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# X8/X10/X12

Patient Monitor

Version 1.3

# Service Manual

CE<sub>0123</sub>

  
**EDAN**

## About this Manual

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## Statement

This manual will help you understand the operation and maintenance of the product better. It is reminded that the product shall be used strictly complying with this manual. User's operation failing to comply with this manual may result in malfunction or accident for which EDAN INSTRUMENTS, INC. (hereinafter called EDAN) cannot be held liable.

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EDAN holds the rights to modify, update, and ultimately explain this manual.

## Responsibility of the Manufacturer

EDAN only considers itself responsible for any effect on safety, reliability and performance of the equipment if:

Assembly operations, extensions, re-adjustments, modifications or repairs are carried out by persons authorized by EDAN, and

The electrical installation of the relevant room complies with national standards, and

The instrument is used in accordance with the instructions for use.

EDAN will make available on request circuit diagrams, component part lists, descriptions, calibration instructions, or other information that will assist service personnel to repair those parts of the equipment that are designated by EDAN as repairable by service personnel.

## Terms Used in this Manual

This guide is designed to give key concepts on safety precautions.

### **WARNING**

A **WARNING** label advises against certain actions or situations that could result in personal injury or death.

### **CAUTION**

A **CAUTION** label advises against actions or situations that could damage equipment, produce inaccurate data, or invalidate a procedure.

### **NOTE**

A **NOTE** provides useful information regarding a function or a procedure.

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## Chapter 1 Warranty and Service

### Standard Service

EDAN provides a one-year-warranty for the warranted products (accessories are included). The warranty period begins on the date the products are shipped to customers. If a customer promptly notifies EDAN of customer's warranty claim hereunder, EDAN will either repair, adjust or replace (with new or exchange replacement parts) EDAN's products. EDAN warrants that any service it provides to customers will be performed by trained individuals in a workmanlike manner.

### Limitation of Warranty

Direct, indirect or final damage and delay caused by the following situations for which EDAN is not responsible may void the warranty:

- ✧ Groupware is dismantled, stretched or redebugged.
- ✧ Unauthorized modification or misuse.
- ✧ Damage caused by operating beyond the environmental specifications for the medical product.
- ✧ Change or remove original serial number label or Manufacturer symbol.
- ✧ Improper use.

### Service Procedure

(1) Fill in the **Service Claim Form (SCF)**.

Fill in the SCF with detailed information including: **Model Name, Serial Number (SN)** and **Problem Phenomena**.

EDAN should not have any obligation to take over the case without this information. The form can be downloaded at: <http://www.edan.com> or obtained from EDAN's Service Department.

(2) Send EDAN the SCF and Select a Solution.

Once the service department receives the fully filled SCF, EDAN's engineer will offer a solution in three working days. EDAN will follow out the case based on the two conditions below:

#### ***Within Warranty:***

There are two options:

- i) After receiving the **Return Material Authorization (RMA)** form from EDAN service department, the customer sends EDAN the defective parts and informs about the shipment tracking number. Then we will dispatch new part(s) to your confirmed address with confirmed shipping invoice.
- ii) The customer signs the **Declaration Form** and sends it back by email or fax. This form is legally certificated to make sure the customer or end-user will return the defective parts to EDAN on time. We will, at this option, dispatch the replacement one(s) with confirmed shipping invoice.

**NOTES:**

- (1) Both Return Material Authorization Form and Declaration Form are offered by EDAN service department once the SCF is confirmed by service engineer.
- (2) The customer is responsible for freight & insurance charges when the equipment is shipped to EDAN for service, including custom charges. EDAN is responsible for the freight, insurance & custom charges from EDAN to the customer.

***Out of Warranty:***

After receiving the RMA form from the service department, the customer sends defective parts to EDAN in advance. We will analyze the problems and discuss with the customer about either repairing or replacing the part(s). Once the maintenance fee is invoiced and paid, we will make sure to dispatch good part(s) to the confirmed address.

**NOTE:**

The customer is responsible for any freight & insurance charge for the returned product.

- (3) Obtain the RMA Form.

Before the shipment of the materials, the customer must obtain an RMA form from our service department, in which the RMA number, description of returning parts and shipping instructions are included. The RMA number should be indicated on the outside of the shipping container.

**NOTE:**

EDAN should not have any obligation to the end-user or customer who returns the goods without the notification by EDAN's service department. The sender takes full responsibility for the accounted fee.

- (4) Send the Parts to EDAN.

Follow these recommended instructions:

- ✧ Please disassemble the parts with anti-static facility, do not touch the parts with naked hand.
- ✧ Please pack the parts safely before return.
- ✧ Please put the RMA number on the parcel.
- ✧ Please describe the returned parts as 'sample of \*\*\*\*\*' and put the total value on the invoice, and note on the invoice as 'sample, no commercial value'.
- ✧ Please confirm the invoice with EDAN before shipment.
- ✧ Please send back the parts after EDAN's confirmation.

### **Contact Information**

If you have any question about maintenance, technical specifications or malfunctions of devices, do not hesitate to contact us.

EDAN Instruments, Inc.

TEL: +86-755-26898321, 26899221

FAX: +86-755-26882223, 26898330

E-mail: support@edan.com

## Chapter 2 Safety Guidance

### 2.1 Introduction

This service manual is a reference for periodic preventive maintenance and corrective service procedures for the X8/X10/X12 patient monitor. It provides information on troubleshooting, assembly procedures, and instructions for functional testing as well as performance verification. The manual is intended for use only by technically qualified service personnel.

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#### **WARNING**

**Please follow the instructions exactly in accordance with this manual during service. Failure of doing so might result in damage to the monitor or personal injury.**

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### 2.2 General Information

X8/X10/X12 Patient Monitor (hereinafter called monitor) is designed in accordance with the international safety requirements in IEC/EN 60601-1 for medical electrical equipment. Classification information of this equipment is as follows:

Anti-electroshock Type	Class I equipment and internal powered equipment
Anti-electroshock Degree	CF
Ingress Protection	IPX1
Degree of Safety in Presence of Flammable Gases	Not suitable for use in presence of flammable gases
Working System	Continuous operation equipment

### 2.3 Safety Precautions

To avoid possible injury, please observe the following precautions during the operation of the monitor.

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#### **WARNING**

- The monitor must be serviced only by authorized and qualified personnel. EDAN does not assume any responsibility for damage or injury if modifications or repairs are carried out by unauthorized personnel.**
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**WARNING**

- 2 Use and replace the substitutive parts provided or recommended by EDAN only.
  - 3 The service personnel must be familiar with the operation of this monitor. Refer to *Patient Monitor User Manual* for details.
  - 4 Perform periodic safety test to ensure patient safety. Safety test should include leakage current measurement and insulation testing.
  - 5 Disconnect the monitor from power before replacing the fuses which are with the identical specifications.
  - 6 **SHOCK HAZARD** – Do not remove the top panel cover during operation or while power is on. The unit cover must be removed only by authorized service personnel.
  - 7 **SHOCK HAZARD** – Do not attempt to connect or disconnect the power cord with wet hands. Make sure that your hands are clean and dry before touching the power cord.
  - 8 Accessory equipment connected to the analog and digital interface must be certified according to the respective IEC/EN standards (e.g. IEC/ EN 60950 for data processing equipment and IEC/EN 60601-1 for medical equipment). Furthermore, all configurations shall comply with the valid version of the system standard IEC/EN 60601-1. Anybody who connects additional equipment to the signal input connector or signal output connector to configure a medical system must ensure that the system complies with the requirements of the valid version of the system standard IEC/EN 60601-1. If you have any question, please consult our technical service department or your local distributor.
  - 9 Do not remove the battery while AC power is on.
  - 10 Do not directly solder the lead wire and the battery terminal.
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







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

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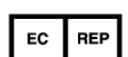



**CAUTION**

- 1 The device is designed for continuous operation. Avoid splashing water over the device.
  - 2 Do not operate the device when it is damp or wet. Avoid using the device immediately after relocating it from a cold environment to a warm and humid environment.
  - 3 While the battery is charged, used or stored, keep it away from objects or materials with static electric charges.
- 
-

## 2.4 Explanation of Symbols on the Monitor

1		DEFIBRILLATION-PROOF TYPE CF APPLIED PART
2		Caution
3		MR Unsafe - Keep away from magnetic resonance imaging (MRI) equipment
4		Equipotentiality
5		Alternating Current
6		Power Supply switch
7		Serial number
8		Network port
9		USB (Universal Serial Bus) Connection
10		Bell cancel
11		NIBP measurement
12		Trend
13		Screen or video image, freeze
14		Menu
15		Video output

16		Defibrillator synchronization/Signal output port
17		Output
18		Date of manufacture
19		MANUFACTURER
20	P/N	Part Number
21		General symbol for recovery/recyclable
22		Disposal method
23		Operating instructions
24		Refer to instruction manual/ booklet (Background: Blue; Symbol: White)
25		Warning (Background: Yellow; Symbol & outline: black)
26		Gas inlet
27		Gas outlet (evac)
28	<b>IPX1</b>	Ingress Protection IPX1 (Protected against vertically falling water drops)
29	<b>Rx Only</b>	Caution: Federal (U.S.) Law restricts this device to sale by or on the order of a physician.
30		Non-ionizing electromagnetic radiation

31	Contains FCC ID	Federal Communications Commission: Contains FCC ID: SMQ9113EDAN
32		Do not reuse
33		This way up
34		Fragile, handle with care
35		Keep dry
36		Stacking limit by number
37		Handle with care
38		Do not step on
39		CE marking
40		AUTHORISED REPRESENTATIVE IN THE EUROPEAN COMMUNITY
41		Use-by date
42	<p>ETL CLASSIFIED</p>  <p>Intertek 4005997</p>	<p>Conforms to AAMI Std. ES60601-1, IEC Std. 60601-2-25, IEC Std. 60601-2-27, IEC Std. 80601-2-30, IEC Std. 60601-2-34, IEC Std. 60601-2-49, ISO Std. 80601-2-55, ISO Std. 80601-2-56, ISO Std.80601-2-61</p> <p>Certified to CSA Std. No. 60601-1, No 60601-2-25, No 60601-2-27, No 80601-2-30, No 60601-2-34, No 60601-2-49, No 80601-2-55, No 80601-2-56, No 80601-2-61</p>
43		Medical Device

44		Unique Device Identifier
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**NOTE:**  
The service manual is printed in black and white.

## Chapter 3 Installation

### **WARNING**

Only qualified service engineers should install this equipment.

### 3.1 Environment Requirements

Working	
Temperature	0 °C ~ 40 °C (32 °F ~ 104 °F)
Relative Humidity	15%RH ~ 95%RH (non-condensing)
Atmospheric Pressure	86 kPa ~ 106 kPa
Storage	
Temperature	-20 °C ~ 55 °C (-4 °F ~ 131 °F)
Relative Humidity	15%RH ~ 95%RH (non-condensing)
Atmospheric Pressure	70 kPa ~ 106 kPa

#### **NOTE:**

- 1 Do not install the monitor in close proximity to flammable anesthetics.**
- 2 Keep the environment clean and keep the device away from corrosive medicine. Prevent the device from vibration, high temperature, humidity and exposure to the sun.**

### 3.2 Electrical Requirements

Operating Voltage	100 V-240 V ~
Operating Frequency	50 Hz/60 Hz
Input Current	X8: Current=1.0 A-0.5 A; X10/X12: Current=1.4 A-0.7 A;

### 3.3 Safety Requirements

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**CAUTION**

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- 1 **SHOCK HAZARD** – To protect patients and medical staff, the power receptacle must be well grounded. Never adapt the three-prong plug from the monitor to fit a two-socket outlet.
  - 2 Do not simultaneously touch the signal input or output connector and the patient.
  - 3 The monitor and equipment connected to the monitor should be equipotential to ensure effective grounding.
  - 4 Do not switch on the monitor until all units and accessories have been properly connected and verified.
- 
- 

### 3.4 Installing the Monitor

- To install the monitor on a flat surface.

Place the monitor on a flat surface. Make sure the surface does not vibrate, and is free of corrosive medicine and dust.

- To install the monitor on a trolley.

If the user wants to install the monitor on a trolley, please refer to the assembling instruction delivered with the trolley for details.

- To install the monitor on a wall.

If the user wants to install the monitor on a wall, please refer to the assembling instruction delivered with the wall mount for details.

### 3.5 Connecting to AC Power

Apply the power cable offered with the monitor. Plug one end of the power cable to the power socket of the monitor before buckling the security lock to the plug. Then connect the other end to a grounded 3-prong power output special for hospital usage.

## Chapter 4 Test and Maintenance

### 4.1 Routine Test

An overall check of the monitor, including safety check and performance check, should be performed by qualified personnel every 24 months or after service.

#### 4.1.1 Visual Inspection

Before using the monitor, the user must:

- Inspect the monitor and accessories for obvious signs of damage.
- Check the external cables, power socket and power cable.

Do not use the monitor if any damage is detected until the monitor is repaired by the service personnel of EDAN or professional service personnel of the dealer.

#### 4.1.2 Power- on Test

Switch on the monitor after it is connected to the power source and check:

- If the power indicator lights up;
- If the alarm indicators flicker and if the alarm tone is heard;
- If some images and characters are missing;
- If there are bright spots and dark shadows on the LCD screen;
- If the waveforms, fonts and symbols displayed on the LCD screen are normal.

If any failure is detected, refer to section *Monitor Booting Failures* and *Display Failures* for details.

#### 4.1.3 Key Test

Press the keys on the front panel in turn to check if they work properly. When pressing a key, a corresponding functional display is supposed to be seen onscreen. Refer to *Patient Monitor User Manual* for details about the key function. The user can move the cursor by turning the rotary knob clockwise or anticlockwise. Also, the user can confirm the operation by pressing the rotary knob.

#### 4.1.4 Recording Test

Check if the recorder can perform recording without problem. Also, check if all the

recorded traces are correct and clear on the paper.

If any failure is detected, refer to section *Recorder Failures* for details.

**NOTE:**

**Please make sure paper is well loaded and the setting is correct before recording.**

### 4.1.5 Alarm Test

Trigger a signal that is higher than the upper limit or lower than the lower limit to activate a physical alarm. Disconnect one of the accessories from the monitor to activate a technical alarm. Check if the audible and visible alarms work properly.

## 4.2 Functional Tests and Accuracy Tests

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**WARNING**

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- 1 Functional tests and accuracy tests must only be carried out by qualified service personnel.**
  - 2 If function of the monitor is in question, conduct an overall test on the function and accuracy of the monitor according to the instructions offered by the manufacturer.**
  - 3 A functional tester, such as ECG simulator, SpO<sub>2</sub> simulator, NIBP simulator and IBP simulator, can only be used to assess the parameter consistency and function but not to be used to assess the clinical measurement accuracy.**
- 

A functional check should be performed once possible device malfunction emerges or after servicing the device.

It is unnecessary to open the device case for functional checks.

### 4.2.1 ECG Functional Test

This test checks the function of the ECG measurement.

Tools required: ECG simulator.

Procedure:

1. Connect the ECG simulator to the monitor with an ECG cable.
2. Switch on the monitor and the simulator.
3. Set the simulator to the following configuration:
  - HR=30 bpm.

4. Check the displayed HR value against the simulator configuration. The value should be 30 bpm  $\pm$ 1 bpm or  $\pm$ 1% (whichever is greater).

### 4.2.2 SpO<sub>2</sub> Functional Test

This test checks the function of the SpO<sub>2</sub> measurement.

Tools required: SpO<sub>2</sub> simulator (Provided with a calibration curve approved by EDAN).

Procedure:

1. Connect the monitor and the SpO<sub>2</sub> simulator with a SpO<sub>2</sub> cable.
2. Switch on the monitor and the simulator.
3. Set the simulator to the following configuration:
  - Patient type: adult or pediatric;
  - SpO<sub>2</sub> = 70%.
4. Check the displayed SpO<sub>2</sub> value against the simulator configuration. The value should be 70%  $\pm$ 2%.

### 4.2.3 NIBP Functional Test

This test checks the function of the NIBP measurement.

Tools required:

- NIBP simulator;
- Stopcock
- Extension tube;
- Artificial limb.

Procedure:

1. Connect the NIBP simulator to the monitor.
2. Switch on the monitor and the simulator. Calibrate the simulator before using it.
3. Set the patient type on the monitor to adult; set the simulator to the following configuration:
  - Patient type: adult;
  - Systolic pressure=255 mmHg (1 mmHg=0.133 kPa, 1 mmHg=1.36 cmH<sub>2</sub>O);
  - Diastolic pressure=195 mmHg;

- Mean pressure=215 mmHg.

And then start a NIBP measurement.

4. Check the displayed values against the simulator configuration. The differences should be within the range of  $\pm 8$  mmHg.

#### 4.2.4 NIBP Leakage Test

This test checks leakage of the airway and the performance of the NIBP system. See Figure 4-1 for details about tools required.

Procedure:

1. Connect the cuff securely with the socket for NIBP air hole.
2. Wrap the cuff around the cylinder with an appropriate size.
3. Make sure the patient type has been set to **Adult**.
4. Access **Menu > Maintenance > User Maintain** by inputting the password. Start a leakage test by selecting **NIBP Maintain > Leak Test**.

The system will automatically inflate the pneumatic system to about 180 mmHg. After 20 seconds to 40 seconds, if system leakage has detected, the system will automatically open the deflating valve to stop the leak test and indicates **NIBP Leak**. If no system leakage is detected when the pneumatic system is inflated to 180 mmHg, the system will perform a deflation to an approximate value of 40 mmHg and subsequently perform the second phase leak test. After 20 seconds to 40 seconds, the system will automatically open the deflating valve and provide corresponding indication based on the test result.

If the alarm information **NIBP Leak** appears, it indicates that the airway may have air leaks. In this case, the user should check for loose connection. After confirming secure connections, the user should re-perform the leakage test. If the failure prompt still appears, please contact the manufacturer for repair.

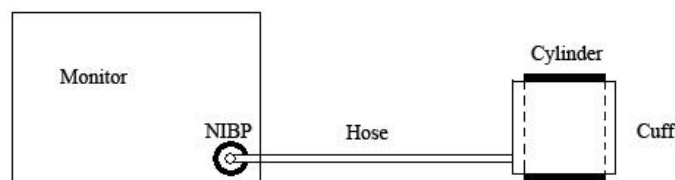


Figure 4-1 Diagram for NIBP Leakage Test

#### 4.2.5 NIBP Accuracy Test

This test checks the performance of the NIBP system.

**NOTE:**

**Manometer test is for checking the measurement accuracy and cannot change the measurement results.**

Tools required:

- Stopcock
- NIBP extension tubes
- Cylinder (200 ml)
- Manometer (Its measurement range should be within the range of 0 to 300 mmHg; its accuracy should be more precise than the accuracy of  $\pm 0.3$  mmHg.)

Procedure:

1. Access **Menu > Maintenance > User Maintain** by inputting the password.
2. Connect the equipment as shown below:

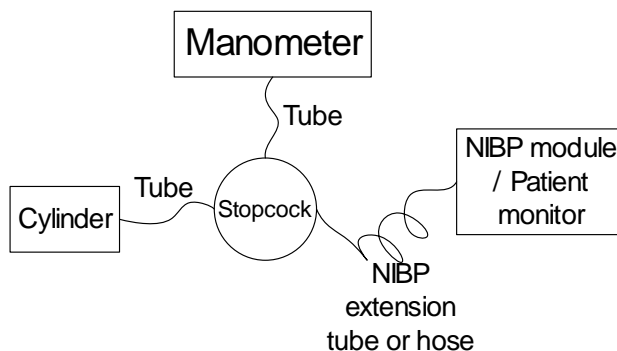


Figure 4-2 Diagram for Manometer Test

3. Select **NIBP Maintain > Manometer**.
4. Apply a fixed static pressure on the monitor with the help of the manometer.
5. Wait 10 s until the pressure stabilizes. Check the displayed values on the monitor against the manometer configuration.
6. A tolerance of  $\pm 3$  mmHg is reasonable.

## 4.2.6 NIBP Calibration

**NOTE:**

- 1 **NIBP calibration must be performed by professional personnel authorized by EDAN.**
- 2 **NIBP calibration can influence measurement results. Incorrect operation may influence measurement accuracy.**

Tools required:

- Stopcock
- NIBP extension tubes
- Cylinder (200 ml)
- Manometer (Its measurement range should be within the range of 0 to 300mmHg; its

accuracy should be more precise than the accuracy of  $\pm 0.3$  mmHg.)

Procedure:

1. Connect the equipment as shown below:

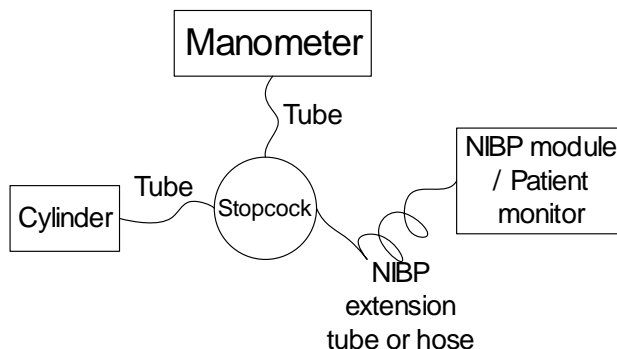


Figure 4-3 Diagram for NIBP Calibration

2. Access **Menu > Maintenance > Factory Maintain** by inputting the password 998.
3. Select **NIBP Calibration (Xm)** from the menu.
4. Select **Calibrate Initialization** to start calibration.
5. Adjust the manometer value to 50 mmHg (If different values are required for calibration, keep the value of the manometer consistent with the one displayed on the monitor). After the value of the manometer stabilizes, select **Calibrate Low**.
6. Adjust the manometer value to 250 mmHg (If different values are required for calibration, keep the value of the manometer consistent with the one displayed on the monitor). After the value of the manometer stabilizes, select **Calibrate High**.
7. Select **Calibrate Confirm**.
8. Select **Calibrate Protection Unit**.
9. Apply a fixed static pressure on the monitor with the help of the manometer. Check the displayed values on the monitor against the manometer configuration.
10. A tolerance of  $\pm 3$  mmHg is reasonable.

#### 4.2.7 TEMP Accuracy Test

This test checks the accuracy of the TEMP measurement.

Tools required: resistance box.

Procedure:

1. Switch on the monitor and the resistance box.
2. Set the probe type on the monitor to YSI-10K, and respectively connect the probes to channel T1 and T2 connectors. And then connect the probes with the resistance box.
3. Set the resistance value to  $(6017\Omega)$  37 °C in the resistance box.

4. The displayed value should be  $37\text{ }^{\circ}\text{C} \pm 0.1\text{ }^{\circ}\text{C}$ .

### 4.2.8 CO<sub>2</sub> Functional Test

This test checks the function of the CO<sub>2</sub> measurement.

Tools required: nasal cannula.

Procedure:

1. Switch on the monitor.
2. Access CO<sub>2</sub> setup menu, and set the **Work Mode** to **Measure**.
3. Place the nasal cannula below the nose and normally breathe; check if the CO<sub>2</sub> measurement waveforms are available on the monitor.
4. The displayed CO<sub>2</sub> concentration is supposed to be 34 mmHg ~ 40 mmHg.

