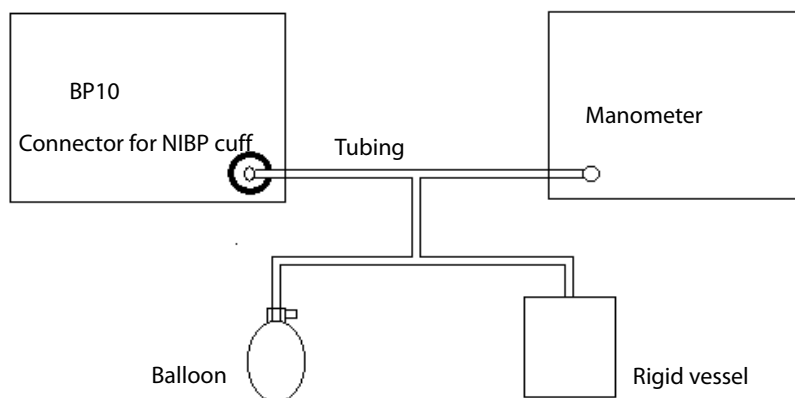
### 6.2.4.1 NIBP Accuracy Test

Tools required:

- T-shape connector
- Appropriate tubing
- Balloon pump
- Rigid Vessel with volume  $500 \pm 25$  ml
- Reference manometer (calibrated with accuracy equal to or greater than 1 mmHg)

Follow this procedure to perform the test:

1. Connect the equipment as shown below.



2. Before inflation, the reading of the manometer should be 0. If not, turn off the balloon pump to let the whole airway open to the atmosphere. Turn on the balloon pump after the reading is 0.
3. On the main menu of the BP10, select **System** → **Maintenance** → **NIBP Accuracy Test**.

4. Check the manometer values and the values displayed on the BP10. Both should be 0mmHg.
5. Raise the pressure in the rigid vessel to 50 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable.
6. Compare the manometer values with the values displayed on the BP10. The difference should be 3 mmHg. If it is greater than 3 mmHg, contact your service personnel.
7. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable and repeat step 6.

---

**NOTE**

- **You can use an NIBP simulator to replace the balloon pump and the reference manometer to perform the test.**
  - **You can use an appropriate cylinder and a cuff instead of the rigid vessel.**
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#### **6.2.4.2 NIBP Leakage Test**

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**NOTE**

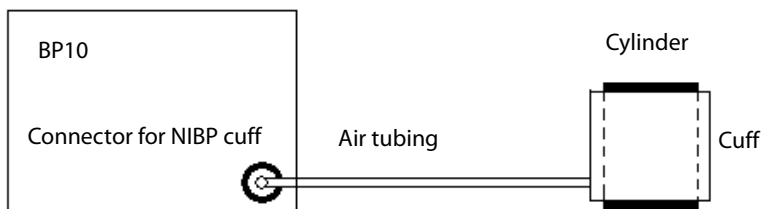
- **You should perform NIBP accuracy test and make sure the test result is pass prior to NIBP leakage test.**
- 

Tools required:

- NIBP cuff for adult patient
- Appropriate tubing
- Cylinder

Follow this procedure to perform the test:

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



4.

On the main menu of the BP10, select **System** → **Maintenance** → NIBP Leakage Test. The NIBP parameter area displays Leakage Testing....

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

You can either perform a manual leakage test:

1. Perform Steps 1 to-4 in the **NIBP Accuracy Test** section.
2. Raise the pressure in the rigid vessel to 250 mmHg with the balloon pump. Then, wait for 5 seconds to let the measured values becoming stable.
3. Record the current pressure value and meanwhile use a time counter to count time. Then, record the pressure value after counting to 60s.
4. Compare the two values and make sure the difference should not be greater than 6 mmHg.

## 6.3 Miscellaneous Tests

### 6.3.1 Visual Inspection

Perform a visual inspection before the equipment is first used every day. Verify that the equipment meets the following requirements:

- The housing and display screen are free from cracks or other damages.
- All keys function properly.
- Connectors are not loose, cracked, or bent and cables have no cuts, nicks, or fraying.
- ECG leadwires are securely connected with the equipment.
- Battery pack is installed and has sufficient charge.
- Chest electrodes are free from cracks and limb electrodes can properly clamp.

### 6.3.2 Power-On Test

This test is to verify that the transmitter can power up correctly.

Follow this procedure to perform the test:

1. Install a lithium-ion rechargeable battery pack or AA batteries into the transmitter's battery compartment.
2. Press the Power on/off key to turn on the transmitter. The cyan alarm light will momentarily turn on to indicate that the device is starting.

When the boot screen appears, the device sounds a beep, and the alarm light serially turns red, yellow, cyan, and then off. This indicates that the alarm system functions correctly. When the boot screen disappears, the main screen displays and the device finishes starting.

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#### WARNING

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- **Check that visual and auditory alarm signals are presented correctly when the equipment is powered on. Do not use the equipment for any monitoring procedure on a patient if you suspect the equipment is not working properly or if the equipment is mechanically damaged. Contact your service personnel or Mindray.**
- 

### 6.3.3 Nurse Call Test

Follow this procedure to perform the test:


1. Press the nurse call button  on the transmitter.
2. Observe corresponding display on the CMS. If a nurse call icon appears, it indicates that the nurse call test passes.

### 6.3.4 Electric Safety Test

Refer to A *Electrical Safety Inspection* for details.

### 6.3.5 Network Print Test

Follow this procedure to perform the test:

1. Power on the transmitter.
2. Connect the transmitter to the CMS wirelessly.
3. Press  to enter the main menu of the transmitter or swipe your finger up from the bottom of the main screen to display the quick keys area.
4. Select **Print**.
5. Verify that the network printer shall print out a report correctly.

### 6.3.6 Battery Check

Refer to **11 Battery** in *BeneVision TMS60 Telemetry Monitoring System Operator's Manual (P/N 046-007056-00)* for methods to check battery status and verify battery supply specifications.

### 6.3.7 Tests in Service Menu


Refer to 6 Service Menu for test items in the service menu.

# 7 Service Menu

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In the **Service** menu, you can update TD60 software, check the service log, perform the factory test, and check the system software version.

## 7.1 Entering the Service Menu

1. Press  to enter the main menu
2. Select **Maintenance**.
3. Input the passcode, and then tap **Accept**.
4. Select **Service**.
5. Input the passcode, and then tap **Accept**.

## 7.2 Performing Software Update

Software upgrade must be performed by Mindray. Please contact Mindray for software upgrade.

## 7.3 Service Log

The service log stores and displays the error codes.

To check the service log, select **Service Log** in the **Service** menu.

For details on the error codes, refer to **7.1.3 Error Codes**.

## 7.4 Factory Test

To enter the **Factory Test** menu, select **Factory Test** from the **Service** menu.

### 7.4.1 Device Test

The option is to do the device self-test.

1. In the **Factory Test** menu, select **Device Test**.
2. Tap **Start**.

The device self-tests including device test, MO module test, and Bluetooth module test start.

The test results will correspondingly display to the right of the test. If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.2 Screen Test

This option is to test the screen.

1. In the **Factory Test** menu, select **Screen Test**.
2. Tap the screen in turn.

If the screen color turns red, green, cyan, white, and then off, tap **Pass**. If the screen color is not displayed in this way, tap **Fail**.

If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.3 Touch Screen Test

This option is to test the touch screen.

1. In the **Factory Test** menu, select **Touch Screen Test**.
2. Touch the white blank screen, and move around.





If a touch line appears on the screen, tap **Pass**.

If a touch line does not appear on the screen, tap **Fail**. If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.4 Keys Test

This option is to test the hard keys.

1. In the **Factory Test** menu, select **Keys Test**.
2. Press each key to test.

- ◆ Press  and the screen displays "Power Key is Pressed Shortly"; or keep pressing  and the screen displays "Power Key is Pressed Long".
- ◆ Press  and the screen displays "Nurse Call Key is Pressed".
- ◆ Press  and the screen displays "Menu Key is Pressed".

3. Tap **Pass** to finish the keys test.

If any key test fails, refer to **6.4.10 Processing Method**.



### 7.4.5 Sound & Light Test

This option is to test speaker, and red, yellow, cyan LEDs.

1. In the **Factory Test** menu, select **Sound & Light Test**.
2. Select **Sound Test**. If the speaker sounds, tap **Pass**.
3. Select **Red Light Test**. If the red light flickers, tap **Pass**.
4. Select **Yellow Light Test**. If the yellow light flickers, tap **Pass**.
5. Select **Cyan Light Test**. If the cyan light flickers, tap **Pass**.

### 7.4.6 USB Interface Test

This option is to test USB interface.

1. Insert a USB drive.
2. In the Factory Test menu, select USB Interface Test.

If the test is completed successfully, tap Pass. If it fails, refer to **6.4.10 Processing Method**.

#### NOTE

- 
- The upgrade tools kit (Dubhe) P/N 115-033434-00 is required to perform the USB interface test.
- 

### 7.4.7 System Watchdog Test

This option is to test the system watchdog.

1. In the **Factory Test** menu, select **System Watchdog Test**.
2. Tap **Yes**. Then, the device will be restarted. If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.8 MO Module Watchdog Test

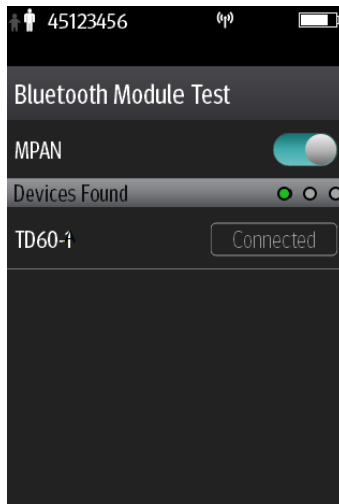
This option is to test the MO module watchdog.

1. In the **Factory Test** menu, select **MO Module Watchdog Test**.
2. Tap **Yes**. The device will be restarted. If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.9 Bluetooth Module Test

This option is to test the Bluetooth module. Two or more TD 60 devices are required for this test. To show the test procedures clearer, we use two TD 60 devices which are called as TD 60-2 and TD 60-1 hereinafter.

1. For TD 60-2, in the **Factory Test** menu, select **Bluetooth Module Test**.
2. For TD 60-1, in the **Maintenance** menu, select **Defaults** and then select **Import Device Settings**.
3. Slide the MPAN on/off switch of TD 60-2 to right. Then, TD 60-2 starts searching devices.
4. Tap **Connect** when TD 60-1 was found. When they are connected successfully, the connection status on the right of TD 60-1 will be changed to Connected, as shown in Figure 6-1.



**Figure 6-1 Example of Bluetooth Module Test Screen**

If the test fails, refer to **6.4.10 Processing Method**.

### 7.4.10 Processing Method

If the factory test fails, please contact your service personnel or Mindray.

## 7.5 Checking System Software Version

In the **Service** menu, select **System Software Version**.

The screen displays the software version of development as follows:

Format: xx.xx.xx.xx.

Compile Time: Month day, year

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# 8 Troubleshooting

## 8.1 Telemetry Monitoring System Problems

The section describes the troubleshooting about the transmitter, and the receiver.

