M9/M9T/M9CV/M9GI/M9Vet/
M8/M8CV/M8T/M8GI/M8 Elite

Diagnostic Ultrasound System

Service Manual（Advanced）

Revision 23.0

Table of Contents

Version Information

Mindray may revise this publication from time to time without written notice. The detailed information is shown below:

Version	Release Date	Reason for Revision
1.0	2013.12.30	Initial release
2.0	2014.1.27	Add the picture of field replaceable unit in Chapter 7.1; Change the order number of the speaker and cable in Chapter 7.1; Change the disassembly method of the shield cover of PHV board in Chapter 8.2.10
3.0	2014.3.19	Add the precaution of the disassembly of the CPU assembly; Update the content of the appendix C.1.25
4.0	2014.6.12	Update figures in chapter 8.2.7 since a pressure plate is added for ECG cable; Update contents of Z0501 in appendix C.1.25
5.0	2014.9.24	Change FRU materual No. in Chapter 7; Change iStorage screen picture in section 3.5.5.1; Add section 3.5.6 Network Configure; Add in "4-protective grounding impedance" testing applies to M9 portable system with UMT-500Plus trolley (with power supply) only in Appendix A.
6.0	2015.2.15	Add SONY UP-D898MD, UP-X898MD printers in chapter 2.1.4 along with compatibility description.
7.0	2015.5	Section 7.1, add the part number of main board and SSD card used for CE M9GI; Section 7.1, change the picture of SSD card; Section C.1.27, change the picture of keyboard testing; Add M9GI product model
8.0	2015.8	Section 3.5, add the wired network connection information.
11.0	2016.4.7	Section 7, change the wired network connection information.
12.0	2016.5.20	Section 7, the modification of the FRU.
13.0	2016.8.9	Update the labels in 1.2.2.
14.0	2017.1	Add M9Vet model. Add 4D and TEE related self-test items in C.1.16 – C.1.19 chapter Update trolley probe holder part number and add part number of intracavity probe holder in 7.2 chapter Add assembly/disassembly descriptions in 8.3.9 – 8.3.11 for probe holders.
15.0	2017.6	Update Monitor Assembly(eDP screen/FRU), Monitor Assembly(LVDS2eDP/FRU), CPU Module(6100 PC module/eDP output/FRU), CPU Module(6100 PC module/LVDS output/FRU), M9

		Main Board(eDP output+M.2 port WiFi/FRU), M9 Main Board(M9GI/eDP output+M.2 port WiFi/FRU), Wireless net adapter(M.2 port), iDock51 Audio/Video Extend Module, SSD card FRU, Monitor front cover assembly FRU, control panel assembly FRU in chapter 7.1. Update Audio/Video extend module FRU in chapter 9.2.
16.0	2017.9	Add the FRU number of Russian keyboard.
17.0	2017.12	Change the FRU number of TR64 board in chapter 7.1.
18.0	2017.06	1. Add M8 series product models. 2. Add FRUs. 3. Add anti-virus, Q-Path, EAP network.
19.0	2018.09	1. Update the unpacking information in section 3.2 2. Update th screw type in section 8.3.3
20.0	2018.10	1. Add the lithium-ion Battery FRU 2. Modify the screwdriver size.
21.0	2019.01	Change the FRU number of Small keyboard assembly(FRU) in chapter 7.1.
22.0	2019.7	Change DS6707 to DS4308 in Chapter 2.1.4. Change the FRU number of Main Board, Control panel assembly (FRU) and Silicon keypad in chapter 7.1.
23.0	2019.09	Change the FRU number of Control Panel Assembly and PC Keyboard in chapter 7.1.

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Descriptions Committed

The following marks are used for describing keys on the control panel, menu items, buttons on dialog boxes and other basic operations in the manual:

- <Button>: the angle bracket for enclosing the button's name refers to the buttons on the keyboard, rotation knobs, switches or controls.
- [Menu item or key]: the square bracket for enclosing menu item or key refers to the menu items or the keys on dialog boxes.
- Click [Menu item or key]: move the cursor to the menu item or the key on the dialog box, and then press <Set>. Or, click other optional keys on touch screen.
- [Menu item]-[Sub-menu item]: select sub-menu item based on the operation path

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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 service 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 be aware of the meaning of the signal words before reading this manual.

Signal word	Description
⚠**DANGER**	**Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**
⚠**WARNING**	**Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.**
⚠**CAUTION**	**Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.**
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.
Description	Important information that helps you to use the system more effectively.

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	Description	Position
🧍	Type-BF applied part Note: The ultrasound probes connected to this system are type-BF applied parts. The ECG module connected to this system is Type-BF applied part.	Right side of main unit
⚠	Caution	Main unit

1.2.2　Warning Labels

No.	Warning Labels	Description	Label Position
1.		Read the manual carefully before using the system.	On the upper left corner of the control panel
2.	The following labels are available when the system works with the mobile trolley. 	a. Do not place the system 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. b. Do not sit on the system. c. DO NOT push the system when the casters are locked.	On the left part of the trolley panel
3		Non-ionizing radiation	On the bottom part of the ultrasound system

1.2.3　General Symbols

This symbols used in the device are listed in the following table. Meanings are:

No.	Symbol	Description
1		Type-BF applied part
2		To avoid safety accidents, refer to relevant content in the manual.
3		Dangerous voltage
4		No user serviceable parts (applied to the power adapter)
5		Indoor, dry location use only (applied to the power adapter)
6	⊙/Ò	Power button
7		Probe sockets
8		USB port
9		S-VIDEO signal port; VIDEO signal port
10	∼	AC (Alternating current)
11		Battery Status Indicator

No.	Symbol	Description
12		Pencil probe port (reserved)
13		IO extend port
14		unlocked symbol
15		locked symbol
16		Battery installation position indicator
17	IOIOI	Connects serial port devices
18	ECG IOIOI	ECG function
19	DVI-I	Connects a display monitor or projector
20		Audio signal
21		Microphone input jack
22		Remote control port
23	SN	Product serial number
24		Manufacture date
25	CE_{0123}	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.
26		The environment-protective application period of the system is 20 years period.
27		Standby

1.3   Safety Precautions

Please read the following precautions carefully to ensure the safety of the patient and the operator when using the probes.

⚠DANGER： **Do not operate this system in an atmosphere containing flammable or explosive gases such as anesthetic gases, oxygen, and hydrogen or explosive fluid such as ethanol because an explosion may occur.**

1.3.1 Electric Safety

⚠WARNING:	1.	Connect the power plug of this system and power plugs of the peripherals to wall receptacles that meet the ratings indicated on the rating nameplate. Using a multifunctional receptacle may affect the system grounding performance, and cause the leakage current to exceed safety requirements. Use the power cord accompanied with the system provided by Mindray.
	2.	Disconnect the AC power before you clean or uninstall the ultrasound machine, otherwise, electric shock may result.
	3.	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.
	4.	In maintenance or assembly/disassembly, make sure other cables are connected well before the battery connecting cable is connected, otherwise the system may be damaged due to hot-plug.
	5.	Do not use this system simultaneously with equipment such as an electrosurgical unit, high-frequency therapy equipment, or a defibrillator, etc.; otherwise electric shock may result.
	6.	This system is not water-proof. If any water is sprayed on or into the system, electric shock may result.

⚠CAUTION:	1.	DO NOT connect or disconnect the system's power cord or its accessories (e.g., a printer or a recorder) without turning OFF the power first. This may damage the system and its accessories or cause electric shock.
	2.	Avoid electromagnetic radiation when perform performance test on the ultrasound system.
	3.	In an electrostatic sensitive environment, don't touch the device directly. Please wear electrostatic protecting gloves if necessary.
	4.	You should use the ECG leads provided with the ECG module. Otherwise it may result in electric shock.5. Maximum output power of the trolley is 240 VA.

1.3.2   Mechanical Safety

⚠WARNING:	1.	When moving the system, you should first power off the system, fold the LCD display, disconnect the system from other devices (including probes) and disconnect the system from the power supply.
	2.	Do not subject the transducers to knocks or drops. Use of a defective probe may cause electric shock to the patient.

⚠CAUTION:	1.	Do not expose the system to excessive vibration (during the transportation) to avoid device dropping, collision, or mechanical damage.
	2.	When you place the system on the mobile trolley and move them together, you must secure all objects on the mobile trolley to prevent them from falling. Otherwise you should separate the system from the mobile trolley and move them individually. When you have to move the system with the mobile trolley upward or downward the stairs, you must separate them first and then move them individually.
	3.	Do not move the ultrasound system if the HDD indicator is green, sudden shake may cause the HDD in damage.4 When moving the trolley with mounted system, please take care of the connector of the power adapter in case of damage.

1.3.3   Personnel Safety

Note:	1.	The user is not allowed to open the covers and panel of the system, neither device disassemble is allowed.
	2.	To ensure the system performance and safety, only Mindray engineers or engineers authorized by Mindray can perform maintenance.
	3.	Only technical professionals from Mindray or engineers authorized by Mindray after training can perform maintenance.

1.3.4   Others

Note:	For detailed operation and other information about the ultrasound system, please refer to the operator's manual.

2   Product Specifications

2.1   Introduction

2.1.1   Intended Use

The diagnostic ultrasound system is intended for use in clinical ultrasonic diagnosis.

2.1.2   System Appearance

No.	Name	Function
1	Monitor	Displays the images and parameters during the scan.
2	Control Panel	Operator-system interface or control
3	Handle	Used for carrying the system
4	Power input port 19V ===7.9A (Max.)	Connects the power adapter
5	HDMI port	Outputs high definition multimedia signals
6	USB port•⟷	Connects USB devices (2 ports)
7	ECG port	Connects ECG lead or DC-IN cable
8	Probe port ⩣	Connects a probe to the main unit; or connects a probe extend module
9	Probe locking lever	Locks or unlocks the probe connected with the main unit 🔒：locked symbol 🔓：unlocked symbol
10	Pencil probe port	Connects to a pencil probe.

2.1.2.1   Extend Modules

Extend modules to the system are: probe extend module, video/audio extend module.

■   Probe extend module
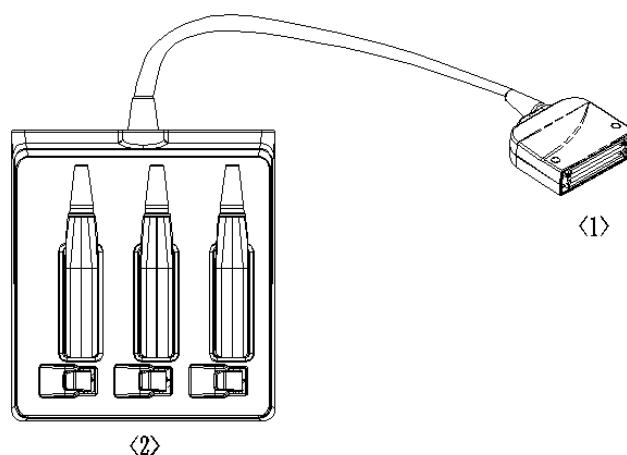
No.	Name	Function
<1>	Connector	Connects to the probe port of the main unit, and extends the probe port to three.
<2>	Probe port	To extend ports for connecting probes
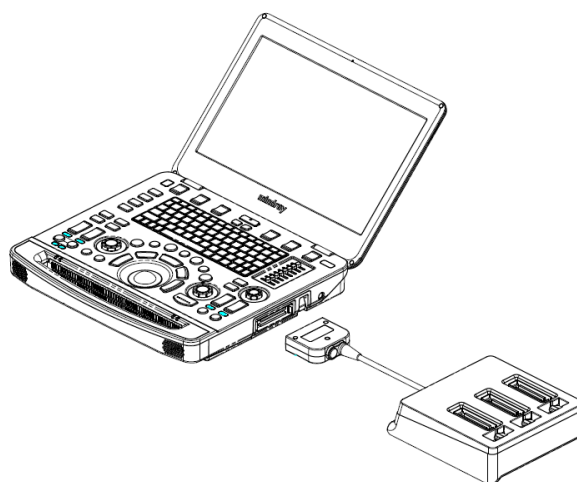
Note:	1.	Perform the plug and unplug of the probe module. To reduce the wastage of probe module, the operation should be conducted under frozen status of the system.
	2.	If you use the probe extend module to connect a probe, the image quality may be degraded.

■ Audio/Video extend module

➢ Panel introduction
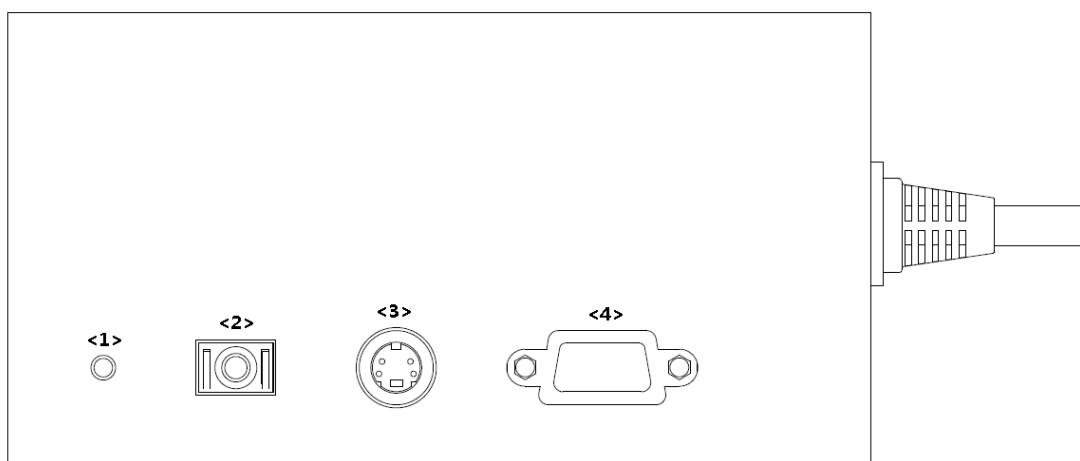
No.	Symbol	Function
<1>	Indicator	Used for connecting to main unit. The green indicator is on.
<2>	◯→	Used for audio signal output.
<3>	◯→	Used for separate video output.
<4>	VGA ▯◯▯◯→	VGA signal output

➢ Connection

Connect the V/A extend module to the main unit via an HDMI port. As shown in the following figure.
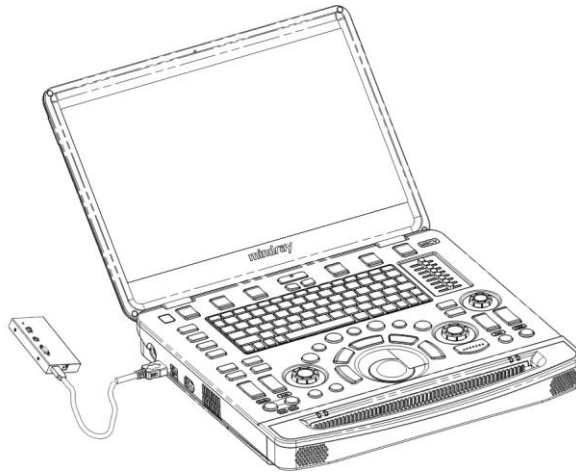
2.1.2.2   Control Panel

No.	Name	English Name	Description
1.	B mode button	B	Press to enter B mode
2.	P mode button	P	Press to enter Power mode.
3.	C mode button	C	Press to enter the Color mode.
4.	CW mode button	CW	Press to enter CW mode.
5.	PW mode button	PW	Press to enter the PW mode.
6.	TDI Functional buttons	TDI	Press to enter TDI mode
7.	M mode button	M	Press to enter the M mode.
8.	Update button	Update	Switching key: Press to change the currently active window. Start or end capturing the image in iScape
9.	Measure button	Measure	Press to enter/exit application measurement
10.	Caliper button	Caliper	Press to enter/exit general measurement
11.	Trackball	/	To move the cursor.
12.	Confirm key (left<Set> key)	/	Press to confirm key
13.	Confirm key (right <Set> key)	/	
14.	Angle adjustment and quick angle knob	Angle	Adjust the angle
15.	Gain and iTouch knob	iTouch	Adjust the gain of the image in various modes Press to enter iTouch mode
16.	Cine button	Cine	Press to enter/ exit the Cine Review status.

No.	Name	English Name	Description
17.	Clear button	Clear	Press to clear off the comments or measurement calipers on the screen.
18.	Freeze button	Freeze	Press to freeze or defreeze the image.
19.	Power button	/	Power button
20.	Soft menu adjustment button 1	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
21.	Soft menu adjustment button 2	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
22.	Soft menu adjustment button 3	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
23.	Soft menu page up button	/	Press to turn the soft menu pages upward.
24.	Soft menu page down button	/	Press to turn soft menu pages downward.
25.	Soft menu display mode switch button	/	Press to switch the mode for the soft menu.
26.	Soft menu adjustment button 4	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
27.	Soft menu adjustment button 5	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
28.	Soft menu adjustment button 6	/	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
29.	Patient information button	Patient	Press to enter the Patient information screen.
30.	Probe/exam mode switch button	Probe/Exam	Press to switch probe and exam mode
31.	Image review button	Review	Press to review the stored images.
32.	End exam button	End Exam	Press to end an exam.
33.	User-defined key 3	P3	User-defined key
34.	User-defined key 2	P2	User-defined key
35.	Body mark button	Body Mark	Press to enter/ exit the body mark mode.

2-6 Product Specifications

No.	Name	English Name	Description
36.	Cursor button	Cursor	Press to show/hide the cursor
37.	Baseline position adjustment button and auxiliary interface	Baseline	Adjust the baseline parameter.
38.	Scale adjustment button and auxiliary interface	Scale	Adjust scale parameter.
39.	Steer/Invert adjustment button	Steer/Invert	Adjust steer/invert parameter.
40.	TGC and functional interface	/	Move to adjust depth gain compensation.
41.	Single-window button	Single	Press to enter active window in Dual or Quad mode.
42.	Dual-split window button	Dual	Press to enter the Dual mode from another mode; Press to switch between the two windows in the Dual mode.
43.	Image zoom and spot/pan zoom switch knob.	Zoom	Press to enter or exit zoom status.
44.	Depth adjustment button and fictional interface	Depth	Adjust depth
45.	Focus position adjustment button and functional interface	Focus Position	Adjust the focus position.
46.	Save static image button	Save1	Press to save the image; user-defined key.
47.	User-defined key 1	P1	User-defined key
48.	Standby status indicator	/	Standby indicator Standby: blinking in orange Other status: light off
49.	Hard disk read indicator	/	Hard disk status indicator The indicator blinks in green when hard disk is running. The indicator is off on the other status. DO NOT move the machine when the indicator blinking in green. Otherwise the hard disk may be damaged by sudden shake.

No.	Name	English Name	Description
50.	Battery indicator	/	Battery status indicator. Charging status: It illuminates in orange when batteries are charging; It illuminates in green when batteries are charged to full capacity; Discharging status: It illuminates in green when batteries are charged fairly; It illuminates in orange when batteries run out.
51.	AC power indicator	/	AC indicator The indicator is green at AC supply. The indicator is off when batteries (AC does not supply the power) supplied.
52.	Esc	Esc	Cancel the operation or exit.
53.	On-line help	Help	Press to open or close the accompanying help documents.
54.	Patient data management system	iStation	Press to enter or exit patient information system.
55.	Report	Report	Open/ close the exam report.
56.	User-defined key 5-8	P5~P8	User-defined keys, functions of which can be defined in preset.
57.	Stress echo	Stress Echo	Press to enter Stress Echo mode
58.	Physiological signal	Physio	Press to enter or exit ECG.
59.	Setup	Setup	Press to enter/ exit setup.
60.	Biopsy	Biopsy	Press to enter biopsy
61.	Set home	Set Home	Set home of comments
62.	Quad-window display	Quad	Enter Quad mode in Non-Quad mode; Press to switch among interfaces in Quad mode.
63.	iZoom (Full-screen Zooming)	iZoom	Enter/switch/exit full-screen zoom status.
64.	Arrow	Arrow	Enter/exit the arrow comment status.
65.	Home	Home	Activate the Home function: return to start position of comment.
66.	Comments	Comment	Enter/exit the textual comment status.

No.	Name	English Name	Description
67.	Direction-control keys	/	Moves the cursor one letter each time; or, select the ambient one in a selectable area.
68.	User-defined key 4	P4	User-defined keys, functions of which can be defined in preset.
69.	Alphanumeric keys	/	Enter characters.

For functions of undefined buttons or keys, the user can define it on your own. Refer to *Operator manual* for details about function setting.

■ Functions of key combination

The system supports multi-language input; you can use the key combinations. The key combinations include <Shift>, <Alt Gr>, <Ctrl> and some alphabet keys.

● <Shift> combination key

<Shift> + key: input the upper left letter of the key.

For the alphabet keys (<A>~<Z>), press <Shift>+key to input the letter of different case with the current state.

● [Alt Gr] combination key

Combined with other letter keys, [Alt Gr] can be used for entering other languages.

Press [Alt Gr], and meanwhile press a letter key, the letter on the upper-right corner of the key can be entered.

● [Ctrl] combination key

In iStation or Review screen, use <Ctrl> and <Set> to select more than one patient.

The combination of <Ctrl> and <Space> can switch the input between Chinese and English.

● Combination key used together with [Fn] key

For those combination keys, press <Fn>+key to use the functions indicated with a frame on the key.

No.	Fn+	Name	Function
1.	→	End	Turn up the volume
2.	←	Home	Turn down the volume
3.	↑	Pg Up	Increase the brightness of the LCD display.
4.	↓	Pg Dn	Decrease the brightness of the LCD display.

2.1.3 Trolley Appearance
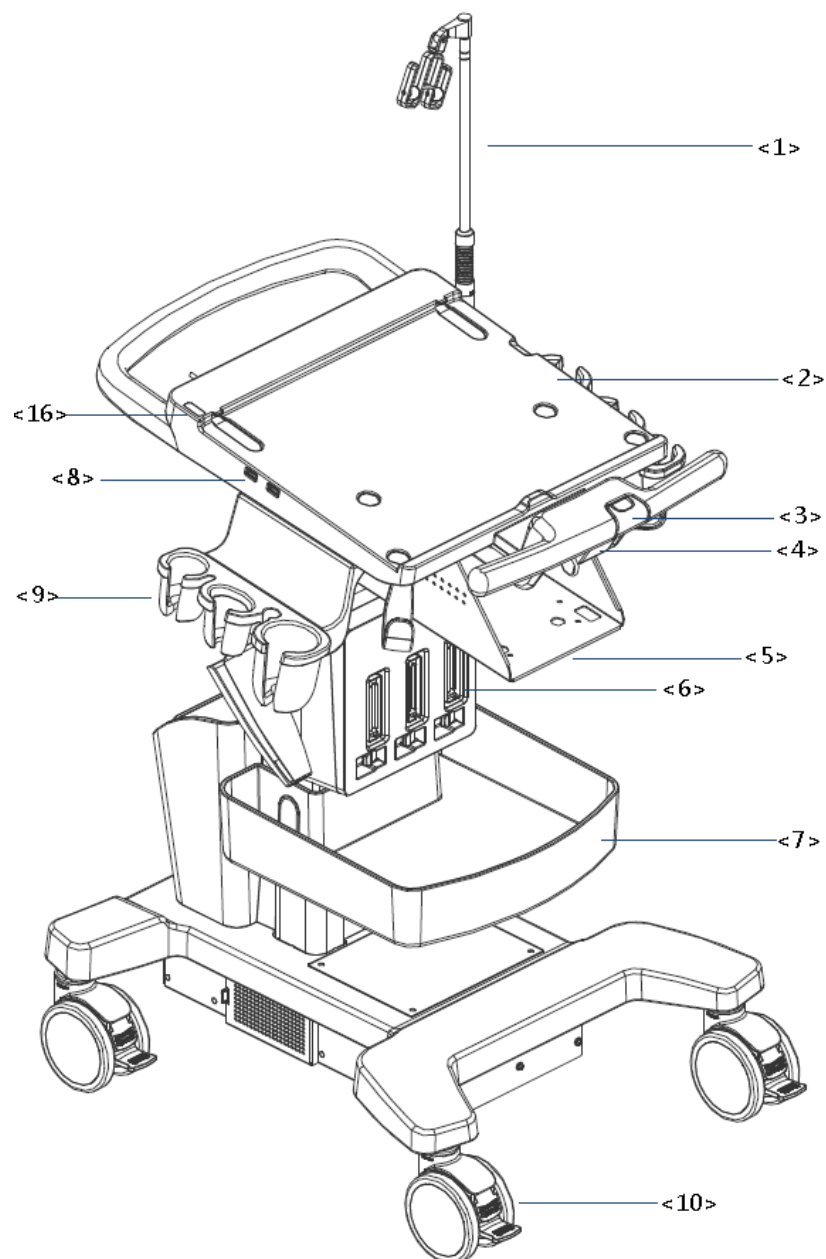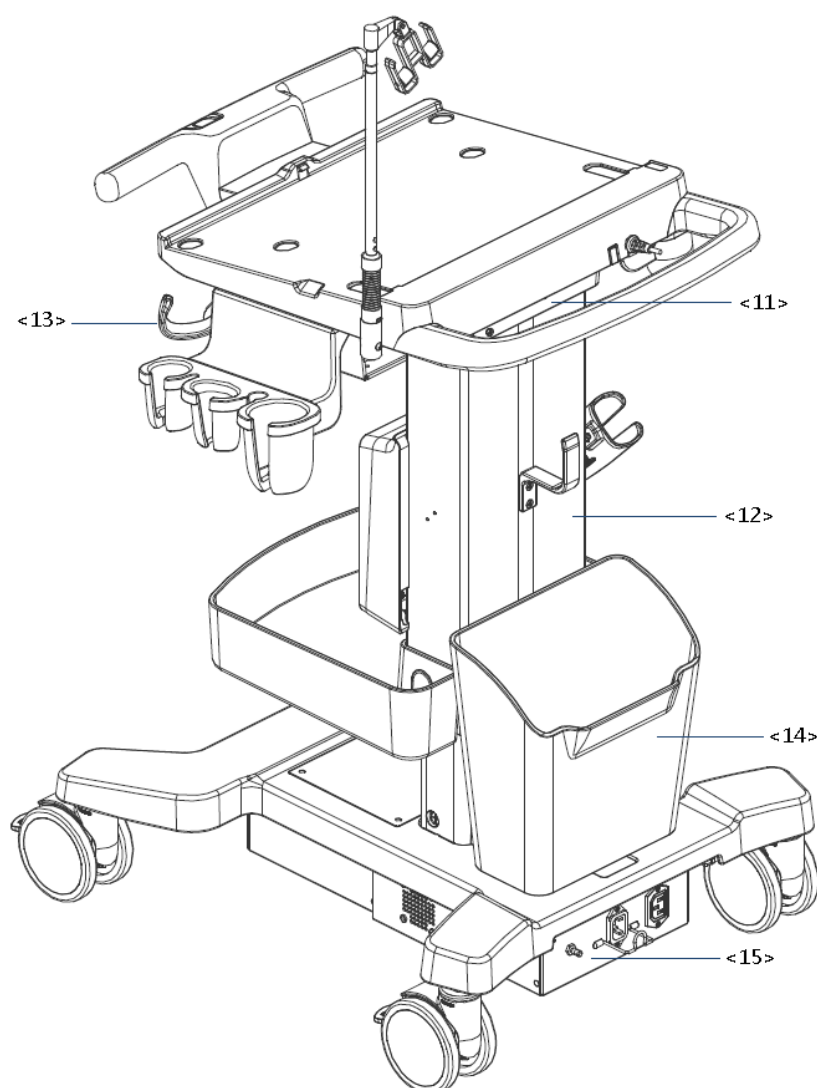
No.	Name	Function
<1>	Probe cable hook	Manage probe cable
<2>	Ultrasound main unit	Ultrasound system
<3>	Ascending/descending switch	Press to adjust the height of operation panel
<4>	Anti-theft setting	Used to fix the ultrasound system to the trolley.
<5>	Printer bracket	Used to place the printer
<6>	Probe extend module	Used to extend ports for connecting probes (optional)
<7>	Storage tray	Used to place the adaptor, gel and other stuff.
<8>	USB port	Connects USB devices (2 ports)
<9>	Probe holder	Used to place probes temporarily
<10>	Caster	Used for securing or moving the system Step on the second footswitch to lock the trolley. Step on the first footswitch to unlock the trolley.
<11>	Audio/video extender	Used to switch audio/video (optional)
<12>	Lifting column	Used to adjust the height of operation panel

No.	Name	Function
<13>	Moveable hook	Manage probe cable
<14>	Storage box	Used to place report or other stuff.
<15>	Power supply panel	Used to offer output/input port, equipotential terminal for power supply.
<16>	Indicator	⊟⊞ Battery indicator: ● It illuminates in orange when batteries are charging; ● It illuminates in green when batteries are in the charge. ● It illuminates in green when batteries are charged fairly; ● It illuminates in orange when batteries run out. ∿AC power indicator: ● The indicator is green at AC supply. The indicator is off when batteries (AC does not supply the power) supplied.

2.1.3.1   Power Supply Panel

<1>   *<2>*   *<3>*
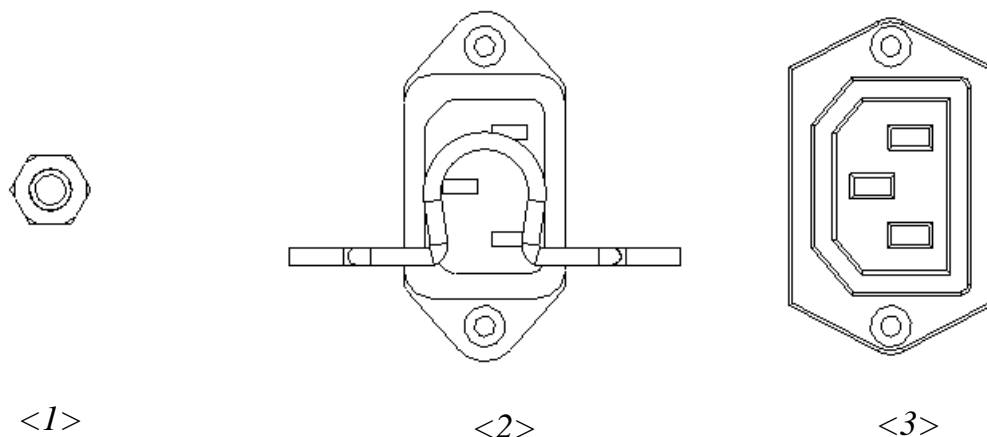
No.	Name	Function
1	Equipotential terminal	Used for equipotential connection, balancing the protective earth potentials between the device and other electrical equipment.
2	Power inlet	AC power inlet
3	Power supply outlet	Supply power for optional peripheral devices (e.g. DVR)

The symbol ▽ represents the equipotential terminal that is used for balancing the protective earth potentials between the system and other electrical equipment.