### 4.2.9 IBP Functional Test

This test checks the function of the IBP measurement.

Tools required: patient simulator

Procedure:

1. Connect the IBP cable to the connector for channel BP2 on the patient simulator and to the IBP connector on the monitor.
2. Set the simulator to 0 pressure and perform a zero calibration.
3. After completing the zero calibration, configure the simulator as P (static) = 200 mmHg.
4. Perform a dynamic pressure test. Set the simulator to the following configuration:
  - RADIALART 120/80

The tolerances for the measurement value provided by the monitor should be  $\pm 1$  mmHg or  $\pm 2\%$ .

### 4.2.10 IBP Calibration

**NOTE:**

1. **IBP calibration must be performed by professional personnel authorized by EDAN.**
2. **IBP calibration can influence measurement results. Incorrect operation may influence measurement accuracy.**

**Method 1:**

Tools required:

- FLUKE MPS450 or FLUKE ProSim 8 or FLUKE ProSim 3 Simulator
- Special IBP cable for the simulator

Procedure:

1. Connect the equipment as shown below, Only the IBP module on the monitor is zeroed and calibrated by this method.

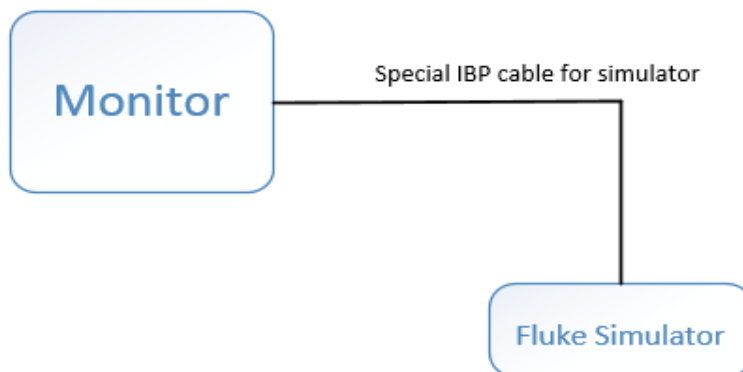


Figure 4-4 Diagram for IBP Calibration

2. Connect the IBP special cables to the IBP interface of the monitor and simulator respectively, Note that IBP has multiple interfaces. The interfaces must be correctly selected. Then, each IBP channel will be calibrated and zero.

3. Turn on the monitor and the simulator respectively, enter the **IBP Setup** menu of the simulator, and select the corresponding zero channel. At this time, the IBP parameter of the monitor is 0 mmHg, click this parameter, and the **Options** dialog box will appear. Select **Zero All** to complete IBP zero;

Note: Only when the software interface has only one IBP parameter, **Zero All** is available. If the interface has two IBP parameters, **Zero All** is disabled.

4. Access **Menu > Maintenance > Factory Maintain** by inputting the password 998. select **IBP Maintain > P1**, set the **IBP Transducer Type** to **Other**, Then set the static pressure as 200 mmHg in the simulator, and when the air pressure is stable at 200mmHg, click the **Calibrate** button on the monitor to enter the calibration interface. After confirming **Cal value** on the monitor is 200 mmHg, click **Calibrate** and **Confirm** to complete the IBP calibration.

5. By setting 120mmHg and 80 mmHg signal on the simulator, confirm that the IBP measurement displayed by the monitor is within the claimed range of the monitor. If it is not within the claimed range, repeat the zero and calibration.

6. Repeat the above procedures to complete the zero and calibration of the other channels.

**Method 2:**

Tools required:

- FLUKE ProSim 8 or Manometer (Its measurement range should be within the range of 0 mmHg to 300 mmHg; its accuracy should be more precise than  $\pm 0.3$  mmHg.)
- IBP cable for the transducer
- Stopcock
- NIBP tube
- NIBP cuff or Cylinder (200 ml)

Procedures:

1. Connect the device and monitor as shown in the following figure. If a simulator is used, the pressure source mode on the simulator should be used, which has the same function as the manometer, that is, to provide air pressure. The method is to zero and calibrate the whole monitoring system with accessories.

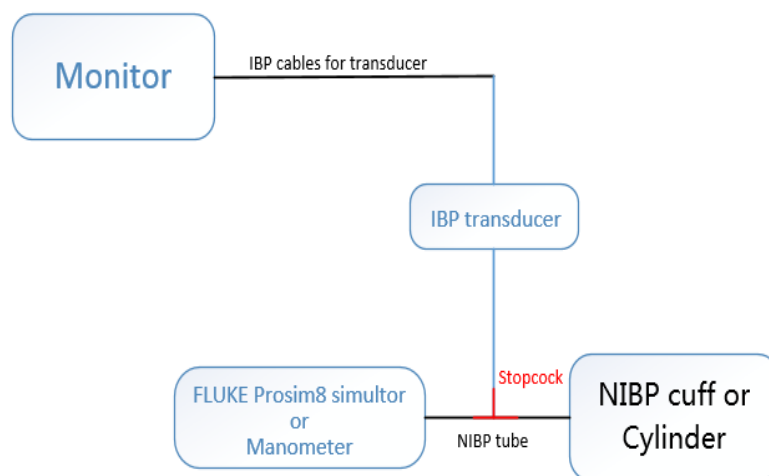


Figure 4-5 Diagram for IBP Calibration

2. Connect the Stopcock on the IBP transducer to the air.
3. Click IBP parameters on the interface of monitor, and **XX Options** will pop up, click **Zero All** to complete zero.

Note: Only when the software interface has only one IBP parameter, **Zero All** is available. If the interface has two IBP parameters, **Zero All** is disabled.

4. Connect the Stopcock on the IBP transducer to the manometer, and inflate the manometer to 200 mmHg;
5. Access **Menu > Maintenance > Factory Maintain** by inputting the password 998. select **IBP Maintain > P1**, set the **IBP Transducer Type** to **Other**, Then set the static pressure as 200 mmHg in the simulator, and when the air pressure is stable at 200 mmHg, click **Calibrate** button on the monitor to enter the calibration interface. After confirming **Cal value** on the monitor is 200 mmHg, click **Calibrate** and **Confirm** to complete the IBP calibration.
6. Inflate the manometer by 120 mmHg. Verify that the measured P1 value shown on the monitor is within the claimed range of the monitor. If not, repeat the zero and calibration.
7. Repeat the above procedures to complete zero and calibration of the other channels.

## 4.2.11 C.O. Functional Test

This test checks the function of the C.O. measurement.

Tools required: patient simulator

Procedure:

1. Connect the simulator to the C.O. module using the patient cable.
2. Configure the patient simulator as follows:
  - Injection temperature: 0 °C
  - Computation Const: 0.542  
(Edward's Catheter)
  - Flow: 5 l/min
3. Check displayed value against the simulator configuration.
4. Expected test result: C.O.= 5+/- 1 l/min

## 4.3 Safety Test

### 4.3.1 Safety Test Procedures

Use the test procedures outlined here only for verifying safe installation or service of the product. These tests are not a substitute for local safety testing where it is required for an installation or a service event.

When performing a safety test, you must use a standard safety analyzer such as Fluke 601Pro Series safety analyzer or equivalent, and perform the test according to your local regulations, for example, in Europe according to IEC/EN60601-1, in USA according to UL60601-1. For the test setup, please refer to the Instructions for Use of the test equipment used.

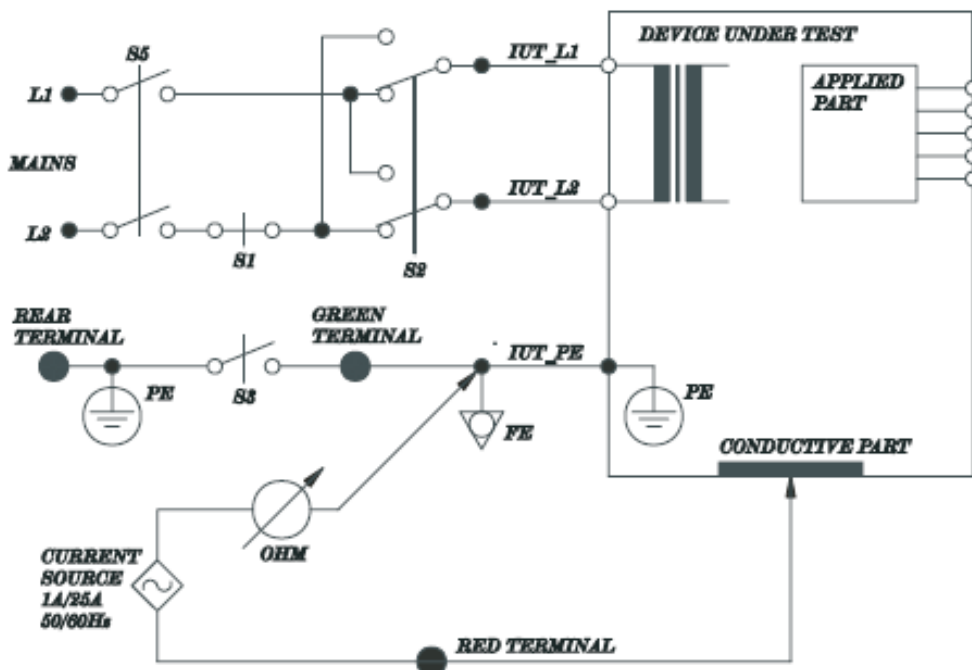
Additional test may be required by your local regulations.

You are recommended to document the result of the safety test.

#### **NOTE:**

- 1 After the system is installed or set up, safety test must be performed according to IEC 60601-1.**
- 2 Systems must be handled as devices.**
- 3 A system is a combination of several devices of which at least one is a medical electrical device which is connected to other devices by functional connections or by a transportable multiple socket outlet.**
- 4 With devices that are connected to other devices by means of a data cable, this connection must be disconnected prior to performing the electrical safety check, in order to avoid incorrect measurements.**

### 4.3.2 Protective Earth Resistance



**Notes:**

- S1 = Not applicable
- S2 = Not applicable
- S3 = Open
- S5 = Open

**NOTE:**

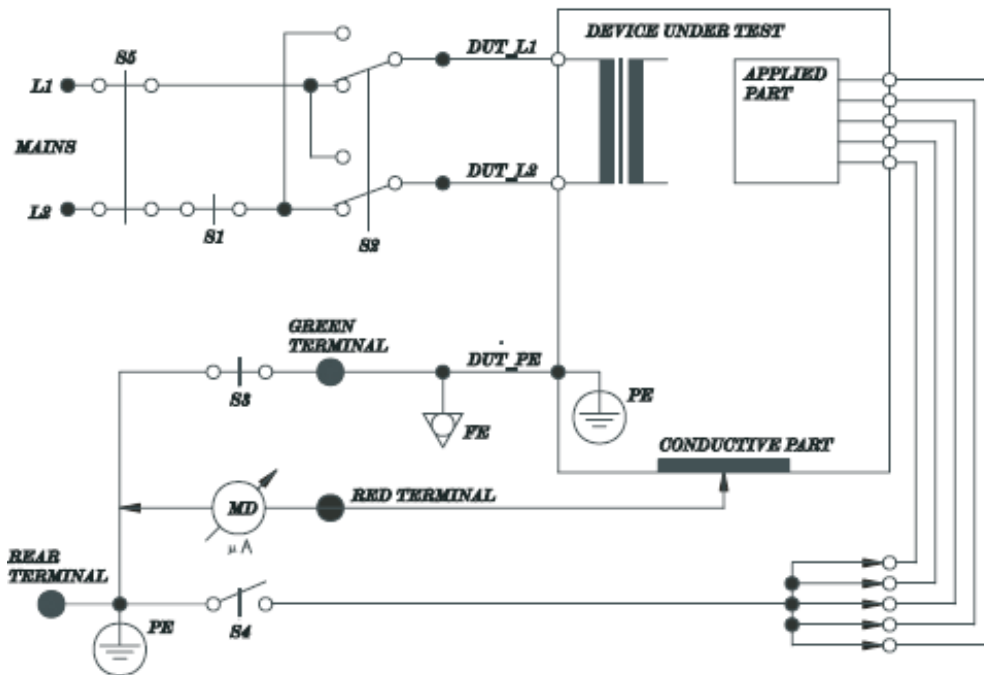
The circuit diagram is based on the Fluke 601Pro series safety analyzer.

This measures impedance of Protective Earth (PE) terminal to accessible metal part of Device under test (DUT) which is protectively earthed. A current of 25 A is passed for 5 s to 10 s through the protective terminal and each accessible metal part which is protectively earthed.

Allowable value: without mains cable, maximum impedance: 100 mOhms

(IEC 60601-1 and UL60601-1)

### 4.3.3 Enclosure Leakage Current



**Notes:**

- S1 = Variable
- S2 = Variable
- S3 = Variable
- S4 = Variable
- S5 = Closed

**NOTE:**

The circuit diagram is based on the Fluke 601Pro series safety Analyzer.

This measures leakage current of exposed metal parts of Device under test (DUT) and parts of the system within the patient environment; normal and reversed polarity using S2 test performed both in normal condition and single fault conditions.

Normal condition (NC): with S1, S3, S5 closed, S2, S4 variable.

Single fault condition (SFC): S1, S3 open (one for each time) and S5 closed, S2, S4 variable.

Allowable value:

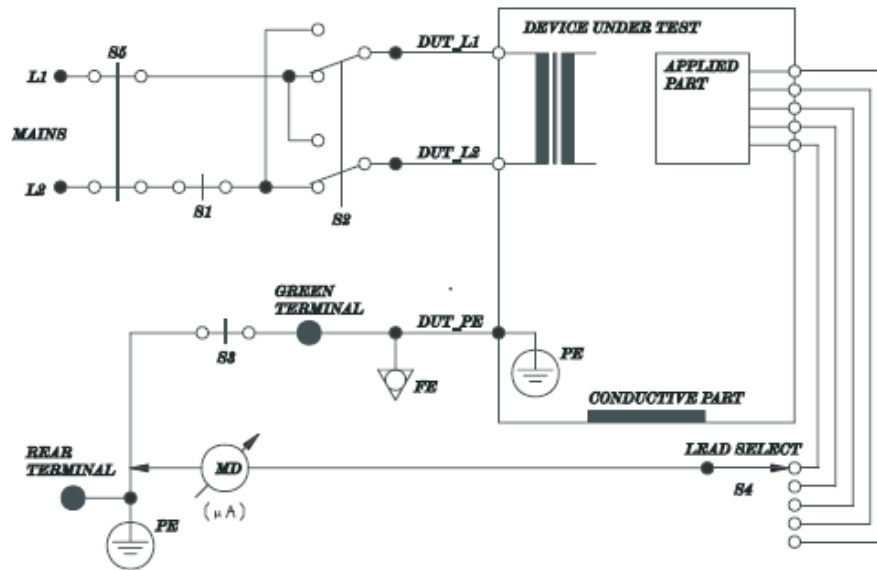
Normal condition: 100  $\mu$ A (IEC/EN60601-1)

Single fault condition: 500  $\mu$ A (IEC/EN60601-1)

Normal condition: 100  $\mu$ A (UL60601-1)

Single fault condition: 300  $\mu$ A (UL60601-1)

### 4.3.4 Patient Leakage current



**Notes:**

- S1 = Variable
- S2 = Variable
- S3 = Variable
- S4 = Variable
- S5 = Closed

**NOTE:**

The circuit diagram is based on the Fluke 601Pro series safety Analyzer.

This test measure the leakage current flowing between the selected applied part and the mains PE; the test with normal and reverse polarity, in normal condition and single fault condition.

Normal condition (NC): with S1, S3, S5 closed, S2, S4 variable.

Single fault condition (SFC): S1, S3 open (one for each time) and S5 closed, S2, S4 variable.

Allowable value:

Normal condition: 10  $\mu$ A (BF applied part), 10  $\mu$ A (CF applied part)

(IEC/EN60601-1, UL60601-1)

Single fault condition: 500  $\mu$ A (BF applied part), 50  $\mu$ A (CF applied part)

(IEC/EN60601-1, UL60601-1)

## Leakage Current

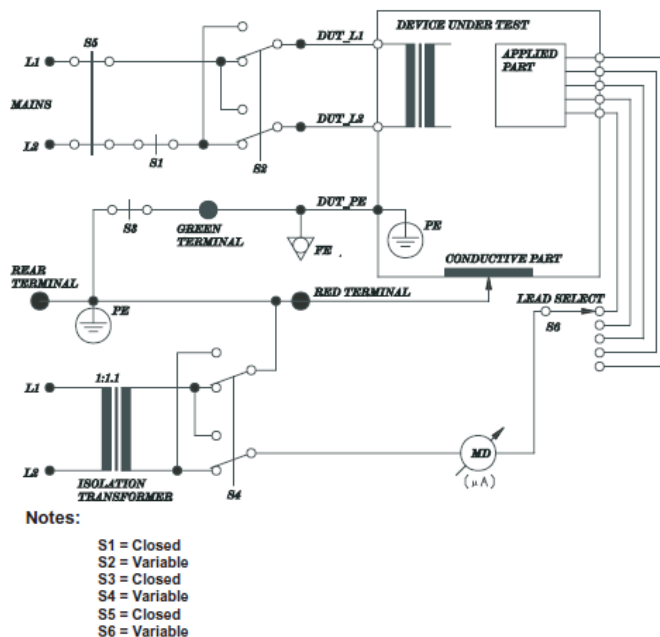
	Applied Part	Normal Condition	Single Fault Condition
Earth Leakage Current	/	< 0.5 mA	< 1 mA
Enclosure Leakage Current	/	< 0.1 mA	< 0.5 mA
Patient Leakage Current	CF	AC: < 0.01 mA DC: < 0.01 mA	AC: < 0.05 mA DC: < 0.05 mA
	BF	AC: < 0.1 mA DC: < 0.01 mA	AC: < 0.5 mA DC: < 0.05 mA
Patient Leakage Current (Mains on Applied Parts)	CF	/	< 0.05 mA
	BF	/	< 5 mA
Patient Auxiliary Current	CF	AC: < 0.01 mA DC: < 0.01 mA	AC: < 0.05 mA DC: < 0.05 mA
	BF	AC: < 0.1 mA DC: < 0.01 mA	AC: < 0.5 mA DC: < 0.05 mA

### 4.3.5 Patient Leakage Current- Single Fault Condition (S.F.C) Mains on

#### Applied Part

#### NOTE:

The following test is based on test with the Fluke 601 pro series safety analyzer. This device allows applying a 110% mains voltage between the applied part and the device PE. When testing with other device, you may need to apply the 110% mains voltage manually.



**NOTE:**

The circuit diagram is based on the Fluke 601Pro series safety Analyzer.

This test measure the current flowing between the applied part and the mains PE in response to an isolate mains voltage (110% of the mains voltage) applied to applied part. This test is performed with normal and reverse polarity of the mains voltage using S2, and normal and reverse polarity of the isolate voltage using S4.

Single fault condition: S1, S3, S5 closed, S2, S4, S6 variable.

Allowable value:

Single fault condition (110% mains voltage on applied part):

5000 μA (BF applied part), 50 μA (CF applied part)

(IEC/EN 60601-1 UL 60601-1)

**4.4 Maintenance**

For details about basic cleaning and maintenance methods, refer to relevant sections in *Patient Monitor User Manual*. For further technical support, contact service engineers of EDAN.

Users are responsible for preventive maintenance and periodic inspection for the monitor.

**4.4.1 Cleaning the Monitor and Accessories**

Refer to relevant sections in *Patient Monitor User Manual* for details.

## 4.4.2 Maintaining the Battery

Refer to relevant sections in *Patient Monitor User Manual* for details.

## 4.4.3 Replacing the Battery

To install or replace the battery, please follow the procedure:

1. Remove the screws on the battery door, open the battery.
2. Unplug the battery connector; take out the battery needs to be replaced.
3. Plug the connector of the new battery; insert the new battery into the battery compartment.
4. Close the battery door, fix the screws on it.

## Chapter 5 Configuration

The users cannot change the configurations in factory maintain. The service engineer is required to change the configuration after the monitor is installed and checked properly.

### 5.1 Opening User Maintain Menu

- 1 Select **Menu** on the main interface;
- 2 Select **Maintenance > User Maintain**;
- 3 Input the password by using the soft keyboard;
- 4 Select **OK** to enter the **User Maintain** menu.

### 5.2 Entering Demo Mode

The monitor works in real-time monitoring mode when monitoring a patient. If you want to show the traces and parameters for a demonstration, you need to enter the **Demo** mode.

- 1 Select **Menu > Common Function**.
- 2 Select **Demo Mode**, and input the password **3045** by using the soft keyboard.
- 3 Select **OK** to enter the Demo mode.

---

#### **WARNING**

**Demonstration function is for performance demonstrating and training usage. It is forbidden in clinical applications in case medical staff mistake what displays on the monitor as the waveforms and parameters of the patient, which will affect patient monitoring and delay diagnosis and treatment.**

---

### 5.3 Selecting Electrode Standard

Two styles of ECG standard are available: American standard and European standard. Users can set it according to the condition.

- 1 Select **User Maintain > Electrode Standard**.
- 2 Select **AHA** or **IEC** from the list and press the knob to confirm it.

## 5.4 Changing the Bed No.

The bed No. determines the bedside monitor ID on the data receiving software, such as MFM-CMS central monitoring system by EDAN. To set the device No., the user should:

- 1 Select **Menu > Patient Setup**;
- 2 Select **Patient Info > Bed No.**;
- 3 Select a device No. from 1 to 254 as the Bed No..

---

**CAUTION**

---

**Make sure the device No. of the monitors in the same system do not overlap.**

---

## 5.5 Network Setup

The monitor is provided with two network connection methods: wired network and Wi-Fi. The IP address in wired network and Wi-Fi can be chosen as static and dynamic, and only if in static, it can be set up. To set the device IP:

- 1 Select **Menu > Maintenance**;
- 2 Select **User Maintain > Network Maintain**;
- 3 Set **Network Type** as **Wired** or **Wi-Fi**, access **Config**;
- 4 Set **Mode** as **Static**, and set the network **IP** as desired.

Steps of importing certificate for MFM-CMS and Gateway:

- ✓ Step 1, in CA Certificate column, select corresponding CA certificate whose suffix should be '.cer'.
- ✓ Step 2, in Client Certificate column, select corresponding client certificate whose suffix should be '.cer'.
- ✓ Step 3, in Private Key Certificate column, select corresponding private key whose suffix should be '.pem'.
- ✓ Step 4, in Password column, input corresponding password.
- ✓ Step 5, click **Confirm**.

Steps of importing certificate for HL7:

- ✓ Step 1, in CA Certificate column, select corresponding CA certificate whose suffix should be '.cer'.

- ✓ Step 2, in Server Certificate column, select corresponding server certificate whose suffix should be '.cer'.
- ✓ Step 3, in Private Key Certificate column, select corresponding private key whose suffix should be '.pem'.
- ✓ Step 4, in Password column, input corresponding password.
- ✓ Step 5, click **Confirm**.