### 8.1.1 Troubleshooting Tools

- Receiver
- Transmitter

### 8.1.2 Technical Alarm Messages

Alarm Message	Possible Cause	Processing Method
Low Battery	The battery charge of the transmitter is to be depleted.	Replace the battery of the transmitter.
No RF signal (The receiver does not receive valid data for consecutive 5 seconds)	<ol style="list-style-type: none"><li>1. The battery charge of the transmitter is to be depleted.</li><li>2. The transmitter in the dormant status.</li><li>3. The patient is out of the antenna array coverage area.</li><li>4. There is an error in the antenna array.</li><li>5. The transmitter is not connected with the ECG cable.</li><li>6. The receiver frequency is not paired with the transmitter frequency.</li><li>7. There is an IP addresses conflict.</li></ol>	<ol style="list-style-type: none"><li>1. Check if the battery charge of the transmitter is depleted.</li><li>2. Check if the corresponding transmitter is in dormant status.</li><li>3. Check if the patient is out of the coverage area.</li><li>4. Check if there is an error in the antenna array. Refer to <b>7.1.5.1 Determining RF Signal Interference</b> and <b>7.1.5.2 Low RSSI Signal Check</b> for details.</li><li>5. Check if the transmitter is connected with the ECG cable properly.</li><li>6. Check if the receiver frequency configuration that is consistent with the transmitter.</li><li>7. Reset the IP addresses at the CMS.</li></ol>
RF interference (The transmitter	<ol style="list-style-type: none"><li>1. The transmitter signal is weak.</li></ol>	<ol style="list-style-type: none"><li>1. Check if the Patient is at the edge of the coverage area or</li></ol>

Alarm Message	Possible Cause	Processing Method
receives three consecutive wrong frames.)	2. There is RF interference around.	in an elevator. Remove behind a reinforced concrete wall. 2. Check for RF Interference. Refer to <b>7.1.5.1 Determining RF Signal Interference</b> and <b>7.1.5.2 Low RSSI Signal Check</b> for details.
Wrong Channel	1. The channel name for the transmitter is incorrect. 2. The receiver receives the data sent from some other transmitter which does not belong to the system. 3. The same frequency is allocated to different transmitters.	1. Reset the channel name at the CMS. 2. Check if there is another telemetry monitoring system in the vicinity. Re-configure the frequency. Refer to <b>7.1.5.3 Programming Telemetry Packs</b> for details. 3. Check the frequencies of all the transmitters. If duplicated frequency exists, re-allocate the frequency.
Receiver Offline	1. The receiver is not powered on. 2. The receiver cannot be connected to the CMS.	1. Check if the receiver is powered on; 2. Check if the network cable is properly connected.
SpO <sub>2</sub> No Pulse	The SpO <sub>2</sub> sensor failed to obtain pulse signal.	Check the patient's condition and change the sensor application site. If the error persists, replace the sensor.
Transmitter key error	The transmitter detects that a key has been pressed for over 10 seconds.	Check if the key is pressed by a foreign object or jammed.
Receiver Fault	An error occurred to the receiver.	Restart the receiver.
MPAN Disconnected	The MAPN is disconnected.	1. Enable the MPAN switch. 2. Put the TD60 and BP10 closer to each other.
NIBP Cuff or Airway Leak	The NIBP airway may leak air.	1. Verify that the cuff is properly connected. 2. Verify that the airway does not leak air.
NIBP Timeout	Time is out. The measurement time is over 120 seconds.	Check the patient's condition and NIBP connections. Replace the cuff.

### 8.1.3 Error Codes

Error Code	Message Displayed on the Screen	Possible Cause	Processing Method
001	Module Selftest Err(0xff)	The parameter board MCU is faulty.	Power off and then on the transmitter to see if the fault disappears. If the fault persists, change the parameter board.
002	ECG ASIC Init Err	The ECG ASIC chip is faulty.	Power off and then on the transmitter to see if the fault disappears. If the fault persists, change the parameter board.
003	ECG ASIC 3.3V Err	The power supply for the parameter board is abnormal.	Power off and then on the transmitter to see if the fault disappears. If the fault persists, change the parameter board.
004	SPO2 Init Err	<ol style="list-style-type: none"> <li>1. The SpO<sub>2</sub> module is faulty.</li> <li>2. The SpO<sub>2</sub> module is not supported by the transmitter.</li> <li>3. The SpO<sub>2</sub> connection circuit of the transmitter is abnormal.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replug the SpO<sub>2</sub> module.</li> <li>2. Replace with a SpO<sub>2</sub> module supported by the transmitter.</li> <li>3. Replace the SpO<sub>2</sub> connection circuit or the parameter board.</li> </ol>
006	Bluetooth Init Err	<ol style="list-style-type: none"> <li>1. The Bluetooth firmware is abnormal.</li> <li>2. The Bluetooth firmware is faulty.</li> <li>3. The power supply for the Bluetooth module is</li> </ol>	<ol style="list-style-type: none"> <li>1. Power off and then on the transmitter to see if the fault disappears.</li> <li>2. Upgrade the Bluetooth firmware.</li> <li>3. Replace the parameter board.</li> </ol>

Error Code	Message Displayed on the Screen	Possible Cause	Processing Method
		abnormal.	
008	Battery Comm Err	<ol style="list-style-type: none"> <li>1. Batteries are not installed properly.</li> <li>2. The battery contacts inside the battery compartment of the transmitter are damaged or distorted.</li> <li>3. Batteries are faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reinstall batteries per instructions in Operator's Manual.</li> <li>2. Check that the battery contacts are not depressed. If they are depressed, pull the battery contacts to the original positions.</li> <li>3. Replace with new batteries.</li> </ol>
011	Power 2.5V Err(0xff)	<ol style="list-style-type: none"> <li>1. Battery voltage is low.</li> <li>2. The power supply circuit of the parameter board is abnormal.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace with new batteries.</li> <li>2. Replace the parameter board with a known good one.</li> </ol>
020	ECG Selftest(0xff)	The ECG detection circuit is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources and then restart it.</li> <li>2. Replace the parameter board.</li> </ol>
021	Module Watchdog Err	The watchdog circuit on the parameter board is abnormal.	<ol style="list-style-type: none"> <li>1. Power off and then on the transmitter.</li> <li>2. Replace the parameter board.</li> </ol>
103	RTC Comm Err	<ol style="list-style-type: none"> <li>1. RTC battery is low.</li> <li>2. RTC chip is faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the RTC battery.</li> <li>2. Replace the parameter board.</li> </ol>
104	E2PROM Err	The main control EEPROM is faulty.	Replace the parameter board.
105	ECG Init Err	An error occurred while initializing the	<ol style="list-style-type: none"> <li>1. Move the transmitter away</li> </ol>



Error Code	Message Displayed on the Screen	Possible Cause	Processing Method
		parameter board ECG.	<p>from interference sources and then restart it.</p> <ol style="list-style-type: none"> <li>2. Replace the parameter board.</li> </ol>
106	ECG Comm Stop	Communication between the parameter board and the main control board is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources and then restart it.</li> <li>2. Check the FPC connection between the parameter board and the main control board.</li> <li>3. Replace the parameter board.</li> </ol>
107	ECG Comm Abnormal	Communication between the parameter board and the main control board is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources and then restart it.</li> <li>2. Check the FPC connection between the parameter board and the main control board.</li> <li>3. Replace the parameter board.</li> </ol>
108	ECG COMM Err	Communication between the parameter board and the main control board is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources and then restart it.</li> <li>2. Check the FPC connection between the parameter board and the main control board.</li> <li>3. Replace the parameter board.</li> </ol>

Error Code	Message Displayed on the Screen	Possible Cause	Processing Method
109	SPO2 Init Err	An error occurred while initializing the SpO <sub>2</sub> module.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources.</li> <li>2. Replug the SpO<sub>2</sub> module.</li> <li>3. Replace with a known good SpO<sub>2</sub> module.</li> </ol>
110	SPO2 Comm Stop	Communication between the SpO <sub>2</sub> module and the transmitter is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources.</li> <li>2. Replug the SpO<sub>2</sub> module.</li> <li>3. Replace with a known good SpO<sub>2</sub> module.</li> </ol>
111	SPO2 Comm Abnormal	Communication between the SpO <sub>2</sub> module and the transmitter is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources.</li> <li>2. Replug the SpO<sub>2</sub> module.</li> <li>3. Replace with a known good SpO<sub>2</sub> module.</li> </ol>
112	SPO2 Comm Err	Communication between the SpO <sub>2</sub> module and the transmitter is abnormal.	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources.</li> <li>2. Replug the SpO<sub>2</sub> module.</li> <li>3. Replace with a known good SpO<sub>2</sub> module.</li> </ol>
114	Module Init Err	The parameter board MCU is abnormal.	Replace the parameter board.
115	Module Comm Err	Communication between the parameter board MCU and the main control board is	<ol style="list-style-type: none"> <li>1. Move the transmitter away from interference sources and then restart it.</li> </ol>

Error Code	Message Displayed on the Screen	Possible Cause	Processing Method
		abnormal.	2. Check the FPC connection between the parameter board and the main control board. 3. Replace the parameter board.
116	Main Board Selftest Err	The main board selftest error	1. Power off and then on the transmitter. 2. Replace the main control board.


### 8.1.4 Other Failures

Symptom	Possible Cause	Processing Method
The receiver cannot connect to network.	1. Bad network cable connection 2. The IP address of the receiver is set incorrectly.	1. Replug the network cable of the receiver and make sure that it is connected securely. 2. Connect the receiver to the PC via a network cable. The PC is installed with a telemetry configuration tool. Change the receiver IP address and confirm the change at the PC side. If the IP address of the CMS is set to DHCP, the IP address of the receiver should be set to DHCP. If the IP address of the CMS is set to a static IP, the IP address of the receiver should be set to a static IP in the same network segment.
The telemetry monitoring system cannot connect to the network of the CMS.	1. Incorrect network cable connection. 2. Incorrect IP address setting	1. Check the network cable connection. 2. Configure correct IP address.

Symptom	Possible Cause	Processing Method
The CMS does not display the SpO <sub>2</sub> data.	<ol style="list-style-type: none"> <li>1. The SpO<sub>2</sub> module is not connected to the transmitter.</li> <li>2. There may be error in the SpO<sub>2</sub> module.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect the SpO<sub>2</sub> module to the transmitter.</li> <li>2. If there is an error in the SpO<sub>2</sub> module, replace the SpO<sub>2</sub> module with a new one.</li> </ol>
ECG noise	ECG waveforms are overlapped with the noise interference.	Check that the electrodes are properly attached, the leadwires are secured properly, and the patient does not come into contact with any ungrounded electric device.
ECG signal saturation	The transmitter detects that ECG signal saturation or overload.	<ol style="list-style-type: none"> <li>1. Check if patient has excessive movement.</li> <li>2. Check if the electrodes are in good contact with the skin.</li> <li>3. Check if the electrodes operating time is over the electrode service life.</li> </ol>
Low signal intensity	The signal of the CMS (average value) is less than -75dBm.	Check if the ECG cable is firmly connected to the transmitter. 1.
The AC power indicator on the receiver is off.	<ol style="list-style-type: none"> <li>1. The receiver is not connected to the power.</li> <li>2. The receiver is power off.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check if the receiver is connected to the power.</li> <li>2. Check if the receiver sounds a beep when turn the receiver on.</li> </ol>
Transmitter or SpO <sub>2</sub> module restarting repeatedly.	The battery charge of the transmitter is to be depleted.	Replace the battery of the transmitter.
The TD60 and BP10 are prone to offline.	When the TD60/TM80 and BP10 are secured to the patient, signals may be blocked by the patient's body.	Put the TD60 and BP10 closer.