<table>
<tr><td>⚠WARNING:</td><td>1. **Be sure to connect the equipotential wire before inserting the power plug into the receptacle; be sure to pull out the power plug from the receptacle before disconnecting the equipotential wire; otherwise electric shock may result.**

2. **When you connect another device to this system, you should use the equipotential wire to connect each of equipotential terminals; otherwise electric shock may result.**

3. **Connect the earth cable before turning ON the system. Disconnect the earth cable after turning OFF the system. Otherwise electric shock may result.**

4. **DO NOT connect this system to outlets with the same circuit breakers and fuses that control the current to devices such as life-support systems. If this system malfunctions and generates 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.**</td></tr>
</table>

2.1.4   Peripherals Supported

The peripheral devices supported by the system. The information is shown as below:

No.	Item	Model
1.	Graph/text printer	HP Officejet 7000 wide format
2.	Black/white video printer	MITSUBISHI P95DW-N SONY UP-D897 SONY UP-D898MD SONY UP-X898MD
3.	Digital color video printer	SONY UP-D25MD
4.	1D/2DBarcode reader	SYMBOL DS4308 SYMBOL LS2208-SR JADAK HS-1M JADAK HS-1R
5.	DVR	
6.	External DVD R/W drive	ASUS DVD SDRW-08D2S-U

NOTE: printer UP-D898MD and UP-X898MD should be used in compatible with 1.00.7 2015-1-27 OS version or above versions. You can also select "DVR: 897" in the DIGITAL -> - DRIVER path on the printer (use UPD897 driver) if OS is not updated.

<table>
<tr><td>⚠WARNING:</td><td>**This device complies with IEC60601-1-2:2007, and its RF emission meets the requirements of CISPR11 Class B. In a domestic environment, the customer or the user should guarantee to connect the system with Class B peripheral devices; otherwise RF interference may result and the customer or the user must take adequate measures accordingly.**</td></tr>
</table>

2.2　Specifications

2.2.1　External Dimensions and Weight

■ Size: (362±5) X (390±5) X (59±3) mm

■ Weight (built-in battery assembly): < 6.5KG

2.2.2　Electric Specifications

2.2.2.1　AC IN

Main unit

Voltage	100-240V~ (for adapter)
Frequency	50/60Hz (for adapter)
Output power	2.0 A max (for adaptor)

Trolley

Voltage of power supply	100-240V～
Frequency of power supply	50/60Hz
Output power	500VA

2.2.2.2　Battery

Main unit battery:

Voltage	14.8V
Battery capacity	5800mAh (one battery) x 2

Trolley battery

Voltage	14.8V
Battery capacity	6600mAh (one battery) x 2

2.2.3   Environment Specifications

	Operational Conditions	Storage and Transportation Conditions
Ambient temperature	0℃-40℃	-20℃-55℃
Relative humidity	30%-85% (no condensation)	20%-95% (no condensation)
Atmospheric pressure	700hPa-1060hPa	700hPa-1060hPa

⚠**WARNING:**	**Do not use this system in the conditions other than those specified.**

2.2.4   Monitor Specifications

Working voltage	12V
Monitor size	15.6 inches; 16: 9
Resolution	1920×1080
Visual angle	≥160

3   System Installation

3.1   Installation Preparations

Note:	Do not install the machine in the following locations:
	Locations near heat generators
	Locations with high humidity
	Locations with flammable gases

3.1.1   Electrical Requirements

3.1.1.1   Requirements of Regulator

See *Chapter 2.2.2* for power supply specifications. 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 cord of the system is a three-wire cable. The grounding terminal should be connected with a power grounding cable to ensure that protective grounding works normally. Make sure that the protective grounding 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) from radio frequencies, magnetic fields, and transient in the air wiring. They also generate EMI. Possible EMI sources should be identified before the unit is installed.

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 Condition

3.1.2.1   Space Requirements

Place the system with the necessary accessories at a proper position for convenient use.

Place the system in a room with good ventilation or having an air conditioning unit.

Maintain a generous – free air flowing space around the back and both sides of the system; failure may result due to increased rise in system operating temperature.

A combination lighting system in the room (dim/bright) is recommended.

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.

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   Network Environment

Both wireless and wired LAN functions are supported by this ultrasound device.

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.

General information: default gateway IP address, and the other routers related information.

DICOM application information: DICOM server name, DICOM port, channels, and IP address.

3.1.3   Installation Confirmation

Please confirm the following items before installation:
- The video format of installation area or country.
- The language of installation area or country.
- Power frequency of installation area or country.
- The universal obstetrics formula and other measurement formula of installation area or country.
- The preset values of installation area or country that are different from the default values.
- The doctor's operation habits.
- The items above prior to the installation training, and do the system settings according to the universal setting of installed region or country.

3.2   Unpacking

Unpacking tool: scissor

Installation duration: 2 people, 10 minutes.

3.2.1   Unpacking Process

3.2.1.1   Trolley Unpacking

1. Use the scissor to cut off four white tapes around the external package as follows:

2. Take out the wooden cover.

3. Unpacking
   - Remove the box upwards if the space is commodious enough;
   - If the space is not commodious enough, please follow the instructions below:
     Press the middle of plastic clasp on the one side of the box as shown below;

Pull out the plastic clasp;

Take out the plastic clasp out of the box (5 plastic clasps);

Take off the plastic clasps to open the box.

4.   Take out the foam of M9's top plate.

5.   Take out the auxiliary box.

6. Take out foam lifting of the trolley.
7. Take out the fixing board

8. Turn the wooden cover to a slope.
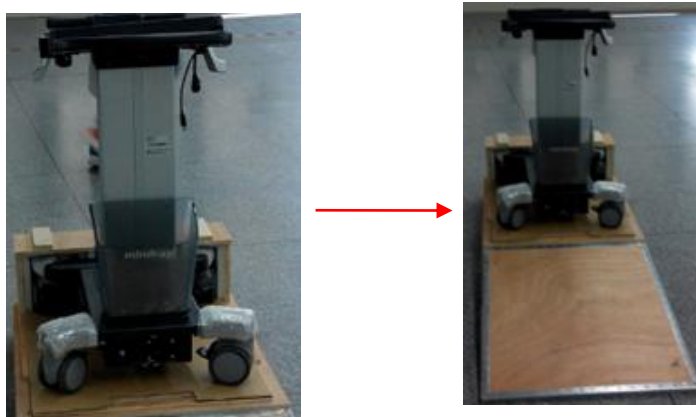
9. Push the trolley down over the wooden slope.

3.2.1.2 Unpack Main Unit

1. Cut off four tapes of the external package, open the external box, and take out the auxiliary box and fixing foam;

2. Take out the trolley case.

3. Unlock the clasp to open the trolley case.

4. Remove the protective pad, and take out the main unit and adaptor.

5. Remove the protective pad and take out other attachments

6. Take out the probe.

Probe

3.2.2   Check

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. If there is, please contact Mindray Customer Service Department.

3.3   Installation of Whole Device

3.3.1   Connecting Power Cable

Connect the connector of the power adapter to the adapter port in the system. Use a three-wire cable to connect the adapter with the external power supply.

3.3.2   Connecting ECG

Connect the ECG cable to the corresponding lead interface on ECG of the ultrasound device.

3.3.3   Connecting a Ultrasound Probe

⚠WARNING:	The probes, cables and connectors are in proper operating order and free from surface defects, cracks and peeling. Using a defective probe may cause electric shock.

Keep the cable end of the probe to the right side of the system, and insert the connector into the port of the system, and then press in fully. See the figure below.

Toggle the locking lever to the top position.

Place the probe properly to avoid being treaded or wrapping with other devices. DO NOT allow the probe head to hang free.
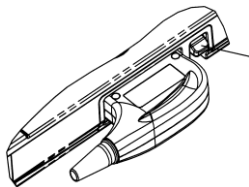
3.4 Installing Peripherals

Please see *Chapter* 2.1.4 for the device model that the system supports.

3.4.1 Connecting the Footswitch

The system supports footswitch of USB port type. As shown in the following figure.

You can set the functions of the footswitch in the [Key Config] page. Refer to Operator's Manual for footswitch setup.

3.4.2 Connecting/Removing a USB Memory Device

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

■ When connecting a USB memory device to the ultrasound system via a USB port, You can hear a sound if it is connected successfully. You can see the icon [icon] in the lower right corner of the imaging screen.

■ To remove the USB memory device: Click the icon [icon]. Press <Set>, as shown in the figure below. Select the memory device to be removed. Click [OK] to remove the USB memory device. There will be sound feedback when removing the USB memory device.

3.4.3 Graph/Text Printer

■ Connecting a local printer

 Note: Printers listed in *Chapter* 2.1.4 have drivers installed already.

As shown in the figure below, a graph / text printer has a power cord and data cable. The power cord shall be directly plugged into a well-grounded outlet.

1. Connect the data cable to the USB port on the ultrasound system.
2. Power the system and the printer on.

■ Installing the printer driver

Perform the following steps to install the printer driver as needed:

1. Connect the data cable to the USB port on the ultrasound system.
2. Power the system and the printer on.
3. Put the installation optical disk of the printer driver into the external DVD R/W drive.
4. Enter [Setup]→[Maintenance]→[Setup]→[Enter Windows], input the password. For details about obtaining password, please refer to "6.3 Enter Windows".

 The system enters the following page:
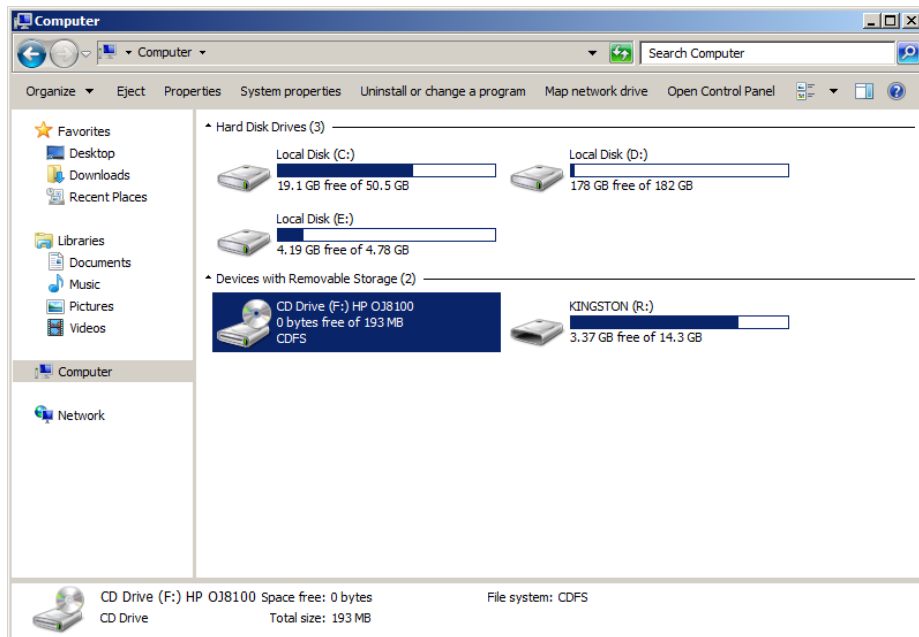
5. Double click the CD driver (HP8100 is given as an example). The installation is starting.

6. Complete the operation according to the prompts on the screen. Click [Finish] to end the installation.

7. Click [OK] to save the settings.
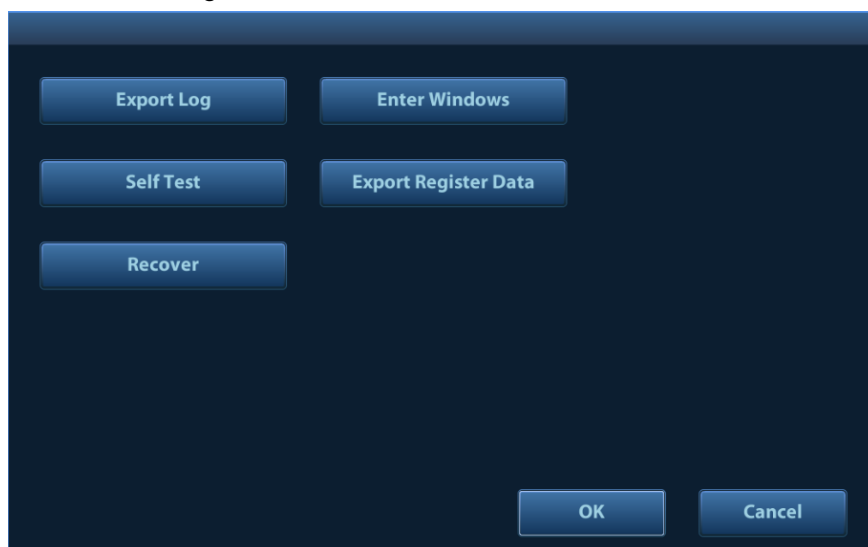
■ Print

Both report and image can be printed on a graph/text printer.

3-10 System Installation

1. To set the default report printer and its attribute:
   (1) Enter "[Setup]→[Print Preset]" screen.
   (2) Select the "Report Print" column in the Service Type list.
   (3) In the "Property" frame, select printer from the driver list next to "Printer" in the lower screen and set the items as needed.
   (4) Click [Save] after you have finished setting.
2. Report print

   In Report screen, select [Print] to print the report.

   If you want to use a shortcut key for report print, you need to define the user-defined key in "Key Configuration". For details, see *Operator manual*.

Please refer to the accompanying manuals of the printers for more details.

3.4.4   Video Printer

The system support video printers, consist of the B/W digital printers and color digital printers.

Power cable port
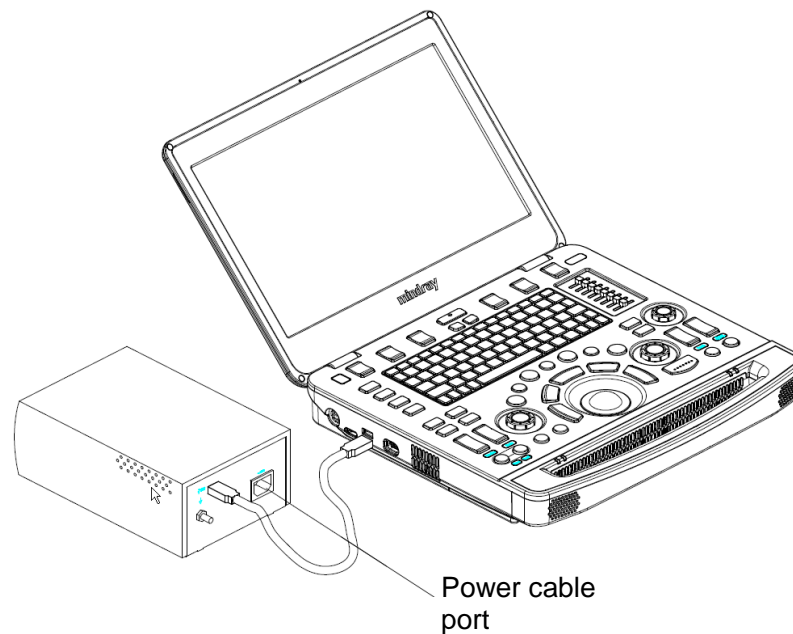
1. Position the printer in the proper place.
2. Plug the printer power cord into an appropriate outlet.
3. Use a USB cable to connect between the system's USB port and the printer's USB port.
4. Load a paper roll, and turn on the system and printer.
5. See section "3.4.3 Graph/Text Printer" for the driver installation procedure (printer drivers listed in chapter "2.1.4 Peripherals Supported" are installed already).

■ Add a print service:

1. Open the "[Setup] → [Print Preset]" screen.
2. Click [Add Service] to enter the page.

3. Select the service type and enter the service name manually.
4. Click [OK] to return to the page.
5. Select the target printer from the drop-down list in the "Property" box and set other printing properties.
6. Click [Save] to complete.

3.4.5 Barcode Reader

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

Note:	If the letter case displayed on the dialog box is inversed after scanning the barcode, please press the <Caps Lock> button on the control panel to toggle between upper and lower cases, and then scan the barcode again.
	The reader does not support Multilanguage decoding.

3.4.5.1 1-D Barcode Reader

1. The appearance of barcode reader. Each part of the barcode reader: LED indicator, scan window and scan trigger button.

1.	LED indicator	Green light is on if scan is successful.
		Red light is on if the scan fails.
2.	Scan window	Receive barcode.

3.	Scan trigger button	Press to perform the scan.

2. Plug connecting terminal of the cable to the port of the barcode reader. Ensure the contact works well.

3. Connect USB terminal of the connecting cable to the USB port of main unit.

	1.	Barcode reader port
	2.	Connecting terminal of connecting cable
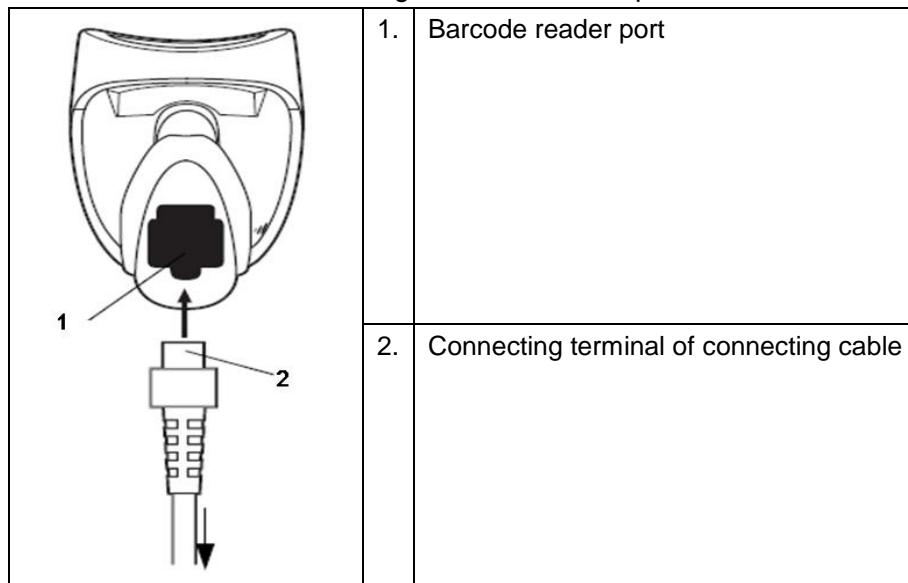
4. Press scan trigger button to receive barcode when ultrasound device is running (without installing driving program). For more operation details, see relevant barcode reader manual.

3.4.5.2   2-D Barcode Reader

■ Install the connecting cable

1. The appearance of barcode reader. Each part of the barcode reader: LED indicator, scan window and scan trigger button.
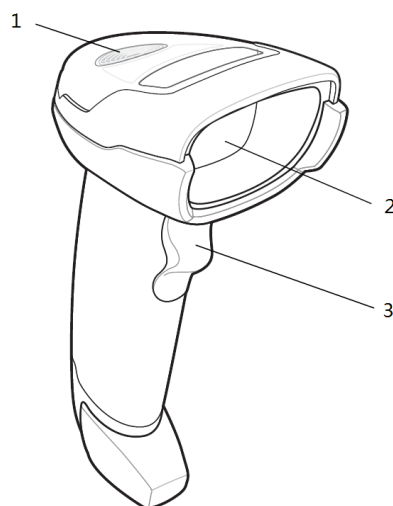
1.	LED	Green: A barcode was successfully decoded.
		Red: A data transmission error or reader malfunction occurred.
2.	Scan window	Scan the barcode.
3.	Trigger	Press to decode

2. Plug connecting terminal of the cable to the port of the barcode reader. Ensure the contact works well.

3. Connect USB terminal of the connecting cable to the USB port of main unit.
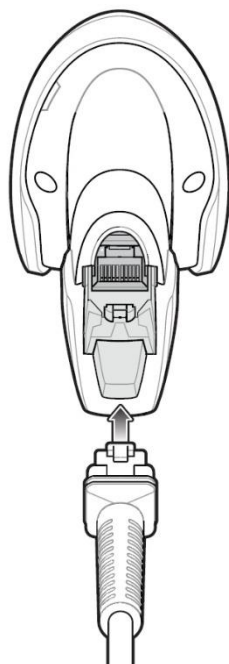
4. Press scan trigger button to receive barcode when ultrasound device is running (without installing driving program). For more operation details, see relevant barcode reader manual.

■ Disconnect the connecting cable

1. Using the tip of a screwdriver or some other tools with a sharp head, depress the cable's modular connector clip.
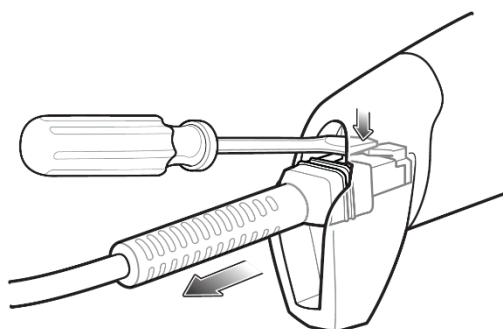
2. Carefully slide out the cable.

3.4.5.3 JADAK Barcode Reader

■ Supported Barcode Reader Model

The Ultrasound System supports the following barcode readers: HS-1M JDK-2413 and HS-1R JDK-2601.

■ Operating System Version

If you need to use the JADAK barcode reader with the Ultrasound System, ensure that the operating system version is as follows:

PC module (SOM5892-3517-M-8G)	2.0.11 or later versions
PC module (SOM-6897C3-T02A1E)	3.3.13 or later versions

If the version is lower than the requirements, upgrade the operating system.

For version upgrading, contact the Mindray service engineers. Select [Setup]→[About]→[About Details]→[Operating System Version] to check the operating system of your device.

■ Configuration Before Use

The barcode reader is configured through scanning the 1-D/2-D barcode. The configuration steps are as follows: configuring the barcode reader→enabling the suffix→setting the suffix to **Enter**. Ensure that the barcode reader is properly connected to the Ultrasound System before scanning. After the barcode is successfully scanned, the barcode reader buzzes, and the green indicator is **On**.

HS-1M JDK-2413 Barcode Reader

1. If the barcode reader is in malfunction, scan the following 1-D barcode to configure the barcode reader:

2. Scan the following 2-D barcode to enable the suffix:

3. Scan the following 2-D barcode to set the suffix to **Enter**:

HS-1R JDK-2601 Barcode Reader

1. If the barcode reader is in malfunction, scan the following 1-D barcode to configure the barcode reader:

2. Scan the following 1-D barcode to enable the suffix:

For scanning Barcode

For scanning RFID

Notes: **Users can customize the JADAK barcode reader based on specific requirements or contact the Mindray service engineers. This configuration guide is applicable for the Ultrasound System only.**

3.4.5.4 Setting Up the JADAK Barcode Reader (Taking HS-1R as an Example)

1. Turn off the power to the Ultrasound System;

2. Connect the appropriate interface cable to the barcode reader;

3. Plug the other end of the cable into a free USB port on the Ultrasound system;

4. Once the imager has been fully connected, power on the Ultrasound System.

3.5 Wired Network Connection

Connect the USB plug of the USB to LAN Adapter to the USB port on the machine, and insert the network cable into the LAN port of the adapter to get a wired network connection.

WARNING	The LAN port of the adapter **CAN ONLY** be used to connect to wired network. Device interconnection using the adapter through LAN port is forbidden; otherwise, electric shock may result. If you intend to connect an external device, please make sure it meets the requirement of STANDARD GB9706.15 or *IEC60601-1:2005 chapter 16.*

Note: the ultrasound system supports the following usb2lan devices for network connection:

Manufacturer	Model
highspeed usb ethernet control	/
Anker (USB3.0 to Gigabit Ethernet Adapter)	A7611
J5create (USB3.0 to Gigabit Ethernet Adapter)	JUE130
uGreen (USB3.0 to Gigabit Ethernet Adapter)	20258

In case of interfering the network communication, only one usb2lan device should be connected to the system each time

3.6 System Configuration

3.6.1 Power-on Running

Connect the connecting terminal of the power adapter to the adapter port in the system. Use a three-wire cable to connect the adapter with the external power supply. Ensure the connection of ultrasound and optional device works well.

3.6.2 Enter Doppler

After the initialization process (about 1 minute), the system enters Doppler interface, as shown below:
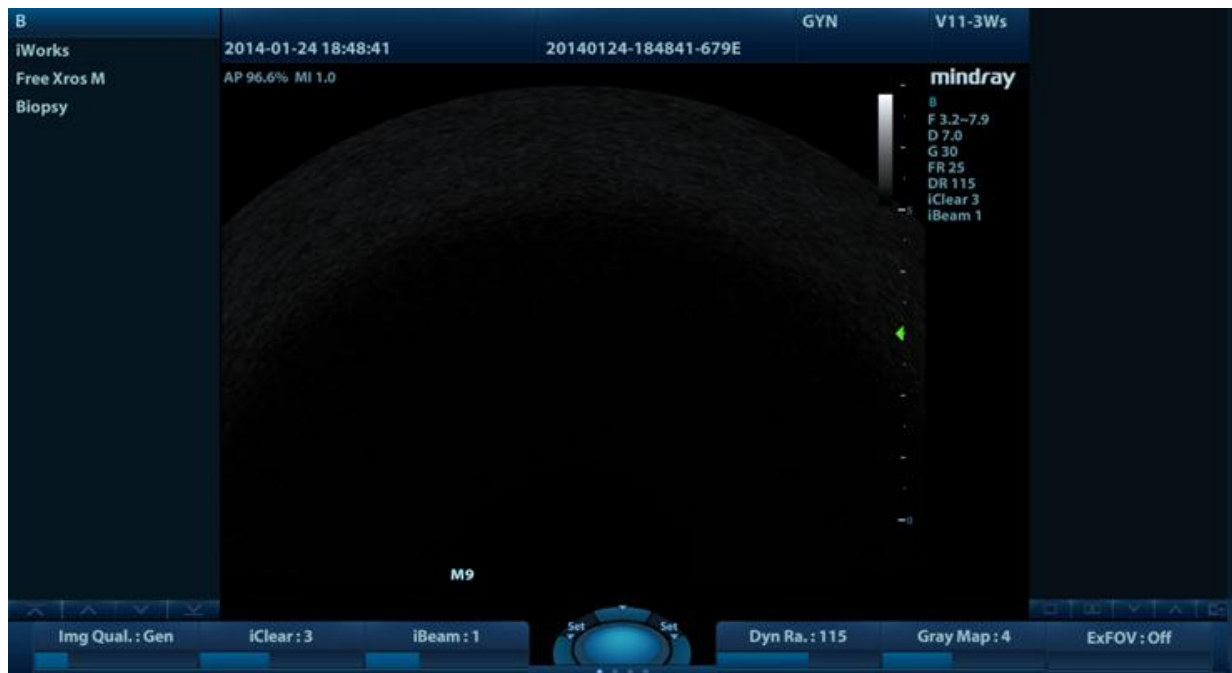
3.6.3   System Preset

1.   Press [Setup]. Setup menu appears.
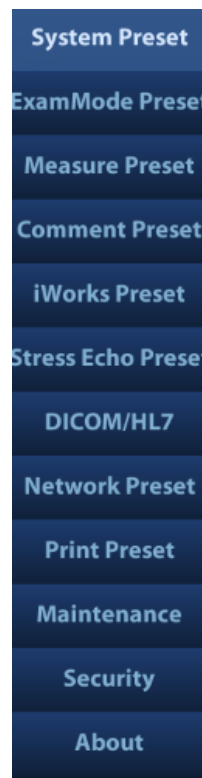
2.   Click [System Preset] to enter System Preset interface.

The following settings can be performed on the System Preset interface.

Preset Interface	Description
Region	To set the hospital name, language, time zone, system time format, system date format and system date/time.
General	To set patient information, exam setup, patient management, image storage, display, system dormancy, etc.
Image	To set some general parameters in imaging modes.
Application	To set the measure caliper, measure setting, follicle method, comment setting, etc.
OB	To set the relevant information about fetal gestational age, fetal growth curve and fetal weight, etc.
Key Config	To assign functions to footswitch and the user-defined keys.
Audio Control	To assign functions to the speech commands.
Access Control	To set the user account control relevant information.
Scan Code	To set relevant information of barcode.