**NOTE:**

- 1 CA certificate is the root certificate of CA institution.**
- 2 Client certificate/Server certificate are the SSL certificate obtained from CA institution and it is recommended to use OV-SSL certificate type.**
- 3 The private key shall be generated by the RSA-2048 algorithm and be encrypted by using the AES-256 algorithm. The password for encryption shall be at least 8 characters (a combination of letters and numbers).**
- 4 The certificate format is as follows: For CA and Client certificate/Server certificate, '.cer' is supported; for private key, '.pem' is supported. All the certificates should comply with X.509 format.**
- 5 Gateway is not available in U.S.A.**
- 6 The storage path for certificate related to TLS enterprise-level encryption method:**

**For MFM-CMS\gateway: root directory of USB flash drive \certs\cms\**

**For HL7: root directory of USB flash drive \certs\hl7\**

## **5.6 Synchronization Configuration**

### 1. Build the environment

1) One computer with tftp server

2) A monitor with synchronous configuration function (it can be determined whether the monitor has synchronous configuration function by confirming whether there is a synchronous configuration key in Factory Maintain).

### 2. Operation Steps

(1) For the computer side, download the tftp server software on the Internet, set the computer IP as the tftp server IP in the tftp software, meanwhile specify the path to store files in the tftp transfer process.

(2) For the monitor, enter into **Network Maintain > Server IP**, set the server IP as the IP address configured by the computer server, and set the IP address of the monitor as the same network segment as the IP of the computer side server.

(3) After the monitor configuration is completed, enter into **Factory Maintain**, click the **Synchronize Configuration** button, enter the **Synchronization Configuration** interface, and choose whether to upload the configuration or download the configuration as required.

(4) There will be a corresponding prompt if the upload succeeds or fails. If it succeeds, there will be a compressed package file named with the model and software version of the machine under the path specified by the server. At the same time, it will prompt the service personnel to upload successfully, otherwise it will prompt failure.

There will also be a corresponding prompt if the download succeeds or fails, if download succeeds, there will be a pop-up prompt the user whether to synchronize. If select **Synchronize**, the monitor will automatically restart, after restart, the configuration will be consistent with the synchronous machine and the zip file is deleted. If select **Not Synchronize**, the monitor will not restart, but zip files downloaded from the server will be deleted.

**NOTE:**

- 1 Synchronous configuration is only limited to the same model and the same software version of the monitor, otherwise cannot be synchronized.**
- 2 The information related to monitor characteristics will not be synchronized, such as: monitor IP address, MAC address, gateway, subnet mask, patient bed number.**
- 3 The synchronization contents include system configuration, interface configuration, password configuration, user configuration and patient information configuration.**

# Chapter 6 Principle Introduction

## 6.1 System Principle Block Diagram

Here is the system principle block diagram.

Note: the three models of X8 X10 X12 share the main control board and the parameter version, but the screen drive board and sensor board are not shared, each model has its own board card, "Null" in the figure indicates that this model has no such configuration.

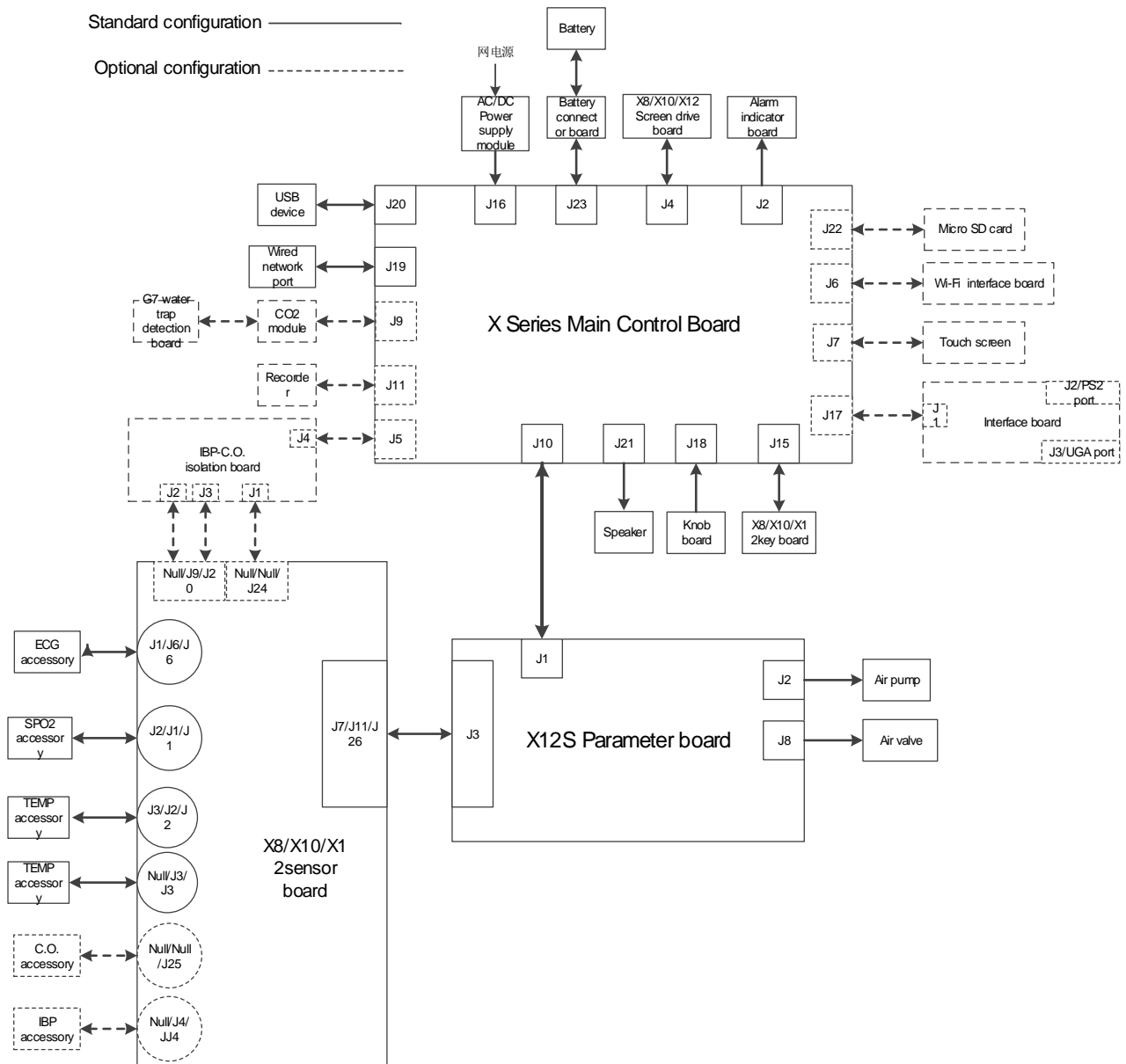


Figure 6-1 X8 X10 X12 System Principle Block Diagram

### 6.1.1 Main Control Board

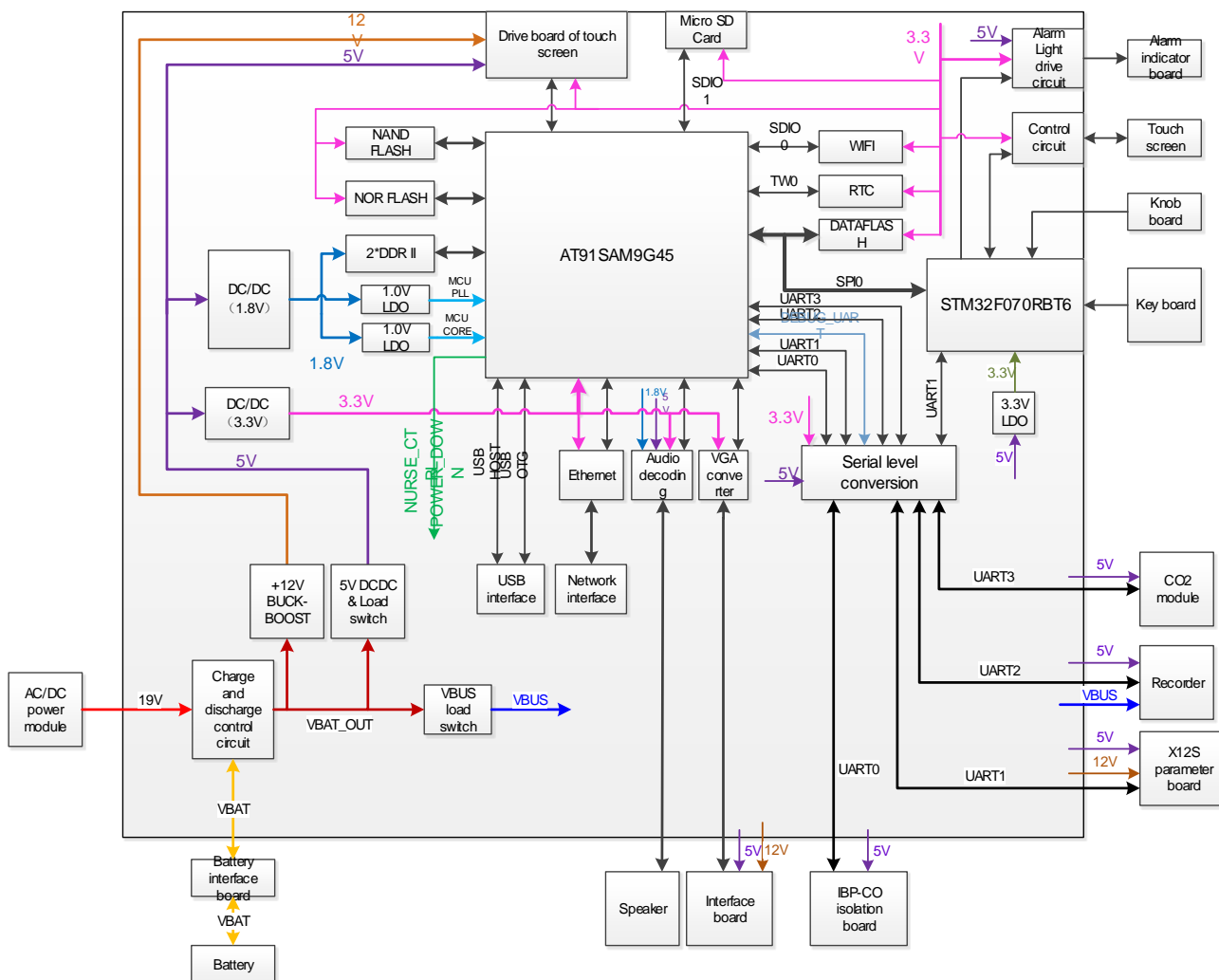


Figure 6-2 Main Control Board Principle Block Diagram

X series main control board is core board of X series host, which has the following functions as shown above:

Front housing functions: provides front housing control and display interface, including connecting to screen driven board the screen to display, provides interface connecting to touch screen for user operation, provides the interface connecting to alarm light board for alarm indicator, provides the interface connecting knob and key board for interactive operation, provides the interface connecting to the speaker for sound prompt and alarm prompt.

Interface signal input and output: the main board also provides power supply interface, battery interface board, Micro SD card interface, dual USB interfaces, wired network interface, CO<sub>2</sub> module interface, recorder interface, IBP-C.O. interface, X12S parameter board interface, interface board port, Wi-Fi interface board port. These interfaces are used for collecting and transmitting data, and performing connections between each

board.

Power supply conversion: the main control board can input 19 V DC current or connect to the battery. The DC/DC circuit can generate 12 V, 5 V, 3.3 V and 1.8 V power supplies. After two LDO circuit, 1.8 V power source becomes two-way 1.0 V voltage.

Power supply output: The main control board outputs 12 V and 5 V to X12S parameter board for power supply of pump valve and X12S plate card; it outputs 12 V, 5 V and 3.3 V to the screen drive board for power supply of the screen drive circuit; it outputs 9~19.95 V and 5 V to recorder;

It outputs 5 V to USB device and CO<sub>2</sub> module.

Internal communication interface signal output: The main MCU provides 5 ways of serial port output. One way debugs the serial port output, one way connects IBP-C.O., one way connects X12S parameter board, one way connects recorder and one way connects CO<sub>2</sub>. It also provides one way IIC to connect RTC real-time clock chip; and it provides one way SPI interface for DATAFLASH and ARM7 reuse.

## 6.1.2 Parameter Board

X12S parameter board, multi-parameter measurement board, includes parameters such as ECG, RESP, NIBP, SpO<sub>2</sub>, and TEMP, which is classified into two parts: floating ground and ground. Floating ground is for measuring ECG, RESP, NIBP, SpO<sub>2</sub> and TEMP parameters. Ground is for switching isolated power supply and communicating with upper PC.

MCU of Floating ground 2 completes the data processing of main pressure, SpO<sub>2</sub>, and TEMP, then transmits them to MCU of Floating ground 1. While MCU of Floating ground 1 is in processing ECG, RESP, and overpressure parameters, it transmits Floating ground 2's data. Finally MCU of floating ground 1 sends out the five parameters data to upper PC.

### ECG

X12S parameter board supports 3/5/6/10 and auto electrodes ECG.

In 3-electrode mode, three ECG electrodes are used: RA, LA and LL. 3-lead ECG measurement can be realized by controlling conversion of the drive electrodes.

In 5-electrode mode, five ECG electrodes are used: RA, LA, LL, RL and V; RL is the drive electrode. ECG signal of seven leads (I, II, III, AVR, AVL, AVF and V1) can be collected.

In 6-electrode mode, six ECG electrodes are used: RA, LA, LL, RL, Va, and Vb; RL is the drive electrode. ECG signal of eight leads (I, II, III, AVR, AVL, AVF, Va, and Vb) can be collected.

In 10- electrode mode, ten ECG electrodes are used: RA, LA, LL, RL and V1~V6; RL is the drive electrode. ECG signal of 12 leads (I, II, III, AVR, AVL, AVF and V1~V6) can be collected.

## **RESP**

The respiratory carrier wave of 45.6 kHz will act on the body via the resistance-capacitance network. The change of celiac impedance during respiration a minute amplitude modulated wave can be obtained on the front end of the respiratory amplifying circuit. By amplifying, demodulating and reamplifying the amplitude modulated wave, a real respiratory wave can be attained. X12S parameter board supports I and II lead selection which can switch between each other by the host computer sending instruction.

## **SpO<sub>2</sub>**

SpO<sub>2</sub> principle: By outputting the control pulse via DAC, MCU controls red ray and illumination of the infrared illuminators of the SpO<sub>2</sub> sensors. The ray measuring system amplifies the minute measured signal. Subsequently, the amplified signal is delivered for ADC sampling. Measurements of SpO<sub>2</sub> and PR will be calculated based on the corresponding algorithm. To adapt the difference between the strong and weak signal, the receiving circuit is outfitted with a program control amplifier. If the measured signal is weak, the system will enhance the gain; if the measured signal is strong, the system will lessen the gain.

## **NIBP**

NIBP part can be divided into two parts: main pressure and overpressure. Main pressure can measure the pressure via the pressure transducer and then convert the pressure signal into electric signal which is subsequently amplified and delivered to ADC; after ADC detects and measures the pressure and pulse wave signal, BP can be calculated based on the related algorithm.

The pressure protection unit of NIBP will protect the patient when individual malfunction occurs. Once the pressure protection unit detects that the value of pressure exceeds the normal one, it will activate the valve and deflate.

## **TEMP**

The mode utilizing steady voltage source is adopted to collect the body temperature. Compared with utilizing constant current source, using steady voltage source is relatively simple. There are two channels in the TEMP circuit, supporting YSI-10K and YSI-2.252K sensor.

### 6.1.3 Interface Board

Interface board has the following main functions as shown below.

Multi-function interface output function: it provides analog output, sync defibrillation and nurse call circuit, and outputs analog output, sync defibrillation and nurse call signal through PS2 interface.

VGA interface: it provides VGA signal output. Through the interface, the monitor can connect to video device and outputs real time screen.

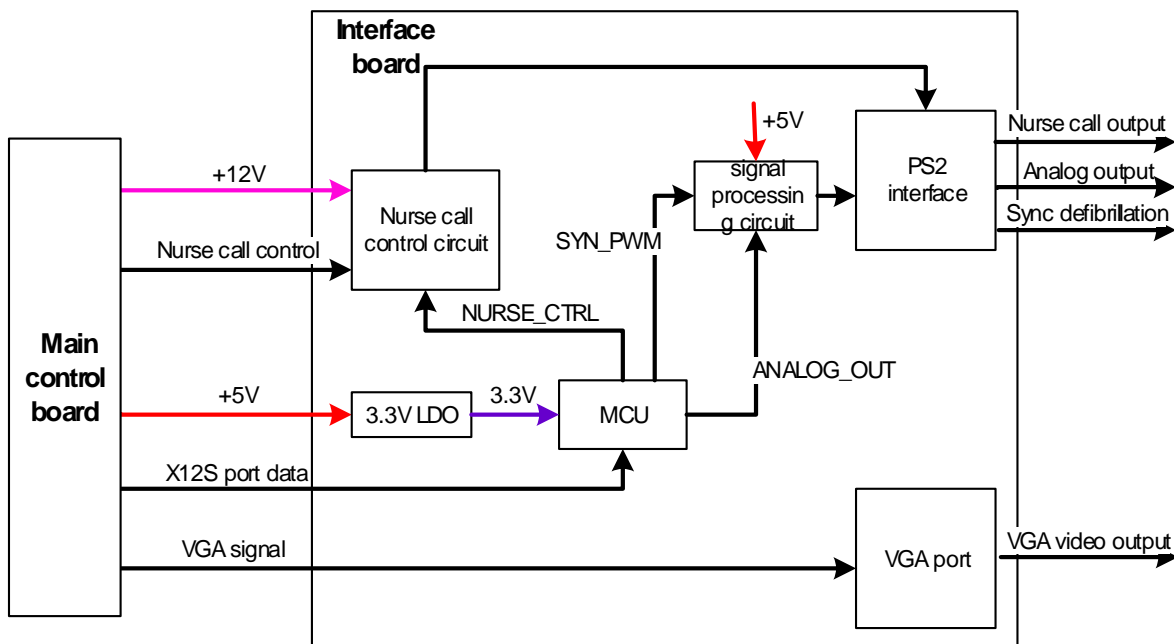


Figure 6-3 Interface Board Diagram

### 6.1.4 Screen Drive Board

Due to the different screen specifications, the X8/X10/X12 series models use a different screen driver board separately. The main control board mainly provides RGB signal, power supply and control signal to the screen driver board.

The connection block diagram of the X8 series screen driver board is shown below. The X8 series screen driver board is mainly responsible for transferring the RGB signal and some control signals of the main control board to the LCD interface. The board itself also contains the model recognition circuit and the power conversion circuit, which converts the power of the main board into LCD needed power.

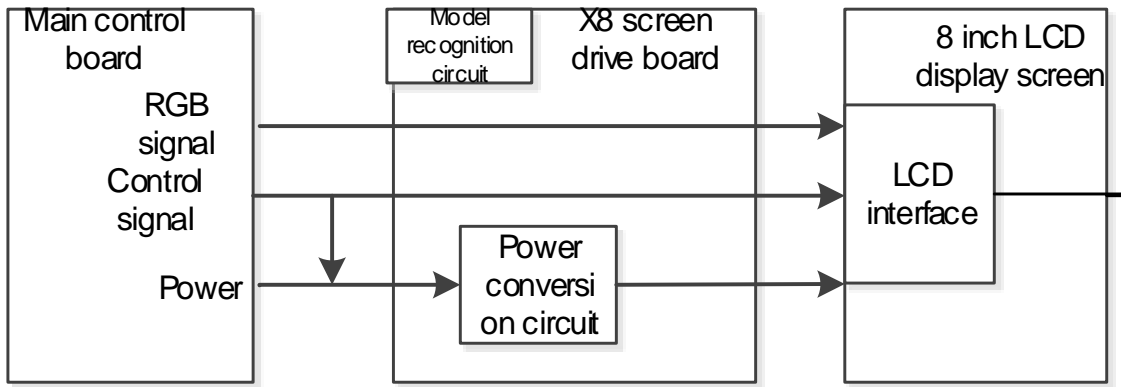


Figure 6-4 X8 Screen Drive Block Diagram

The connection block diagram of the X10 screen driver board is shown in the following figure. The X10 screen driver board is mainly responsible for output the RGB signal and control signal of the main control board to the LCD through the LCD timing controller. The board itself also contains the model recognition circuit and power conversion circuit.

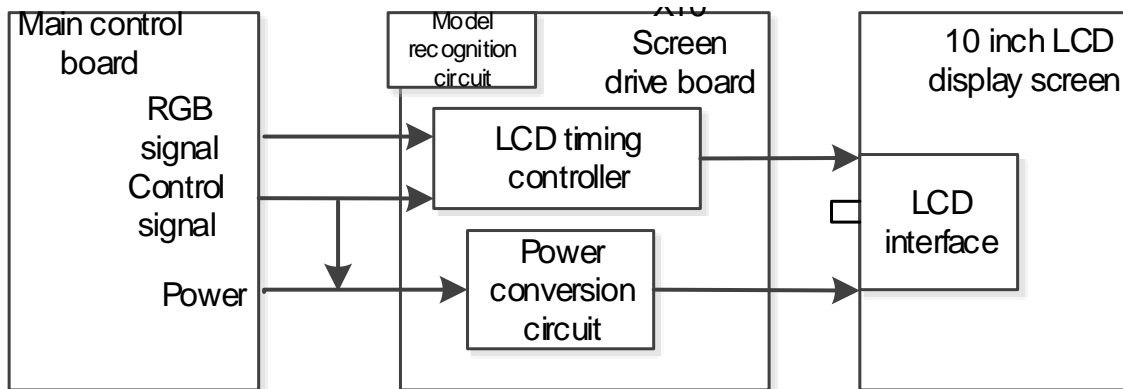


Figure 6-5 X10 Screen Drive Block Diagram

The connection block diagram of the X12 screen driver board is shown below. X12 screen driver board mainly transfers the control signal of the main control board and the power supply to the LCD. In addition, the RGB signal is transferred to the LCD through the RGB to LVDS conversion circuit in the board card, and the LVDS signal is output to the LCD.

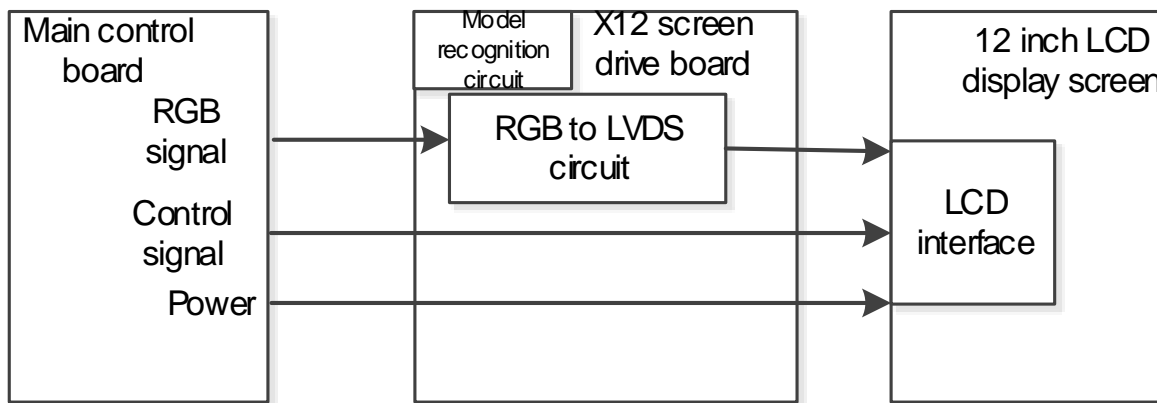


Figure 6-6 X12 Screen Drive Block Diagram

### 6.1.5 Other Small Boards

As the system block diagram, other small boards of the whole device include: battery interface board, alarm lamp board, Wi-Fi interface board, key board, knob board, sensor board, IBP-C.O. isolation board.