## 8.1.5 Failure Examinations

### 8.1.5.1 Determining RF Signal Interference

1. Connect a receiver to the antenna array.
2. Turn on the telemetry monitoring system and the CMS. Ensure that the telemetry monitoring system works normally.
3. Remove the battery of interference transmitter; make sure its RSSI in the telemetry window of the CMS is not higher than 130 (-105dBm). If the RSSI is higher than 130 (-105dBm), use the CMS configuration tool to scan all of the frequencies, and choose a frequency, of which the signal is lower than -105dBm, and program it to the interference transmitter.
  - ◆ Method to enter the telemetry window of the CMS (version earlier than 03.00) : select the **System Setup** button → select the **Admin Setup** button → select the **Telemetry** tab → select the **Frequency Setup** section
  - ◆ Method to enter the telemetry window of the CMS (version 03.00 or above) : select the system menu area  in the upper left corner of the CMS screen to enter the **System Setup** menu → enter the passcode → select the **Telemetry** tab → enter the passcode → select the **OK** button
4. If there is more than one transmitter with interference, resolve each transmitter one by one according to step 2.

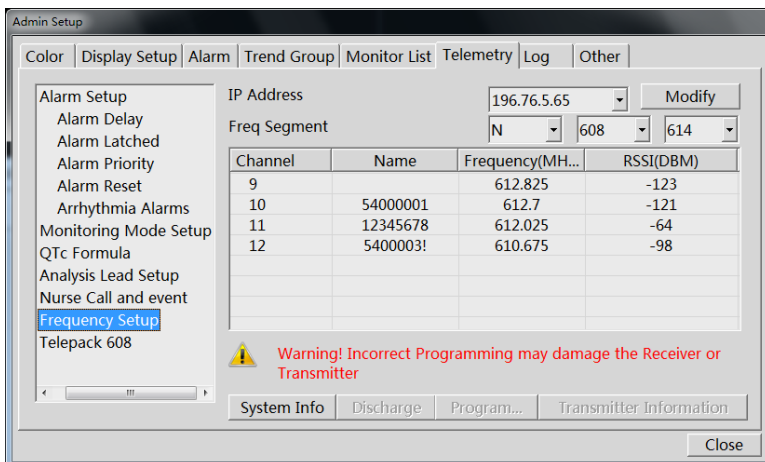
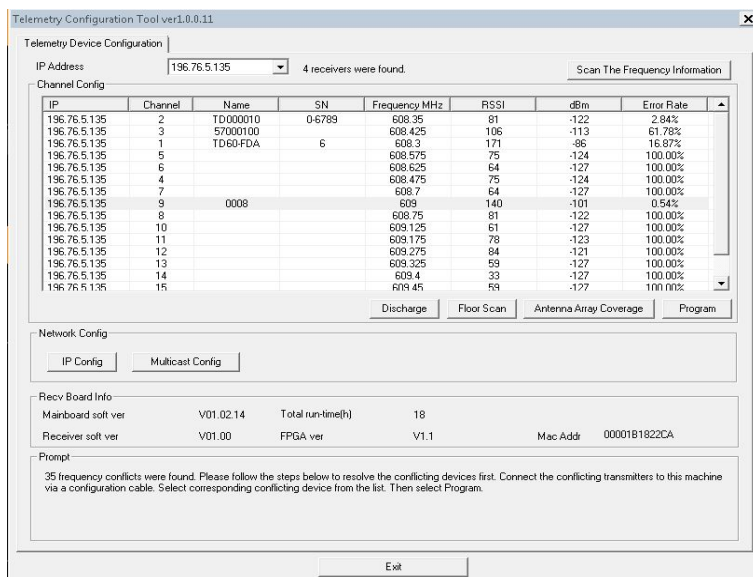


Figure 8-1 Example of Telemetry Tab in the CMS (Version Earlier than 03.00)



**Figure 8-2 Example of Telemetry Tab in the CMS (Version 03.00 or Above)**

### 8.1.5.2 Low RSSI Signal Check

1. When a transmitter has a low signal strength indication, access the **“Telemetry”** tab and check the RSSI to see if it is low.
2. Choose a known good transmitter whose RSSI is above -75dBm.
3. Program the known good transmitter to the frequency of the suspected bad transmitter and vice versa.
4. If the low RSSI follows the transmitter, the transmitter is defective. If the low RSSI stays with the channel, the receiver board is defective.

### 8.1.5.3 Programming Telemetry Packs

#### Programming Telemetry Packs at the CMS (Version Earlier than 03.00)

1. Connect one end of the dedicated programming cable to the serial port 1 (COM1) on the CMS, and the other end to the SpO<sub>2</sub> connector on the transmitter.

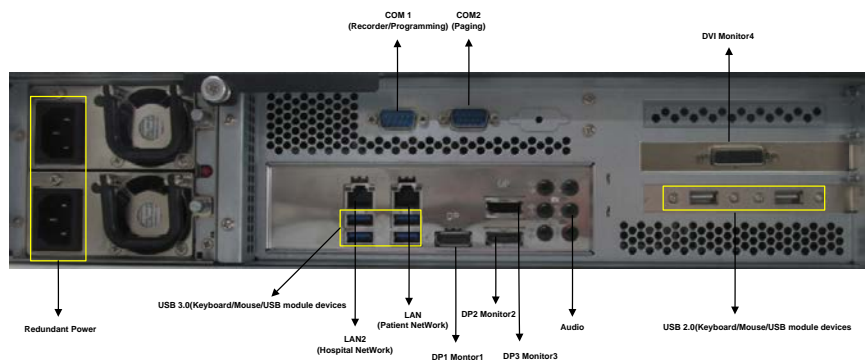
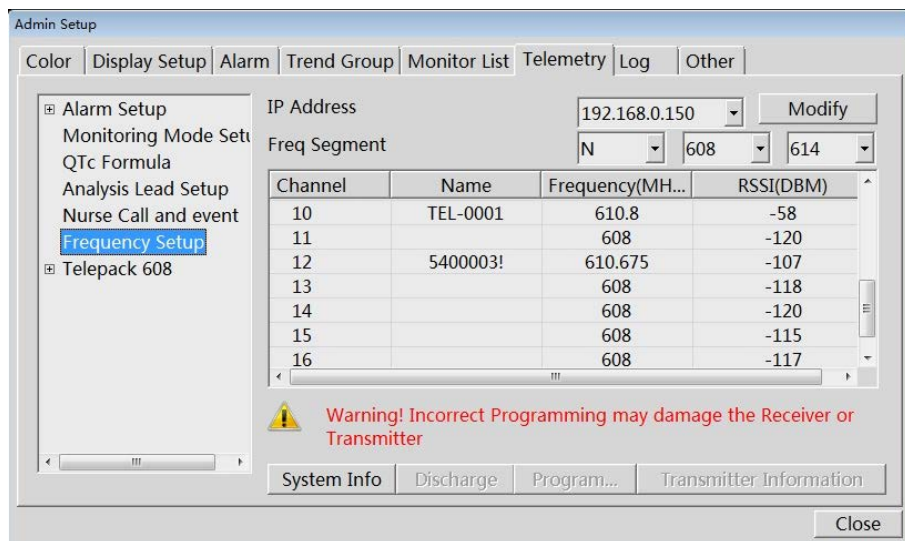


Figure 8-3 CMS Host Rear View

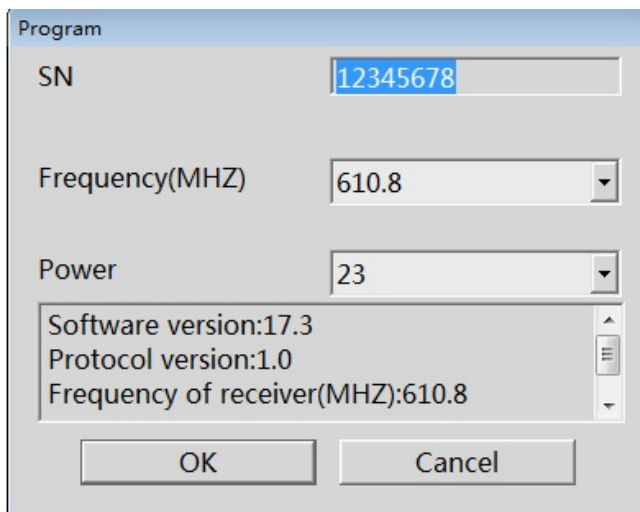
2. At the CMS, select **System Setup** and then select **Admin Setup**. After entering a passcode, tap **OK** to enter the “**Admin Setup**” window.
3. Select the **Telemetry** tab, and then select **Frequency Setup**. The “**Telemetry**” tab displays as shown in Figure 8-4.



**Figure 8-4 Example of Telemetry Tab in the CMS (Version Earlier than 03.00)**

4. View the transmitter SN number, and remember the last eight digitals, such as 12345678.
5. In the **"Frequency Setup"** field, select the desired transmitter name, such as **"TEL-0001"**, from the **"Monitor Name"** column.
6. Tap **Program** to display the **"Program"** window as shown in Figure 8-5.





**Figure 8-5 Example of Program Window in the CMS (Version Earlier than 03.00)**

7. In the **"Frequency"** input field, enter the frequency as desired.
8. Tap **OK** to start programming.

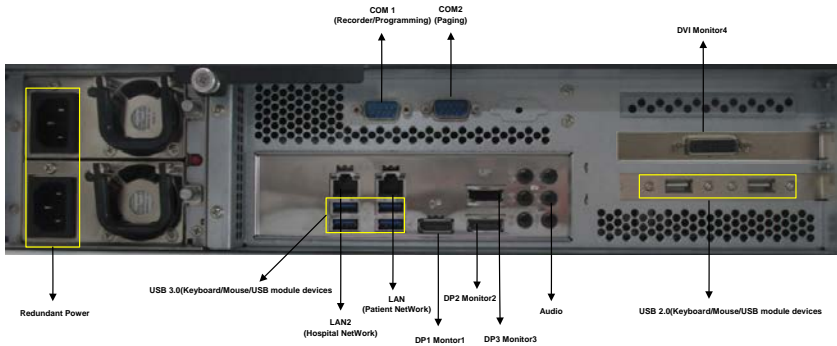
#### **NOTE**

- 
- **The power is 23. Do not change the power level.**
- 

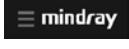
9. After the programming succeeds, the prompt message "Frequency setup completed successfully" displays.
10. Tap **OK** to close the dialog. So far the programming of a pair of transmitter and receiver is finished.  
If you want to program another pair of transmitter and receiver, repeat the above step 6-10.

