

**DC-N3 PRO/DC-N3T/DC-N3S/DC-N3/DC-N3 Vet**

# **Diagnostic Ultrasound System**

**Service Manual**

**Revision 3.0**



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# Revision History

Mindray may revise this publication from time to time without written notice.

Revision	Date	Reason for Change
1.0	2012-8-24	Initial release
2.0	2013-1-31	<ol style="list-style-type: none"><li>1. Increase 3.2.3 Instruction of loading and transporting the Unit in a Van without package.</li><li>2. Delete the function item-“converting human version to vet version” in recovery menu and modify the related figures.</li></ol>
3.0	2013-4-15	<ol style="list-style-type: none"><li>1. Section 2.1.2.2, exchange power input/output descriptions of &lt;2&gt; and &lt;3&gt;.</li><li>2. Section 3.5.1, modify the location of power button to “left corner”.</li><li>3. Chapter 8, modify Hard disk, DVD and 4D board Order numbers and descriptions.</li><li>4. Section 9.3.10.1, modify screw of removing the CPU module to M3X30.</li><li>5. Section 9.3.10.2, change the screw of removing button battery to PT4X10.</li></ol>







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BeneHeart,  are the trademarks, registered or otherwise, of Mindray in China and other countries. All other trademarks that appear in this manual are used only for informational or editorial purposes. They are the property of their respective owners.

## Applicable for

This service manual is applicable for the service engineers, authorized service personnel and service representatives of this ultrasound system.

## Statement

This service manual describes the product according to the most complete configuration; some of the content may not apply to the product you are responsible for. If you have any questions, please contact Mindray Customer Service Department.

Do not attempt to service this equipment unless this service manual has been consulted and is understood. Failure to do so may result in personnel injury or product damage.

# Responsibility on the Manufacturer Party

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

- All installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel;
- The electrical installation of the relevant room complies with the applicable national and local requirements;
- The product is used in accordance with the instructions for use.

Mindray's obligation or liability under this warranty does not include any transportation or other charges or liability for direct, indirect or consequential damages or delay resulting from the improper use or application of the product or the use of parts or accessories not approved by Mindray or repairs by people other than Mindray authorized personnel.

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- Any Mindray product which has been subjected to misuse, negligence or accident;
- Any Mindray product from which Mindray's original serial number tag or product identification markings have been altered or removed;
- Any products of any other manufacturers.



## **WARNING:**

**It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or injury of human health.**

## Customer Service Department

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# 1 Safety Precautions

This chapter describes important issues related to safety precautions, as well as the labels and icons on the ultrasound machine.

## 1.1 Meaning of Signal Words


In this operator's manual, the signal words **⚠DANGER**, **⚠WARNING**, **⚠CAUTION** and **NOTE** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meanings clearly before reading this manual.

Signal word	Meaning
<b>⚠DANGER</b>	Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
<b>⚠WARNING</b>	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
<b>⚠CAUTION</b>	Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.
<b>NOTE</b>	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

## 1.2 Symbols

The following tables provide location and information of the safety symbols and warning labels, please read carefully.

### 1.2.1 Meaning of Safety Symbols

Symbol	Meaning
	Type-BF applied part The ultrasound transducers connected to this system are type-BF applied parts. The ECG module connected to this system is Type-BF applied part.



"Attention" indicates the points that you should pay attention to. Before using the system, be sure to carefully read the relevant contents of this operator's manual.






























## 1.2.2 Warning Labels

Symbol	Meaning	Position
<p>(a) (b) (c)</p>	<p>(a) NOTE: Do not sit on the system.</p> <p>(b) WARNING: Don't move the machine when the caster is locked.</p> <p>(c) NOTE: Beware of excessive stress exerted to the system.</p>	On the upper right corner of the control panel
<p>(a)</p> <p>(b)</p>	<p>(a) DANGER: There is explosion risk if the system is used in flammable anesthetics.</p> <p>(b) DANGER: The transducer is highly sensitive to shock; always handle carefully; refer to the operation manual for handling and cleaning instructions</p>	On the right cover
<p>(a)</p> <p>(b)</p>	<p>(a) CAUTION: Do not place the system with the mobile trolley on a sloped surface. Otherwise the system may slide, resulting in personal injury or the system malfunction. Two persons are required to move the system over a sloped surface.</p> <p>(b) CAUTION: Do not open the system covers, because the high voltage inside may cause electric shock. Only maintenance engineer is allowed to open the covers.</p>	on the upper section of monitor's back cover

## 1.2.3 General Symbols

This system uses the symbols listed in the following table, and their meanings are explained as well.

1-2 Safety precautions

No.	Symbol	Description	
1		Type-BF applied part	
2		Refer to relevant content in the Operator's Manual, to avoid safety accidents	
3		Dangerous voltage	
4		Equipotential ground	
5		Power button	
6		Transducer sockets	
7		Network port	
8		Connects the control port of the video printer	
9		USB port	
10		Used for DVI signal output.	
11	<b>VGA</b> 	Used for VGA output.	
12	<b>S-VIDEO</b> 		Used for separate video input
13			Used for separate video output
14	<b>AUDIO</b> 		Used for stereo audio input.
15			Used for stereo audio output.
16	<b>VIDEO</b> 		Used for composite video input
17			Used for composite video output
18		AC (Alternating current) indicator	
19		Pencil probe socket	
20		Hard disk indicator	
21		Battery indicator	
22		Standby indicator	
23		Microphone input jack	
24		Product serial number	
25		Manufacture date	
26		This product is provided with a CE marking in accordance with the regulations stated in Council Directive 93 / 42 / EEC concerning Medical Devices. The number adjacent to the CE marking (0123) is the number of the EU-notified body certified for meeting the requirements of the Directive.	

## 1.3 Safety Precautions

Please observe the following precautions to ensure patient and operator's safety when using this system.



### **DANGER:**

**Do not operate this system and probes in an atmosphere containing flammable gasses or liquids such as anesthetic gasses, hydrogen, and ethanol, because there is danger of explosion.**



### **WARNING:**

1. Do not connect the power plug of this system to wall receptacles that meet the ratings indicated on the rating nameplate. If adapters or multifunctional receptacles are used, it may cause the leakage current to exceed the safety requirement.
2. In the environment that patient is 1.5 meters around, connect peripherals to the auxiliary power outlet which is capable of isolation protection, or power the peripherals by auxiliary output cable or isolation transformer complied with IEC 60601-1-1 or the power input of the same safety level.
3. **DO NOT** use power supply of different phases to power peripherals, like power supply of air-conditioning.
4. When using peripherals not powered by the auxiliary output of the ultrasound system, or using peripherals other than permitted by Mindray, make sure the overall leakage current of peripherals and the ultrasound system meets the requirement of the local medical device electrical regulation (like enclosure leakage current should be no more than 500uA of IEC 60601-1-1), and the responsibility is held by the user.
5. Connect the grounding conductor before turning **ON** the system. Disconnect the grounding cable after turning **OFF** the system. Otherwise, electric shock may result.
6. For the connection of power and grounding, follow the appropriate procedures described in this operator's manual. Otherwise, there is risk of electric shock. Do not connect the grounding cable to a gas pipe or water pipe; otherwise, improper grounding may result or a gas explosion may occur.
7. Before cleaning the system, disconnect the power cord from the outlet. Otherwise, system failure and electric shock may result.
8. This system is not water-proof. Do not use this system in any place where water leakage may occur. If any water is sprayed on or into the system, electric shock may result. If water is accidentally sprayed on or into the system, contact Mindray Customer Service Department or sales representative.



9. **DO NOT** use a probe that has a damaged, scratched surface, or exposed wiring of any kind. Immediately stop using the probe and contact Mindray Customer Service Department or sales representative. There is risk of electric shock if using a damaged or scratched probe.
10. Do not allow the patient to contact the live parts of the ultrasound system or other devices, e.g. signal I / O ports. Electric shock may occur.
11. Do not use an aftermarket probe other than those specified by Mindray. The probes may damage the system causing a profound failure, e.g. a fire in the worst case.
12. Do not subject the probes to knocks or drops. Use of a defective probe may cause an electric shock.
13. Do not open the covers and front panel of the system. Short circuit or electric shock may result when the system hardware is exposed and powered on.
14. Do not use this system when any digital device such as a high-frequency electrotome, high-frequency therapeutic device or defibrillator is applied already. Otherwise, there is a risk of electric shock to the patient.
15. Only use the ECG leads and PCG transducer provided with the physiology module; otherwise, electric shock may be resulted.
16. When moving the system, you should hold the handle; otherwise, damage may be resulted by abnormal force. Do not push the system from the left/right side; otherwise, it may be toppled over.
17. The auxiliary power output outlet in the system is used to supply power for the recommended peripheral devices. Do not connect other devices to the outlet, otherwise, the rated output power may be exceeded and failure may be resulted. Maximum output power of the outlet is 240VA.
18. Accessory equipment (analog or digital) connected to the ultrasound system must comply with the relevant IEC standards (e.g., IEC 60950 information technology equipment safety standard and IEC 60601-1 medical equipment standard). Furthermore, all configurations must comply with the standard IEC 60601-1-1. It is the responsibility of the person, who connects additional equipment to the signal input or output ports and configures a medical system, to verify that the system complies with the requirements of IEC 60601-1-1. If you have any questions regarding these requirements, consult your sales representative.
19. Prolonged and repeated use of keyboards may result in hand or arm nerve disorders for some individuals. Observe the local safety or health regulations concerning the use of keyboards.
20. When using intra-cavity probes, do not activate the probe outside the patient's body.
21. **DO NOT** touch the Signal I/O ports if in contact with the patient; otherwise patient injury may result.

**CAUTION:**

1. **Precautions concerning clinical examination techniques:**  
This system must be used only by qualified medical professionals. This operator's manual does not describe clinical examination techniques. The clinician should select the proper examination techniques based on specialized training and clinical experience.
2. **Malfunctions due to radio wave:**  
If a radio wave emitting device is used in the proximity of this system, it may interfere with operations. Do not use or take any devices transmitting RF signals (such as cellular phones, transceivers and radio controlled products) in the room placing the system.  
If a person brings a device that generates radio waves near the system, ask him / her to immediately turn OFF the device.
3. **Precautions concerning movement of the system:**  
Please install the system on a flat plane with casters locked. Otherwise, damage may be resulted by accidental moving.  
Do not move the system laterally, which may result in damage in case of toppling.  
Move the system slowly on the slope by two people, otherwise, damage may result in case of unexpected sliding.  
Do not sit on the system, which may result individual falling in case of system moving.  
Object placed on the monitor may fall and injure an individual.  
Fasten and fully secure any peripheral device before moving the system. A loose peripheral device may fall and injure an individual.  
When move the system on the steps, please take care to prevent the system from toppling.
4. If the circuit protector is tripped, it indicates that the system or a peripheral device was improperly shut down and the system is unstable. You cannot repair the system under this circumstance and must call the Mindray Customer Service Department or sales representative.
5. There is no risk of high-temperature burns during normal ultrasound examinations. It is possible for the surface temperature of the probe to exceed the body temperature of a patient due to environmental temperature and exam type combinations. Do not apply the probe to the same region on the patient for a long time. Apply the probe only for a period of time required for the purpose of diagnosis.
6. Do not use the system to examine a fetus for a long period of time.
7. The system and its accessories are not disinfected or sterilized prior to delivery. The operator is responsible for the cleaning and disinfection of probes and sterilization of biopsy brackets according to the manuals, prior to the use. All items must be thoroughly processed to completely remove harmful residual chemicals, which will not only be harmful to the human body, but also damage the accessory.

8. It is necessary to press <End Exam> to end the current scan that is in progress and clear the current Patient Information field. Otherwise, new patient data may be combined with the previous patient data.
9. Do not connect or disconnect the system's power cord or its accessories (e.g., a printer or a recorder) without turning OFF the system power first. This may damage the system and its accessories or cause electric shock.
10. If the system is powered off improperly during operation, it may result in data damage of the system hard disk or system failure.
11. Do not use a USB memory device (e.g., a USB flash drive, removable hard disk) which has unsafe data. Otherwise, system damage may result.
12. It is recommended to only use the video devices specified in this manual.
13. Do not use gel, disinfectant, probes, probe sheath or needle-guided brackets that are not compatible with the system.
14. The applied contrast agents should be compliant with the relevant local regulations.
15. Read the Acoustic Output Principle in the operation manual carefully before operating this system on clinical examination.
16. The cover contains natural rubber that can cause allergic reactions in some individuals.
17. Please use the ultrasound gel compliant with the relevant local regulations.
18. Normal operation may be affected by unstable mains power supply; it is recommended that our product be powered from an uninterruptible power supply.

- NOTE:**
1. DO NOT use the system in the vicinity of strong electromagnetic field (such as a transformer), which may affect the performance of the system.
  2. Do not use the system in the vicinity of high-frequency radiation source (e.g. cellular phones), which may affect the performance of the system or even lead to failure.
  3. When using or placing the system, keep the system horizontal to avoid imbalance.
  4. To avoid damaging the system, do not use it in following environment:
    - Locations exposed to direct sunlight;
    - Locations subject to sudden changes in environmental temperature;
    - Dusty locations;
    - Locations subject to vibration;
    - Locations near heat generators;
    - Locations with high humidity.
  5. Turn ON the system only after the power has been turned OFF for a while. If the system is turned ON immediately after being turned OFF, the system may not be rebooted properly and could malfunction.
  6. Press <Freeze> key to freeze an image or turn off the power of the system before connecting or disconnecting a probe. Otherwise, the system and/or probe can be damaged.

7. Remove the ultrasound gel from the face of the probe when the examination is completed. Water in the gel may enter the acoustic lens and adversely affect the performance and safety of the probe.
8. You should properly back up the system to a secure external storage media, including system configuration, settings and patient data. Data stored to the system's hard drive may be lost due to system failure, improper operation or accident.
9. Do not apply external force to the control panel. Otherwise, the system may be damaged.
10. If the system is used in a small room, the room temperature may rise. Please provide proper ventilation and free air exchange.
11. To dispose of the system or any part, contact Mindray Customer Service Department or sales representative. Mindray is not responsible for any system content or accessories that have been discarded improperly. Mindray is not responsible for any system content or accessories that have been discarded improperly.
12. Electrical and mechanical performance may be degraded due to long usage (such as current leakage or distortion and abrasion); the image sensitivity and precision may become worse too. To ensure optimal system operations, it is recommended that you maintain the system under a Mindray service agreement.
13. The replaceable fuse is inside the chassis. Refer replacing job to Mindray service engineers or engineers authorized by Mindray only.
14. Do not turn OFF the power supply of the system during printing, file storage or invoking other system operations. An interrupted process may not be completed, and can become lost or corrupted.
15. The iScape feature constructs a single extended image from a series of individual image frames. The quality of the final image is user-dependent and requires skill to efficiently apply the feature and technique. Exercise caution when measurements are performed from an iScape image.
16. Ensure that the current exam date and time are the same as the system date and time.

# 2 Specifications

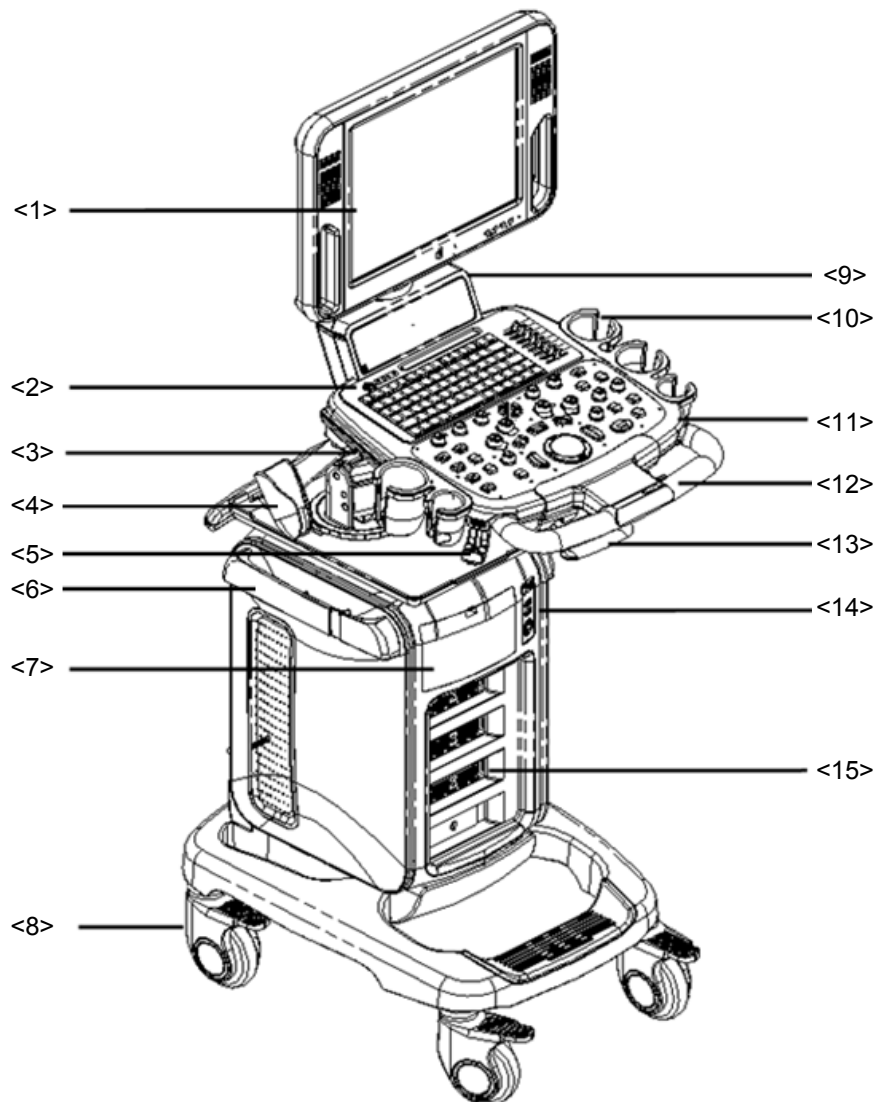
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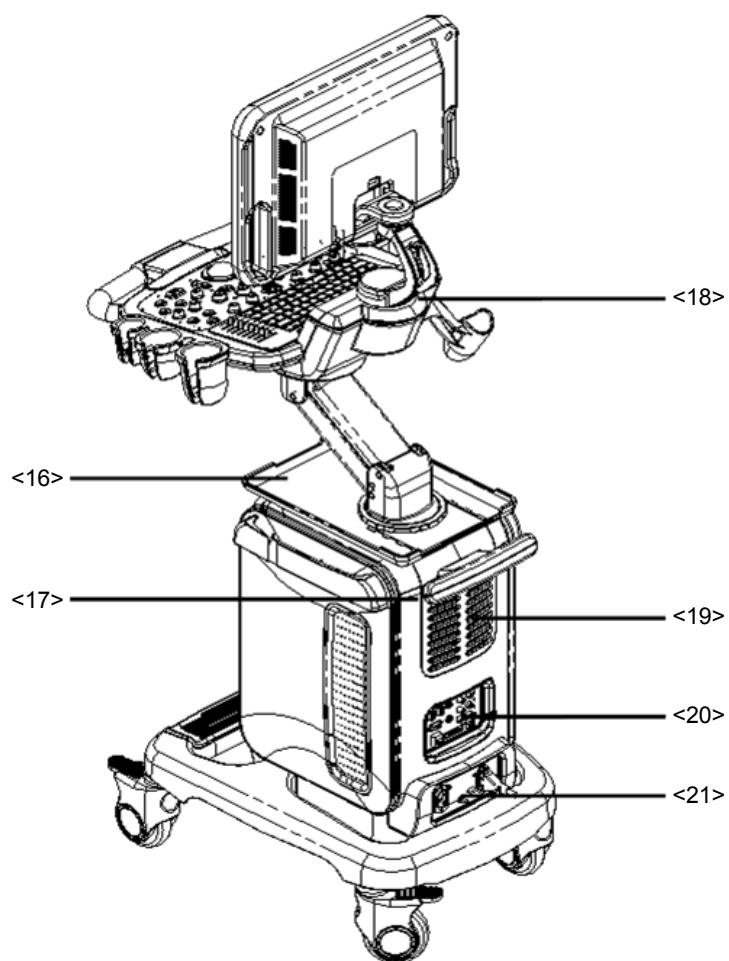
## 2.1 Overview

### 2.1.1 Intended Use

DC-N3 PRO/DC-N3T/DC-N3S/DC-N3 diagnostic ultrasound system is intended for use in clinical ultrasonic diagnosis. DC-N3 Vet is a type of veterinary use.

### 2.1.2 Introduction of Each Unit

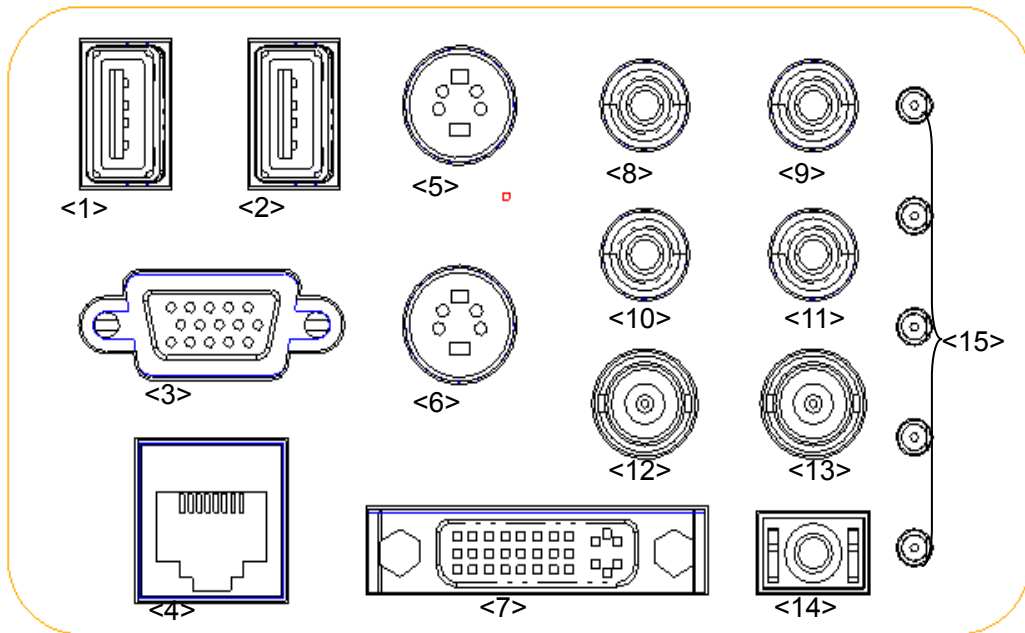













No.	Name	Function
<1>	Monitor	Displays the images and parameters during scanning.
<2>	Power button	Used for turning on/off the power supply (on the upper left corner of control panel).
<3>	DVD-RW	DVD-RW drive.
<4>	Intra-cavity probe holder	Used for placing the intra-cavity probe.
<5>	Probe cable hook	Used for fixing the probe cable.
<6>	Probe cable fixing bracket	Used for fixing the probe cable
<7>	Compartment	Used for placing B/W video printer.
<8>	Caster	Used for securing or moving the system.
<9>	Speaker	Audio output.
<10>	Probe and ultrasound gel holder	Used for temporarily placing probes or ultrasound gel.
<11>	Control Panel	Operator-system interface or control.
<12>	Frontal handle	Used for pushing and moving the system.

No.	Name	Function
<13>	Control table adjusting handle	Lift and hold the handle to lift/down the control table, or to turn the control table left / right.
<14>	Physiological-signal panel	Used for connecting the ECG leads, footswitch, and inputting ECG signal.
<15>	Probe ports	Sockets connecting probes and the main unit. The lowest one is for 4D probes.
<16>	Table for placing peripherals	Placing peripherals.
<17>	Rear handle	Used for lifting the machine, or managing the probe cable.
<18>	Monitor support arm	Used for support and adjustment of height and position of LCD monitor.
<19>	Heat rejection panel	Main unit heat rejection.
<20>	I/O Panel	Interface panel used for inputting and outputting signals.
<21>	Power supply panel	Electrical port panel.

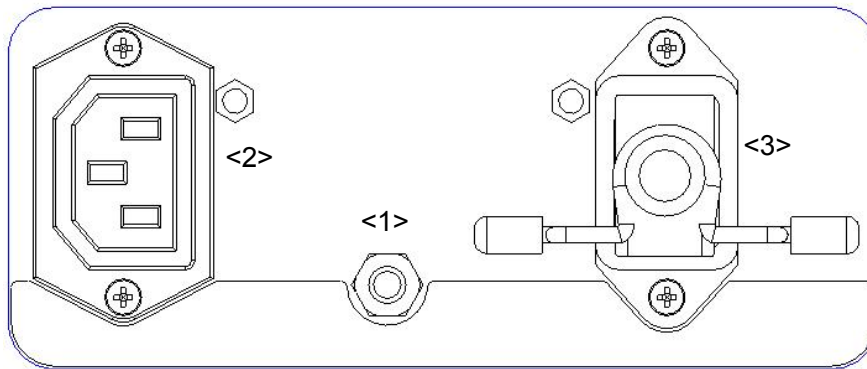
### 2.1.2.1 I/O panel



No.	Symbol	Function
<1><2>		USB port; used for connecting USB devices.
<3>		VGA signal output; connects a monitor or projector.

<4>		Ethernet interface.
<5>		Reserved, separate video input.
<6>		Separate video output.
<7>		DVI signal output.
<8><9>		Audio signal input port, left channel/ right channel.
<10><11>		Audio signal output port, left channel/right channel.
<12>		Reserved, used for composite video input.
<13>		Used for composite video output.
<14>		Remote interface for connecting video printer.
<15>	Status indication lights	Indicate the voltage and other status of the ultrasound machine (referring to 11.1.2).

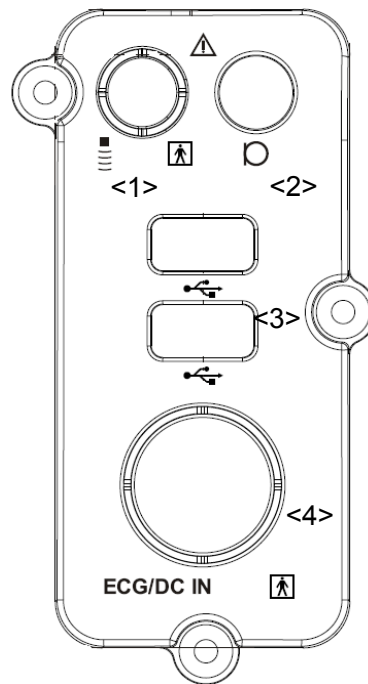
### 2.1.2.2 Power Supply panel





No.	Name	Function
<1>	Equipotential terminal ↓	Used for equipotential connection, balancing the protective earth potentials between the system and other electrical equipment.
<2>	AC Auxiliary Output	Power supply port for peripherals.
<3>	AC Input	AC power inlet.

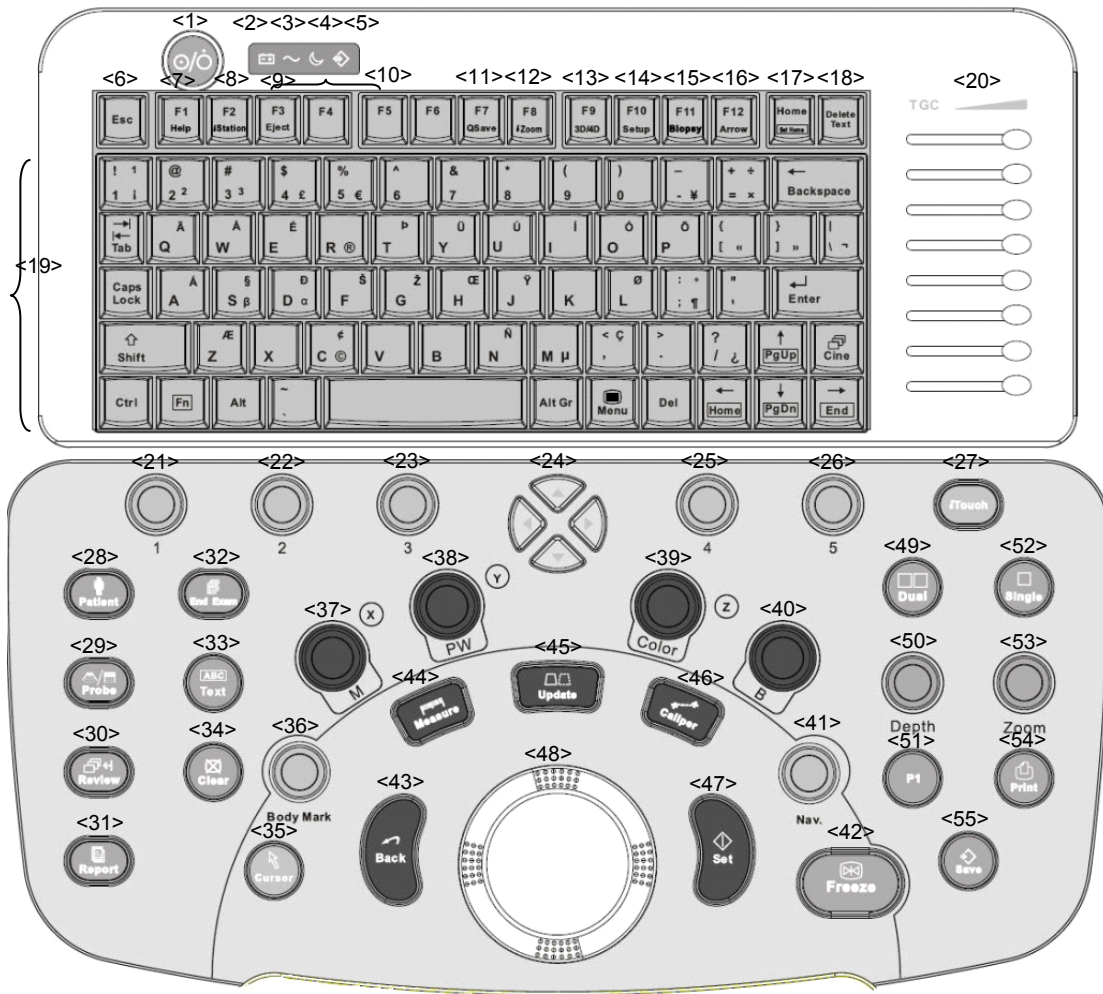






### 2.1.2.3 ECG Panel



No.	Name	Function
<1>	Pencil probe port	Pencil probe port (reserved).
<2>	Mic In port 	Use for connecting microphone to record vocal comments
<3>	Two USB ports 	Used for connecting USB devices.
<4>	ECG lead signal input port/external ECG signal input port	Connects to ECG leads, to directly obtain patient electrocardio signal/used for connecting the signal output port of ECG monitor.

## 2.1.2.4 Control Panel



No.	Name	Description	Function
<1>	/	Power button	Press the button to turn on the system, at the moment the indicator lights on and becomes green and flashes.
<2>	/		Battery status indicator.
<3>	/		AC power supply status indicator
<4>	/		Standby status indicator
<5>	/		Hard disk status indicator
<6>	Esc	Exit	Press to exit the current status to the previous status.
<7>	F1 Help	Help	Press to open or close the accompanying help documents.
<8>	F2 iStation	/	Press to enter or exit the patient information management system.
<9>	F3 Eject	/	Press to eject the disc.
<10>	F4-F6	User-defined	You can assign a function to the key.

		key	
<11>	F7 QSave	/	Save image quickly.
<12>	F8 iZoom	iZoom	Enter/exit iZoom mode.
<13>	F9 3D/4D	3D/4D	Enter/exit 3D/4D.
<14>	F10 Setup	Setup	Enter/exit setup.
<15>	F11 Biopsy	Biopsy	Enter/exit biopsy.
<16>	F12 Arrow	Arrow	Enter/exit arrow comment status.
<17>	Home	/	Set the default position of the comment/return to the default position.
<18>	Delete text	/	Press to delete the word in the reserved order.
<19>	/	Alphanumeric keys	Same as those of PC.
<20>	TGC	Slide bar	Move to adjust time gain compensation.
<21>	/	Soft menu controls 1	Press or rotate to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<22>	/	Soft menu controls 2	Press or rotate to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<23>	/	Soft menu controls 3	Press or rotate to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<24>	/	Directional soft menu controls	Up/down controls are used to turn pages up/down when there is more than one page for the soft menu. Left/right keys are used to switch among the different modes.
<25>	/	Soft menu controls 4	Press or rotate to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<26>	/	Soft menu controls 5	Press or rotate to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<27>	iTouch	/	Press to optimize the image, serving as a one-key optimization.
<28>	Patient	Patient Information	Press to open the [Patient Info] screen.
<29>	Probe	Probe	Press to select the probe and exam mode.
<30>	Review	Review	To review the stored images.
<31>	Report	Report	Press to open or close the diagnosis reports.
<32>	End Exam	End Exam	Press to end an exam.
<33>	Text	ABC (Text)	Press to enter or exit the character comment status.

<34>	Clear	Clear	Clear the measurement caliper, comments and body mark. Press <Clear> to clear the selected item, return to the previous operation or to delete the last project. Long press <Clear> to delete the mode related elements or all elements on the screen.
<35>	Cursor	Cursor	Show/ hide the cursor.
<36>	Body Mark	Body Marks	Press to enter or exit the Body Mark status.
<37>	M(X)	Pressable knob	Press to enter M mode, and rotate to adjust M gain; while in 3D/4D mode, rotate the knob to make the 3D image to rotate around X axis.
<38>	PW(Y)	Pressable knob	Press to enter PW mode, and rotate to adjust PW (in PW mode) or CW gain (in CW mode); while in 3D/4D mode, rotate the knob to make the 3D image to rotate around Y axis.
<39>	Color(Z)	Pressable knob	Press to enter Color mode, and rotate to adjust Color (in color mode) or Power gain (in Power mode); while in 3D/4D mode, rotate the knob to make the 3D image to rotate around Z axis.
<40>	B	Pressable knob	Press to enter B mode, and rotate to adjust B gain.
<41>	Nav.	Navigation	Multi-function knob.
<42>	Freeze	Freeze	Press to freeze or unfreeze the image.
<43>	Back	Back	Exit the current status to the previous status
<44>	Measure	Measure	Press to enter or exit the application measurement mode.
<45>	Update	/	Press to change the currently active window. Or start/stop image acquisition in iScape or 3D/4D.
<46>	Caliper	Caliper	Press to enter or exit the general measurement mode.
<47>	Set	Set	Press to confirm an operation, same as the left-button of the mouse.
<48>	/	Trackball	Roll the trackball to change the cursor position.
<49>	Dual	/	Enter Dual mode in Non-Dual mode; Switch between the two displaying windows in Dual mode.
<50>	Depth	Depth	Adjust depth in real-time imaging.
<51>	P1	/	User-defined key.
<52>	Single	/	Enter into single displaying window from splitting mode.
<53>	Zoom	Zoom	Adjust the zoom ratio.
<54>	Print	Print	Press to print, user-defined key.
<55>	Save	Save	Press to save image, user-defined key.

## 2.1.3 Peripherals Supported

Name	Model
Footswitch	FS-81-SP-2 (1 pedal, USB port) 971-SWNOM (2-pedal, USB port) SP-997-350 (3-pedal, USB port)
Black / white video printer	Analog: SONY UP-897MD, MITSUBISHI P93W-z Digital: SONY UP-D897
Color video printer	Analog: SONY UP-20, MITSUBISHI CP910E
Graph/ text Printer	HP LaserJet p1007 HP LaserJet 1020 plus
External DVD R/W	SE-S224Q
Barcode scanner	SYMBOL LS2208

## 2.2 Specifications

### 2.2.1 Dimensions & Weight

Dimension: 1285~1425mm (H) ×720mm (D) ×500mm (W)

Net weight: about 70Kg (not including the accessories and peripherals)

### 2.2.2 Electrical Specifications

#### 2.2.2.1 AC Input

Voltage	100-240V~
Frequency	50/60Hz
Power consumption	600VA

#### 2.2.2.2 Battery

Voltage	14.8V
Capacity	6600mAh

### 2.2.3 Environmental Conditions

	Operating conditions	Storage and transportation conditions
<b>Ambient temperature</b>	0°C~40°C	-20°C~55°C
<b>Relative humidity</b>	30%~85% (no condensation)	30%~95% (no condensation)
<b>Atmospheric pressure</b>	700hPa~1060hPa	700hPa~1060hPa
<b>Note:</b>	D6-2,D6-2A probe: Operating ambient temperature:+10°C~+40°C, Relative humidity:25%~90%, Storage ambient temperature:-10°C~60°C	

<b>⚠Warning :</b>	<b>Do not use this system in the conditions other than those specified</b>
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## 2.2.4 Monitor Specification

<b>Voltage</b>	12V
<b>Dimension</b>	15 inch
<b>Resolution</b>	1024x768
<b>Viewing angle</b>	170 degrees (vertical and horizontal)

# 3 System Installation

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## 3.1 Preparations for Installation

**NOTE:** Do not install the machine in the following locations:

Locations near heat generators;

Locations of high humidity;

Locations with flammable gases.

### 3.1.1 Electrical Requirements

#### 3.1.1.1 Requirement of Regulated Power Supply

Power specification is showing in 2.2.2. Due to the difference of the power supply stability of different districts, please advise the user to adopt a regulator of good quality and performance such as an on-line UPS.

#### 3.1.1.2 Grounding Requirements

The power cable of the system is a three-wire cable, the protective grounding terminal of which is connected with the grounding phase of the power supply. Please ensure that the grounding protection of the power supply works normally.

**⚠WARNING:** **DO NOT connect this system to outlets with the same circuit breakers and fuses that control the current of devices such as life-support systems. If this system malfunctions and generates an over current, or when there is an instantaneous current at power ON, the circuit breakers and fuses of the building's supply circuit may be tripped.**

#### 3.1.1.3 EMI Limitation

Ultrasound machines are susceptible to Electromagnetic Interference (EMI) by radio frequencies, magnetic fields, and transient in the air wiring. They also generate a weak electromagnetic radiation. Possible EMI sources should be identified before the unit is installed. Electrical and electronic equipment may produce EMI unintentionally as the result of defect.

These sources include: medical lasers, scanners, monitors, cauterizing guns and so on. Besides, other devices that may result in high frequency electromagnetic interference such as mobile phone, radio transceiver and wireless remote control toys are not allowed to be presented or used in the room. Turn off those devices to make sure the ultrasound system can work in a normal way.

## 3.1.2 Installation Conditions

### 3.1.2.1 Space Requirements

Place the system with necessary peripherals in a position that is convenient for operation:

1. Place the system in a room with good ventilation or an air conditioner.
2. The door is at least 0.8m wide. The ultrasound machines can move into the room easily.
3. Leave at least 20cm clearance around the system to ensure effective cooling.
4. A adjustable lighting system in the room (dim/bright) is recommended.
5. Except the receptacle dedicated for the ultrasound system, at least 3-4 spare receptacles on the wall are available for the other medical devices and peripheral devices.
6. Power outlet and place for any external peripheral are within 2 m of each other with peripheral within 1 m of the unit to connect cables.

### 3.1.2.2 Networking Pre-installation Requirements

Both wireless and wired LAN are supported by this ultrasound system.

Data transmission is allowed between different departments or areas without network cable. Network can be automatically connected after disconnection in case that the device is required to be moved, wireless transmission task can be recovered after the network resumed to normal condition. Confirm the network devices and network conditions before the installation.

1. General information: default gateway IP address, and the other routers related information.
2. DICOM application information: DICOM server name, DICOM port, channels, and IP address.

## 3.1.3 Confirmation before Installation

Perform the following confirmation before installing the system:

1. The video format used in the region or country where the system is installed.
2. The language used in the region or country where the system is installed.
3. The power voltage used in the region or country where the system is installed.
4. Obstetric formulae and other measurement formulae used in the region or country where the system is installed.
5. Other settings to be used in the region or country where the system is installed but different from the factory settings.
6. The doctor's habits of using the system.

Perform the confirmation above before installing the system. And set up the system to make it according with the usage of the region or country where the system is installed.

## 3.2 Unpacking

Tool: A scissor or a knife



Installation duration:2 person, 0.5 hour.

### 3.2.1 Unpacking

1. Use the scissor to cut the 4 plastic strapping bands from around the crate as follows:



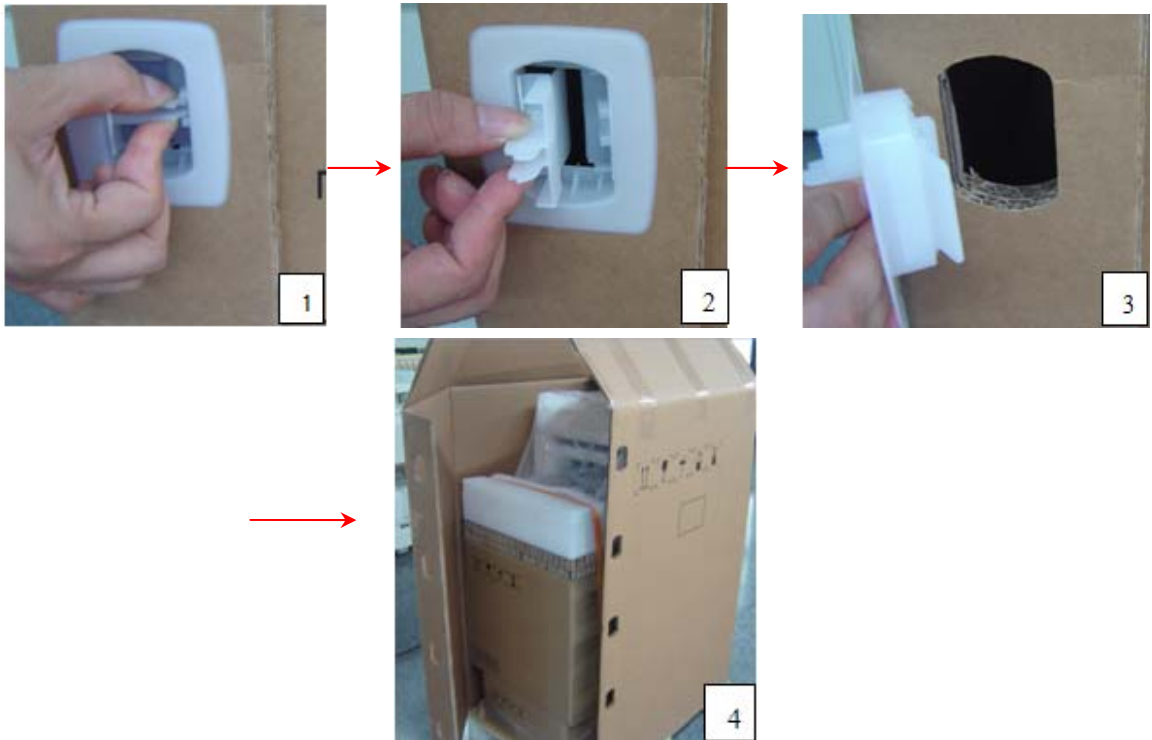
2. Use a knife to cut 3 tapes on the top of crate;



3. Remove the wrap from the crate pallet.



- ◆ If the height is enough, you can remove the wrap from the crate pallet upwards directly.
- ◆ If the height is not enough, do it as follows: Clamp a plastic locking clip from two sides to middle with two fingers, meanwhile pull it out until you can remove the clip(there are five clips).After removing all the clips, open the wrap and remove it from the crate pallet.