3.6.4   Print Preset

Press <Setup> and click [Print Preset] to set video printer, graph/text printer parameters (set the parameters according to the printer, and select the relevant printer services).
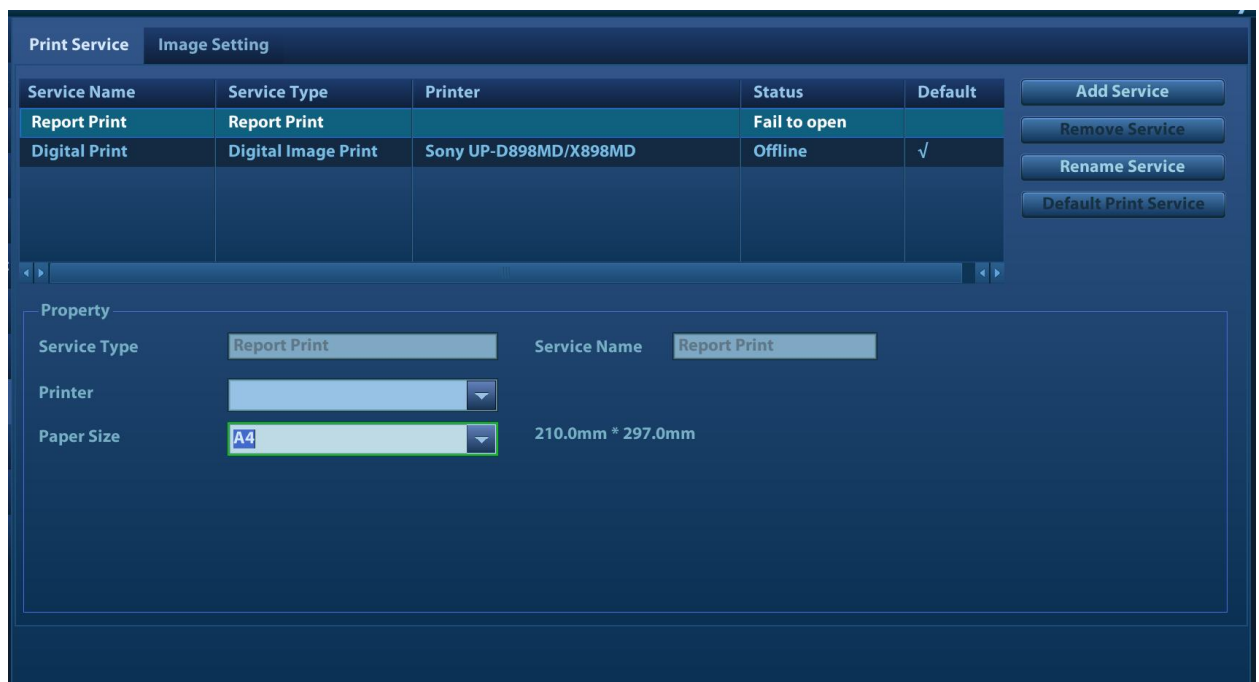
- **Print service setting**
  - ➤ Add Service: click to add print service.
  - ➤ Remove Service: click to delete the selected print service.
  - ➤ Rename Service: click to rename the selected print service.
  - ➤ Default print service: click to set the selected print service as the default one.
  - ➤ Set Service Property: to preset the service property, such as paper size, paper orientation, etc. set the print service according to the type. The print service include: report print, digital image print and analog image print.
- **Image Settings**

     Click [Image Setting] to enter the page, you can set the brightness, contrast and saturation of image printing, or you can use the default values.

3.6.5   Network Preset

3.6.5.1   iStorage Preset

Select [Preset]-[Network Preset]-[iStorage] to enter iStorage interface (see the figure below):

Name	Description
Service Name	The name of the iStorage service.
IP Address	IP address of the iStorage service device.
Port	Port for transmitting.
Connect	Click to verify connection.
Add	Click to add the Network service to the service list.
Update	To save the changed parameters.
Delete	Click to delete the selected service from the service list.

■ Add an iStorage service

1. Set the network server properties as described above.

2. Click [Add] to add the service to the Service list.

■ Modify a network service

1. Select the service to be updated in the service list.

2. You can see properties in the Configure Service area.

3. Modify the parameters and click [Update] to update the setting.

3.6.5.2 Wireless Network Connection

You can set the M9 or M8 series system as a hotspot. When other devices (with available wireless network function) are connected to the the M9 or M8 series system, DICOM, iStorage and network print function can be implemented this way.

■ Turn on hosted network function:

1. Select [Wireless Network Connection] page in Network Preset screen.

2. Confirm the Wi-Fi is enabled: you see [Disable Wifi] in the screen.

3. Enter the name and password for this hotspot in the Hosted Network box.

4. Click [Start] to enable the function.

5. Use other devices to search and connect to this network.

3.6.5.3 MedTouch/MedSight Preset

You can set environment for MedTouch/MedSight here and then use the MedTouch/MedSight function by mobile phone or tablet computers. See MedTouch/MedSight manual for details.

3.6.5.4 Q-Path

● **Overview**

You can use the ultrasound system to check data on browser directly. After you have ordered storage service of a network website service, you can check data using the website, authorized account and password (provided by the service vendor).You can open the browser (Q-View) to review previously sent DICOM data.

Q-path is a network server provided by Telexy Healthcare Inc. for digital image storage. Q-View is a client viewing tool for the server. Telexy Healthcare developed technology and a command structure that allows any Q-view enabled ultrasound system to access Q-path directly from the ultrasound system using a single control. The primary purpose for Q-view is to provide remote access to Q-path from the ultrasound system to complete the exam report on the ultrasound system and submit for QA,

To access Q-Path on the M9 or M8 series, the user just opens the Q-View first and then enters the URL, user account and password provided by Telexy Healthcare, and the M9 or M8 series software system will call Q-View tool then for user Q-Path application.

For details, please contact Q-Path service provider.

● **Q-Path Basic Procedure**

■ Set related setting: check the check box by "Enable Q-Path" in the path: "[Setup]→[Network Preset]→ [Q-Path]", as shown in the following:

Figure 1

The preset procedures are as follows:

1. Select [Enable Q-Path].
2. Enter the server address in the field box of "Server Address".
3. Select user type: Personal User or Default User.
   - Personal User: the personal user needs to enter the user name and password in every-time login.
   - Default User: after the default user enters the user name and password in the field box of the "User Name" and "Password", and click [Save], no login is required to access the Q-Path server later.
4. Select an appropriate item from the drop-down list of "Available Items"
5. Select an exam mode in the left "Exam Mode" column.
6. Select a worksheet in the right "Worksheets" column.
7. Click [Save] to exit, and the system will shut down.

Parameter	Description
Advanced	Sets the sub URLs of "QVIew full" and "QView lite". The sub URL is set by default. Users can modify the sub URL and click [Apply] to exit the "QView sub URL setting" window.
Enable Direct Report	Sets whether to open the Q-Path server through pressing the <Report> key.
Worksheet Only	Sets whether to directly enter the Worksheet interface after opening the Q-Path server.
Password On Worksheet	Sets whether to display the Signature field box in a worksheet. Press <Report>→[WorkSheet] or press <Review> → [Report] → [WorkSheet], enter the worksheet password in the field box, and click [OK]. Users can query the corresponding worksheet by searching the worksheet password in the Q-Path server.
Password On End Exam	Sets whether to input the worksheet password after ending an exam.
Password Visible	Sets whether the password is visible.
Import	Imports a user-defined worksheet template from the USB storage (downloaded from the Q-Path server).
Backup	Backs up worksheets to the USB storage.
Restore	Restores the backup worksheet template from the USB storage to the ultrasound system.
Delete	Deletes a worksheet template.
Restore Factory	Restores the worksheet template to the default state.

The operating procedures are as follows:

1. Set the DICOM storage server.
2. Send stored images or worksheet reports from iStation/Review/thumbnail area to the Q-Path server.
3. Press the user-defined key for Q-Path or press <Report> to open the Q-View browser.

4. Log in to the Q-Path server through the Q-View browser to check the stored images and worksheet reports.

5. Click [Esc] to exit the Q-View browser.

Note: the following prompt will display every time you enter Q-Path after powering on the machine. Select "Yes" to enter the website service.
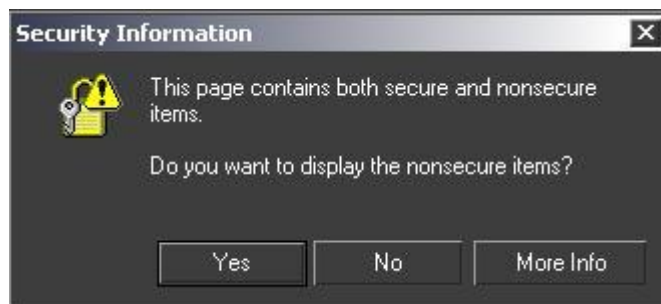
Figure 2

■ Press <ESC> or the user-defined key to exit the function.

Select "Enable User Account Login" and you are able to login using single user account.

NOTE:	If you use the function to connect to websites other than Q-Path applications (website setting in "[Setup]→[Network Preset]→ [Q-Path]"), the system will prompt the following information:

Only Q-path application is allowed to be loaded!

● **Q-Path Functions using Q-view**

When Q-Path is accessed from the ultrasound system using Q-view, access is restricted to the active exam and only certain functions are available.

NOTE: What functions you can acquire by using Q-View is only related to what you have purchased from Q-Path service provider. Please contact Q-Path service provider for details.

The primary purpose of accessing Q-path from an ultrasound machine using Q-view is to complete the exam report template and submit the exam for review or quality assurance, eliminating the necessity to log in to Q-path from a separate workstation.

■ Q-path Functions Available on the Ultrasound System:

● Update Patient and Exam Information;
● Image Annotation;
● Image thumbnails;
● Exam Worksheets;

Note: Only credentialed physicians are authorized to approve or sign a report.

● Submit Exam for QA.

3.6.6   Network Configure

1. Press <Cursor> to show the cursor, click [icon] in the bottom bar to open the wireless network manager.

2. Roll the trackball and press <Set> to select the target network, click [Connect] to connect to the network.

   When connecting an encrypted network, enter the password in the box first.You can select to hide password characters or not.

3. The system tries to connect and the wireless manager icon turns into . The icon turns into or after successful connection.

4. Click [Refresh] to refresh the "Wireless Network Connection" list.

   ■ IP Config

Note:	When the system background is processing network task (DICOM sending for example), please do not enter network setting to change the IP, otherwise the background task may fail. You can check if there are tasks undergoing in the task manager.

   IP config is used for setting local network parameters, which is also applied to DICOM connection.

1. In Wireless network manager screen, click [IP Config] to open the page:
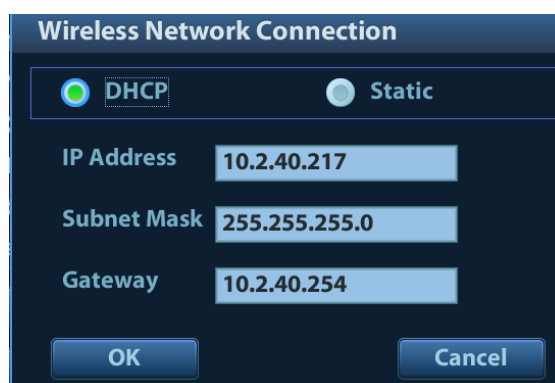
   ● If "DHCP" is selected, the IP address will be automatically obtained from the DNS server.
   ● If "Static" is selected (using a static IP address), enter the IP address.
     ➤ IP address of the system should be in the same network segment with the server.
     ➤ Subnet Mask: set different network segment.
     ➤ Gateway: set the gateway IP.
2. Click [OK] to save current setting. Click [Cancel] to exit.

Note:	If the IP address displays as 0.0.0.0, this means that the network is abnormal. The reason for the failure may be disconnection or the system cannot obtain the IP address.

■ EAP Network

EAP (Extensible Authentication Protocol) is an authentification frame protocol that supports multiple authentification methods. It is mainly used for network access authentification, and is applicable for wireless enterprise security authentification.

1. In Wireless Network Connection screen, click [Eap Network] to open the page:

● Import certificate: Click [Certificate Manage] to enter Certificates page, click [Import…] to import root certification in "Trusted Root Certification Authorities" page, then click [Import…] to import personal certification in "Personal" page, and set Eap network password.

● Set Eap network: Click [Manage Wireless Network] to set.

➤ Click [Add]->[Manually create a network profile] to set.

Network name: input Eap nerwork name;

Security type: WPA2-Enterprise;

Encryption type: AES;

Security key: keep black;

Select "Start this connection automatically" and "Connect even if the network is not broadcasting".

➤ Click [Next] to finish the network setting.
➤ Click [Close] to exit.
➤ Select Eap network, then press right <Set> key, and select [Properties] menu.
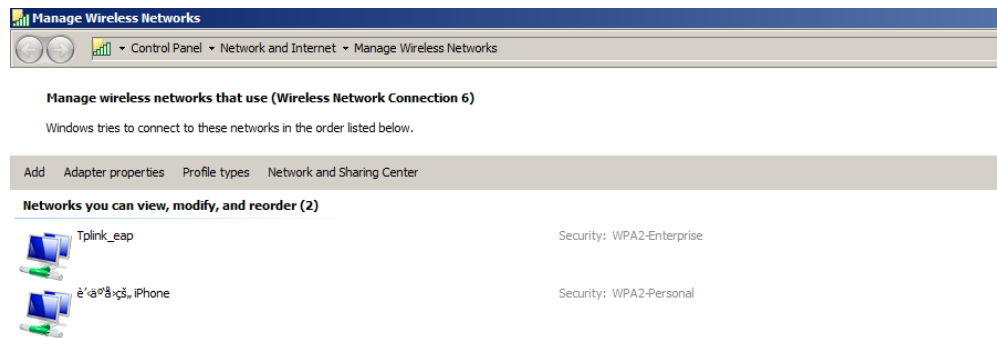
➤ Enter "Security" page, select [Microsoft: Smart Cart or other certificate] from "Choose a network authentication method" drop-down list.
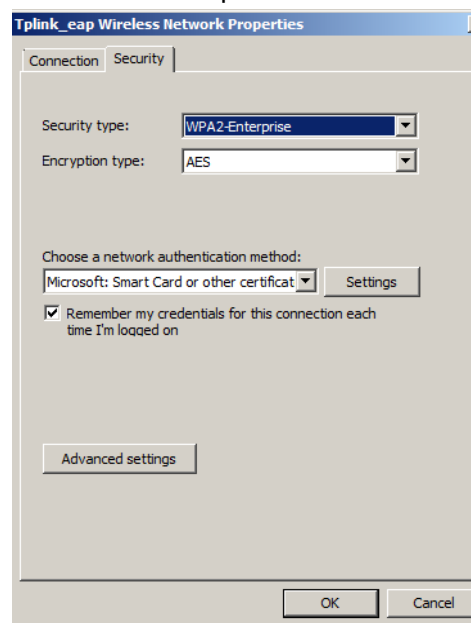
➤ Click [Settings], select trusted root certification from "Trusted Root Certification Authorities" drop-down list, click [OK].
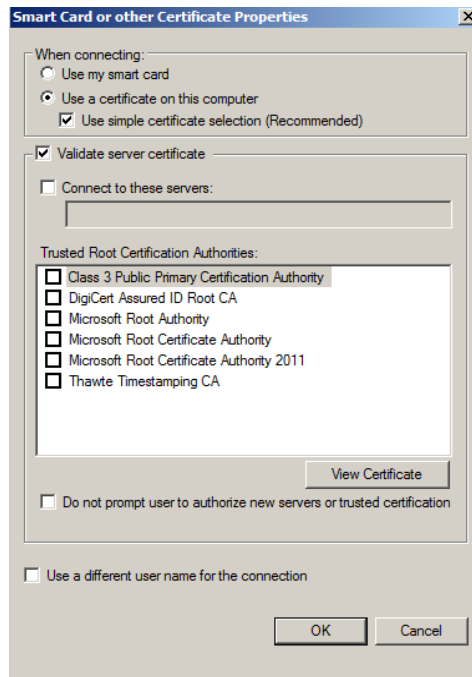
➤ Click [Advanced Settings] to set in "Security" page. Select "Specify authentication mode", and select "user or computer authentication" from the drop-down list. Then click [OK], close the setting page.
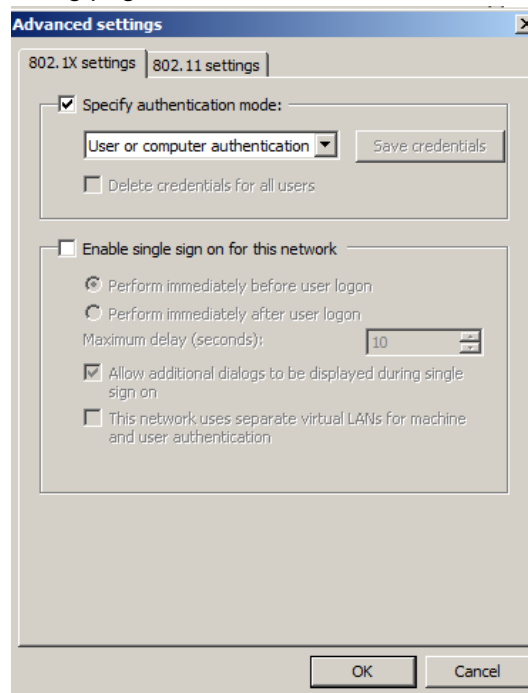
Select Eap network in the "Wireless Network Connection" list, click [Connect] to connect to the network.

3.6.7 DICOM/HL7 Preset

Note:	Only if DICOM basic option is configured, [DICOM Preset] is available.

1. Click [DICOM Preset] to enter the DICOM Preset interface. Set DICOM service attributes first:

enter AE Title (use Application Entity title for ultrasound system), terminal and package size.

2. Server setting

    1) Enter the device name and the IP address;

    2) Verify connection after entering the correct IP address by clicking [Ping].

    3) Click [Add] to add the server to the list if the connection works normally.

    The following is an example:

Note:	1.	AE Title should be the same with the SCU AE Title preset in the server (PACS/RIS/HIS).
	2.	DICOM communication port should be the same with the one on the server.
	3.	If the currently entered name has already existed, the system will pop up: "The server name exists!"

3. Click [DICOM Service].

When the system is configured with DICOM basic function module, and installed DICOM Worklist, storage commitment, and Query/ Retrieve modules, the corresponding preset settings can be found in DICOM Service screen.

The DICOM Service Setting is used to set properties of DICOM services. See *the basic volume* for details.

> **Note:**   Only if DICOM basic option is configured, Worklist page is available.

3.6.8   Security

Click [Security] on the Setup menu to enter the security-setting screen.

1.   Drive Encryption/Secure Data Wipe

Encrypt the patient data stored in the hard disk. The system provides two encryption methods: Factory Default and User Define.

■ Factory Default: the system is in factory state by default.

■ User Define: add a user-defined password.

1) Select [User Define]. If the patient data are already stored in the hard disk, the system prompts the following message: (if no patient data are stored in the hard disk, perform steps 5 to 6 directly)
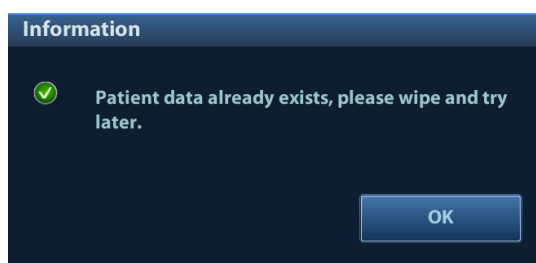
2) Click [OK] to return to the Security screen, click [Wipe], and the system prompts the following message:
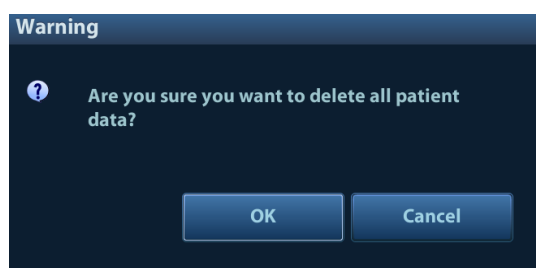
3) Click [OK], and the system prompts the following message:
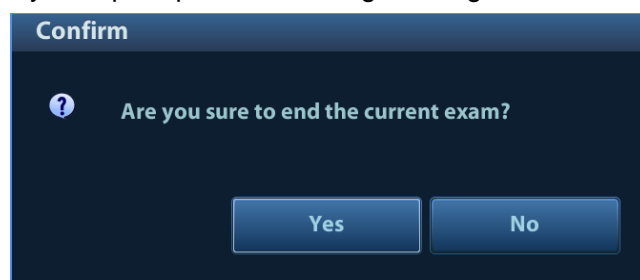
4) Click [Yes] to wipe the patient data.

5) Select [User Define] and click [Confirm].

6) Input the password and click [Confirm] to finish the password setting.

Notes   1.   If you want switch to Factory Default, perform steps 1 to 6 again. The password is the same as that of the User Define.

2.   When you set password, multi-language and Chinese characters are not supported.

2.   Anti-Virus

The system provides two anti-virus software: Microsoft Security Essentials (MSE) and McAfee. They can effectively prevent the ultrasound system from being attacked by virus, spyware, or other malware.
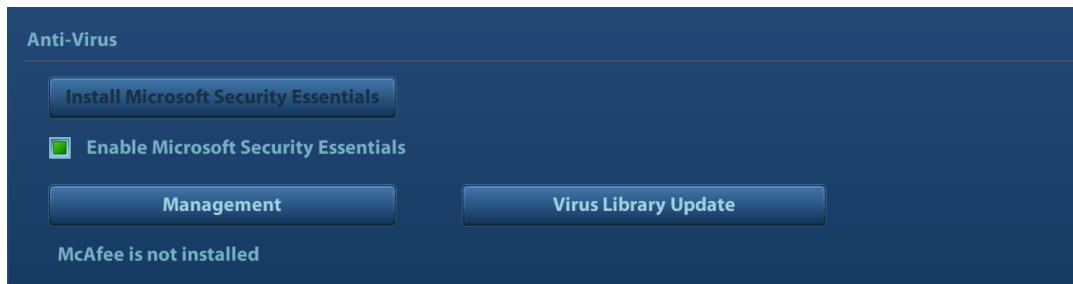
■ Click [Install Microsoft Security Essentials] to enter the "Microsoft Security Essentials" interface:

Click [Next].

Click [I Accept].
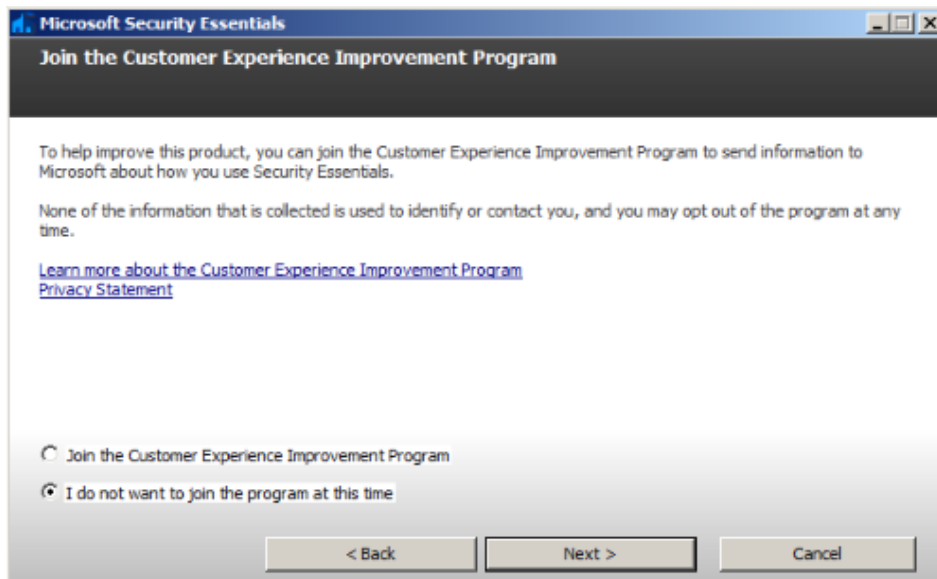
Select "I do not want to join the program at this time" and click [Next].
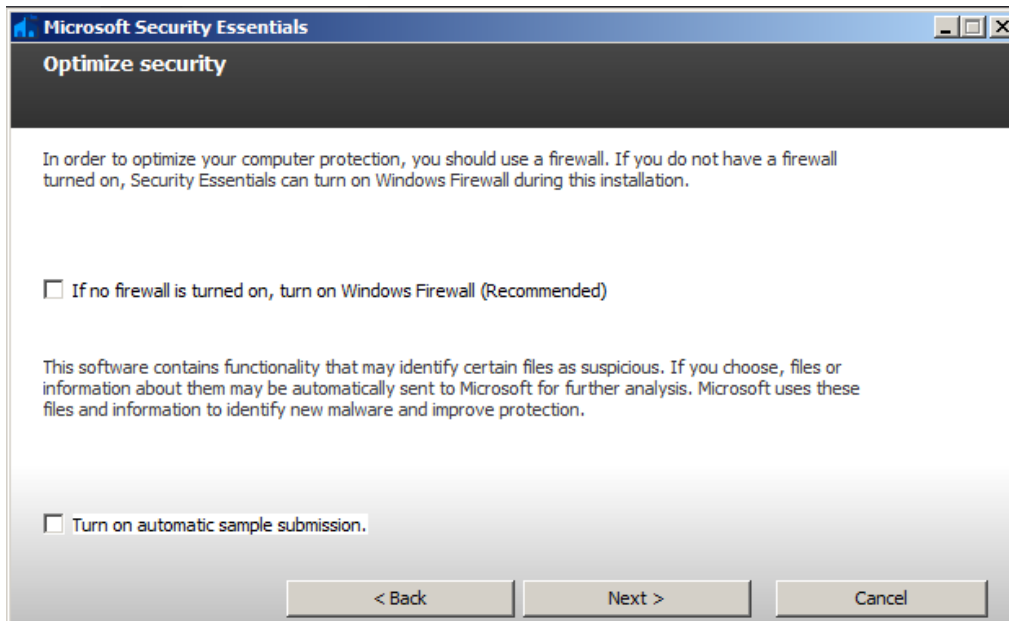
Deselect "If no firewall is turned on, turn on Windows Firewall (Recommended)" and "Turn on automatic sample submission." Click [Next] to enter "Preparing to install Microsoft Security Essentials" interface.
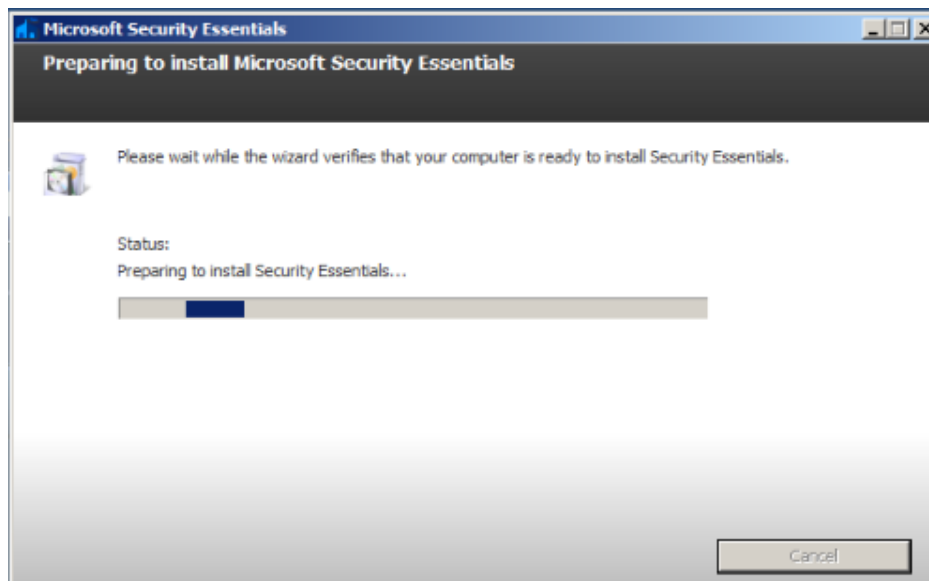
After preparing to install Security Essentials, the MSE software enters the following interface:
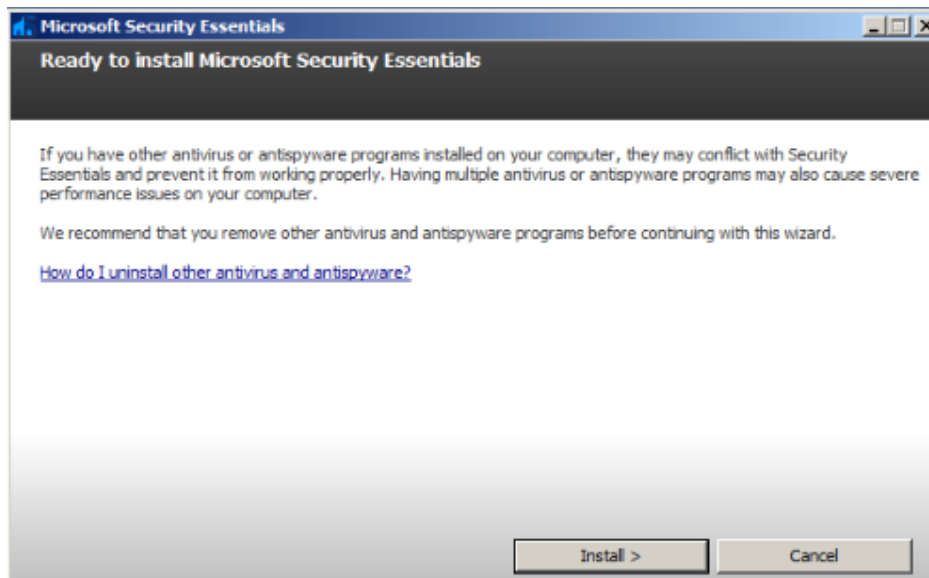
Click [Install] to enter the "Installing Microsoft Security Essentials" interface.
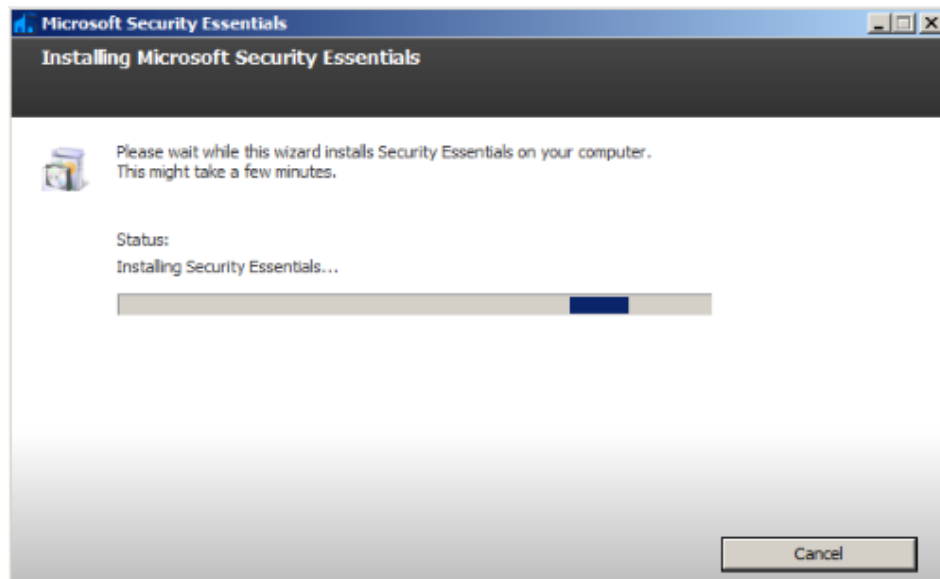
After installing Security Essentials, the MSE software enters the following interface:
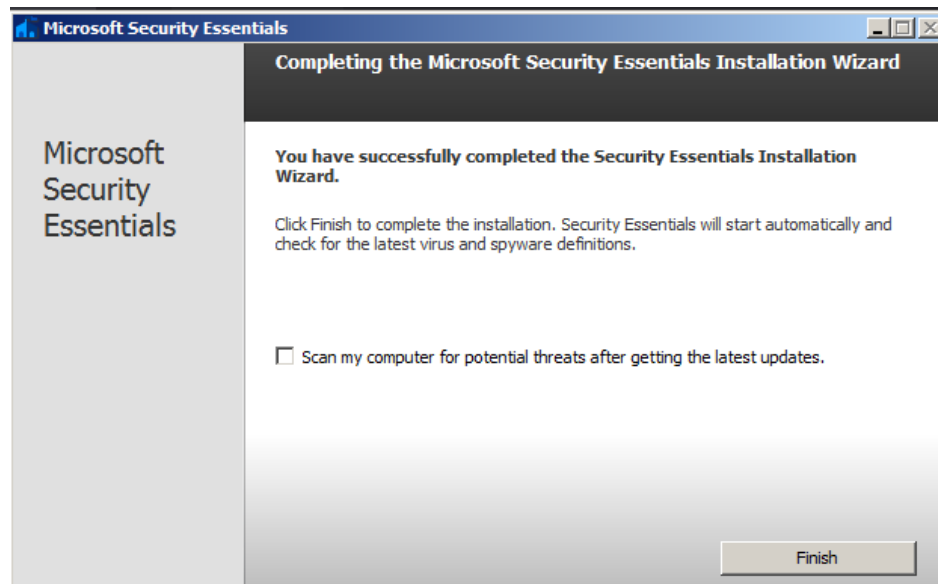
Deselect "Scan my computer for potential threats after getting the latest updates." Click [Finish], and the system enters the "Microsoft Security Essentials" setting interface. After the message "PC status: Protected" is displayed, select [Settings] → [Scheduled scan] and do as follows:
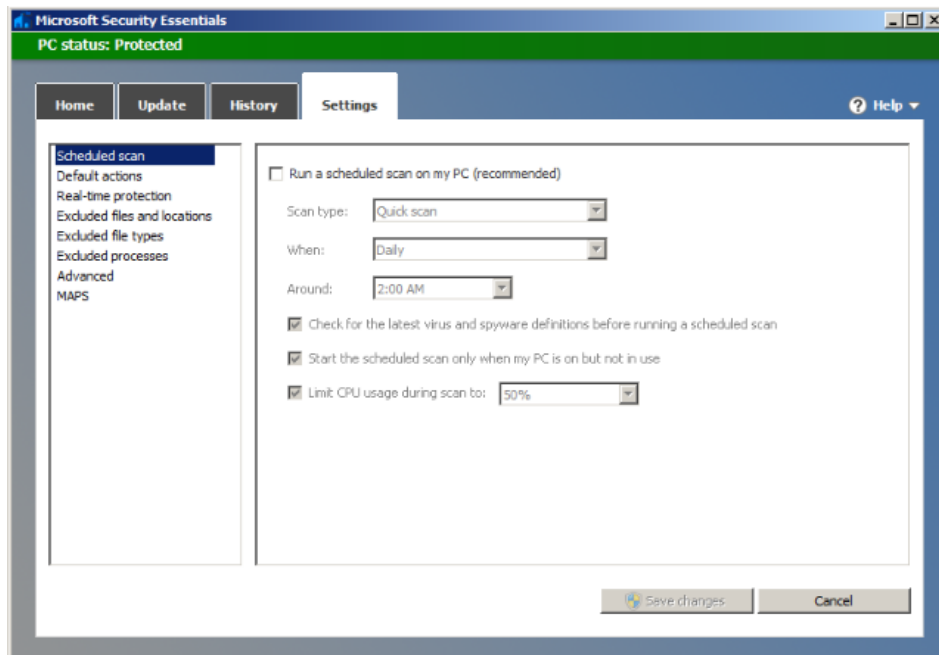
Select [Advanced] and do as follows:
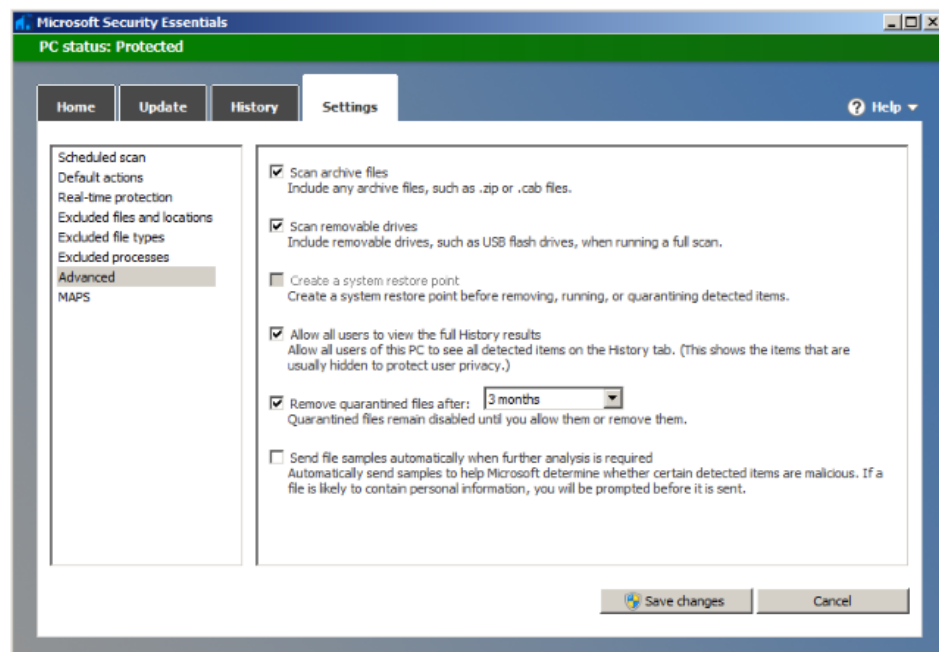
Select [MAPS] and do as follows:
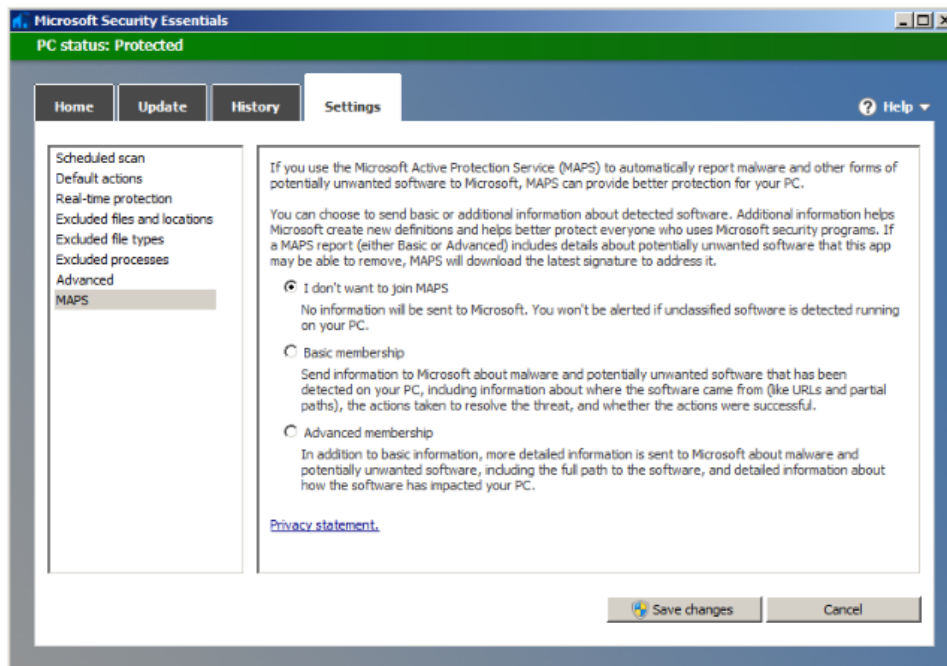
Click [Save Changes] and [Cancel] to exit.