## Programming Telemetry Packs at the CMS (Version 03.00 or Above)

1. Connect one end of the dedicated programming cable to the serial port 1 (COM1) on the CMS, and the other end to the SpO<sub>2</sub> connector on the transmitter.



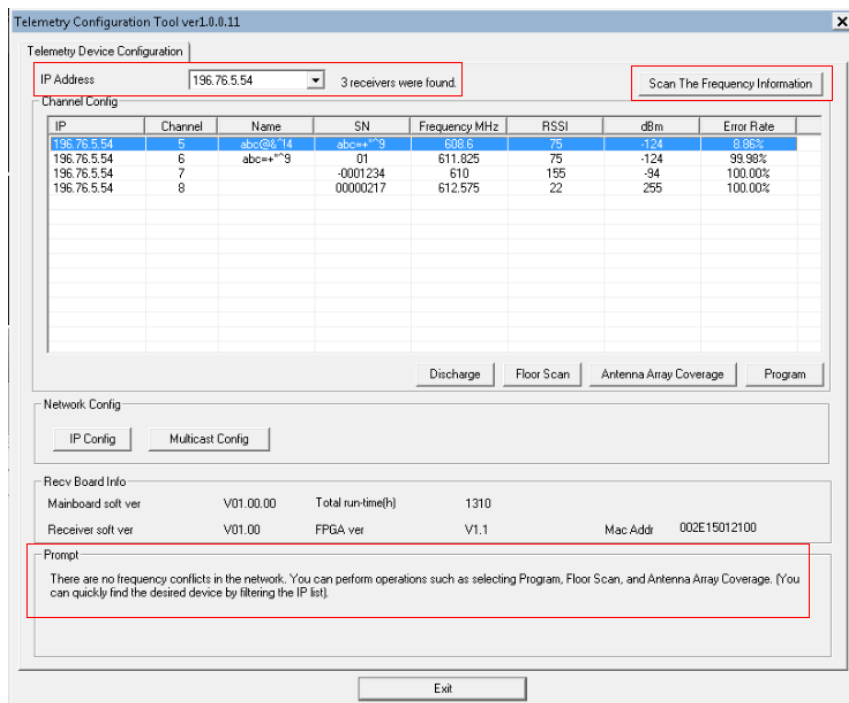
**Figure 8-6 CMS Host Rear View**

2. Select the system menu area  in the upper left corner of the CMS screen to enter the **System Setup** menu → enter the required passcode → tap **OK** → select the **Telemetry** tab → enter the required passcode → tap **OK**.
3. Select **Frequency Setup** and then click **Frequency Setup**, as shown in Figure below.



4. After tapping **Frequency Setup**, the window of **Telemetry onfiguration Tool** displays. By tapping **Scan the Frequency Information**, you can check the information of all the receivers connected to the CMS. By select the **IP Address** of the receiver you want to check, such as "196.76.5.54", you can check the channel information corresponding to the selected receiver. If there are any

frequency conflicts, the number of these frequency points will be shown. If not, the prompt "There are no frequency conflicts in the network" displays. As shown as below.

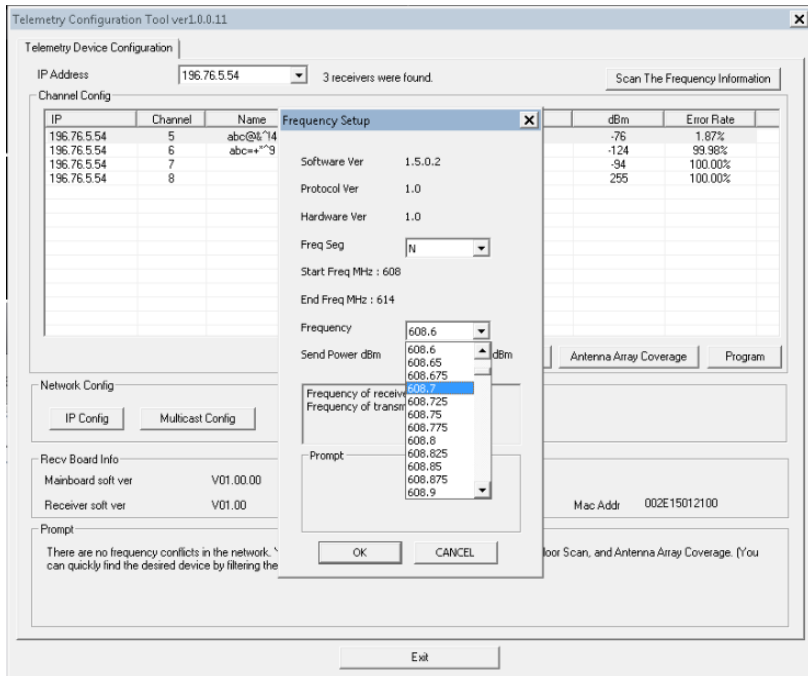


**Figure 8-7 Example of the Telemetry Configuration Tool**

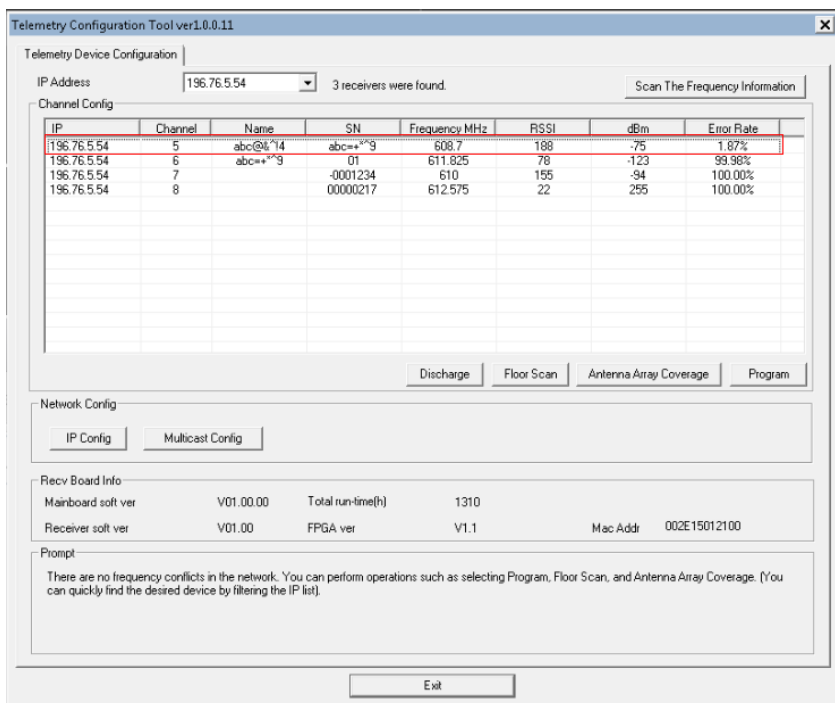
5. View the information of the transmitter, such as SN number. Select one of the transmitters and then tap **Program**. When the prompt window "Please ensure this channel is not used to monitor patients" displays, tap **OK**. Then the following window displays as shown below.



6. In the **"Frequency"** input field, enter the desired frequency, for example: 608.7MHz, as shown as Figure



7. Tap **"OK"** to finish programming.
8. After the programming succeeds, the prompt message "Frequency setup completed successfully" displays and the frequency of the channel has been changed successfully.

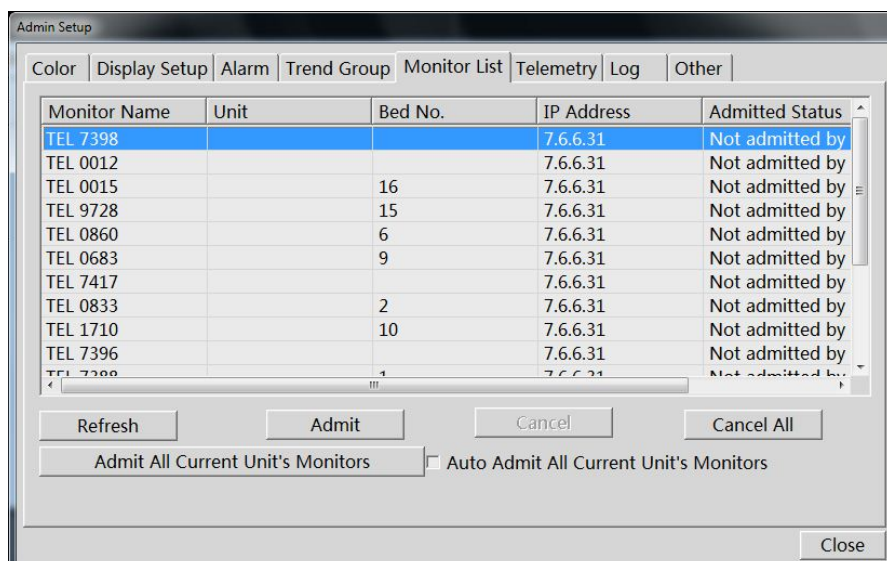


#### 8.1.5.4 Admitting the Transmitter

After programming the telemetry packs, you can continue to admit the transmitter at the CMS.

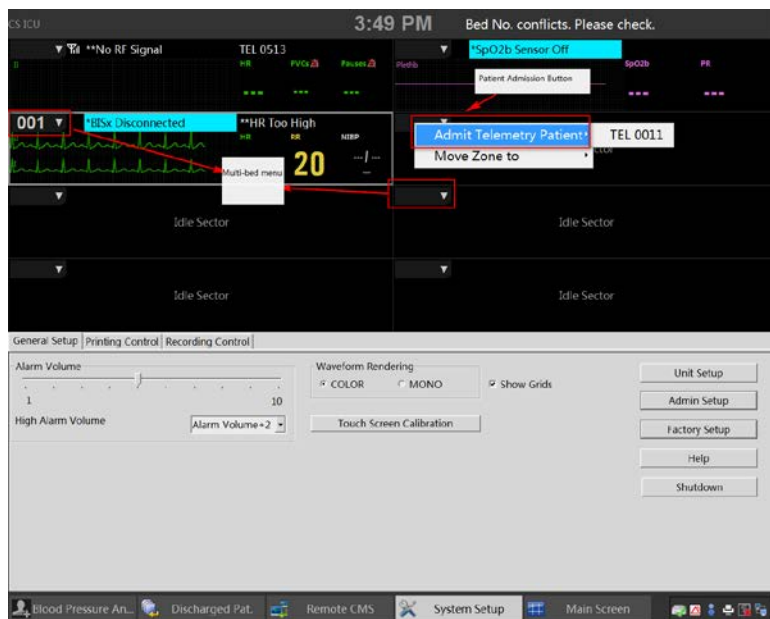
#### Admitting the Transmitter at the CMS (Version Earlier than 03.00)

1. In the “**Admin Setup**” window, select the “**Monitor List**” tab. The “**Monitor List**” tab displays, as shown in Figure 8-8.



**Figure 8-8 Example of the Monitor List Tab**

2. Select your desired transmitter name from the “Monitor Name” column, such as TEL 7398.
3. Tap **Admit**.
4. Click the ☒ button to enter the multi-bed menu and then select **Admit Telemetry Patient** by clicking the ☒ patient admission button. Then, the patient will be admitted successfully.