4. Loosen the strainer: Press the part of strainer with thumb to let the spring shrink to the bottom (as shown in figure 1), then turn upwards until loosen the strainer (as shown in figure 2).there are two strainers.



5. Remove the control panel protecting foam;



6. Take out the probe box and accessory box.

### 3-4 System Installation



Probe box



Accessory box

7. Remove the base protecting foam behind.



8. Remove the silver protecting foam.



9. Take out the plastic packing of the main unit.



10. Remove the LCD protecting foam.



11. Use a knife to cut the tapes attached to the height adjusting handle and loosen it ;



12. Carry the machine off the pallet with another person.



## 3.2.2 Checking

1. After unpacking, check the objects in the container with the package list to see if anything is in short supply or is wrong.
2. Inspect and make sure there is no damage to the machine, no indentation, no cracks.

## 3.2.3 Loading and Transporting the Unit in a Van

### 3.2.3.1 Overview

When moving or transporting the unit without original packing materials, follow the instructions and precautions below to ensure maximum safety for personnel, the system and other equipment.

Minimum size for the vehicle door: 700mm (W)\*550mm (H)

Minimum size for the vehicle capacity (inside):700mm(L)\*550mm(W)\*1150mm(H)。

Tools necessary: LCD bumper, 1 piece

Strap, several

### 3.2.3.2 Securing the Unit



Figure 1 Securing the Unit



Figure 2 Securing the Unit

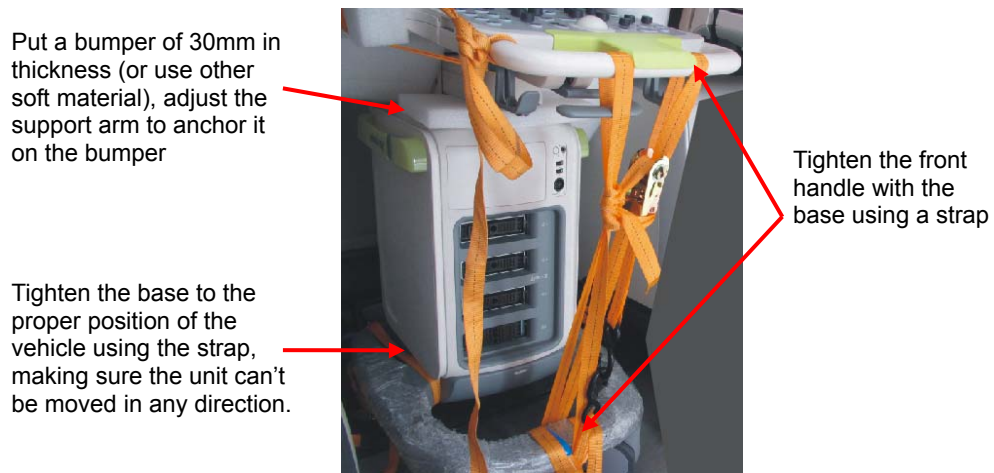
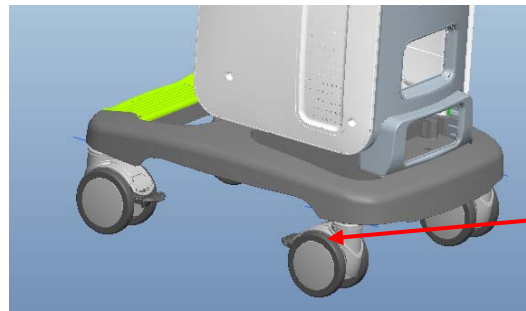


Figure 3 Securing the Unit

Use a strap to fix the upper part of the unit

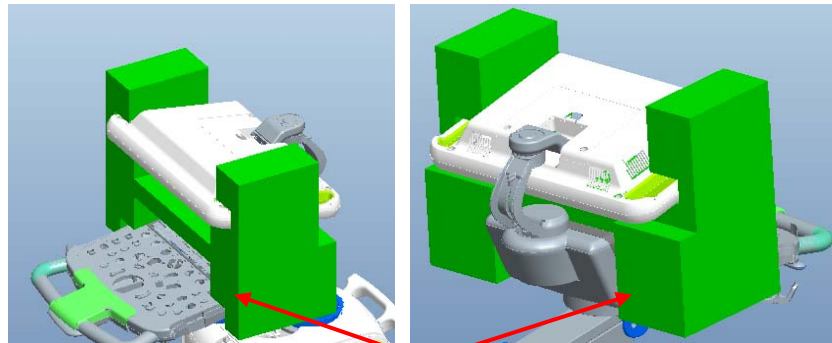


Figure 4 Securing the Unit



Brake off four casters

Figure 5 Details



LCD bumper position (front view and rear view)

Figure 2 Details

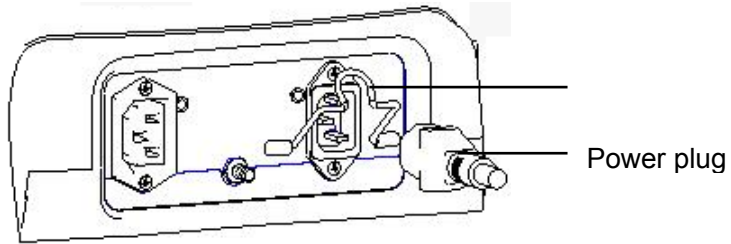
## 3.3 Installation of Main Unit

**NOTE:** To prevent the machine from damage, when you perform the following operations, please lock the casters if the machine doesn't to be moved

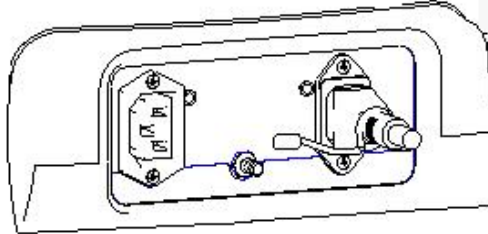
### 3.3.1 Connecting the Power Cord

1. Push the retaining clamp upward, and insert the power plug into the receptacle, as shown in the figure below.





2. Push the retaining clamp downward, and lock the power cord, as shown in the figure below.



3. Plug the other end power plug into an appropriate outlet. The grounding terminal should be connected with a power grounding cable to ensure that protective grounding works normally.

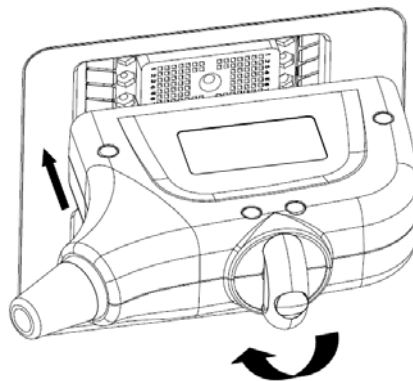
**NOTE:** Make sure to allow sufficient slack in the cable so that the plug is not pulled out of the wall if the system is moved slightly.

### 3.3.2 Connecting ECG

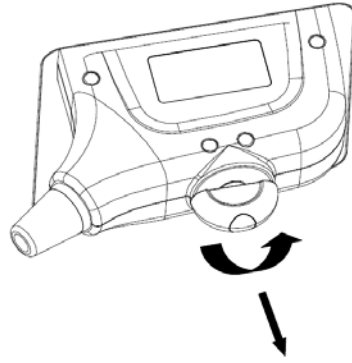
Connect the ECG cable to the corresponding interface on the ECG panel.

### 3.3.3 Connecting the Transducer

1. Check the probe connector, if it is not open, turn the locking lever anticlockwise to open it.
2. Keep the cable toward probe holder and insert the connector into the port.
3. Turn the locking lever 90° clockwise in the horizontal position to lock the probe connector.
4. Place the probe properly to avoid being trod or wrapping with other devices. DO NOT allow the probe head to be hung freely.



5. To disconnect the probe, turn the locking lever 90° anticlockwise and pull the probe straight out.



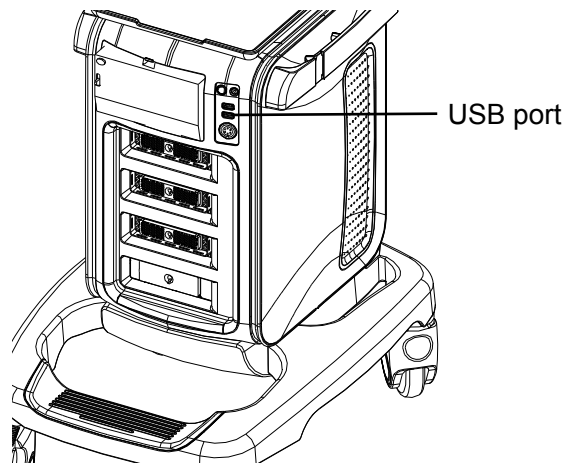
**NOTE:** Before inserting the connector into the probe port, inspect the connector pin. If the pin is bent, do not use the probe until it has been inspected / repaired / replaced.

## 3.4 Installing Peripherals

For the models of the supported peripherals, please refer to “2.1.3 Peripherals Supported”.

### 3.4.1 Connecting the Footswitch

1. Insert the USB plug of the footswitch to the system applicable USB port directly.

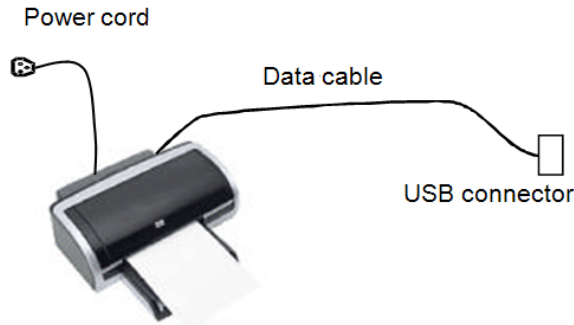


2. Function setting: for details, please refer to “3.5.3 System Preset”.

### 3.4.2 Installing Graph / Laser Printer

**The graph / laser printer** is connected to the system via the USB port on system. As shown in the figure below, a graph or laser printer has a power cord and a data cable.





1. Connect the data cable to the USB port on the system.
2. Connect the power cord to an appropriate power supply that is well grounded.
3. Printers listed in this manual (referring to 2.1.3) have drivers installed already.

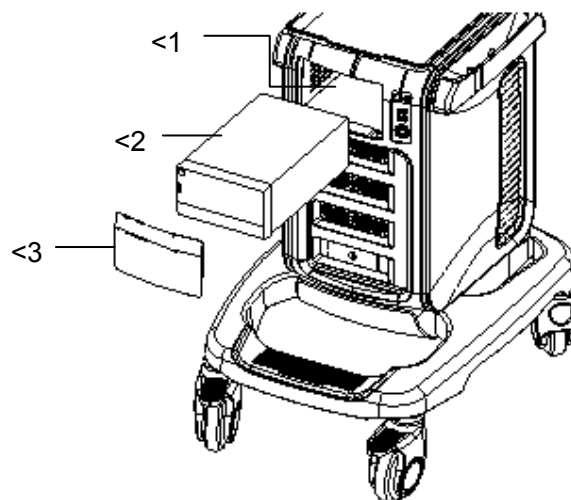
### 3.4.3 Installing Video Printer

The system support both black/white video printers (analog and digital) and color video printers (analog and digital).

**⚠CAUTION:** The auxiliary power outlet in the system is used to supply power for approved peripheral devices. Do not connect other/unapproved devices to this outlet; otherwise the rated output power may be exceeded and the system failure may result. Maximum output power of the outlet is 240VA.

#### 3.4.3.1 B/W Video Printer

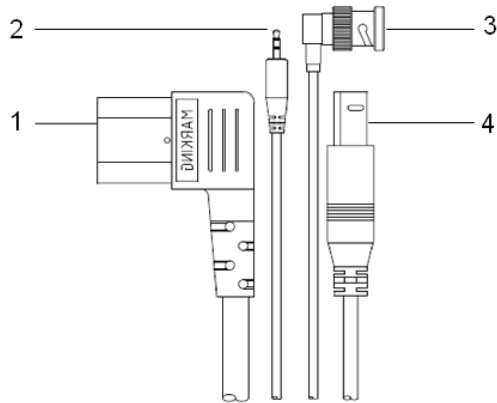
1. Take off the cover board of compartment under the control panel.
2. Plug the AC power cord hidden in the compartment to the AC input port of the printer.
3. Analog B/W video printer: Connect the video signal cable in the compartment to the VIDEO IN port on the printer, and connect the Remote control cable to the Remote port on the printer.  
(Only USB cable is need to be connected for digital B/W video printer) .



<1. Compartment for placing video printer    <2. B/W video printer    <3. Compartment cover

The printer compartment under the control panel provides the following cables:

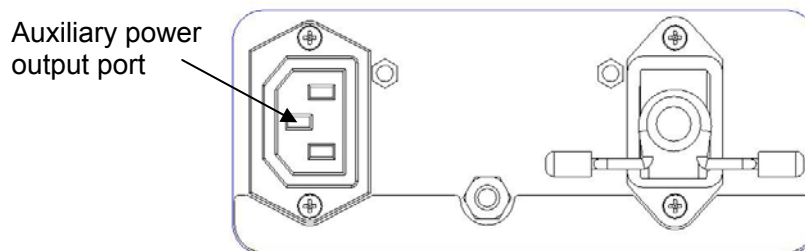
- 1) Power cord
- 2) Remote control cable
- 3) Video signal cable
- 4) USB cable (Used for connecting digital video printer) , as shown in the figure.



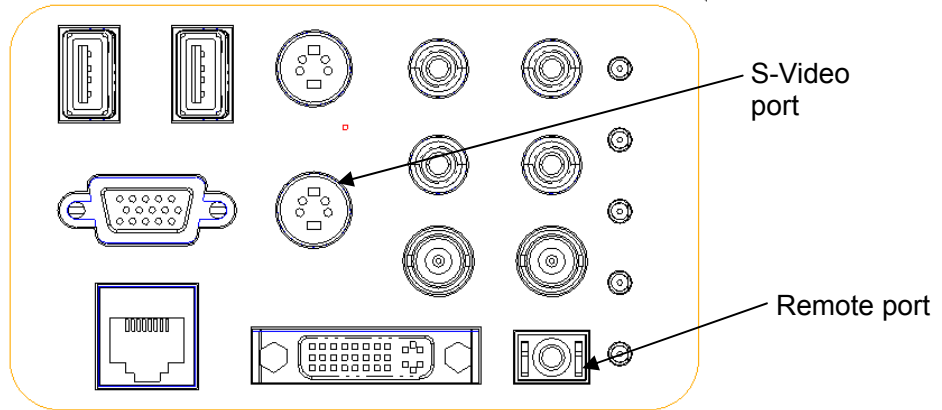
4. Place the printer in the compartment, locking the foot pad in the limit convex band of the main unit front cover, so that the printer will not slide freely.
5. For printers that need to install the driver, please refer to 3.5.4. Printers listed in this manual (referring to 2.1.3) have drivers installed already.

### 3.4.3.2 Color Video Printer

1. Place the color video printer on the platform behind the ultrasound system.
2. Connect the printer power cord to the auxiliary power output port on the power supply panel of the ultrasound system.



3. Analog color video printer: Connect the video signal cable of printer to the S-Video port on I/O board, and connect the Remote control cable to the Remote port on I/O board.

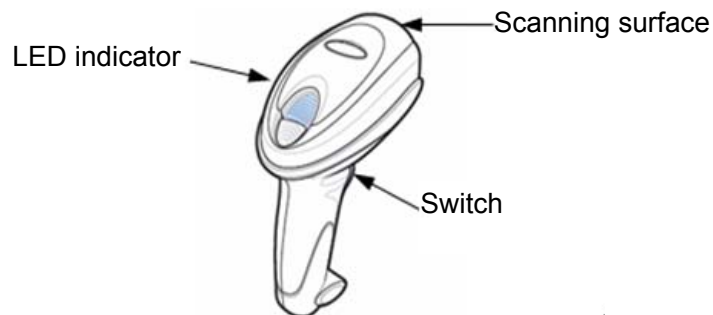


4. For a digital color video printer, just need to connect the power cord and USB cable to the ultrasound system.
5. For printers that need to install the driver, please refer to 3.5.4. Printers listed in this manual (referring to 2.1.3) have drivers installed already.

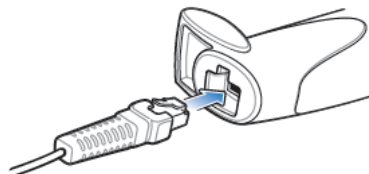
### 3.4.4 Installing Barcode Scanner

The system supports barcode reader to read the patient information (ID).

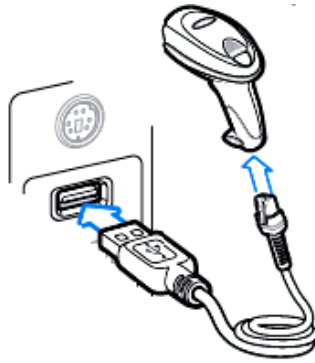
1. For structure of the scanner, see the figure below. The important parts are: LED indicator, scanning surface, and the switch.



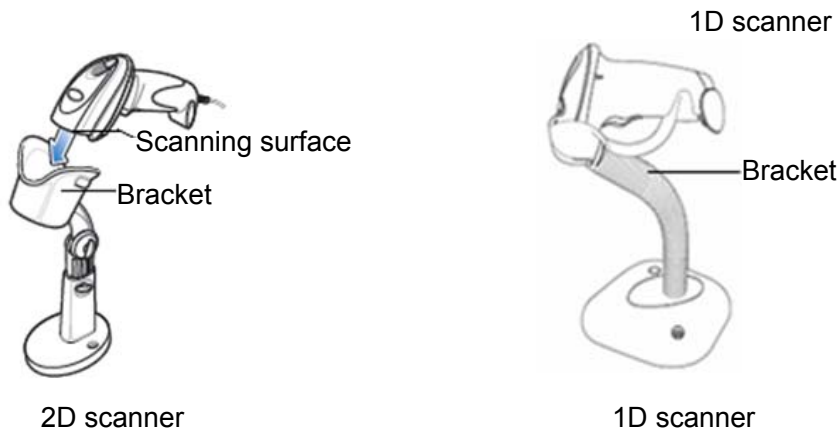
2. Connect the cable to the port on the scanner.



3. Connect the other end of the cable to the USB port on the ultrasound system.



4. When the ultrasound system is working, information scanning can be performed by pressing the switch on the scanner. For detailed operations, please refer to the operator's manual of the scanner.
5. Fix the scanner on the bracket (see the figure below) to avoid accidental falling.



## 3.5 System Configuration

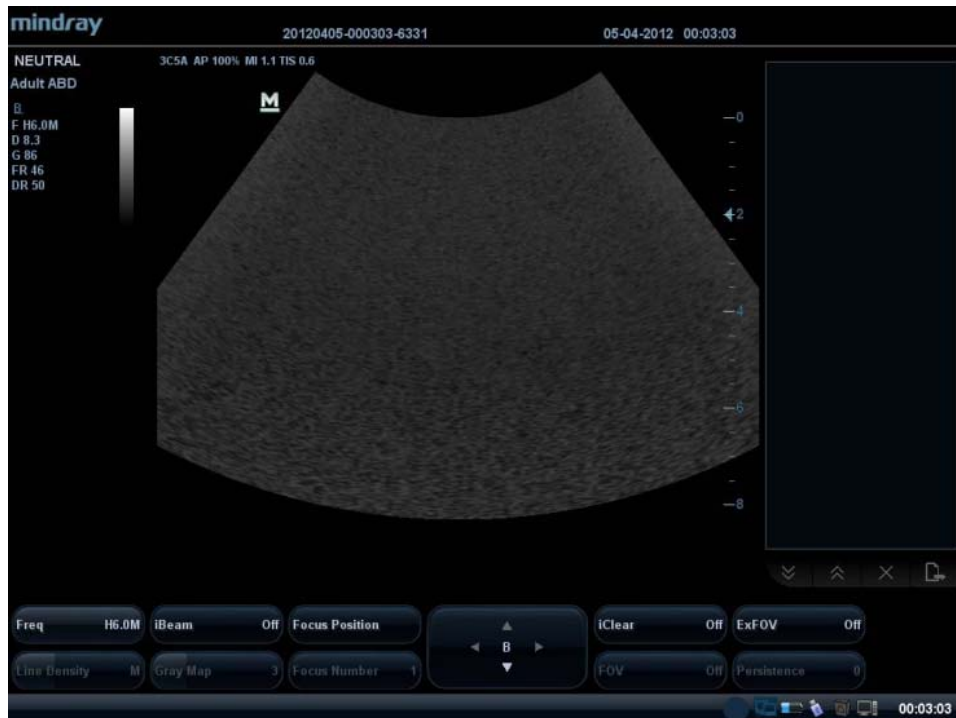
### 3.5.1 Running the System

Connect the system power cord to the AC power, and make sure the ultrasound system and other optional devices are correctly connected.

When the AC indicator is green, you can press the power button (located at the upper left corner of the system) to turn on the system. After being normally initiated, it will display image interface. Or press the power button directly when the battery is of sufficient capacity.

### 3.5.2 Enter Doppler

After the system is powered on after initiation (about 30S), it enters Doppler directly:



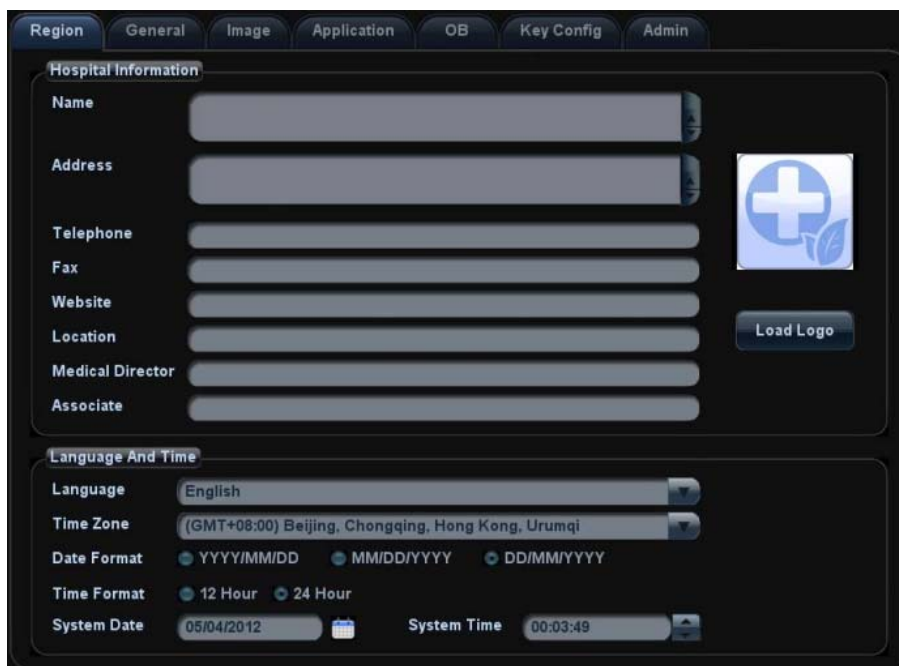
### 3.5.3 System Preset

1. Press the <Setup> key to enter the [Setup] menu.



2. Click <System Preset> to enter the screen as follows:

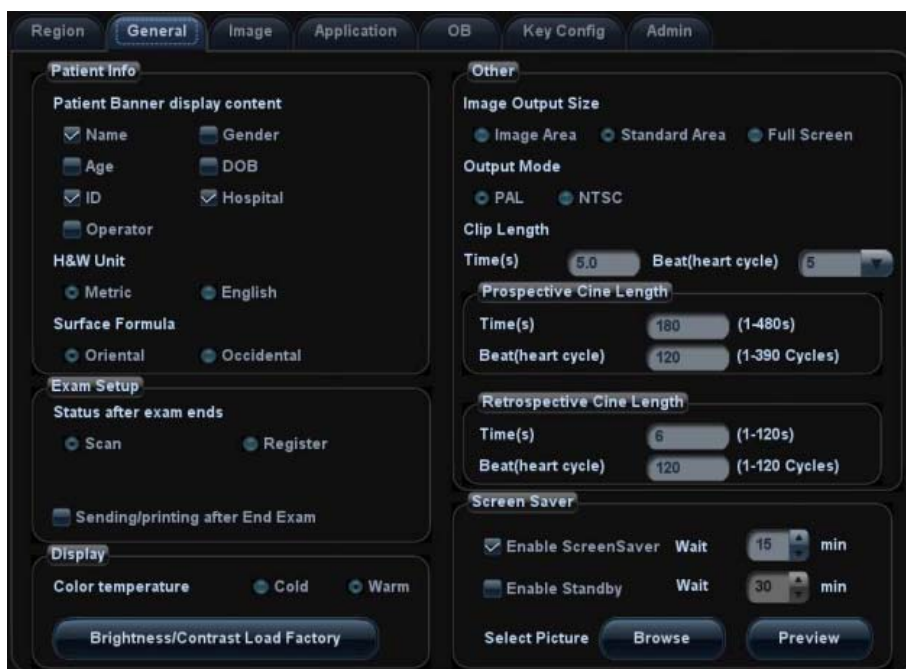
➤ **Region**



In the Region page, set the system language, date format, date, time and hospital related information.etc.

➤ **General**

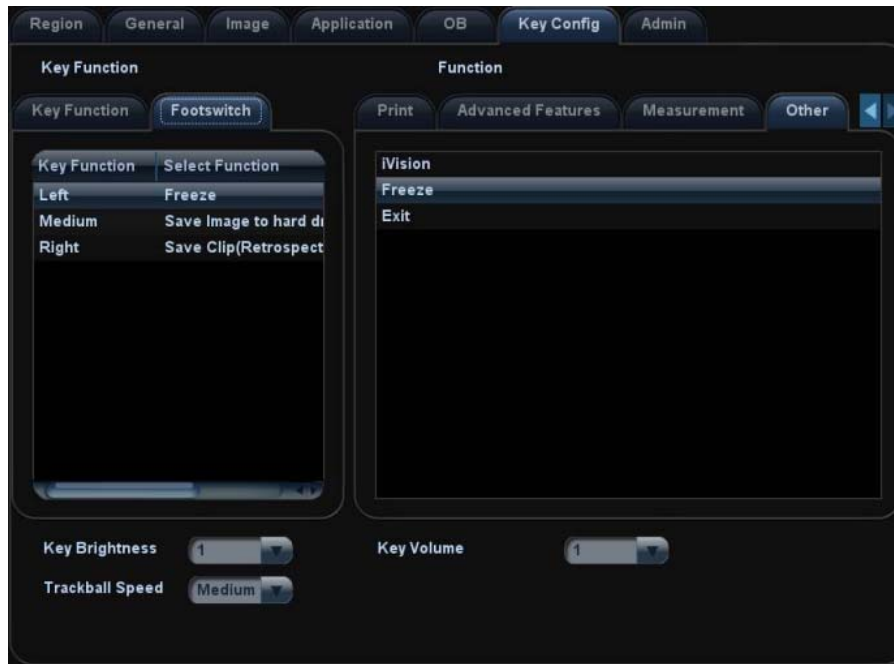
Click <General> to enter:



In this page, set the time of standby/screen-saver, color temperature of display and Output mode, etc.

➤ **Key Config**

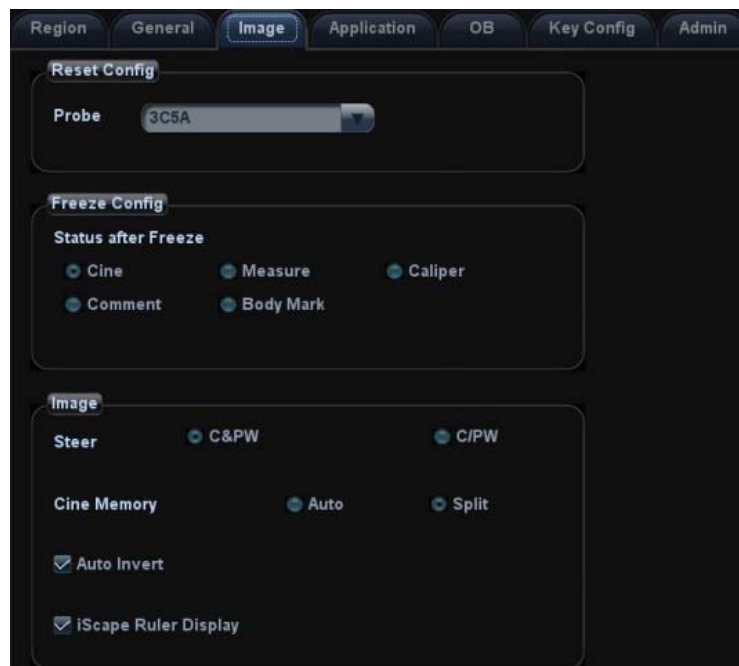
Click <Key Config> to enter:



- 1) Function of keyboard keys ( F1,F4~6,Save and Print) and footswitch keys (left, mid, right) are user-defined.
- 2) Key brightness, key volume and trackball sensitivity can be adjusted.

➤ **Image Preset**

Click [Image Preset] to enter:



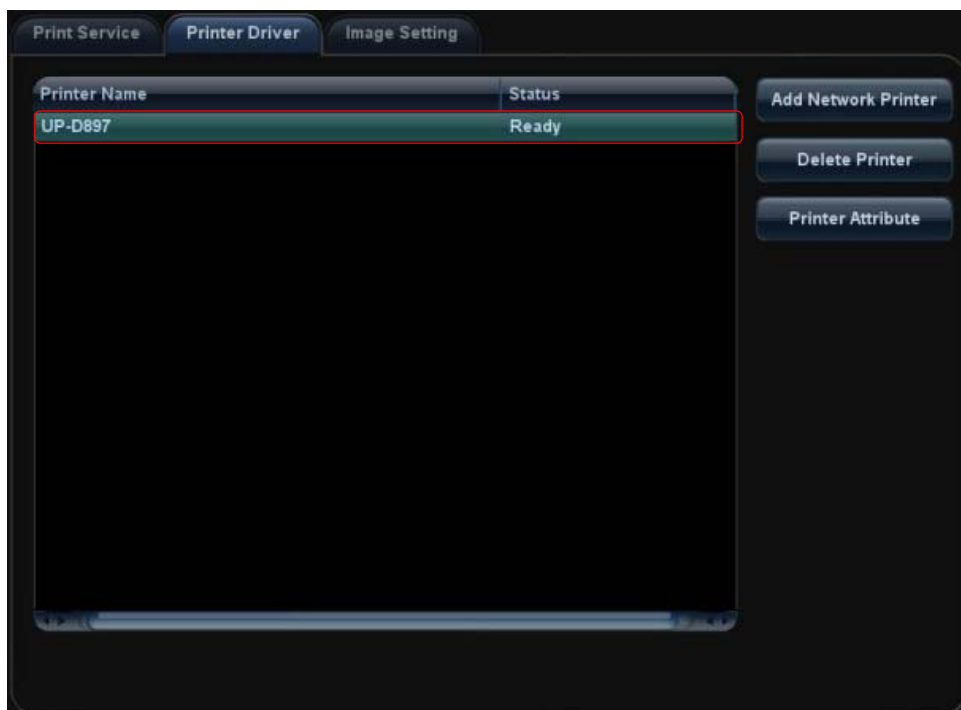
General image parameters can be set in this page.

### 3.5.4 Print Preset

1. Press <Setup> and click [Print Preset] to set video printer, graph/text printer parameters:

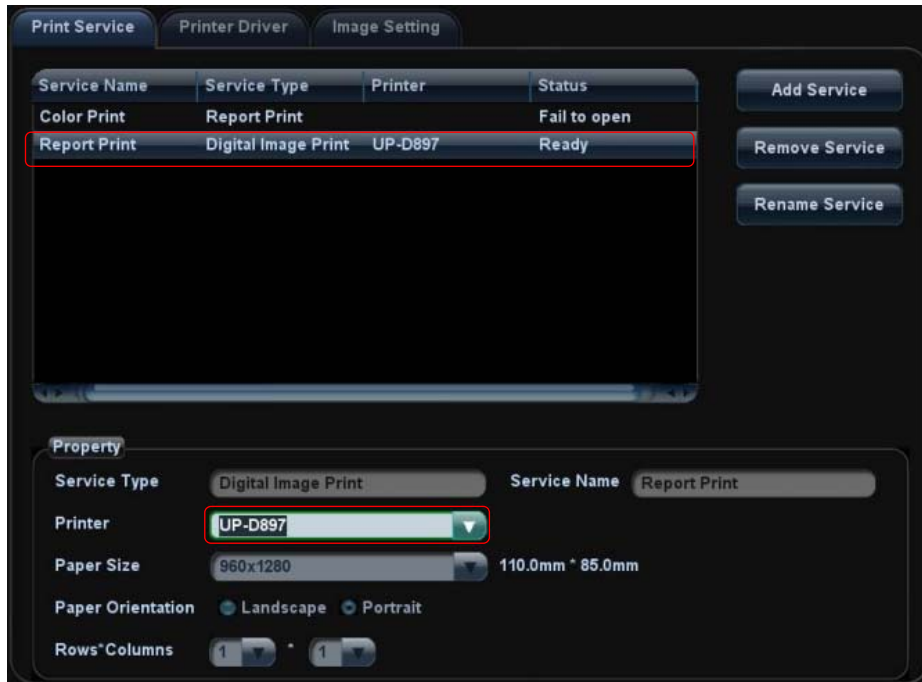


- After connecting the local printer, Click "Printer Driver", the system will display the printer name and status (Ready) automatically which already installed printer driver successfully.



- Return "Printer Service" page, Select the corresponding service from the printer list and increase the service.





The system integrates drivers of HP printers, after HP printers are connected, drivers will be installed automatically (about 10s). If auto installation fails, icon will display on the lower right corner of the screen to warn you that manual installation is necessary. The driver installation method is as follows:

- a) Download the ppd file from HP official website (contact R&D engineer if necessary), and copy the ppd file to the storage device (USB disk as an example).
  - b) Connect the U disk to the USB port nearside the control panel of ultrasound system, click the icon to pop up the screen, select the U disk to run the ppd file and finish the installation.
- Add network printer
1. In "Printer Driver" screen, click [Add Network Printer] to pop up the screen, enter the necessary information (IP address, shared printer name, server name, domain name and password).

2. After successful connection, the newly added network printer name will be shown in the printer driver list.

**NOTE:**

1. Before connect the network printer, make sure the ultrasound system and the printer are in the same network domain, and the network is working normally.
2. The IP address and the server name should be valid, e.g. \\10.2.40.123 or \\5-HP, otherwise, the system will fail to connect.

3. If the server has set accessing limitation, the system will prompt a dialogue box to identify the user. Enter the correct user name, domain name and password, and then click [OK].

## 3.5.5 Network Preset

### 3.5.5.1 Network Preset

Open “[Setup]→[Network Preset]” to enter the screen.



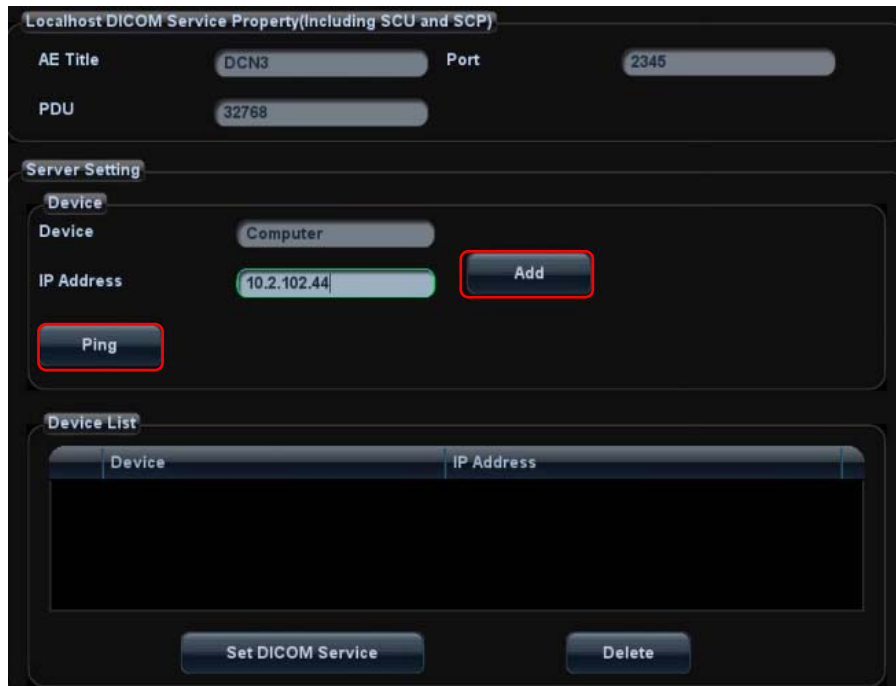
- Please select the network type according the actually status, Select “DHCP”, click [OK].
- Or, select “Static”, and input the IP address, subnet mask and gateway, then click [OK].

Name	Description
Current Network Adapter	To select the network connection mode
DHCP / Static	If “DHCP” is selected, IP address will be automatically obtained from DNS server; if “Static” is selected (using static IP address), you need to enter the IP address.
IP Address	IP address of the system should be at the same network segment with the server IP.
Subnet Mask	Used to set different network segment.
Gateway	Used to set the gateway IP.

### 3.5.5.2 DICOM Preset

**NOTE:** Only if DICOM basic option is configured, [DICOM Local], [DICOM Server], [DICOM Service] are available.

1. Click [DICOM Preset] to open the DICOM preset screen, and then set the DICOM Server.



- 1) Enter the device name and the IP address.
- 2) You can ping other machines to verify connection after entering the correct IP address. Also you can check the connection of the already added server in the list.
- 3) If connection is successful, click [Add] to add the service to the Service list.

**NOTE:** If the currently entered name has already existed, the system will pop up: “The server name exists!” Click [OK] to enter another name.

2. Click [DICOM Service] to open the DICOM Service screen.



Only when the system is configured with DICOM basic function module, and installed DICOM Work list, MPPS, DICOM Structured Reporting and Query/ Retrieve modules, can the corresponding preset settings be found in DICOM Service screen.

The DICOM Service Setting is used to set properties of DICOM services as Storage, Print, Work list, MPPS, Storage Commitment and Query/ Retrieve.

**NOTE:** DICOM Work list can be configured only after DICOM Basic is configured, and if DICOM Work list function is not configured, the “Work list” page is not accessible. Please refer to “Operation manual 11 DICOM” to get more operating methods in detail.

### 3.5.6 System Information

In System Information screen, it displays the product configuration, software version, hardware & boards, and driver related information. You can check the product information here.

1. Press <Setup> and click [System Info].



Title	Status
Product	DC-N3
Manufacturer	MINDRAY
Configuration Type	FDA
ECN/TCN	Incorrect
Ultra Sound System Version	1.0
MAC Address	64 31 50 21 9C 15
Series Number	SF-700 000 01
Contact Detail	service@mindray.com

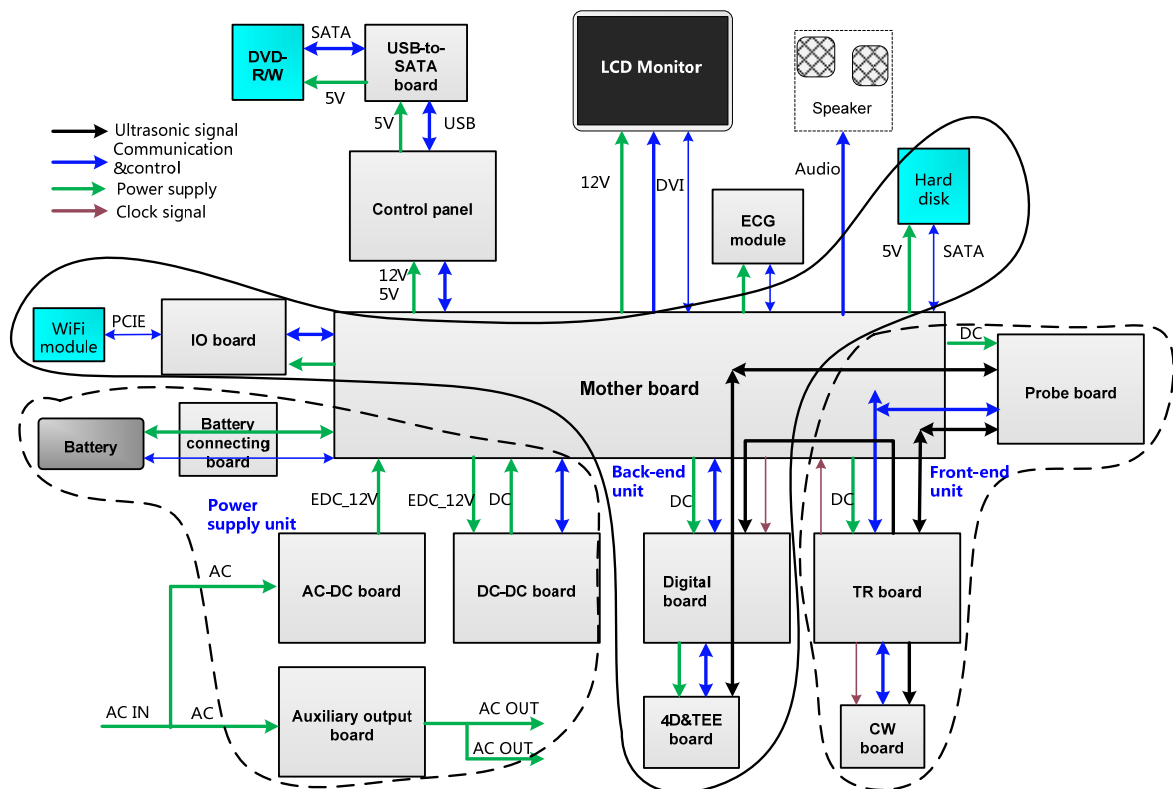
2. Click [About Detail] to check the detailed board information.
3. Click [Save] to export the information in the format of “\*.TXT”; click [Exit] to return to the Setup menu.