Select [Preset] → [Security] to return to the "Security" screen. "Enable Microsoft Security Essentials" is automatically selected, and [Management] and [Virus Library Updates] buttons are highlighted.
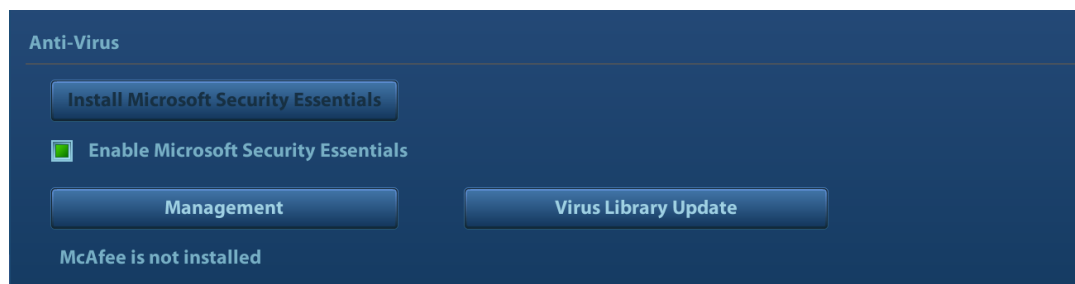
Parameter	Description
Enable Microsoft Security Essentials	Automatically enabled after the MSE software is installed.
Management	Click to enter the Microsoft Security Essentials" setting interface
Virus Library Updates	Click to update the virus library.

■ If the McAfee software is installed, the system displays "McAfee is installed"; if not, the system displays "McAfee is not installed". The McAfee software is an option. Select [Preset] → [Maintenance]→ [Option] to install the the McAfee software. For details, please refer to "9.1 Installation of Optional Devices to Software"
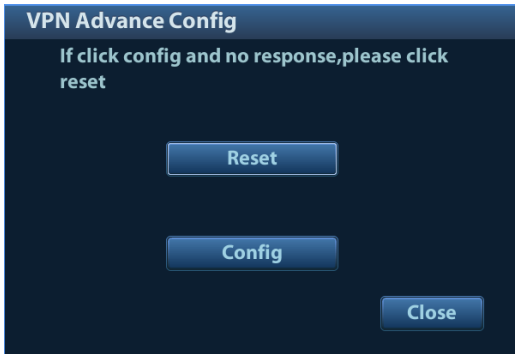
    Notes: 1.   McAfee cannot be uninstalled after successful installation.

                         2.   McAfee can be installed after installation of MSE. But MSE cannot be installed after installation of McAfee. They are alternative.

                         3.   If McAfee is improperly installed due to power-off, shut-down, closing of cmd.exe, or any other abnormal operation during the

installtion, please reinstall the OS and Doppler. For details, please refer to the System Recovery Guide. .

3. Transmission Encryption

After accessing the network, click [VPN Config] to enter the "VPN Config" interface.

Item	Description
Status	No driver: click [SetupDriver] to enter the "TAP-Windows 9.21.2 Setup" interface, and do as instructed. Ready: the VPN is ready for use. Advance: VPN Advance Configuration Connected: VPN is successfully connected. Disconnected: VPN is disconnected. Error: error connection.
Server IP	/
Group	
User Name	
Password	
Hide characters	The password is displayed as *.
Connect/ Disconnect	Connect or disconnect VPN.

Item	Description
Advance	Enters the "VPN Advance Config" interface. Reset: if the system does not respond after you click [Config], click [Reset]. Config: enters the "OpenConnect-GUI VPN client" interface. For details about the settings, please refer to the TAP manual. Note: after exiting the "VPN Advance Config" interface, you need to reboot the system; otherwise, you cannot connect VPN normally.
Close	Close the "VPN Config" interface.

Note: if the system is installed with McAfee, software like VPN that is provided by the third party will be blocked. If users want to use VPN, select [Preset] → [Maintenance] → [Setup] → [Enter Windows], and input password to enter Windows. Open E:\VPNDrivers\tap-windows.exe to start installation.

3.6.9   System Information Verification

Product configuration, version number, hardware board and relevant driver information appear on the system information interface. Confirm the relevant information on this interface.

1.   Click [About] to enter the interface.

About	About Detail	
Title		**Status**
Product		M9
Manufacturer		MINDRAY
Configuration Type		FDA
ECN/TCN		Incorrect
Internal Version		0.1
MAC Address		00 d0 c9 db 67 9e
Serial Number		
Contact Detail		service@mindray.com

2.   All details about the hardware board appear on [About Detail] interface.

Note:	1.	Confirm the system information before and after the software maintenance.

2. If required, the system reminds the user of saving the current system information.

4   Product Principle

4.1   General Structure of Main Unit's Hardware System
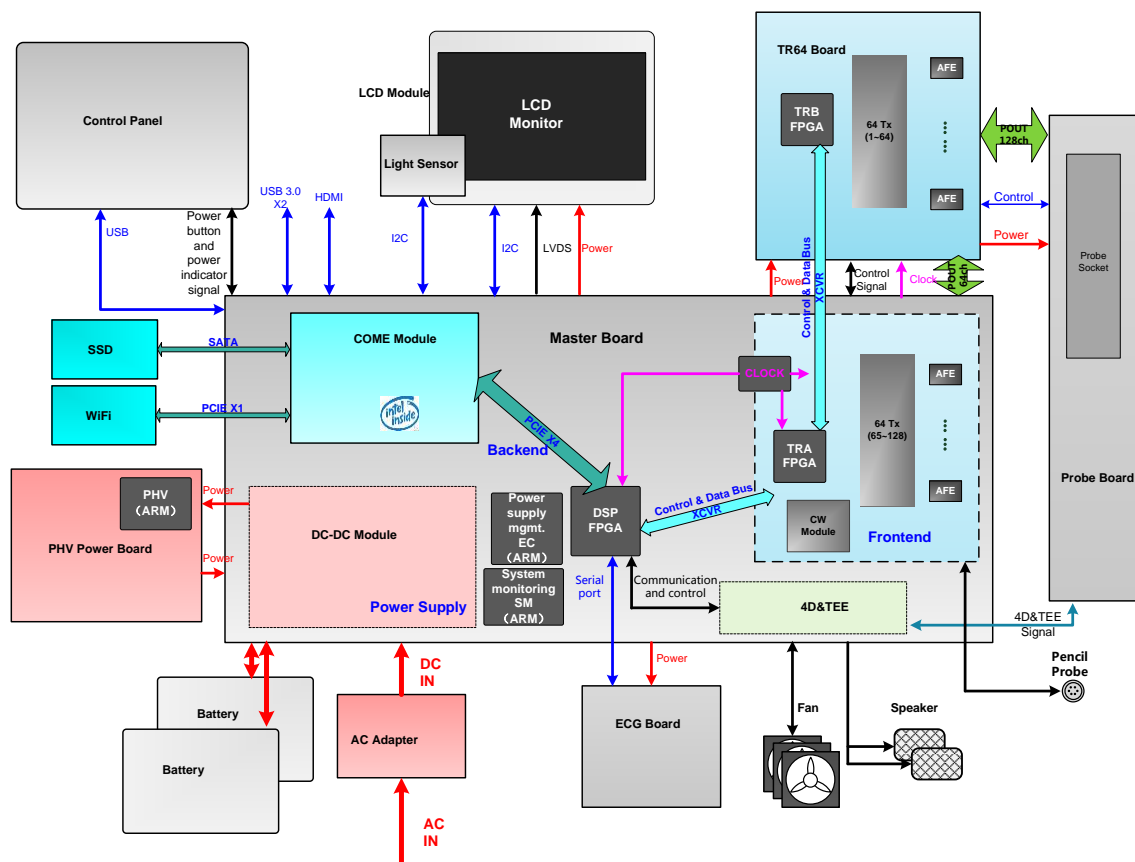
Figure 4-1 Schematic diagram of system hardware The general structure of M9's hardware system is shown in figure above. M9 system hardware consists of each following part:

- ➢ Main board

  - ✧ DC-DC circuit, which offers power supply, charges or discharges the battery.

  - ✧ Functional circuit of back-end offers the functions of stereo audio, video audio, IO interface, etc.

  - ✧ Signal processing FPGA. It processes the beamforming signal and occupies the functional controls except for transmitting and receiving functions.

◇ TRA FPGA is the FPGA which controls the transmission and the receiving.

◇ 65-128 transmitting/receiving channels.

◇ Control interfaces related to probes.

◇ 4D&TEE functional circuit implements functions of 4D drive circuit and TEE temperature measure, etc.

◇ Power supply management (EC) implements functions of the power supply management and control of starting/shutting down the main unit.

◇ System monitoring (SM) implements the power supply monitoring and fan monitoring of main system.

➢ TR64 board: 1-64 transmitting/receiving channels.

➢ Probe board connects the main unit with the probe.

➢ PHV power supply board produces the programmed high-voltage needed in the transmission.

➢ COME module, also named as PC module, runs at Doppler platform.

➢ As a main display unit, LCD module displays the image and inducts the environment brightness.

➢ ECG board offers ECG and respiratory signal acquisition and achieves the triggering function with main unit.

4.2 Main Board

Main board includes: power supply, back-end and front-end.

4.2.1   Power Supply
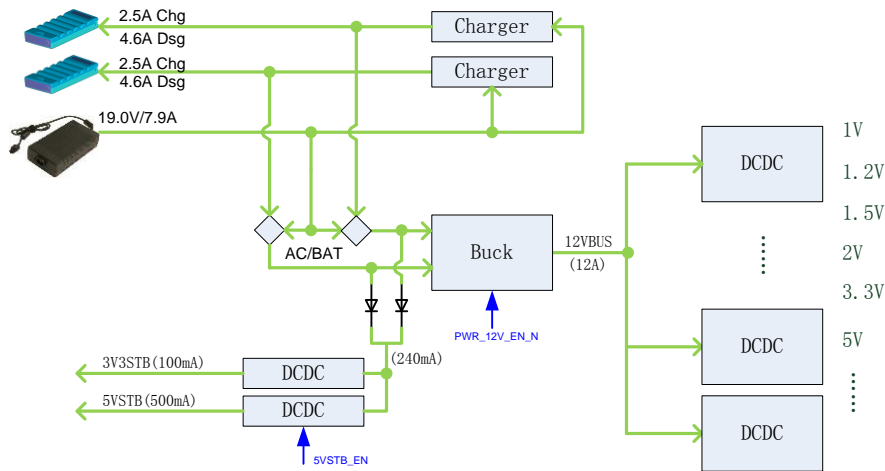
Figure 4-2 Principle diagram of power system

Function description:

➢   It provides the power to start the device and the power when the main unit is in standby.

➢   Battery charging or discharging circuit.

4.2.2   Backend

The backend is integrated with the circuit of the CPU module and main board.
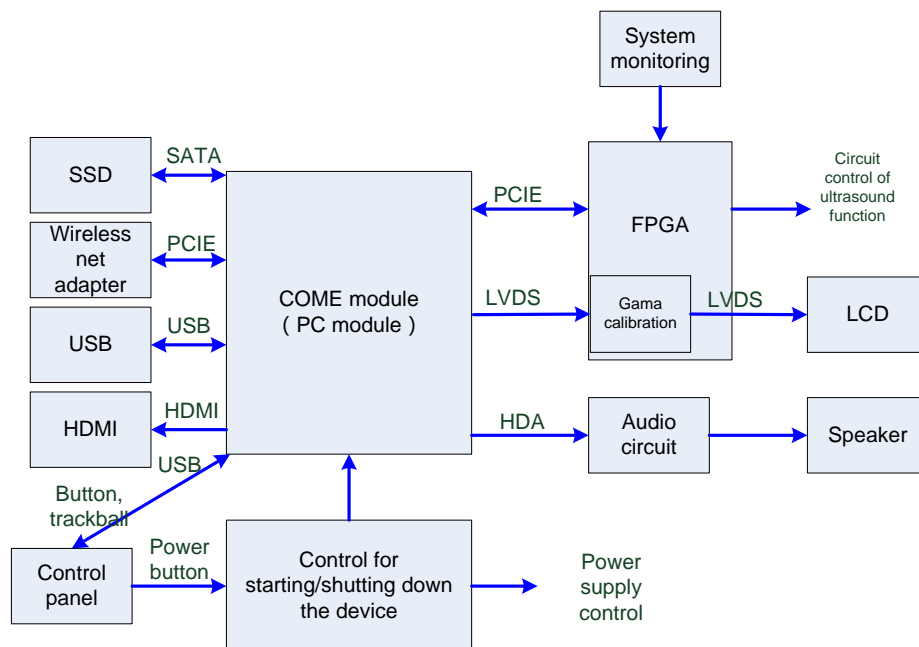
Figure 4-3 Principle diagram of power system

Function description:

Circuit Unit	Function
The control for Starting and shutting down the device	Takes charge of starting and shutting down the device and controls the indicator for starting and shutting down the device
System monitoring	Takes charge of battery management, fan control, voltage detection, battery indicator control, voltage detection and temperature detection
Wireless net adapter	WIFI and Bluetooth
USB ports	Provides two external USB 3.0 ports
SATA port	SSD, mSATA type
HDMI	Provides an HDMI port and supports 1920*1080 resolutions (HD) output.
Audio	Encodes and decodes the audio. Increases the power.
Signal process FPGA	Connects CPU module with the ultrasound circuit
Control panel port	Control panel port
LCD port	Connects to LCD monitor screen, displays parameter board screen and detects of environment brightness.
Other circuits related to ultrasound functions	➤ Transmitting/receiving control ➤ Probe control ➤ 4D, TEE probe control (reserved function, to be released) ➤ PHV control ➤ ECG control

4.2.3 Front-end of Main Board
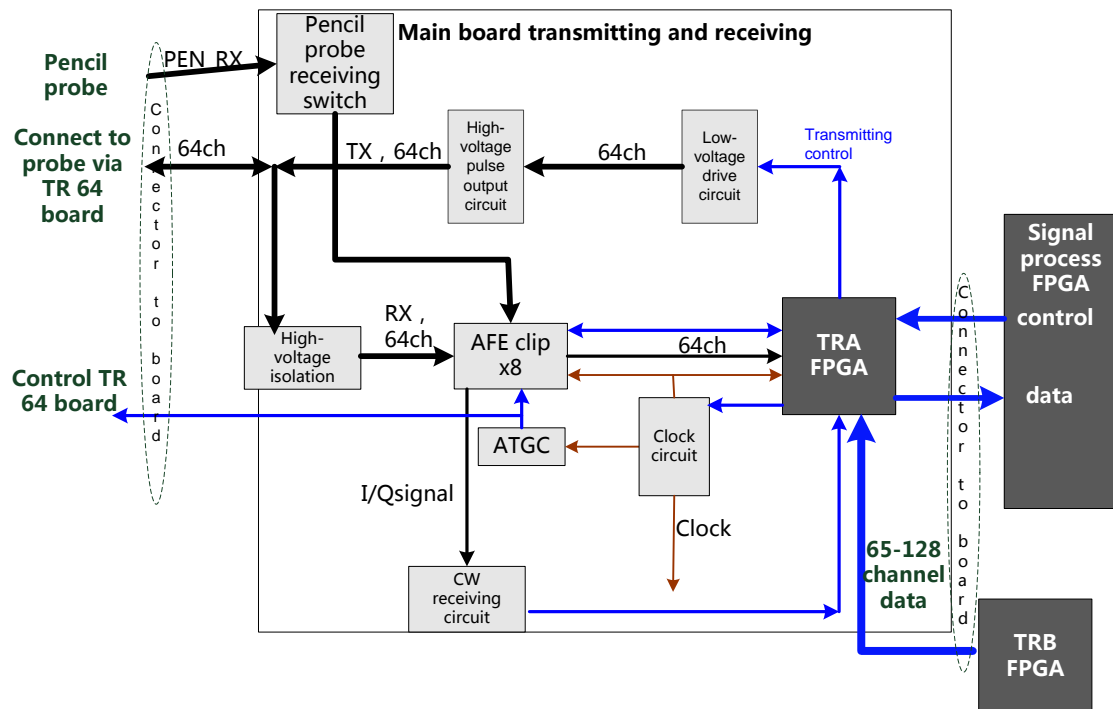
Fig 4-4 Systematical diagram of front-end of main board

The main functions of main board's front-end unit:

➤ Control FPGA (TRA, implements the control of 65-128 channels transmitting and receiving, ATGC adjustment and CW receiving control).

➤ Clock circuit

➤ Transmitting circuit (transmits the pulse with the achievement of 5 electric levels)

➤ High-voltage isolation

➤ AFE (receives echo signal)

➤ ATGC circuit (time gain compensation)

➤ CW receiving circuit (CW signal receiving)

4.3   TR64 Board
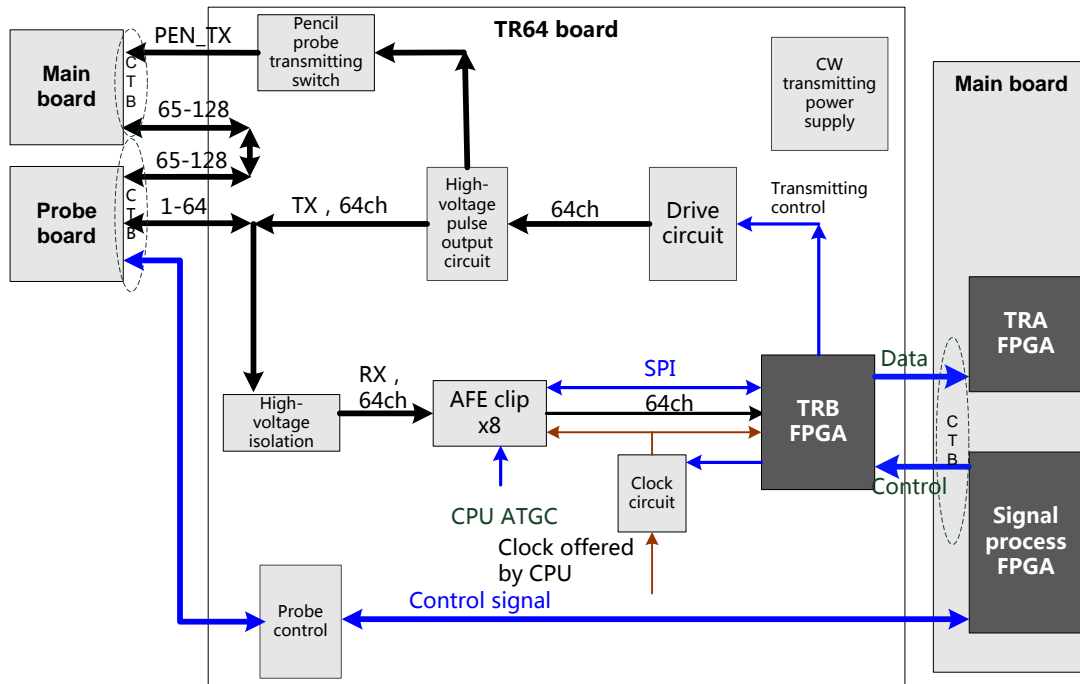
Fig 4-5 Principle diagram of TR64 board

The main functions of TR64 board:

➤ Control FPGA (TRB, implements the control of 1-64 channels transmitting and receiving, ATGC adjustment and CW receiving control).

➤ Clock circuit provides the clock for transmitting/receiving chip.

➤ Transmitting circuit (transmits the pulse with the achievement of 5 electric levels and CW)

➤ High-voltage isolation

➤ AFE (receives echo signal)

➤ ATGC circuit (time gain compensation)

➤ Probe port function (Probe recognition signal, power supply control of the probe)

4.4   Probe Board

➤ Supports 192/128 array probe, phased array probe, bi-plane probe, and other nominal probes, etc.

➤ Implements the connection between the main unit and the probe.

- Implements the switch of 192 array probe within the probe. Probe board only supports 128th channel.

4.5 PHV Power Supply Board
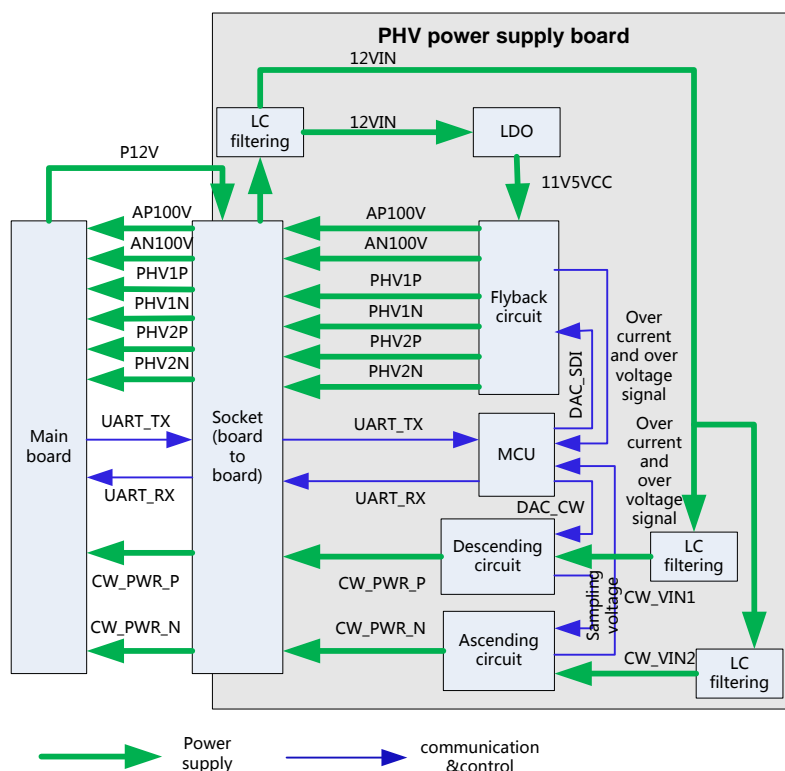
Figure 4-6 Diagram of PHV power supply board

Function description:

- PHV power supply board is the board that provides the power to the transmitting circuit. AP100V, AN100V, PHV1P, PHV1N, PHV2P, PHV2N, CW_PWR_P and CW_PWR_N are all outputs.