**Figure 8-9 Example of Admit Telemetry Patient**

## **WARNING**

- If frequencies of different transmitters in one area are the same, malfunction may occur.

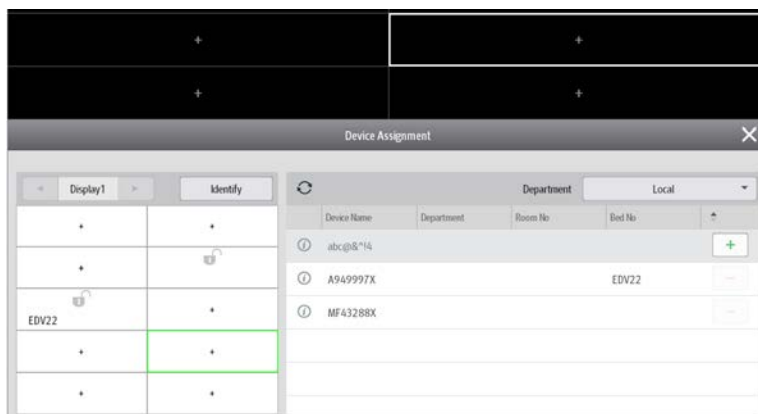
## **NOTE**


- Do not admit one transmitter at different central stations.
- Before configuring transmitters, plan transmitter frequencies properly by following instructions in this chapter and create a list that establishes a one to one correspondence between transmitters and frequencies to avoid frequency conflicts. This list should contain Telemetry Device SN, Telemetry Device ID, Department, Central Station Network IP, and Telemetry Device Frequency points. Then configure transmitters in strict accordance with this list.
- If you need to change a transmitter frequency, observe the frequency points in the list and make sure that the frequency after change does not conflict with frequencies for other transmitters. Please configure the frequency at the central station where the transmitter was admitted last time.

## Admitting the Transmitter at the CMS (Version 03.00 or Above)

After programming the telemetry packs, you can continue to admit the transmitter at the CMS.

1. Select the system menu area  in the upper left corner of the CMS screen to enter the **System Setup** menu → enter the required passcode → tap **OK** → select the **Device Management** tab → enter the required passcode → tap **OK** → select the **Device Assignment** tab to enter the **Device Assignment** screen.



2. Select an idle patient sector on the left of the screen.
3. Check the list of the WMTS devices on the right of the screen. Then tap the button  besides the desired transmitter to admit the transmitter. After successfully the transmitter is admitted successfully, the parameter data and waveforms such as ECG waveform will be displayed on the CMS.

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### WARNING

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- **If frequencies of different transmitters in one area are the same, malfunction may occur.**
-



### 8.1.5.5 Discharging the Transmitter Channel/Frequency from the CMS

#### Discharging the Transmitter from the CMS (Version Earlier than 03.00)

1. Connect one end of the dedicated programming cable to the serial port 1 (COM1) on the CMS, and the other end to the SpO<sub>2</sub> connector on the transmitter.
2. At the CMS, select **Admin Setup** from **System Setup**, input the correct passcode, and then tap **OK** to enter the "Admin Setup" window.
3. Select the **"Telemetry"** tab.
4. In the "Frequency Setup" field, select the desired transmitter name, such as TEL 7398 from the "Monitor Name" column.
5. Tap **Discharge** to release the transmitter from the CMS. Please be noted that if there is still a valid waveform on the transmitter, the transmitter will be connected to the CMS automatically after a patient is discharged from the CMS.


#### Discharging the Transmitter from the CMS (Version 03.00 or Above)

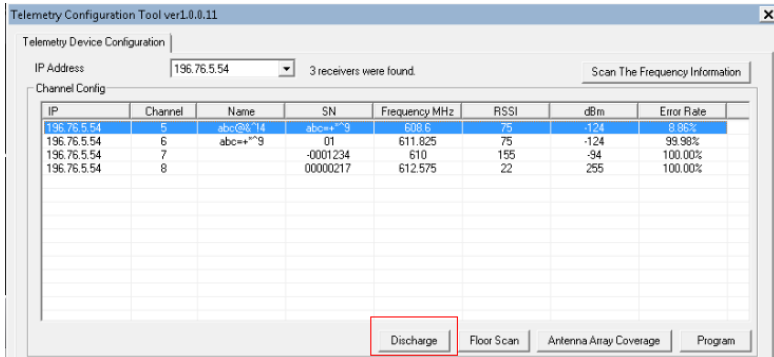
There are two ways to discharge patients.

Method 1:

1. Access the **Discharge Patient** dialog box at the CentralStation/WorkStation in either of the following ways:
  - ◆ On the patient management screen, select the **Discharge Patient** button.
  - ◆ Select the bed number and room number area in the upper left corner of the desired patient sector on the multibed screen and then select **Discharge Patient** from the drop-down list.
2. If you need to print an end case report, select **Print End Case Report**.
3. Select whether to let this monitoring device enter standby mode after the patient is discharged.
4. Select the **OK** button.

## Method 2:

1. Select the system menu area  in the upper left corner of the CMS screen to enter the **System Setup** menu → enter the required passcode → tap **OK** → select the **Telemetry** tab → enter the required passcode → tap **OK** → select the **Frequency Setup** tab.
2. Select the **Frequency Setup** button. The **Telemetry Configuration Tool** window displays.



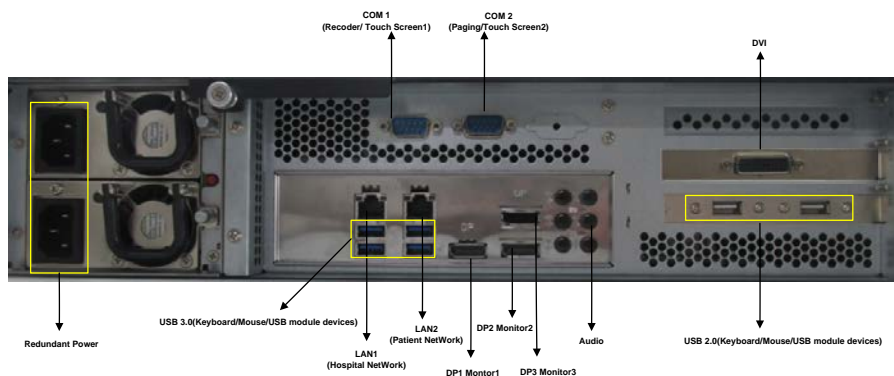
3. Select the desired transmitter.
4. Tap **Discharge**.

### 8.1.5.6 Programming the Replacement Telemetry Packs

#### Programming the Replacement Telemetry Packs at the CMS (Version Earlier than 03.00)

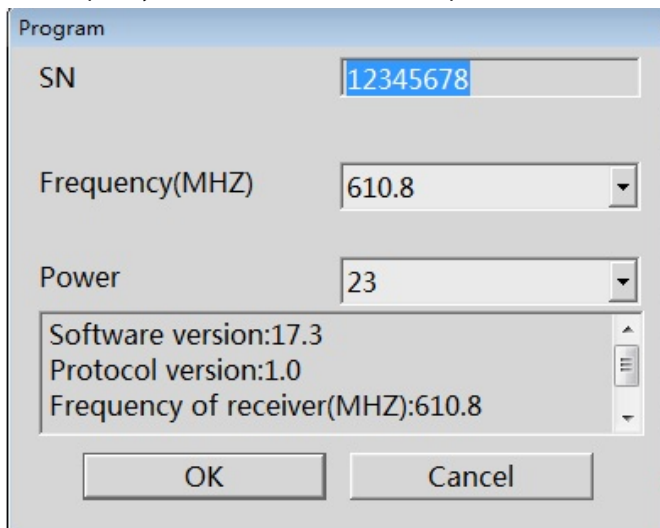
If a telemetry transmitter is damaged, you need to replace a new telemetry transmitter.

1. At the CMS, select **Admin Setup** from **System Setup**, input the correct passcode, and then tap **OK** to enter the “**Admin Setup**” window.
2. Select the “**Telemetry**” tab. The “**Telemetry**” tab displays.
3. In the “**Frequency Setup**” field, select the damaged transmitter name, such as “**TEL 0007**”, from the “**Monitor Name**” column.
4. Tap the **Discharge** button to free the transmitter channel/frequency from the CMS.
5. Connect one end of the dedicated programming cable to the serial port 1 (COM1) on the CMS, and the other end to the SpO<sub>2</sub> connector on the new transmitter.



**Figure 8-10 Example of COM1 Serial Port**

6. Tap the **Program** button to display the “**Program**” window.
7. In the “**Frequency**” input field, enter a frequency that is not being use or the same frequency as the transmitter that was replaced, as shown in Figure 7-6.



**Figure 8-11 Example of Program Window**

8. Tap **OK** to start programming.
9. After the programming succeeds, the prompt message "**Frequency setup completed successfully**" displays.
10. Tap **OK** to close the dialog. So far the programming the replaced telemetry transmitter is finished.

### **Programming the Replacement Telemetry Packs at the CMS (Version 03.00 or Above)**

For details on how to program the replacement telemetry packs at the CMS (version 03.00 or above), see Programming Telemetry Packs at the CMS (Version 03.00 or Above) in Section **8.1.5.3 Programming Telemetry Packs**.

#### **NOTE**

- 
- **For how to admit a transmitter, refer to 8.1.5.4 Admitting the Transmitter.**
-

## 8.2 Central Charger Problems

Symptom	Possible Cause	Processing Method
The AC power indicator is off.	<ol style="list-style-type: none"><li>1. The AC power socket is unavailable.</li><li>2. The connection is not good.</li><li>3. The main board is abnormal.</li><li>4. The AC-DC board is abnormal.</li></ol>	<ol style="list-style-type: none"><li>1. Change another available AC power socket. Check if the AC power indicator is still off.</li><li>2. Correctly reconnect the central charger to the AC power socket. Check if the AC power indicator is still off.</li><li>3. Replace the main board with a new one, check if the AC power indicator is off.</li><li>4. Replace the AC-DC board with a new one.</li></ol>
After the lithium-ion battery is plugged in the charger slot, the corresponding LED indicator is still off.	<ol style="list-style-type: none"><li>1. The battery is not plugged in the charger slot correctly.</li><li>2. The corresponding LED indicator is broken.</li><li>3. The corresponding battery interface board is abnormal.</li><li>4. The main board is abnormal.</li></ol>	<ol style="list-style-type: none"><li>1. Pull the battery from the charger slot, and then re-plug the battery to the end of the charger slot. Check if the LED indicator is still off.</li><li>2. Remove the battery from the current charger slot. Try to use other charger slots. Check if the LED indicator is still off.</li><li>3. Replace the battery interface board with a new one. Check if the LED indicator is still off.</li><li>4. Replace the main board with a new one.</li></ol>