**NOTE:**

1. Be sure to confirm the system information before and after the software maintenance.
2. Ask the user to save the current system information if necessary.

# 4 Product Principle

## 4.1 General Structure of Hardware System

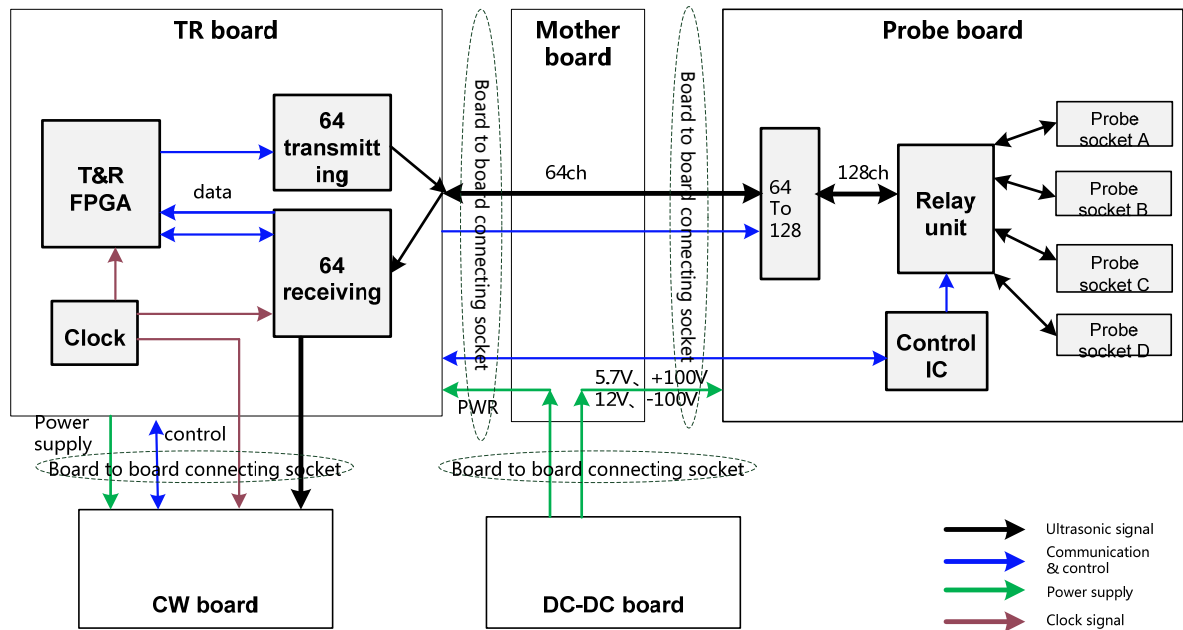


**Figure 4-1 Schematic Diagram of System Hardware**

As described in the figure above, the system hardware consists of the following units:

- Front-end unit (probe board, CW(continual wave) board, TR transmitting and receiving board (TR board for short as below));
- Back-end unit (digital board, 4D&TEE board, IO board, motherboard);
- Control panel unit(control panel, USB-to-SATA board, DVD-R/W);
- Monitor unit;
- ECG unit ( ECG board ) ;
- Power supply unit (auxiliary output board, AC-DC power board, DC-DC power board, battery connecting board).

## 4.2 Ultrasound Front-end Unit



**Fig 4-2 Schematic diagram of ultrasound front-end unit**

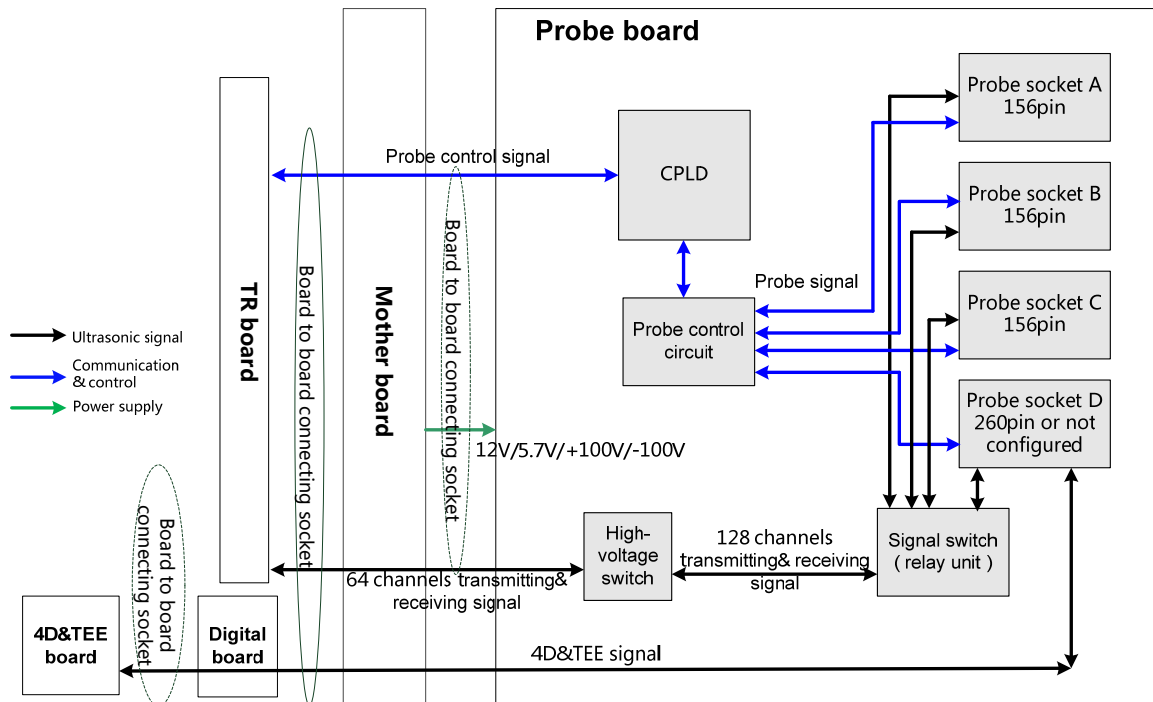
Front-end unit mainly consists of:

- Probe board;
- TR board;
- CW board.

The probe board provides probe socket switching and 64 to 128 channels switching. The TR board provides the function of signal transmitting and receiving. The Ultrasound echoes will be sent to the CPU module on the digital board for post processing after amplification, A/D conversion, beam forming and signal processing by FPGA on digital board.

For details of the boards, see the following chapters:

## 4.2.1 Probe Board

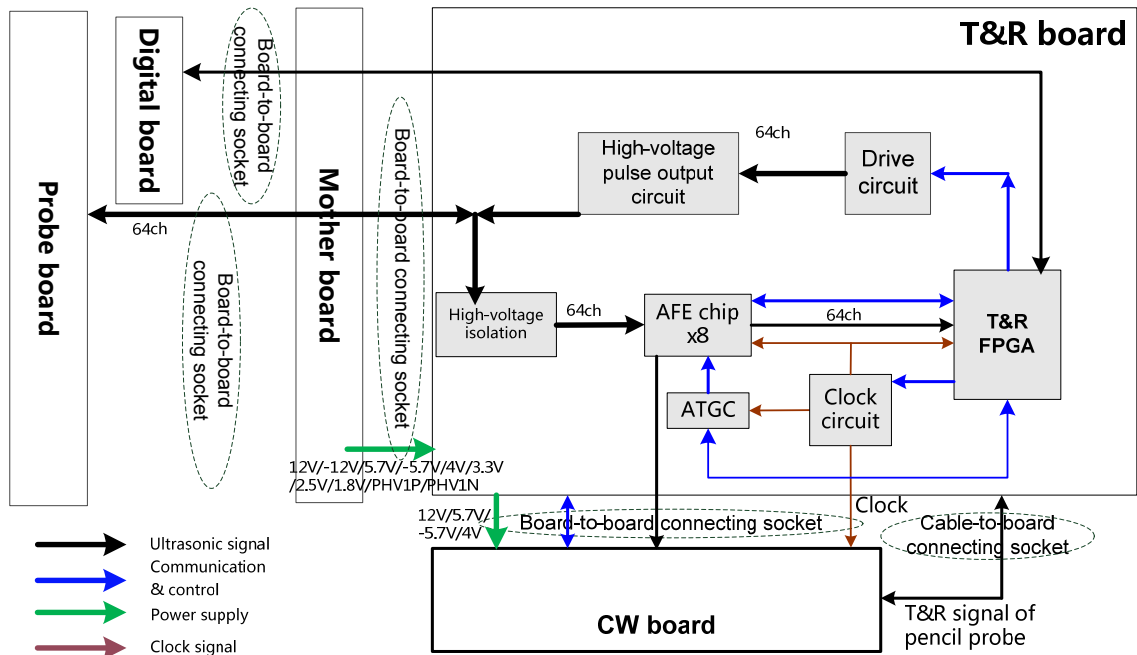


**Fig 4-3 Schematic diagram of probe board**

Functions of the probe board are:

- Supports 192/128 elements probes, 4D probes, phased array probes and bi-planar probe;
- Probe board provides 64 to 128 channels switching ;
- 192 elements switching is performed in the probe. Probe board only supports 128 channels.
- Probe board includes three 156- pin sockets and one 260- pin socket.
- Supports 4 probe ports switching and ID recognition of probes on every port. The circuits for ID recognition and probe switching are independent.

## 4.2.2 TR Board



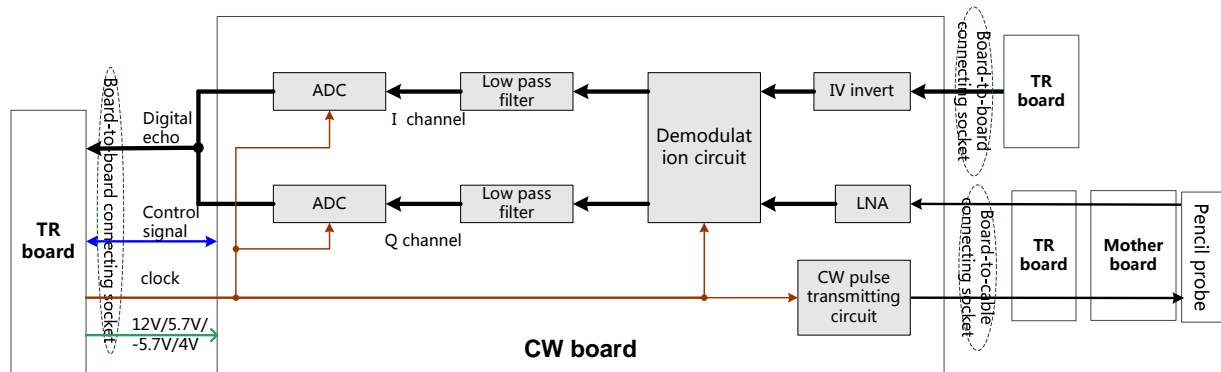
**Fig 4-4 Schematic Diagram of TR Board**

The TR board is designed for signal transmitting and receiving. The system can communicate with the TR board via the communication control bus.

- Generate 64-channel transmission waveform
  - Generate 64-channel transmission waveform according to the scanning sequence and control parameter.
  - The 64-channel transmission waveforms are driven into 64-channel high-voltage transmission pulses by the drive circuit.
- Generate 64-channel signal receiving
  - High-voltage isolation.
  - Amplification and A/D conversion of ultrasound echoes, performed by the integrated front-end chip.
  - ATGC module, voltage gain control module.
  - Beam former, performed by FPGA.
- Clock module, the clock source of the whole front-end unit is on the TR board, clock buffer is sent to the corresponding board after fan-outting.



## 4.2.3 CW Board



**Fig 4-5 Schematic Diagram of CW Board**

Functions of the CW board are:

- Echo signals that received by the phased array probe or pencil probe will first be amplified through low-noise-amplifying (LNA) circuit, then pass through the demodulator to obtain I, Q signals, and I, Q signals will be sampled through ADC after being filtered out the useless low-frequency and high-frequency signals. The sampled digital signals then will be sent to TR board FPGA through the interface for processing.
- Convert low- voltage digital signal into pulse transmitting signal which will drive the transmission of pencil probe.
- Control signal port provides the system with information like CW board ID, pencil probe presenting signal and pencil probe ID.
- The pencil probe port is on ECG panel, being connected to motherboard via a cable. There is no connection between pencil probe and ECG board.

## 4.3 Ultrasound Back-end Unit

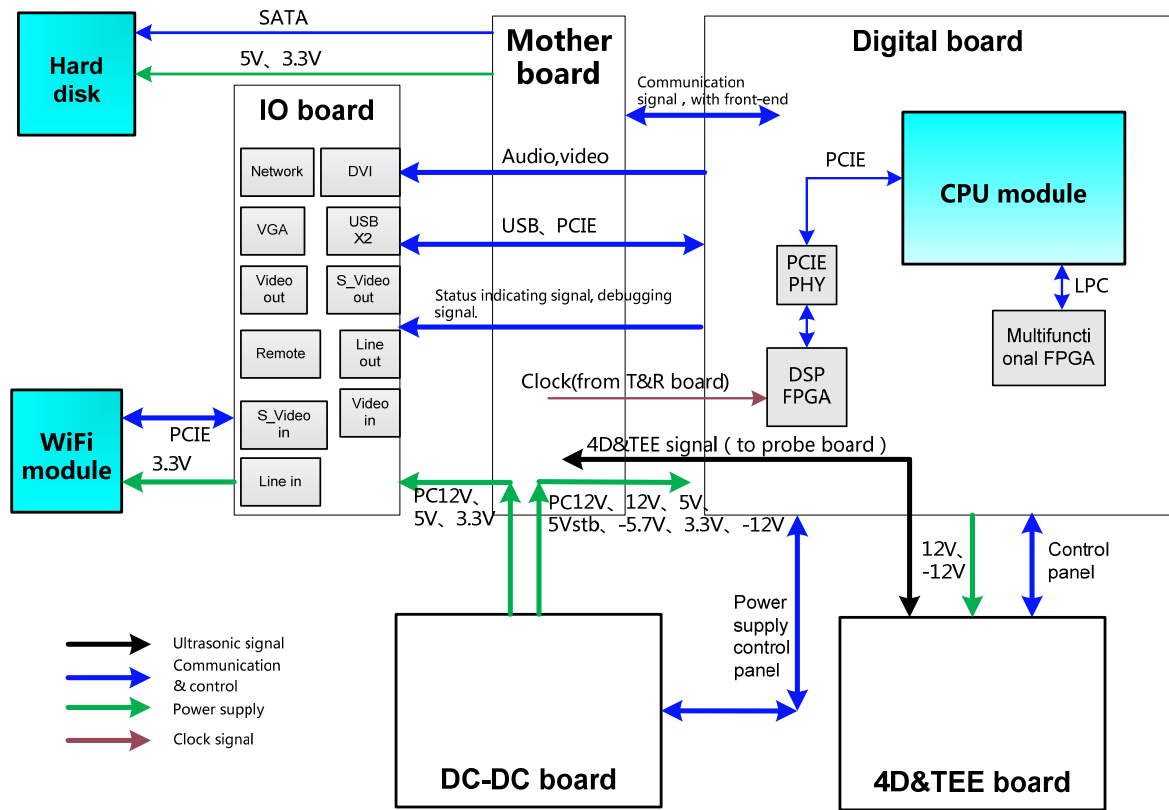
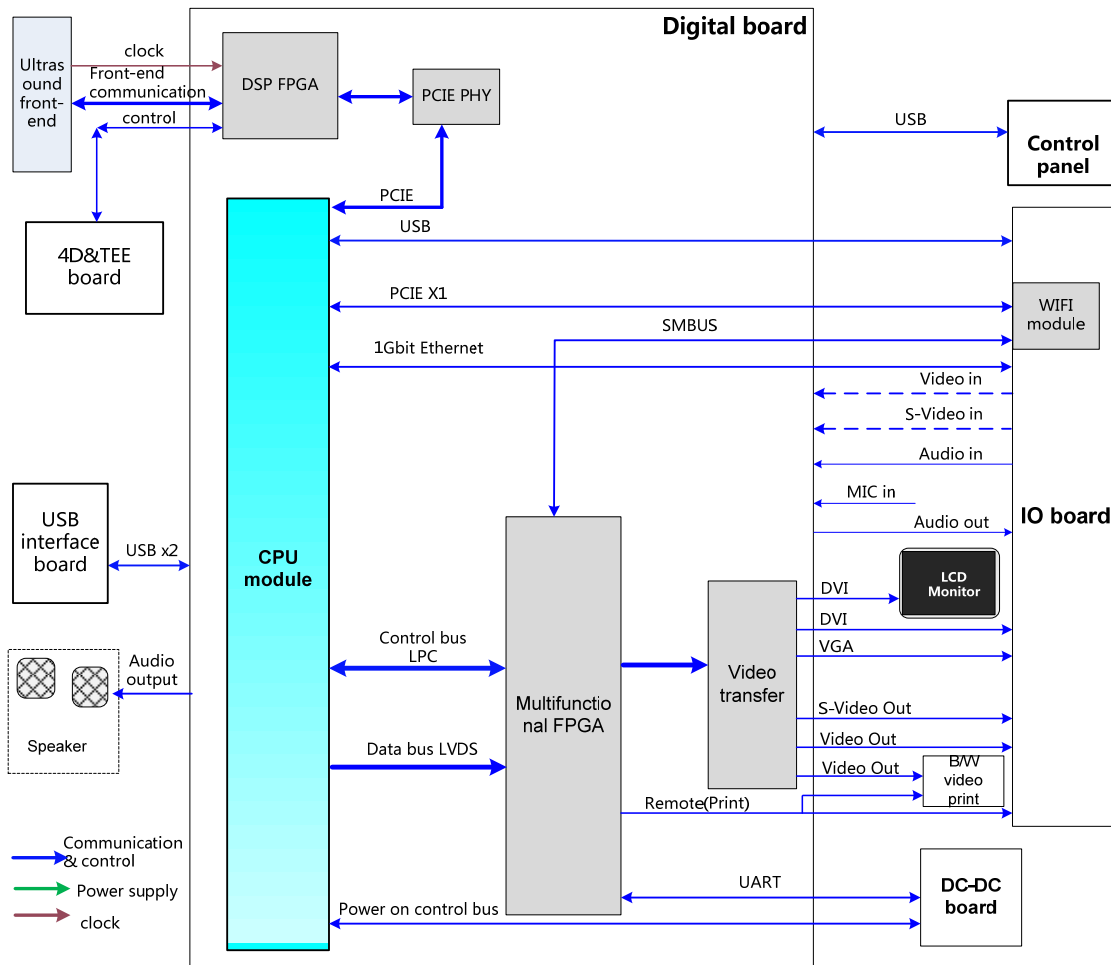


Fig 4-6 Schematic Diagram of Back-end Unit

The back-end unit mainly consists of: digital board, motherboard, IO board, 4D&TEE board, etc. See the diagram above.

### 4.3.1 Digital Board & IO board

The block diagram of the digital board is shown as below:



**Fig 4-7 Schematic diagram of the digital board**

Main functions of the digital board are:

- Standard COM-E socket;
- DSP (digital signal processing) FPGA:
  - a) Digital signal processing of B,C,D mode, etc.
  - b) Pack the data which is already processed by corresponding image mode, and then send it to CPU module to perform post processing.
  - c) System control bus which is sent to all the boards of whole front-end unit by CPU module is also transmitted via DSP FPGA.
- Multifunctional FPGA mainly implements video format transfer, back-end control, port extending, etc. includes:
  - a) Display extending: Convert LVDS signal to all other video formats required by video output port chips, time sequence conversion, video cutting and filling.
  - b) Digital video port. Supports digital video compressing and storage, and the related control.
  - c) Back-end communication and control. Extend serial port, used for battery management, high-voltage controlled SCM communication, etc. The functions are realized by the multifunctional FPGA using LPC bus.
  - d) Video print control, support video printer connecting.

- e) Support I2C port, used for monitor status obtaining, parameter writing, etc.
- Communication bus
  - a) PCIE ×1, 2 channel; front-end data and control communication port. WiFi module support
  - b) LPC, used for multifunctional communication control and transfer extending for part of the communication ports.
- Back-end video processing, realize CPU module video output extending.
  - a) DVI, 2 channels; used for monitor and IO board external display port, the resolution should support 1024×768@60Hz.
  - b) VGA, 1 channel; used for external VGA port display extending, resolution 1024×768@60Hz.
  - c) Composite Video, 1 input (reserved), 2 outputs, used for external video output and internal B/W video printer, support PAL/NTSC switching.
  - d) S-Video, 1 input (reserved), 1 outputs, support PAL/NTSC switching.
- Audio processing
  - a) Audio 1 input (reserved), 1 output, left and right stereo
  - b) Power amplify output, the maximum single channel power is 12W, left and right stereo
  - c) Support external MIC input.
- Port support
  - a) G-bit Ethernet port, 1
  - b) WiFi port, 1, internal
  - c) Support Bluetooth, USB port (external)
  - d) Support footswitch, USB port
  - e) Video print control port, 2, for both B/W and color
  - f) SATA port, 1, for HDD
  - g) USB port, 5 for external, as shown in the figure.

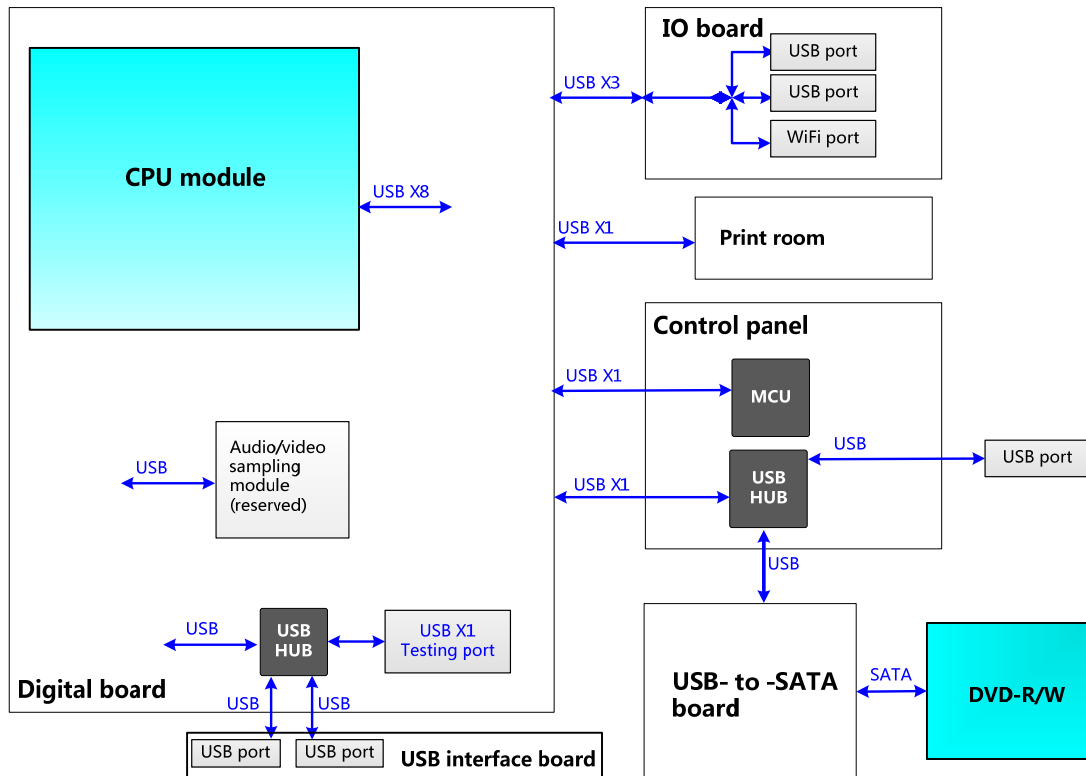


Fig 4-8 Distribution diagram of USB ports

### 4.3.2 4D&TEE Board

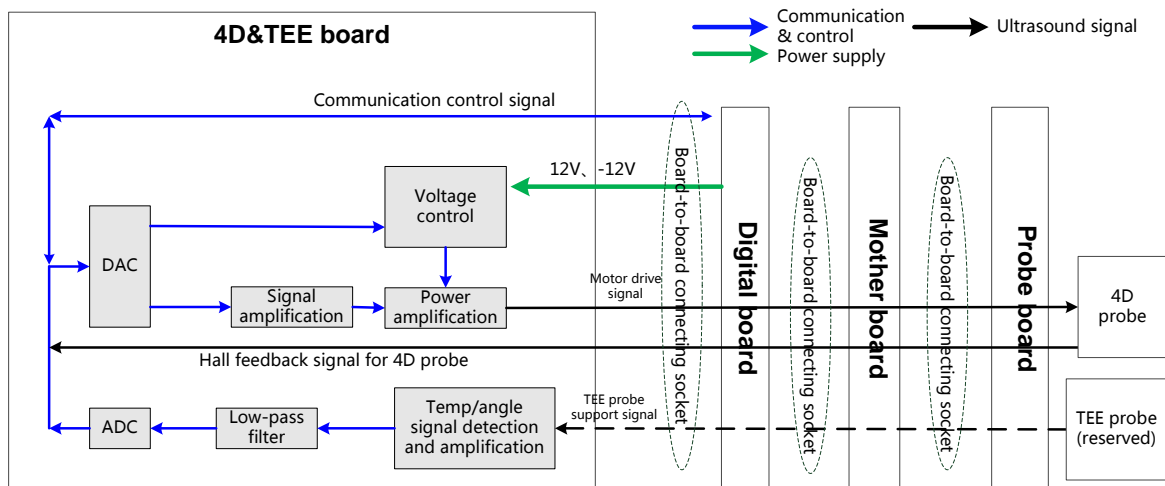


Fig 4-9 Principle Block Diagram of 4D&TEE board

Function description:

- Power amplification for 4D drive signal; outputs required signal to drive the probe to the designated position.
- Provides 4D Hall signal returning channel.
- Amplify and collect the TEE probe temperature and angle signal.

## 4.4 Control Panel Unit

The control panel unit mainly consists of control panel and USB-to-SATA board.

USB-to-SATA board, implements communication conversion between USB port and SATA port, for supporting DVD-R/W with SATA port.

The control panel consists of power on/off key, retractable keyboard, trackball, TGC slider, and encoder, including key volume and key light. The keys, trackball, TGC and encoders are used for signal input, key volume and key light for output.

USB HUB is adopted for USB extending on the keyboard. See the figure below, the following function circuits are designed on the control panel:

- Power on/off key circuit;
- TGC adjust circuit;
- Trackball circuit;
- LED drive control circuit;
- Key volume circuit;
- FPGA control circuit;
- Encoder circuit;
- USB HUB circuit.

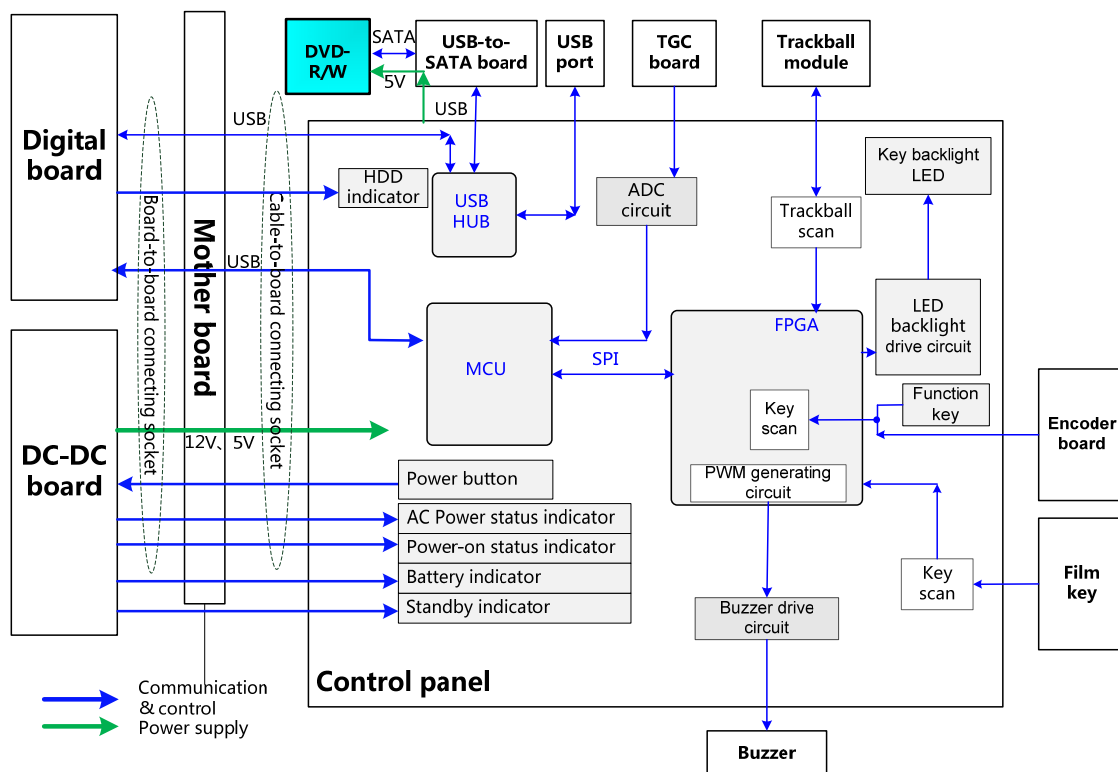


Fig 4-10 Schematic diagram of control panel

## 4.5 ECG Unit

ECG unit, which mainly consists of ECG board, takes charge of ECG signal detection, and signal display. As the reference of ultrasound image, ECG signal is synchronous with

2D image and color flow image which real-time displays. After amplification, filtering and sampling, the ECG signal will be sent to DSP FPGA. Meanwhile, detect R-wave and the detected ECG triggering signal will be sent to DSP FPGA through serial port.

The system can be connected with ECG leads and transducer; the ECG leads are compatible with the port on the patient monitor device of Mindray. Besides, USB interface board is adopted in the ECG unit. USB signal from the digital board will be sent to USB interface board via mother board and cables. For the user's convenience, two USB ports are designed on the USB interface board. Structure of ECG unit is described as below:

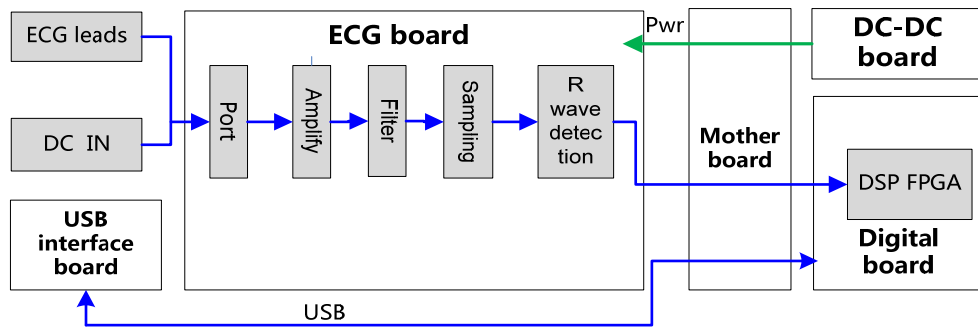


Fig 4-11 Schematic diagram of ECG unit

## 4.6 Monitor Unit

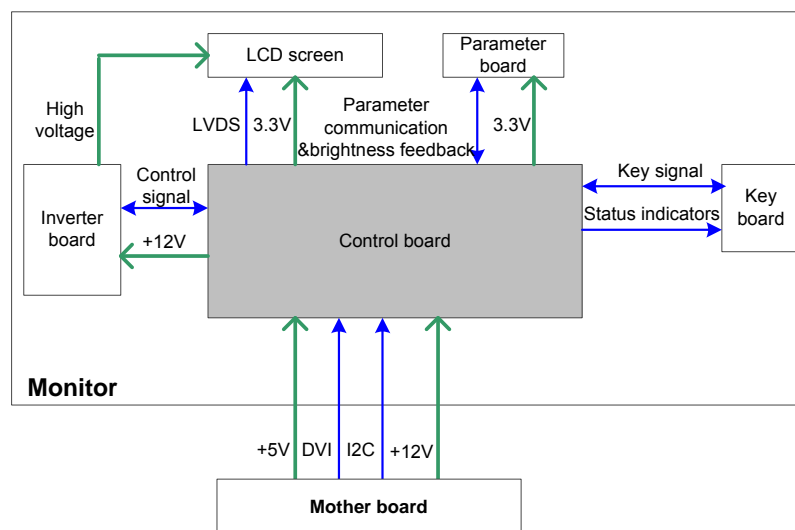


Fig 4-12 Schematic diagram of the monitor

The monitor unit mainly consists of control board, inverter board, LCD screen, data board, key board, etc.

(NOTE: The backlight type of LCD screen decides that if monitor unit has an inverter board or not:

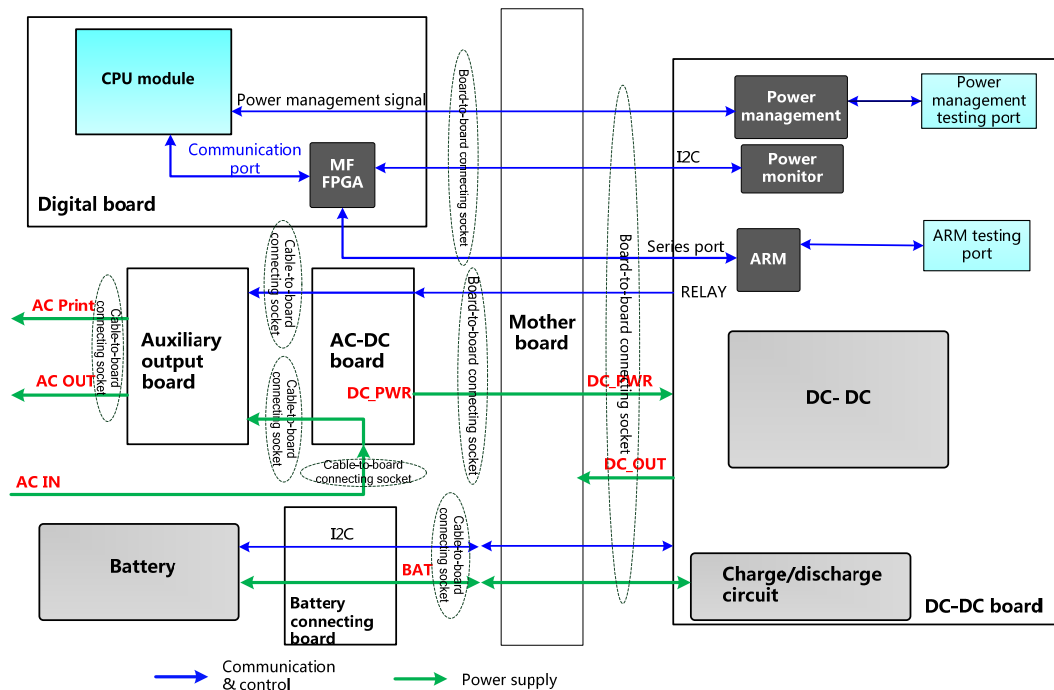
1. If the backlight type of LCD screen is LED backlight, monitor need not to use inverter board. The control signal and 12V voltage output by control board are provided to the backlight of LCD screen directly.
2. If the backlight type of LCD screen is CCFL backlight, monitor need to use inverter board.

Function:

- The control board, as the main part of the monitor, transfers DVI input into LVDS signal then output to the LCD screen, monitors other board or signal; meanwhile, it can communicate with the main system through I2C port. So it is convenient for the main system gathering information from the monitor or controlling the monitor.
- The inverter board generates high voltage to illuminate backlight of LCD which is adjusted by control board with signal on-off and brightness.
- The parameter board memorizes the color temperature and gamma correction data; It is used with LCD screen, so that the corresponding display effect shall be consistent. For the first time of installation or replacing the control board / LCD board, related parameters should be updated in the control board. Meanwhile, it monitors the backlight brightness of LCD. The control board will adjust the LCD backlight brightness according to the current, transferring efficient of backlight or temperature changed, the brightness of LCD screen can keep stable.
- User operation is accepted through key board, and monitor displays the menu so that user can adjust some monitor parameters.

## 4.7 Power Supply Unit

Power supply unit provides power to the system (front-end, back-end, peripherals, etc.). The power supply unit consists of auxiliary output board, AC-DC power board, DC-DC power board, battery module, etc.



**Fig 4-13 Schematic Diagram of Power Supply Unit**

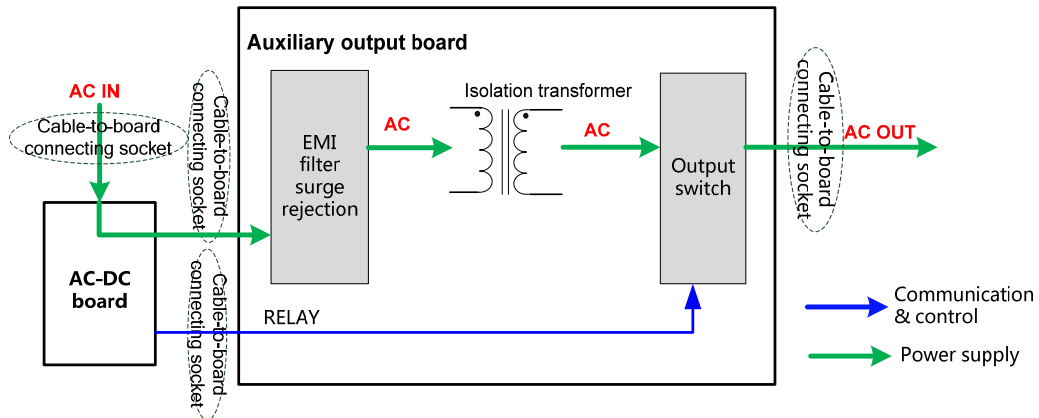
The mains power goes to the auxiliary output board and AC-DC power board.

After transferring, it will provide power to AC auxiliary output or peripherals (printer, e.g.) on auxiliary output board. Once the AC-DC power board is powered by the mains power, it will provide 12V to DC-DC power board. Except power management, including system on-off logic, system status indicating, etc; DC-DC power board also implements charge management, voltage monitor, battery management and programmable voltage control, etc.



For details about the boards of power supply unit, please refer to the following chapters.

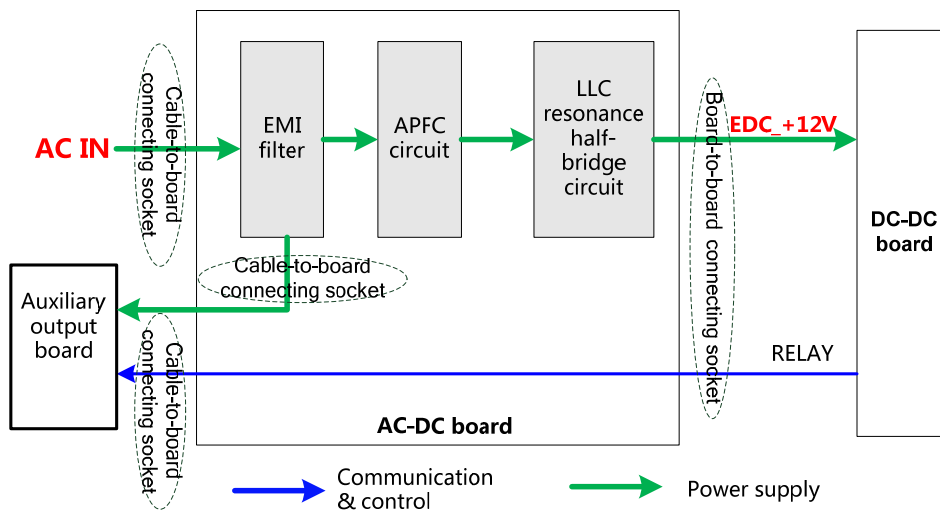
## 4.7.1 Auxiliary Output Board



**Fig 4-14 Schematic diagram of auxiliary output board**

Auxiliary output board implements isolation and inversion to AC input then control the AC output for peripherals via switch.