**Battery interface board:** The battery interface board is used to transfer the battery voltage and the identification signal of three-core and six-core batteries to the main control board, realizing the transfer function.

**Alarm lamp board:** there are two LED lights on the alarm lamp board, and the main control board has red, green and blue control signals to drive the alarm lamp board to send corresponding alarm colors.

**Wi-Fi interface board:** connect with the main control board through the SDIO interface to realize the collection and transmission of Wi-Fi data.

**Key board:** X8 X10 and X12 are separately configured with one key board, the key board is membrane switch, and the information collection of the key is realized mainly by pressing the overload disc. There are six keys: power on/off key, NIBP key, freeze key, trend key, mute key, and main menu key. There are two monochrome lights and a two-color light on the key board to indicate the power supply and battery status.

**Knob board:** The knob board transmits the signal to the main control board through the user to rotate or press the knob.

**Sensor board:** Each of the three X series models is equipped with a sensor board, which is mainly used to transfer the sensor signal and input it to the X12S parameter board.

**IBP-C.O. isolation board:** IBP-C.O. is mainly used to connect the sensor board to collect IBP and C.O. data and realize serial port isolation.

### 6.1.6 Power Module

The power module is EDAN power module. It outputs +19 V voltage to main control board, which is system's total input power source. The total output power of power module is 45 W.

### 6.1.7 CO<sub>2</sub> Module

The X series use the existing EDAN G2 module. The G2 module connects with the main

control board through the serial port, and is responsible for collecting CO<sub>2</sub> data and sending it to the main control board.

### 6.1.8 LCD

Product	Display
X8	Display screen: 8.0 inch color TFT, TTL interface; Resolution: 800×600
X10	Display screen: 10.1 inch color TFT, TTL interface; Resolution: 800×480
X12	Display screen: 12.1 inch color TFT, LVDS interface; Resolution: 800×600

## 6.2 Interfaces

For the interfaces, please refer to *Patient Monitor User Manual*.

## Chapter 7 Troubleshooting

EDAN supports replacement of PCB and major subassemblies for this monitor. When replacement is needed, follow the procedures described in chapter 8 *Disassembling the Monitor*.

### 7.1 Monitor Booting Failures

Phenomenon	Possible Cause	Solution
After switching on, no display is on the LCD; the power indicator is off; no fuses melt and break.	None AC power inputs.	Check whether the cable is intact and whether it is well connected with the monitor as well as the AC output.
	Keyboard failure.	Replace the keyboard.
	Power board failure.	Replace the power board.
	Main control board failure.	Replace the main control board.
The fuses melt and break during switching.	Power failure.	Replace the power board.
	Short circuit of other parts.	Retry after checking the short circuit source and fixing it.
Abrupt switching off.	If the monitor is powered by battery and switch off suddenly, maybe the battery is too low.	Please charge the battery and connect AC to the monitor.
	The monitor is stricken by strong high voltage, e.g. lightning strike.	Check the power supply and grounded system.
	Bad connection of power input.	Check the power input.
	The power supply button on keyboard failure.	Replace the keyboard.
	Power failure.	Replace the power supply.
	Interface board failure.	Replace the interface board

## 7.2 Display Failures

Phenomenon	Possible Cause	Solution
After switching on, the power indicator runs normally; but no display is on the screen.	LCD failure.	Replace the display screen.
	Screen drive board failure.	Replace the screen drive board. Refer to the principle diagram and repair the replaced one.
	Keyboard failure.	Bad connection of key board interface. Replace the keyboard.
	Main control board failure.	Replace the interface board. Refer to the principle diagram and repair the replaced one.
Wrong characters are displayed on screen.	LCD bad connection.	Check the LCD connection to main control board, screen drive board and keyboard.
	Screen drive board failure.	Replace the screen drive board. Refer to the principle diagram and repair the replaced one.
	LCD failure.	Replace display screen.
Incomplete display	Screen drive board failure.	Replace the screen drive board. Refer to the principle diagram and repair the replaced one.

## 7.3 Operation Failures

Phenomenon	Possible Cause	Solution
Keys are not functioning.	Key board failure.	Replace the key board.
	Key board connection failure.	Check the connection of the key board.
	The edge of the touch screen is pressed.	Check the assembling of the front cover and the touch screen.
It is mute when a key is pressed.	Speaker or wire failure.	1. Replace the speaker or wire. 2. Check the keyboard

Phenomenon	Possible Cause	Solution
		volume setting. Refer to relevant sections in <i>Patient Monitor User Manual</i> for details.
Turn the rotary knob and press on it, but there's no reaction.	Rotary knob failure.	Replace the rotary knob board.
Turning the rotary knob once, and the screen responds twice.	Rotary knob failure.	Replace the rotary knob board.
Hoarse sound or no sound from the speaker.	Speaker failure.	Replace the speaker.
	Main control board failure.	Replace the main control board.
Inaction of the touch screen.	The touch screen calibration failure.	Please calibrate touch screen twice.
	The touch screen is disconnected.	Check the connection of the main control board, the touch screen control board and the touch screen.
	The touch screen is damaged.	Replace the touch screen.
Deflection of the touch positions	The edge of the touch screen is pressed.	Check the assembling of the front cover and the touch screen.
	The touch screen has not been calibrated.	Calibrate the touch screen.
Touch screen has action after pressing on it, but calibration cannot be performed.	Screen drive board failure.	Replace the screen drive board. Refer to the principle diagram and repair the replaced one.
Micro-SD card cannot read.	Micro-SD card connection failure	Reinsert Micro-SD card, and ensure that Micro-SD card is completely fit with the card slot.

## 7.4 Recorder Failures

Phenomenon	Possible Cause	Solution
Press <b>Record</b> but no paper is out.	No paper in the drawer	Load paper and close the drawer.
	Printer mode is not selected.	Select <b>Manufacturer Maintain</b> . Turn on the printer mode. If the printer is Unicode, select U, otherwise E.
	The drawer is open.	Close the drawer.
	Paper is jammed.	Open the drawer and remove the paper. Reload paper and close the drawer.
	Recording control board failure.	Replace the recording control board.
	Recorder connection failure.	Check all the connections.
	Gear box/ gear failure.	Replace the gear box or the gear.
	Main control board failure.	Replace the main control board.
Alarm is displayed onscreen as “out of paper”, but there is still paper in the drawer.	The detector of recording paper is contaminated.	Clean the detector of recording paper.
	Detector of recording paper failure.	Replace the detector of recording paper.
	The drawer is not fastened up.	Fasten up the drawer.
Trace on the recording paper is blurred or tilts; or it is blank on the paper.	Inexact loading of the recording paper.	Load the recording paper exactly.
	Printer mode is not selected.	Select <b>Factory Maintain</b> . Turn on the printer mode. If the printer is Unicode, select U, otherwise E.
	Recording head failure.	Replace the recording head.
Printer setup is correct, and the power indicator of printer module is lightened, but printing	Connection failure between the main control board and interface board.	Reconnect the connecting wires between the main control board and interface board.

Phenomenon	Possible Cause	Solution
cannot be performed.		

### 7.5 Alarm Failures

Phenomenon	Possible Cause	Solution
Inaction of audible alarm.	The audible alarm is temporarily disabled.	Activate the audible alarm.
	Speaker or wire failure.	Replace the speaker or the wire.
	Connection failure between the main control board and interface board.	Reconnect the connecting wires between the main control board and interface board.
Alarm indicator stays off.	Alarm indicator failure.	Replace the alarm indicator.
	Alarm indicator board failure.	Replace the alarm indicator board.
Inaction of audible or visual alarm.	Program failure.	Update the software.

### 7.6 ECG/RESP Monitoring Failures

Phenomenon	Possible Cause	Solution
No ECG waveform	Bad connection of ECG cable.	Check the connection of the ECG cable.
	The ECG cable is damaged.	Replace the ECG cable.
	Bad connection of electrodes.	Check the connection or use new electrodes.
	RL electrode is suspended.	Connect RL electrode.
	ECG waveform is disabled.	Enable ECG waveform via system menu. Refer to the user manual for details.

	Lead type configuration is incorrect, for instance, 5-Electrode is set while applying 3-Electrode.	Reset the electrode type according to the following steps: on <b>ECG Setup</b> menu, set <b>Electrode Type</b> to <b>3 Electrodes</b> , <b>5 Electrodes</b> , <b>6 Electrodes</b> or <b>10 Electrodes</b> based on the lead used.
	ECG circuit failure on X12S parameter board.	Replace the X12S parameter board.
ECG waveform is abnormal or interference exists	Incorrect connection of electrodes.	Connect measurement electrodes correctly.
	There is suspending electrode.	Remove unused electrodes.
	No grounding wire for AC power.	Use 3-wire power supply.
	Wrong selection of ECG filter mode.	Select proper filter mode.
	ECG circuit failure on X12S parameter board.	Replace the X12S parameter board.
Heart rate is not precise. Arrhythmia and ST analysis are not correct.	ECG measuring waveform is not good.	Adjust the connection to make the measuring waveform normal.
	ECG circuit failure on X12S parameter board.	Replace the X12S parameter board.
No RESP waveform or RESP waveform is abnormal	Bad connection of electrodes.	Use RL-LL electrodes and connect them to the correct position.
	Frequent patient movement	Quiet the patient.
	RESP waveform is disabled.	Enable the RESP waveform via system menu.
	RESP waveform amplitude is small.	Adjust waveform amplitude via RESP menu.
	ECG circuit failure on X12S parameter board.	Replace the X12S parameter board.

## 7.7 SpO<sub>2</sub> Monitoring Failures

Phenomenon	Possible Cause	Solution
No SpO <sub>2</sub> waveform	SpO <sub>2</sub> sensor or module defective	Replace the SpO <sub>2</sub> sensor.
	Connection failure of SpO <sub>2</sub> sensor wires.	Check the connection.
	SpO <sub>2</sub> circuit failure on X12S parameter board.	Replace the X12S parameter board.
Strong interference exists in SpO <sub>2</sub> waveform	Patient movement	Quiet the patient.
	High level of ambient light interference	Minimize ambient light.
	SpO <sub>2</sub> circuit failure on X12S parameter board.	Replace the X12S parameter board.
SpO <sub>2</sub> value inaccuracy	SpO <sub>2</sub> sensor or module defective	Replace the SpO <sub>2</sub> sensor.
	Connection failure of SpO <sub>2</sub> sensor wires.	Check the connection.
	SpO <sub>2</sub> circuit failure on X12S parameter board.	Replace the X12S parameter board.

## 7.8 NIBP Monitoring Failures

Phenomenon	Possible Cause	Solution
NIBP value cannot be got occasionally	Cuff not wrapped tightly enough or patient movement	Wrap the cuff tightly to the patient; quiet the patient.
The cuff fails to be inflated.	Connection failure of cuff, extension cable and NIBP socket.	Check the connection from the external of the monitor.

Phenomenon	Possible Cause	Solution
	Connection failure of NIBP module, pump/valve and NIBP socket.	Check the NIBP airway connection inside the monitor.
	Cuff, extension cable or pump/valve is damaged.	Replace the damaged part.
	NIBP measuring pipe has leakage.	Perform leakage test to the monitor. Replace the pipe or pump/valve after confirmation.
	NIBP circuit failure on X12S parameter board.	Replace the X12S parameter board.
NIBP cannot be measured and no alarm information.	Cuff or extension cable is abnormal.	Replace cuff or extension cable.
	NIBP circuit failure on X12S parameter board.	Replace the X12S parameter board.
Big error in NIBP numeric value	Cuff size is unsuitable for patient	Use appropriate cuff.
	NIBP circuit failure on X12S parameter board.	Replace the X12S parameter board.

## 7.9 TEMP Monitoring Failures

Phenomenon	Possible Cause	Solution
No TEMP value or TEMP value is inaccurate.	TEMP sensor failure	Replace TEMP sensor.
	Bad connection of TEMP sensor	Check the connection.
	TEMP circuit failure on X12S parameter board.	Replace the X12S parameter board.

## 7.10 CO<sub>2</sub> Monitoring Failures

Phenomenon	Possible Cause	Solution
No CO <sub>2</sub> waveform	Bad connection of CO <sub>2</sub> module	Switch off the monitor and reconnect CO <sub>2</sub> module.
	CO <sub>2</sub> module defective	Replace the CO <sub>2</sub> module.
The CO <sub>2</sub> waveform is straight.	CO <sub>2</sub> module stays in standby mode.	Set the working mode of CO <sub>2</sub> module to measurement mode.
	The CO <sub>2</sub> sampling tube is jammed or not connected well.	Disconnect the sampling tube and clean it out or replace the sampling tube; reconnect it to the monitor.
CO <sub>2</sub> waveform is abnormal and the numeric value is incorrect.	CO <sub>2</sub> module has not been zeroed for a long time; thus, the measurement is inaccurate.	Access CO <sub>2</sub> setup menu and zero CO <sub>2</sub> module.
CO <sub>2</sub> waveform is smooth and the numeric value are displayed as “---”	CO <sub>2</sub> module stays in standby mode.	Set the working mode of CO <sub>2</sub> module to measurement mode.
A prompt message indicating tube jam is issued onscreen during CO <sub>2</sub> measurement	CO <sub>2</sub> sampling tube is jammed.	Disconnect the sampling tube and clean it out or replace the sampling tube; reconnect it to the monitor.
Correct CO <sub>2</sub> waveform with incorrect measured value	CO <sub>2</sub> module has not been zeroed for a long time; thus, the measurement is inaccurate.	Access CO <sub>2</sub> setup menu and zero CO <sub>2</sub> module.
	Compensation gas and barometric settings inaccuracy.	Access CO <sub>2</sub> setup menu and correctly set compensation gas and barometric pressure.

## 7.11 IBP Monitoring Failures

Phenomenon	Possible Cause	Solution
The IBP waveform is available; yet IBP measurement value is unavailable	The IBP module has not been zeroed or zero drift occurs.	Zero the IBP module.
The IBP waveform appears and disappears time after time	Bad connection of the IBP cable and sensor.	Check the connection of IBP cable and sensor.
The IBP waveform is flat and there is no apparent fluctuation	Unsuitable selection of the ruler.	Check whether the IBP label is consistent with the measured site of the patient; adjust the ruler.
The monitor indicates an IBP communication failure	Failure in the PCB of IBP module or disconnection of the IBP module and communication board.	Check the connection of IBP module and communication board or change the IBP module.

## 7.12 C.O. Monitoring Failures

Phenomenon	Possible Cause	Solution
C.O. value cannot be got	Injectate temperature is too high.	Use injectate with a lower temperature.
A prompt message indicating "C.O. measure need param" is issued	Absence of setting patient height and weight.	Check and make sure the patient settings are configured.
The monitor indicates an C.O. communication failure	Failure in the PCB of C.O. module or disconnection of wires inside the C.O. module.	Check the wires inside the module or replace the PCB for the module.

## 7.13 Technical Alarms

For details on technical alarms, please refer to relevant section in the user manual.

## Chapter 8 Disassembling the Monitor

### **WARNING**

- 1 Only qualified service personnel shall open the monitor housing.
- 2 Switch off the monitor and disconnect it from AC power before disassembling the monitor.
- 3 After any repair of the device, perform safety tests prior to use.

### 8.1 Tools Required

1 – A cross-head screwdriver



2 – A flat-head screwdriver



3 – A M3 nut driver



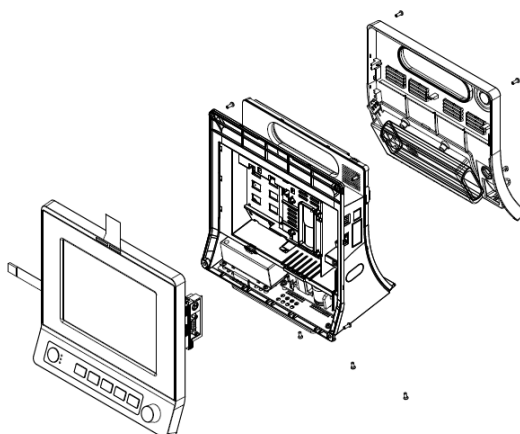
4 – A pair of pliers



### 8.2 Disassembling the Main Unit

#### 8.2.1 Disassembling X8 Main Unit

The main unit of the patient monitor consists of three parts: front housing, rear housing and main frame.



To disassemble the main unit:

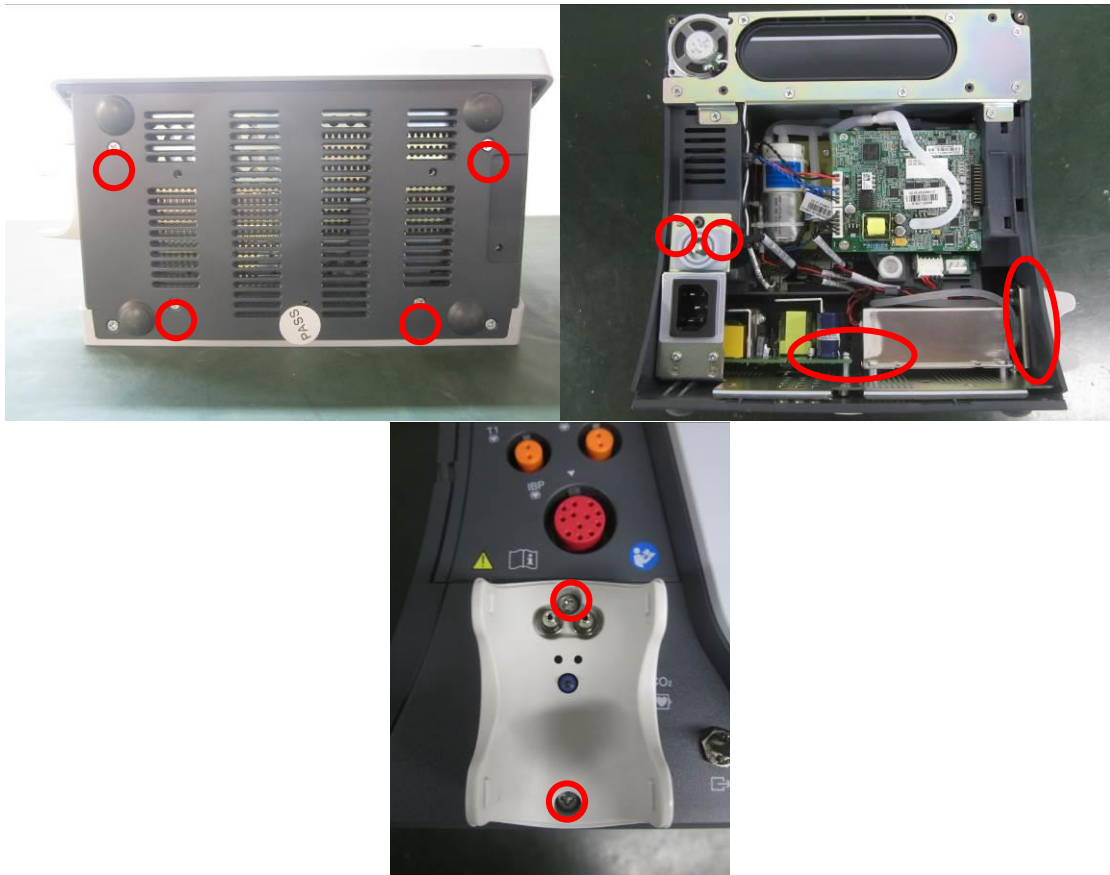
1. Unscrew the rear housing screw with a screwdriver to open the main frame.



2. Unscrew the front housing screw with a screwdriver and unplug the linking wire connecting the main board of the front housing, then the front housing assembly can be opened.

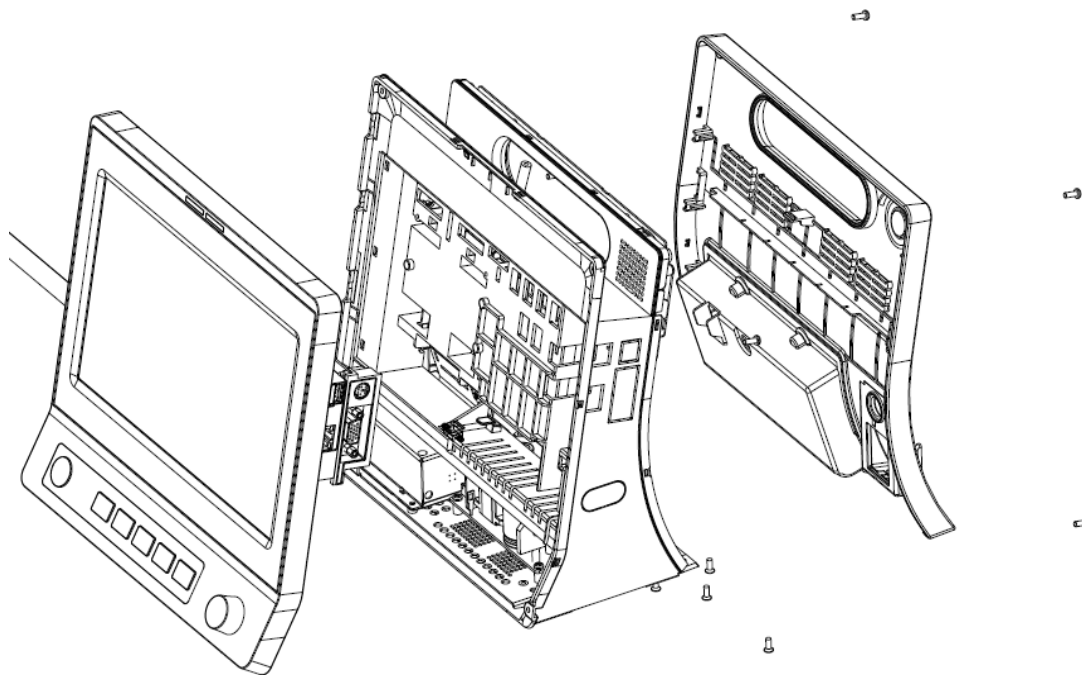


3. Unscrew the fixed frame base plate screw and water trap holder screw with the cross-head screwdriver, and unplug the linking wire of the front housing main board, the water trap holder and the air tube, then the base housing assembly and the main frame can be separated.



### 8.2.2 Disassembling X10 Main Unit

The main unit of the patient monitor consists of three parts: front housing, rear housing and main frame.