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### WARNING

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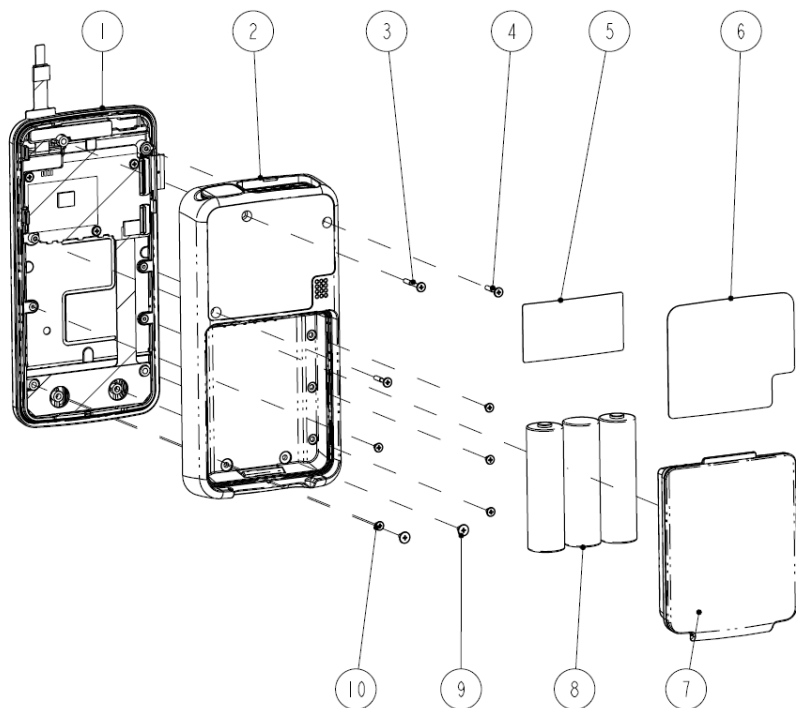
- **To avoid the electric shock, disassemble the central charger after the central charger is disconnected from the AC power source for five minutes later.**
-

**FOR YOUR NOTES**

## 9 Parts

### 9.1 Transmitter (P/N 115-029485-00/115-047566-00)

#### 9.1.1 Exploded View of Main Unit

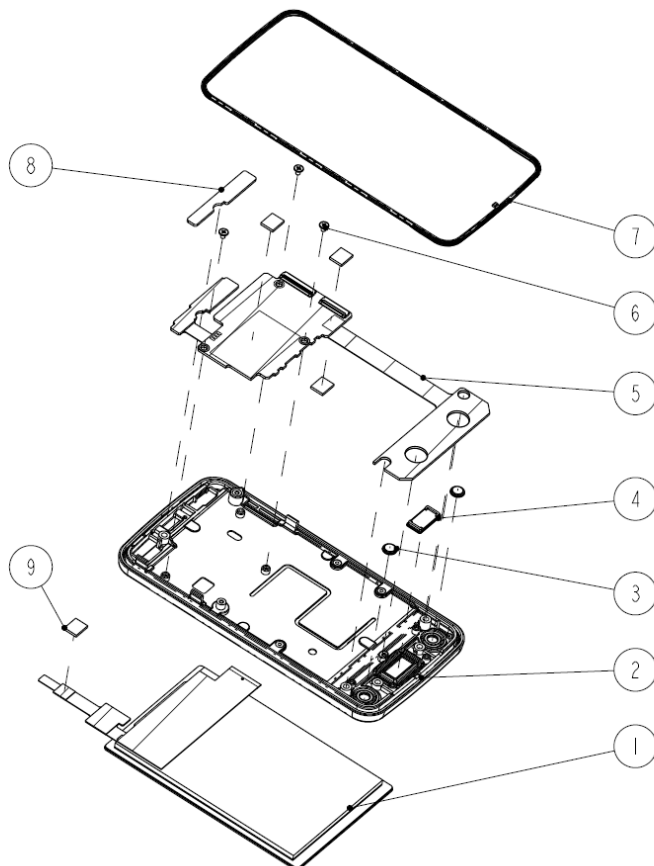


**Figure 8-1 Exploded View of Main Unit**

No.	P/N	Description
1	115-026846-00	Front cover assembly(old plastic, new BT)
	115-053694-00	Front cover assembly(new plastic, new BT)
2	/	Back cover assembly FRU
3	030-000659-00	Screws M1.6x13.3mm color zinc plating
4	030-000660-00	Screws M1.6x9.8mm color zinc plating
5	047-014418-00	Blank label
6	047-014659-00	The host label (FDA)

No.	P/N	Description
7	115-030105-00	Battery frame (2AA) (with 3pcs)
	115-030106-00	Battery frame (3AA) (with 3pcs)
8	0000-10-10902	AA battery
9	030-000658-00	Screws M1.6x3.5mm color zinc plating
10	030-000661-00	Screws M1.6x2.4mm color zinc plating

### 9.1.1.1 Exploded View of Front Cover Assembly (P/N 115-026846-00/115-053694-00)



**Figure 8-2 Exploded View of Front Cover Assembly**

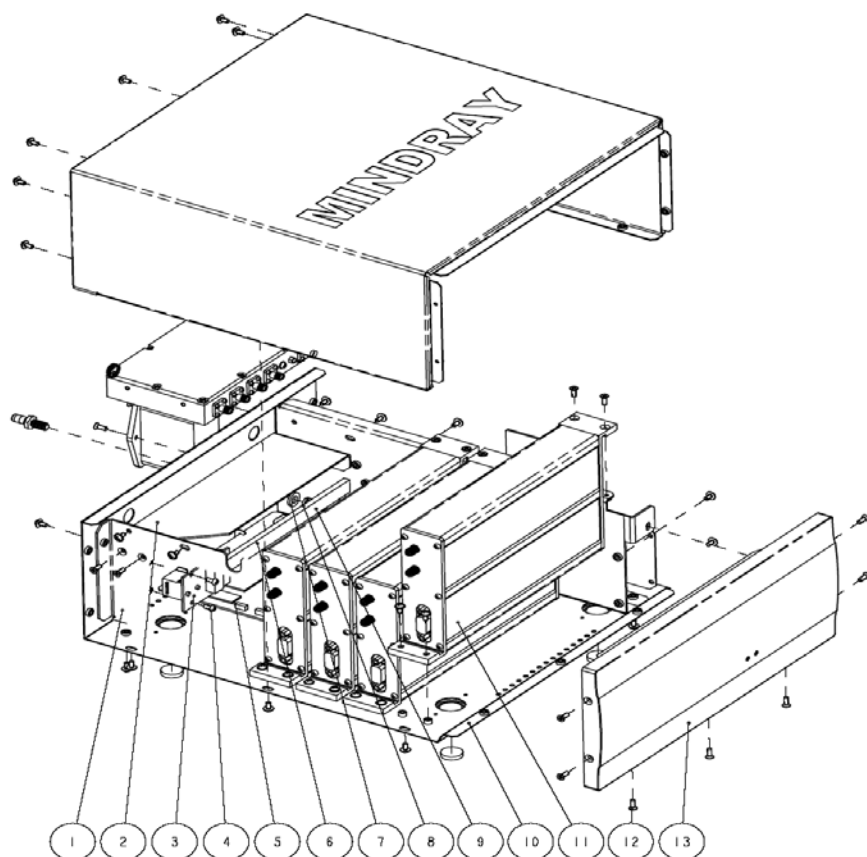


No.	P/N	Description
1	115-032157-00(old plastic) 115-053696-00(new plastic)	LCD TFT 3.5" 480*272 3.3V PCT
2		TP Front Cover
3		TP key gasket (small)
4		TP key gasket (big)
7		Seal
5	051-001986-02	0155 main board PCBA
6	030-000661-00	Screws M1.6x2.4mm color zinc plating
8	048-004511-00	TP warning light PCBA gasket
9	048-004512-00	TP outlet gasket

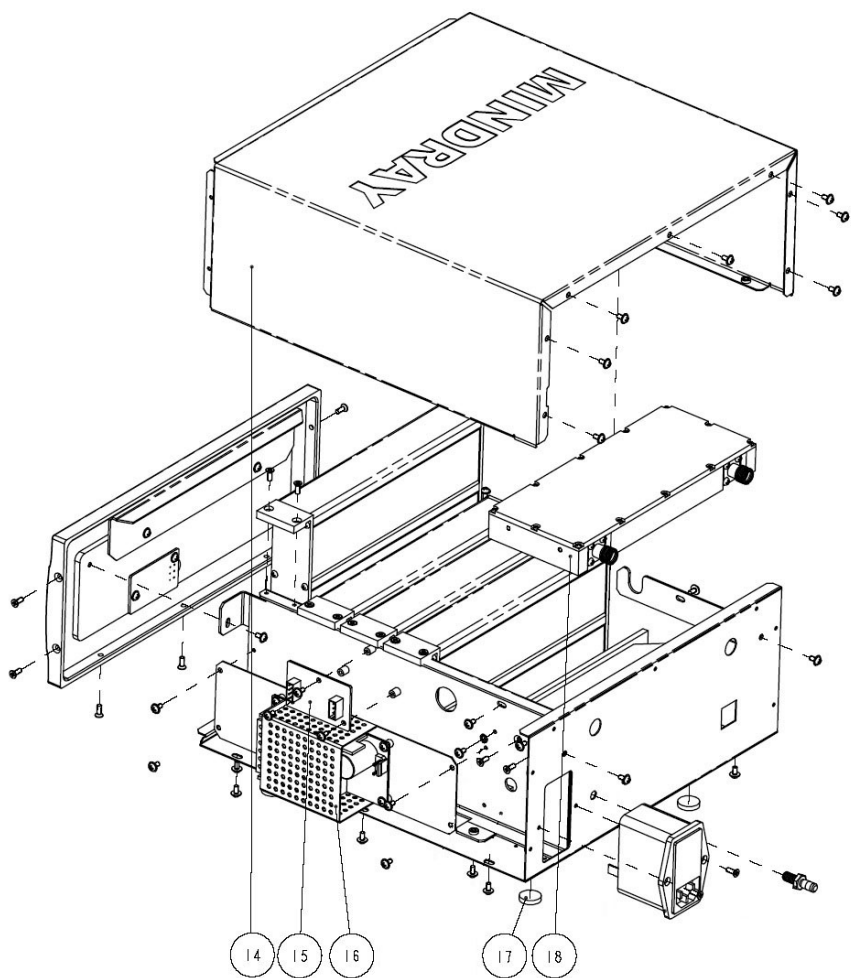
No.	P/N	Description
1	030-000658-00	Screws M1.6x3.5mm color zinc plating
2	042-011883-00	Shield cover
3	050-001539-01	0156 FPC for main and parameter Board
4	051-001705-02	New Telemetry ECG Board PCBA
5	115-032160-00	USB silica gel plug
6		Speaker 0.5W IPX8
7		ECG and SpO <sub>2</sub> socket gasket
8		Speaker bracket
9		TP horn dust network
12		Bluetooth antenna (P/N 024-000750-00)
14		TP back Cover
17		SpO <sub>2</sub> silicone plugs (P/N 049-000782-00)
19	115-032156-00	SpO <sub>2</sub> gasket
10		TP battery sheet metal bayonet mount
11		TP battery snaps shrapnel
13	115-032159-00	TP battery snaps
15		ECG-connector
18	115-032159-00	ECG limit frame
16	051-001709-00	SpO <sub>2</sub> connector assembly
20	047-013564-00	TP insulation sheet