## 4.7.2 AC-DC board

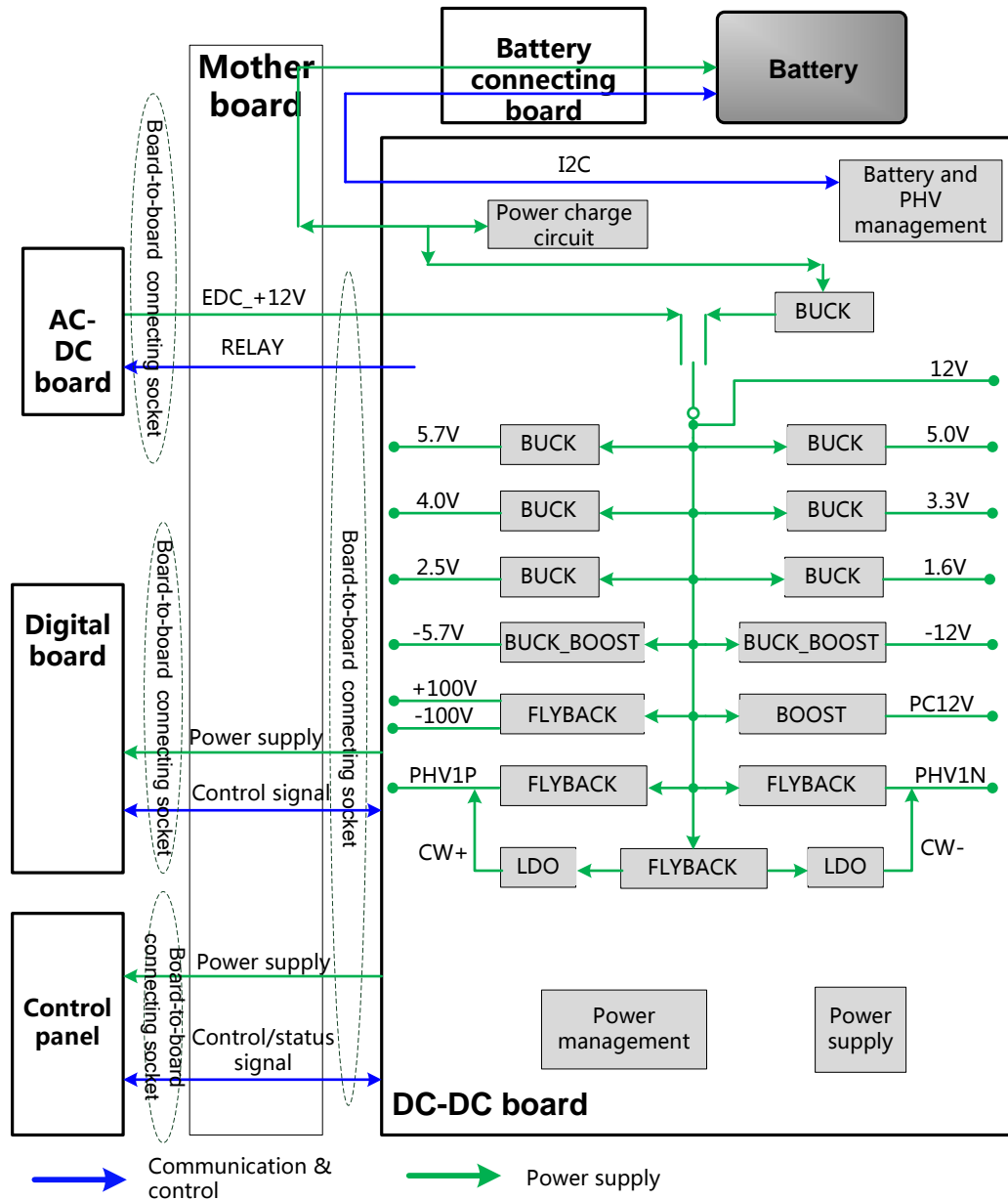


**Fig 4-15 Schematic diagram of AC-DC board**

Function description:

- The mains power is input to AC-DC power board, after pass through the EMI filter circuit, been rectified and filtered, then APFC circuit starts to work normally and provide power to DC-DC board when the system is turned on.
- Adopt LLC resonance half-bridge circuit to implement the DC conversion output, which is +12V.

### 4.7.3 DC-DC board



**Fig 4-16 Schematic diagram of DC-DC board**

Function description:

- DC-DC power board mainly consists of power management, battery management, PHV management and DC-DC power module, etc.
- After the system is turned on, power module in DC-DC power board will output the powers except Standby normally to power the back-end boards according to the status information of CPU module, FPGA and battery. When system is on, the power charge circuit still works normally.
- When the machine configured with battery, it can be powered on by battery. If AC power is connected at the same time, AC provides power in priority.
- DC-DC board mainly generates the ultrasound transmission power, including two channels adjustable PHV and two channels stable voltage  $\pm 100V$ . The host computer can set the value of PHV voltage via especial port.

- DC-DC board includes power monitor IC, Which is provided to host computer to obtain the voltage value of special power.
- After each circuit module on the board is started, PHV and ±HV are still kept closed, PHV and ±HV will be started only if the IC received the commands from host computer, PHV output voltage is determined by the command of host computer.

#### 4.7.3.1 System Power on Control

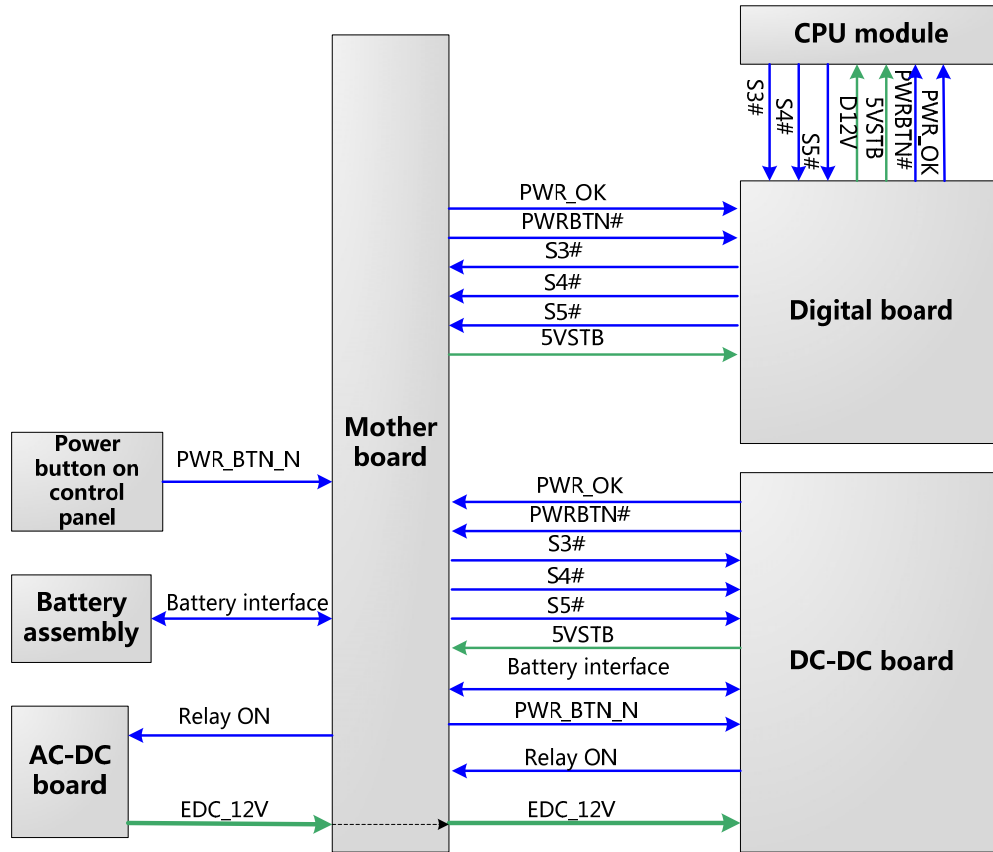


Fig 4-17 Schematic diagram of system power on control

- The related control signals:

No.	Control signal	Explanation	Remarks
1.	PWR_BTN_N, PWR_BTN#	The pulse signal, which is generated by the power button on control panel, is transferred to the CPU module through power management FPGA, for system being turned on.	
2.	S3#	Output by CPU module, If it is effective, the CPU module is in standby status (S4# is high), when 5VSTB_CPU which is controlled by power management FPGA is in the charging status.	
3.	S4#	Output by CPU module If it is effective, CPU module is in hibernation status.	
4.	S5#	This signal is not used currently.	
5.	PWR_OK#	Power management FPGA output to CPU module, means 12V power is OK.	
6.	Relay ON	Output by DC-DC board, when AC is input in power-on	

		status, permits auxiliary output to open.	
7.	EDC_12V	From AC-DC board to DC-DC board, for generating 3.3VSTB and 5VSTB power. If there is AC input, the power keeps output.	

- Both AC power and battery can support the ultrasound system to work normally.
- Only if there is AC input, power supply unit will generate 5VSTB and 3.3VSTB.
- When system is shut down, disconnect the AC power but the battery is in use, the battery management will shut down the 5VSTB output, only 3.3VSTB reserved. It means that the system will be powered on again until press the power button.
- In standby mode, disconnect the AC power, when the battery is in use, the battery provides 5VSBT and 3.3VSTB for system use.

The power on process is shown as below:

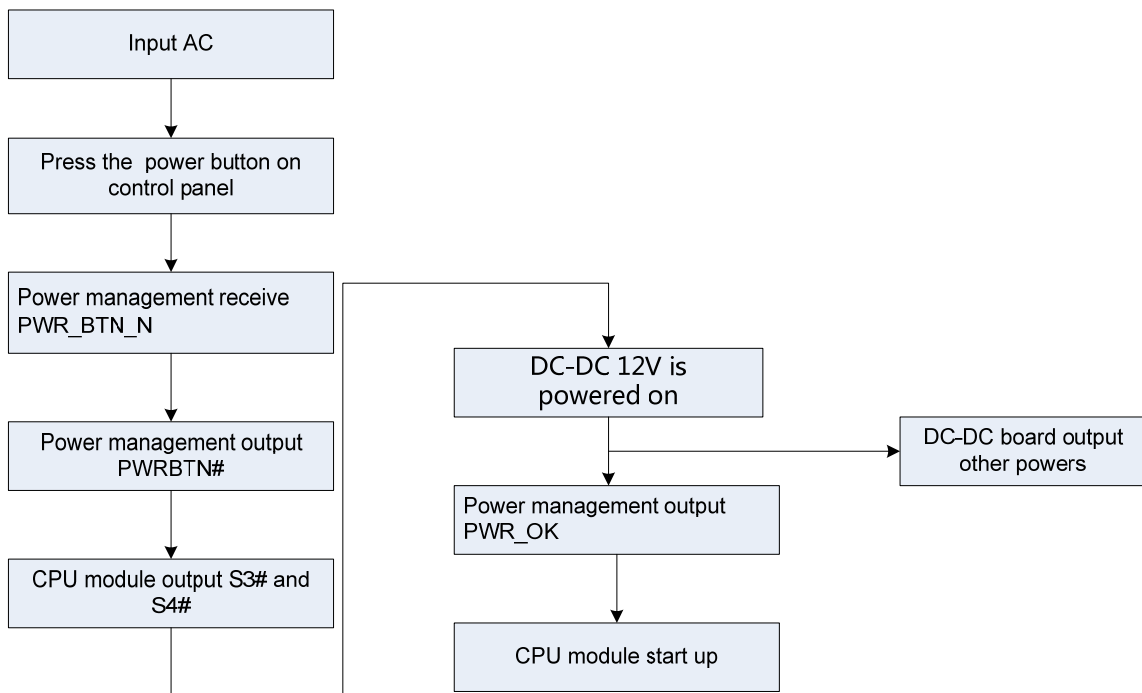


Fig 4-18 Schematic diagram of system power on Process

## 4.8 Cables Connecting of Whole system

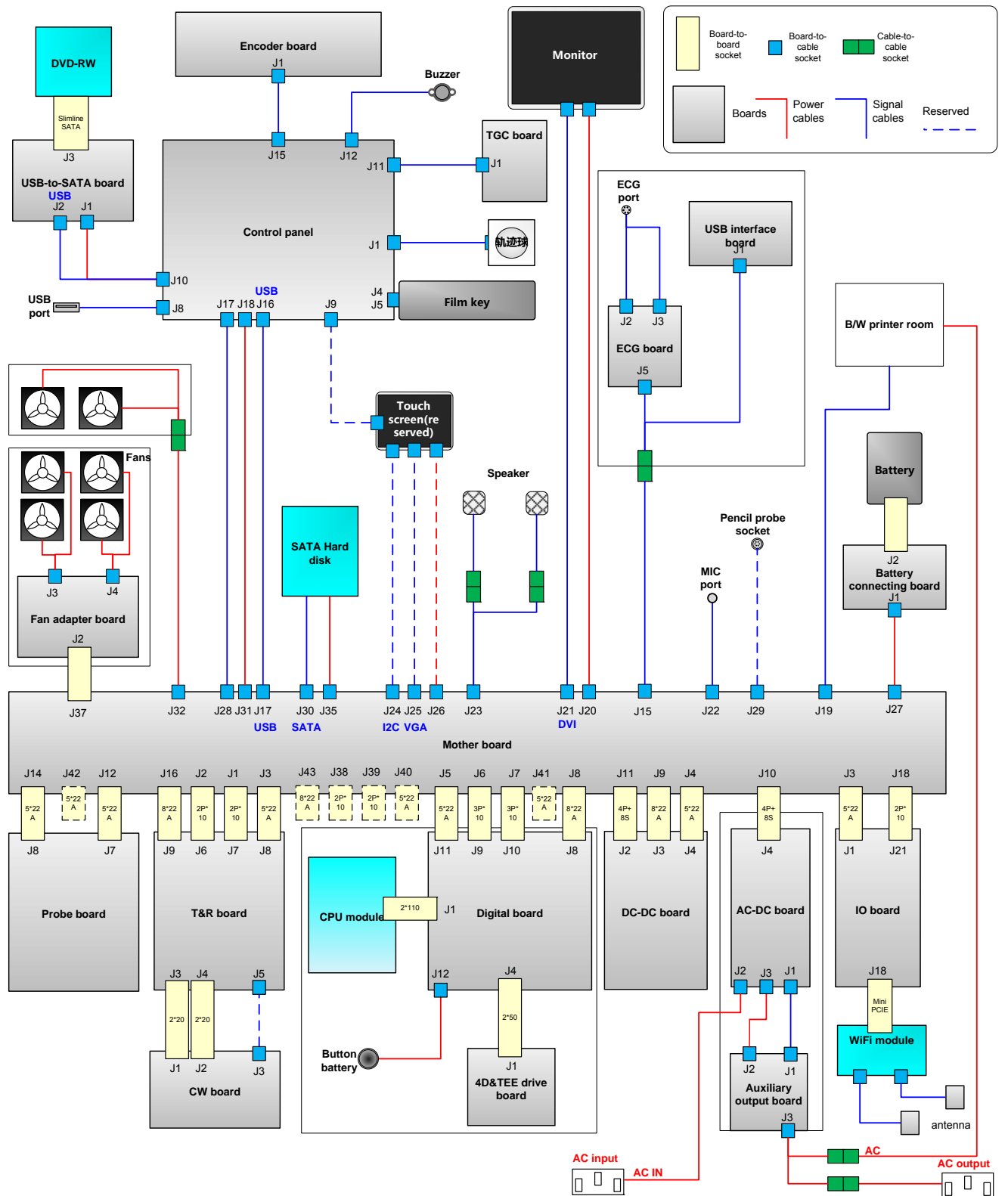


Fig 4-19 Schematic diagram of cable connecting of whole system



# 5 Function and Performance Checking Method

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## 5.1 Instruction

The chapter supplies the method to verify main function and performance of product. This is only used for reference, not preventive execution.

Function checking and testing of this part shall be carried out by Mindray service engineers and the user together.

## 5.2 System Running Status

### 5.2.1 Running Status

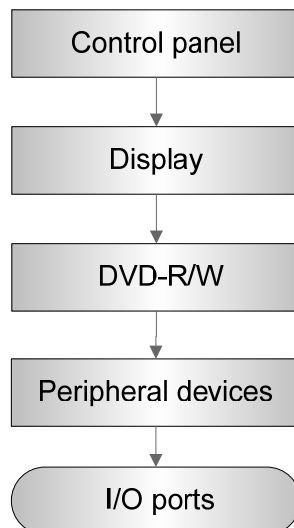
1. The ultrasound system can be turned on or off normally, working normally, no any abnormal noise and phenomenon appear when the system is running.
2. The fan starts to work as soon as the system is turned on, no any abnormal noise appear in process
3. Check basic system information such as product configuration, options, software version, etc. Confirm all the information is normal.
4. Check if contrast and brightness of the monitor are normal.
5. Check if time and date are valid and correct. If not, please preset them again.
6. Check if all status indicators are normal.
7. Check the log together with the user to confirm any abnormality or occasional abnormalities when the system is running.

### 5.2.2 Working Condition

Check if the ambient temperature and humidity are in the specified range described in chapter 2.

## 5.3 General exam

### 5.3.1 Check Flow



### 5.3.2 Checking Content

#### 5.3.2.1 Check Control Panel

Procedure	Standard
Check the functions of all keys and knobs Follow the direction: left to right, and up to down.	All keys and knobs are effective.
Function checking of the trackball <ul style="list-style-type: none"> <li>● Press the &lt;Freeze&gt; key to enter the Freeze status.</li> <li>● Press &lt;Measure&gt; to enter into measure status, do vertical and horizontal measurement, or do other trackball operations.</li> </ul>	The trackball can be rotated easily and smoothly, the cursor responds sensitively, the rotation direction is the same as the direction of the cursor.

#### 5.3.2.2 Check the Monitor

Procedure	Standard
<ul style="list-style-type: none"> <li>● Adjust LCD brightness</li> <li>● Adjust LCD contrast</li> </ul> Press<Setup> to enter [System Preset]→[General], In "Display" column: <ul style="list-style-type: none"> <li>● Click color temperature [Cold/Warm].</li> </ul>	<ul style="list-style-type: none"> <li>● Press "+", the brightness increases; and press "-", the brightness decreases.</li> <li>● Press "+", the contrast increases; and press "-", the contrast decreases.</li> <li>● The LCD color temperature changes correspondingly.</li> </ul>



<ul style="list-style-type: none"> <li>● Click [Load factory].</li> <li>● Display maintenance</li> </ul> <p>Log in as “Service”, click [Maintenance] in the Preset menu, then click [Test Main Monitor] to enter the monitor test.</p>	<ul style="list-style-type: none"> <li>● Brightness/contrast return to the default setting.</li> <li>● Click each functional button, the LCD responds correctly, the standard is as follows:             <ol style="list-style-type: none"> <li>1. Light-spot: 0; flash point: 0.</li> <li>2. The adjoining dark dots are no more than 3 pairs, and there is no adjoining dark dot in image area.</li> <li>3. There is no adjoining dark dot of 3 or more than 3.</li> <li>4. The dark dots are no more than 7 and those in the image area are no more than 2</li> <li>5. The distance between bad dots is no less than 5mm.</li> </ol> </li> </ul> <p>Note: image area refers to the rectangle when the background is black/white.</p>
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### 5.3.2.3 Check DVD-R/W

Procedure	Standard
<p><b>DVD-R/W Drive</b></p> <ul style="list-style-type: none"> <li>● Check if connection is normal</li> <li>● Press 『F3』 function key</li> <li>● Perform DVD reading and writing.</li> </ul>	<ul style="list-style-type: none"> <li>● The DVD-R/W driver can be ejected smoothly.</li> <li>● Data reading and writing performs normally without abnormal noise.</li> </ul>

### 5.3.2.4 Check Peripheral Device

Procedure	Standard
<p><b>Footswitch:</b></p> <p>Connect the footswitch and check the functions of footswitch according to the functions listed in Key Config.</p>	<ul style="list-style-type: none"> <li>● Press the freeze key (the right key), image is frozen, the freeze menu is displayed; press the key again, image is unfrozen.</li> <li>● Press the key (middle key), color printing starts</li> <li>● Press the print key (left key), B/W printing starts</li> </ul>
<p><b>Video Printer:</b></p> <p>Check if the video printer and ultrasound system are correctly connected. Then check the function of each key.</p>	<ul style="list-style-type: none"> <li>● Press &lt;Print&gt; key, the printer begins to work, no image print deficiency or degradation. Switch video output port</li> <li>● Press &lt;Print&gt; key, the printer begins to work, the image printed has no deficiency or degradation.</li> </ul>
<p><b>Graph/ text Printer:</b></p> <p>Check if the graph/text printer and ultrasound system are correctly connected. Then check the function of each key.</p>	<p>Press &lt;Print&gt; key, the printer begins to print, no print deficiency or degradation.</p>
<p><b>bar Code scanner:</b></p> <p>Perform code bar scanning when the ultrasound system is running normally.</p>	<p>The bar code is correctly displayed on the screen.</p>

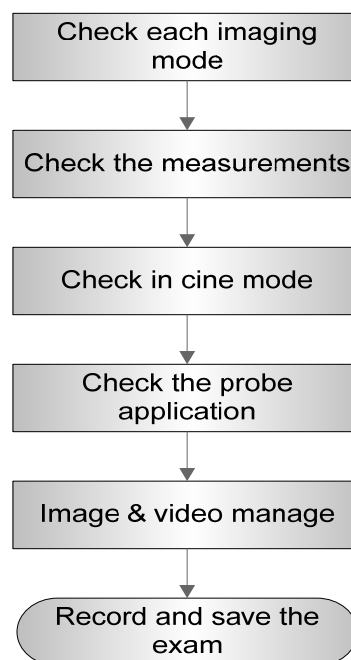
### 5.3.2.5 Check IO Ports

Procedure	Standard
Checking IO ports: Video/audio interface, USB port have been verified, remains are: <ul style="list-style-type: none"><li>● VGA port</li></ul> Connect VGA display <ul style="list-style-type: none"><li>● Network port</li><li>● USB port</li></ul>	<ul style="list-style-type: none"><li>● The contents displayed on the VGA/LCD are the same as those displayed on the ultrasound system display, no character and image loss, no color difference, no fluttering and flicking.</li><li>● Network connection and communication are all normal.</li><li>● USB port data storage/accessing are normal.</li></ul>

## 5.4 Function Checks

**NOTE:** A completed function inspection is described here, do the checking according to the actual system configuration.

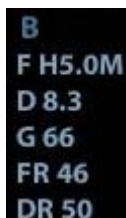
### 5.4.1 Check Flow



## 5.4.2 Checking Content

### 5.4.2.1 B Mode

- In B Mode scanning, the image parameter area in the left corner of the screen will display the real-time parameter values as follows:




Display	F	D	G	FR	DR
Image Parameters	Frequency	Depth	Gain	Frame Rate	B Dynamic Range

- Parameters that can be adjusted to optimize the B Mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, Depth, TGC, Focus
Soft menu or menu	Gray Map, Line Density, L/R Flip, MFP,U/D Flip, Focus Number, Focus Position, iClear, Dynamic Range, FOV, TSI, Acoustic power, Tint Map, iBeam, H Scale, Free Xros M ,Gray Invert , Biopsy Kit, Frequency, Trapezoid, Rotation, iTouch

#### 1. Control Panel

Procedure	Standard
Press <B>	Enter B mode, and B image displays
Gain adjustment. Adjust <B> button	Rotate clockwise to increase Rotate anticlockwise to decrease The adjusting range is 0-100.The real-time value will be displayed in the image parameter area in the upper left corner of the screen.
Depth Adjustment Adjust <Depth> button	Rotate clockwise to increase Rotate anticlockwise to decrease The adjustable depth values vary depending upon the probe types.
TGC adjustment Adjust through the 8-segment toggles	Push the toggle to the right to increase the corresponding area brightness Push the toggle to the left to decrease the corresponding area brightness About 1.5s after the adjustment is finished, the TGC curve disappears.
iTouch Press <iTouch> button	iTouch sign will be displayed in the image area to activate image effect auto optimization. Click [iTouch] on the image menu to adjust gain value in iTouch mode. Click [iTouch Brightness] on the image menu to adjust brightness in iTouch mode.

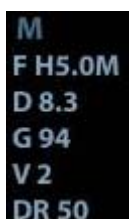
Image Magnification Adjust <zoom> button	Rotate clockwise to zoom in the image (max. magnification factor is 10); rotate anticlockwise to zoom out the image. Roll the trackball to change position of the magnified image. Press <Zoom> in zoom status to exit the mode, the current window returns to the display before zoom.
Press <B>, and then press 	<ul style="list-style-type: none"> <li>● Enter dual mode, and the right image is activated</li> <li>● Press again to switch between the windows</li> </ul>
Press <B>	To enter single mode in dual window mode, or to exit from other modes.

## 2. Soft Menu or Menu

Procedure	Standard
Acoustic power B soft menu→ [A.power]	Rotate the multifunctional knob corresponding to [A.power] to adjust. AP value is displayed in real time in the upper part of the screen. You should perform exams according to actual situation and follow the ALARA Principle.
Frequency B soft menu→ [Frequency]	Rotate the multifunctional knob corresponding to [Frequency] to adjust: Rotate clockwise to increase. Rotate anticlockwise to decrease
Focus B soft menu→ [Focus Number]	Rotate the multifunctional knob corresponding to [Focus Number] to adjust: (B mode image has max. 4 focus ) The focus position symbol is displayed on the right side of the image.
Focus B soft menu→ [Focus Position]	Rotate the multifunctional knob corresponding to [Focus Position] to adjust: The focus position symbol is displayed on the right side of the image.
FOV (Field of View) B soft menu→ [FOV]	Rotate the multifunctional knob corresponding to [FOV] to adjust: The system provided four levels of scan range: W, N, M1, M2.
Dynamic Range B soft menu→ [Dynamic Range]	Rotate the multifunctional knob corresponding to [Dynamic Range] to adjust: the real time value will be displayed on the image parameter area in the upper left of the screen. As the dynamic range increases, the darker the image and the contrast, as well as the noise may increase.
Line Density B soft menu→ [Line Density]	Rotate the multifunctional knob corresponding to [Line Density] to adjust the parameter. There are four levels of line density available: UH/ H/ M/ L. The higher the line density, the higher the resolution, and the lower the frame rate.
iClear B soft menu→ [iClear]	Rotate the multifunctional knob corresponding to [iClear] to adjust: the bigger the value the stronger the effect. The bigger the value the more exquisite the image. The bigger the value the more outstanding the outline.
B soft menu→ [U/D Flip]/[L/R Flip]	Rotate the multifunctional knob corresponding to [U/D Flip]/[L/R Flip] to adjust.

### 5.4.2.2 M Mode

- In M Mode scanning, the image parameter area in the left corner of the screen will display the real-time parameter values as follows:



Display	V	DR	G	F	D
Image Parameters	M Speed	M Dynamic Range	M Gain	M Frequency	Depth

- Parameters that can be adjusted to optimize the M Mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, TGC, Depth
Soft menu or menu	Frequency, Speed, Tint Map, Acoustic Power, Edge Enhance, Focus Position, Dynamic Range, M Soften, Gray Map, Display Format.

#### 1. Control Panel

Procedure	Standard
Press <M>	Press <M> on the control panel, and roll the trackball to adjust the sampling line.
Then press <M> again.	Press [M] on the control panel again to enter M Mode, then you can observe the tissue motion along with anatomical images of B Mode.
Press <Update>	To switch between the active B image and frozen B image.
<ul style="list-style-type: none"> <li>■ Tips: <ul style="list-style-type: none"> <li>a) Adjustment of the depth, focus position or TGC to the B Mode image will lead to corresponding changes in M Mode image.</li> <li>b) For details of other control panel adjusting parameters, please refer to descriptions in B mode</li> </ul> </li> </ul>	

#### 2. Menu

Procedure	Standard
Speed B soft menu-> [Speed]	Rotate the multifunctional knob corresponding to [Speed] to adjust. There are 6 ranks of speed provided. The lower the value the faster the refreshing.
Display Format M soft menu-> [Display Format]	There are 4 formats available for image display: L/R, V1:1, V1:2, Full.
<ul style="list-style-type: none"> <li>■ Tips: <ul style="list-style-type: none"> <li>a) During M Mode scanning, frequency and acoustic power of the probe are synchronous with that of B Mode.</li> <li>b) Refer to B mode for more details.</li> </ul> </li> </ul>	

### 5.4.2.3 Color Mode

- In Color Mode scanning, the image parameter area in the left corner of the screen will display the real-time parameter values as follows:

F 2.5M  
G 0  
WF 59  
PRF 0.4k

Display	F	G	WF	PRF
Image Parameters	Frequency	Color Gain	Color Wall Filter	Pulse Repetition Frequency

- Parameters that can be adjusted to optimize the Color Mode image are indicated in the following.

Adjustment	Items
Control Panel	Color Gain, Depth, Steer
Soft menu or menu	Caliper, Baseline, Invert, Priority , Packet Size, Persistence, Wall Filter, Color Map, Dual Live, B/C Align, Line Density, Speed Display, Smooth, Acoustic Power, Power Mode ,Frequency, Scale,

### 5.4.2.4 PW Mode

- In PW Mode scanning, the image parameter area in the left corner of the screen will display the real-time parameter values as follows:

PW  
F 2.5M  
WF 0  
G 0  
SVD 21.0  
SV 0.5  
PRF 18.0k  
Angle 0°

Display	F	G	WF	PRF	SVD	SV	Angle
Image Parameters	Frequency	PW/CW Gain	Wall Filter	Pulse Repetition Frequency	Sample Volume Depth	Sample Volume Size	Angle

- Parameters that can be adjusted to optimize the PW Mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain
Soft menu or menu	Frequency, Speed, Acoustic Power ,Scale, Wall Filter, Duplex/Triplex, SV, Quick Angle, Angle, Invert, Baseline, Trace Area, T/F Res, Audio, Auto Calc, Auto Calc Cycle, Auto Calc Para, HPRF, Dynamic Range, Gray Map, Tint Map, Display Format

### 5.4.2.5 Cine Review

Procedure	Standard
<ul style="list-style-type: none"> <li>● Press &lt;Freeze&gt; key to freeze an image and the &lt;Cine&gt; key indicator lights on. The system automatically enters the manual cine status.(Precondition: set “Status after Freeze” to be “Cine” in [image] )</li> <li>● Press &lt;iStation&gt;, click [Review] or press &lt;Review&gt; to open the cine file</li> </ul>	<ul style="list-style-type: none"> <li>● Cine Review status</li> <li>● To enter cine auto cine review status.</li> </ul>
Roll the trackball	Manual cine review
Click image menu->[Auto Play]	Activate auto cine play status. Rotate the knob to set the cine review speed. The bigger the value the faster of speed. When [Auto Play] is “stop”, exit auto cine play status.
Manually review the images until the frame which you want to set it as start point, and then click [Set First Frame] to set a start mark.	Set first frame
Manually review the images until the frame which you want to set it as end point, and then click [Set End Frame] to set an end mark.	Set end frame
Click [Auto Play]	The cine is played within the setting region.
Then press the [Cine] key again.	Cine review stops
<ul style="list-style-type: none"> <li>● Press the &lt;Freeze&gt; key to defreeze the image.</li> <li>● Press &lt;ESC&gt; or &lt;Cine&gt;</li> </ul>	<ul style="list-style-type: none"> <li>● &lt;Freeze&gt; backlight is off, the image returns to the scanning process and exits cine review.</li> <li>● The images are still frozen but the system exits cine review.</li> </ul>
<p>Start mark Cursor End mark Current frame/ Total frames</p>	

### 5.4.2.6 Measurement

Procedure	Standard
In B mode <ul style="list-style-type: none"> <li>● Press &lt;Measure&gt;:</li> <li>● Press &lt;Caliper&gt; key</li> </ul>	<ul style="list-style-type: none"> <li>● Enter the application measurement mode.</li> <li>● Enter the general measurement mode.</li> </ul> Click any 1-2 measurement items, the measurement results will be displayed below the image
Press <ESC> or the same key again.	Exits measurement.

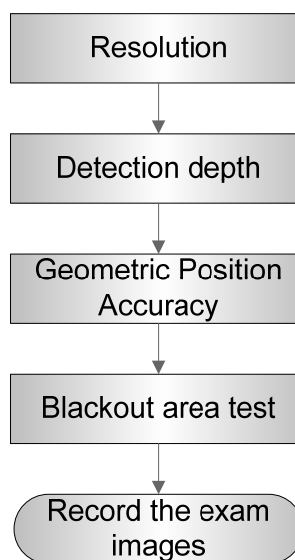
Perform similar operations in other modes	Application measurement functions are related to certain application software packages.
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### 5.4.2.7 Patient Information Management

Procedure	Standard
Press <Save> in image scanning process.	The image will be saved to corresponding patient database and the saving icon will be displayed in the right of the screen.
<ul style="list-style-type: none"> <li>● Press &lt;Review&gt;</li> <li>● Click [Exit] on the Review screen; or press &lt;Review&gt; or &lt;ESC&gt;.</li> </ul>	<ul style="list-style-type: none"> <li>● To enter Review:</li> <li>● To exit Review:</li> </ul>
Press <iStation> to enter Patient information management (iStation page)	Saved images and information for the patient can be checked here, and you can: <ul style="list-style-type: none"> <li>● Backup/ Restore</li> <li>● Send to (DICOM , network or removable storage device )</li> </ul>

## 5.5 Performance Test

### 5.5.1 Test Process



### 5.5.2 Test Content

<b>NOTE:</b>	The image used here is only for reference, stick to the image effect in the real situation.
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#### Requirements:

5-10 Function and Performance Checking Method



1. Display: set the contrast and brightness at the clinical application value (or the default status)
2. Operation environment: dark room, simulating the clinical application environment.
3. Scanning techniques: contact the probe with the acoustic window of the phantom, no spacing nor pressing.

**Tips:**

For the testing phantoms, please refer to Appendix B.

KS107BD is low frequency phantom and used when Probe focus frequency is less than 4MHZ;  
KS107BG is high frequency phantom and used when Probe focus frequency is more than 5MHZ;

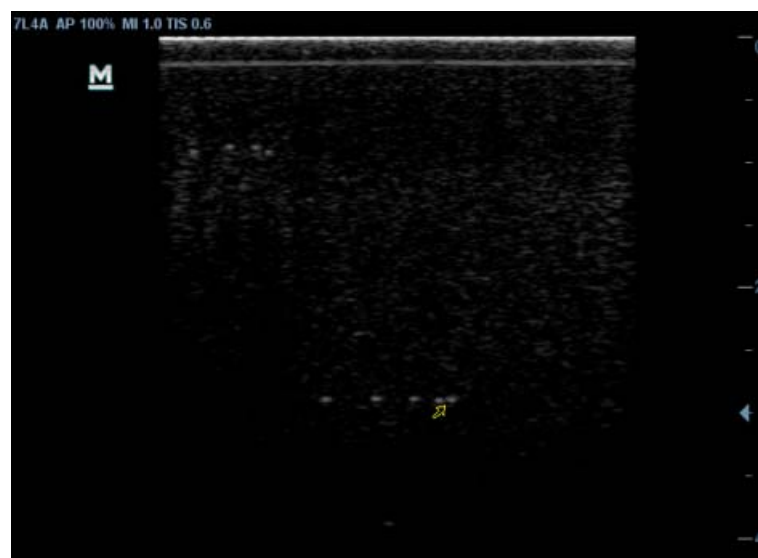
### 5.5.2.1 Resolution

■ transverse resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the transverse resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the transverse resolution testing targets are displayed.
3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. In condition that the transverse resolution testing targets are horizontally displayed, record the minimal distance of two targets that can be clearly recognized.
5. Repeat the operation above for the transverse resolution testing targets at other depths.

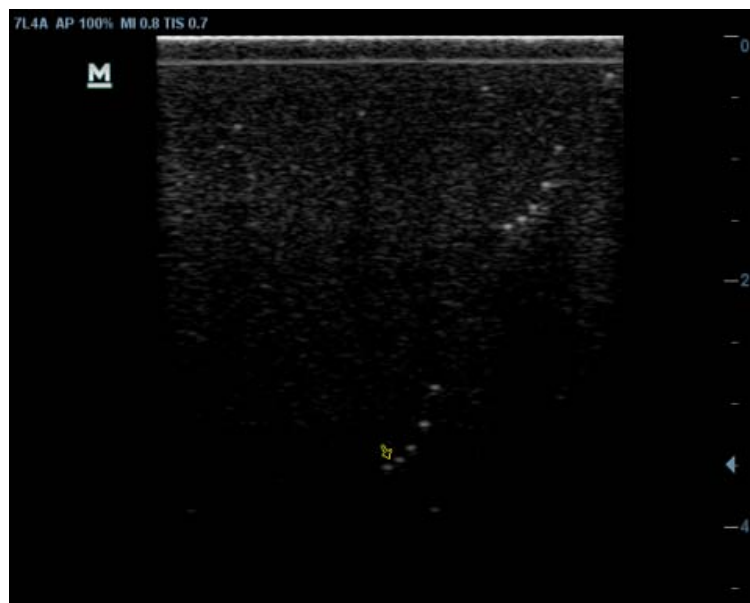
As shown in figure below.



■ Axial resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the longitudinal resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the longitudinal resolution testing targets are displayed.
3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. Record the minimal distance of two longitudinal resolution testing targets that can be clearly recognized.
5. Repeat the operation above for the longitudinal resolution testing targets at other depths.



**NOTE:**

1. When using the convex probe, keep the transverse resolution testing targets to be displayed near the midline.
2. When using a linear probe with steer function, do not turn on the steer function when perform the transverse resolution test.
3. Zoom in the region where the targets located if necessary.
4. The diameter of the target point at a certain depth is equal to the transverse resolution at the depth.

### 5.5.2.2 Maximum Depth

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Set the system display depth according to the eXPcted maximum available depth of the probe in use.

3. Adjust the focus point to the deepest, and AP at the maximum value.
4. Set gain, contrast, TGC at a greater value, but no halation nor defocus is allowed.
5. Record the depth of the furthest target (the target can be seen clearly).

<b>NOTE:</b>	<ol style="list-style-type: none"> <li>1. Increasing the gain will also increase the noise, and echo may be covered.</li> <li>2. When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed.</li> <li>3. When using a convex or phased-array probe, make the axis targets to be displayed at the middle of the scanning image.</li> <li>4. When system is not frozen, the fast field target information may be similar to that of the noise, do not use this target.</li> </ol>
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As shown in figure below.



### 5.5.2.3 Geometric positioning accuracy

■ Longitudinal geometric positioning accuracy

Test Step:

1. Do adjustments as the way in testing the maximum depth.
2. Record the distance by 20mm each segment on the longitudinal targets line using the measurement caliper;
3. Select the value with the greatest error (to 20mm), calculate the accuracy using the formula below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value} - \text{Actual distance}}{\text{Actual distance}} \right| \times 100$$

- NOTE:**
1. The measurement caliper should be positioned at the upper edge of the target, not the middle nor the lower edge.
  2. The scanning plane should be vertical to the target line, that means the scanning plane is parallel with the cross-section of the phantom

As shown in figure below.



■ Transverse geometric positioning accuracy

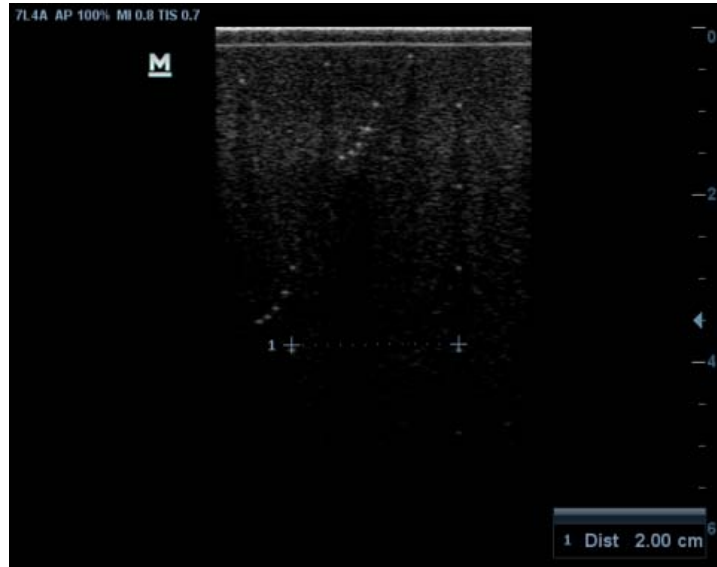
Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth, making the transverse targets to be displayed in the image.
3. Adjust the focus point to be posited beside the transverse targets (the standard is not clear)
4. Adjust parameters like gain, TGC, making each transverse targets to be clearly displayed.
5. Record the distance by 20mm each segment on the transverse targets line by using the measurement caliper
6. Select the value with the greatest error (to 20mm), calculate the accuracy by using the formula below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value} - \text{Actual distance}}{\text{Actual distance}} \right| \times 100$$

- NOTE:**
1. When using a linear probe, record the transverse distance by segment.
  2. When using a convex probe, all transverse targets should be displayed integrally in an image.
  3. The measure caliper should be posited at the upper side or lower side of the target center.

As shown in figure below.



### 5.5.2.4 Blackout Area

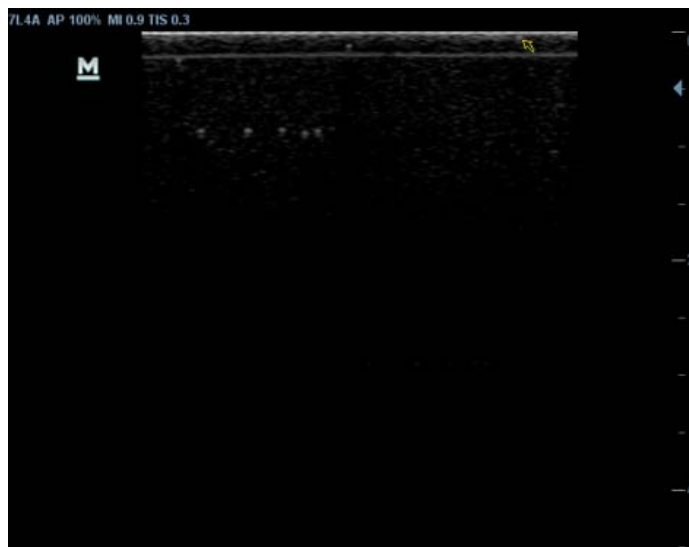
Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth at a lower value, and set the focus at the nearest place to the scan surface.
3. Decrease the value of parameters like AP, Gain until the background noise just can be seen.
4. Record the smallest depth of the target that can be seen clearly, that value is the blackout area value.

**NOTE:**

1. When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed.
2. For convex probe, the targets in the blackout area should be positioned on the midline of the scanning plane.

As shown in figure below.





# 6 Software Installation & Maintenance

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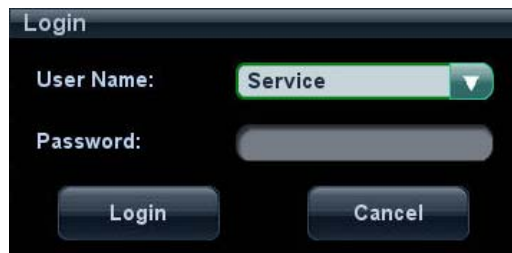
**⚠ WARNING: DO NOT** directly remove a USB memory device; otherwise, the USB memory device or the system may be damaged.