1. Unscrew the rear housing screw with a screwdriver to open the main frame.



2. Unscrew the front housing screw with a screwdriver and unplug the linking wire connecting the main board of the front housing, then the front housing assembly can be opened.

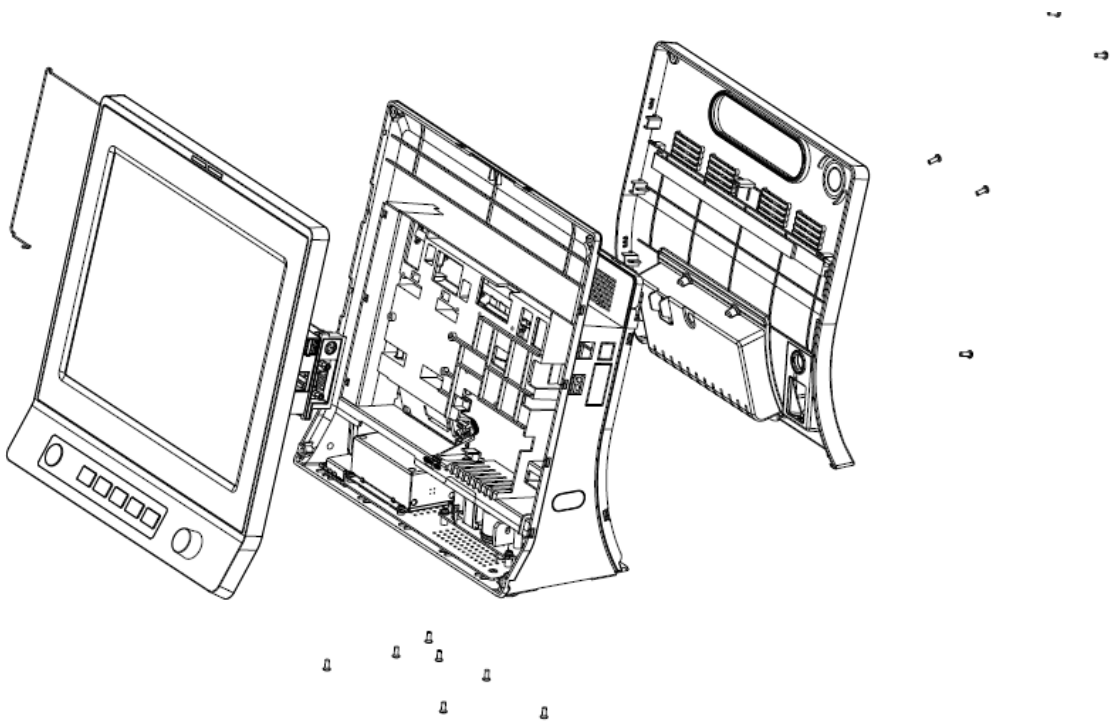


3. Unscrew the fixed frame base plate screw and water trap holder screw with the cross-head screwdriver, and unplug the linking wire of the front housing main board, the water trap holder and the air tube, then the base housing assembly and the main frame can be separated.



### 8.2.3 Disassembling X12 Main Unit

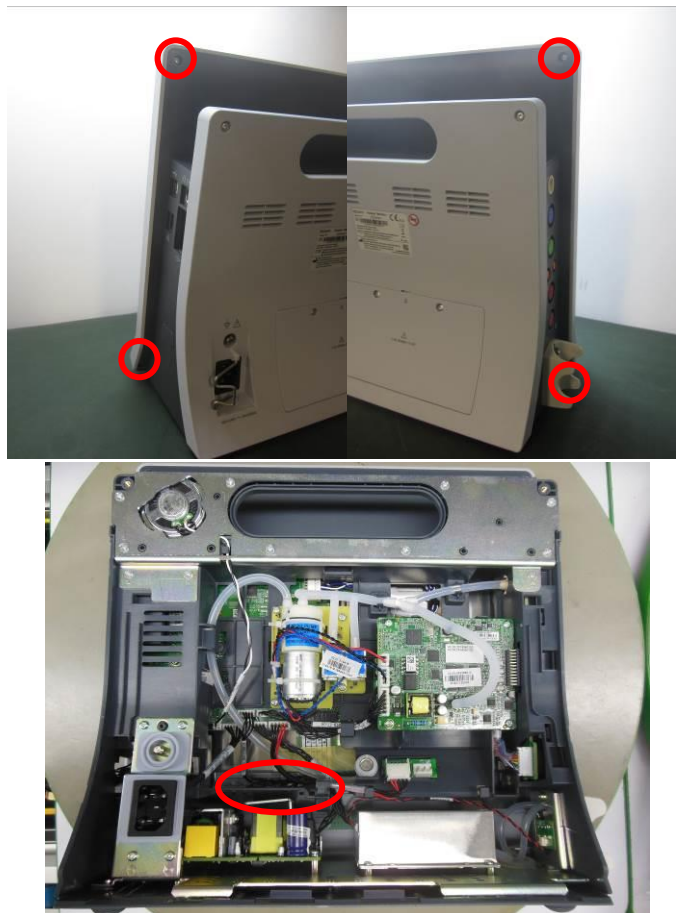
The main unit of the patient monitor consists of three parts: front housing, rear housing and main frame.



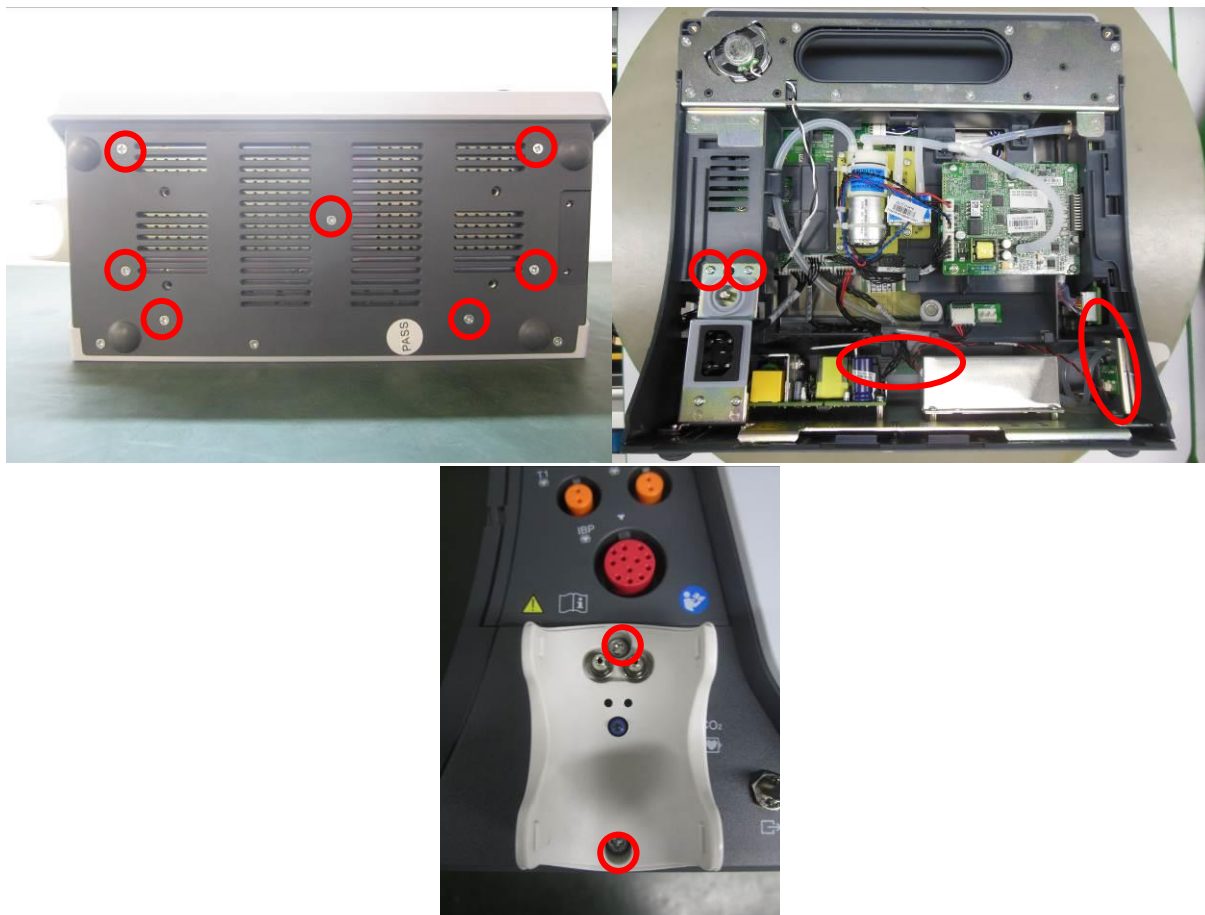
1. Remove the rear housing screw with a screwdriver to open the main frame.



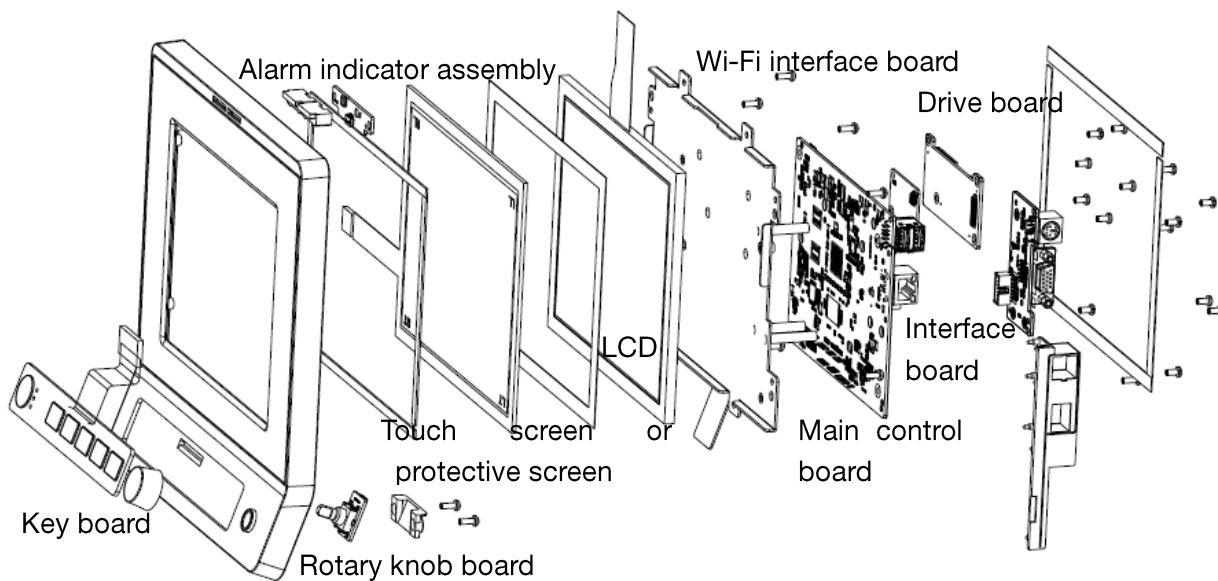
2. Unscrew the front housing screw with a screwdriver and unplug the linking wire connecting the main board of the front housing, then the front housing assembly can be opened.



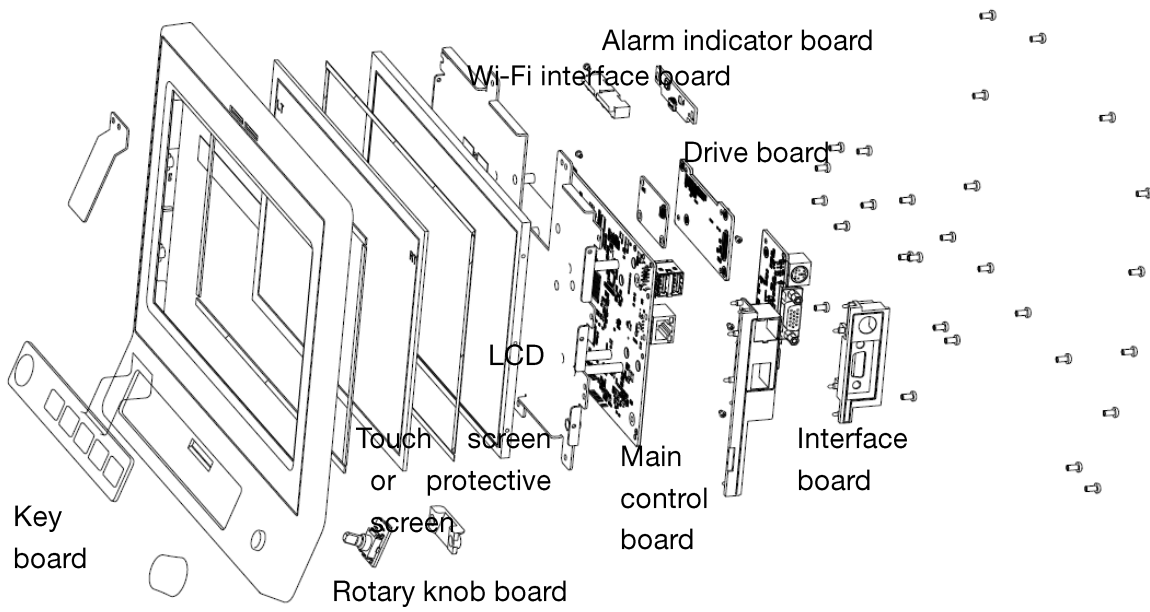
3. Unscrew the fixed frame base plate screw and water trap holder screw with the cross-head screwdriver, and unplug the linking wire of the front housing main board, the water trap holder and the air tube, then the base housing assembly and the main frame can be separated.



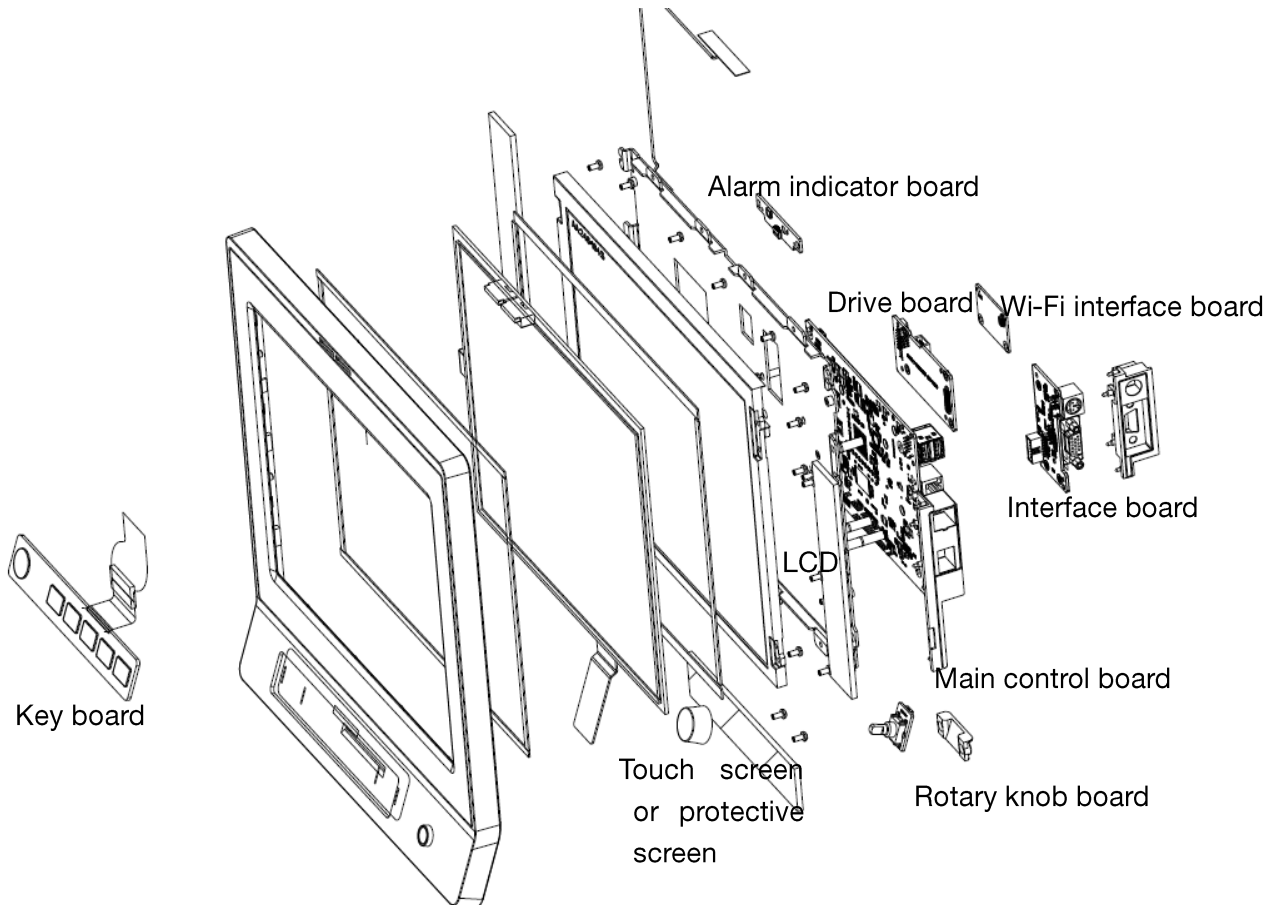
### 8.3 Disassembling the Front Housing Assembly



X8 Front Housing Structure Block Diagram



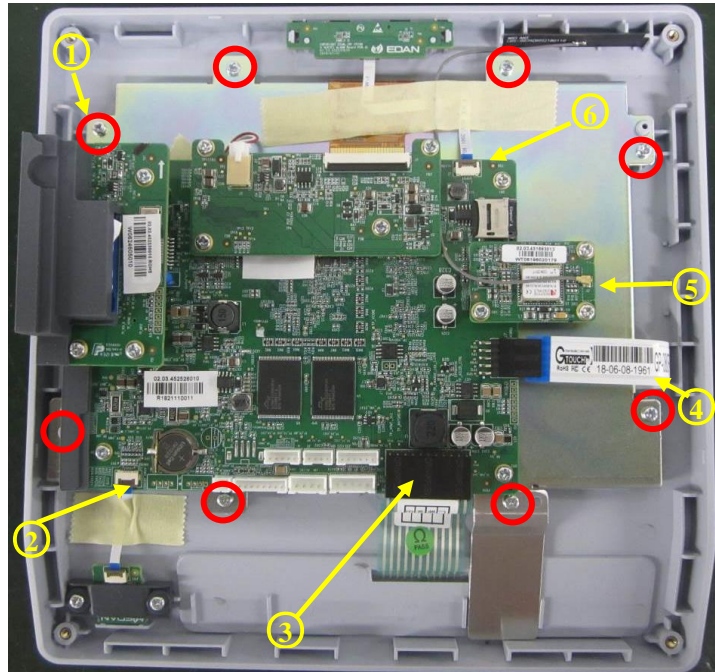
X10 Front Housing Structure Block Diagram



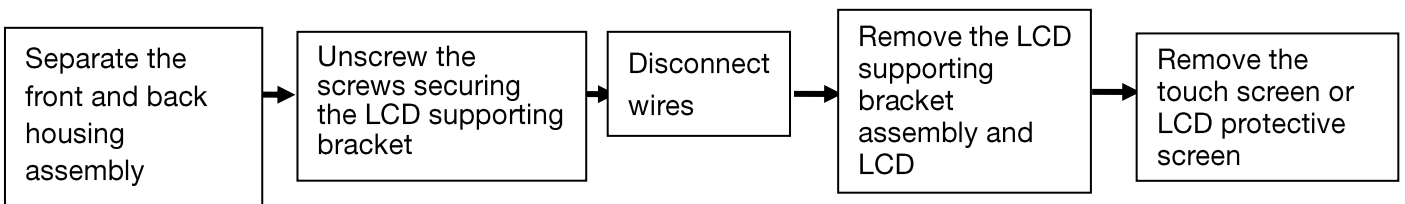
X12 Front Housing Structure Block Diagram

### 8.3.1 Replacing the Touch Screen or Protective Screen

#### 1. Replacing the Touch Screen or Protective Screen for X8



①	Screws	④	Touch screen linking wire
②	Wires linking main control board and rotary knob board	⑤	Wi-Fi linking wire
③	Wires linking main control board and key board	⑥	Alarm indicator linking wire

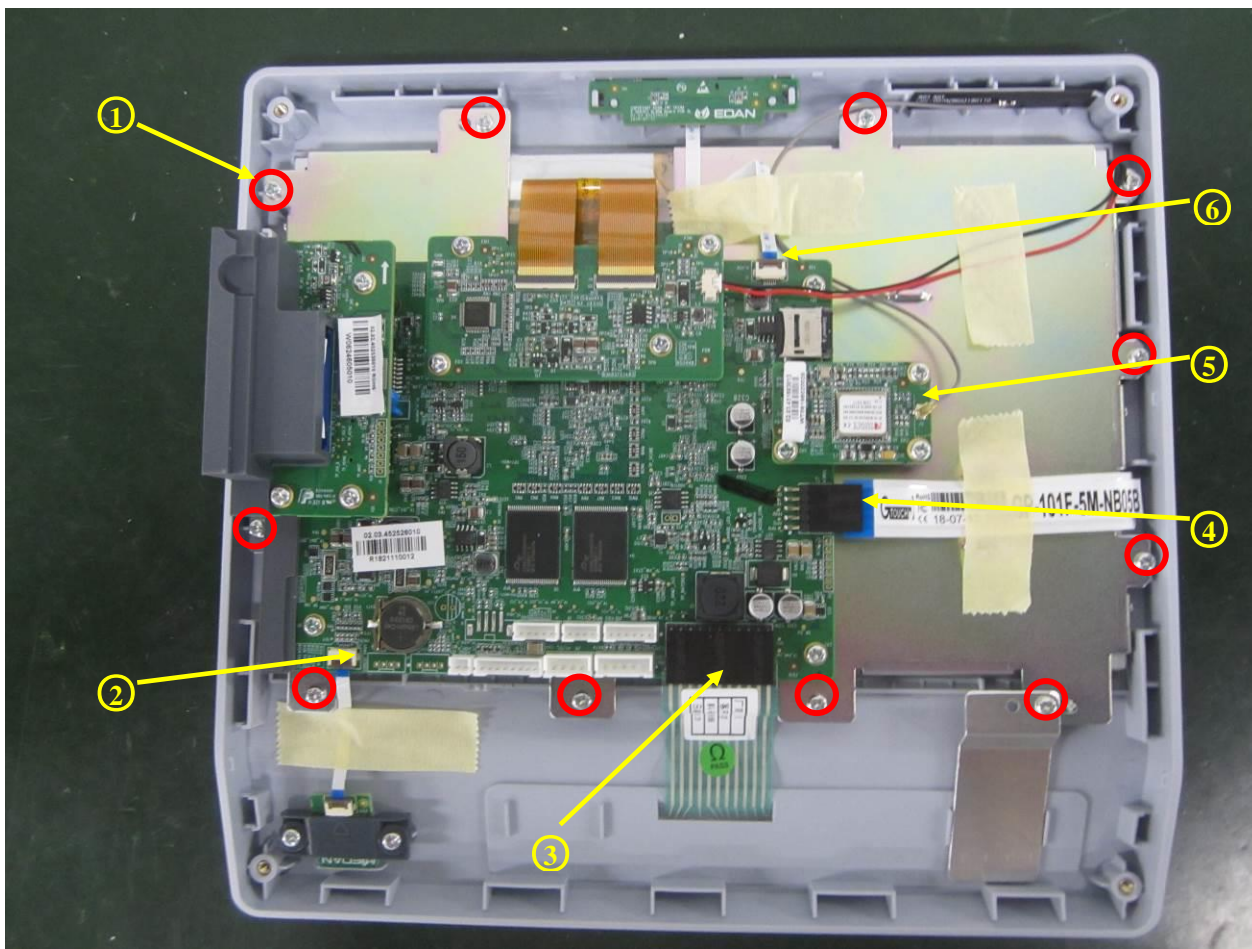


Assemble the touch screen or protective screen in the reversed order. Connect the wires and fix the main unit. Check whether the sponge around the LCD is damaged. If so, please replace a new one.