- PHV output goes into the power supply by producing the circuit via LDO.

- PHV input goes into the main board after being filtered.

4.6 ECG Unit

ECG module is designed for monitoring ECG signals and displaying ECG waveforms, which serves as reference of ultrasound images. This module can synchronize with 2D images and color flow images in real-time display. With R wave detected, ECG signals, after being

magnified, filtered and sampled, are sent to DSC nodule via series port UART. Triggered ECG signals that are detected are sent to control system for control. Then, it starts scan transmitting.

ECG transducer can be connected externally in this module design, which is also compatible with other monitoring products manufactured by Mindray.ECG unit structure is shown as below:
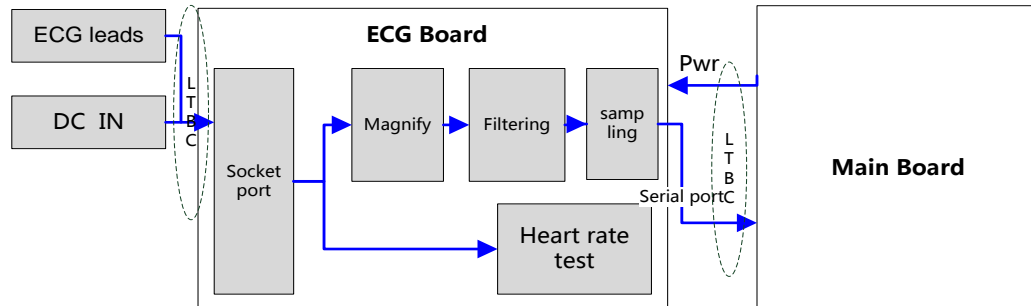
Figure 4-7 Principle diagram of ECG board

4.7 Control Panel

Control panel unit includes two boards, as shown below:

No.	Board Name	Description on Board Function
1	Control Panel	LCD monitor folding/unfolding detection, power button, trackball, standard keys on keyboard, user-defined functional keys, backlight control, status indicator of the device, encoder, buzzer, TCG detection, etc.
2	TGC Board	TCG adjustments in 8 segments
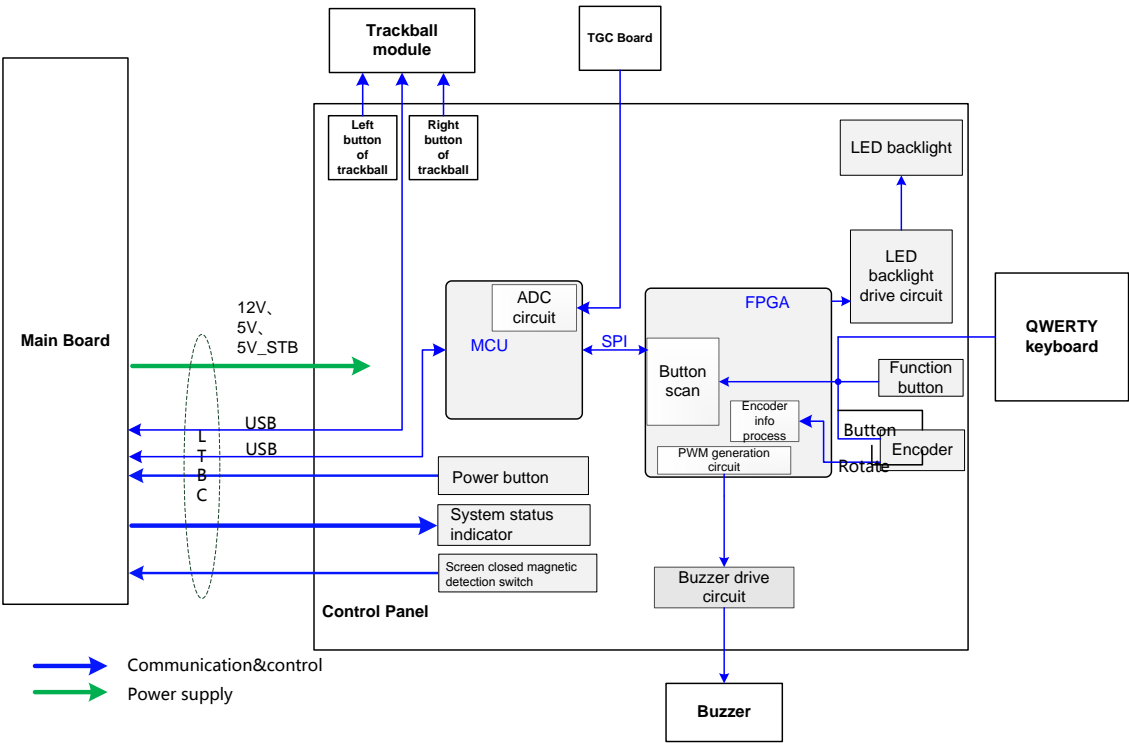
The functional diagram of the control panel unit is shown above. The main functions are described in details.

1. FPGA module adopts FPGA and implements key scan detection, backlight control, encoder detection, buzzer control and other functions.

2. MCU module implements USB communication, TGC detection, etc. FPGA and PSOC communicate via SPI port: PSOC obtains detection result of FPGA via SPI port and sends the result to the host by USB. PSOC obtains control information from the host via USB and sends it to FPGA via SPI port. FPGA performs the control operations to corresponding units after parsing control orders.

3. TGC board implements the fix of TCG's sliding rheostat.

4. Trackball sub-module communicates with the host via USB.

5. Sub-module of QWERTY keyboard adopts "thin film + silicon keys + structure keys" to implement the standard keyboard.

6. Buzzer sub-unit adopts PWM waveforms that FPGA outputs to control the length and sound of volume and frequency.

4.8 Main Display Unit
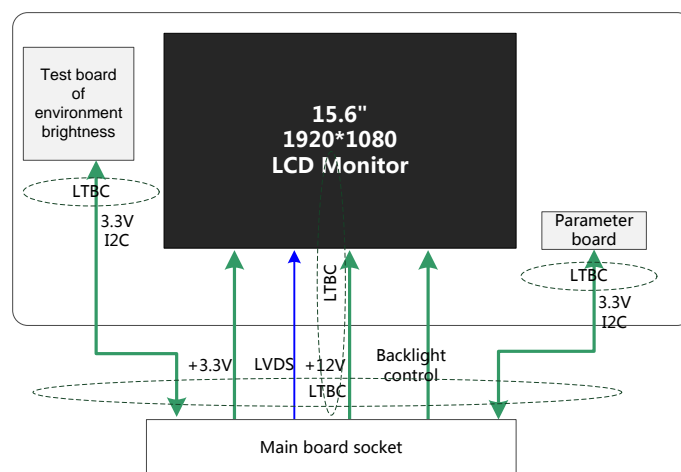
Fig 4-8 Principle diagram of monitor

The monitor unit consists of LCD screen, connecting wires, parameter board, environmental light detecting board, etc.

Function description:

➢ To make the display effect of LCD screen equal to that on the parameter board, parameter board stores color temperature and gamma calibration data. It is necessary to update the parameters in control panel for first time machine assembly or control panel/LCD screen replacements.

➢ Signal processing FPGA calibrates the video signal that CPU board outputs based on the information from parameter board, and then drives LCD display screen. Brightness and power supply of LCD display screen are also controlled by this FPGA.

➢ Environmental light detecting board detects the brightness level of environment. To achieve better display effect, main unit adjusts LCD brightness level according to the environment.

4.9   Probe Extension Board
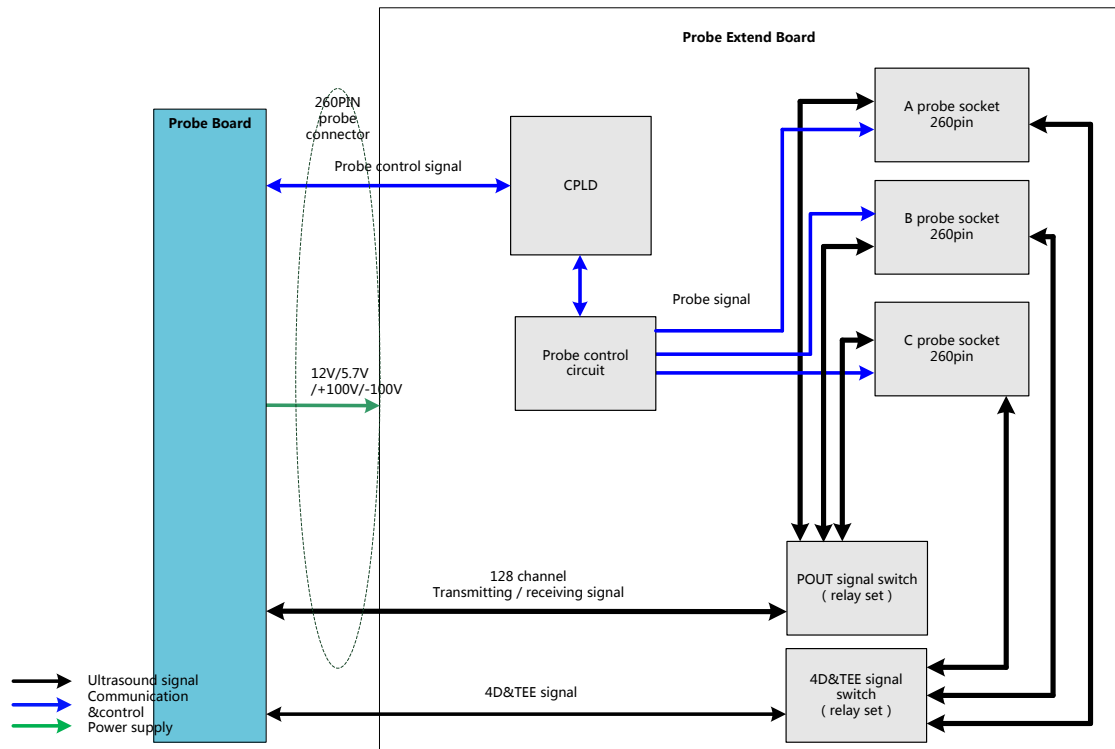
Figure 4-9 Hardware diagram of probe extension board

Function description:

➢ Supports 192/128 array probe, 4D probe, phased array probe, bi-plane probe, and other nominal probes, etc.

➢ Implements the switch of 192 array probe within the probe. Probe board only supports 128 channels.

➢ Probe board contains three 260pin Mini probe sockets.

➢ Supports the retrieving of three probes' IDs and the switch among three probe socket. ID recognition and the circuit of probe switch are independent to each other.

4.10 Audio/Video Transfer Module
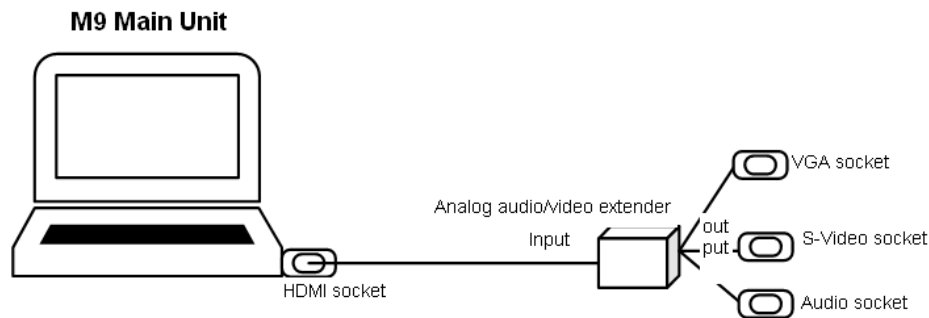
M9 Main Unit

Figure 4-10 Function of audio/video extend module

Audio/video transfer board (or module) adopts non-standard HDMI input port. Main unit outputs *1920×1080p@60Hz HDMI 1.4a* signal as input signal of the extender. The module supports *line-out* video signal of analog stereo audio, *xxxx×xxxx@60Hz analog RGB* video signal, *NTSC*, S-Video signal with format of PAL.

M9 audio/video transfer module includes: power supply, HDMI signal receiving, digital video signal processing, and audio/video code.
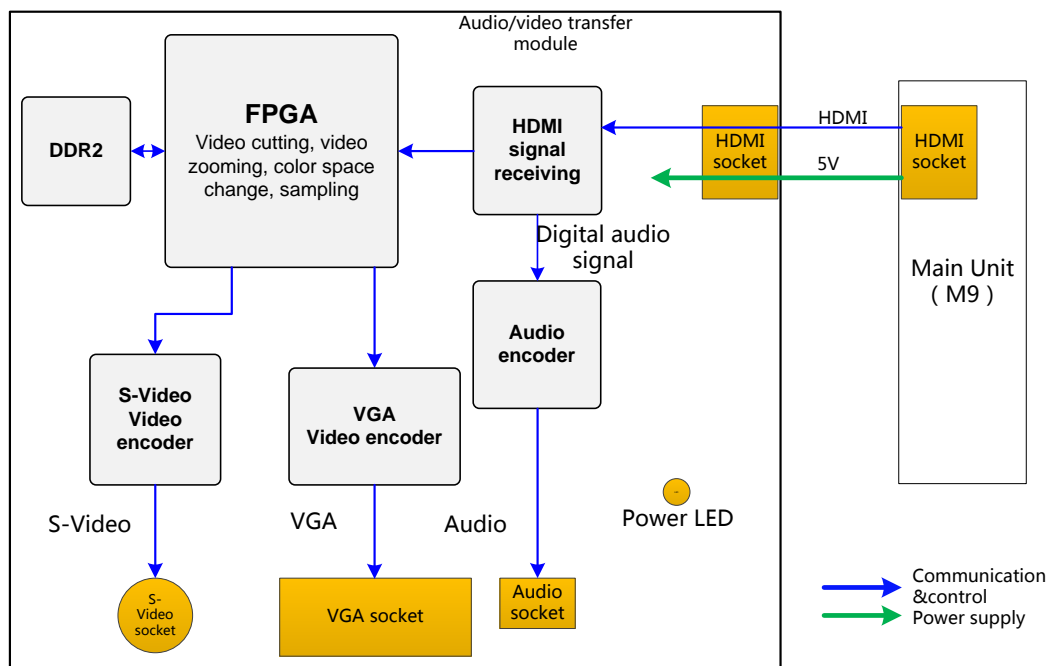
Figure 4-11 Diagram of audio/video extend module

4.11　USB HUB Board
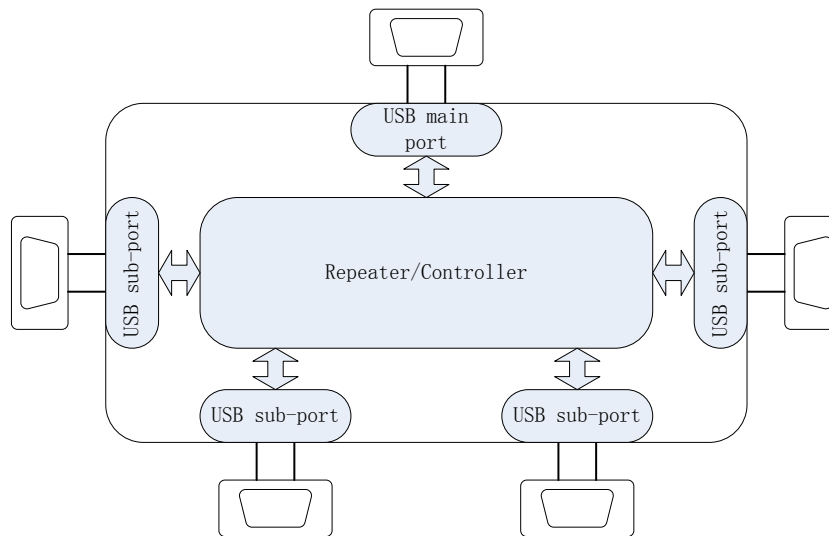
Fig 4-12 Principle diagram of USB HUB board

The main functions of USB HUB board:

➢ Compatible with the USB 2.0 standard;

➢ One USB port can be subdivided for four USB ports (there are two ports in current products.)

➢ Detect the plug and unplug of USB device via main port.

➢ Charge the device connecting to USB via main port.

4.12　Trolley Power Supply

Trolley power supply provides the power to main unit system. AC-DC power supply provides the power to main unit system when there is AC input. If there is no AC input, trolley power supply provides the power to main unit system. Trolley power supply includes connecting board of trolley power supply, AC-DC power supply, management board of trolley battery and two pieces of chargeable lithium-ion batteries. The connection of each part is shown below:
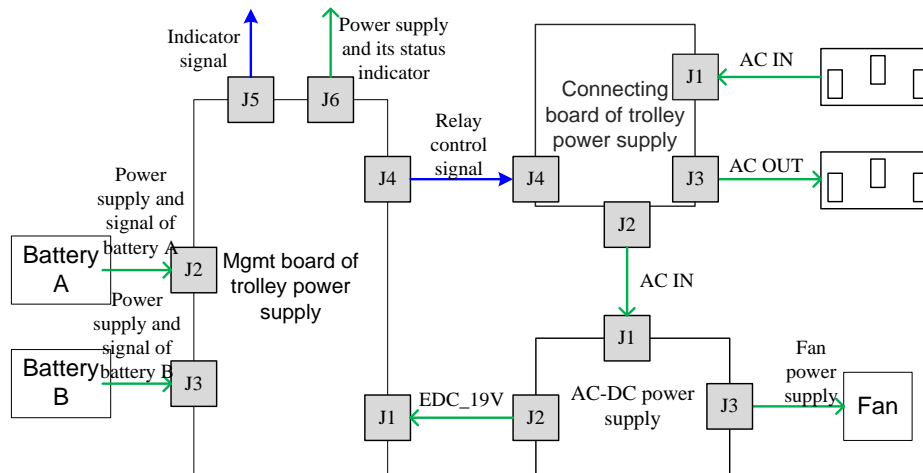
Figure 4-13 Diagram of related boards of trolley power supply

4.12.1　Connection Board of Trolley Power Supply

Main functions of connection board of trolley power supply:

➢　AC input transfer

➢　Auxiliary output control. Auxiliary output is enabled after starting main unit. Auxiliary output disconnects when main unit is in standby or shuts down.

4.12.2　AC_DC Power Supply

AC_DC power supply implements power supply isolation and voltage transfer. It outputs 19 V DC transferred from AC input. In terms of 150 W of main unit power and 50 W charging power, the maximum power of AC_DC power supply is 200 W.

4.12.3　Management Board of Trolley Battery

The main functions of management board of trolley battery:

➢　Implements AC power supply and auto switch of battery supply. AC power supply has the priority over others.

➢　Battery charge and battery management;

➢　AC status and battery status indication;

➢　Works with main unit system and recognizes the status of main unit system. Implements auxiliary output control and low battery-consumption when the trolley is in standby.

Principle diagram of management board of trolley battery is shown below:
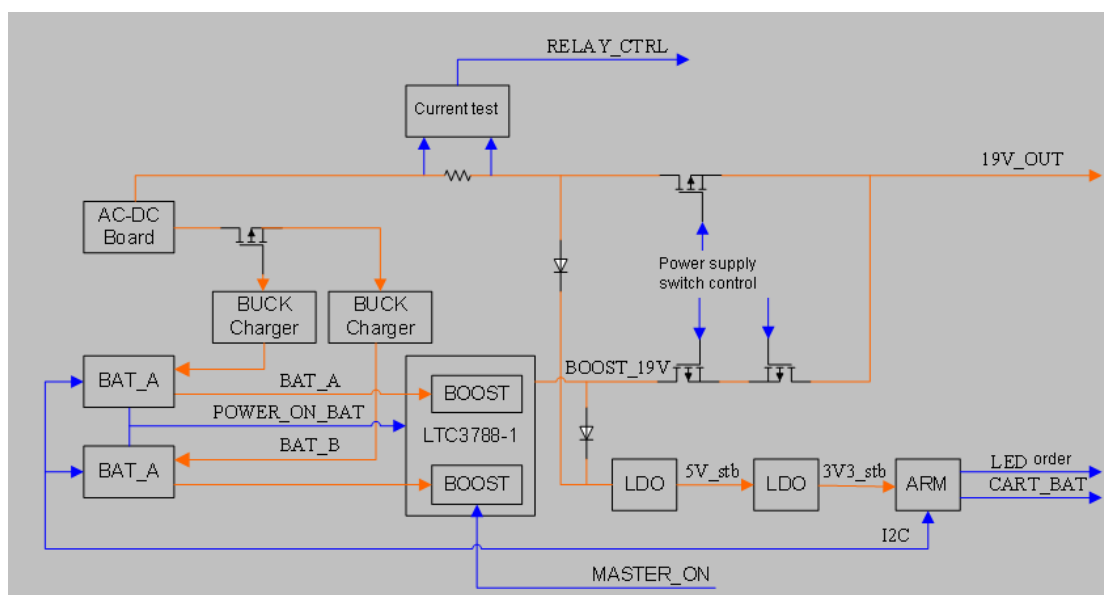
Figure 4-14 Diagram of management board of trolley battery

4.13   System Power-on Control
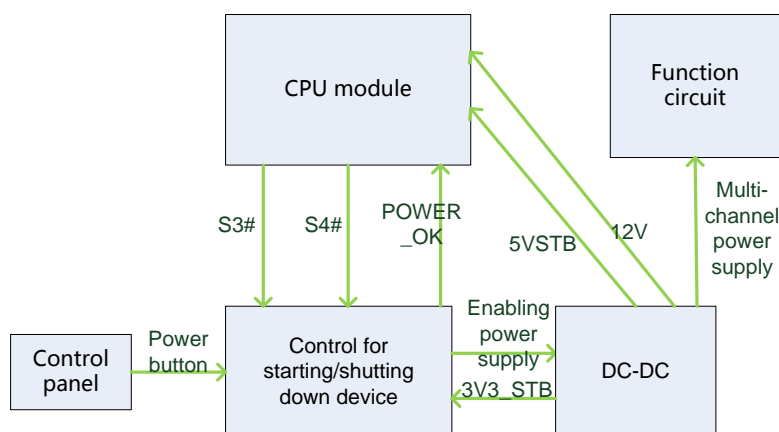
Figure 4-15 System power-on diagram

Description of related controlling signals:

No.	Controlling signal	Description	Comments
1	PWR_BTN_N, PWR_BTN#	Pulse signal that power-on button of control panel produces passes to CPU board through FPGA, and is used for starting the device.	
2	S3#	Output by CPU board, effectively represents that CPU system is in standby (the electrical level of S4# is high) and keeps 5VSTB powered on when it is in standby via FPGA.	
3	S4#	Output by CPU board, effectively represents that CPU system is in dormancy.	
4	S5#	The signal is not used currently	

5	PWR_OK#	Sent out by power management FPGA to CPU board, indicates that the 12V is powered on.	

➢ Power supply of main unit/battery enables the start of device.

➢ Power supply produces 5VSTB and 3.3VSTB as the AC inputs.

➢ Unplug AC when shutting down the device. Power supply cuts off 5VSTB output, but only keeps the output of 3.3VSTB. Only with power button pressed again, it's re-powered on.

➢ Unplug AC when the device is in standby. Batteries, for standby usage, provide the output of 5VSBT and 3.3VSTB.

➢ The process of power-on is shown below:
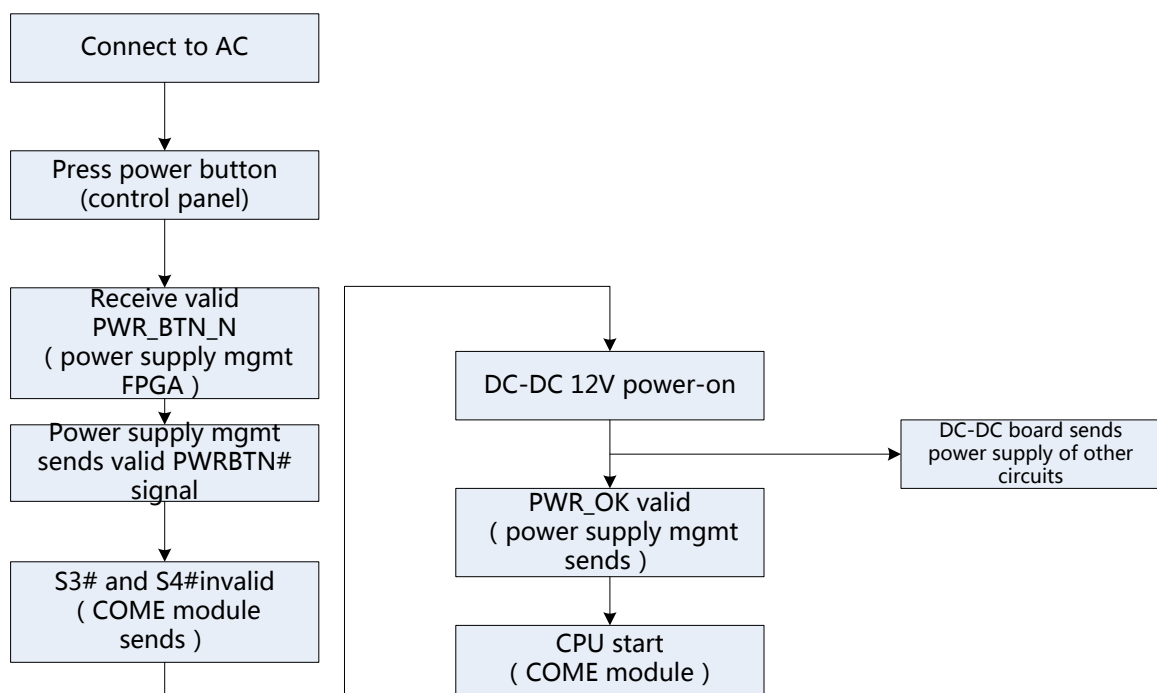
Figure 4-16 Diagram of system power-on

4.14 Internal Connection Diagram of Main Unit and Trolley
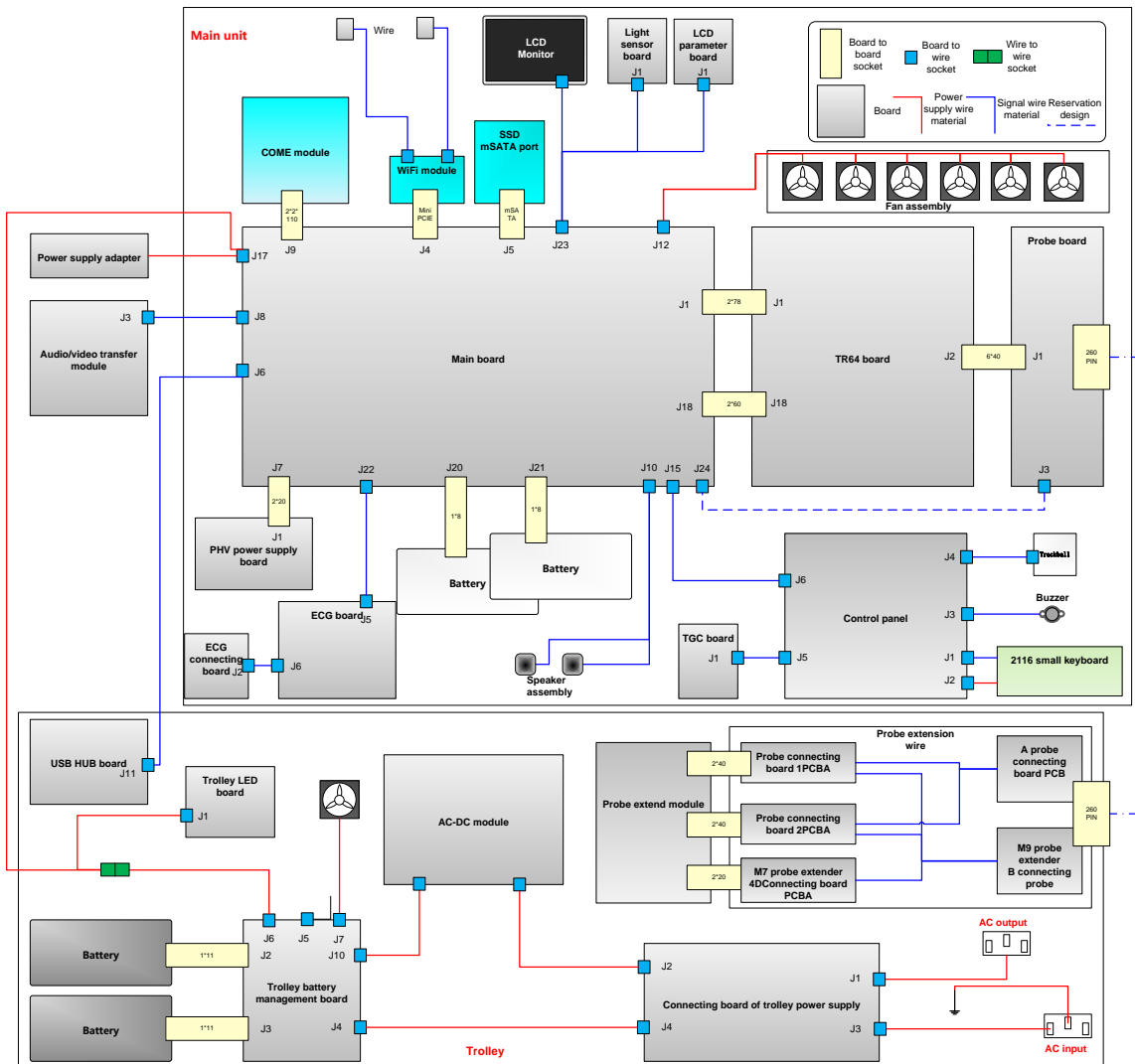
Figure 4-17 Internal connection diagram of main unit and trolley

4.15 Details in Main Unit's Power-on

Start-up procedure of main unit and the performance of power supply & display in various steps are shown below:

AC is active→Active AC indicator，green，lighting

Battery supply→battery status indicator，green，lighting

Press Power Button

EC ARM receives signal

Effective power-on — N → Exit, without starting

Y

Enabling CPU_PWR_BTN

Work status (below Power Button),green,blinks

COME module receives signal

COME module sends S3, and starts power-on flow

EC ARM receives S3 signal

Work status indicator (below Power Button), green, lighting

EC ARM enables power supply of main unit

Power supply power-on 1V→... ...