## 6.1 Enter the Maintenance Window

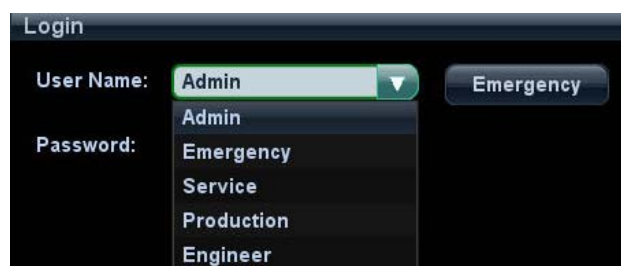
**NOTE:** Log on the system with the identity of Service before perform system maintenance.

To log on the system:

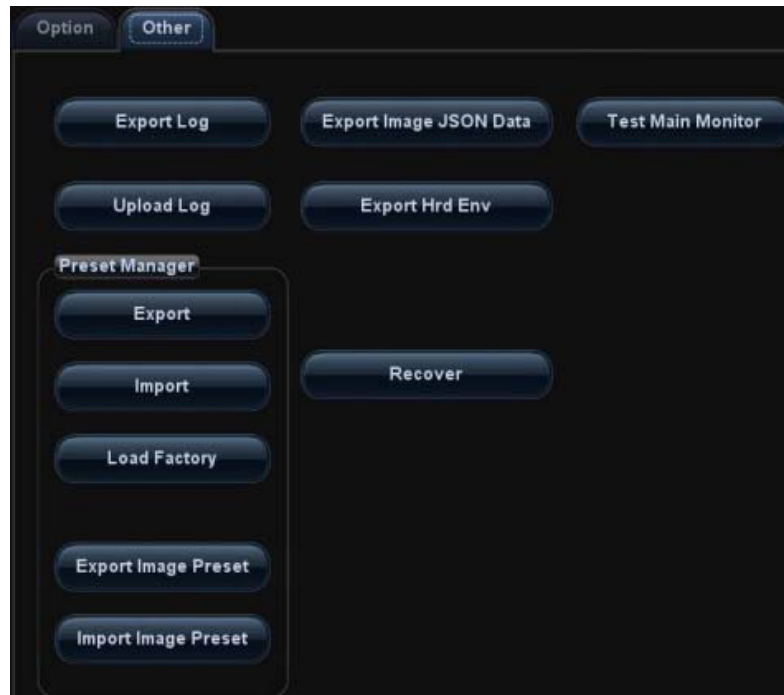
1. When access control function has not been activated: press “Ctrl+” to show the Login dialogue box, and then select the Service as the user name.



2. When access control function has been activated already: press “Ctrl+” when the Login dialogue box is displayed, and then select the Service as the user name.



3. Press <Setup> key to open the Setup menu, click [Maintenance] and then select the target items to perform the maintenance respectively.



## 6.2 System Software Installation/ Restoration

- |                          |                                                                                                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>⚠ WARNING:</b></p> | <ol style="list-style-type: none"><li>1. Back up the patient data and preset data before restoring the system.</li><li>2. Do not cut off power, shut down or restart the system during system restoring.</li></ol> |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 6.2.1 Restore the Operating System and Doppler

#### 6.2.1.1 Preparation before Restoring

1. Back up preset data and patient data.
2. USB disk requirement:
  - a) Volume of USB disk should be more than 2G.
  - b) The system supports only FAT or FAT32 format USB disk.
  - c) If there are many drives in USB disk, installation may fail.
  - d) Disconnect the extra USB devices to the machine.

#### 6.2.1.2 Method

The operation system (“OS” for short) adopts Linux kernel and uses USB disk to install. You can install the ultrasound software to the hardware when installing the operation system.

1. Copy files of the system restoration package (including operation system and Doppler) to USB disk root, and make sure that all the files of Doppler restoration package (referring to 6.2.2.3) are in the Doppler directory.



**NOTE:**

1. The restoration package must be copied to USB disk root, or else it may cause to failure of restoration;
2. Please check all the files in the restoration package when copying, or else copy the package again.

2. Insert the USB disk to the USB port of ultrasound machine.
3. Power on the machine, press the power button to start, then press <F4> immediately, when the "Mindray eRescue" displays on the screen, stop pressing <F4> to enter system installation program.

```
Ready to install system, please wait .....
1. Install system with keeping user's data.
2. Install system without keeping user's data (format all disk)
please enter your choice[1,2,or q=quit(defalut)]:
```

4. Select the installation operation to enter. Enter the corresponding method (1, 2 or q) and press <Enter>.

Option	Display	Note
1	1.Install system with keeping user's data	Start the OS restoring directly, D and E Drive will not be formatted and user data will be kept when finished.
2	2.Install system without keeping user's data (format all disk)	The HDD will be formatted and all data will be erased at first, then start the OS restoring (Note: please backup the data).
q	quit	Exit, The system does nothing and restarts.

5. Screen prompts:

- If you enter q and press <Enter>, the screen displays as below:

```
Ready to install system, please wait .....
1. Install system with keeping user's data.
2. Install system without keeping user's data (format all disk)
please enter your choice[1,2,or q=quit(defalut)]:
q
System will reboot, press ENTER to continue.
```

- If you enter 1 and press <Enter>, the screen displays as below:

```
Ready to install system, please wait .....
1. Install system with keeping user's data.
2. Install system without keeping user's data (format all disk)
please enter your choice[1,2,or q=quit(defalut)]:
1
formatting disk...
Installing system,please wait.....
.....
```

- If you enter 2 and press <Enter>, the system will ask the user to confirm whether to delete all data, enter "Y" and the system performs formatting and then goes to installation.

```
Ready to install system, please wait .....
1. Install system with keeping user's data.
2. Install system without keeping user's data (format all disk)
please enter your choice[1,2,or q=quit(defalut)]:
2
ALL DATA on disk will be DELETED, are you sure? [Y/N]
```

If you enter N here, the installation is stopped, and the system remains unchanged.

```
Ready to install system, please wait .....
1. Install system with keeping user's data.
2. Install system without keeping user's data (format all disk)
please enter your choice[1,2,or q=quit(defalut)]:
2
ALL DATA on disk will be DELETED, are you sure? [Y/N]
n
It seems that you are not so sure, you can try again later.
System will reboot, press ENTER to continue.
```

6. After the system has been installed successfully, the following information will display on the screen, press <Enter> to restart the system.

```
System has been installed successfully!
System will reboot, press ENTER to continue.
```

7. After the OS is restored, Doppler restoration starts automatically. The process of restoring refer to 6.2.2 Doppler restoration (from the 5<sup>th</sup> to the 8<sup>th</sup> step)

### 6.2.1.3 File Processing during Restoration

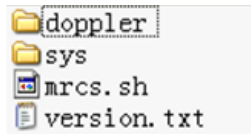
During the OS installation procedure, the machine will back up the key file in the HDD automatically, see below:

- ◆ Select the choice 1:
  1. Back up the option key file of the C drive to D: /mnt/bkcfg (temporary catalogue)
  2. Format the C drive and restore the OS.
  3. Copy the option Key file to the previous catalogue in C drive, and the temp file will be deleted.
- ◆ Select the choice 2:
  1. Back up the option key file of the C drive to U: /bkcfg (temporary catalogue)
  2. Format the whole HDD and restore the OS.
  3. Copy the option Key file to the previous catalogue in C drive, and the temporary file in U disk will be deleted.

In the OS with previous configuration data, if the ultrasound system is restored by package without configuration data, the product configuration and the option state will take effect as the configuration data in OS.

### 6.2.1.4 Software Introduction

Operating System restoration package includes the files as follow:



Doppler: Doppler software restoration data will be placed here. If the data exists, ultrasound software will be restored after the operation system is restored; otherwise, only the OS will be installed.

Sys: operation system data is placed here.

Mrcs.sh: installation program.

Version.txt: version file.


**NOTE:** Please check all the files in the restoration package before starting restoring, or else copy the package again.

## 6.2.2 Doppler Restoration

### 6.2.2.1 Using Package in Doppler

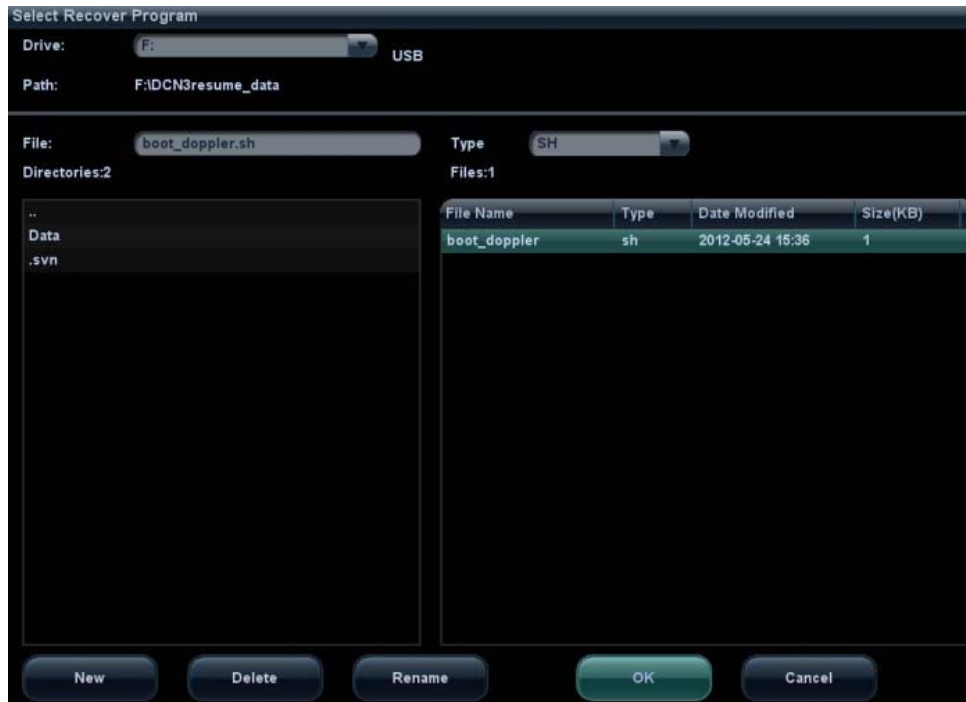
**NOTE:**

1. Before executing the restoration package, please back up the patient data as well as the user-defined preset data.
2. When using the restoration package, key catalog in the HDD will remain the same, and after restoration, the option key can take effect directly.

1. Copy the Doppler restoration package to USB disk root (USB disk requirement is the same as in 6.2.1.1)
2. Insert the USB disk to USB interface in the ultrasound system, the USB icon displays on the right corner of the screen. 
3. Logged on the system as Service (referring to 6.1)
4. Press <Setup> to enter [Preset] menu, Click [Maintenance] to enter the [Other] page, Select [Recover] in the Maintenance menu and press <Set>.
5. The dialogue box will pop up on the screen in the process asking “This option will restart the system, continue?” If click [Yes], the system will ask user to select the restoring file; If select [No], the operation will be canceled and returns to Doppler.



6. Switch to the USB catalog in the popped up dialogue box, and select boot\_doppler.sh file in the package, click [OK] and then the system will shut down automatically.



- The restoration will start automatically after pressing the power button. After all items are restored successfully, when the restoration is almost done, the following prompts will display:

```
Do you want to delete user preset data?<Y/N>
```

Enter "Y" or "y" to delete the data in D:\DCN3\Preset\, Enter "N" and the system will not delete data.

**NOTE:** The old user preset data may be not compatible with the restored system, if this happen, the operator must select "Y" when the system asks whether to delete user preset data or not, otherwise, the system can't be restarted normally.

- After the whole system is restored, if there is only green shutdown prompts displayed, the restore process is normal, and press <Enter> to exit.

```

Start recovering, please do not shutdown the machine!!
./Target/27.DRD -> /n7/driverdata recover succeed!!
Driver Install Success: /n7/driver/AbEsqion.ko
Driver Install Success: /n7/driver/AbFunctionKeys.ko
Driver Install Success: /n7/driver/AbMultiFunc.ko
Driver Install Success: /n7/driver/AbSMBus.ko
./Target/27.FTD -> /n7/flasherdata recover succeed!!
Start burning BF-Tx Fpga...
Comparing data from file with data from Fpga...
Data are identical!
Burn BF-Tx Fpga Successfully!
Start burning Dsp Fpga...
Comparing data from file with data from Fpga...
Data are identical!
Burn Dsp Fpga Successfully!
Start burning MultiFunc Fpga...
Comparing data from file with data from Fpga...
Data are identical!
Burn MultiFunc Fpga Successfully!
All FPGA Burn Success, Take effect after out the power!
./Target/27.ARM file recover succeed!!
UpdateFrmFlashData::handshake Succeed!
UpdateFrmFlashData::Erase Flash Succeed!
Write :1077 Line Data Succeed!
ARM Update OK!
Keyboard program recover start .....
UKeyFprogUpdate::UpdateHost success
UKeyFprogUpdate::write data, please waiting ...
UKeyFprogUpdate::Write Data success
UKeyFprogUpdate::check_sum ,please waiting ...
UKeyFprogUpdate::update keyboard success!
NFIOS and FPGA update succeed!
./Target/27.EXD -> /n7/exedata recover succeed!!
./Target/27.VBD -> /n7/videdata recover succeed!!
./Target/27.AFD -> /n7/appdata recover succeed!!
./Target/27.GUD -> /n7/guiata recover succeed!!
./Target/25.IMD -> /n7/imagdata recover succeed!!
./Target/25.PCD -> /n7/configdata recover succeed!!
Do you want to delete user preset data?(Y/N)
y
User preset data have been deleted.
Start copying demo files...
cp: cannot stat './demo': No such file or directory
Finish copying demo files...
./doppler.out -> /n2/xxx/main/doppler.out*
./calib/libk -> /n2/xxx/libk*
the system need to shut down after recover process finish.
press Enter key to exit...

```

**the system need to shut down after recover process finish.  
press Enter key to exit...**

Check if every item is restored successfully, press <Enter> according to the prompts, and the machine shut down automatically.

**NOTE:** If red prompts displays, please check the failed items.

- After restoration and restart, the system will enter the Doppler directly. Please check in the path: <Setup>-[About] to confirm the version is consistent with release version public in restoration package.

### 6.2.2.2 Data Processing during Restoration

Data structure and location is as the following after Doppler package restoring.

**Table 6-1 data processing list**

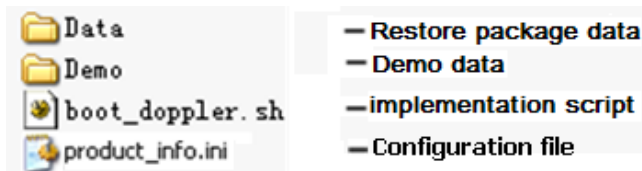
Type	File Suffix	Process	Destination
HDD data	APD	Analyze the update file; replace the old data with the new data according to the update item.	C:\DCN3\app
	EXD		C:\DCN3\exe
	VDD		C:\DCN3\video
	GUD		C:\DCN3\gui
	IMD		C:\DCN3\image
	PST		C:\DCN3\Preset
	PCD		C:\DCN3\config, C:\usr\share\splashy\themes\default\poweron.png and poweroff.png

Demo Data		Replace the old demo with the new demo in the resume package.	E:\DCN3\Demo
Driver	DRD	Decompress the update file to the temporary directory in the hard disk, then install the driver,	Install the drivers C:\DCN3\driver
FPGA	FPD	Decompress the update files to the temporary directory of the hard disk, and write data in their configured flash through the corresponding drive program. Delete the temporary directory when finished.	Configuration flash chip in the main board in corresponding to logic.
Control Panel	KUG	Decompress the update files and cache the keyboard data to the buffer, inspect keyboard communication and erase the flash.	Control Panel
Power supply monitor	ARM	Decompress the update file, save ARM data to the temporary directory in the hard disk, inspect the ARM communication and erase the flash, and then delete the temporary directory in the hard disk after the installation finished.	Power supply panel

**NOTE:** After the Doppler is restored, product configuration data will be overwritten by general configuration data in Doppler restore package, if necessary, please configure the product manually.

### 6.2.2.3 Doppler Software Introduction

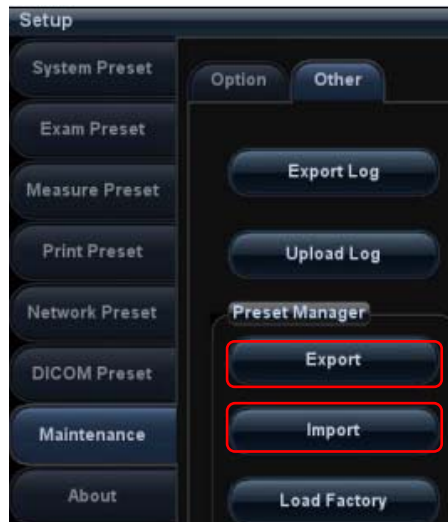
Doppler restoration includes files as follow:



## 6.3 Data Backup and Storage

### 6.3.1 Manage Settings

Press <Setup> to open the Setup menu, click [Other] to open the Manage Setting interface. System preset can be performed here. Image parameters can be exported, imported or restored to factory.



### 6.3.1.1 Back up the Preset Data

1. On Manage Settings page, Click [Export] to open the [Export Data] dialogue box.
2. Select the path to save data.
3. Click [OK], a progress bar will appear and the preset data of the selected items will be exported to the specified path.

### 6.3.1.2 Restore the Preset Data

1. On Manage Settings page, Click [Import] to open the [Import Data] dialogue box.
2. Select the path of the preset data.
3. Click [OK], a progress bar will appear and the preset data will be imported to the specified module.

Note: If selecting [Load factory], it will restore the system to the factory setting, but the [Region],[Admin] , [Network Preset] and [DICOM Preset] cannot be restored.

## 6.3.2 Patient Data Backup and Restore

### 6.3.2.1 Patient Data Backup

1. Press [iStation] on the control panel to open the iStation dialogue box.
2. Click [Select All] to select all the data or select the target data one by one.
3. Select the data, click [Backup] to pop up the Backup Patient Record dialogue box, select the target storage device (recorder or USB disk), click [Backup], the data will be backed up.

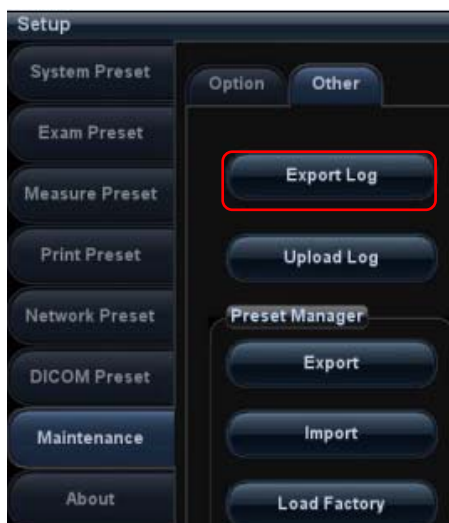
### 6.3.2.2 Restore Patient Data

1. Press [iStation] on the control panel to open the iStation dialogue box;
2. Select the drive which contains the patient data, click [Select All] to select all the data or select the target data one by one, and click [Restore] to restore the patient data from the current drive to the patient database.

## 6.4 Log Maintenance

### 6.4.1 Export the Log

1. Connect the USB disk to USB port of Ultrasound machine.
2. Click [Export Log] on the Maintenance menu.



3. Select the path in the Browse page to save the log, and click [OK].



4. When the log is exported, the system prompts "Export succeed!" click [OK] to return to the Maintenance menu.

**NOTE:** The log can be exported to the external USB storage device only, make sure the connection between U disk and ultrasound is normal before the exporting.

### 6.4.2 Log Uploading

1. Click [Upload Log] on the Maintenance menu.
2. Click [Upload] in the popping up dialogue box, the system performs log uploading automatically. After the uploading is finished, the system will prompt "Upload succeed"





If uploading is failure or can't find the server, the system will prompt information as below.



**NOTE:**

1. Before uploading the log, make sure the ultrasound system has been connected to network, otherwise, the system may warn "could not connect to server"
2. The server ([smtp.163.com](mailto:smtp.163.com)) is already specified by the system, the user doesn't have to select it.

## 6.5 HDD Partition

1. The storage capacity of the system HDD is 320G or more, and the partition information is as follows:

Blocks(G)	system	Notes
10	Linux	C:
≅ 263	Linux	D:
38	Linux	E:

1. C drive

Catalog	Data	Illustration	
C:\n7	\Image	POD	Probe data (supported probes in the system)
		ColorSpectrum	map data, color scale and colorize
	\gui	Font	Font file
		Skin	Skin file
		Cursor	Cursor picture
		Word	Input setting data
		LayoutInfo	Layout configuration file
	\app	bodymark	Pictogram
		DCM	Structured report related data file and DICOM viewing software
		Report	Report template
		Comment	Comment file
		AnatomyImage	Anatomical images
		ExamMode	Exam mode files
		Log	Log translation files
		manual	Operation manual
		Menu	Menu configuration
		SoftKey	Soft-key configuration data files
	Measurement	Measurement library	
	\exe	main	Doppler program and related boot configuration file and plug-ins, remote desktop server
		nls	Multilanguage string file
		videoplay	Video play exe file
		Sound	Cine saving and hint sound file
		version.txt	Version file
	\video	MonitorTest	Display testing picture
	\preset	factory	Factory data
	\config	Boot_logo.png	Doppler boot-up graphics
		Hospital_logo.bmp	Hospital logo
		manu_logo.png	Manufacturer logo
		Real_Image.bmp	Active icon
		Non_Real_Image.bmp	Inactive icon
Dorm_logo.bmp		Standby graphics	
Product.PCF		Product configuration file	
OS_1024_768_24.png	OS boot-up graphics		
\Key	Factory.key	Factory key file	
\ProductConfig	product_info.ini	PCF files, product and regulation type	

## 2. D drive

Catalog		Data	Illustration
lost+found			
D:\n7	\Dump	\	Dump files
	\log	\DcmLog	DICOM log
		\Operation	Operation log
		\SystemStat	Power on/off log
		message.txt	Warning message
		PeriLog.txt	Peripheral log
	\PATIENTDATA	\	Main patient database path
	\Preset	\Current	User preset data
	\temporary	\	Temporary file
	\PatientBack	\	Patient back up data

## 3. E drive

Catalog		Data	Illustration
lost+found			
E:n7	Demo		Ivision default DEMO path
	Patient Backup		Patient data back up
	demofile.txt		Ivision default DEMO path



# 7 Adjustments

---

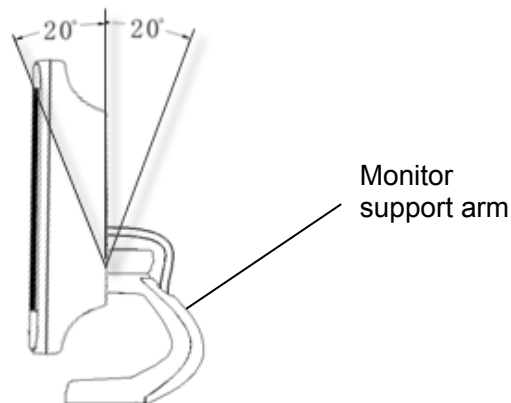
## 7.1 Monitor Adjustment

### 7.1.1 Position Adjustment

Gently hold the bottom edge of the monitor when adjusting its position.

- ◆ Tilt the monitor

The monitor can be tilted for 20 degree forward or 20 degree backward when positioned vertically. (The monitor can keep still when no outside force is imposed on it).



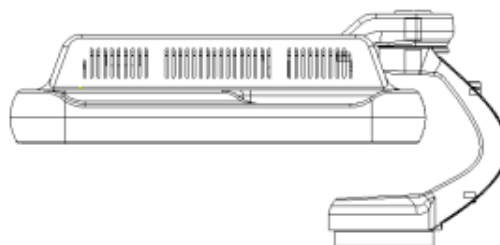
- 

- ◆ Rotate the monitor

- The monitor support arm is fixed, you can hold the monitor to rotate it left or right within the range of  $-90^{\circ}\sim+90^{\circ}$ .

- ◆ Move the monitor up/ down

- When packed for transportation or pushed around, you can hold the monitor at two sides to place the monitor in the horizontal position as below:



- 

### 7.1.2 Brightness and Contrast Adjustment

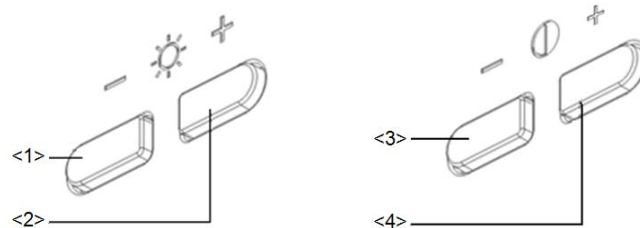
The adjusting method as below:

◆ Brightness adjustment:

<1>, <2> refer to the brightness control keys with a sun marked at the top side; key <1>, which marked a “-” on the top side, can be used to decrease the brightness; while key <2>, which marked a “+” on the top side, can be used to increase the brightness.

◆ Contrast adjustment:

<3>, <4> refer to the contrast control keys with a lune marked at the top side; key <3>, which marked a “-” on the top side, can be used to decrease the contrast, while key <4>, which marked a “+” on the top side, can be used to increase the contrast.



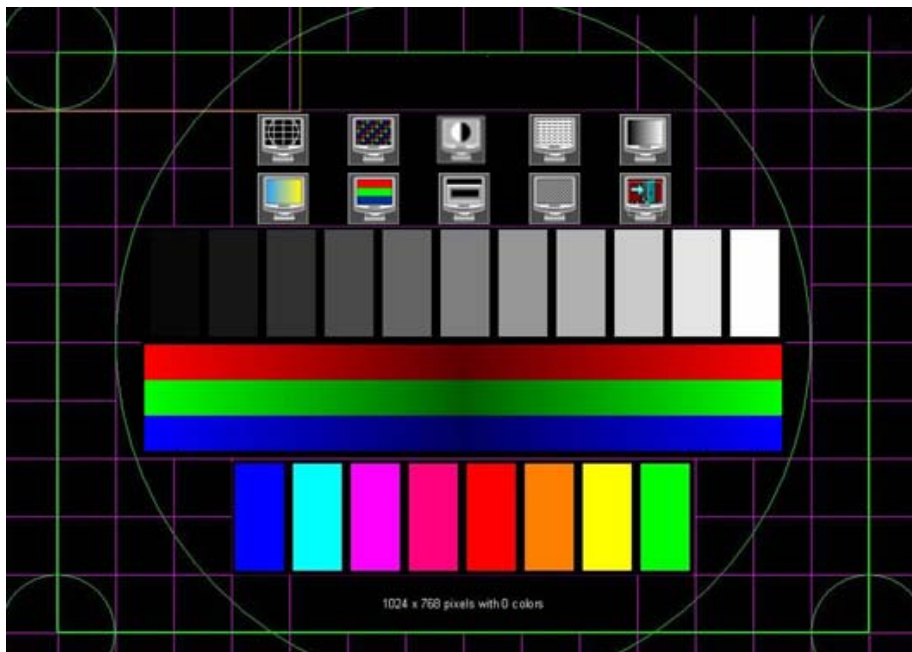
**NOTE:** On the monitor, the brightness adjustment comes before contrast. After readjusting the monitor's contrast and brightness, please adjust all presets.

◆ Restore the factory default settings

In [Preset]→[General Preset], click [Brightness/Contrast Load Factory] to restore the values to factory settings. Or press both <2> and <3> buttons at the same time and hold for about 3s, the default brightness and contrast settings will be recovered (The factory settings is 50 and 50).

### 7.1.3 Monitor Test

1. Log on as the "Service"; refer to chapter 6.1 for details.
2. Press the [setup] key to enter setup menu, and click [Maintenance] to enter the screen.
3. Click [Other] and select [Test Main Monitor] to enter the screen:



No.	Item	Description
1.	Adjust	Click [Adjust] to enter the test interface, press [Set] and the system will automatically detect the border of the screen and adjust accordingly.
2.	Auto Color Balance	Click [Auto Color] to enter the test interface, press [Set] and the color will be adjusted automatically with the screen color changing 3~5s and the prompting "Auto coloring..." displaying in the black box, the auto adjustment succeeds when the prompting is disappeared.
3.	Contrast	The screen displays a white strip in the middle while the above and below are black, if the boundary of black and white is clear, the test is passed.
4.	Resolution	Press [Set] to switch between the 2 interfaces, and it's required that the black and white strips in the middle or around are clear, while the adjacent strips can be distinguished to pass the test.
5.	AshRank	Images of different gray rank levels can be distinguished easily with a smooth transition, and the brightness transition can also be obtained from the images. Gray rank of low level is not obviously lean to red or green, and then the test is passed.
6.	ColorRank	Images of different color rank levels can be distinguished easily with a smooth transition, and the brightness transition can also be obtained from the images.
7.	Colorful	If different kinds of color graphics appear on the screen where the color and the word of each graphics are consistent, test is passed.
8.	focus	Press [Set] to switch among the 3 interfaces, if the images are clear with letters and characters easy to be recognized and there is no ambiguous display or variance among them, the test is passed.
9.	BadPoint	Press [Set] to enter pure color interfaces of green, blue, red, black and white. Observe the LCD screen. Check bright point and dark point in the black and white interfaces. Criterion for pass: bright point number is 0; number of continuous dark point pair is $\leq 3$ , and no continuous dark point appears in the image area; there are no three or more than three continuous dark point; dark point defects number is $\leq 7$ , and number of dark points in the image area is $\leq 2$ ; point flash defects is 0; space between fail points is $\geq 5\text{mm}$ .

4. After the entire test items are finished, Click [Exit] or press [ESC] to return to the main screen interface.

## 7.2 Control Panel Adjustment

### 7.2.1 Control Panel Position Adjustment

◆ Rotate the control panel

1. Hold the handle of control panel, then grasp the height adjusting handle by the left hand to move it to the middle of the adjustable height (as shown by red arrow in figure below), you can rotate the control panel left or right within the range of  $-42^{\circ}\sim+42^{\circ}$
2. Release the height adjusting handle when rotate control panel to the appropriate position, The control panel is already locked .



Height adjusting handle

The handle of control panel

◆ Move the control panel up/down

1. Hold the handle of control panel, then grasp the height adjusting handle by the left hand to move it to the end of the adjustable height (as shown by red arrow in figure below), you can move the control panel up/down by lifting or pressing it, or rotate the control panel left or right within the range of  $-42^{\circ}\sim+42^{\circ}$ .
2. Release the height adjusting handle when rotate control panel to the appropriate position, The control panel is already locked .

### 7.2.2 Key backlit brightness adjustment

In the [System Preset]→[Key Config] page, you can adjust backlit brightness and volume of the key.

## 7.3 Caster Adjustment

There are four casters of the main unit, as shown in the figure: tread “On” button downwards by foot to lock the caster, tread “Off” button downwards by foot to release the caster. (Rotate the casters when locking or releasing the casters if necessary.)



**LOCKING**





**RELEASING**










# 8 Field Replaceable Unit

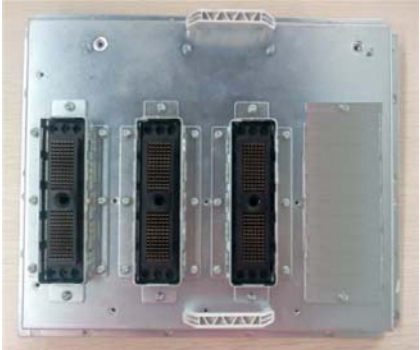
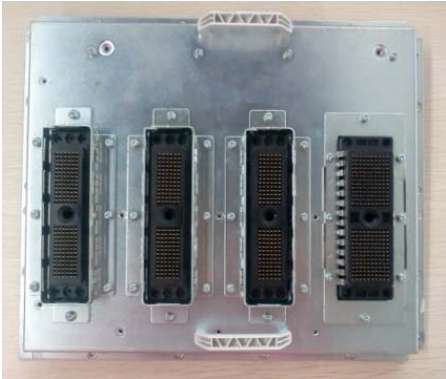
The detailed information of Field Replaceable Unit is as follows:

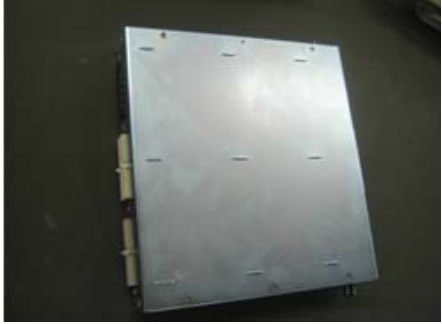

NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/Disassembly
1.1	Main Unit related	DC-N3 series	Digital board assembly	115-015299-00		Please indicate the software version when you apply.	9.3.10
1.2		DC-N3 series	Transmitting and receiving board	115-015304-00			9.3.9



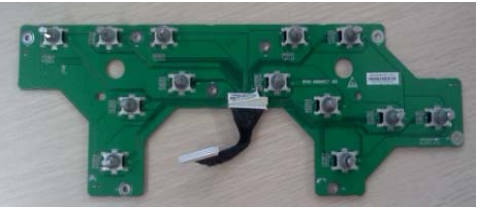
NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/Disassembly				
1.3		DC-N3 series	CPU module (not supporting 4D)	115-015300-00			9.3.10.1				
1.4		DC-N3 series	CPU module (supporting 4D)	115-015301-00							
1.5		DC-N3 series	Hard disk	<table border="1"> <tr> <td>115-018499-00</td> </tr> <tr> <td>115-018500-00</td> </tr> <tr> <td>115-018501-00</td> </tr> <tr> <td>115-018502-00</td> </tr> <tr> <td>115-018503-00</td> </tr> </table>	115-018499-00	115-018500-00	115-018501-00	115-018502-00	115-018503-00		Remark software version; FDA; DC-N3
115-018499-00											
115-018500-00											
115-018501-00											
115-018502-00											
115-018503-00											
	Remark software version; FDA; DC-N3 Vet										
	Remark software version; CE; DC-N3T										
	Remark software version; CE; DC-N3										
	Remark software version; CE; DC-N3 Vet										

8-2 Field Replaceable Unit

NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
1.6		DC-N3 series	IO board	051-001050-00			9.3.6
1.7		DC-N3 series	Mother board	051-001049-00			9.3.14
1.8		DC-N3 series	Probe board assembly(not supporting 4D)	115-015302-00			9.3.2



NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
							
1.9		DC-N3 series	Probe board assembly(supporting 4D or especial probes)	115-015303-00			9.3.2

NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
2.1	Power related	DC-N3 series	DC-DC board assembly	115-015305-00			
2.2		DC-N3 series	AC-DC board	115-015306-00			9.3.12.1


NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
2.3		DC-N3 series	Auxiliary output board	115-015307-00			9.3.12.1
3.1		DC-N3 series	Top cover assembly of keyboard	115-015313-00		Not including trackball, buzzer and TGC board.	9.3.15.6
3.2		DC-N3 series	Encoder board assembly	115-015312-00		One board contains all encoders.	9.3.15.1



NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
3.3		DC-N3 series	Trackball	801-2109-00001-00			9.3.15.2
3.4		DC-N3 series	Buzzer cable	801-2109-00030-00		Including buzzer	9.3.15.4
3.5		DC-N3 series	TGC board	051-000550-00			9.3.15.3

NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
4.1	Monitor related	DC-N3 series	Monitor Assembly	115-015311-00			9.3.1
5.1	Others	DC-N3 series	Inlet fan	115-015308-00		On bottom of main unit, two as a group.	9.3.4

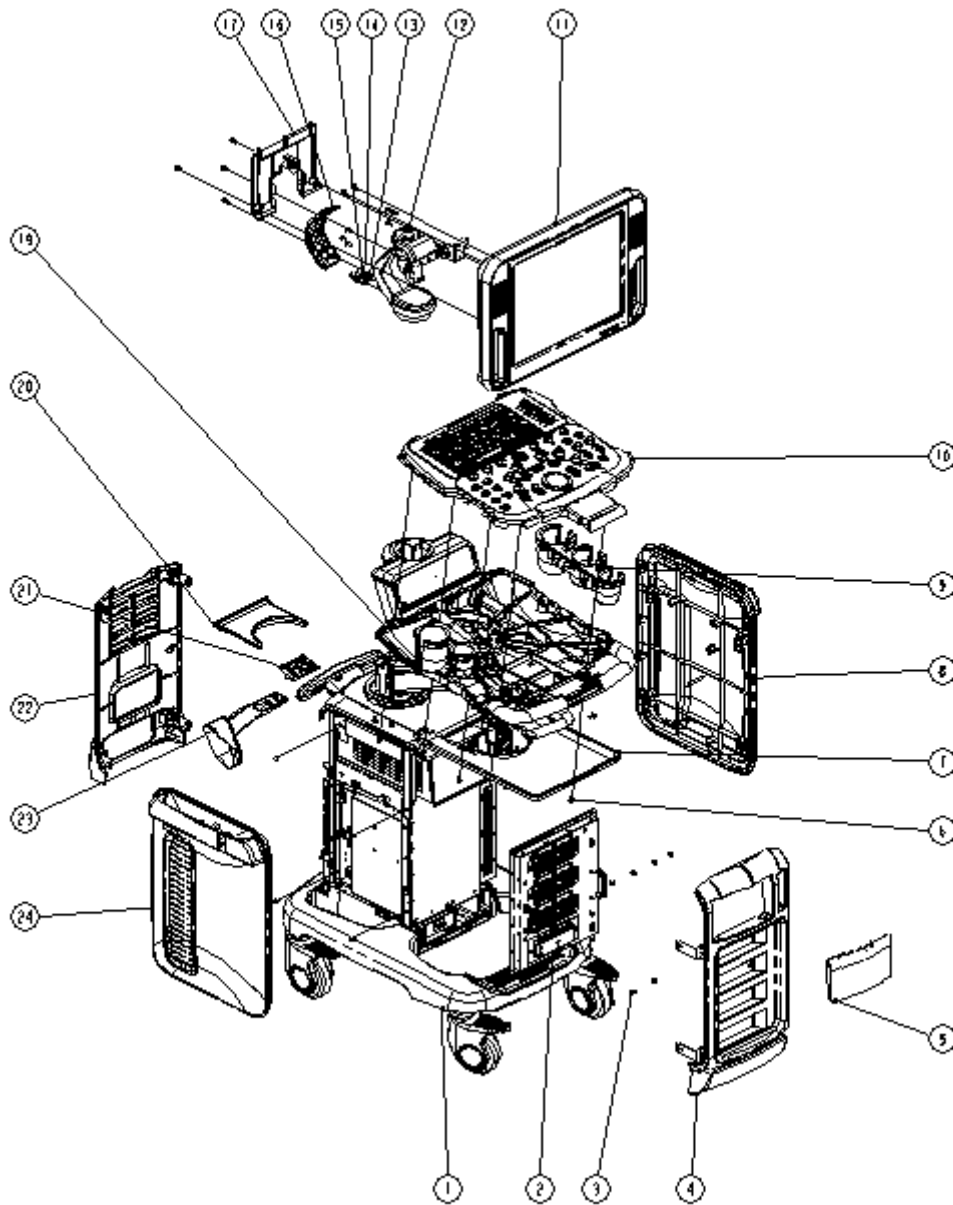
NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
5.2		DC-N3 series	Outlet fan	801-2120-00031-00		On top of main unit, two as a group.	9.3.13
5.3		DC-N3 series	Single-speaker	115-015309-00			9.3.17
5.4		DC-N3 series	DVD-R/W assembly	115-013428-00			9.3.16

NO.	Classification	Model	Description	Order Number	Photo	Compatibility	Assembly/ Disassembly
5.5		DC-N3 series	4D board	115-016652-00		Optional materials, used for maintenance.	9.3.10.1
5.6		ECG module, CW board and battery refer to chapter 10 “Optional installation”.					

# **9 Structure and Assembly/Disassembly**

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## **9.1 Structure of the Whole System**





NO.	Part	NO.	Part
1	Main machine and keyboard assembly	13	inner hex head screws M8×25
2	Probe board assembly	14	Spring washer
3	M4×8 panhead screw	15	Flat washer
4	Front cover assembly	16	Back cover of supporting arm
5	Print room door	17	Cable cover of monitor
6	M4×12 panhead screw	18	Ground wire clip
7	Slaver B	19	Left side holder

NO.	Part	NO.	Part
8	Right cover assembly	20	Slaver S
9	Right side holder	21	Intra-cavity probe holder adapter part
10	Control panel assembly	22	Back cover assembly
11	Monitor assembly	23	Intra-cavity probe bracket
12	Monitor supporting arm assembly	24	Left cover assembly

## 9.2 Preparation

### 9.2.1 Tools Required

Name	Specification	Account	Picture
Cross-headed screwdriver	105 X100	1 pcs	
Solid wrench	with opening diameters of 36mm	1pcs	
Anti-static gloves	/	1 pair	/

### 9.2.2 Requirement for Engineers

Only technical professionals from Mindray or engineers authorized by Mindray after training can perform assembly and disassembly.