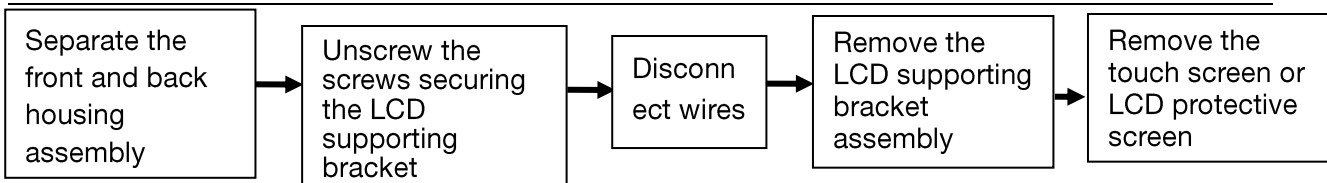
**NOTE:**

The user can only choose one from the touch screen and protective screen to assemble in the main unit.

## 2. Replacing the Touch Screen or Protective Screen for X10



- |   |  |
|---|--|
| <p>① Screws</p> <p>② Wires linking main control board and rotary knob board</p> <p>③ Wires linking main control board and key board</p> | <p>④ Touch screen linking wire</p> <p>⑤ Wi-Fi linking wire</p> <p>⑥ Alarm indicator linking wire</p> |
|---|--|

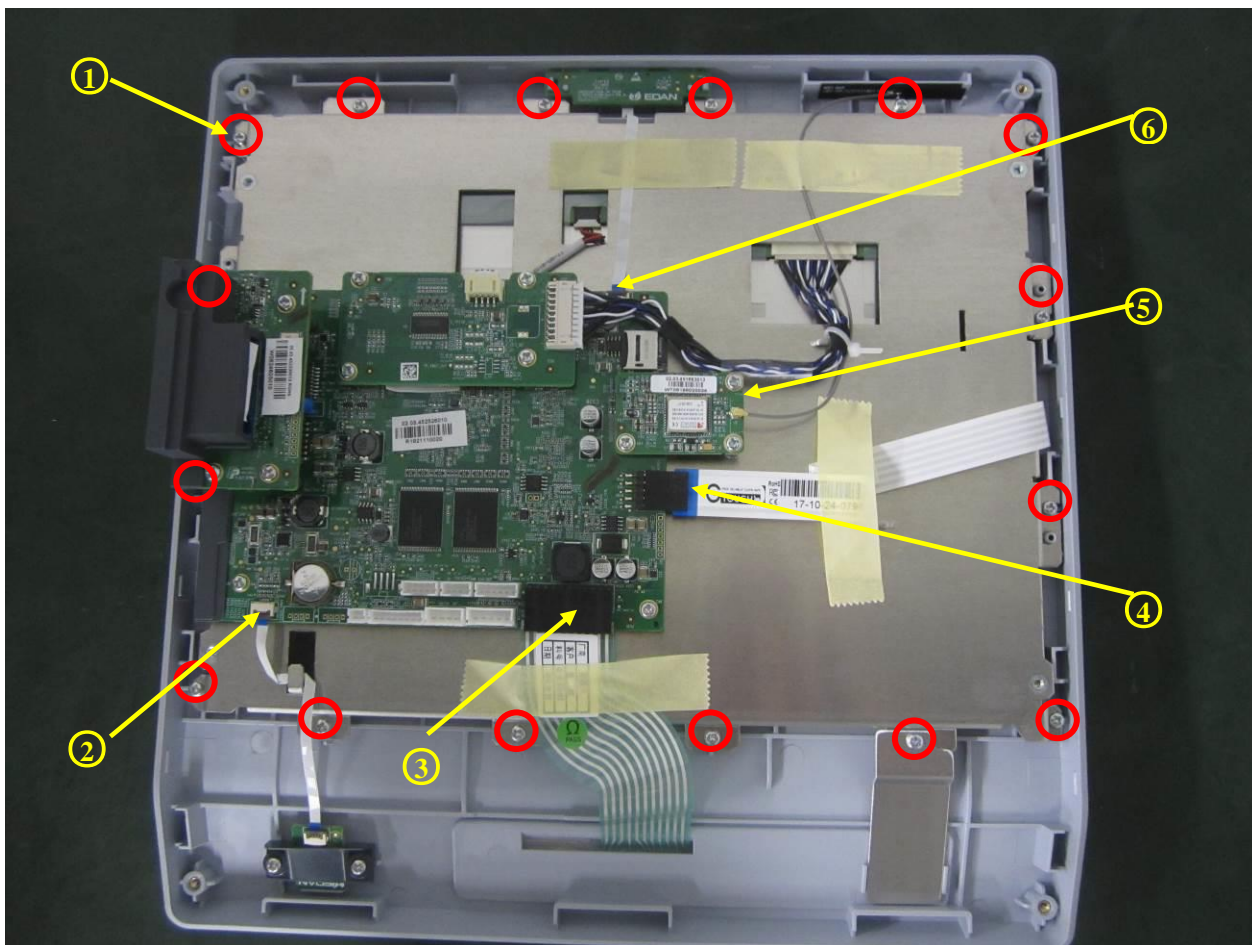


Assemble the touch screen or protective screen in the reversed order. Connect the wires and fix the main unit. Check whether the sponge around the LCD is damaged. If so, please replace a new one.

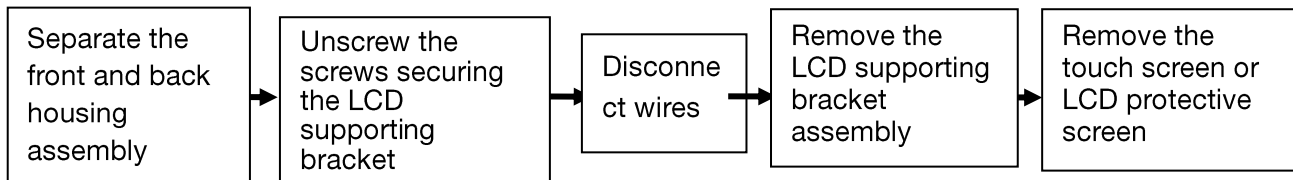
**NOTE:**

The user can only choose one from the touch screen and protective screen to assemble in the main unit.

### 3. Replacing the Touch Screen or Protective Screen for X12



①	Screws	④	Touch screen linking wire
②	Wires linking main control board and rotary knob board	⑤	Wi-Fi linking wire
③	Wires linking main control board and key board	⑥	Alarm indicator linking wire



Assemble the touch screen or protective screen in the reversed order. Connect the wires and fix the main unit. Check whether the sponge around the LCD is damaged. If so, please replace a new one.

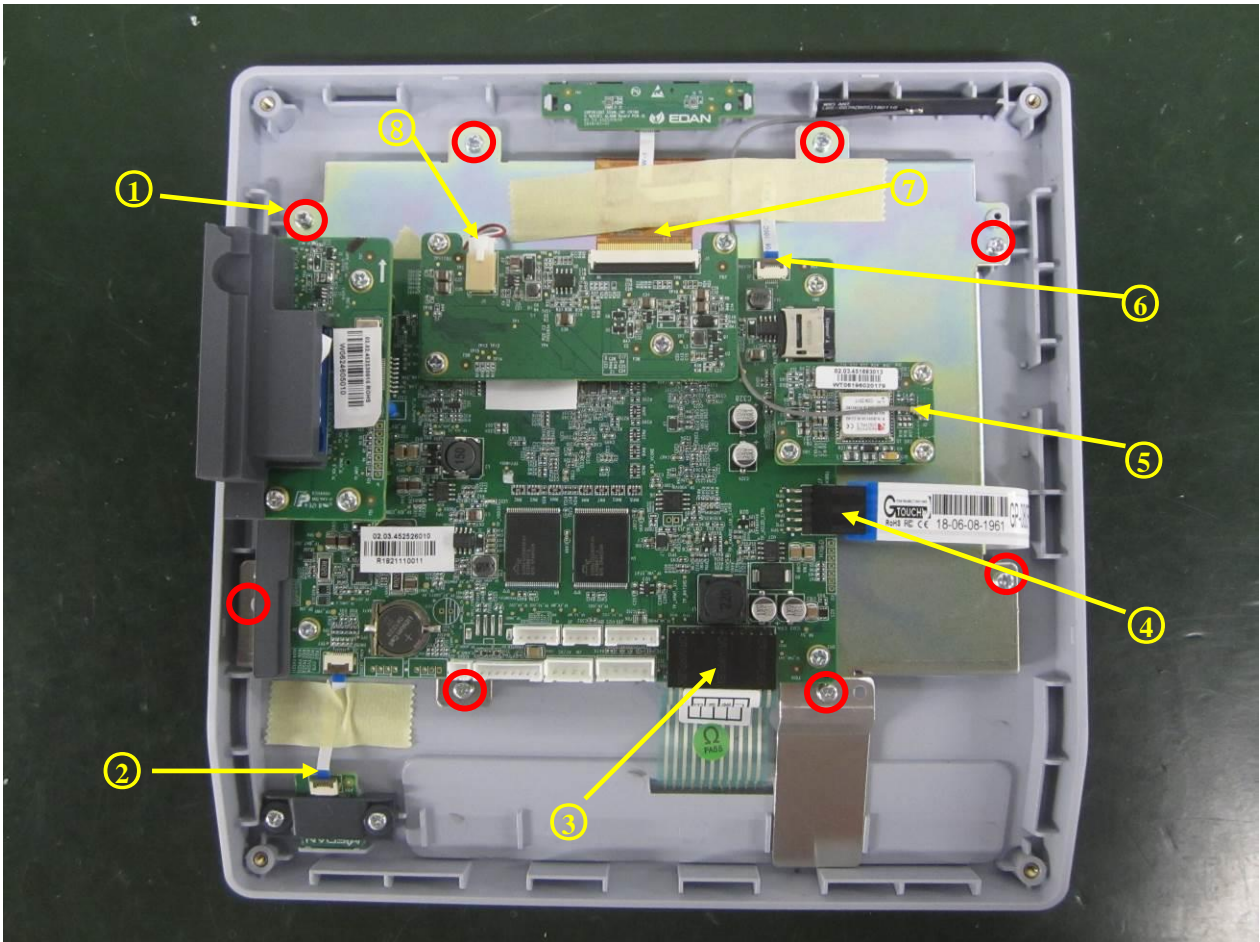
**NOTE:**

The user can only choose one from the touch screen and protective screen to

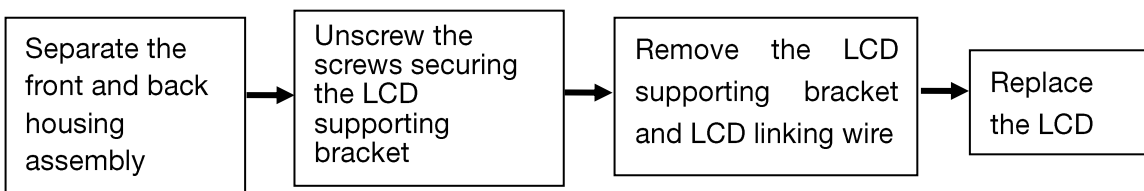
assemble in the main unit.

### 8.3.2 Replacing the LCD

#### 1. Replacing the LCD for X8

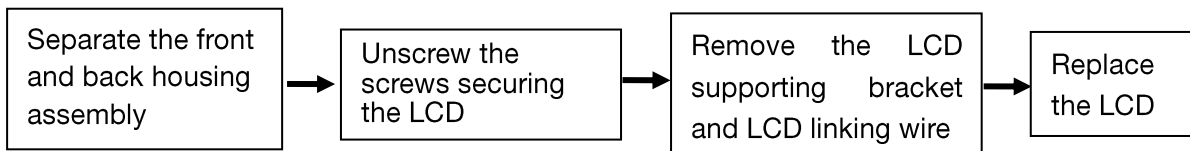
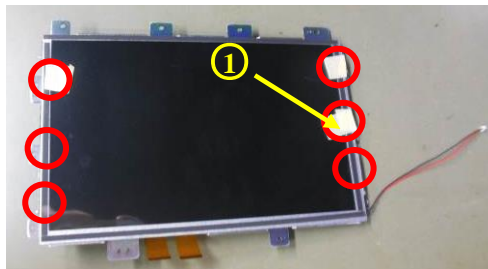
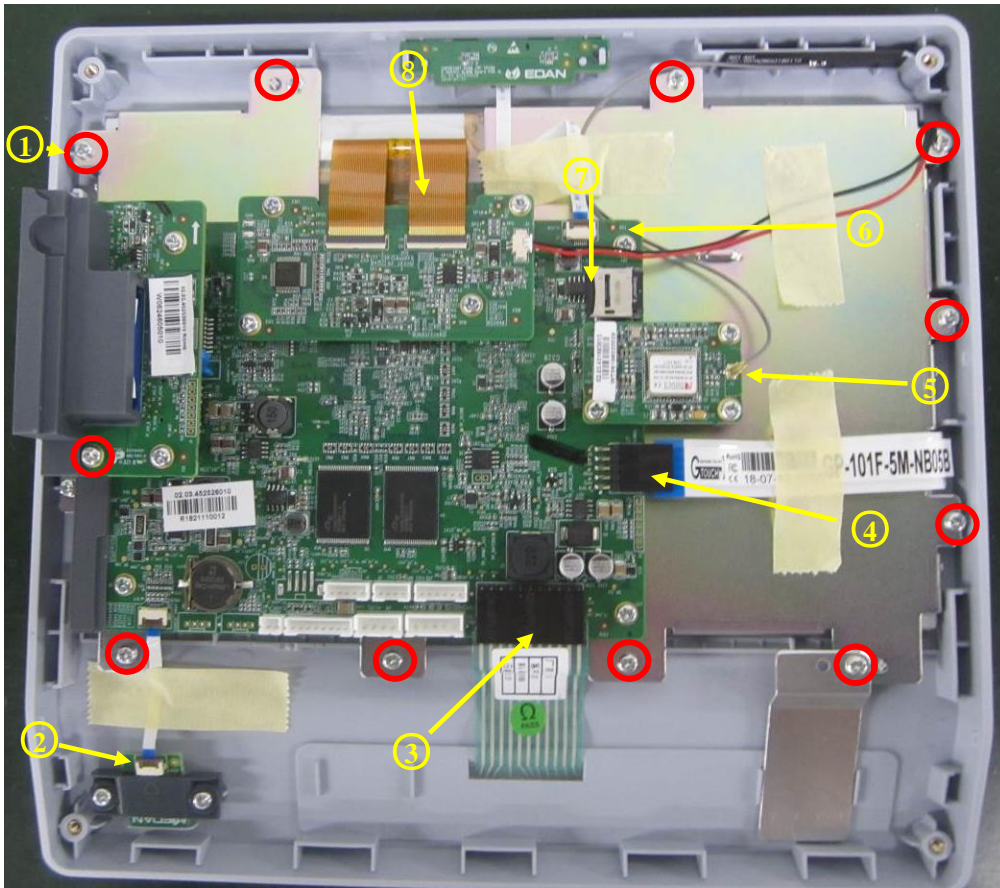


①	Screws	⑤	Wi-Fi linking wire
②	Wires linking main control board and rotary knob board	⑥	Alarm indicator linking wire
③	Wires linking main control board and key board	⑦	LCD linking wire
④	Touch screen linking wire	⑧	LCD backlight linking wire interface



Assemble the LCD in the reversed order. Connect the wires and fix the main unit.

2. Replacing the LCD for X10



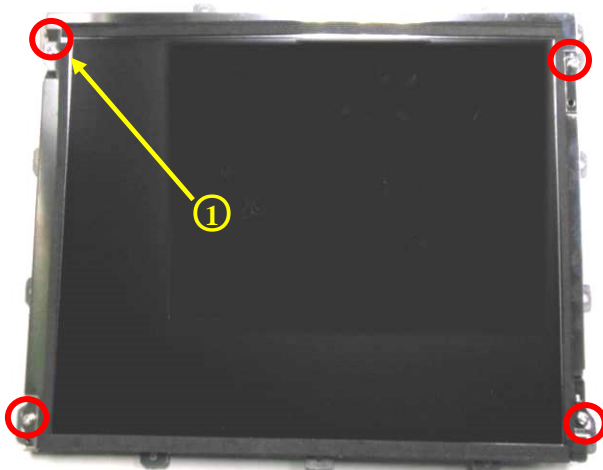
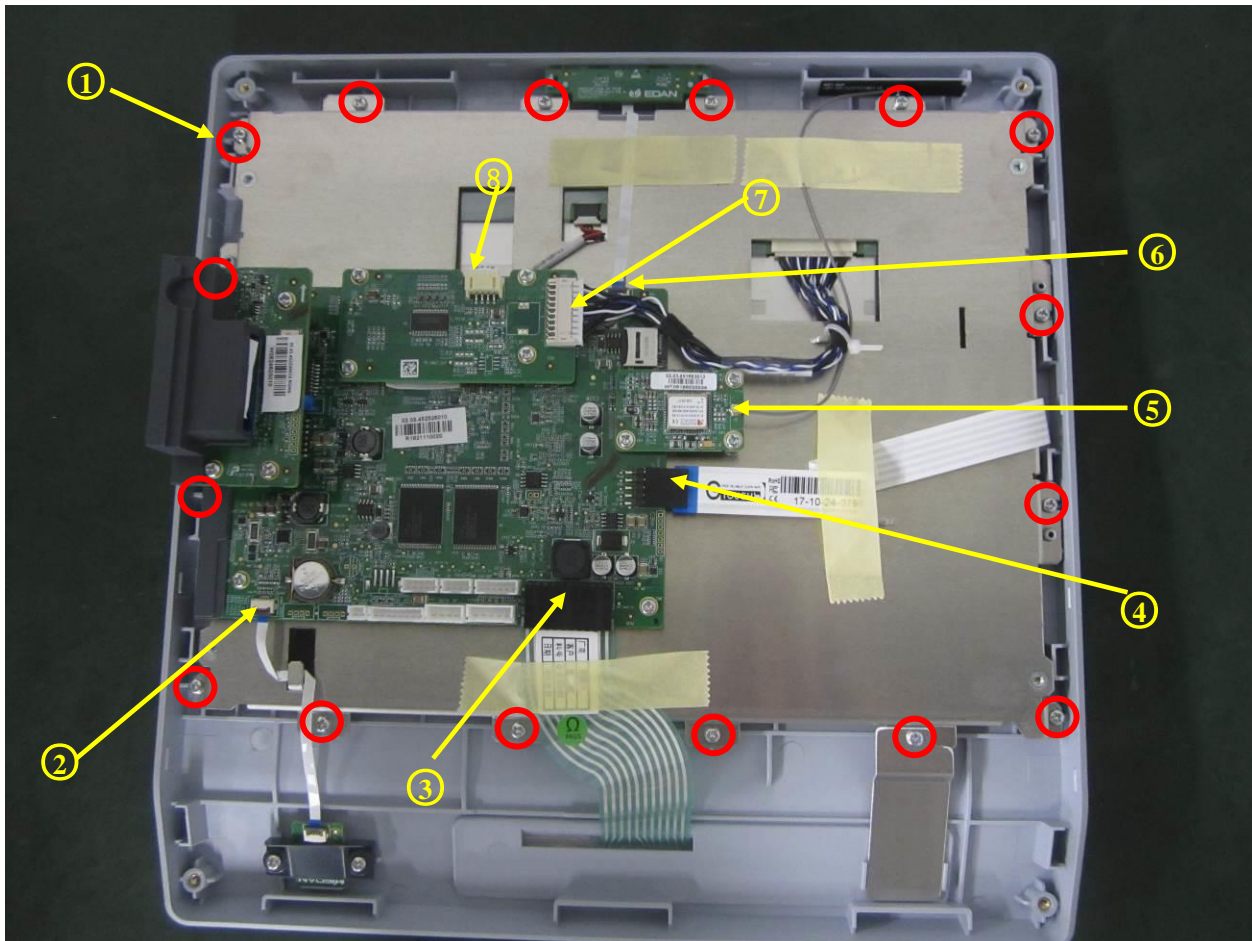
①	Screws	⑤	Wi-Fi linking wires
②	Wires linking main control board and rotary knob board	⑥	Alarm indicator linking wire
③	Wires linking main control board and key board	⑦	LCD backlight linking wire interface

④ Touch screen linking wire

⑧ Touch screen linking wire

Assemble the LCD in the reversed order. Connect the wires and fix the main unit.

3. Replacing the LCD for X12



① Screws

⑤ Wi-Fi linking wire

② Wires linking main control board and rotary knob

⑥ Alarm indicator linking wire

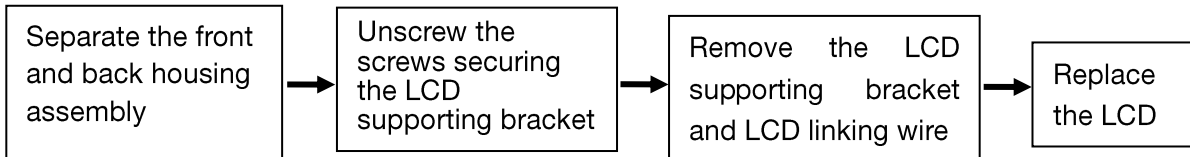
board

③ Wires linking main control board and key board

⑦ LCD linking wire

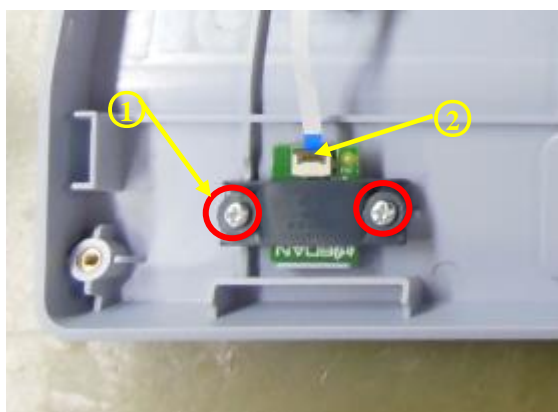
④ Touch screen linking wire

⑧ LCD backlight linking wire interface



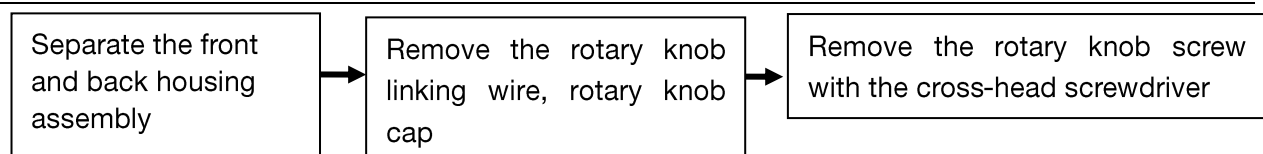
Assemble the LCD in the reversed order. Connect the wires and fix the main unit.