5V 12V

Control panel power-on

No sign on screen

Control panel FPGA configuration

EC ARM delay

DSP FPGA(PCIE device)start configuration

Control panel PSOC BOOT

DSP FPGA(PCIE device) complete configuration

Initialize control panel (white backlight is on)

EC ARM sends PWR_12V_OK order

DSP FPGA(PCIE device) in non-reset status

Control panel ready

COME module receives PWR_12V_OK

Initialize display. Turn off backlight. Do not output LVDS signal

No sign on monitor

COME module, start BIOS

Open DSP FPGA Open LCD backlight, adjust brightness

Backlight of monitor brightens. No display

COME module, output boot screen

DSP FPGA sends LVDS data to LCD

Correct image displays on monitor(BIOS boot screen)

COME module, complete BIOS

No sign on monitor

Hard disk indicator, green, blinks

Start loading OS Display changes of resolution

LOGO (MINDRAY) displays on monitor

Complete OS loading

No sign on monitor

Adjust final resolution

Image from desktop displays on monitor

Enter OS desktop

Start Doppler

Doppler start screen displays on monitor

4-18 Product Principle

5   Checking Performance and Functions

5.1   Description

The chapter describes checking methods to main functions and performance. The methods are only for reference.

5.2   Checking System Status

5.2.1   Running Status

1. Power on/off normal (duration time is normal), no abnormal sounds or occasion occur during normal operation.

2. After ultrasound system gets started, the fan starts working, and no abnormal noise is heard when the fan is working.

3. Check whether product configurations and software versions are normal via [About] interface.

4. Check whether contrast and brightness of the monitor are normal.

5. Check whether time and date are valid and correct.

6. Check whether all status indicators are normal.

7. Check all log records together with the users to confirm whether there are any abnormalities.

5.2.2   Working Condition

Check the ambient temperature and humidity. The measurement related to security features is sensitive to humidity. If the insulation feature of the system deteriorates due to the increase of system service time or system malfunctions, the fluctuation range of measurement results are likely to increase with the humidity increasing.

5.3 General Check

5.3.1 Check Flow

```
┌─────────────────────────────┐
│   Check the control panel   │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│      Check the monitor      │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│      Check peripherals      │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│         Check ECG           │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│       Check I/O port        │
└─────────────────────────────┘
```
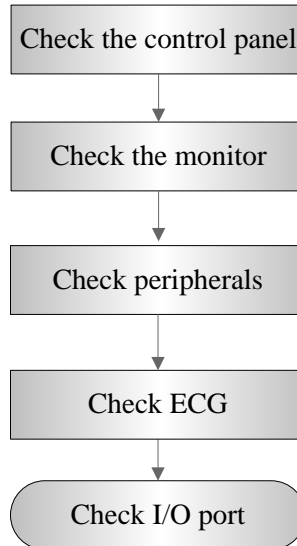
5.3.2 Check Content

5.3.2.1 Check Control Panel

Procedure	Checking criteria
1. Check all buttons, keys and knobs Follow the direction: left to right, and up to down.	All keys and knobs are effective.
2. Trackball function check ● Press <Freeze> to enter frozen status and move the trackball. ● Press <Measure> to enter measurement status. Measure the vertical distance and horizontal distance and perform other trackball operations.	The move of the trackball is smooth. The response to the cursor is rapid. The direction the trackball goes is same with that of the cursor.

5.3.2.2 Check Monitor

Procedure	Checking criteria
● Monitor brightness adjustment ● Monitor contrast adjustment ● Monitor maintenance Log on with the account named as "Service", select [Preset]-[Maintenance]-[Test Main Monitor] to check the monitor functions.	● Height adjustment: Auto adjustment: select [Preset]-[System Preset]-[General]. Click [Brightness Auto Adjustment] from [About]. Manual adjustment: press <Fn>+<↑> to increase the brightness. Press <Fn>+<↓> to decrease the brightness. ● Select [Preset]-[System Preset]-[General]. Click [+] from [Contrast] to increase the contrast. Click [-] to decrease the contrast. ● The monitor display works well after testing each function. Bad points are: 1 Light dot is 0; blinking dot defect is 0. 2 The adjoining dark dots are no more than 3 pairs, and there are no adjoining dark dots in image area. 3. 3 or 3 successive dark dots are no more than 0 pair. The dark dots are no more than 7 and those in the image area are no more than 2 5 The distance between bad dots is no less than 5mm. Note: the image area refers to the area enclosed by the rectangle with black/white background.

5.3.2.3 Checking Peripherals

Procedure	Checking criteria
Footswitch: confirm the normal connection between footswitch and USB port. Check the configuration status of footswitch under [Key Config] and corresponding implementation. (E.g. right key-image freeze; middle key-color print; left key-white/black print).	Trigger the freeze key of the footswitch (right key). Image freeze menu and freeze menu appear. The image is unfrozen if the key is triggered again. Trigger the print key of the footswitch (middle key). Start color print. Trigger the print key of the footswitch (left key). Start black/white print.
Video printer: confirm the connection between video printer and ultrasound device works well and check the implementation of each function.	Press the Print key which is setup well already to start the print. The image has no defect or degradation. Switch video output terminal. Then repeat the previous steps.
Graph/text printer: confirm the connection between graph/text printer and ultrasound device works well and check the implementation of each function.	Press the Print key which is setup well already to start the print. The image has no defect or degradation.
Barcode reader: scan any piece of barcode when the system is under running.	The barcode information displays on the image interface. The information is correct compared with the data information of barcode.

5.3.2.4 Checking ECG Module

Procedure	Checking criteria
Perform the following tests after the system is configured with ECG module: Connects ECG lead. Move the cursor to image menu. Click [Physio] to enter its interface.	ECG activation, ECG waveform and heart icon appear on the right corner of the interface. The parameters for [Scan speed], [ECG gain] and [ECG position] can be adjusted in real-time. Review ECG signals.

5.3.2.5 Checking I/O Interface

Procedure	Checking criteria
Checking I/O interface Verify video/audio interface, USB port, etc. ● VGA interface Connect external VGA/LCD monitor (the resolution should be one of them: 1920*1080，1024*768，1280*1024，1280*720). ● Other USB ports	● The information on VGA/LCD monitor is same with that on the screen of main unit. The characters and images are complete; the images are stable; no color cast; no shaking and no blinking. ● Network connection and communication work well. ● USB storage and read work well.

5.4 Functions Checking

> **Note:** The chapter lists the system checking items with complete configurations and describes them in details. If the items are not configured, the relevant tests can be ignored.

5.4.1 Checking Flow

```
┌─────────────────────┐
│  Check image mode   │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│    Check basic      │
│    measurement      │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│   Check cine mode   │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│  Check probe usage  │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│  Image and imaging  │
│     management      │
└─────────────────────┘
           │
           ▼
⟨ Record and save the ⟩
⟨        check        ⟩
```
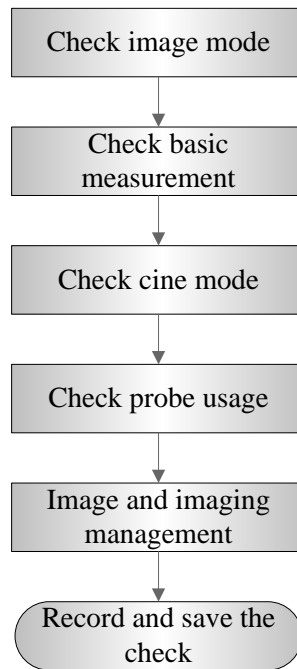
5.4.2 Checking Content

5.4.2.1 Imaging Mode

■ B-mode

◆ In B mode scan, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

Items	F	D	G	FR	DR	iClear	iBeam	iTouch
Meaning	Frequency	Depth	Gain	Frame Rate	B Dynamic Range	Display when the function is activated.		

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

Adjustment	Parameter Item
Control panel and image soft menu adjustment	Frequency (image quality), gain, depth, TGC, acoustic power, focus, scan range, steer, ExFov, line density, dynamic range, iClear, persistence, rotation/invert, iBeam, auto piecing, gray map, tint map, TSI, iTouch, HScale, dual live, LGC, Echo, Boost.

Parameter Adjustment

Procedure	Checking criteria
Press <B> button.	Enter B mode image. B mode interface appears.
Frequency adjustment B image soft menu-[Image quality]	The real-time value of frequency is displayed in the image parameter area in the upper right corner of the screen (fundamental wave-F, Harmonic frequency-H). Values of frequency vary depending upon the probe types.
Gain adjustment G Rotate <Gain> button	Gain increases with rotating the knob clockwise; Gain decreases with rotating the knob anticlockwise;
Depth adjustment D Press <Depth> button.	The depth of the image changes accordingly. Depth range varies depending upon the probe types.
TGC adjustment Adjust 8 sliders on the control panel	Push the slider right to increase the gain. The brightness of the area becomes brighter. Push the slider right to decrease the gain. The brightness of the area becomes darker. About 1.5s after the adjustment is finished, the TGC curve disappears.
Acoustic power adjustment B image soft menu-[Acoustic power].	The system offers 34 values to adjust the acoustic power. Acoustic power (AP) is displayed in real time in the upper part of the screen.
Focus B image soft menu-[Focus number] Press <Focus Position> to adjust focus position.	Focus position/number adjustment The focus position icon ◀ is displayed on the right side of the image.
Scan range and FOV position B image soft menu-[Scan range].	Image display adjustment [Scan range] is on and move the trackball to adjust the scan range.
Steer Press <Steer> arrow button.	To steer the beam the probe transmits.
ExFov B image soft menu-[ExFov]	Click [ExFov] on the soft menu to enable/disable the function.
Line Density B image soft menu-[Line Density].	The function determines the quality and information of the image. Levels of line density: UH/ H/ M/ L.
Dynamic Range B image soft menu-[Dynamic Range].	Rotate the knob clockwise to increase dynamic range; rotate the knob counterclockwise to decrease dynamic range. The adjusting range of parameter is 30-180 dB in increments of 5 dB.
iClear B image soft menu-[iClear].	The system provides 7 levels of iClear effects adjustment, *Off* represents iClear is disabled, and the bigger the value is the stronger the effect becomes.

Persistence B image soft menu-[Persistence].	The system provides 7 level of persistence. The bigger the value is the stronger the effect becomes.
Rotation/Invert B image soft menu-[L/R Flip]/[U/D Flip].	To invert the image horizontally or vertically. Image can be rotated by the angle of 0°, 90°, 180° and 270°. When the image is rotated in the angle of 90° or 270°, the depth scale is displayed on the upper part of the screen. The "M" mark indicates the direction of the image; the M mark is located on the top of the imaging area by default.
iBeam B image soft menu-[iBeam].	The system provides 4 values of iBeam in B mode. iBeam is disabled when it is off.
Auto Merge B image soft menu-[Auto Merge].	In the Dual-split mode, when the images of the two windows have the same probe type, depth, invert status, rotation status and magnification factor, the system will merge the two images so as to extend the field of vision. Turn on or off the function through the [Auto Merge] item in the soft menu;
Gray Map B image soft menu-[Gray Map]	Adjust the gray from [Gray Map] on the soft menu; There are 8 different maps available.
Tint Map B image soft menu-[Tint Map]	Select the tint map from [Tint Map] on the soft menu. Turn on or off the tint map from [Tint Map] on the soft menu.
TSI B image soft menu-[TSI].	Select TSI from [TSI] on the soft menu. The system provided 4 ways of optimization for specific tissues: general, muscle, fluid and fat.
iTouch Press <iTouch> button	Press <iTouch> on the control panel to enter the iTouch status, the symbol of which will be displayed in the image parameter area of the screen. Click [iTouch] on the image menu to adjust the gain in iTouch status among -12 through 12dB. Long press <iTouch> to exit iTouch mode.
HScale B image soft menu-[HScale]	Click [HScale] on the menu to display or hide the scale (HScale).
Dual live B image soft menu-[Dual live].	Enable [Dual Live] on soft menu, and dual-split window of images are displayed on the screen. Two pages of adjustable parameters are displayed on the touch screen as well; where, shared parameters and left window parameters are displayed on the B(L) page, while right window parameters are displayed on the B(R) page. Switch the display mode via <Switch Mode> and adjust the image parameters.

LGC B image soft menu-[LGC].	Images corresponding to four groups of parameters are displayed on the soft menu (from left to right). Click [LGC1-5] to adjust the parameters. To each segment of image area, the system offers 5 values to adjust the gain. The gain increases with the value becoming bigger. In addition, the system provides several preset parameters for imaging.
Echo Boost B image soft menu-[Echo Boost].	[Echo Boost] is enabled when it is on in B mode.(Highlighted) the system is in "Echo Boost" status.

■ M mode

◆ In M mode scan, the image parameter area on the right side of the screen displays the real-time parameter values as follows:

Parameter Item	F	D	G	V	DR
Meaning	Frequency	Depth	M Gain	M Speed	M Dynamic Range

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

Adjustment	Parameter Item
Control panel and soft menu adjustment	Gain, TGC, Depth, Focus Position, Display Format, Line Correlation, Tint Map, Scan Speed, Edge Enhance, Dynamic Range, Gray Map.

■ Color mode

◆ In Color mode scan, the image parameter area on the right side of the screen displays the real-time parameter values as follows:

Parameter Item	F	G	WF	PRF
Meaning	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	Parameter Item
Control panel and soft menu adjustment	Gain, Depth, TGC, Steer, iTouch Image Quality, Scan Density, Persistence, Smooth, Sensitivity, B/C Wide, Velocity, Flow, Wall Filter, Steer, B/C dual live, Caliper, Color Map, Color Priority, Baseline, HR Flow.

■ Power mode

◆ In Power mode scan, the image parameter area on the right side of the screen displays the real-time parameter values as follows:

Parameter Item	F	G	WF	PRF
Meaning	Frequency	Power Gain	Power Wall Filter	Pulse Repetition Frequency

◆ Parameters that can be adjusted to optimize the Power mode image are indicated in the following.

Adjustment	Parameter Item

5-8 Checking Performance and Functions

Adjustment	Parameter Item
Control panel and soft menu adjustment	Gain, Map, Dynamic Range

■   PW / CW Mode

◆   In PW/ CW mode scan, the image parameter area on the right side of the screen displays the real-time parameter values as follows:

Parameter Item	F	G	WF	PRF	SVD	SV	Angle
Meaning	Frequency	Gain	Wall Filter	Pulse Repetition Frequency	SV Position	SV Size (Only for PW mode)	Angle

◆   Parameters that can be adjusted to optimize the PW/ CW mode image are indicated in the following.

Adjustment	Parameter Item
Control panel and soft menu adjustment	Gain, SV, Depth, Image Quality, Caliper, iTouch, Auto Calculation, Invert, Scan Speed, T/F Res, WF, Tint Map, Gray Map, Display Format, Duplex/Triplex, HPRF, Baseline, Angle, Quick Angle, Dynamic Range, Volume, Steer.

5.4.2.2   Basic Measurement

Procedure	Checking criteria
B mode: ● Press <Measure> button ● Press <Caliper> button	● Enter application measurement mode ● Enter general measurement mode Measure 1-2 items (such as length, area). The calculation result is displayed at the bottom of the image in real-time.
Press the same button or press<Esc>.	Exit the corresponding measurement.
Similar operations for other modes	Application measurement options agree with various application software packages.

5.4.2.3 Cine Review

Procedure	Checking criteria
• Press <Freeze> to freeze the image. The system enters manual-review. (Precondition: Set "Enter in frozen status" to "Cine". • Open cine files in thumbnail, iStation or Review. The system enters automatic cine review status.	• Enter Cine Review status • The system enters auto review status.
Roll the trackball	Manual cine review
Click soft menu-[Auto Review]	Start auto review. Adjust soft menu knob to change the speed of cine review. Review speed gets faster with the value becoming bigger. Review speed gets slower with the value becoming smaller. If the review speed is 0, it exits auto review mode
Move the cursor to the start point to review (or image frame), and then click soft menu of image [Set as Start Point].	Set start point of auto review.
Move the cursor to the end point to review (or image frame), and then click soft menu of image [Set as End Point].	Set end point of auto review.
Click soft menu-[Auto Review] again.	The cine review plays between the start point and the end point.
• Press <Freeze> to defreeze the image again.	• Return to scan status with the image defreezing and exit cine review.

Auto play area

Total frame number

Start point of auto review

Current frame number

Review progress bar

End point of auto review

5.4.2.4 Probe Switch and Recognition

Procedure	Checking criteria
Press <Freeze> button – plug the probe – press <Freeze> button – press <Probe> button.	Ultrasound device can be recognized while connecting the probe.
Press <Freeze> button – unplug the probe – plug a new probe.	Recognize the probe type instantly.

5.4.2.5 Image and Imaging Management

Procedure	Checking criteria
Press <Save> in scan process (set based on the preset)	Save B mode image to patient data library in real-time. The icons of the images appear on the right side of the interface.
Select [Preset]-[System Preset]-[General]. Select "Exam Setting" from "Sending/Printing after End Exam". Press <End Exam> in scan process.	The system sends the image to the default DICOM server or printer server automatically.
● Press <Review> button ● Click [Close] button on the review interface; or press <Review>/<Esc> to exit the interface.	● To enter Review ● To enter Review
● Press iVision user-defined button ([Preset]-[System Preset]-[Key Config]-[Others]). ● iVision interface. Add the demonstration item, and select display method. Select a demo from the list, and then click [Start]. ● Click [Exit] or press <Esc> to exit after the demonstration finishes.	● Enter iVision screen ● Start image demonstration Image files are played according to file names one by one (including the image of system-relevant and PC-compatible format). ● Exit the image demonstration
Press <iStation> to enter patient information management interface.	Agree with patient's ID. View the real-time image/imaging information. The following operations are also available: ● Back up (Restore) ● Send (DICOM, USB flash disk, etc)

5.5 Performance Test

5.5.1 Test Procedures

Check resolution

Check detection depth

Check geometric positioning accuracy

Blind area test

Record the imaging
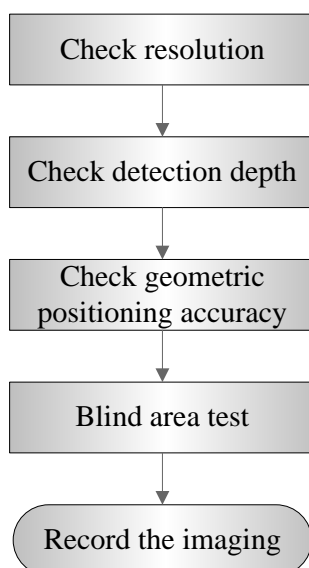
5.5.2 Test Content

Note:	The following figure is only used for reference in the testing, and the actual image effect depends on the specific system.

◆ **Requirements:**

1. Display: set the brightness and contrast values to clinical (or default) status;

2. Ambient: dark room to simulate actual clinical using;

3. The probe surface should contract with the acoustic window without separation or pressing.

◆ **Description:**

Refer to <Appendix B Illustration or Phantom Using> for the phantoms used in the test.

Phantom KS107BD, low frequency, used when center frequency of the probe ≤ 4MHz;

Phantom KS107BG, high frequency, used when center frequency of the probe ≥5MHz;

5.5.2.1 Resolution

■ Lateral resolution

Test Procedure:

1. Place the probe head gently on the acoustic window of the phantom which is covered by water or gel, and make sure the lateral resolution targets are displayed in the center of the image.

2. Focus to the lateral resolution target group.

3. Adjust gain, dynamic range, TGC, etc., make sure only the target line is displayed clearly on the image with no tissue image in the background.

4. Read the separation between two target points that can be distinguished clearly, while keeping the transverse target group horizontal.

5. Repeat upper steps at other depth.

Image effect is show in figure below:
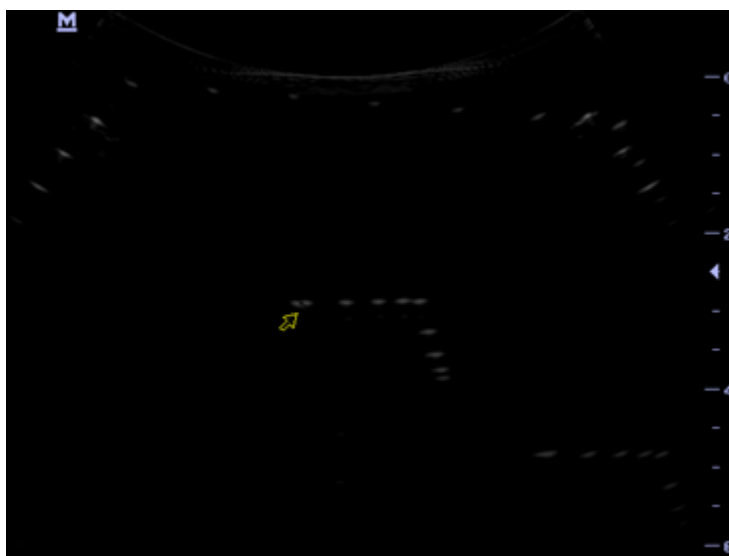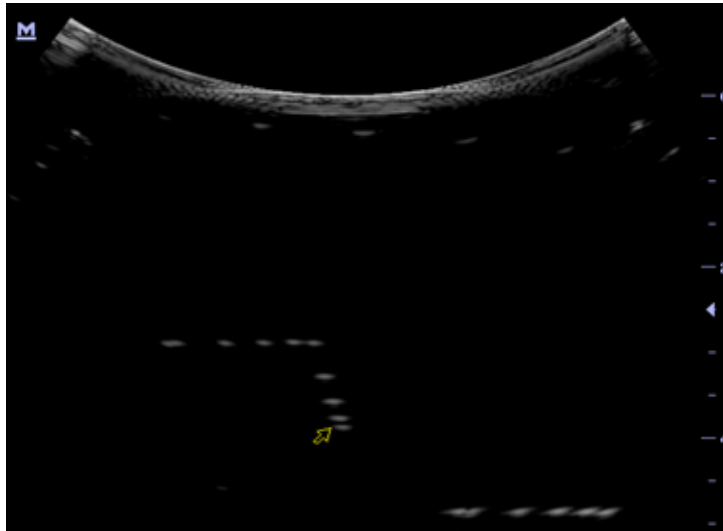

■ Axial resolution

Test Procedure:

1. Place the probe head gently on the acoustic window of the phantom which is covered by water or gel, and make sure the axial resolution targets are displayed in the center of the image.
2. Focus to the axial resolution target group.
3. Adjust gain, dynamic range, TGC, etc., make sure only the target line is displayed clearly on the image with no tissue image in the background.
4. Read the distance between two target points that can be separated clearly.
5. Repeat upper steps at other depth.

Note:	1.	For convex probe, keep the lateral resolution targets near the central line of the scanning plane.
	2.	For linear probe with Steer function, DO NOT turn on Steer when testing the transverse resolution.
	3.	Magnify (zoom) the targets for observation if necessary.
	4.	Distance between the left and right edges of a target point at a certain depth indicates the transverse resolution at this depth also.

5.5.2.2   Maximum Detection Depth

Test Procedure:

1. Place the probe gently on the phantom surface which is covered by water or gel.
2. Set displaying depth (according to the max depth of the current probe);
3. Adjust Focus to the deepest value, set AP value to largest.
4. Increase Gain, Contrast, TGC, but make sure no halos or defocusing appears.
5. Record the depth of the most distant target line which is imaged clearly.

Note:	1.	An overlarge gain may result in large noise and submergence of the echo signal.
	2.	For linear probe, the probe surface should be perfectly fit with the acoustic window on the phantom without any inclination during scan.
	3.	For convex and phased probe, make sure the axial target group is placed in the central of the scanning plane which keeps the justice of the interfering effect.

4.	In non-frozen mode, a distant target may be similar to a noise dot which should be discarded.

Image effect is show in figure below:
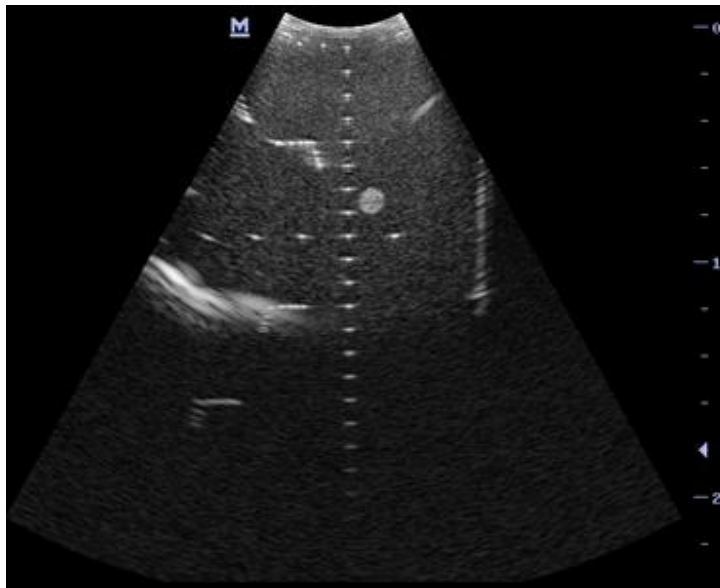
5.5.2.3 Geometric Positioning Accuracy

■ Axial Geometric Positioning Accuracy

Test Procedure:

1. Adjusting steps are the same with the Maximum Detection Depth.

2. Record the separation values with measuring caliper in step of 20 mm on the axial target group.

3. Select all measurement values deviating largely from 20 mm, and calculate the error by the following formula.

$$\text{Geometric positioning accuracy} \ (\%) = \left| \frac{\blacksquare \text{ value-actual D}}{\text{actual D}} \right| \times 100$$

Note:	1.	Measuring cursor should be placed on the top edge of the target image, not in the middle or bottom edge.
	2.	Scan plane should be perpendicular to each target line, in other words, scan plane should be parallel to phantom section plane.

Image effect is show in figure below:
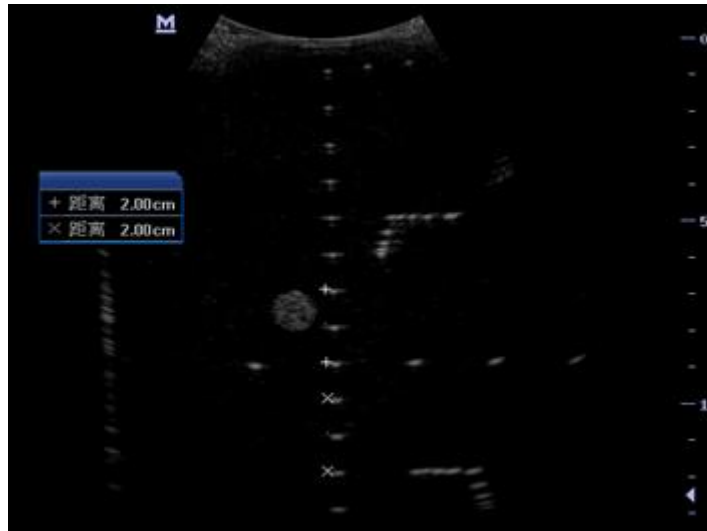
■ Lateral Geometric Positioning Accuracy

Test Procedure:

1. Place the probe gently on the acoustic window of phantom which is covered by water or gel.

2. Adjust display depth, to make horizontal groups display in the image.

3. Adjust focus to be in horizontal groups (no explicit standard).

4. Adjust gain, TGC, etc to make horizontal groups display clearly.

5. Use caliper to measure horizontal target distance by step of 20mm.

6. Select all measurement values deviating largely from 20 mm, and calculate the error by the following formula.

$$\text{Geometric positioning accuracy} \ (\%) = \left| \frac{\blacksquare \text{ value-actual D}}{\text{actual D}} \right| \times 100$$

| **Note:**	1.	To linear array probe, read the lateral distance one segment after another.
	2.	For convex probe, display all lateral targets one time.
	3.	The measurement caliper lies at the top or bottom of the target to be measured.