### 9.2.3 Assembly/Disassembly Requirements

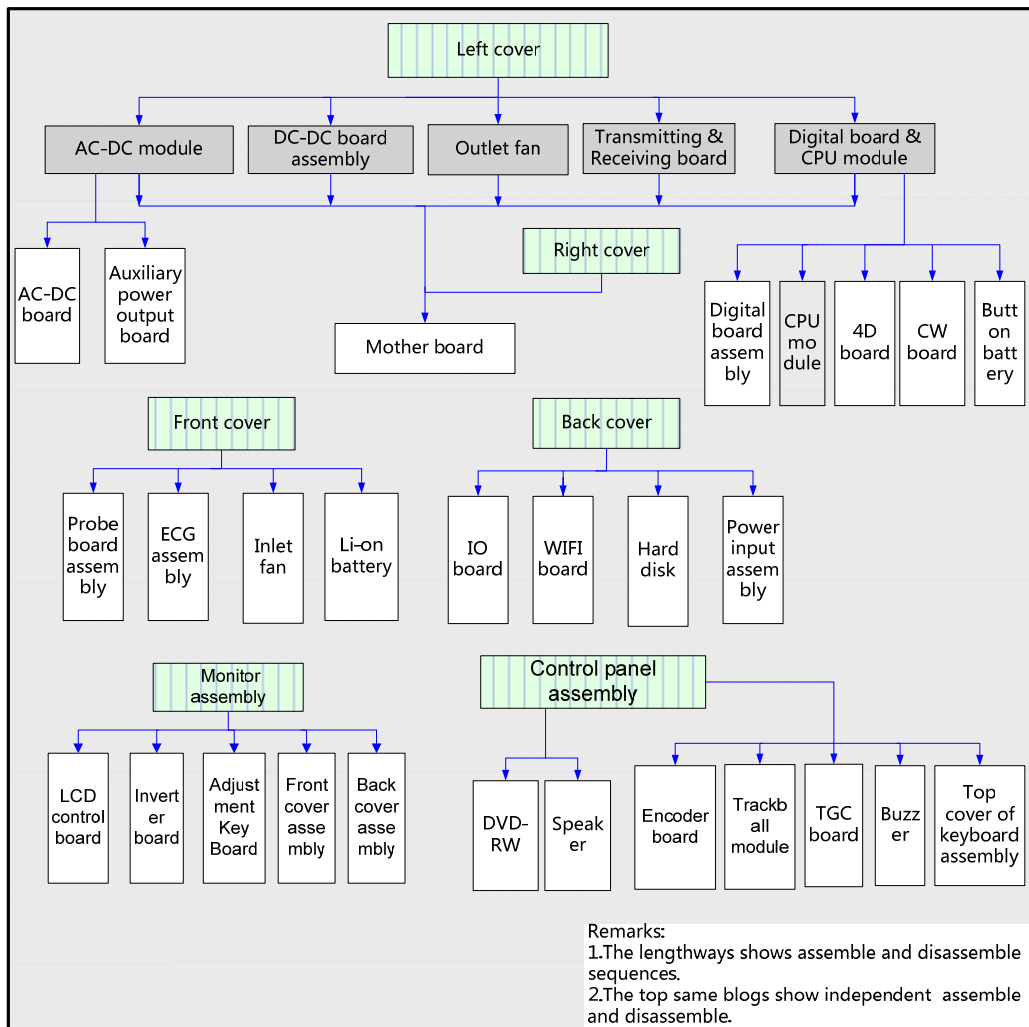
You should make the following preparations before disassembling of ultrasound equipment.

1. When you stop scanning and capturing image, you should power off the system and disconnect the system from the AC power supply, then pull out AC power cable.
2. Lock the casters to prevent accidental movement during assembly and disassembly.
3. Prepare the tools.

## 9.3 Assembly and Disassembly

This section describes the disassembling and assembling of the main assemblies and boards. Assembly procedure is inverse with disassembly procedure if no special explanation

### ◆ Disassembling scheme



**NOTE:** Figures below are for reference. Please take actual equipment as a standard.

**⚠ WARNING:** As to the machine configured with battery, Please remove the battery first when do the disassembly.

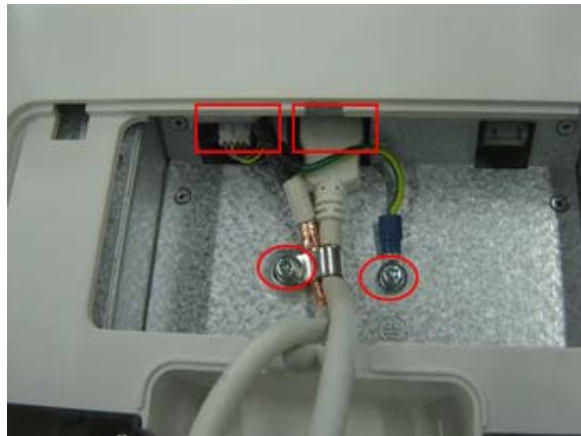
### 9.3.1 Monitor Assembly

1. Unscrew two M4X12 screws as shown in the figure; remove the cable rear cover of monitor.





2. Unscrew two M4X12 screws, remove signal cable and power wire of monitor;



3. Unscrew six M4X12 screws, You can remove the monitor upwards easily.



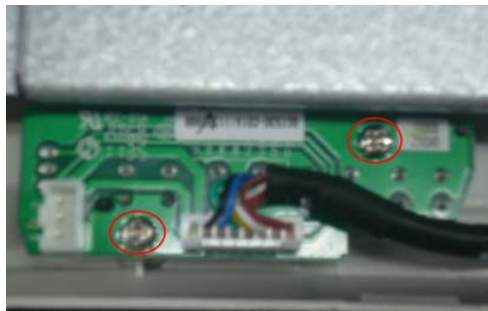
**NOTE:** The installation metal part is inserted in the hole of plastic part; Don't force to assemble the back cover of monitor to prevent damage.

You can do the following disassembly on monitor assembly.

1. Unscrew four M4X12 screws; remove the back cover of the monitor.



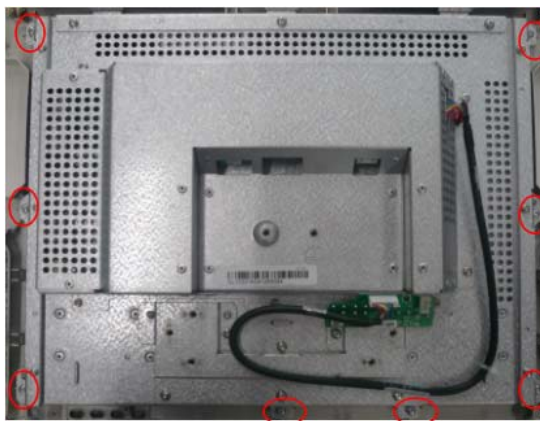
2. Remove two PT3X8 screws fixing the adjusting key board; Remove the adjusting key board assembly.



3. You can take out the plastic adjusting keystroke directly. Pay attention to the direction when install it again.

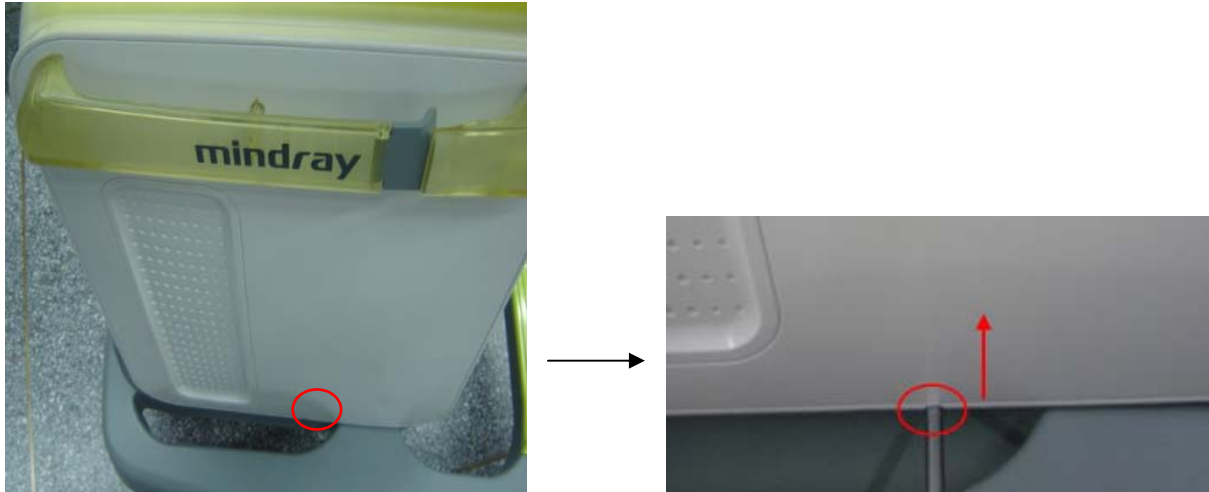


4. Unscrew eight M3X8 screws fixing LCD machine assembly on the front cover, then take out the front cover assembly.



### 9.3.2 Probe Board Assembly

1. Use screwdriver to push the buckle inward from the semicircle gap at the bottom of left cover until it can't be pushed again, then use the back of screwdriver to pry the left cover and take it out.



**NOTE:** Cables cannot be blocked by buckle when install the left cover again.

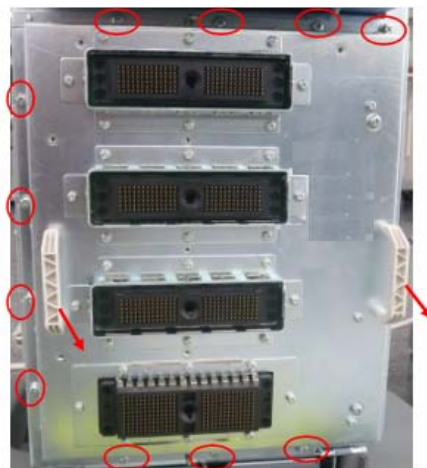
2. Remove the right cover referring to the 1<sup>st</sup> step.



3. Unscrew the M4X12 screws fixing the front cover (two at each side); take out the front cover upwards.



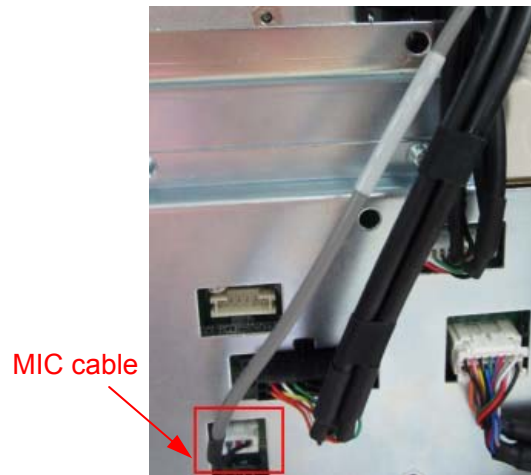
4. Unscrew eleven M4X12 screws, hold two plastic handles to pull out the probe board assembly outward.



- NOTE:**
1. The socket is on the right side of probe board, use force evenly to prevent damaging the connector pins when pulling probe board out.
  2. There are two guide pins beside the socket of probe board, make sure to push the probe board assembly to the probable position after inserting guide pin exactly when installing, then fix it by screws.

### 9.3.3 ECG Assembly

1. Remove the left cover, right cover and front cover, referring to 9.3.2 the 1<sup>st</sup>~3<sup>rd</sup> step.
2. Pull out the cable connecting ECG assembly and MIC, and then untie the cable clip.



3. Unscrew three M4X12 screws fixing the ECG assembly. Hold the ECG assembly and take it out.

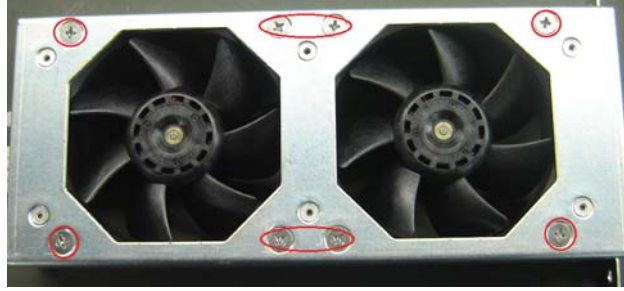


### 9.3.4 Inlet Fan

1. Remove the left cover, right cover and front cover, referring to 9.3.2 the 1<sup>st</sup>~3<sup>rd</sup> step.
2. Unscrew two M4X12 screws fixing the fan frame. Hold the metal handle to take out inlet fan assembly.



3. Unscrew eight screws fixing the fans.



4. Pull out the socket feet from the hole of metal frame as shown in the figure, then you can take out the inlet fan.



### 9.3.5 Li-ion Battery

1. Remove the left cover, right cover and front cover, referring to 9.3.2 the 1<sup>st</sup>~3<sup>rd</sup> step.
2. Unscrew two M3X8 screws, remove battery pressing plate, and then you can take out the battery.



### 9.3.6 IO Board/WIFI Board

1. Remove the left cover and right cover, referring to 9.3.2 the 1<sup>st</sup>~2<sup>nd</sup> step.
2. Unscrew the M4X12 screws fixing the back cover (two at each side); take out the back cover outward.





3. Unscrew five M4X12screws, Pull the two spanners outward to separate the socket of IO board from the socket of mother board, and then take out the IO board assembly outward.



**NOTE:** Make sure to push the IO board assembly to the probable position after inserting guide pin exactly to avoid damaging the socket pins when installing.

4. Unscrew two M3X8 screws securing the WIFI shielding cover, and then remove the cover.



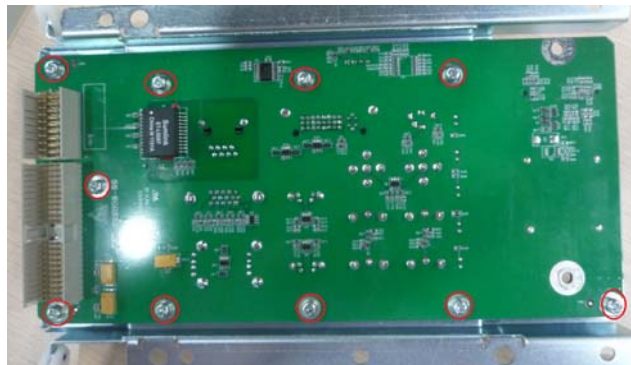
5. Uncover the adhesive strip of antenna and pull out the connector of antenna.



6. Push the elastic sheet aside with two fingers, and then take out WiFi board.



7. Unscrew ten M3X8 screws and then remove IO board.



### 9.3.7 Hard disk

1. Remove the left cover, right cover and back cover, referring to 9.3.2 the 1<sup>st</sup>, and 2<sup>nd</sup>, 4<sup>th</sup> step.
2. Pull out the plugs of power wire and SATA signal cable connecting HDD assembly to mother board.





3. Unscrew three M4X12 screws fixing HDD assembly, and then remove the HDD assembly.



4. Press the plugs of power wire and SATA signal cable to pull them out. Unscrew the M4X12 screws fixing the HDD (two at each side) and take it out.



### 9.3.8 Power Input Assembly

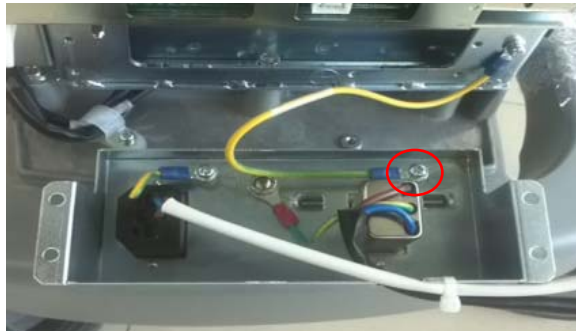
1. Remove the left cover, right cover and back cover, referring to 9.3.2 the 1<sup>st</sup>, and 2<sup>nd</sup>, 4<sup>th</sup> step.
2. Pull out 4 plugs of cables connecting power input assembly to AC-DC module and printer.



3. Unscrew four M4X12 screws to open the power input assembly.



4. Unscrew one M3X8 screw to remove the grounding cable, and then you can take out power input assembly.

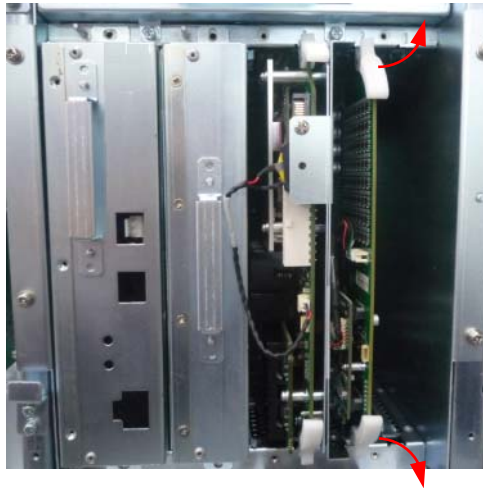


### 9.3.9 TR board / CW board

1. Remove the left cover, referring to 9.3.2 the 1<sup>st</sup> step.
2. Unscrew four M4X12 screws fixing the shielding cover of main unit box (two for each), and then remove the cover.



3. As shown in the figure: there are two plastic detachers on two sides of the board, release them outwards to a certain position, the TR board and CW board assembly will be released automatically and then take the assembly out.



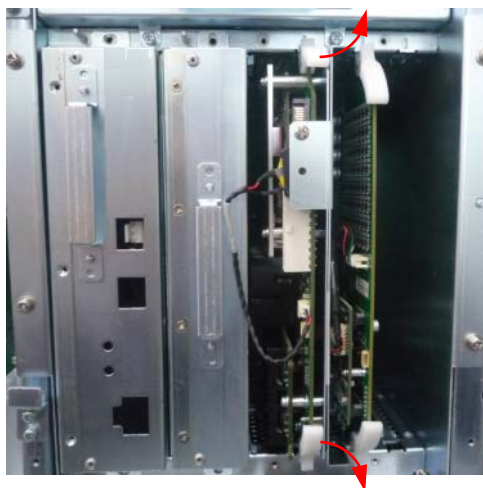
4. Pull out the plug, unscrew two M3X8 screws to remove the CW board, the left is TR board.



**NOTE:** When installing, Aim at the guiding tracks and use force evenly to insert the assembly to prevent damaging the socket pins, and then push two plastic detachers inward until lock the assembly.

### 9.3.10 Digital Board and CPU Module Assembly

Referring to 9.3.9 the 1<sup>st</sup>~2<sup>nd</sup> step, and then push the plastic detachers outward with two handles to take out digital board and CPU module assembly.



You can do the following disassembly on digital board and CPU module assembly:

### 9.3.10.1 CPU Module and 4D&TEE Board

1. Unscrew four M3X30 screws, hold the edge of sheet metal with CPU module to pull out the module upwards.



2. Unscrew three M3X8 screws to pull out the 4D&TEE board upwards.



**NOTE:** Be careful and use force evenly to install the 4D&TEE board to a certain position, and then fix it with screws.

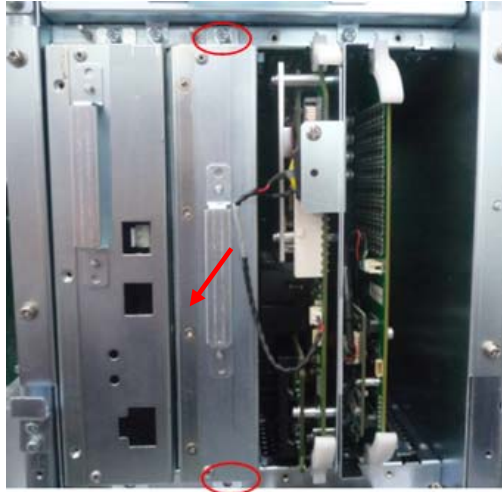
### 9.3.10.2 Button Battery

Unscrew one PT4X10 screw and pull out the plug of button battery cable.



### 9.3.11 DC-DC Board Assembly

1. Referring to 9.3.9 the 1<sup>st</sup>~2<sup>nd</sup> step;
2. Unscrew two M4X12 screws fixing the DC-DC board assembly; hold the metal handle to pull it out in the horizontal direction outwards.



**NOTE:** When installing, Aim at the guiding tracks and use force evenly to insert the assembly to prevent damaging the socket pins.

### 9.3.12 AC-DC Module

1. Remove the left cover, referring to 9.3.2 the 1<sup>st</sup> step.
2. Pull out three plugs, Unscrew two M4X12 screws and then hold the metal handle to pull AC-DC module out in the horizontal direction outwards.



**NOTE:** When installing, Aim at the guiding tracks and use force evenly to insert the module to prevent damaging the socket pins.

You can do the following disassembly on AC-DC module:

#### 9.3.12.1 AC—DC Board/Auxiliary Output Board

1. Unscrew four M3X8 screws fixing top cover and 6 M3X8 screws on two sides (3 for each).





2. Unscrew five M3X8 screws fixing AC-DC board; you can remove the AC-DC board.



3. Unscrew four M3X8 screws fixing auxiliary output board; you can remove the auxiliary output board.



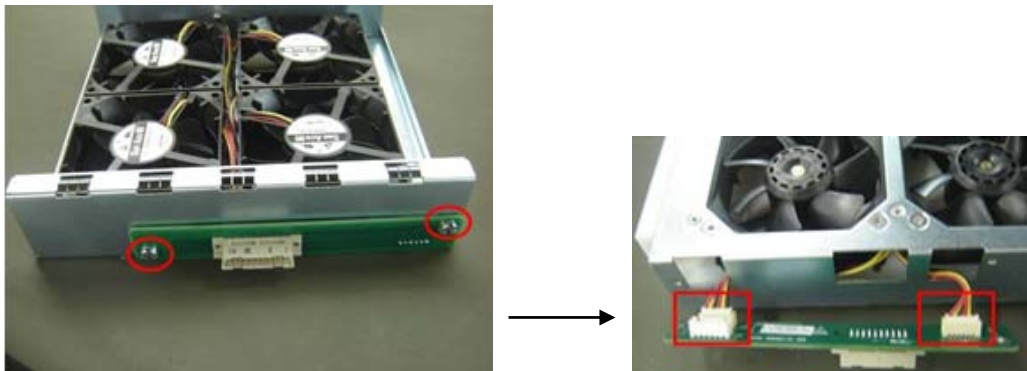
### 9.3.13 Outlet Fan

1. Remove the left cover, referring to 9.3.2 the 1<sup>st</sup> step.
2. Unscrew two M4X12 screws and then hold the metal handle to pull outlet fan assembly out in the horizontal direction outwards.



**NOTE:** When installing, use force evenly to insert the module to prevent damaging the socket.

3. Unscrew two M3 ladder screws, release the fan adapter board and pull out two plugs of fan cable.



4. Unscrew sixteen screws fixing the fans to the bracket as shown in the figure, and then you can take two groups of the fan. (There are two groups, 2 as a group).



### 9.3.14 Motherboard

1. Remove the left cover, right cover, front cover and probe board assembly, referring to 9.3.2.
2. Remove the front cover and IO board assembly, referring to 9.3.6.
3. Remove TR board, digital board and CPU module, AC-DC module and DC-DC board assembly, referring to 9.3.9~9.3.12.
4. Unscrew one M4X12 grounding screws from the right side of machine.



5. Pull out all the cable plugs; unscrew four M4X12 screws to remove protecting cover of motherboard.

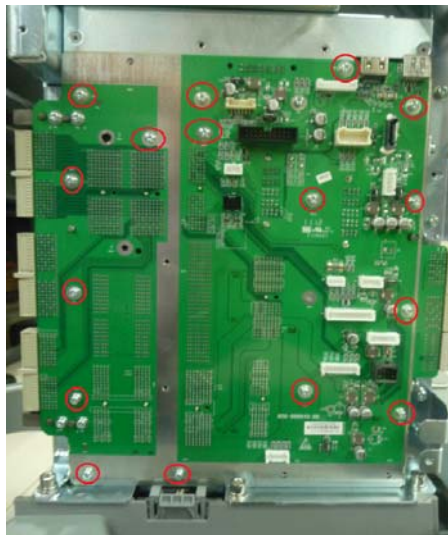


6. Unscrew six M3X8 screws, move the protecting cover ahead and take it off meanwhile. Pay attention to prevent damaging the components on motherboard.





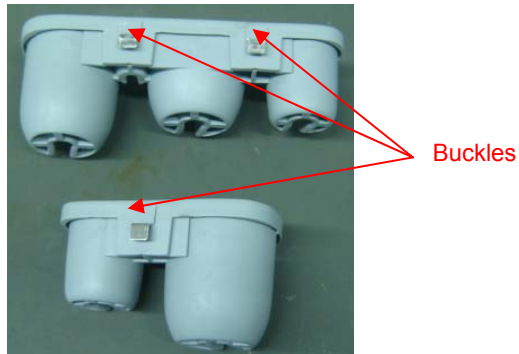
7. Unscrew sixteen M3X8 screws at last, and then take out the motherboard outwards.



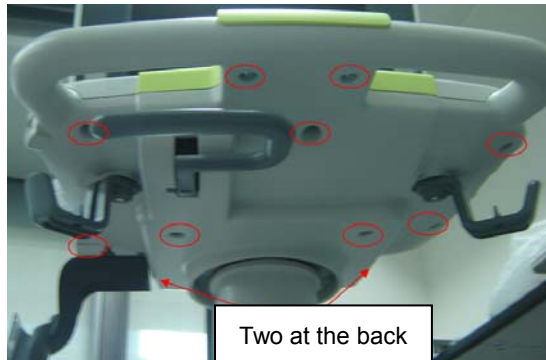
### 9.3.15 Control Panel Assembly

1. Remove holders on two sides: take the buckles off the control panel and bring them up. You can take out the holders.





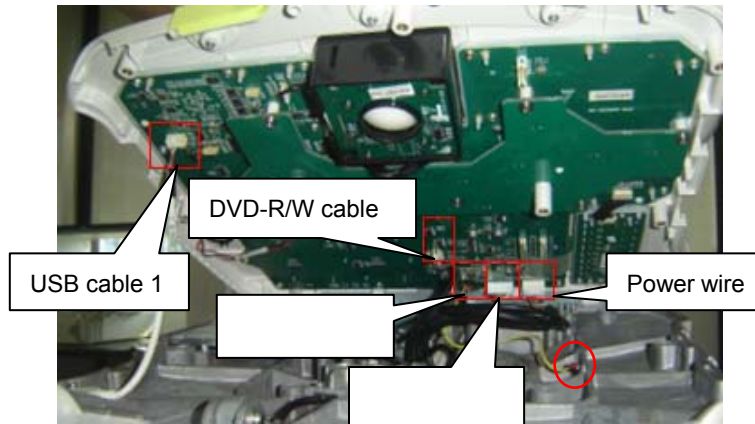
2. Unscrew eleven M4X12 combination screws fixing the control panel assembly.



3. Lift the top cover from the position of DVD-R/W, release two clasps to separate control panel assembly from the casting aluminum base.



4. Pull out five plugs of cables between control panel assembly and main unit (as shown in the figure), Unscrew one M3X8 combination screw fixing grounding cable to casting aluminum base. And then remove the assembly.



**NOTE:** Nip the buckle to pull out the plug of USB cable 2, avoiding destroying the plug or socket.

You can do the following disassembly on control panel assembly:

### 9.3.15.1 Encoder Assembly

1. Pull out four big and nine small encoder knobs.



**NOTE:** Pay attention to differentiate the size of knobs when installing.

2. Unscrew eight PT4X10 self-tapping screws, pull out the plug of cable connecting to the keyboard, and then remove the encoder assembly.



### 9.3.15.2 Trackball

Unscrew two M3X8 combination screws, pull out the plug connecting to the keyboard, and then remove the trackball assembly.

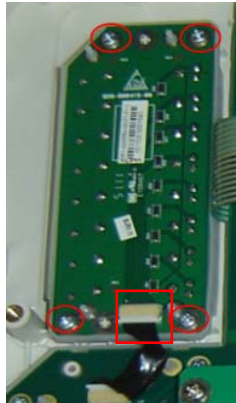


### 9.3.15.3 TCG Board

1. Pull out eight deflector rod knobs of TGC board.



2. Unscrew four PT3X10 self-tapping screws, pull out the plug of cable connecting to the keyboard, and then remove TGC board and silicon gel assembly.



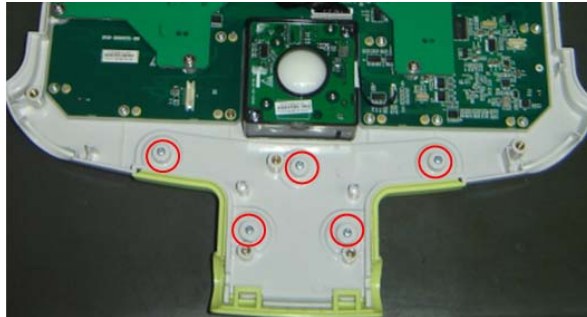
### 9.3.15.4 Buzzer

Unscrew two PT2X6 self-tapping screws and gaskets, pull out the plug of connecting cable, and then remove the buzzer.



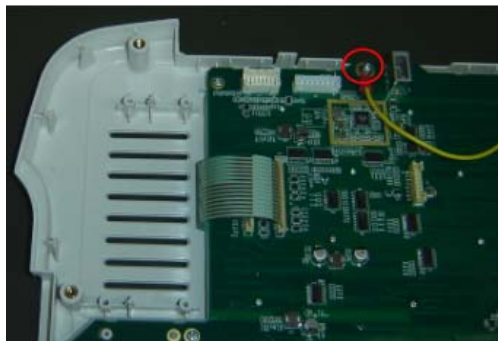
### 9.3.15.5 Hand Supporting cushion

Unscrew five PT3X10 self-tapping screws to remove the hand supporting cushion.



### 9.3.15.6 Top Cover Assembly of Keyboard

1. Remove encoder assembly, trackball assembly, TGC board and buzzer.
2. Unscrew one M3X8 combination screw fixing the grounding cable; the left is top cover assembly of keyboard.

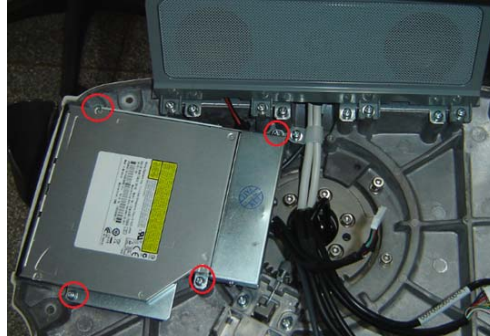


Top cover  
assembly of  
keyboard



### 9.3.16 DVD-R/W

1. Remove control panel assembly, referring to 9.3.15 the 1<sup>st</sup>~5<sup>th</sup> step.
2. Unscrew four M3X8 combination screws fixing the DVD-R/W assembly, and then remove the assembly from casting aluminum base.



3. Unscrew three M3X6 panhead screws with washers fixing the back cover of DVD-R/W assembly, and then remove the cover.



4. Unscrew two M3X6 panhead screws with washers fixing USB to SATA adapter board, and then remove the board and cables.

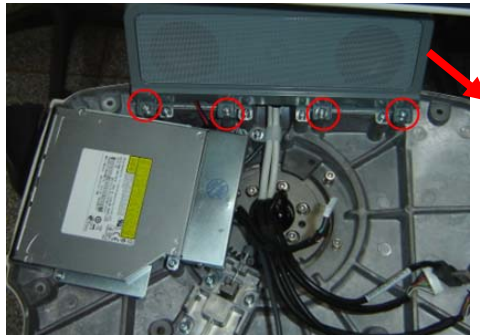


5. Unscrew four M2X4 panhead screws with washers fixing DVD-R/W and take out DVD-R/W from the bracket.

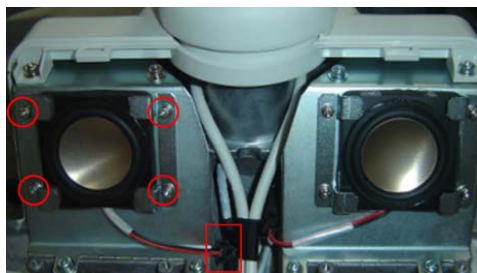


### 9.3.17 Speaker\ Speaker Cover Assembly

1. Remove control panel assembly, referring to 9.3.15 the 1<sup>st</sup>~5<sup>th</sup> step.
2. Unscrew four M4X12 combination screws fixing the speaker cover assembly, and then pull the assembly out from the position as shown by the arrow in the figure below.



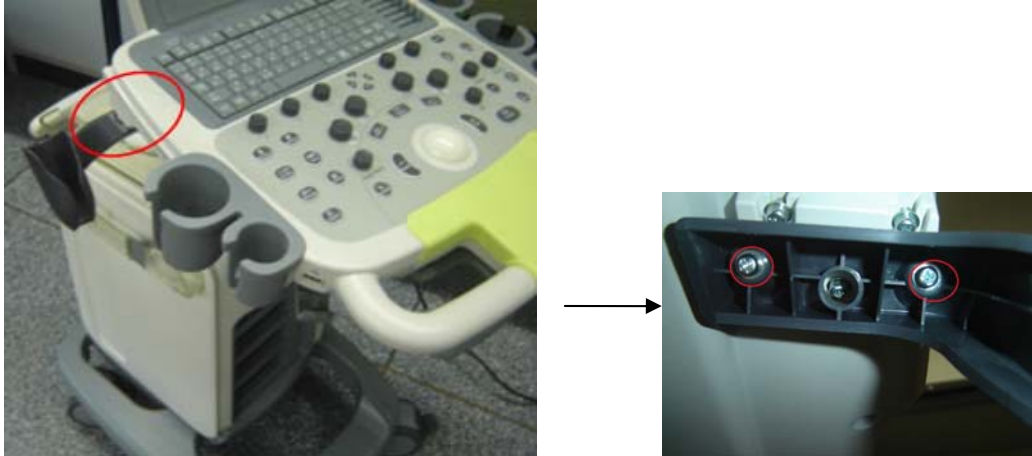
3. Unscrew four M3X6 combination screws fixing speaker assembly to the bracket, remove the bracket and pull out the cables connecting speaker to main unit, you can take out the speaker.



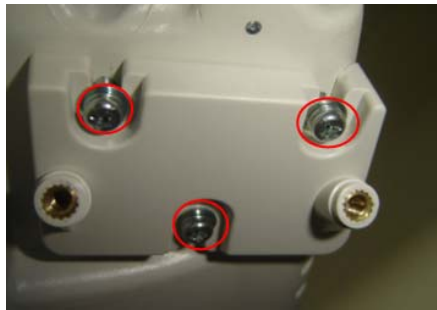
**NOTE:** Pay attention to the label affixed on the cable to avoid confusing left and right speaker when installing.

### 9.3.18 Intra-cavity Probe Bracket and Adapter Part

1. Unscrew two M4X12 combination screws fixing intra-cavity probe holder, and then take out the holder.



2. Unscrew three M4X12 combination screws fixing adapter part of intra-cavity probe holder, and then take it out.



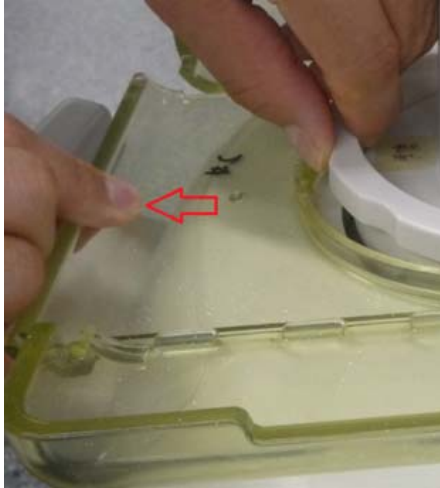
### 9.3.19 Salver B and S

1. Holding the flange plate to rotate it clockwise, and then lift it up.



2. Gently hold the flange plate with one hand, pull out salver B and S in the direction of the arrow as shown in the figure with the other hand.





### 9.3.20 Casters

1. Lock four casters of machine (Trampling down the “ON” brake of the caster), and then make the machine tilt for about 30°.



2. Use solid wrench to lock the Stud Screw, and then turn it clockwise until you can take out the caster.



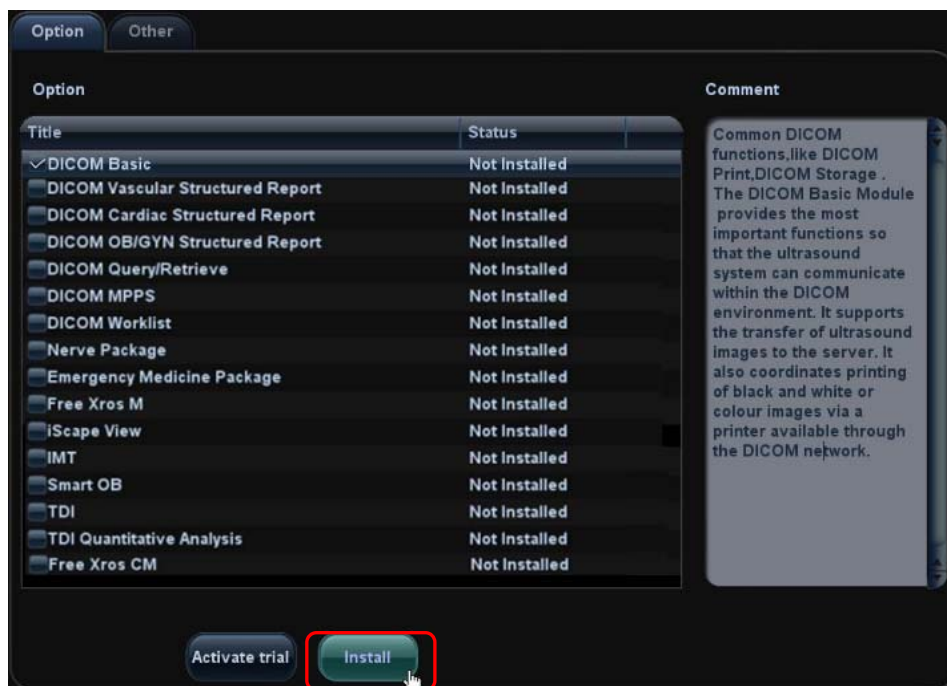


# 10 Optional Installation/Assembly

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## 10.1 Installing Optional Software

1. Copy optional key file into U disk and connect it to USB port.
2. Open Preset menu and click [Maintenance] into [Option] in which select desired software function.



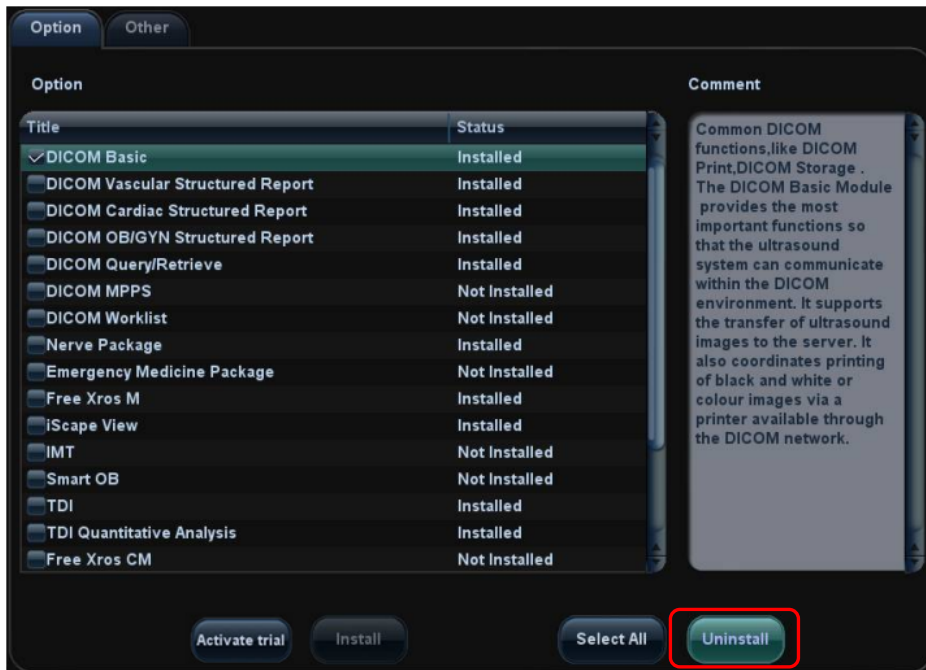
3. Click [Install] to pop up the dialog box and select required Key file and click [OK].
4. Return from preset after successful installation to confirm if optional function has been installed. After returning from preset, the required function can be used.
5. < Trial: Select desired software, and then click the [Activate trial] and input the password, click [OK] to enter at last.

**NOTE:**

1. Optional modules can be installed with Key singly. If the selected modules have been installed or two or more modules are selected, installation key is unavailable.
2. After all optional modules are installed, Please return to confirm.

◆ **Uninstalling**

1. Enter into [Option] menu, and in the list select the software package to be uninstalled.
2. Click [Uninstall] to pop up the [Confirm] dialogue box, and click [OK];



3. Return to the system preset interface, the optional devices status changes into "uninstalled".

**NOTE:**

Optional uninstalling is only available to internal users. Service engineers must log on as service.

## 10.2 Installing Optional Hardware

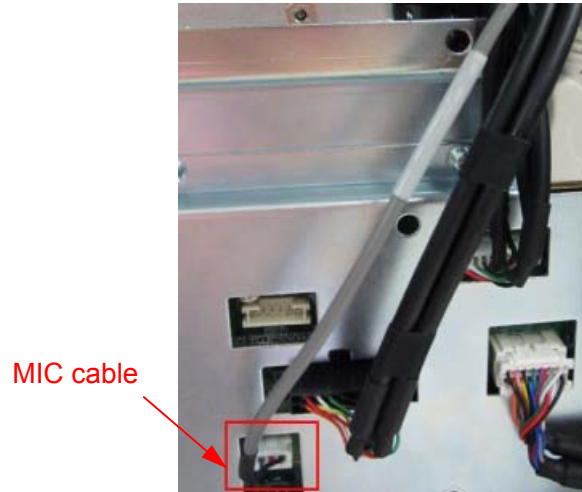
The optional hardware of the product are as follows:

NO.	Part Number	Part Name and Description	Material Photo	Assembly
-----	-------------	---------------------------	----------------	----------

1.	115-013443-00	ECG assembly		10.2.1
2.	115-013525-00	CW assembly		10.2.2
3.	M05-010005-09	Li-ion 14.8V6600mAh LI34I002A		10.2.3
4.	043-001629-00	Intra-cavity probe bracket		10.2.4
<p>Note: Materials which are used for update can also be used for maintenance.</p>				

### 10.2.1 ECG Assembly

1. Remove the left cover, right cover and front cover, referring to 9.3.2 the 1<sup>st</sup>~3<sup>rd</sup> step.
2. Pull out the cable connecting ECG assembly and MIC, and then untie the cable clip.