### 8.3.3 Replacing the Rotary Knob



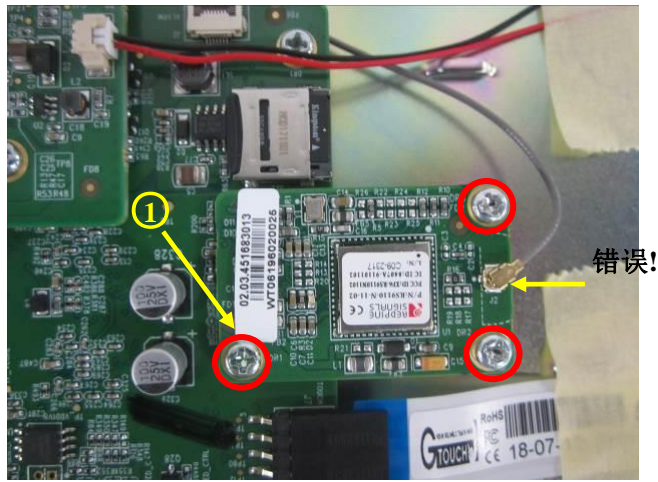
① Screws

② Rotary knob linking wire



Assemble the rotary knob board in the reversed order. Connect the wires and fix the main unit.

### 8.3.4 Replace Wi-Fi Interface Board



① Screws

② Wi-Fi antenna

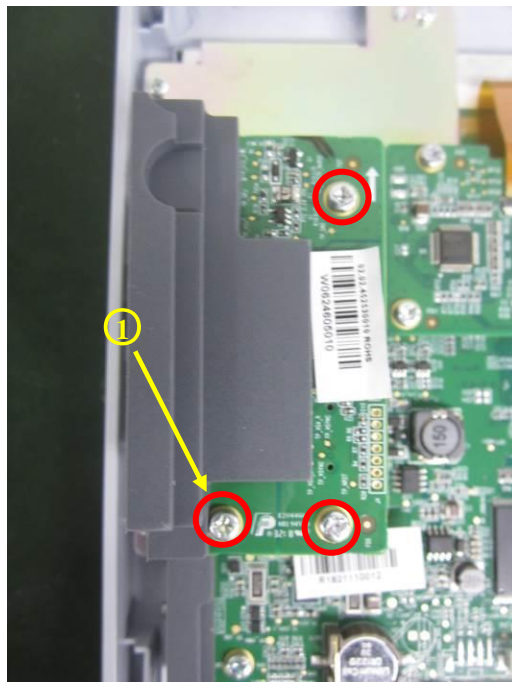
Separate the front and back housing assembly

Remove the Wi-Fi antenna

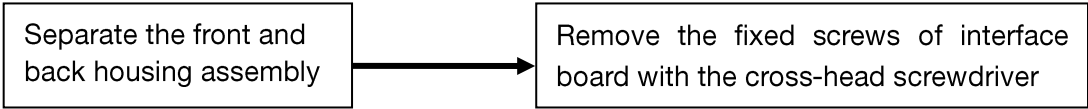
Remove the Wi-Fi board screw with the cross-head screwdriver

Assemble the Wi-Fi interface board in the reversed order. Connect the wires and fix the main unit.

### 8.3.5 Replacing the Interface Board

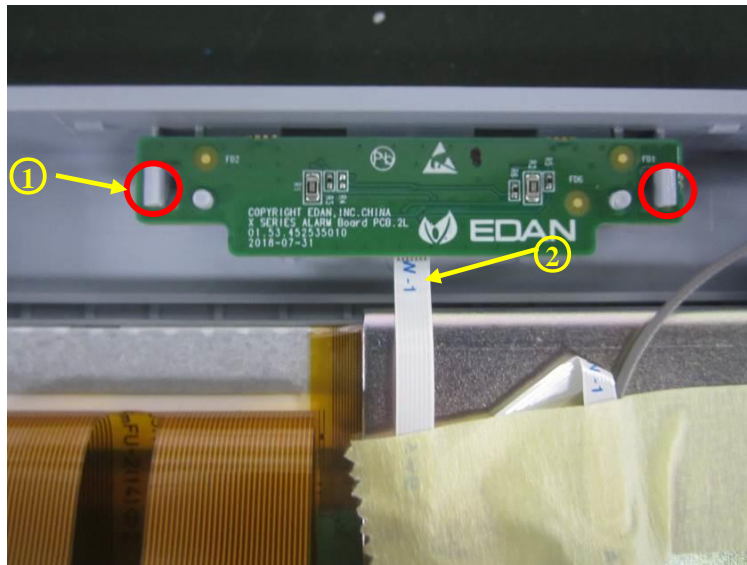


① Screws



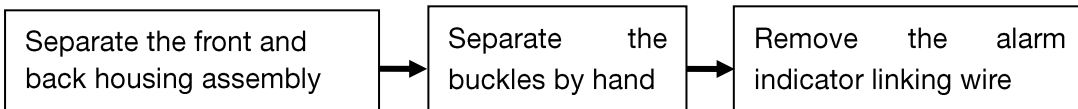
Assemble the alarm indicator board in the reversed order. Connect the wires and fix the main unit.

### 8.3.6 Replacing the Alarm Indicator Board



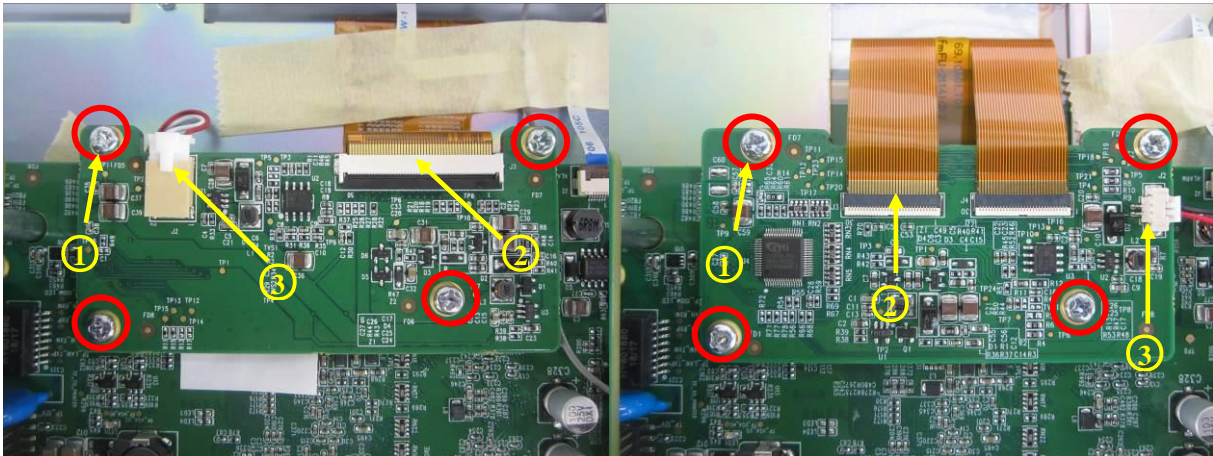
① Fixed buckles

② Alarm indicator linking wire



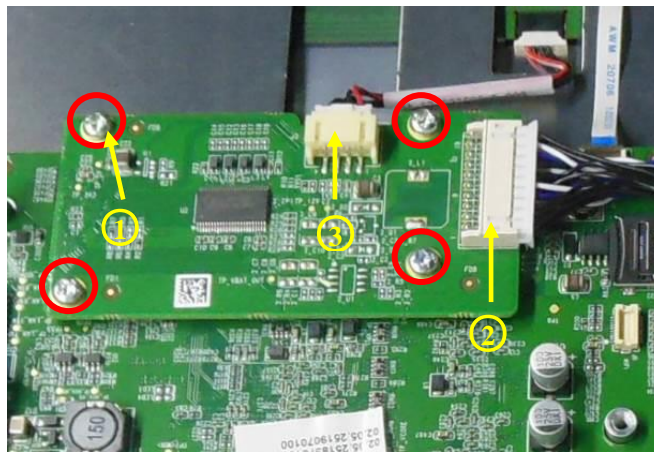
Assemble the alarm indicator board in the reversed order. Connect the wires and fix the main unit.

### 8.3.7 Replacing the Screen Drive Board



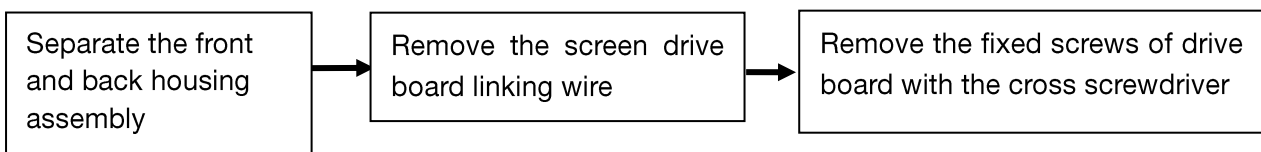
8" Screen Drive Board

10" Screen Drive Board



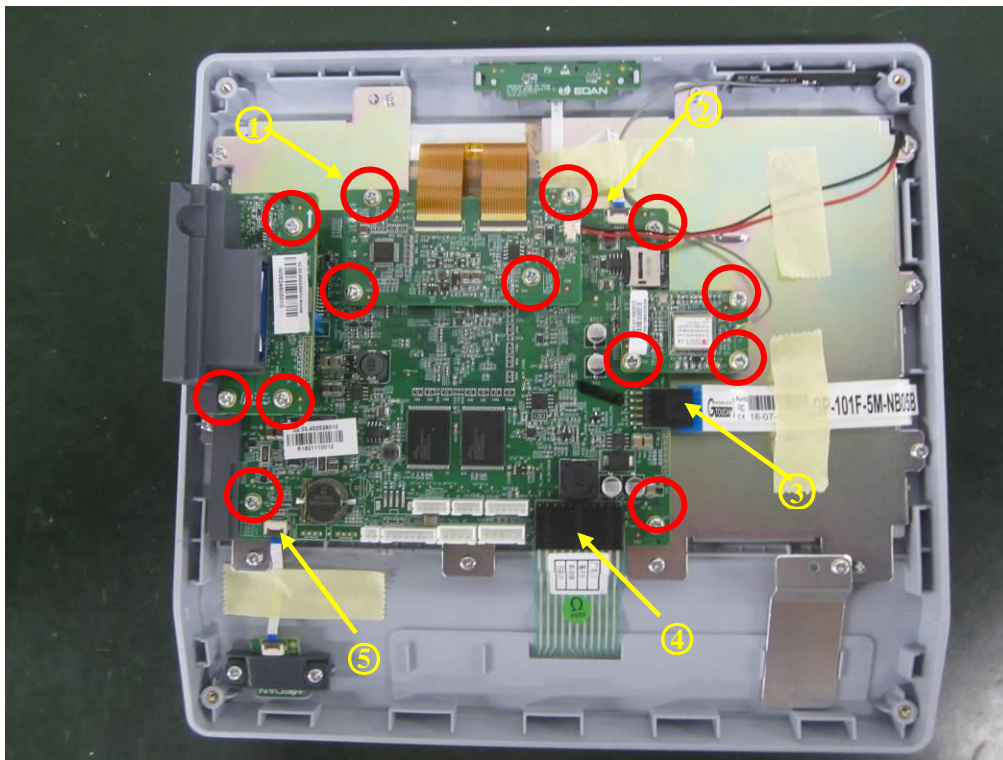
12" Screen Drive Board

- |                                     |                            |
|-------------------------------------|----------------------------|
| <p>① Fixed screws</p>               | <p>③ LCD linking wires</p> |
| <p>② LCD backlight linking wire</p> |                            |

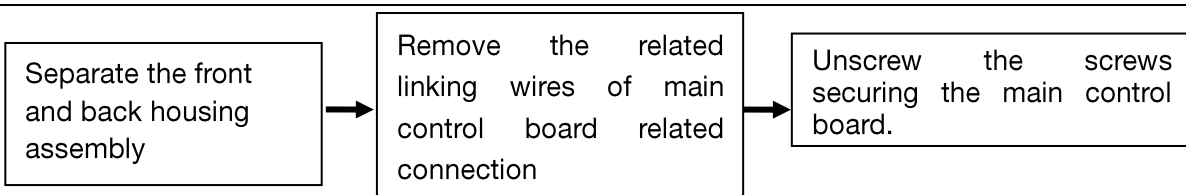


Assemble the screen drive board in the reversed order. Connect the wires and fix the main unit.

### 8.3.8 Replacing the Main Control Board

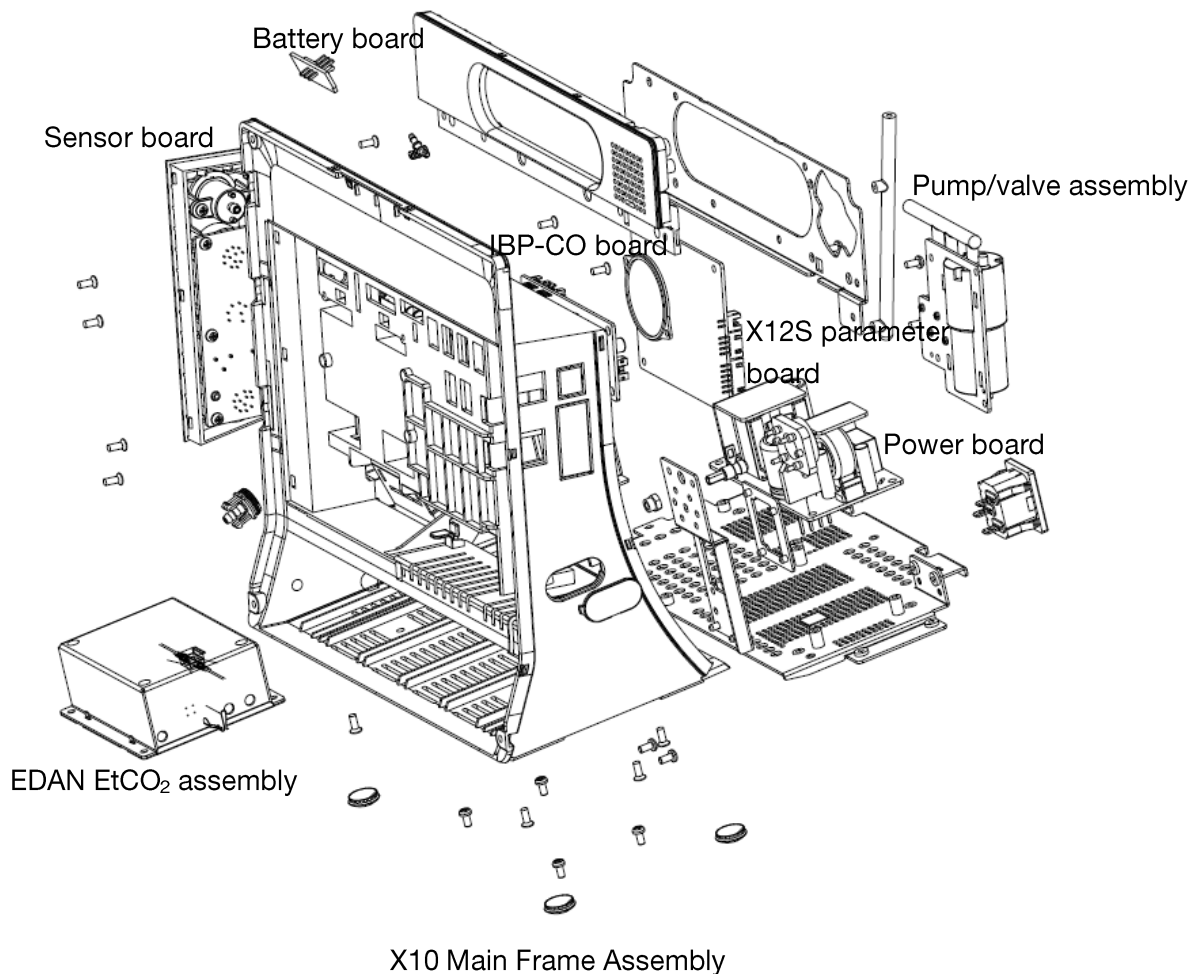
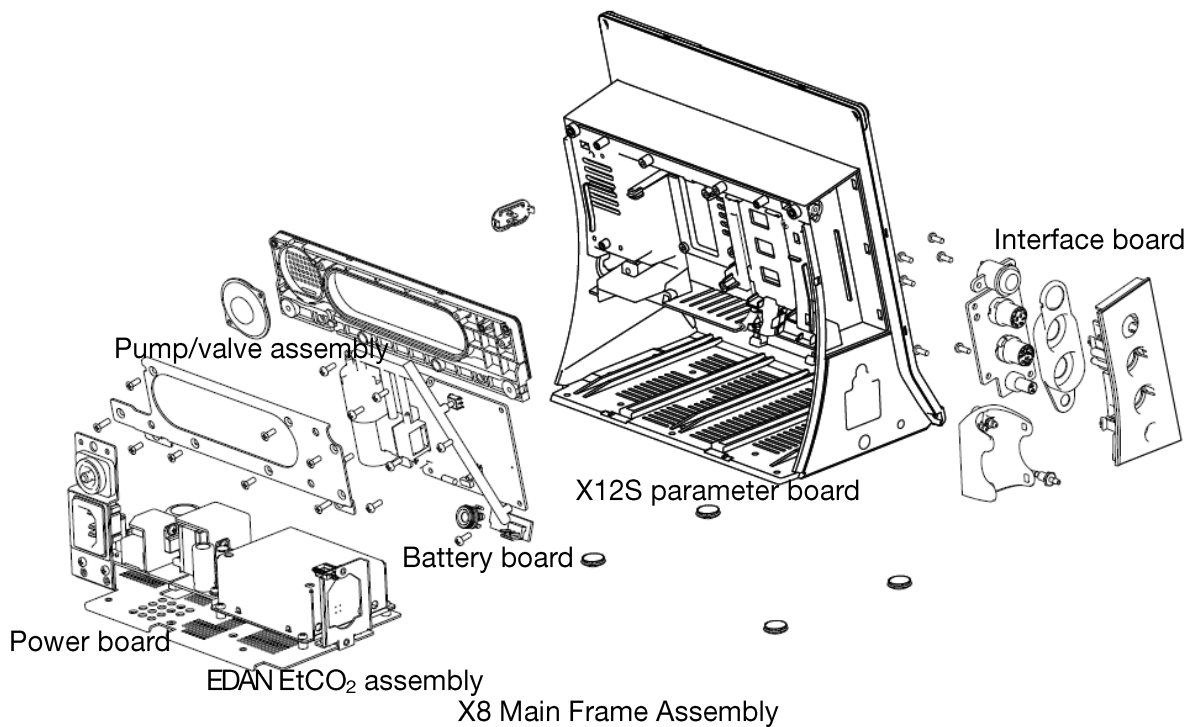


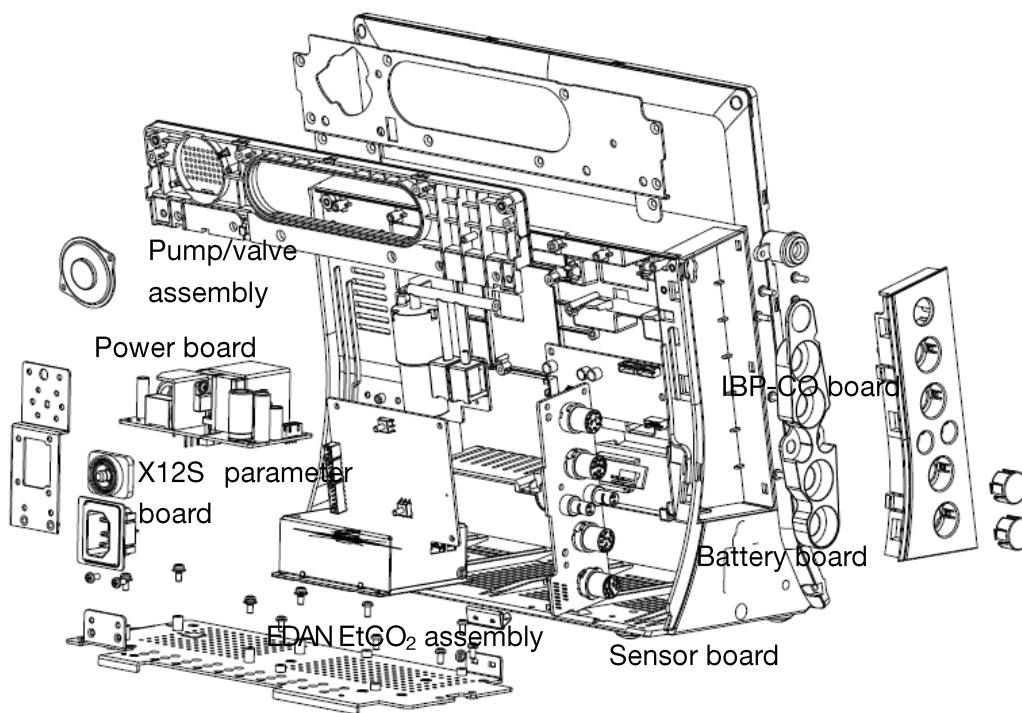
- |   |                              |   |   |
|---|------------------------------|---|---|
| ① | Screws                       | ④ | Linking wire connecting main control board and key board    |
| ② | Alarm indicator linking wire | ⑤ | Linking wire connecting main control board and rotary board |
| ③ | Touch screen linking wire    |   |   |



Assemble the alarm indicator board in the reversed order. Connect the wires and fix the main unit.