Image effect is show in figure below:
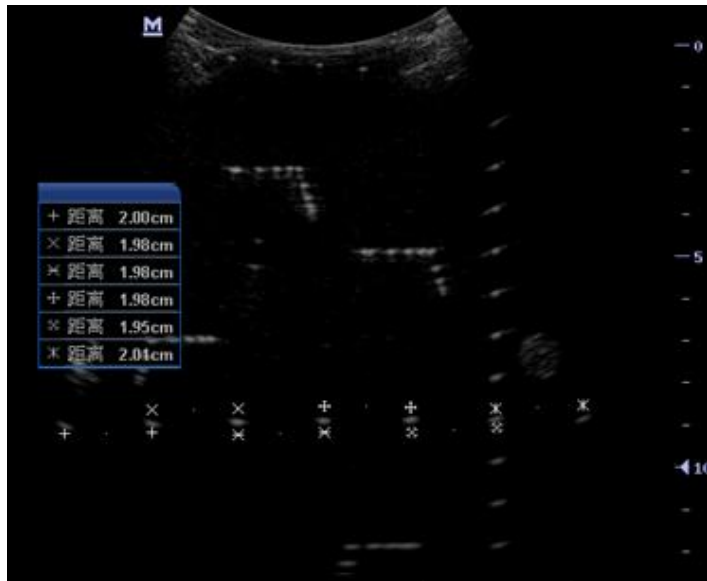
5.5.2.4   Blind Area

Test Procedure:

1.   Place the probe gently on the phantom surface which is covered by water or gel.

2.   Adjust the depth to lower value and set the focus to shallowest.

3.   Reduce AP, Gain, etc until the background noise is barely visible.

4.   Observe the depth of shallowest target image. It is also the blind area value.

| **Note:** | 1. | For linear probe, the probe surface should be perfectly fit with the acoustic window on the phantom without any inclination during scan. |
| | 2. | For convex probe, blind area target in the observation must lie on the central line of the scan plane. |

Image effect is show in figure below:
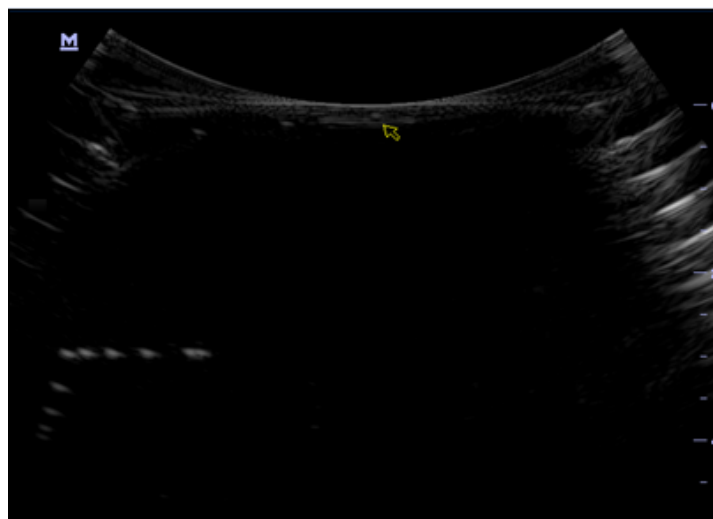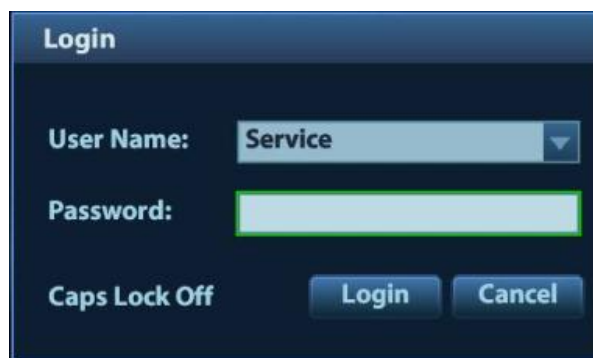
6 Software Installation & Maintenance

6.1   Enter Maintenance

Note: Before the maintenance operation, the engineer should login the system as Service.
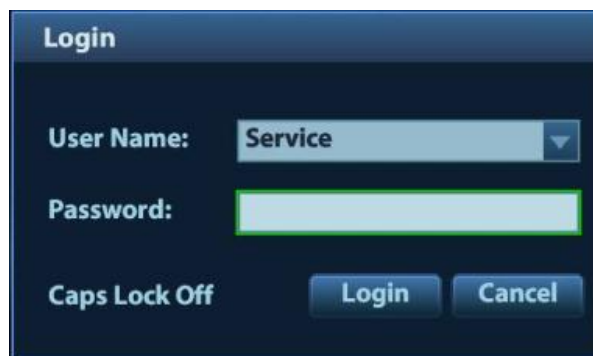
Log-in:

1. When Access Control is disabled: press "ctrl"+"/" to pop up the Login dialogue box, select Service as the user name and input the password.

2. When Access Control is enabled, press "ctrl"+"/" on the login dialogue box to show the inner users, select Service and input the password to login.

3. Log in with the account of Service and press <Set up> to enter maintenance interface by selecting [Preset]-[Maintenance]-[Setting].
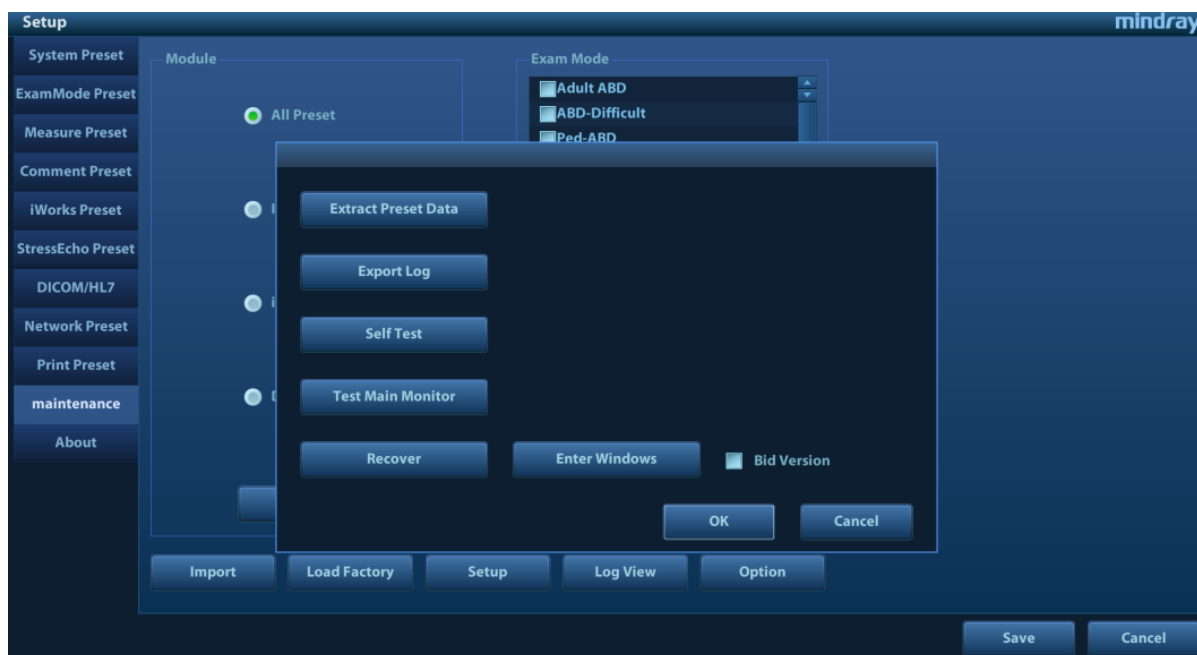
6.2   Software Installation/Restoration

See *Software Recovery Guide* for detailed system operations and Doppler system restoration.

> ⚠**WARNING:**
> 1. To avoid data loss, back up user's preset data and patient data before system restores.
> 2. Do Not cut off, shut down or restart the system in the restoration.

6.3   Enter Windows

1. The password is generated by device Mac address and serial number (see System Information), please contact Mindray Service Department for details.

2. Enter maintenance menu. Click [Enter Windows]. Type the password to enter Windows system.

6.4   Software Maintenance

6.4.1   Log Export

1. Insert the USB disk to the device;

2. Enter [Setting] interface; select [Export Log] to export the log.

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

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

Note:	The log can be exported to the external USB storage device only. Make sure there is enough space for the storage before the exporting.

6.5 Data Backup and Storage

6.5.1 Preset Data Management

Select [Preset]-[Maintenance]. Export and import system preset data or load the factory.

6.5.1.1 Back up the Setup Data

1. Click [Export] to open the [Export Data] dialogue box on [Preset Data Management] interface.
2. Select the path to save data.
3. Click [OK]. A progress bar appears and the setup data of the selected item is exported to the specified path.

6.5.1.2 Restore the Setup Data

1. Click [Export] to open the [Export Data] dialogue box on [Preset Data Management] interface.
2. Select the path to import the data. Select path to import all data or some of the data;
3. Click [OK], a progress bar appears and the setup data is imported to the specified module.

Tip: If select [Load Factory], the settings are restored to the factory defaults, except for region preset and admin.

6.5.2   Patient Data Backup and Restoration

6.5.2.1   Patient Data Backup

1.   Press [iStation] on the control panel to open the iStation dialogue box;

2.   Click [Select All] to select all data or select the desired data one by one;

3.   Select the information. Click [Backup Exam] to pop up the "Backup Patient Record" dialogue box. Select the desired storage device (recorder, DVD or USB disk). Click [Backup]. Back up the selected data automatically.

4.   Select whether to encrypt backup exams for USB only, input the password, confirm password in the field box, and then click [Backup], A "Patient.7z" compressed package is backed up to the USB device

Note: You need to input the password to open the package. If the password is forgotten, you cannot open the backup package.

6.5.2.2   Restore Backup 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. Click [Restore] to restore the patient data from the current drive to the patient database.

6.6   Introduction on HDD Partition Data

1.   The whole capacity is 128 G. The details are shown as follows:

Notes	Blocks(G)	Notes
C:	30G	NTFS
D:	84G	NTFS
E:	5.13G	NTFS

2.   Data distribution in each drive is shown as follows:

a)   D drive

Data directory of Drive D		Data	Description
D:\M9	\StressEcho	\UserProtocolTemplates	StressEcho Protocol Template
	\gui	\word	User-defined library
	\PATIENTDATA	\	Patient database path
	\Preset	\Current	User preset data
	\temporary	\	Temporary file directory
	\ScreenSaver		Screensaver
	\crash		Dump file directory
	\DICOMRevFiles		Temporary file backed up by DICOM
	\Log		Log file
		\DcmLog	DICOM log

	Userconfig		User information file

b) E drive
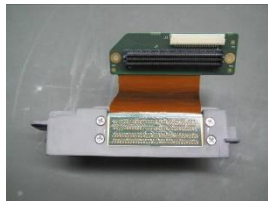
Directory structure of saved data in E Drive.		Data	Description
E:\M9	PatientBack		Patient data backup
E:	\Demo		Demo file

7 Field Replaceable Unit

The chapter describes the detailed information of units, which can be replaced in the system scene.

7.1　Main Unit

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
1	M9 series	Main unit related	M9 Main Board (FRU)	115-023067-00		Used for old machine(LVDS output+miniPCIEport WiFi); Mark Software version; Includes button battery and radiator washer.	8.2.10
				115-033406-00		For M9GI in CE region.Used for old machine(LVDS output+miniPCIEport WiFi); Mark Software version; Includes button battery and radiator washer.	
			M9 Main Board(eDP+M.2/8s/FRU)	115-048332-01		Used for new machine (eDP output+M.2 port WiFi); Mark Software version; Includes button battery and radiator washer.	8.2.10
			M9 Main Board(M9GI/eDP+M.2/8s/FRU)	115-048333-01		For M9GI in CE region. Used for new machine (eDP output+M.2 port WiFi); Mark Software version, Includes button battery and radiator	

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
						washer.	
	M8 series		M8 Main Board(M8 Series/8s/FRU)	115-055539-01		For M8 in CE region. Mark Software version when apply the FRU. Includes button battery and radiator washer.	
2	M9 series		CPU Module (FRU)	115-023066-00		Used for old machine (old PC+LVDS output); The MAC address will change with the replacement of CPU, so you may need apply the optional key the machine installed before.	8.2.10
			CPU Module(6100 PC module/eDP output/FRU)	115-048330-00		Used for new machine (6100 PC+eDP output); The MAC address will change with the replacement of CPU, so you may need apply the optional key the machine installed before.	
3	M9 series		Probe Board Assembly (FRU)	115-023070-00		/	8.2.9

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
	M9 series		TR64 Board (2116/FRU)	115-050982-00		/	8.2.10
	M9 series		SSD Card (M9/CE/FRU)	115-024561-00 For M9 in CE region.		Mark software version. NOTE: If SSD card is replaced, you need to select the second installation method (2. Install system without keeping user's data <format all disk>.) during OS recovery.	8.2.5

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
			SSD Card (M9/CE/FRU/6100 PC)	115-024561-01 For M9 in CE region.		Aplicable for M9 with 6100 PC	
			SSD Card (M9CV/CE/FRU)	115-024562-00 For M9CV in CE region.		/	
			SSD Card (M9CV/CE/FRU/6100 PC)	115-024562-01 For M9CV in CE region.		Aplicable for M9CV with 6100 PC	
			SSD Card (M9T/CE/FRU)	115-024563-00 For M9T in CE region.		/	
			SSD Card (M9T/CE/FRU/6100 PC)	115-024563-01 For M9T in CE region.		Aplicable for M9T with 6100 PC	
			SSD Card (M9GI/CE/FRU)	115-033405-00 For M9Gi in CE region.		/	
			SSD Card (M9GI/CE/FRU)	115-033405-01 For M9Gi in CE region.		/	
			SSD Card (M9/FDA/FRU)	115-026787-00 For M9 in FDA region		/	
			SSD Card (M9/FDA/FRU/61	115-026787-01 For M9 in FDA		Aplicable for M9 with 6100 PC in FDA region	

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
			00 PC)	region.			
			SSD Card (M9CV/FDA/FRU)	115-026788-00 For M9 in FDA region		/	
			SSD Card (M9CV/FDA/FRU/6100 PC)	115-026788-01 For M9CV in FDAregion.		Aplicable for M9CV with 6100 PC in FDA region	
			SSD Card (M9T/FDA/FRU)	115-026789-00 For M9 in FDA region		/	
			SSD Card (M9T/FDA/FRU/6100 PC)	115-026789-01 For M9T in FDA region.		Aplicable for M9T with 6100 PC in FDA region	
			SSD Card (M9Vet/CE/FRU)	115-045290-00		/	
			SSD Card (M9Vet/CE/FRU/6100 PC)	115-045290-01		Aplicable for M9Vet with 6100 PC in CE region	
			SSD Card (M9Vet/FDA/FRU)	115-045291-00		/	
			SSD Card (M9Vet/FDA/FRU/6100 PC)	115-045291-01		Aplicable for M9Vet with 6100 PC in FDA region	
			SSD Card	115-048923-00		For FDA region only	
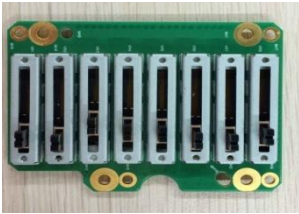
No.	Model	Classific ation	Material Name	Order Number	Picture	Remarks	Disassembl y Reference
			(M8Elite/FDA/FR U/6100 PC)	For M8Elite in FDA region.			
			SSD Card(M8GI/FRU/ 6100PC)	115-055538-00		Aplicable for M8GI with 6100 PC in CE region	
			SSD Card(M8T/FRU/6 100PC)	115-055537-00		Aplicable for M8T with 6100 PC in CE region	
			SSD Card(M8CV/CE/ FRU/6100PC)	115-055536-00		Aplicable for M8CV with 6100 PC in CE region	
			SSD Card(M8/FRU/61 00PC)	115-055535-00		Aplicable for M8 with 6100 PC in CE region	
5	M9 series		Wireless net adapter (Not include cables and antenna)	023-001226-00 Wireless net adapter(HalfMi niPCIE WIFI+Bluetooth)		Compatibility description: The vision of the software with 023-001226-00 wireless net adapter: OS version: V2.0.5 or higher Doppler version: V02.03.00(Rev29860) or higher	8.2.4
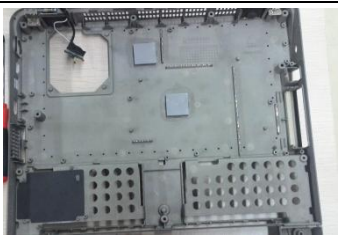
No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
				023-001528-00 Wireless net adapter(M.2 port)		Compatibility description: The vision of the software with 023-001528-00 wireless net adapter: OS version: V3.3.9 or higher Doppler version: V02.03.00(Rev29860) or higher	
6	M9 series		ECG assembly (FRU)	115-035832-00		/	8.2.7
7	M9 series	Power supply related	PHV Power Board(FRU)	115-023068-00		/	8.2.10

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
8	M9 series		Power supply adapter	022-000147-00		/	
9	M9 series		M9 Li-ion battery FRU (For CE region)	115-023405-00		Includeing Two batteries, should be replaced together	8.2.2
			M9 Li-ion battery FRU (For FDA region)	115-023072-00			
10	M9 series	Control panel related	Control Panel Assembly(Human/FRU)	115-023071-03		1. Not include trackball assembly,TGC board and QWERTY keyboard; 2. For human use only, include QWERTY keyboard shelter.	8.2.6
			Control Panel Assembly(Vet/FRU)	115-065680-00		1. Not include trackball assembly,TGC board and QWERTY keyboard; 2. For Vet use only, include control panel shelter.	

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
	M8 series		Control Panel Assembly(M8 Series/Human/FRU)	115-055540-02		1. Not include trackball assembly,TGC board and QWERTY keyboard; 2. For human use only, include QWERTY keyboard shelter.	
11	M9 series		Silicon keypad	049-000559-01		/	8.2.11
12	M9 series		Short swing key assembly	043-003222-00		/	8.2.11
13	M9 series		Long swing key assembly	043-003218-00		/	8.2.11
14	M9 series		Trackball	023-000706-00		Not include the connecting cable	8.2.11

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
15	M9 series		TGC Board	051-001383-01		Not include the connecting cable	8.2.11
16	M9 series		2116 PC Keyboard(Human/FRU)	115-060585-01		For human use only, include QWERTY keyboard shelter.	8.2.11
			2116 PC Keyboard(Vet/FRU)	115-065681-00		For Vet use only, include control panel shelter.	
			2116 PC Keyboard(Human/FRU/ Russian)	115-060586-01		Only used in Russian area; For human use only, include QWERTY keyboard shelter.	
			2116 PC Keyboard(Vet/FRU/ Russian)	115-065682-00		Only used in Russian area; For Vet use only, include control panel shelter.	
17	M9 series		Buzzer (FRU)	801-2300-00008-00		/	8.2.11

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
18	M9 series	Monitor related	Monitor assembly (FRU)	115-023069-00		LVDS signal	8.2.12
			Monitor Assembly(eDP screen/FRU)	115-048328-00		eDP signal	
			Monitor Assembly(LVDS 2eDP/FRU)	115-048329-00		Used to repair monitor with LVDS signal; When 115-023069-00 is used up, apply 115-048329-00.	
			Monitor assembly(M8 Series/FRU)	115-056405-00		Used to repair M8 series machine.	
19	M9 series		Monitor rear assembly(FRU)	115-023075-01		Not include main screen and WIFI antenna	8.2.12
			Monitor Rear Assembly (M8 Series/FRU)	115-056406-00			

7-12 Field Replaceable Unit

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
20	M9 series		Monitor front assembly	115-016997-00		115-016997-00 can repair only old M9 machines with LVDS signal; 115-016997-01 can repair all M9 machines.	8.2.12
				115-016997-01			
21	M9 series		M9 FAN(FRU)	115-023074-00		Stick the fan cladding to the fan on the scene.	8.2.8
22	M9 series		Back cover assembly of main unit	115-017214-00		/	8.2
23	M9 series	Others	Speaker and cable	020-000034-00		One pair (2)	8.2.7
24	M9 series		Battery cover assembly	115-017222-00		/	8.2.2

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
25	M9 series		Edge dust-proof mesh of main unit	043-003268-00		/	8.2.3
26	M9 series		Front dust-proof mesh of main unit	043-003265-00		Dust-proof mesh of fan	8.2.3
27	M9 series		Right Damping Shaft	045-000885-00		/	8.2.12
28	M9 series		Left Damping Shaft	045-000884-00		/	8.2.12
29	M9 series		iDock51 Audio/Video Extend Module	115-020783-01		/	9.2.3

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
30	M9 series		M9 Travelling case	115-039785-00		/	3.2.1.2
31	M9 series		M9 Ordinary Probe Bag	048-004129-00		/	3.2.1.2
32	M9 series		M9 Intracavity Probe Bag	048-004130-00		/	3.2.1.2

7.2   Mobile Trolley

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
1	UMT-500 trolley series	Main unit relate	Gas spring assembly	115-020353-00		/	8.3.5

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
2	UMT-500 trolley series	d	USB-HUB assembly	115-021103-00		/	8.3.5
3	UMT-500 trolley series		Drawer lock	034-000353-00		/	8.3.5
4	UMT-500 trolley series		Trolley panel cover assembly	115-020346-00		/	8.3.4
5	UMT-500 trolley series		Caster (FRU)	115-015314-00		/	8.3.8

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
6	UMT-500 trolley series	Power supply related	Trolley power supply fan	024-000320-00		/	8.3.3
7	UMT-500 trolley series		Power supply board	022-000148-00		/	8.3.3
8	UMT-500 trolley series		lithium-ion Battery FRU(CFDA/CE)	115-058717-00		This package includes two batteries.	
			lithium-ion Battery FRU(FDA)	115-058720-00			8.3.3

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
9	UMT-500 trolley series		Connection board of trolley power supply	051-001386-02		/	8.3.3
10	UMT-500 trolley series		Management board of trolley battery	051-001387-02		/	8.3.3
11	UMT-500 trolley series		Probe holder and probe holder backet (FRU)	115-037617-01		/	8.3.10

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
			Intracavity probe holder and probe holder backet (FRU/Upgrade)	115-045239-00			8.3.11
12	UMT-500 trolley series		Probe cable hook assembly (maintenance spare)	801-2102-00016-00		/	8.3.6
13	UMT-500 trolley series		Trolley storage tray	043-003592-00		/	8.3.2
14	UMT-500 trolley series		Trolley Pallet storage	043-003430-00		/	9.2.1

No.	Model	Classification	Material Name	Order Number	Picture	Remarks	Disassembly Reference
15	UMT-500 trolley series		Probe extend module	115-020784-00		/	9.2.2

8 Structure and Assembly/Disassembly

8.1 Structure of the Complete System

8.1.1 Main Unit
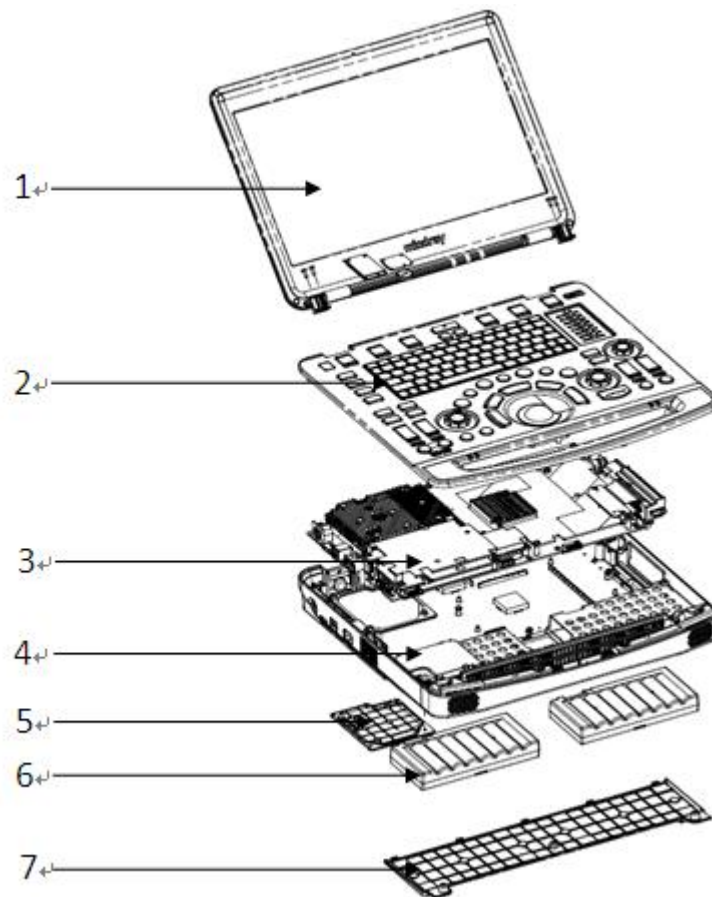
Fig   Overall Exploded View

No.	Name	No.	Name
1	Display (monitor) assembly	5	Hardware cover
2	Control panel assembly	6	Battery
3	Machine board assembly	7	Battery cover assembly
4	Back cover assembly of main unit		

8.1.2　Mobile Trolley
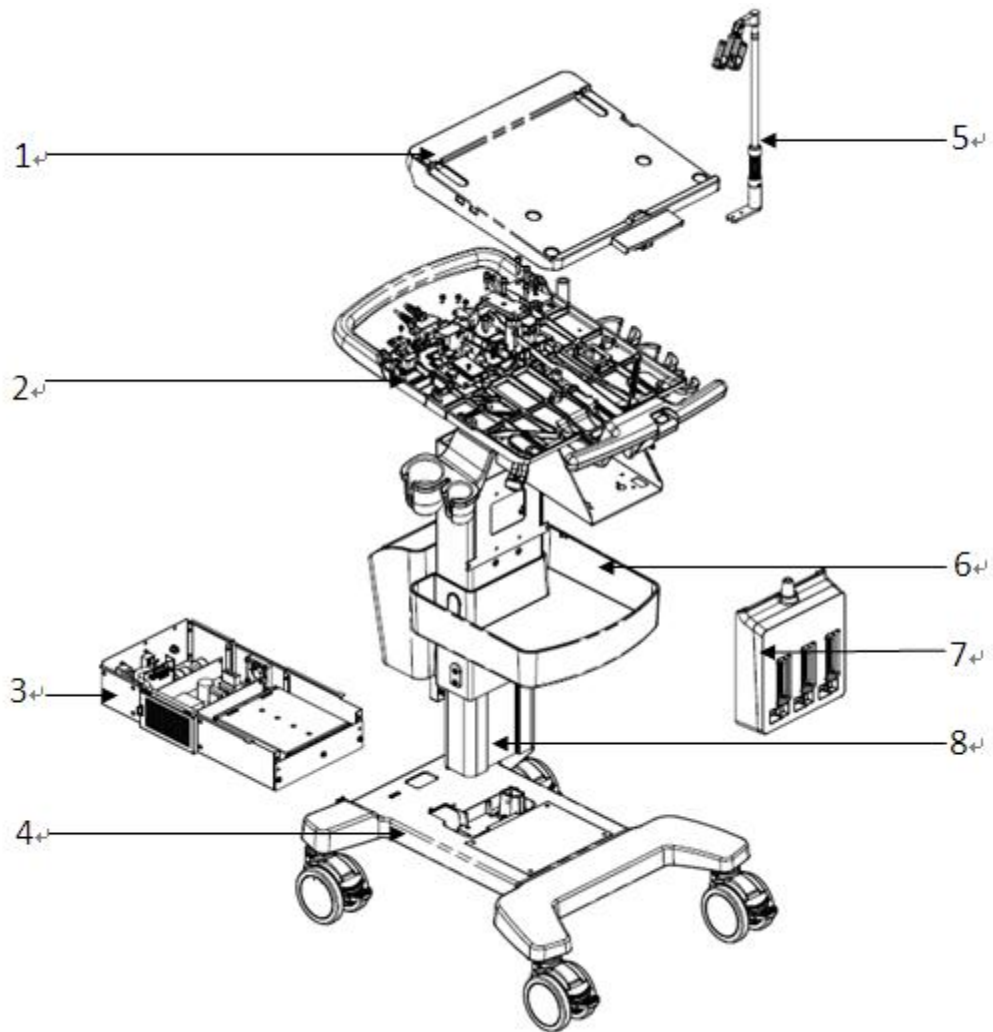
No.	Name	No.	Name
1	Trolley panel cover assembly	5	Probe cable hook assembly
2	Cast-aluminum base assembly of trolley panel	6	Storage tray
3	Power supply assembly	7	Probe extender assembly
4	Trolley base assembly	8	Lifting column assembly

8.2 Main Unit Assembly/Disassembly

This section describes the disassembling and assembling of the main parts and hardware boards. The assembling is the inverse process of disassembling if not mentioned in particular.

◆ **Sketch**
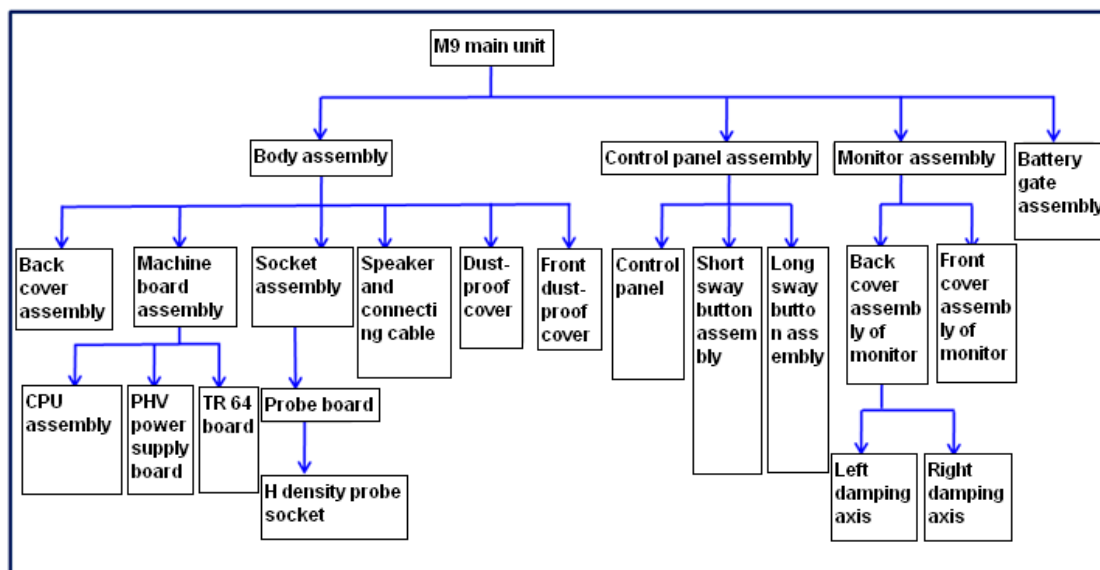
> **Note:** The illustration of disassembly is for reference only; please relies on the actual model.

8.2.1 Preparation

8.2.1.1 Disassembly Tools Required

Name	Type	Material No.	Remarks
Cross-headed screwdriver	107*75	/	M2
Cross-headed screwdriver	102*100	0000-10-10884	M3、M4
Spanner	1PK-H024	095-000063-00	4″
Diagonal cutting pliers	N-206S	095-000077-00	/
Anti-electrostatic glove: 1 pair.	/	/	/

8.2.1.2 Engineers Required

The disassembly should be performed by professionals from Mindray or the staff who are qualified for the maintenance after the training.