3. Unscrew three M4X12 screws fixing the ECG assembly. Hold the original front output panel assembly and take it out.

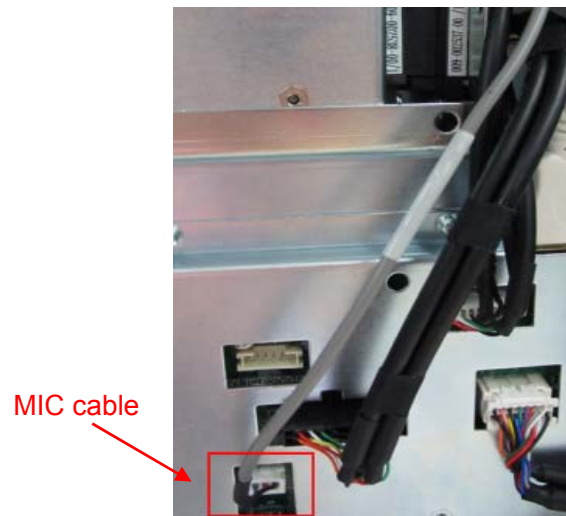


4. Insert ECG assembly into the space, and then use three M4X12 screws to fix the ECG assembly on the bracket of main unit.



5. Insert the connector of MIC cable into the corresponding socket on motherboard (as shown in

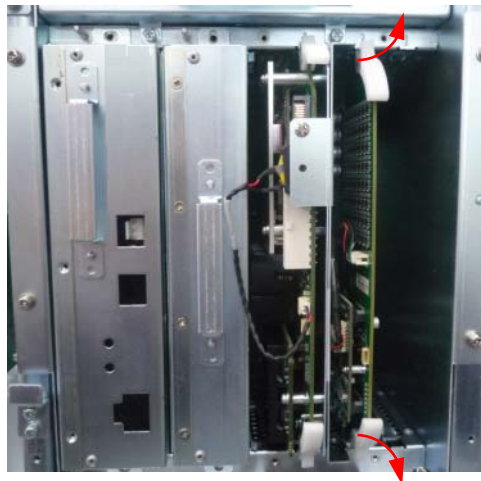
the figure).



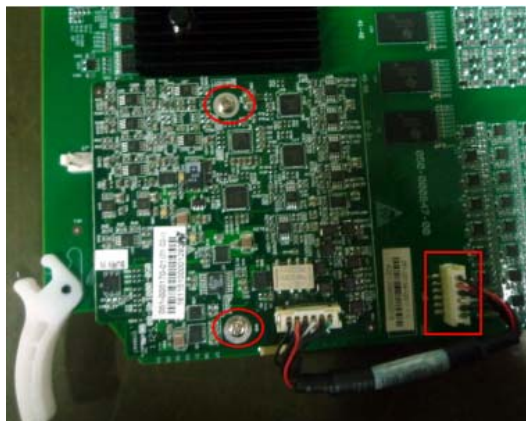
6. Install the front cover, left cover and right cover at last, the installation is finished.

## 10.2.2 CW Board

1. Referring to 9.3.9 the 1<sup>st</sup>~3<sup>rd</sup> step, remove the TR board.



2. Insert CW board to the corresponding socket on TR board and use two M3X8 screws to fix it, and then plug into the cable.

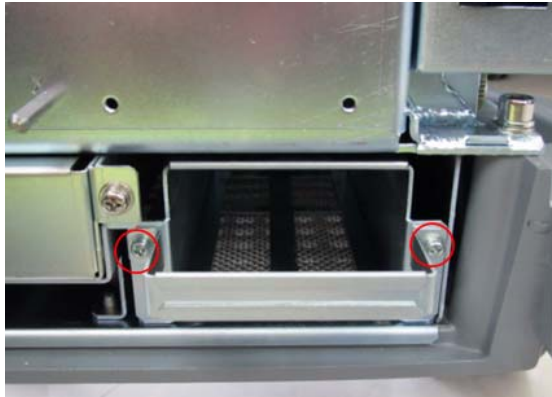




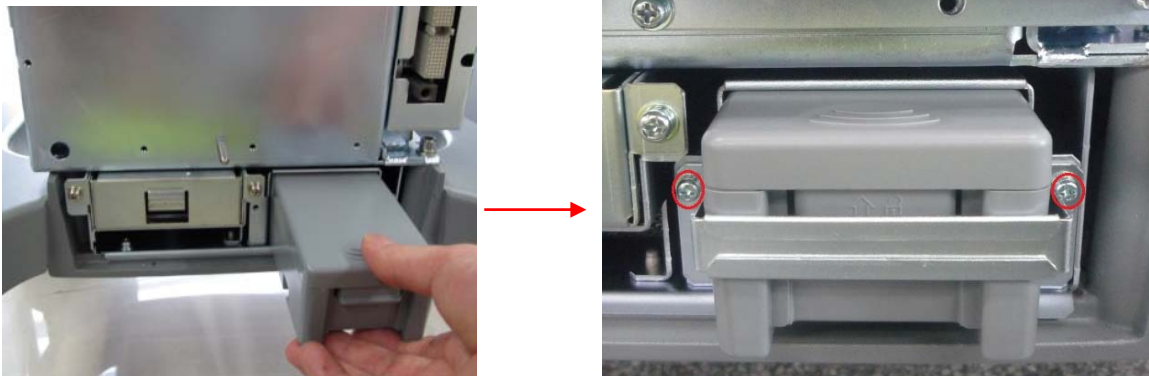
3. Insert TR board assembly into the guiding tracks to a target position, and then push two plastic detachers inward until lock the assembly. Install the left cover, the installation is finished.

### 10.2.3 Li-ion Battery

1. Remove the left cover, right cover and front cover, referring to 9.3.2 the 1<sup>st</sup>~3<sup>rd</sup> step.
2. Unscrew two M3X8 screws, remove battery pressing plate.



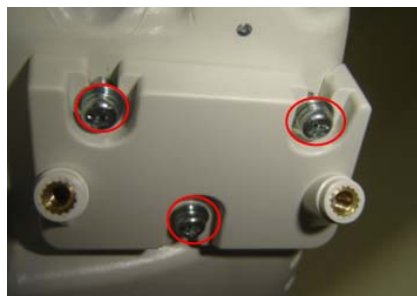
3. Insert the battery (keep arrow upwards) into the battery metal frame, push the battery to the target position, and then use two M3X8 screws to fix the battery pressing plate.



4. Install the left cover, right cover and front cover, the installation is finished.

### 10.2.4 Intra-cavity Probe Bracket

1. Use three M4X12 combination screws to fix adapter part of intra-cavity probe holder on the base of keyboard.





2. Use two M4X12 combination screws to fix intra-cavity probe bracket on adapter part again, the installation is finished.











# 11 System Diagnosis and Support

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## 11.1 General Status Indicator

### 11.1.1 The Status Indicators of the Control Panel

Status indicators	Icon	Status definition and indicators
Power-on status indicator		The indicator is not on when the system is turned off; Press the POWERBTN button, the indicator blinks in green when the system is powered on. After power on, the indicator is green.
Battery status indicator		Indicate the status of battery: it's off when the machine has no battery ,the other status: It illuminates in orange when battery is being charged; It illuminates in green when battery is charged to full capacity; The battery discharges with more than 20% capacity, the indicator is green. The battery discharges with less than or equal 20% capacity, the indicator blinks in orange. The battery discharges with less than or equal 5% capacity, the indicator blinks in orange quickly. When the battery is in non-charge/discharge status, the indicator is off (not including the situation with 100% capacity).
AC indicator		The indicator is on green when the ultrasound system is connected to the AC power supply. The indicator is off only when batteries supplied.
Standby status indicator		The indicator blinks orange in standby status. The indicator is off on the other status.
Hard disk indicator		The indicator light blinks in green when the hard disk is reading or writing. The indicator is off automatically in other situations.
W-LAN status icon (Software)		The icon turns green when W-LAN is open and wireless signal can be used.

interface)		
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### 11.1.2 The Status Indicator of the Power on the IO Board

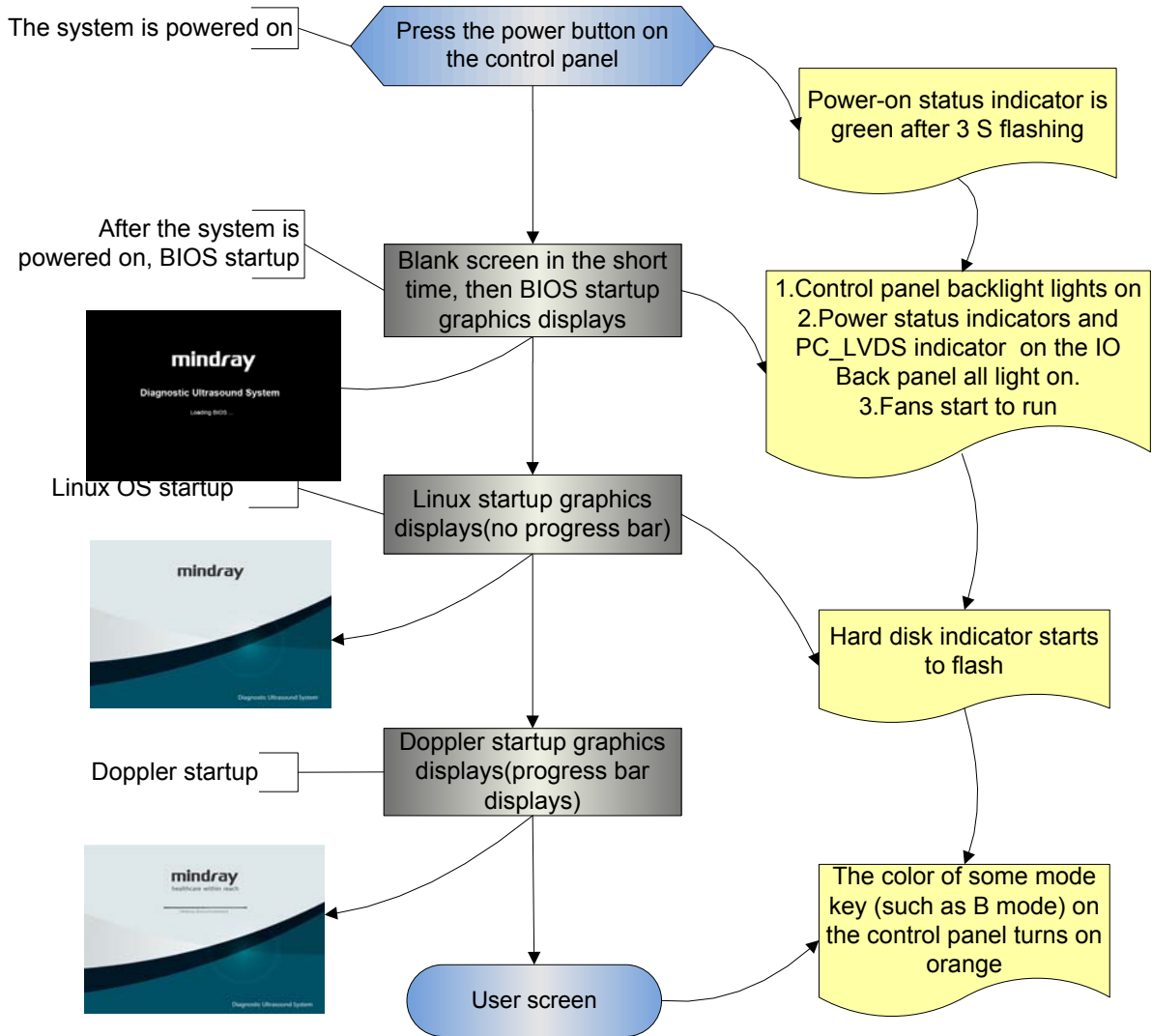
Status indicators	Icon	Status definition and indicators
Digital board power supply D+12V status indicator	12V	Power on, and indicator is on (green), which indicates D+12V output of the main unit box power module is normal.
Digital board power supply D+5V status indicator	5V	Power on, and indicator is on (green), which indicates D+5V output of the main unit box power module is normal.
Digital board power supply D+3V3 status indicator	3.3V	Power on, and indicator is on (green), which indicates D+3V3 output of the main unit box power module is normal.
PC LVDS indicator	PC_LV DS	The indicator is on(orange) ,which indicates LVDS signal output by CPU module is normal. It's off ,which indicates FPGA or CPU module malfunction.
PHV_OP indicator	PHV_O P	The indicator is on(orange) ,which indicates PHV over current protection is opened. It's off ,which indicates PHV is normal.

### 11.1.3 The Status of Whole Machine

Status of whole machine	Status definition and indicators	To enter	To exit
Scanning status	The Power-on status indicator turns on green; The [Freeze] key is white or light off.	Entering or exiting the scanning status by the [Freeze] key	
Freezing status	The Power-on status indicator turns on green, and the [Freeze] key is orange	Entering or exiting the freezing status by the [Freeze] key	
Standby status	The standby indicator blinks in orange.	<ol style="list-style-type: none"> <li>1. Press the power button for a short time, and then the system enters into the standby status by choosing from the status popped on the screen.</li> <li>2. If there is no operation for the time set at first, the system would enter into the standby status automatically.</li> </ol>	The system restores to the freeze status after restarting by pressing the power button for a short time.

<p>Screen-saver status</p>	<p>The brightness of the monitor is 0%,  “mindray” is rotating on the display as default and the backlight of the control panel is off.  The main unit is frozen.  The OS is in screen-saver status.  Ultrasound hardware imaging system is in the dormancy mode</p>	<p>There is no operation for the time set at first, and then the system would enter into the screen-saver status from the freezing status automatically.</p>	<p>When you press any key on the control panel, the system would return to the freeze status, both the brightness and the backlight of the control panel restore to the previous status.</p>
<p>Power-off status</p>	<p>The system is on the power-off status, when connected the AC power supply, the AC indicator is on, else refer to the instruction of “Battery status indicator”</p>	<p>Press the power button for a short time, and then the system is turned off by choosing from the status popped on the screen</p>	<p>Starting the system by pressing the power button for a short time</p>

# 11.2 Whole System Start-up Process



## 11.2.1 Complete System Start-up Process

### 11.2.1.1 Powered on by AC

Basic Procedures	Phenomenon
The original status: Finishing loading 3.3VSTB, then finishing loading 5VSTB.	no indication
	The AC status indicator on the control panel lights on, but the indicators of HDD and standby are off.
Press the power button, the power management sends the power-on request to CPU.	The Power-on status indicator on the control panel flashes continuously.
CPU responds to request. Power management opens the power supply.	The Power-on status indicator on the control panel lights for a long time.
The power has been power	1: The control panel backlight lights on.

on.	2: The power status indicators on the IO panel all light on. 3: Fans start to run.
After finishing HDD initialization and logic configuration, PC enters into BIOS stage.	PC_LVDS indicator lights on, There are data output and images displaying on the monitor.

### 11.2.1.2 Powered on by Battery

Basic Procedures	Phenomenon
The original status: finishing loading 3.3VSTB	no indication
Finishing loading 5VSTB	The battery indicator on the control panel lights on, but the indicators of HDD, standby and AC status are off.
The power management send the power-on request to CPU	The Power-on status indicator on the control panel flashes continuously.
CPU responds to request, Power management opens the power supply.	The Power-on status indicator on the control panel lights for a long time.
The power has been power on	1: The control panel backlight lights on. 2: The power status indicators on the IO panel all light on. 3: Fans start to run.
After finishing HDD initialization and logic configuration, PC enters into BIOS stage	PC_LVDS indicator lights on, There are data output and images displaying on the monitor.

## 11.2.2 BIOS Start-up Process

The start-up process of BIOS is a black-box operation, and the primary description is as following:

Basic Procedures	Basic phenomenon
Self-test after the system power-on	The LCD is blank screen, and the time of the course is short.
Initialization& Recording the settings of system& Providing the resident program library &Loading the operation system	Linux boot screen displays.

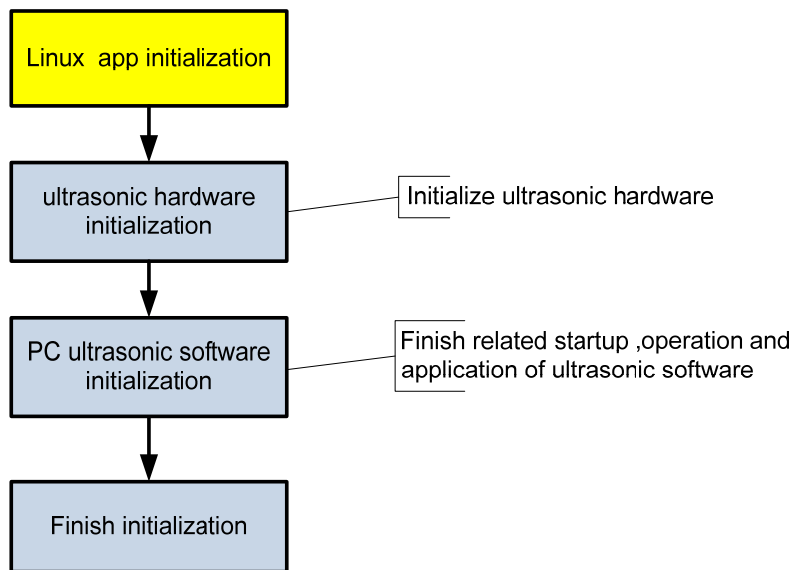
## 11.2.3 Linux Start-up Process

Basic Procedures	Basic phenomenon
Guiding the course of program loading &The course of testing and HDD configuration	The LCD is black screen now, and the time of the course is short.

The course of the internal core loading &The course of logging on	The Linux boot screen appears
Starting DOPPLER	The Doppler boot screen appears, and simultaneously progress bar displays the related information.

## 11.2.4 Doppler Start-up Process

### 11.2.4.1 Start-up Process



### 11.2.4.2 Details

◆ Now, DOPPLER starting is in increments of 20dB, and the detailed course is as following:

Basic Procedures	Sub-procedures	Basic phenomenon	Description
Linux APP initialization		Display Linux boot screen with no progress bar	The progress bar does not appear unit in increments of 7.
PC hardware initialization		Display Linux boot screen with no progress bar	
The PC software initialization	Peripheral initialization	Display Linux boot screen with no progress bar	The total increments are 7, and tips are displayed one by one.
	Platform initialization	Display Linux boot screen with no progress bar	
	GUI initialization	There is progress bar appearing on the Doppler boot screen, and tips under the progress bar are: and tips under the progress bar are: Initializing hardware... Loading system preset... Loading common exam preset...	



		Loading exam preset... Initializing locale...	
PC HDD initialization		Initializing gui...	The total increment is 1
Ultrasonic software initialization	GUI initialization	Initializing gui...	
	Platform initialization	Initializing gui...	
	Peripheral initialization	Initializing ultrasound peripheral...	The total increment is 1
	Imaging initialization	Initializing ultrasound image...	The total increments are 2
	Application initialization	Initializing ultrasound application...	The total increment is 1
Finishing initialization		Initialization completed...	The total increment is 1

◆ The configuration files of the course are as following:

Tips	Related operation	The corresponding increments
No prompt	<p>Attach the path to configuration files</p> <p>Initialize display, the main window, sound and the USB representative</p> <p>Turn on the bus device BackboneDev and LPC</p> <p>Initialize the time and the processing function of Multilanguage</p> <p>Initialize peripheral file system, network and the driver</p> <p>Enumerate peripheral ports</p> <p>Config timer, Initialize soft interruption, construct maintenance server and config static data of the system</p> <p>Config system font</p> <p>Load layout information</p> <p>Initialize UI management, and Initialize UI mark standard library</p>	In increments of 7.
Initializing hardware...	<p>When loading boot-trap graphic, 7 refreshing progress bars will display</p> <p>Release factory package of configuration data</p> <p>Maintain the data server</p>	
Loading system preset...	Generate the server of local setting and system setting	In increments of 1.
Loading common	Generate general data management of the exam	In increments of 1.

exam preset...	mode	
Loading exam preset...	Generate measure preset, peripheral and network, KMP package of images and the preset server of the network storage	In increments of 4.
Initializing locale...	Set related information of the zoom, languages, font library and input Construct widget factory Config the GUI layer Set menu items Initialize function library Construct UICenter	In increments of 1.
Initializing gui...	Config the application layer Initialize the keyboard. Construct the user account control management, and remote desktop management	In increments of 1.
Initializing ultrasound peripheral...	Config the file dialogue box Initialize printing library Monitor battery and system inspection handshaking Load printing mark Construct low power consumption Construct the USB management and writing management Initialize video replay device	In increment of 1.
Initializing ultrasound image...	Create ECG RD thread. Set the virtual machine device, and initialize the virtual machine Construct object trees of the front-end and the back-end (ultrasys and so on)	In increments of 2.
Initializing ultrasound application...	Add function package of measure menu Register the application interface of measure patient	In increments of 1.
Initialization completed...	The architecture of patient information management (UPatientApp)	In increments of 1.
Hide boot-trap graphic		

## 11.3 Warning and Abnormal Information

The machine has alarm function. When the malfunction exists in the machine, an alarm dialog box will be popped up, and the LOG file generated will be saved in the system log, which will be in the directory of D: \DCN3\Log). The detailed description of alarm information is as follows:

<b>NOTE:</b> In the LOG: *** refers to the time, in the format as 2012-6-12 14:15:15.
---------------------------------------------------------------------------------------

## 11.3.1 Battery Alarm

Alarm Tips	LOG Record	Measure
Alarming! Illegal operating battery! Lead to permanent damage!(id10642)	Battery Hot Plug	Stop the illegal operation.
Battery communication error! Battery may not be used or battery power may not be displayed correctly (id7330)	Battery I2C error	Check the battery connection or replace the battery
Battery temperature is too high; please connect to AC power supply or shut down! Otherwise the system shuts down automatically after 60s!(id7333)	Battery temperature is out of range temp, Battery temperature is: xx centigrade	check if the heat radiating condition around is normal.
Battery voltage is too low; please connect to AC power supply or shut down! Otherwise the system shuts down automatically after 60s!(id7336)	battery voltage is low, battery volt is xx V	Check the battery connection or replace the battery
Battery error! Battery cannot be used!(id7476)	battery break	replace the battery
Battery voltage is too low, please connect to AC power supply or shut down! Otherwise the system shuts down automatically after 60s!(id4298)	Low battery power, battery power is XX	Input AC, check if the battery charging is normal, and it can be used when full of power. Or replace the battery
Battery life is approaching, please replace with new battery!(id7420)	battery cycle is XX, please change the battery	Replace the battery
None	Battery I2C error, Shutdown State	Check the battery connection to confirm the malfunction module with I2C. Or replace the battery.
None	Battery Hot Plug, Shutdown State	Stop the illegal operation.

## 11.3.2 The Voltage of System Power Alarm

Alarming tips	LOG record	Measure
Real time clock battery life is approaching, please replace with new battery!(id8577)	*** System Monitor: Power supply alert! [VBAT], Current voltage: [VVV] V, Limit voltage:[LLL]~[HHH]V	The VBAT voltage is too low, replace the button battery.
none	*** System Monitor: Power supply alert! [XXX], Current voltage: [VVV] V, Limit voltage:	DC-DC power board or else power loads

	<p>[LLL]-[HHH] V.  [XXX] represents voltage name, [VVV] represents the current value, and [LLL]-[HHH] represents the lower and upper limits.  The voltage names respectively are:  AD+12V、 A-12V、 A-5V、 AD+2V5、 AD+1V8、 D+1V5、 D+1V2</p>	malfunction
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### 11.3.3 Temperature Alarm

Alarming tips	LOG record	Measure
Main board temperature alert(id2614), Shut down XX (XX means inversion timing, starting from 60S)	*** System Monitor: Temperature Alert! [XXX], Current temperature: [VVV] °C, Limit temperature: [LLL]-[HHH] °C. [XXX] refers to the temperature name, [VVV] refers to the current value, [LLL]~ [HHH] refers to the upper and lower limits. Temperature names are: ADC thermal sensor, Multi FPGA thermal sensor	Check the fan log D: \DCN3\Log \Perilog (if the fan stops working)/check if the heating condition is normal.
None	***: System Monitor: Temperature Alert! [ CPU thermal sensor] , Current temperature: [VVV] degree, Limit temperature: [LLL] degree [VVV] refers to the current value.[LLL]refers to the first level limit.	CPU over-temperature (level 1) The measure is the same as above
CPU temperature alert (id1218) Shut down XX (XX means inversion timing, starting from 60S)	***: System Monitor: Temperature Alert! [ CPU thermal sensor] , Current temperature: [VVV] degree, Limit temperature: 100 degree [VVV] refers to the current value.[LLL]refers to the second level limit.	CPU over-temperature (level 2) The measure is the same as above
Power board temperature alert(id3125), Shut down XX (XX means inversion timing, starting from 60S)	*** System Monitor: Temperature Alert! [Power thermal sensor], Current temperature: [VVV] °C, Limit temperature: [LLL]-[HHH] °C. [VVV] refers to the current value, [LLL]~ [HHH] refers to the upper and lower limits.	Check the fan log D: \DCN3\Log \Perilog(if the fan stops working)/check if the heating condition is normal.

## 11.3.4 Fan Alarm

Alarming tips	LOG record	Measure
Ventilator requires maintenance, please contact to the service engineer! (id7340)	<p>*** System Monitor: Fan alert! [XXX], Current speed : [VVV] rpm, Limit speed: [LLL] rpm</p> <p>[XXX] refers to the fan name, [VVV] refers to the current value, [LLL] refers to the limit value.</p> <p>Fan names are:            Top Fan 0,1,2,3 (refers to outlet fans)            Bottom Fan 0,3(refers to inlet fans)</p> <p>Fan locations are shown as follows:</p>	Replace the fan/connect the cable again/remove the malfunction

## 11.3.5 PHV Alarm

Alarming tips	LOG record	Measure
None	<p>*** +100V Power supply voltage error, the voltage is [LLL]V ,normal region is 95.000V to 105.000V</p> <p>[LLL] refers to the voltage</p> <p>*** -100V Power supply voltage error, the voltage is [LLL]V ,normal region is -95.000V to -105.000V</p> <p>[LLL] refers to the voltage</p>	<ol style="list-style-type: none"> <li>1. Turn off the system and replace the probe to confirm if the probe is normal;</li> <li>2. If the probe is normal, try to replace the probe board.</li> <li>3. Replace the DC-DC board.</li> </ol>
Alarm! High-voltage transmission is abnormal, and images can't display normally!(id7379)	<p>*** [XXX] supply voltage error, [XXX] is [LLL] V (upper limit is 80.000V</p> <p>[XXX] refers to the high-voltage name, they are: PHV0, PHV1 (PHV0 is +PHV, PHV1 is -PHV) [LLL] refers to the current value.</p>	Try to replace the probe.
Alarm! High-voltage transmission is abnormal, and images can't display normally!(id7379)	<p>+PHV 为 0:            ***UBatteryPortMonitor::PhvWarn:PHVprotect ,PHV1P:[LLL]V,PHV1N:[LLL]V</p> <p>-PHV 为 0:            ***UBatteryPortMonitor:PhvWarn:PHVprotect,PHV1P:[LLL]V,PHV1N:[LLL]V。</p>	<ol style="list-style-type: none"> <li>1. Turn off the system and cut the AC power, then restart the system to confirm if the system can recover;</li> <li>2. The system can't recover:            a).If -PHV-OCP appears, replace the TR board. b). If -PHV-OCP doesn't</li> </ol>

		appear, replace the DC-DC board.
		If it still does not recover after restarting the machine, replace the DC-DC board.
/	*** PHV over current protect! *** UBatteryPortMonitor::PhvWarn:PHVprotect,P HV1P:[LLL]V,PHV1N:[LLL]V	-PHV-OCP: over current protect.
/	*** PHV over voltage protect! *** UBatteryPortMonitor::PhvWarn: PHV protect,PHV1P:[LLL]V,PHV1N:[LLL]V	PHV-OVP: over voltage protect

### 11.3.6 Other Alarms

Alarming tips	LOG record	Measure
"SystemConfiguration.ini" can't be opened, please check the HDD data!(id9256)	None	Reinstall the system software
ADT7462 initialization is abnormal!(id9094)	***System Monitor: ADT7462 initialization error:	Reinstall the system software/check if the drive is normal/check if digital board is normal

# 12 Care & Maintenance

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## 12.1 Overview

These procedures in this chapter are recommended.

### 12.1.1 Tools, Measurement Devices and Consumables

Table 12-1 Tools and Measurement Devices

Tool/Measurement Devices	Qty.	Remarks
Resin or plastic container	1 pcs	Can accommodate two probes
Soft brush	1 pcs	About a toothbrush size
Small plastic basin	1 pcs	Used to fill the soapy water
Safety test analyzer	1 pcs	Refer to appendix A
Inner hexagon wrench	1pcs	Inner hexagon wrench 6 #
Solid wrench	1pcs	With opening diameters of 36mm
Cross-headed screwdriver	1pcs	105 X100

Table 12-2 Consumable List

Consumable	Qty.	Remarks
Aluminum foil	About 1 meter	
Physiological saline	About 1000ml	Filling a half container Immersing the whole probe (referring to appendix A). (concentration 0.85 ~ 0.95%)
Mild soapy water	About 400ml	
Dry soft cloth/cotton cloth	About 5 pcs	

### 12.1.2 Care and Maintenance Items

**Table 12-3 Maintenance Items and Frequency**

NO.	Maintain content	Frequency	Method
1.	Clean dust-proof covers	Once a month	Referring to12.2.1
2.	Clean monitor	Once a month	Same as the above
3.	Clean trackball	Once a month	Same as the above
4.	Clean control panel	Once a month	Same as the above
5.	Clean probes (the head)	Every time after using	Same as the above
6.	Clean probe cable and the surface of connector	Once a month	Same as the above
7.	Clean holders (including probe holder and gel holder)	Once a month	Same as the above
8.	Clean cover	Once a month	Same as the above
9.	Clean peripherals	Once a month	Referring to12.2.2
10.	Check surface of probes	Once a day	Referring to12.3.1
11.	Check power cable , plug and circuit breaker	Once a month	Same as the above
12.	Check battery	Once a year	Same as the above
13.	Check function of peripherals and options	Once a year	Referring to12.3.3
14.	Mechanical safety inspection	Once a year	Referring to12.3.4
15.	Electrical safety inspection	Once per two years	Referring to appendix A



## 12.2 Cleaning

### 12.2.1 Clean the System

#### 12.2.1.1 Flow of Cleaning

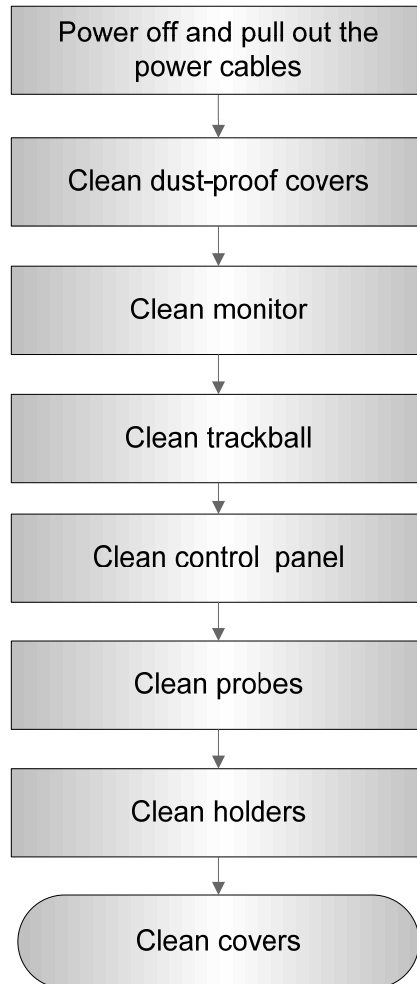


Fig 12-1 Cleaning maintenance flow

**⚠WARNING:** Before cleaning the system, be sure to turn off the power and disconnect the power cord from the outlet. If you clean the system while the power is “On”, it may result in electric shock.

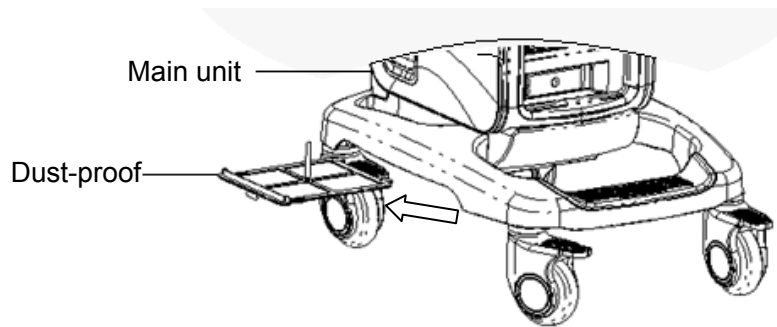
#### 12.2.1.2 Content

##### 1. Clean dust-proof covers

- Tool: Soft brush
- Method:

- a) Disassemble dust-proof cover before cleaning.

System dust-proof cover: Grab the lower side of the dust net frame, and then pull out the net.



Probe port dust-proof cover: there is a probe port dust-proof cover at the front of the system, Pull it out.

- b) Cleaning: with soft brush and then wipe off the dust.
- c) Assemble dust-proof covers.

Input the dust-proof clasp into the slot of the main unit, push the dust-proof inward until the dust-proof clasp is blocked in the slot.

**⚠ CAUTION:** Please clean all dust-proof covers of the system periodically (1 time per month); otherwise, system damage may result. Cleaning times can be increased when the system is used in the open air or somewhere dust is more.

## 2. Clean Monitor

- Tool: soft dry cloth ,clear water or soapy water
- Method:

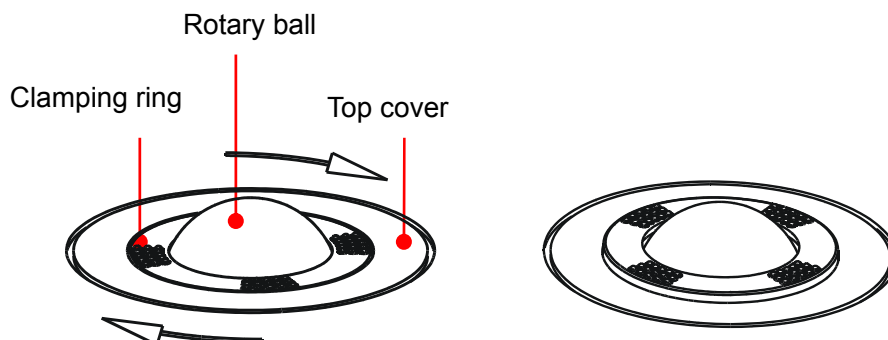
Surface of monitor and should be cleaned with soft dry cloth directly. Remained stain should be washed out by cloth with a little clear water or soapy water, and then air-dry the surface.

## 3. Clean Trackball

- Tool: Dry soft cloth, soapy water
- Method:

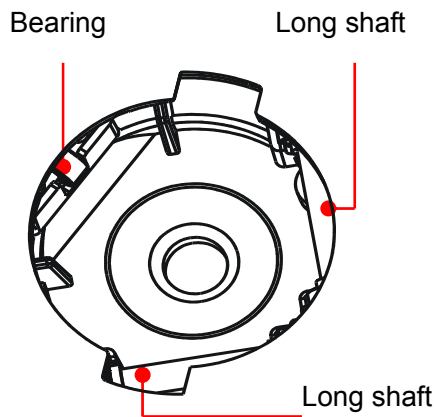
### a) Disassemble

Press the bulges on the clamping ring by both hands and turn the ring about 45°clockwise until it lifts. Take out the ring and the rotary ball. Be careful not to drop the ball. Shown as follows:



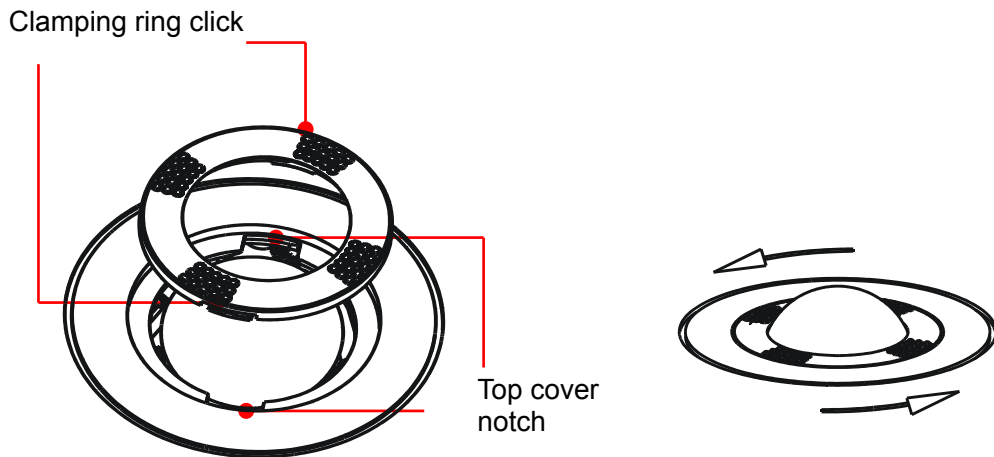
### b) Cleaning

Clean the two long shafts, the bearing and the rotary ball with dry soft cloth .



c) Installing

Put the rotary ball back in the trackball and then align the clamping ring click with the top cover notch. Press the bulges on the ring with both hands and turn the ring about 45°counterclockwise until the ring clicks. As the bulges are flush with the top cover, the ring is secured.



#### 4. Clean Control Panel

- Tools: dry soft cloth, soapy water
- Method:

Use dry soft cloth to clean the surface of control panel (including keystrokes, encoders and sliders). If the control panel is dirty, moisten the soft cloth with a little mild soapy water and wipe off any stains. Use another dry soft cloth to remove any moisture and allow all hard surfaces to completely air-dry. If it is difficult to clean the control panel, disassemble the encoder caps first and then use mild soapy water to clean it.

**NOTE:** The control panel should be cleaned periodically; otherwise, keys maybe blocked by dirt and buzzer dings, keys don't work.

#### 5. Clean Probe

- Tools: mild soapy water , dry soft cloth, soft brush
- Method:
  - a) Wipe out the dust attached to surface of probe head, connector and cable with dry soft cloth.
  - b) Use soft brush to brush the dust inside probe connector gently.

- c) Remained stain or dust attached to surface of cable or surface of connector should be washed out by cloth with a little soapy water, and then air-dry.

**NOTE:** Don't use cloth with water to clean the probe connector.

#### 6. Clean Holders

- Tool: dry soft cloth , soapy water, soft brush
- Method:
  - a) Use dry soft cloth to wipe off the dust attached to inside, outside or gap of probe holder or gel holder. As to small intra-cavity probe holder or its gap, use the soft brush to brush the dust or stain.
  - b) Remained stain attached to inside, outside of holder should be washed out by cloth with a little soapy water after it was taken out, and then install the holder after air-dry.

#### 7. Clean Cover

- Tools: dry soft cloth, soapy water
- Method:

Use dry soft cloth to clean the cover of the system. If the system is dirty, moisten the soft cloth with mild soapy water and wipe off any stains, then air-dry.

Note: Be sure to use soft brush to brush the dust attached to all the sockets or interfaces which can be seen (such as probe sockets, sockets or interfaces in IO panel and power supply panel),not the cloth with water.

## 12.2.2 Clean the Peripherals

Do the cleaning maintenance according to your actual peripheral configuration; items which are not configured can be skipped.

**Table 12-4 Peripherals Cleaning List**

No.	Content	Description
1.	Color and B/W video printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
2.	Graph / text printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
3.	Foot switch	Use soft dry cloth with a little mild soap water to wipe off the dust or stain attached to the pedals or cable of foot switch.
4.	Bar code scanner	First use soft dry cloth to wipe off dust attached to glass panel of scanner, then the dust or strain attached to cable and bracket. Be sure to do the especial cleaning maintenance according to the operation manual if is necessary.

## 12.3 Checking

### 12.3.1 General check

Table 12-5 General check list

No.	Content	Method
1.	Probe	a) Visually check to confirm that there is no crack and expansion to probe head. b) Visually check to confirm that there is no deterioration or desquamation to probe cable. c) Visually check to confirm that there is no bend, destroyed or falling off pins to the connector.
2.	Power supply cable and plug	a) Visually check to confirm that there is no wrinkles, crack or deterioration b) Manually check to confirm that there is no looseness or rupture to cable. The connection of plug is reliable and the retaining clamp of power supply cable is effective.
3.	Battery	Check the battery periodically : a) Check if battery can be charged normally when power-on: That the current capacity is 100% or capacity increases after a short time indicates that the battery can be charged normally. It takes less than 2 minutes to increase 1% capacity when the total capacity is less than 90% and it takes more time when the capacity is more than 90%. b) Disconnect the system from the AC power supply to confirm if the system can maintain normal work status in the battery power supply.

### 12.3.2 System Function Check

The system function checking is not required during Preventive Maintenance. Engineer or Customer may use it as part of their product Quality Assurance Program tests.

Table 12-6 System function list

No.	Content	Method
1.	B mode	Verify basic operation of B mode. Check basic software and hardware controls affecting B mode operations.
2.	Color mode	Verify basic operation of Color mode. Check basic software and hardware controls affecting Color mode operations.
3.	Doppler mode (PW/CW)	Verify basic operation of Doppler mode. Check basic software and hardware controls affecting Doppler mode operations.
4.	M mode	Verify basic operation of M mode. Check basic software and hardware controls affecting M mode operations.

No.	Content	Method
5.	Measurement ( 2D, M, Doppler general measurement, optional applied measurement )	Scanning gray scale imaging on phantom, verify distance and area accuracy with measurement control. Verify measurement accuracy by performance test.
6.	Keyboard test	Operate keyboard test to verify if all control keys can work normally.
7.	LCD	Verify LCD display function and parameters adjustment. Refer to that of LCD checking.
8.	Software menu check	Verify software menu display function: if each operation menu and page can be accessed.
Remark: Please refer to 5.4~5.5 for details.		

### 12.3.3 Peripherals and Options Check

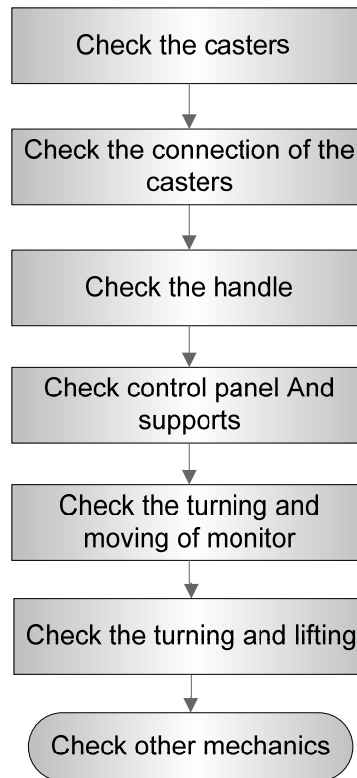
If the system is not configured with any module or peripheral, the corresponding items checking can be skipped.