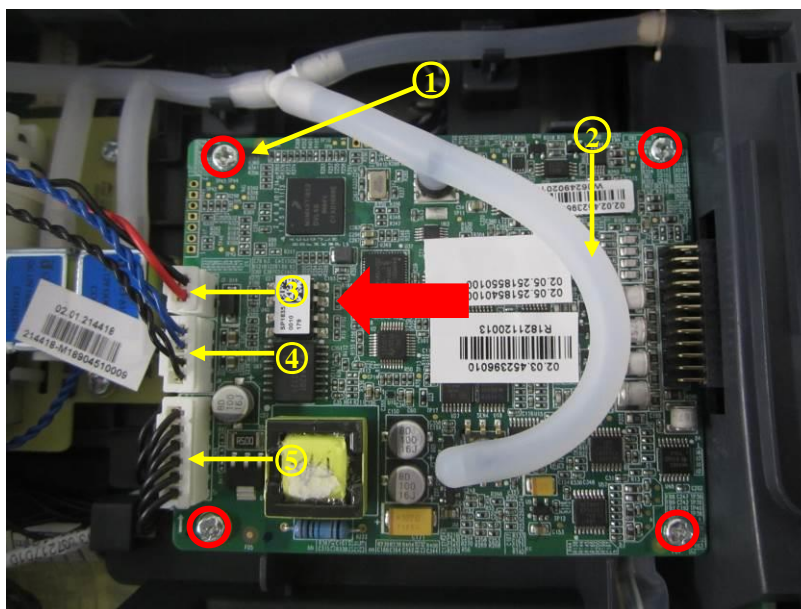
### 8.4 Disassembling the Main Frame Assembly





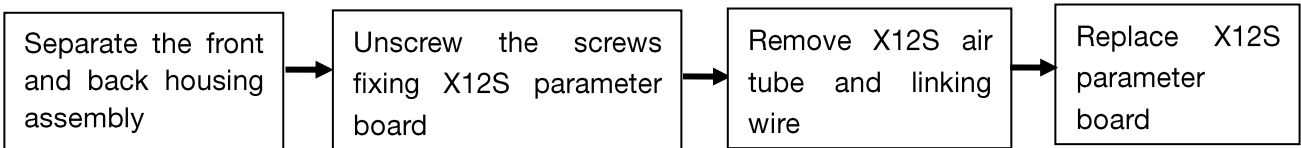
X12 Main Frame Assembly

### 8.4.1 Replacing X12S Parameter Board



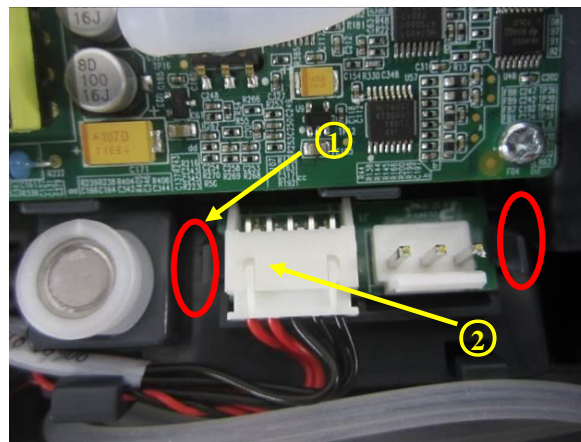
- |   |          |   |                    |
|---|----------|---|--------------------|
| ① | Screws   | ④ | Valve linking wire |
| ② | Air tube | ⑤ | X12S linking wire  |

③ Pump linking wire



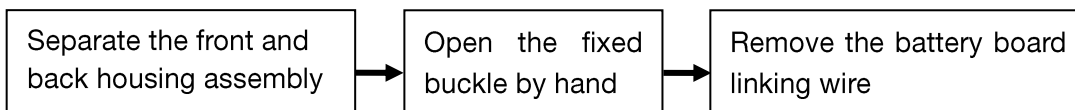
Assemble X12S parameter board in the reversed order. Connect the wires and air tubes, and fix the main unit.

### 8.4.2 Replacing the Battery Board



① Screws

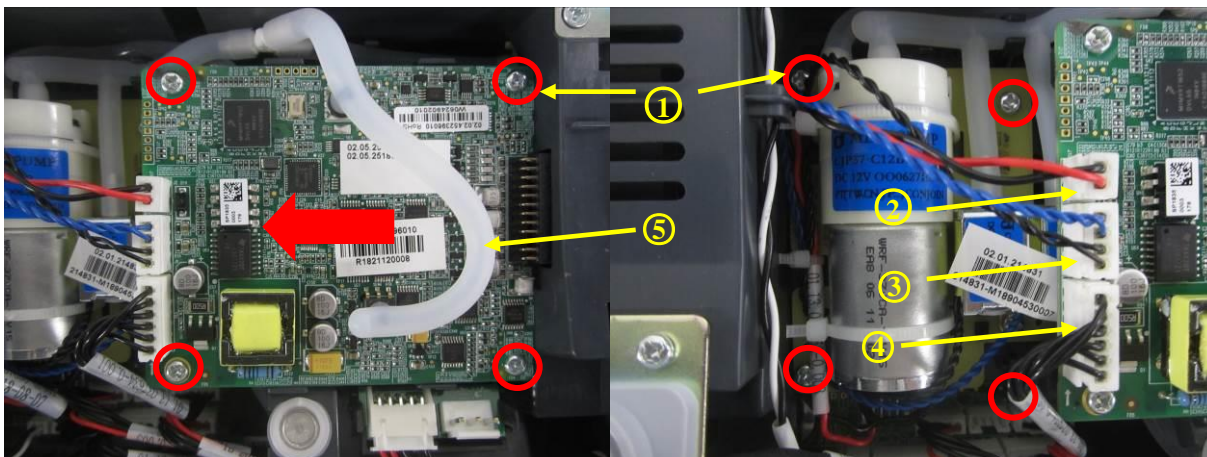
② Battery linking wire



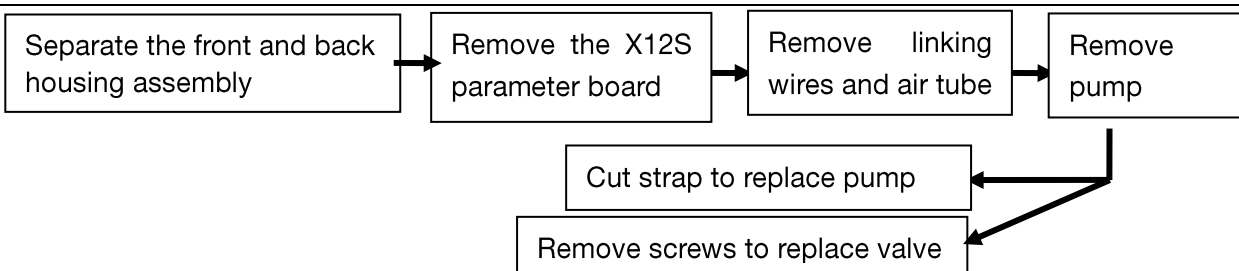
Assemble battery board in the reversed order. Connect the wires, and fix the main unit.

### 8.4.3 Replacing Pump/Valve Assembly

1. Replacing X8 pump/valve assembly:

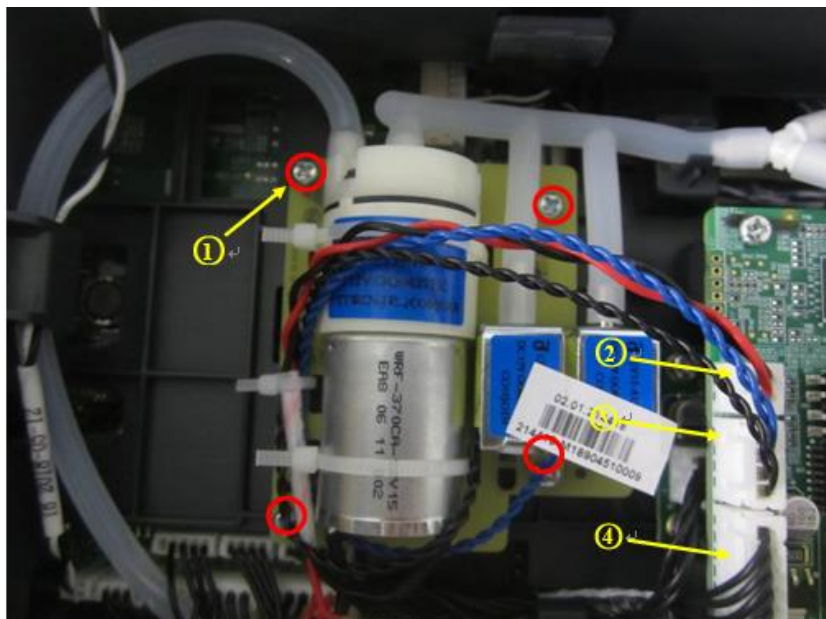


- |   |                   |   |                    |
|---|-------------------|---|--------------------|
| ① | Screws            | ③ | Valve linking wire |
| ② | Pump linking wire | ④ | X12S linking wire  |
| ⑤ | Air tube          |   |                    |

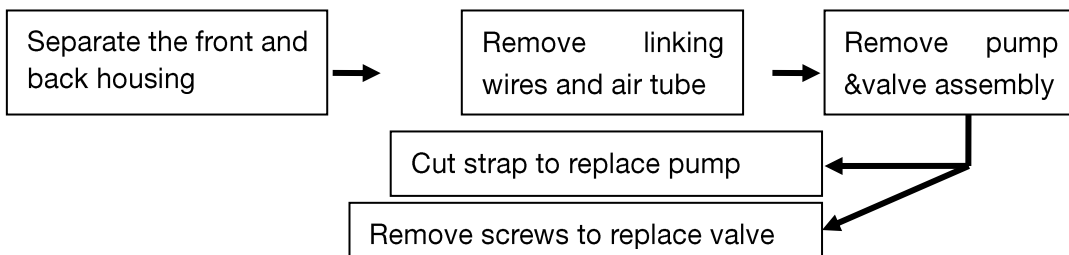


Assemble the pump/valve assembly in the reversed order. Connect the wires and fix the main unit.

3. Replacing X10/X12 pump/valve assembly:

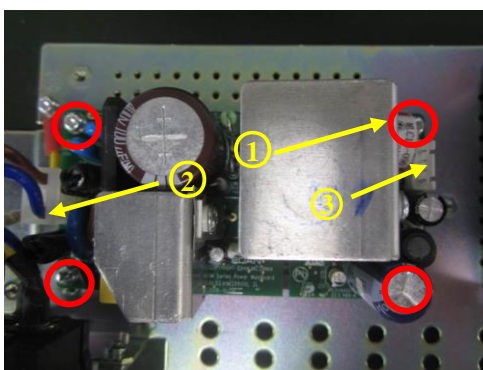


- |   |                    |   |                   |
|---|--------------------|---|-------------------|
| ① | Screws             | ③ | Pump linking wire |
| ② | Valve linking wire | ④ | X12S linking wire |

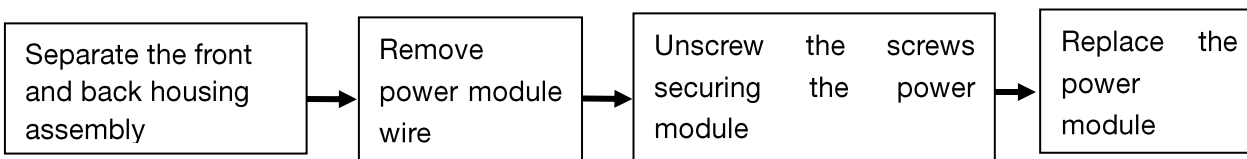


Assemble the pump/valve assembly in the reversed order. Connect the wires and fix the main unit.

### 8.4.4 Replacing the Power Board

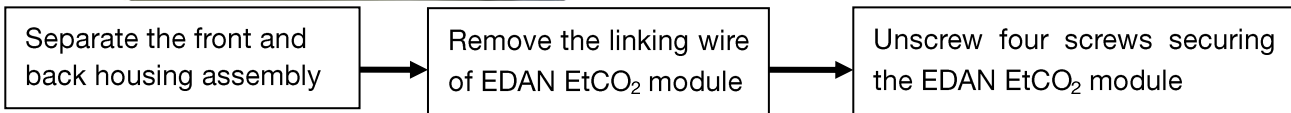
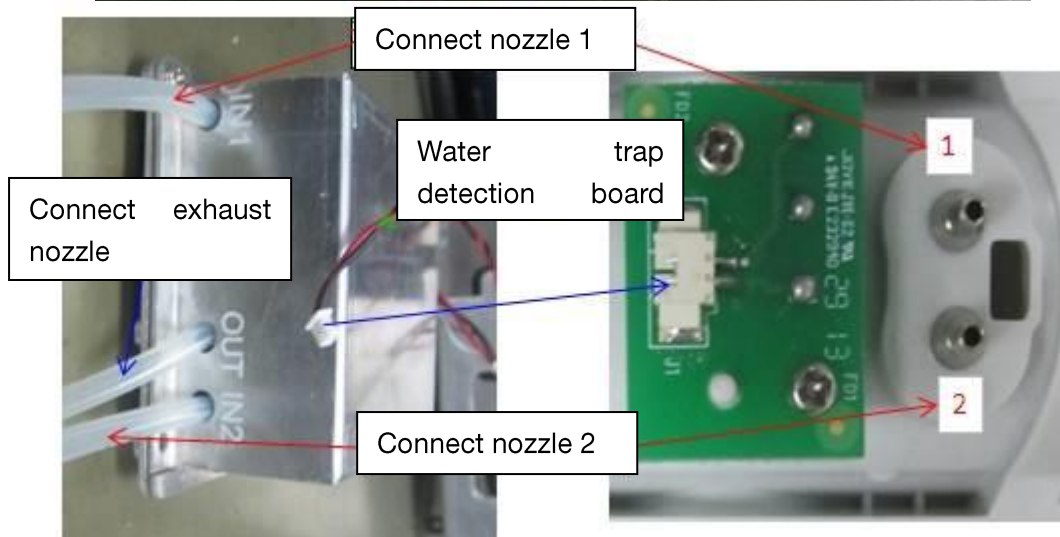
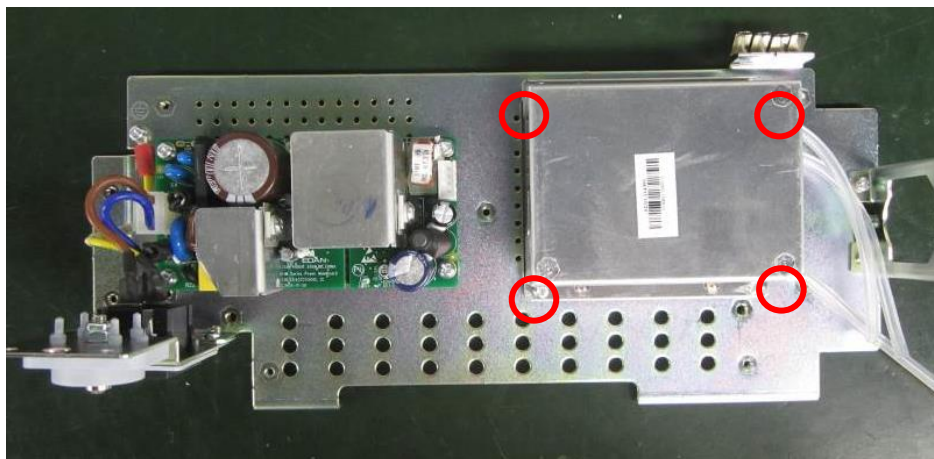


- |   |                       |   |  |
|---|-----------------------|---|--|
| ① | Screws                | ③ | Wire linking main control board and power module |
| ② | AC power linking wire |   |  |



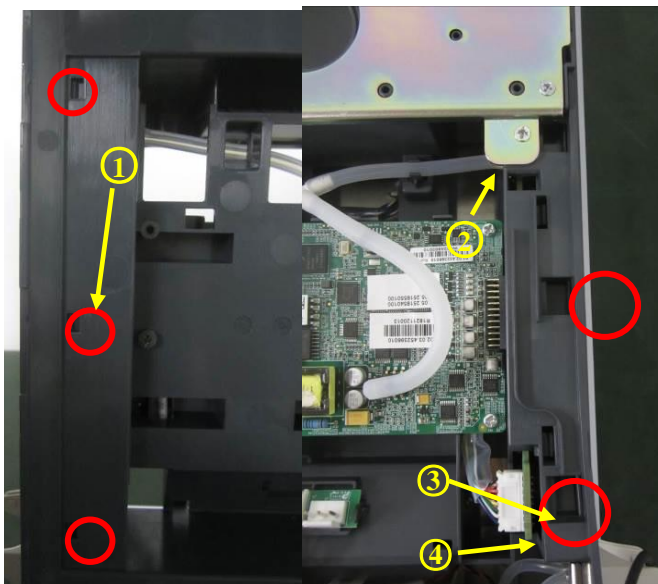
Assemble power module in the reversed order. Connect the wires and then fix the main unit.

### 8.4.5 Replacing EDAN EtCO<sub>2</sub> Module

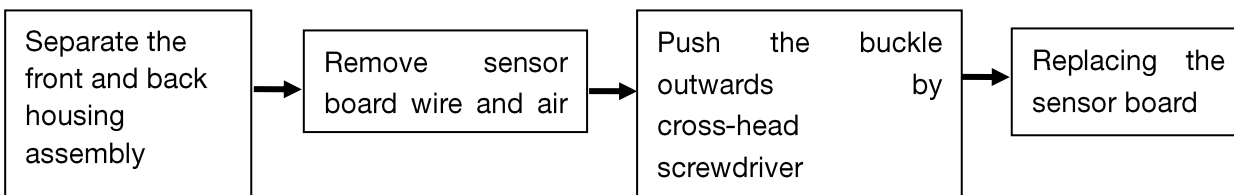


Assemble EDAN EtCO<sub>2</sub> module in reversed order. Connect the wires and then fix the main unit.

### 8.4.6 Replacing Sensor Board



- |   |          |   |   |
|---|----------|---|---|
| ① | Buckle   | ③ | Wire linking sensor board and C2 (IBP module)   |
| ② | Air tube | ④ | Wire linking sensor board and C.O. (IBP module) |



Assemble sensor board in the reversed order. Connect the wires and air tubes, and then fix the main unit.

## Appendix 1 Replaceable Parts

### WARNING

Only connect the replaceable parts supplied by EDAN to the monitor.

Parts	Part Number
X8	
X8 thin film switch (with English printing)	02.48.099165
iM3 knob board PCBA (Not Debugged)	02.02.452353
X series alarm light board PCBA (Not Debugged)	02.02.452535
8" LCD display screen	01.16.045272
Touch screen	01.16.045280
X8 protective screen	01.51.412648
X series main control board PCBA (Debugged, standard)	02.03.452526
X series main control board PCBA (Debugged, compact)	02.03.203749
X series 8 inch screen drive board PCBA (Debugged)	02.03.452528
Lithium-Manganese Button Cell	01.21.064095
Micro SD card	01.17.052452
iM series power module main board PCBA (Debugged)	02.03.220400
X series battery interface board PCBA (not debugged)	02.02.452541
X series EtCO <sub>2</sub> module assembly	02.01.214391
X8 sensor board (3/5 lead) PCBA (Debugged)	02.02.452533
X8 sensor board (12 lead) PCBA (not debugged)	02.02.220888
X12S parameter board PCBA-5 electrode (Debugged)	02.03.452395
X12S parameter board PCBA-10 electrode (Debugged)	02.03.452396
Air pump	01.58.472151
Air valve assembly	01.58.472153
Wi-Fi interface board PCBA (Debugged, outsourcing)	02.03.451683
X series interface board PCBA (Debugged)	02.03.452530
Speaker	01.14.038010
Lithium-Ion Battery	01.21.064380
Lithium-Ion Battery	01.21.064381
Unicode Printer Assembly	02.01.210633
Wi-Fi antenna (LBS-016A)	01.06.016663
X10	
X10 thin film switch (with English printing)	02.48.099166
X series alarm light board PCBA ( not debugged)	02.02.452535
iM3 rotary knob board	02.02.452353

Parts	Part Number
10.1 inch LCD module	01.16.045058
Touch screen	01.16.045279
X10 protective screen	01.51.412649
X series main control board PCBA (Debugged, standard)	02.03.452526
X series main control board PCBA (Debugged, compact)	02.03.203749
X series 10 inch screen drive board PCBA (Debugged)	02.03.452527
Lithium-Manganese Button Cell	01.21.064095
Micro SD card	01.17.052452
iM series power module main board PCBA (Debugged)	02.03.220400
X series battery board PCBA ( not debugged)	02.02.452541
Air pump	01.58.472151
Air valve assembly	01.58.472153
X series EtCO <sub>2</sub> module assembly	02.01.214391
X10 sensor board (3/5 lead) PCBA (not debugged)	02.02.452534
X10 sensor board (12 lead) PCBA (not debugged)	02.02.220892
X10 sensor board (3/5 lead +IBP) PCBA (not debugged)	02.02.220876
X10 sensor board (12 lead +IBP) PCBA (not debugged)	02.02.220889
X12S parameter board PCBA-5 electrode (Debugged)	02.03.452395
X12S parameter board PCBA-10 electrode (Debugged)	02.03.452396
IBP-CO module PCBA (including firmware software) BOM	02.03.33864
Wi-Fi interface board PCBA (Debugged, outsourcing)	02.03.451683
X series interface board PCBA (Debugged)	02.03.452530
Speaker	01.14.038010
Lithium-Ion Battery	01.21.064380
Lithium-Ion Battery	01.21.064381
Unicode Printer Assembly	02.01.210633
Wi-Fi antenna (LBS-024A)	01.06.016667
X12	
X12 thin film switch (with English printing)	02.48.099167
X series alarm light board PCBA (not debugged)	02.02.452535
iM3 rotary knob board (not debugged)	02.02.452353
12.1 inch TFT display screen	01.16.045080
Touch screen	01.16.045283
X12 protective screen	01.51.412650
X series main control board PCBA (Debugged, standard)	02.03.452526
X series main control board PCBA (Debugged, compact)	02.03.203749
X series 12 inch screen drive board PCBA (not debugged)	02.02.452529
Lithium-Manganese Button Cell	01.21.064095

Parts	Part Number
Micro SD card	01.17.052452
X series interface board PCBA (Debugged)	02.03.452530
Wi-Fi interface board PCBA (Debugged)	02.03.451683
iM series power module main board PCBA (Debugged)	02.03.220400
X series battery interface board PCBA (not debugged)	02.02.452541
Air pump	01.58.472151
Air valve assembly	01.58.472153
X series EtCO <sub>2</sub> module assembly	02.01.214391
Speaker	01.14.038010
X12 sensor board (3/5 lead) PCBA (not debugged)	02.02.452532
X12 sensor board (12 lead) PCBA (not debugged)	02.02.220893
X12 sensor board (3/5 lead +IBP) PCBA (not debugged)	02.02.220878
X12 sensor board (12 lead +IBP) PCBA (not debugged)	02.02.220891
X12 sensor board (3/5 lead +IBP+C.O.) PCBA (not debugged)	02.02.220890
X12 sensor board (12 lead +IBP+C.O.) PCBA (not debugged)	02.02.220877
X12S parameter board PCBA-5 electrodes (Debugged)	02.03.452395
X12S parameter board PCBA-10 electrodes (Debugged)	02.03.452396
IBP-CO module PCBA (including firmware software) BOM	02.03.33864
Lithium-Ion Battery	01.21.064380
Lithium-Ion Battery	01.21.064381
Unicode Printer Assembly	02.01.210633
Wi-Fi antenna (LBS-024A)	01.06.016667

**NOTE:**

The part name may vary depending on context, but the part number is constant.

P/N: 01.54.458134  
MPN: 01.54.458134013



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