## 9.2 Receiver (P/N 115-029486-00)

### 9.2.1 Exploded View of Receiver



**Figure 8-4 Exploded View-1 of Receiver**



**Figure 8-5 Exploded View-2 of Receiver**

No.	P/N	Description	Quantity
1	0152-20-39747	Main bracket 3 of the receiver	1
2	0152-20-39746	Main bracket 2 of the receiver	1
3	801-0152-00080-00	Ethernet interface board	1
4	M04-002505---	Cross pan head screw M3×6	2
5	801-0152-00085-00	9210 main control board	1
6	900E-20-04894	Dust washer1	1
7	M04-021003---	Plain washer GB97.26	1
8	M04-004504---	Spring washer BF93 6	4
9	M04-004401---	Stainless steel hexagon nut M6	1
10	0152-20-39744	Bottom plate of the receiver	1
11	115-029487-00	4-channel receiver (608-614)	1
12	M04-000405---	Cross recessed countersunk screw M3×8	21
13	045-001817-00	Front cover of the receiver	1
14	0152-20-39948	Upper cover of the receiver	1
15	801-0152-00002-00	Power adapter board	1
16	0152-30-39738	Power assembly of the receiver	1
17	0152-20-39732	Rubber foot of the receiver	1
18	801-0152-00128-00	Amplifying and branching assembly of the receiver (608-614)	

## 9.2.2 Front Cover Assembly of Receiver

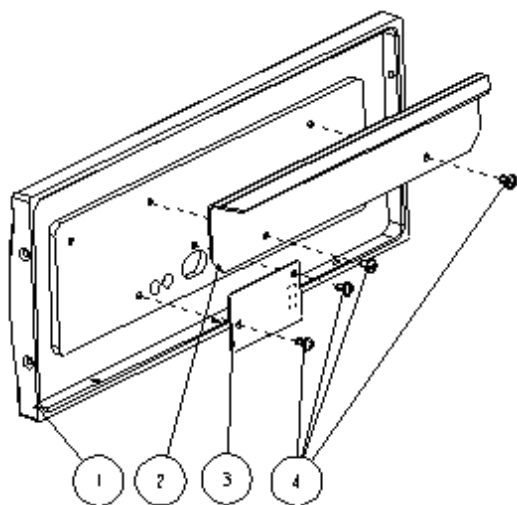


Figure 8-6 Front Cover Assembly of Receiver

No.	P/N	Description	Quantity
1	045-001817-00	Front cover of the receiver	1
2	0152-20-39748	Main bracket 4 of the receiver	1
3	0152-30-39726	LED board	1
4	M04-004012---	Cross pan head screw M3×6	4

9.2.3 Power Assembly of Receiver

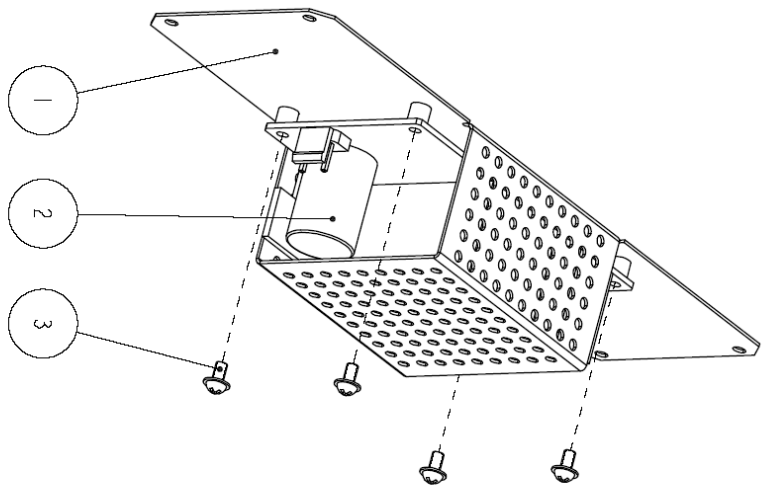
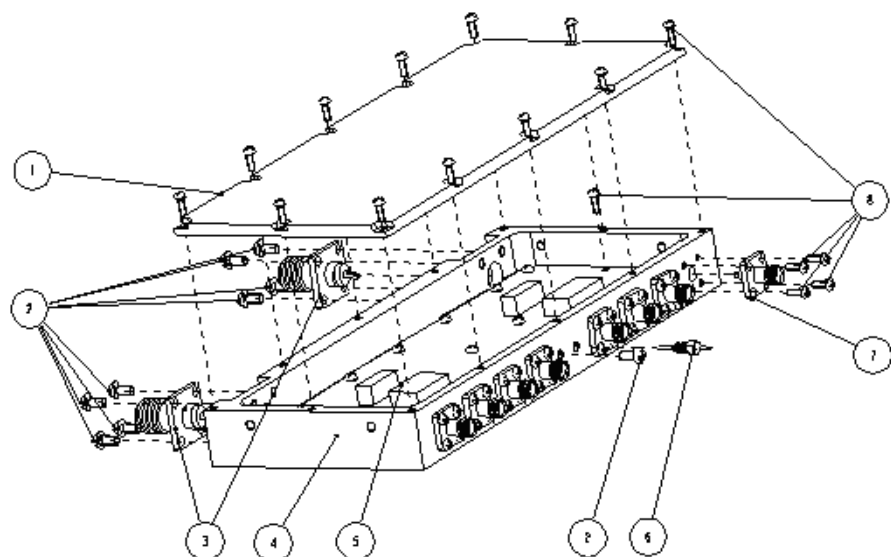


Figure 8-7 Power Assembly of Receiver

No.	P/N	Description	Quantity
1	0152-20-40046	Power cover of the receiver	1
2	801-0000-00009-00	Power module AC/DC 90-264VAC 9VDC	1
3	M04-004012---	Cross pan head screw M3×6	4

## 9.2.4 Amplifying and Branching Assembly of Receiver (P/N 0152-30-39691)

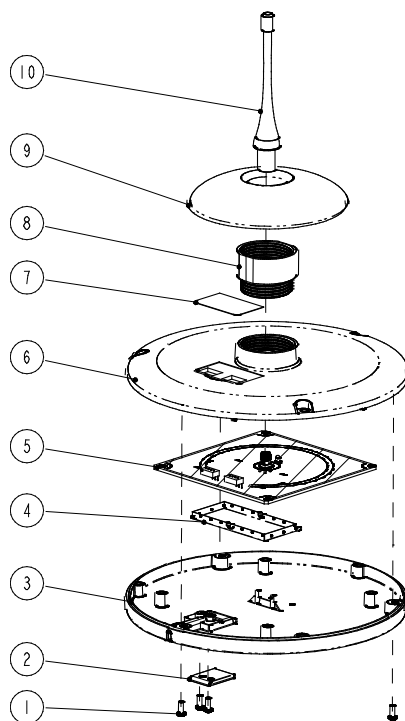


**Figure 8-8 Amplifying and Branching Assembly of Receiver**

No.	P/N	Description	Quantity
1	/	Upper cover of the amplifying and branching assembly of the receiver	1
2	/	Cross pan head screw M3×6	9
3	/	Antenna socket	2
4	/	Bottom cover of the amplifying and branching assembly of the receiver	1
5	/	Amplifying and branching board (185-205)	1
6	/	Feedthrough capacitor	1
7	/	SMA radio frequency socket	8
8	/	Cross pan head screw M2×6	66



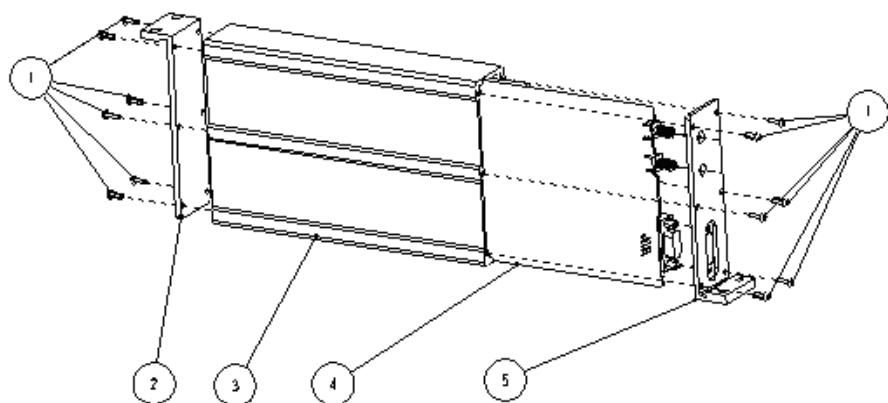
## 9.2.5 Active Antenna (P/N 115-059711-00)



**Figure 8-9 Active Antenna**

No.	P/N	Description	Quantity
1	030-000338-00	ST3. 3X8 screw	5
2	043-010221-00	Cable gland	1
3	043-010217-00	Front panel of active antenna	1
4	042-022799-00	Shield cover of active antenna	1
5	051-003071	0155 antenna PCBA	1
6	043-010218-00	Back cover of active antenna	1
7	047-025555-00	Dustproof sheet	1
8	043-010220-00	SPACER, FLANGE	1
9	043-010219-00	FLANGE, MOUNTING	1
10	0992-00-1003	Flexible Antenna 608-614 MHz	1

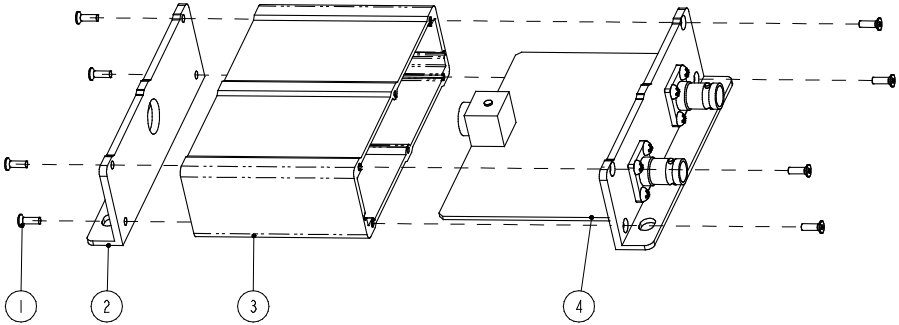
## 9.2.6 4-Channel Receiver Module Assembly (P/N 115-029487-00)



**Figure 8-10 4-Channel Receiver Module Assembly**

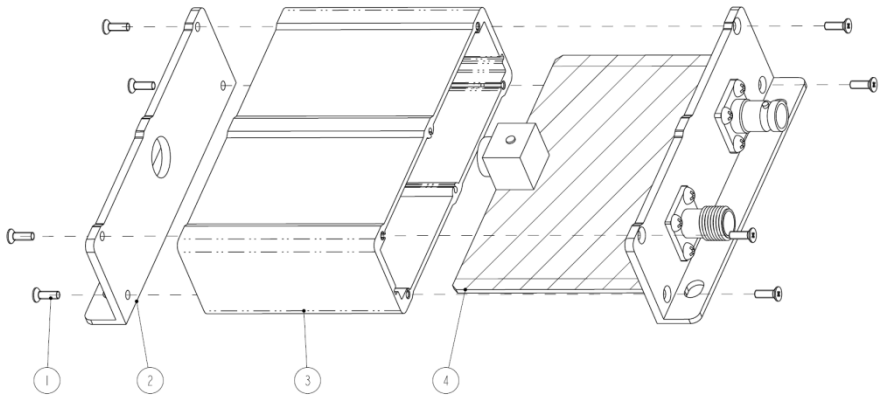
No.	P/N	Description	Quantity
1	/	Cross pan head screw M2.5×8	12
2	/	Back panel of the receiver module	1
3	/	Receiver module cavity	1
4	/	4-channel receiving board	1
5	/	Front panel of the receiver module	1