**Table 12-7 Options, Peripherals and Accessories Check list**

No.	Content	Method
1.	Color and B/W video printer	Check if the output of video printer is normal.
2.	Graph / text printer	Check if the output of graph / text printer is normal.
3.	Foot switch	Check if the foot switch can implement the set functions according to the program.
4.	DVD-R/W	Check if DVD can work normally (write, read and pop).
5.	Bar code scanner	Check if the scanner can work normally and the output content is right.
6.	DICOM	Check if DICOM can work normally and send pictures and other data to DICOM server.
7.	ECG module	Check basic operations and verify the implementation of ECG functions.
Remark: Please refer to 5.3 for details.		

### 12.3.4 Mechanical Safety Inspection

Mechanical safety inspection is mainly used to check mechanical strength and mechanical function of the key assembly of ultrasonic system. The mode of test evaluation mainly is: Perform the evaluation by means of visual check and operating check, if the check result cannot pass, the system is in abnormal status now. Stop using the system and adopt proper measures. The test flow is as following:



**Fig 12-4 Mechanical Safety Inspection Flow**

**Table 12-8 Mechanical Safety Check**

NO.	Item	Method	Tool
1.	Caster	a) Visually check to confirm there is no any crack. b) Operate the casters to confirm the locking and releasing functions are normal.	none
2.	Connection of the caster	a) Visually check to confirm that there is no skewness and the connecting studs are free of breakage or falling off. b) Check with the wrench to make sure that there is no looseness between the caster and the base connection stud.	Solid wrench
3.	Handle	a) Visually check to confirm there is no any crack. b) Hold the handle to push the ultrasound machine, and then pull it gently to confirm that the handle is free of looseness.	none
4.	Control panel and support assembly	Check by hand to confirm that the support assembly is normal and the control panel is free of skewness and looseness.	none
5.	Fixing and rotating	a) Visually check to confirm if any inclination happened to the monitor.	none

NO.	Item	Method	Tool
	mechanism of the monitor	b) Manually operate the monitor to make sure the monitor can be rotated around its central pivot point or tilted for the optimum viewing angle normally, no abnormal sound exists.	none
		c) Remove the rear cover of the control panel and neck cover of the monitor, check by a wrench to confirm that the fixing screw are free of looseness; Visually check to confirm that the cables are not scratched or clipped out that the core can be seen.	Cross-headed screwdriver, inner hexagonal wrench 6#
6.	Turning and lifting mechanism	a) Hold the height adjusting handle under the control panel to move it to the end of the adjustable height , make sure that control panel can go up and down normally without abnormal sounds or phenomena b) Hold the height adjusting handle to move it to the middle of the adjustable height, make sure that the control panel can turn smoothly without abnormal sounds or phenomena.	none
7.	Other mechanics	Check to confirm that there is no looseness to other mechanical parts, no crack to cover and no conductive parts show in sight.	none

### 12.3.5 Electrical Safety Inspection

Only technical professionals or engineers after training can perform electric safety inspection. Please refer to appendix A: Electrical Safety Inspection for details.





# 13 Troubleshooting of Regular Malfunctions

## 13.1 Troubleshooting When System Can't Be Powered on

### 13.1.1 Module or Board Related

No.	Descriptions	Remarks
1	Battery Li-ion 14.8V 6600mAh LI34I002A	
2	AC-DC board	
3	DC-DC board assembly	
4	CPU module	

### 13.1.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	AC power indicator	Located on control panel 
2	Power-on status indicator	Backlight of the power button 
3	Three Power indicators	12V, 5V, 3.3V, located on IO board

### 13.1.3 Troubleshooting When System Can't Be Powered on

No.	Fault Description	Cause Analysis	Measure
1	Fail to start up when powered by the battery only, but can start up normally by AC power supply. After the machine is powered on, battery alarm appears.	Internal battery fails; Related board or module of the other power system is in normal status	Replace the battery
2	No AC input, Fail to start up when powered by the battery; The power-on status indicator flash then turn off, battery indicator flash, succeeding in start up when AC input and battery can charge up normally	Battery is out of power	Charge up

3	The AC input is normal ,AC power indicator remains off; Power indicators on IO board: off	AC-DC board fails	Replace AC-DC board
4	AC power indicator: ON; Power-on status indicator: off after power button pressed Power indicators on IO board: off	DC-DC board fails	Replace DC-DC board assembly
5	AC power indicator: ON; Power-on status indicator: blinks after power button pressed Power indicators on IO board: off	CPU module fails	Replace CPU module
6	AC power indicator: ON; Power-on status indicator: blinks and turns on after pressing power button Power indicator on IO board: 5V off or 3.3V off	DC-DC board fails	Replace DC-DC board assembly

## 13.2 Troubleshooting When System cannot be started up

### 13.2.1 Module or Board Related

No.	Descriptions	Remarks
1	CPU module	
2	HDD	

### 13.2.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Character and progress status during the starting of the system	
2	Alarm and prompts during the starting of the system	
3	Backlight status of control panel during power on the control panel	

### 13.2.3 Troubleshooting When System cannot be Started

No.	Fault Description	Cause Analysis	Measure
1	Control panel backlight normal; LCD blank displaying "No signal";	System powers on normally, enter BIOS self-checking but BIOS screen cannot display.	Replace CPU module

	no output when connecting external display with VGA interface	CPU module failure.	
2	BIOS start-up graphics is normally displayed, but it cannot be kept on	CPU module failure	Replace CPU module
3	Enters BIOS start-up graphics. No LINUX start-up graphics displayed,  With the system prompts for abnormality (e.g. Installer can't find files, please check it and try again)	Cannot find operating system, the HDD or OS in HDD may be damaged.	First restore LINUX and Doppler, or else replace the hard disk.
4	LINUX start-up graphics displays; Graphics disappears to blank screen and system makes no response to control panel input.	Fail to load the operating system, the HDD or OS in HDD may be damaged.	First restore LINUX and Doppler, or else replace the hard disk.
5	LINUX start-up graphics displays; Blank screen with a cursor, can response to control panel input	Fail to load the Doppler software, the HDD or OS in HDD may be damaged.	First restore Doppler, or else replace the hard disk.
6	Doppler software start-up graphics displays but cannot continue	Fail to load the Doppler software, the HDD or Doppler software in HDD may be damaged.	First restore Doppler, or else replace the hard disk.
7	After being turned on or during in use, the monitor displays "GRUB loading please wait....."	The input device cannot be detected. Maybe the control panel defects or bad connection between the control panel and the host.	Confirm if the connection between control panel and the host is OK or replace the control panel.

## 13.3 Troubleshooting for Image Displaying

### 13.3.1 Module or Board Related

No.	Descriptions	Remarks
1	DC-DC board assembly	
2	Transmitting and receiving board PCBA	Transmitting and receiving physical channel are 64.

3	Probe board assembly	
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### 13.3.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Image features, including dark strips and noise	The following table shows the image features and the related description.
2	Image features when contact occurs between different types of probe connect to the same probe sockets.	
3	Imaging features when probe connect to different probe socket.	Maybe some probe switching relays are damaged.

### 13.3.3 Troubleshooting for Image Displaying

No.	Failure Description	Cause Analysis	Measure
1	No image echo in the ultrasonic image region, but probe can be recognized. (PHV_OP indicator is on).	PHV over current protects; Malfunction on the transmitting and receiving board, DC-DC board or probe board.	Malfunction probability on the transmitting and receiving board is bigger than that of DC-DC board PCBA. The third is probe board. Replace the related board to confirm the malfunction. (If the system cannot restore after being broken off the power and turned on, the malfunction is on TR board.)
2	Dark strips on B image	Probe malfunction, e.g. array damage. Confirm it by connecting another probe.	Replace the transducer.
		If several similar dark strips appear in the image.	Replace the transmitting and receiving board
		If dark strips appear, also after replacing the probe socket, dark strips disappear or change the place.	Replace the probe board assembly.
3	Noise on the B image	Probe malfunction, e.g. array damaged, lens with air bubbles or cable shielding damaged etc. Confirm it by connecting another probe.	Replace the probe.
		Other electrical equipments working in the same electrical network may cause interference to the system. e.g. Some ripple wave on the image.	Confirm the cause of failure by turning off all electrical equipments around working in the electrical network or connecting to the system. E.g. charger of electric bicycle, charger of MP3, timing switch of

			fan, elevator, ultrasound work station, TV set. Etc.
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## 13.4 Probe Socket System Related Malfunction Troubleshooting

### 13.4.1 Module or Board Related

No.	Descriptions	Remarks
1	Probe board assembly	
2	4D&TEE board	

### 13.4.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Probe recognition of all models of probes when connecting on the same or different ports	
2	Probe board ID of the system information	

### 13.4.3 Probe Socket System Related Malfunction Troubleshooting

No.	Failure Description	Cause Analysis	Measure
1	Probe can't be recognized	This probe can't be recognized when connected to all probe sockets, while reorganization of other probes is normal. Probe malfunction.	Replace the transducer.
		This probe can't be recognized when connected to a certain socket. Probe board malfunction.	Replace the probe board assembly.
		No probe can be recognized on any probe port; Probe board ID can't be read correctly by the system information; Probe board malfunction.	Replace probe board assembly.

## 13.5 IO System Related Malfunction Troubleshooting

### 13.5.1 Module or Board Related

No.	Descriptions	Remarks
1	Digital board assembly	
2	CPU module	
3	IO board	

### 13.5.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Working condition of control panel	Confirm if main USB device is functional since the control panel is connected by internal USB cable
2	Working condition of each USB port and USB device	Refer to USB Fig 13-1 Distribution diagram of USB ports
3	Working condition of Video, S-video and VGA ports	
4	Printing condition of video printer	Check if output of connected video printer is normal

### 13.5.3 IO System Related Malfunction Troubleshooting

No.	Failure Description	Cause Analysis	Measure
1	Monitor displays normally; No video printer output when press <Print> on control panel; Image printing can be performed by operating the printer directly	Remote printing control failure; As video print control signal is generated directly by the digital board, the malfunction may be caused by digital board or cable connection failure.	Check the cable connection, and if the cable is connected well, then replace the digital board assembly.
2	Monitor displays normally; No video printer output when press <Print> on control panel; Image printing can't be	The printer is OK, Video output malfunction, connect the printer to the other Video port, if neither of the two port works, then the malfunction may be on the digital board.	Replace the digital board assembly

	performed by operating the printer directly	If only Video port output on the IO board is abnormal, the malfunction is on the digital board.	Replace the digital board assembly
		If video printer inside cannot work normally, but the VIDEO port on the IO board is normal. The malfunction may be the signal cable or port.	Replace the signal connecting cable.
3	No sound on the two speakers	Malfunction is on the digital board	Replace the digital board assembly
4	Only one speaker has no sound.	Malfunction on speaker	Replace the speaker
5	Microphone is abnormal.	If there is no something wrong with Microphone, the malfunction may be on digital board.	Replace digital board assembly.
6	USB device can't be recognized by USB port	Other USB port connected devices work normally. The two USB ports on the IO board can't be used, USB HUB malfunction on the IO board.	Replace IO board.
7	Network is disconnected or abnormal	First, check if it was caused by network or problem with setting , if no, malfunction on CPU module (at high rate) or IO board	Replace the IO board or CPU module to confirm the reason.
8	WIFI cannot be recognized.	Check the 3.3V indicator on the IO board, if it is darker than the indicators around or off, then the malfunction is on the digital board.	Replace the digital board assembly.
		First, check if it was caused by network or problem with setting , if no, malfunction on the WIFI board or digital board	Replace the WIFI board or digital board assembly to confirm the reason.

## 13.6 Control Panel Malfunction Troubleshooting

### 13.6.1 Module or Board Related

No.	Descriptions	Remarks
1	Top Cover Assembly of Keyboard	
2	Encoder Assembly	
3	Trackball	
4	TGC board	

## 13.6.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Backlight of control panel	To confirm if the control panel is powered normally
2	Key volume of the keys on control panel.	To confirm if the buzzer works normally.
3	Function key operation response on the control panel	
4	Trackball operation response	
5	TGC slider bar operation response	It can be confirmed the malfunction is on the slider potential device or on the control panel PCBA.
6	Encoder operation response	It can be confirmed the malfunction is on encoder or on the control panel PCBA.

## 13.6.3 Control Panel Malfunction Troubleshooting

No.	Failure Description	Cause Analysis	Measure
1	Buzzer alarms	Key blocked	Check the control panel for key block
2	Part of the keys can't be used normally	Malfunction may be on control panel or Silicon key	Confirm there is no key block first, then replace the top cover assembly of keyboard
3	Trackball can't be used normally	Dust or foreign object blockage in the groove.	Remove the trackball and clean the groove.
		Trackball speed and response time in the system preset are not correct.	Set the trackball speed and response time to a proper value.
		Trackball performance degraded.	Replace the trackball.
4	All keys of control panel are normal, Single encoder is failure.	Encoder malfunction	Replace encoder assembly
5	All keys of control panel are normal, Single slider of TGC is failure.	TGC board malfunction	Replace TGC board
	All sliders of TGC are failure.	Control panel malfunction	Replace top cover assembly of keyboard



# 13.7 LCD and Display Malfunction Troubleshooting

## 13.7.1 Module or Board Related

No.	Descriptions	Remarks
1	Monitor assembly	
2	Digital board assembly	
3	CPU module	
4	IO board	

## 13.7.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	Display assembly status indicator	Located at the lower right corner of the display.
2	Backlight of the display	The effect is evident in a darker environment.
3	Video output port such as VGA, DVI on the IO board	Need to connect with a display.
4	The display displaying status	Blank screen, or the screen warns "No Signal", or snowflakes are displayed on the screen.

## 13.7.3 Display Related Troubleshooting

No.	Failure Description	Cause Analysis	Measure
1	Control panel can be powered normally; Blank screen; Display indicator flashes in yellow. Displays normally with external LCD connecting by VGA port on IO board.	Monitor malfunction	Replace monitor assembly.
2	Control panel can be powered normally; The color of some mode key turns on orange. Blank screen; Display indicator is off.	May be the power line connection of display is not good. Or monitor malfunction	Check the connection or replace monitor assembly.
3	Control panel can be powered	The signal cable of monitor is not connected well.	Check the connection.

	normally; The color of some mode key turns on orange. Warns "No Signal"; Display indicator is yellow.		
4	Control panel can be powered normally and no key indicator turns on orange. Warns "No Signal"; PC LCDS indicator on IO panel is off. Display indicator is yellow.	No signal input, the malfunction may be on CPU module.	Replace CPU module to confirm the malfunction.

## 13.8 ECG Module Related Troubleshooting

### 13.8.1 Module or Board Related

No.	Descriptions	Remarks
1	ECG board	
2	Digital board assembly	

### 13.8.2 Key Points Supporting Troubleshooting

No.	Key Points Supporting Troubleshooting	Remarks
1	ECG waveform characteristic	

### 13.8.3 ECG module Related Troubleshooting

No.	Failure Description	Cause Analysis	Measure
1	ECG related function can't be opened.	ECG function can't be opened, this means ECG port serial port communication is abnormal. The malfunction may be on the ECG cable, or on the ECG module, or on the Digital board ECG serial port related circuit. Generally speaking, ECG module malfunction possibility is big.	Check the ECG cable and Replace ECG module or Digital board assembly to find the reason.
2	Open the corresponding function, and the waveform is displayed as a line or the waveform is abnormal.	ECG leads are abnormal or ECG module is abnormal.	Replace ECG leads or ECG module to find the reason.





# Appendix A Electrical Safety

## Inspection

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

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

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

# ELECTRICAL SAFETY INSPECTION

## 1- Power Cord Plug

### TEST PROCEDURE

#### ◆ The Power Plug

The Power Plug Pins	No broken or bent pin. No discolored pins.
The Plug Body	No physical damage to the plug body.
The Strain Relief	No physical damage to the strain relief. No plug warmth for device in use.
The Power Plug	No loose connections.

#### ◆ The Power Cord

The Power Cord	No physical damage to the cord. No deterioration to the cord. --For devices with detachable power cords, inspect the connection at the device. --For devices with non-detachable power cords, inspect the strain relief at the device.
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# ELECTRICAL SAFETY INSPECTION

## 2- Device Enclosure And Accessories

### TEST PROCEDURE

#### ◆ Visual Inspection

The Enclosure and Accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No physical damage to probe head (e.g., crack)
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

#### ◆ Contextual Inspection

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

# ELECTRICAL SAFETY INSPECTION

## 3- Device Labeling

### TEST PROCEDURE

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

- *Main Unit Label*
- *Integrated Warning Labels*
- *Slope and High Voltage Caution Label*
- *Don't Stress Label*



# ELECTRICAL SAFETY INSPECTION

## 4- Protective Earth Resistance

### VOERVIEW

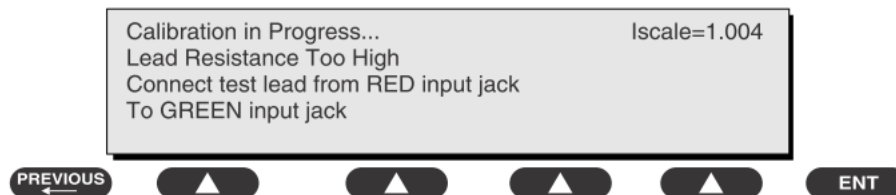
Protective Earth Resistance is measured using the RED test lead attached to the DUT Protective Earth terminal or Protective Earth Metal enclosure or equipotential terminal. Select the test current by pressing SOFT KEY 3 to toggle between 1AMP, 10AMP, and 25AMP. The front panel outlet power is turned off for this test.

The following conditions apply: L1 and L2 Open.

### TEST PROCEDURE

#### ◆ Prepare

- 1) First select the test current that will be used for performing the Protective Earth Resistance test by pressing AMPERES (SOFT KEY 3).
- 2) Connect the test lead(s) between the RED input jack and the GREEN input jack.
- 3) Press CAL LEADS. The 601PRO will measure the lead resistance, and if less than 0.150 Ohms, it will store the reading and subtract it from all earth resistance readings taken at the calibrated current.



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

#### ◆ Warning

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

#### ◆ Perform the Test

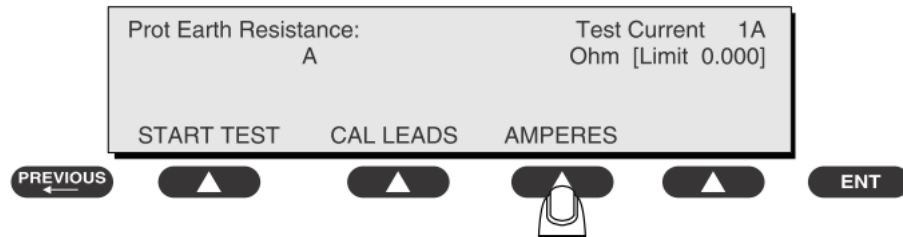
- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet.
- 2) Attach the 601PRO RED input lead to the device's Protective Earth terminal or an exposed

# ELECTRICAL SAFETY INSPECTION

## 4- Protective Earth Resistance

metal area.

- 3) Press shortcut key 3. The Protective Earth Resistance test is displayed.
- 4) Press SOFT KEY 3 to select a test current (1AMP, 10AMP, or 25AMP). The selected test current is displayed in the upper right corner of the display.



- 5) Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.
- 6) Press the print data key at any time to generate a printout of the latest measurement(s).

### ◆ Note

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

### ◆ Failure

Once it reaches the limitation, stop using equipment. Check the protective earth connection between Protective Earth terminal and Protective Earth Metal enclosure and equipotential terminal; Retest and inform the Customer Service Engineer for analysis and disposal if still fail.

### LIMITS

ALL COUNTRIES R = 0.2Ω Maximum

# ELECTRICAL SAFETY INSPECTION

## 5- Earth Leakage Test

### OVERVIEW

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

Leakage current is measured the following ways:

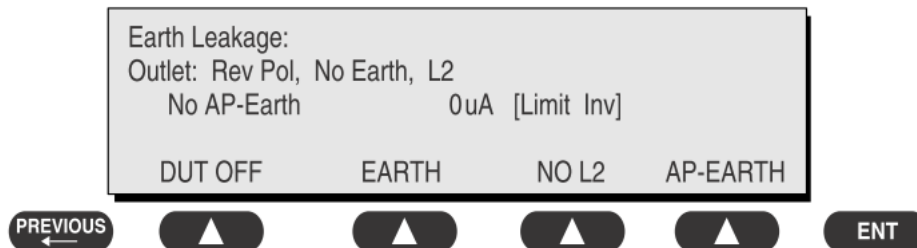
- ◆ Earth Leakage Current, leakage current measured through DUT outlet Earth
- ◆ Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

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

### TEST PROCEDURE

#### ◆ Perform the Test

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the device's applied parts to the 601PRO applied part terminals if applicable.
- 3) Press shortcut key 4. The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
  - SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
  - SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
  - SOFT KEY 4 toggles the AP to Earth to No AP to Earth.
- 4) Press the print data key at any time to generate a printout of the latest measurement.

# ELECTRICAL SAFETY INSPECTION

## 5- Earth Leakage Test

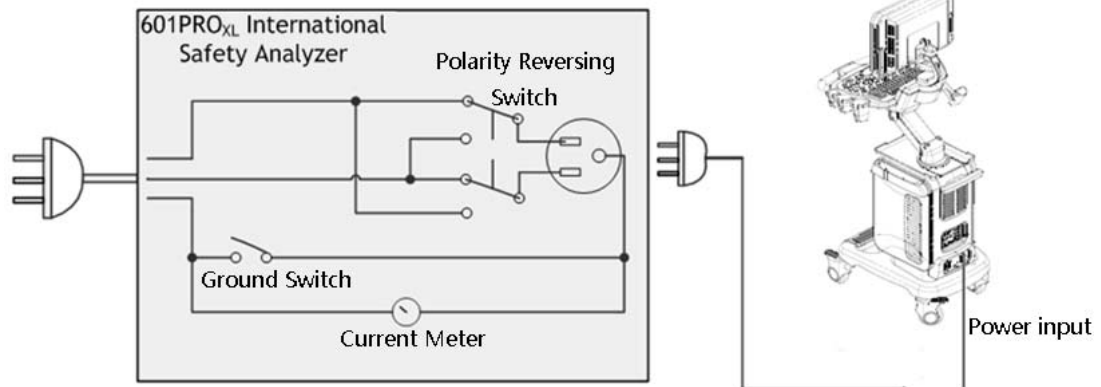


Figure 1 Earth leakage test

### ◆ Failure

Check any short-circuits of the Y capacitor on power unit. Replace a new one if any portion defective.

Check any broken of the Power Unit. Replace a new one if any portion defective.

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

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

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

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

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

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

### LIMITS

UL60601-1:	300 $\mu$ A Normal Condition
	1000 $\mu$ A Single Fault Condition
IEC60601-1.:	500 $\mu$ A Normal Condition
	1000 $\mu$ A Single Fault Condition

# ELECTRICAL SAFETY INSPECTION

## 6- Patient Leakage Current

### OVERVIEW

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

### TEST PROCEDURE

#### ◆ Prepare

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

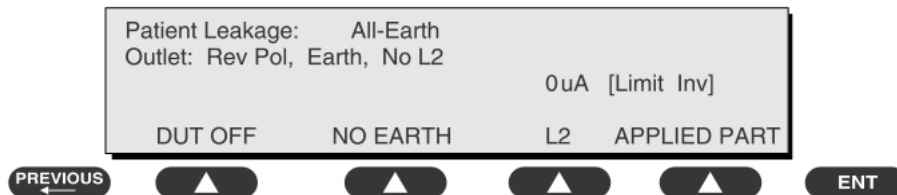
Normal Polarity, Earth Open, Outlet ON	Normal Polarity, Outlet ON
Normal Polarity, L2 Open, Outlet ON	Reversed Polarity, Outlet ON
Reversed Polarity, Earth Open, Outlet ON	Reversed Polarity, L2 Open, Outlet ON

#### ◆ Warning

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

#### ◆ Perform the Test

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the applied parts to the 601PRO's applied part terminals.
- 3) Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.



- 4) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.
- 5) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the

# ELECTRICAL SAFETY INSPECTION

## 6- Patient Leakage Current

601PRO.

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

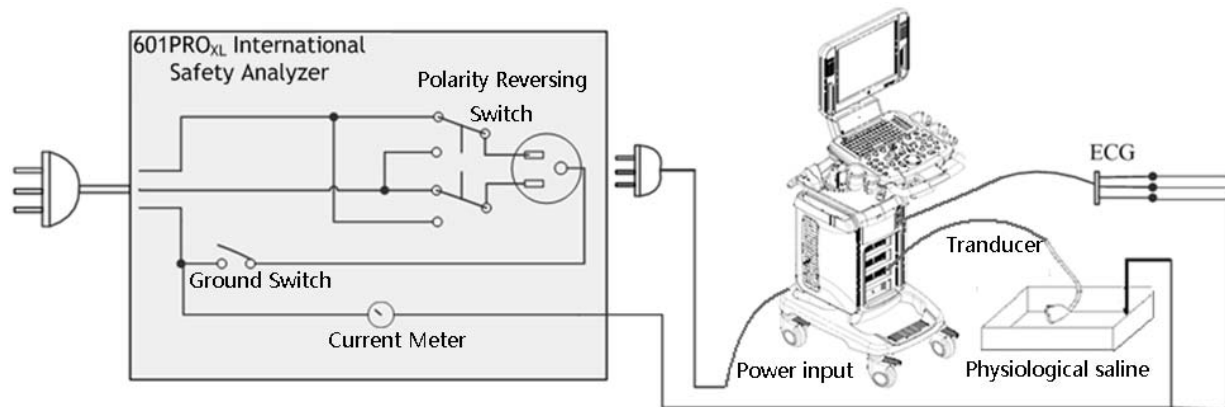


Figure 2 patient leakage Current

### ◆ Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

2, If the current test standard being used does not include Patient Leakage DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections. Refer to Chapter 8, Standards and Principles.

### ◆ Failure

Check any broken of the Applied parts. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

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

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

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

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

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

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

### LIMITS

# ELECTRICAL SAFETY INSPECTION

## 6- Patient Leakage Current

All countries

For BF ECG input and transducer

100 $\mu$ A Normal Condition

500 $\mu$ A Single Fault Condition

# ELECTRICAL SAFETY INSPECTION

## 7- Mains on Applied Part Leakage

### OVERVIEW

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

The following outlet conditions apply when performing the Mains on Applied Part test.

Normal Polarity;

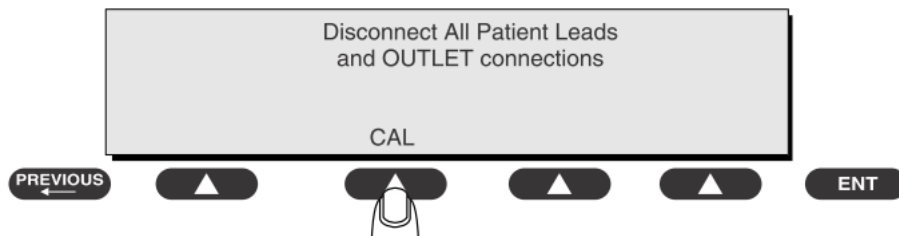
Reversed Polarity

### TEST PROCEDURE

#### ◆ Prepare

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

- 1) Disconnect ALL patient leads, test leads, and DUT outlet connections.
- 2) Press CAL to begin calibration, as shown:



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

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

#### ◆ Warning

- 1) A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.
- 2) High voltage is present at applied part terminals while measurements are being taken.

#### ◆ Performance

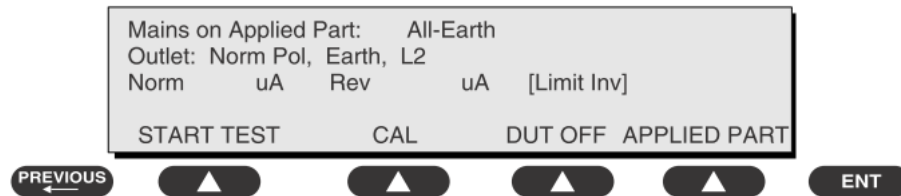
- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601



# ELECTRICAL SAFETY INSPECTION

## 7- Mains on Applied Part Leakage

- 2) Attach the applied parts to the 601PRO applied part terminals.
- 3) Attach the red terminal lead to a conductive part on the DUT enclosure.
- 4) Press shortcut key 7. The Mains on Applied Part test is displayed.



- 5) Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:
- 6) Press START TEST (SOFT KEY 1) to begin the test.
- 7) Press the print data key to generate a printout of the latest measurement.

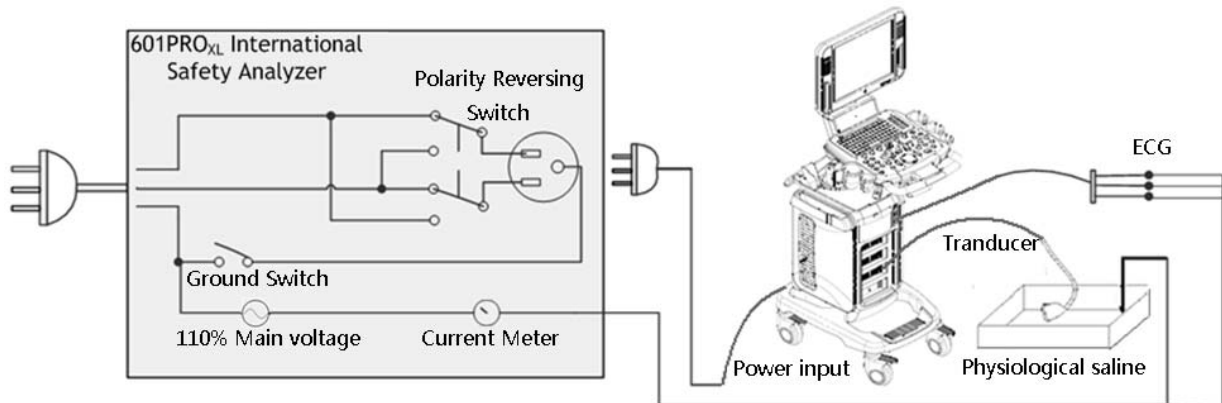


Figure 3 Mains on Applied part leakage

### ◆ Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

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

### ◆ Failure

Check any broken of the Applied part. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

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

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user

## ELECTRICAL SAFETY INSPECTION

### 7- Mains on Applied Part Leakage

or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

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

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

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

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

### LIMITS

All countries:

For BF ECG input and transducer:

5000 $\mu$ A

# ELECTRICAL SAFETY INSPECTION

## 8- Patient Auxiliary Current

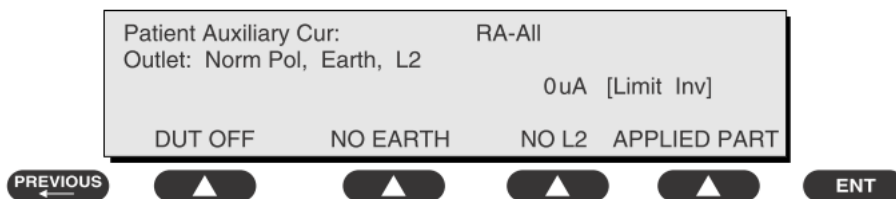
### overview

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

### TEST PROCEDURE

#### ◆ Prepare

- 1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
- 2) Attach the patient leads to the 601PRO ECG jacks.
- 3) Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).
- 4) Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.



- 5) Press SOFT KEYS 1-4 to select leakage tests
- 6) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
- 7) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
- 8) Press the print data key at any time to generate a printout of the latest measurement.

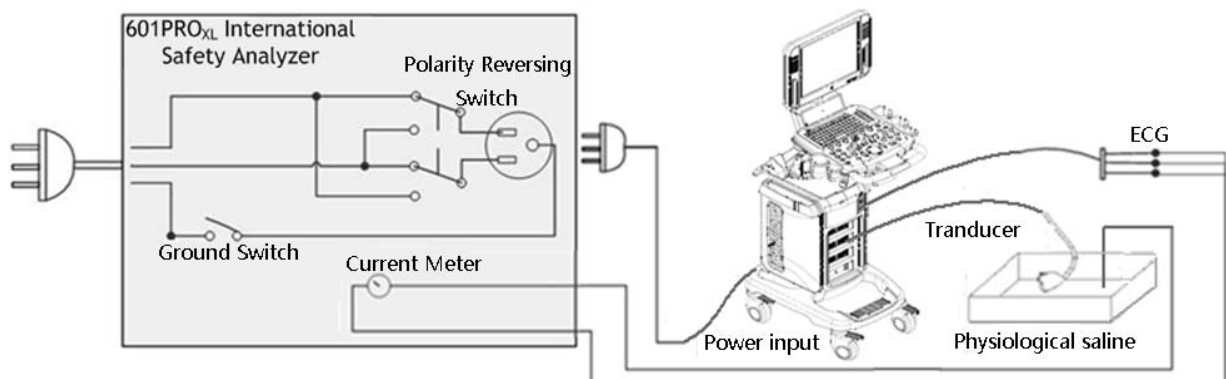


Figure 4 patient Auxiliary Current

# ELECTRICAL SAFETY INSPECTION

## 8- Patient Auxiliary Current

### ◆ Note

If the current test standard being used does not include Patient Auxiliary Current DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections.

### ◆ Failure

Check any broken of the AC cable. Replace a new one if any portion defective.

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

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

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

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

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

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

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

### LIMITS

All countries

For BF ECG input and transducer

100 $\mu$ A Normal Condition

500 $\mu$ A Single Fault Condition

# ELECTRICAL SAFETY INSPECTION FORM

( Class I equipment )

**Overall assessment:**

- Scheduled inspection Test item: 1, 2, 3
- Unopened repair type Test item: 1, 2, 3
- Opened repair type, not modify the power part Test item: 1, 2, 3, 4, 5  
including transformer or patient circuit board
- Opened repair type, modify the power part Test item: 1, 2, 3, 4, 5, 6, 7, 8  
including transformer or patient circuit board

<b>Location:</b>			<b>Technician:</b>		
<b>Equipment:</b>			<b>Control Number:</b>		
<b>Manufacturer:</b>		<b>Model:</b>		<b>SN:</b>	
<b>Measurement equipment /SN:</b>				<b>Date of Calibration:</b>	
<b>Inspection and Testing</b>				<b>Pass/Fail</b>	<b>Limit</b>
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	___μA		Max: NC: 300μA(refer to UL60601-1) * NC: 500μA(refer to IEC60601-1) * SFC: 1000μA
		Single Fault condition(SFC)	___μA		
6	Patient Leakage Current	Normal condition(NC)	<input type="checkbox"/> BF ___μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	<input type="checkbox"/> BF ___μA		
7	Mains on Applied Part Leakage		<input type="checkbox"/> BF ___μA		Max: BF applied part: 5000μA
8	Patient Auxliary Leakage Current	Normal condition(NC)	<input type="checkbox"/> BF ___μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	<input type="checkbox"/> BF ___μA		

**Note:**

**The equipment which sell to America shall comply with the requirement of UL60601-1, others shall comply with the requirement of IEC60601-1.**

Name/ Signature: \_\_\_\_\_

Date: \_\_\_\_\_



# Appendix B Phantom Usage

## Illustration

Targets Disposal of Phantom KS107BD

A1—A5: Axial resolution target group B: Blind-area target group

C: Longitudinal target group D: Horizontal target group

E: Mimic tumor F: Mimic sac (diam 10mm) and stone

G Mimic sac (diam 6mm)

### 4. Line Target System

There are 8 groups of nylon line targets disposed as shown in the figure.

#### 1. A1—A5:

Axial and lateral resolution target group. The distances between the horizontal branch and the acoustic window are 30, 50, 70, 120 and 160mm, the center horizontal distances between two adjacent lines of A1 and A2 groups are 1, 5, 4, 3, 2mm, A3~A5 groups are 5, 4, 3, 2mm. The center longitudinal distances between two adjacent lines of the longitudinal branches are 4, 3, 2, 1mm.

#### 2. B:

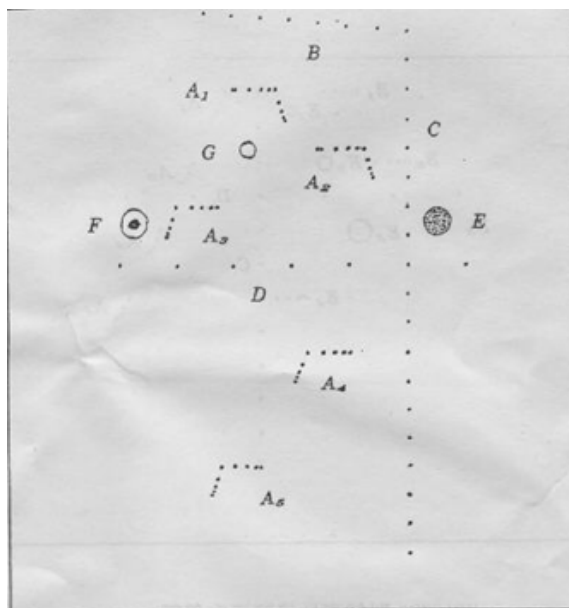
Blind-area target group. Center horizontal distance of adjacent lines is 10mm, distances to the acoustic window are 10, 9, 8, 7, 6, 5, 4, 3mm.

#### 3. C:

Longitudinal target group. 19 target lines with a 10mm center distance between adjacent lines.

#### 4. D:

Horizontal target group. 7 target lines with a 20mm center distance between adjacent lines.



## Targets disposal- KS107BD

- A1—A4 Axial resolution target group
- B1—B4 Lateral resolution target group
- C Longitudinal target group
- D Horizontal target group
- E1—E3 Mimic sacs with diameters of 2, 4, 6mm

### 4. Line Target System

There are 8 groups of line targets disposed in TM material as shown in the figure.

#### 1. A1—A4:

Axial resolution target group. The upmost lines in each target locate at the depth of 10, 30, 50, 70mm, the center longitudinal distances of each group (from the top down) are 3, 2, 1, 0.5mm, and the horizontal distance is 1mm.

#### 2. B1—B4:

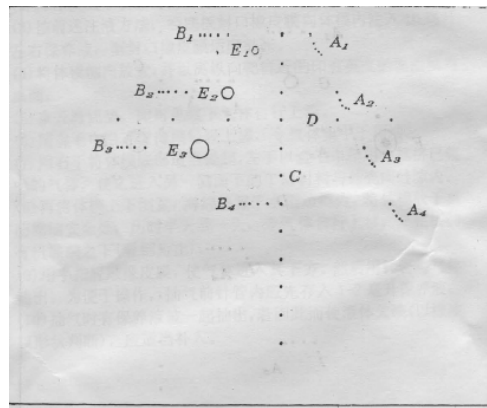
Lateral resolution target group. Locate at a depth of 10, 30, 50, 70mm, with a center horizontal distance of 4, 3, 2, 1mm in each group.

#### 3. C:

Longitudinal target group. 12 target lines with a 10mm center distance between adjacent lines.

#### 4. D:

Horizontal target group. Locate at a depth of 40mm, with a 20mm center distance between adjacent lines.





# Appendix C Requirements of Performance Indices

Probe model	3C5A	6C2	L14-6	L12-4	7LT4
Frequency(MHz)	3.5	6.5	10	7.5	7.5
Lateral resolution (mm)	$\leq 1$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 40$ )	$\leq 1$ (depth $\leq 40$ )	$\leq 1$ (depth $\leq 60$ )	$\leq 1$ (depth $\leq 60$ )
	$\leq 2$ (80<depth $\leq 130$ )				
Axial resolution (mm)	$\leq 1$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 60$ )	$\leq 0.5$ (depth $\leq 40$ )	$\leq 0.5$ (depth $\leq 80$ )	$\leq 0.5$ (depth $\leq 80$ )
	$\leq 2$ (80<depth $\leq 130$ )				
Blind area (mm)	$\leq 3$	$\leq 3$	$\leq 2$	$\leq 2$	$\leq 2$
Detection depth (mm)	$\geq 180$	$\geq 80$	$\geq 60$	$\geq 80$	$\geq 80$
Geometric positioning accuracy %	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$

Probe model	7L4A	2P2	6CV1	D6-2
Frequency(MHz)	7.5	2.5	6.5	4
Lateral resolution (mm)	$\leq 1$ (depth $\leq 60$ )	$\leq 3$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 40$ )	$\leq 2$ (depth $\leq 60$ )
		$\leq 4$ (80<depth $\leq 160$ )		
Axial resolution (mm)	$\leq 0.5$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 60$ )	$\leq 1$ (depth $\leq 80$ )
		$\leq 2$ (80<depth $\leq 170$ )		
Blind area (mm)	$\leq 2$	$\leq 3$	$\leq 3$	$\leq 3$
Detection depth (mm)	$\geq 80$	$\geq 180$	$\geq 80$	$\geq 140$
Geometric positioning accuracy %	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$
Probe model	7L5	L7-3	6LE7	6LB7
Frequency(MHz)	7.5	5	6.5	6.5
Lateral resolution (mm)	$\leq 1$ (depth $\leq 60$ )	$\leq 1$ (depth $\leq 60$ )	$\leq 1$ (depth $\leq 60$ )	convex : $\leq 1$ (depth $\leq 40$ )
				linear : $\leq 1$ (depth $\leq 60$ )
Axial resolution (mm)	$\leq 0.5$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 80$ )	$\leq 1$ (depth $\leq 80$ )	convex : $\leq 1$ (depth $\leq 60$ )
				linear : $\leq 1$ (depth $\leq 80$ )
Blind area (mm)	$\leq 2$	$\leq 2$	$\leq 2$	Convex : $\leq 3$ linear : $\leq 2$
Detection depth (mm)	$\geq 80$	$\geq 120$	$\geq 80$	$\geq 80$
Geometric positioning accuracy %	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$	lateral $\leq 3$ Longitudinal $\leq 3$