### 9.3 Power Injector (P/N 115-035637-00)



No.	P/N	Description	Quantity
1	M04-051099---	Countersunk flat head screws M2.5X8	8
2	041-008877-00	Back plate signal converter(printing)	1
3	041-008875-00	Signal converter box	1
4	051-002362-00	0155 Signal Converter PCBA	1

## 9.4 Signal Switching Box (P/N 115-020216-00)

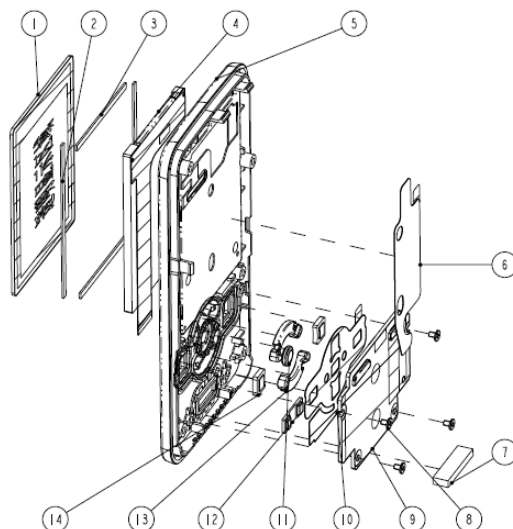


**Figure 8-11 Signal Switching Box**

No.	P/N	Description	Quantity
1	/	Countersunk flat head screws	8
2	/	Back plate signal converter(printing)	1
3	/	Signal converter box	1
4	/	0164 Signal Connection Board PCBA	1
5	/	WIRE power cable American Domestic	1
6	022-000138-00	Adapter 100-240VAC 9V 70W	1

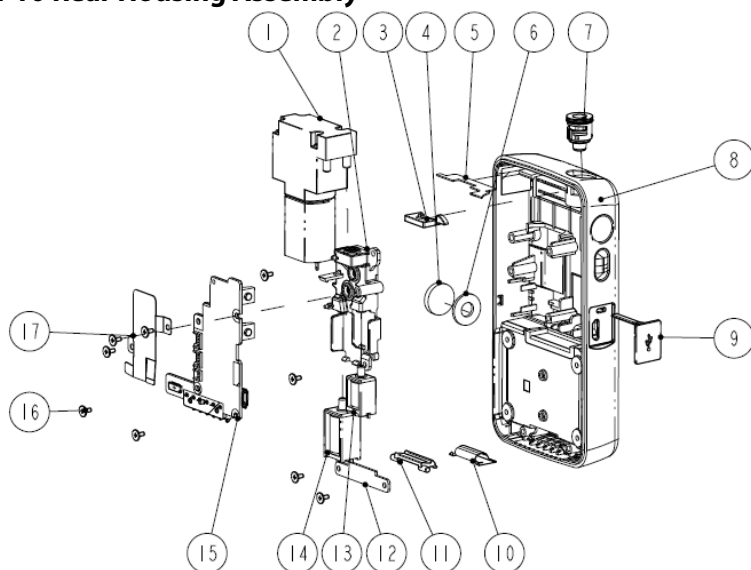
## 9.5 BP 10 (P/N 115-047557-00)

### 9.5.1 BP10 Front Housing Assembly



No.	P/N	Description	Remarks
1	115-035519-00	BP10 front housing assembly (FRU)	/
2			
3			
4			
5			
6			
7			
11	/	Self-made cross recessed cap head screws M1.6x3.4 mm	/
12			
13			
14			
8	115-035518-00	BP10 main control board (FRU)	/
9			
10			

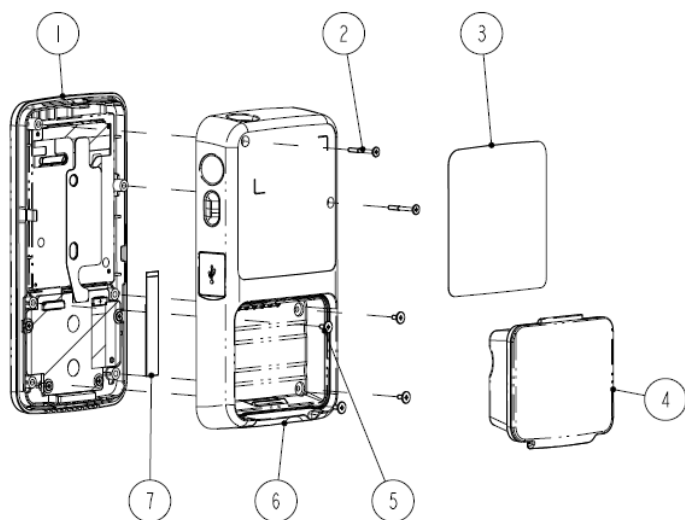
## 9.5.2 BP10 Rear Housing Assembly



No.	P/N	Description	Remarks
3	115-035520-00	BP10 rear housing assembly (FRU)	/
5			
7			
8			
9			
10			
11			
12			
1	082-002009-00	Air pump DC 4.2 V 300 mmHg	/
2	115-035522-00	BP10 integrated gas circuit and valve assembly (FRU)	/
13			/
14			/
4	115-035521-00	BP10 maintenance kit (FRU)	/
3			/
6			
7			

No.	P/N	Description	Remarks
16			
15	051-001707-00	NIBP POD parameter board PCBA	/
17	/	BP-POD pump support sheet metal	/

### 9.5.3 BP10 Main Unit



No.	P/N	Description	Remarks
1	/	NIBP-POD front housing assembly	/
6	/	NIBP-POD rear housing assembly	/
2	115-035521-00	BP10 maintenance kit (FRU)	/
5			
7			
3	/	0156 main unit label (FDA)	/
4	045-001700-00	BP-two AA battery tray assembly	/

## 9.6 Exploded View of Central Charger (PN:115-030108-00)

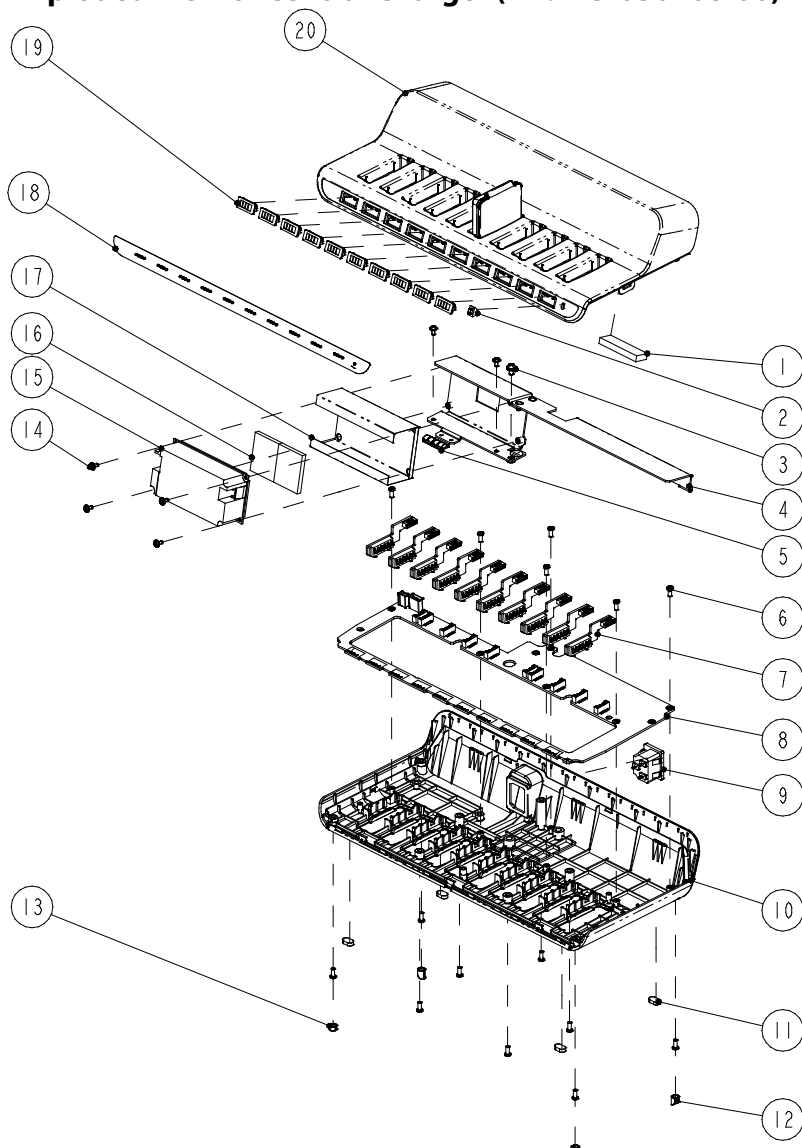


Figure 8-12 Exploded View of Central Charger



No.	P/N	Description
1	/	Gasket of top housing
2	/	AC light pipe
3	/	Pan head screw M4X8
4	/	Charger-main-support
5	/	Spring, EMI
6	/	ST3.3X8 screw
7	/	Charger Connector Board PCBA
8	/	Charger Charge main Board PCBA
9	/	AC power socket & connecting cable
10	/	Charger bottom housing(SY)
11	/	FOOT-VS
12	/	Screw hole cover 1
13	/	Screw hole cover 2
14	/	Screw, Pan Head W/Washer Phillips M3X6
15	/	POWER SUPPLY BOARD 15V 63W
16	/	Thermal Pad
17	/	AC-DC insulating trip
18	/	Indicator label
19	/	Light pipe of central charger
20	/	Charger top housing
21	/	The host label (FDA)
22	/	Main board wire
23	/	Battery interface board wires

## 9.7 Miscellaneous:

No.	P/N	Description
1	009-005427-00	Programming cable
2	DA8K-10-14452	Power cords
3	0000-10-10902	AA batteries
4	115-030109-00	Central charger wall mount
5	115-033434-00	Upgrade tools kit (including update cable and adapter)



# A Electrical Safety Inspection

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

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

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

## A.1 Power Cord Plug

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

## A.2 Device Enclosure and Accessories

### A.2.1 Visual Inspection

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

### A.2.2 Contextual Inspection

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

## A.3 Device Labeling

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

- Main unit label
- Integrated warning labels

## A.4 Scheduled Electrical Safety Inspection

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

## 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 Form*** for the description of the test items.

<b>Repair with main unit not disassembled</b>		Test items: 1, 2, 3
<b>Repair with main unit disassembled</b>	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: 2, 3, 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 Form

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

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