8.2.1.3   Disassembly Requirements

Be prepared before disassembling ultrasound device.

1. Stop scanning the patient and capturing images. Shut down the device and cut off AC power

    supply. Unplug AC power supply cable.
2. Be prepared for a softer platform and keep the platform clear. Prevent the device from scrape.
3. Get the tools and gloves prepared.

8.2.2   Battery

Note: it is recommended to remove the battery first, and the remove other parts when the power supply is cut off.

1. Unscrew 3 screws on the battery cover (2 M3 X 20 cross head screws, 1 M3 X 8 Nylok screw). Remove the battery cover towards the direction as blue shows.

Battery cover

M3X8 Nylok screw

M3X20 panhead screw (2 screws)
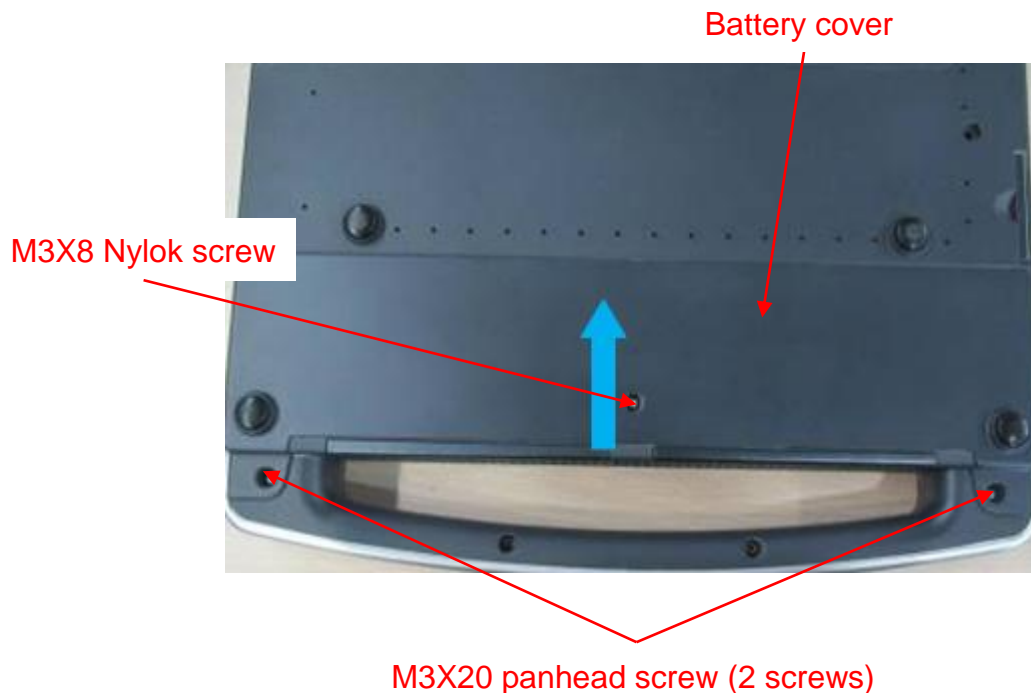
2. Pull the white tab up. Take out the battery.

Battery   Tab
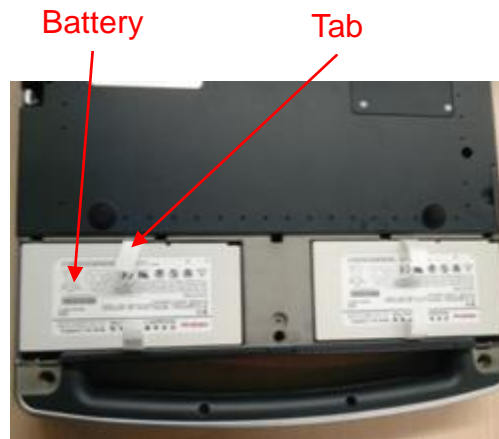
8.2.3 Dust-proof Mesh of Main Unit

1. Take out the dust-proof mesh on the right side.

Dust-proof mesh on the right side

2. Take out the dust-proof mesh in front of main unit.

Dust-proof mesh in front of main unit
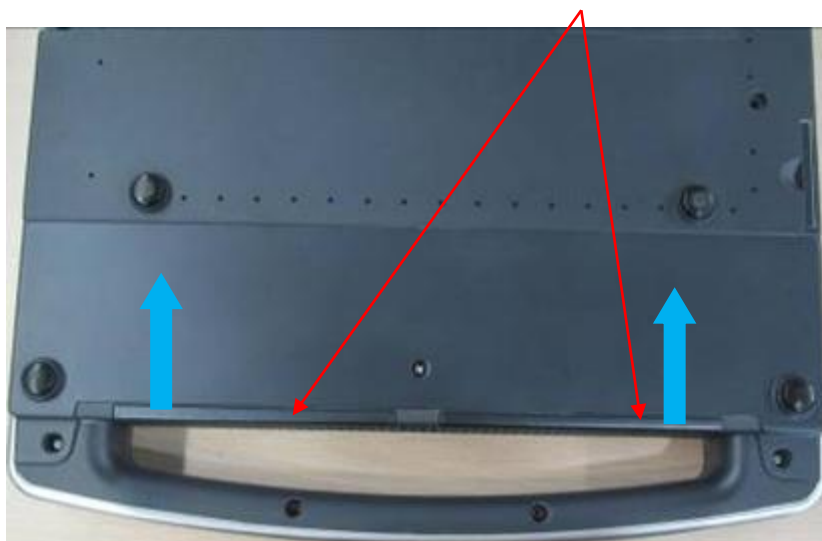
8.2.4   Network Adaptor

1.   Unscrew four screws (M3 X 6 cross panhead screw) on the hard disk cover, and then remove
      the hard disk cover.

Hard disk cover   M3 X 6 cross panhead screw (4 screws)
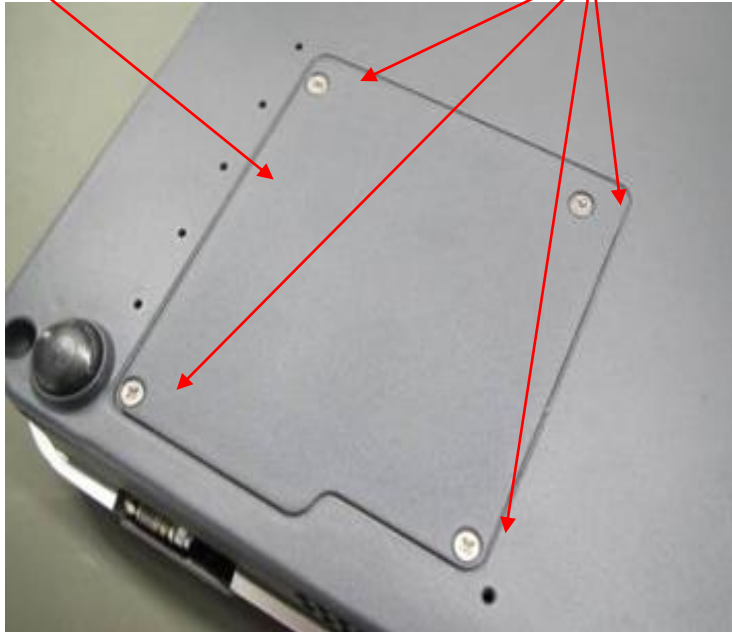
2.   Extract the network cables. Extract the signal cables of monitor via black handle.

Network adaptor snap closure

Extract signal cables of monitor via black handle

3.   Push the metal snap closure backwards as the thick arrow shows. Take the wireless network
      adaptor out by following the direction as left thick arrow shows.

Two metal snap closure to lock wireless network adaptor

Wireless network adaptor

Metal snap closure
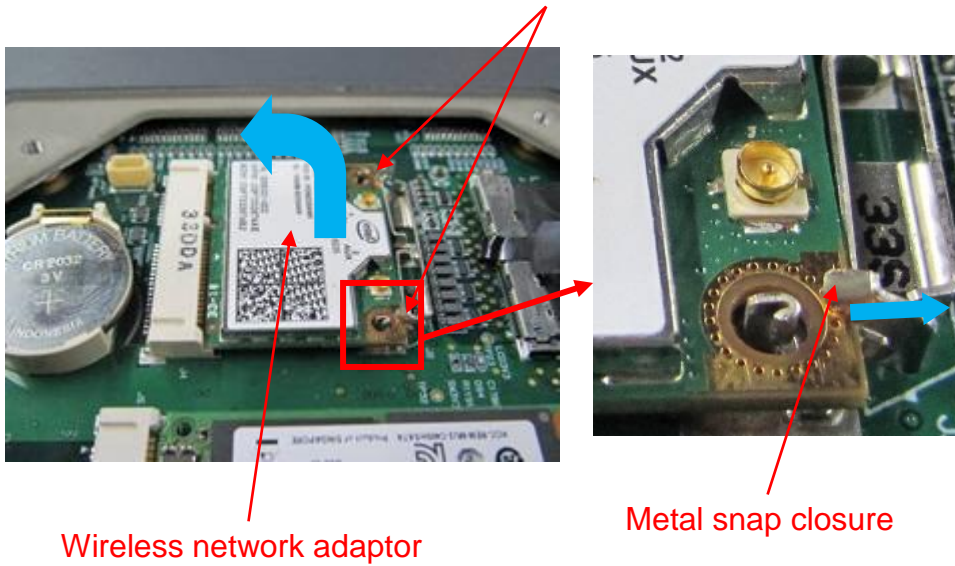
4. Remove button battery

Hold the button battery gently. Put the sharp end of the tweezers or flat-headed screw into the gap between battery and bulges of plastic cover. The button battery bounces off then.

Note: do not press hard in the operation.

Bulges of plastic cover

8.2.5　SSD Card

1. Remove the hard disk cover. See the first step in *Chapter 8.2.4*.
2. Push the metal clasp towards the blue arrow's direction.

Metal clasp
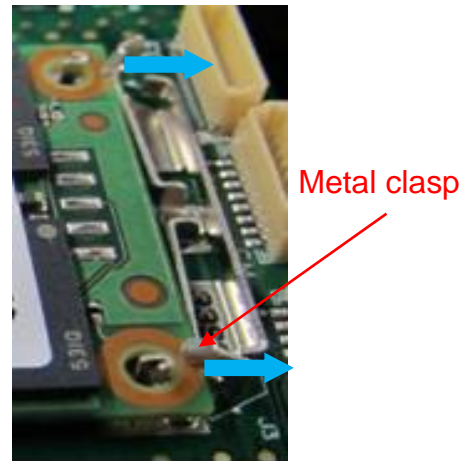
3. Take out SSD card.

8.2.6   Control Panel and Monitor

1. Remove network adaptor and battery assembly. See *Chapter 9.2.2* and *Chapter 9.2.3* for details.
2. Unscrew 11 screws on the back cover (M3 X 8 Nylok screw).

M3X8 Nylok screw (11 screws)
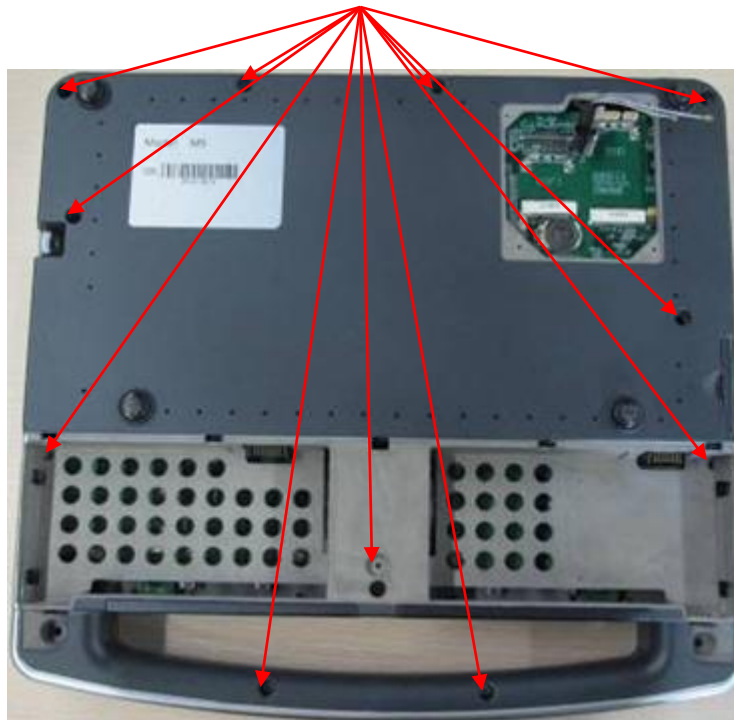
3. Open control panel. Extract the signal cables of control panel, and remove the control panel.

Extract signal cables of control panel
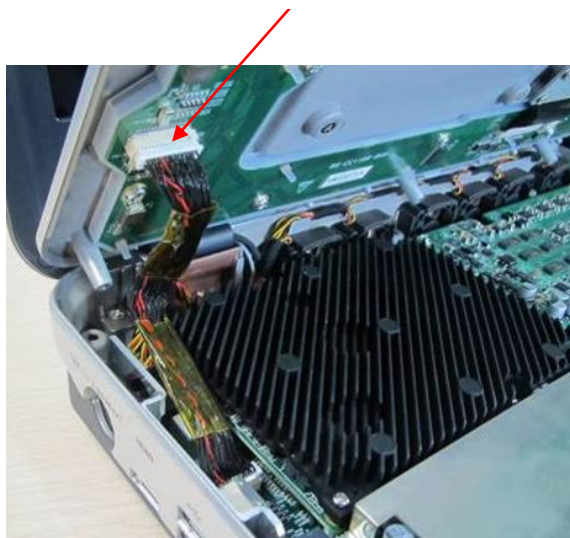
4. Unscrew 4 screws (M3 X 8 Nylok screws) as shown in the Figure. Remove the monitor upwards.

M3X8 Nylok screw
(2 screws for each left and right side)

Remove the monitor assembly
upwards
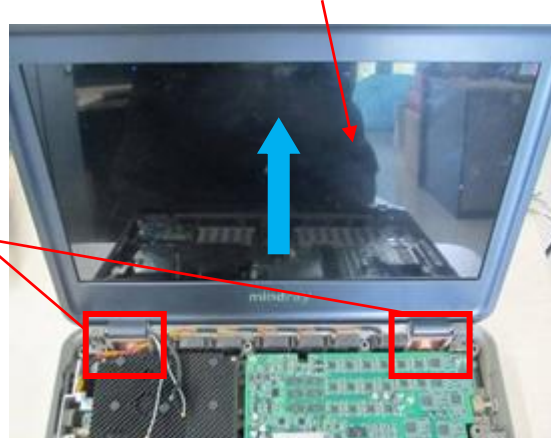
8.2.7 ECG Assembly

1. Remove control panel and monitor assembly. See *Chapter 9.2.4* for details.

2. Unscrew 4 screws on CG shield cover (M2 X 4 stainless steel cross head screws). Remove the shield cover.

M2 X 4 stainless steel cross head screw (4 screws)
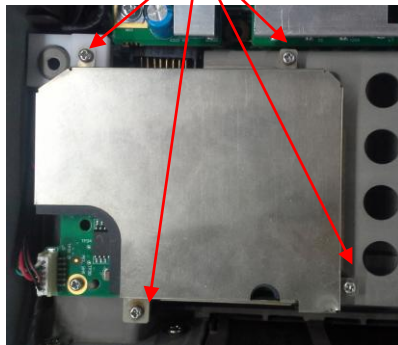
3. Remove the ECG cable pressure plate, and remove 4 screws on ECG board ((M2 X 4 stainless steel cross head screws). Remove ECG board. Extract ECG signal cables.

M2 X 4 stainless steel cross head screw (4 screws)

Pressure plate

ECG signal
cables
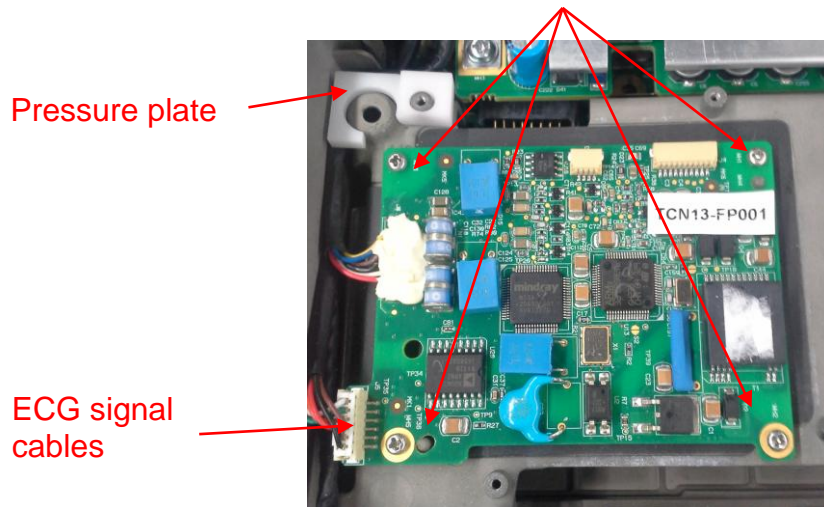
4.   Unscrew 2 screws on ECG fixing bracket (M3 X 8 Nylok screw).Remove ECG's fixing bracket
     and extract ECG connecting cables.

M3 X 8 Nylok screw (2 screws)

Connecting cables to
ECG socket
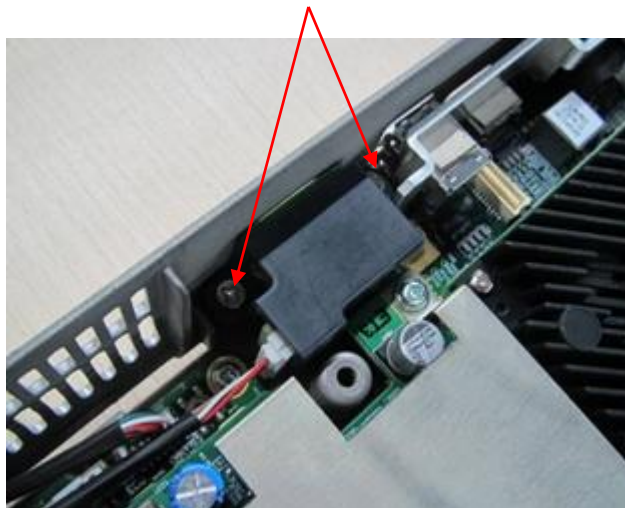
ECG fixing bracket   ECG connecting board
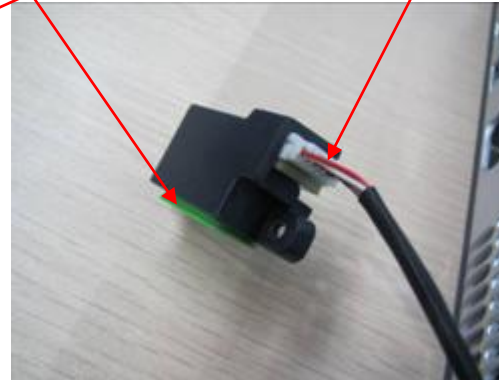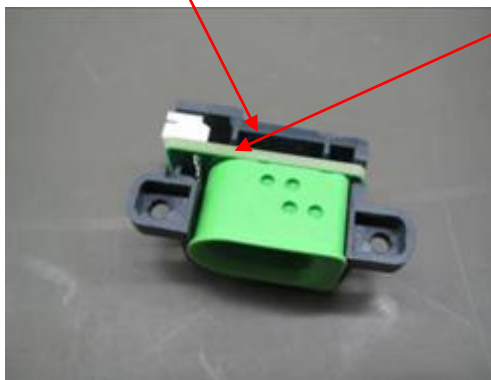
5.   Remove the speaker assembly. Unplug the socket on the main board.

Socket to speaker   Speaker assembly
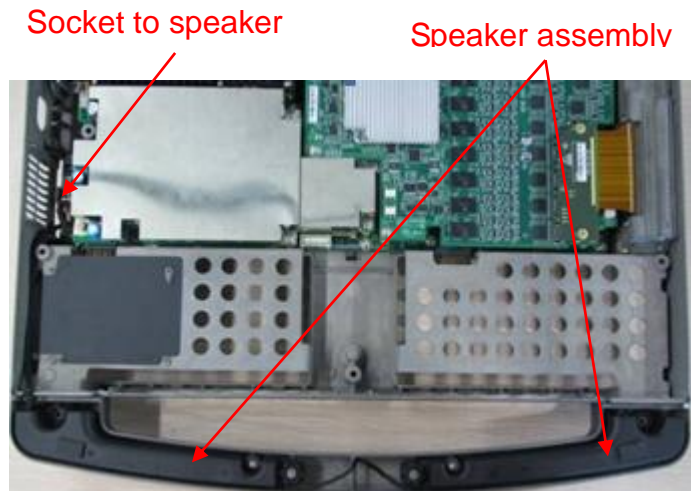
8.2.8   Fan

1.   Remove control panel and monitor assembly. See *Chapter 9.2.4*.
2.   Unplug the connecting cable of fan. Remove the hot-melt adhesive. Take out the fan.

Fan plug   Hot-melt adhesive   Fan's shield cover
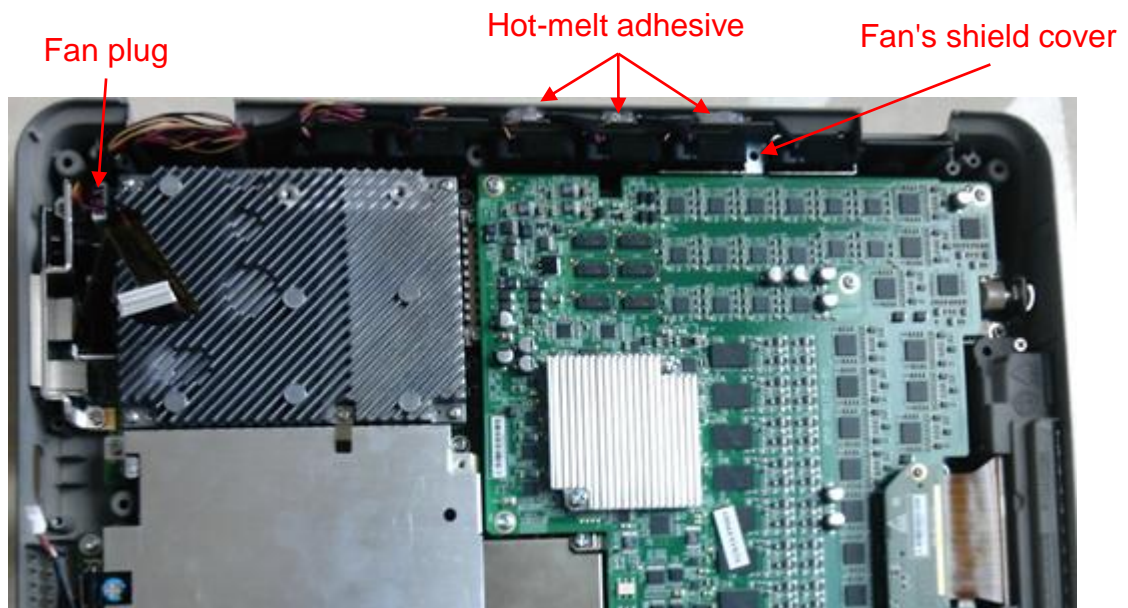
3.   Remove the fan's shield cover.

8.2.9   Probe Board Assembly

1.   Remove control panel and monitor assembly. See *Chapter 9.2.4* for details.
2.   Unscrew 2 screws (M2 X 4 stainless steel cross head screw). Take out the connecting socket of probe board.
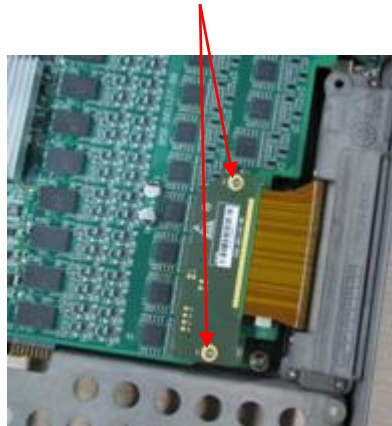
3.   Unscrew 3 screws on the fixing bracket of probe socket (M3 X 8 Nylok screw).

M3 X 8 Nylok screw (3 screws)
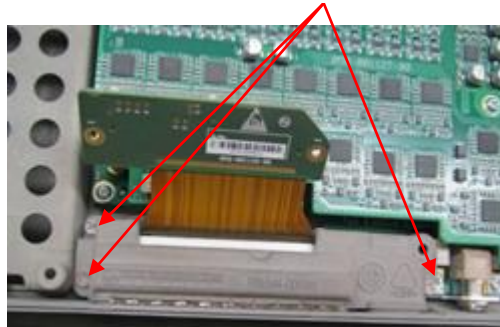
4.   Take out the probe board assembly.
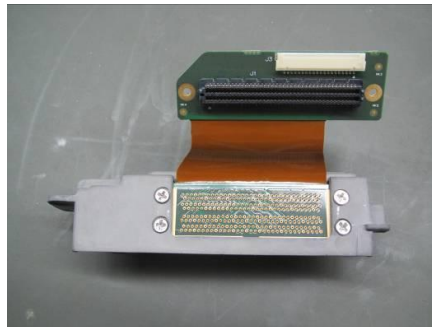
5.   Unscrew 4 screws on probe's socket (M3 X 8 Nylok screw). Take out the probe's socket.

M3 X 8 Nylok screw (4 screws)　　Probe socket　　　Probe board
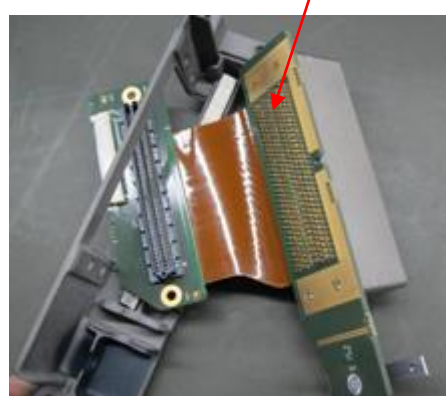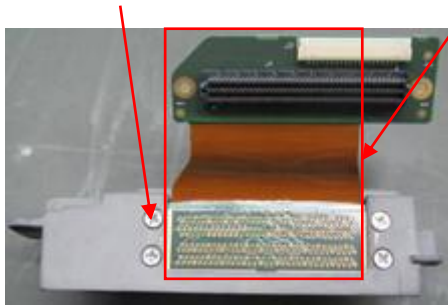
6.　Disassemble IO fixing bracket, fixing bracket of pencil probe structure.

Unscrew 2 screws on IO fixing bracket (M3 X 8 Nylok screw). Take out IO fixing bracket.

IO fixing bracket

M3 X 8 Nylok screw (2 screws)

Unscrew 2 screws on the fixing bracket of pencil probe (M3 X 8 Nylok screw).

M3 X 8 Nylok screw (2 screws)
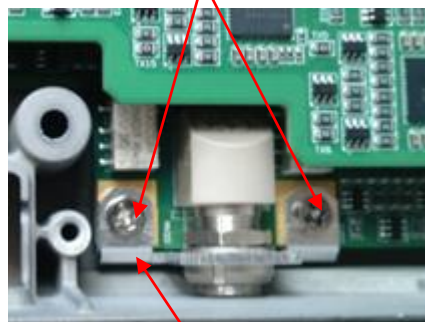
Fixing bracket of pencil probe

8.2.10　Machine Board Assembly

1.　Remove control panel and monitor assembly. See *Chapter 9.2.4* for details.

2. Disassemble machine board assembly.

Unscrew 11 screws (M3 X 6 cross panhead screw). Take out the machine board assembly.

Machine board
assembly

M3X6 cross
panhead screw
(11 screws)
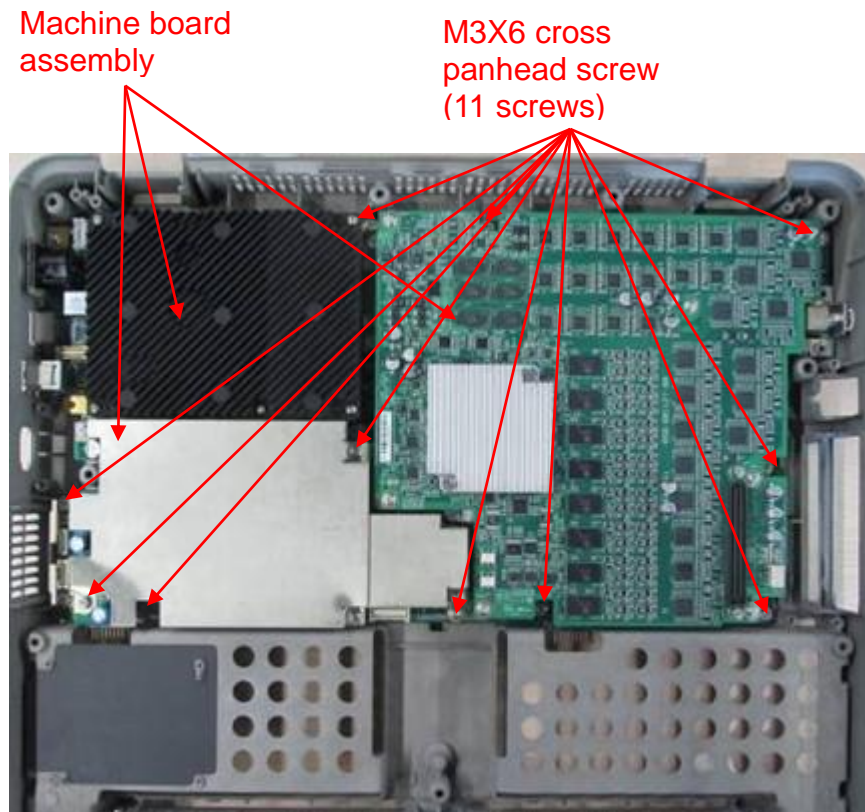
3. Disassemble TR64 board

Unscrew 7 screws on TR64 board (M3 X 6 cross panhead screws). Take out TR64 board with forces.

M3 X 6 cross panhead screw

(7 screws)

TR64 board
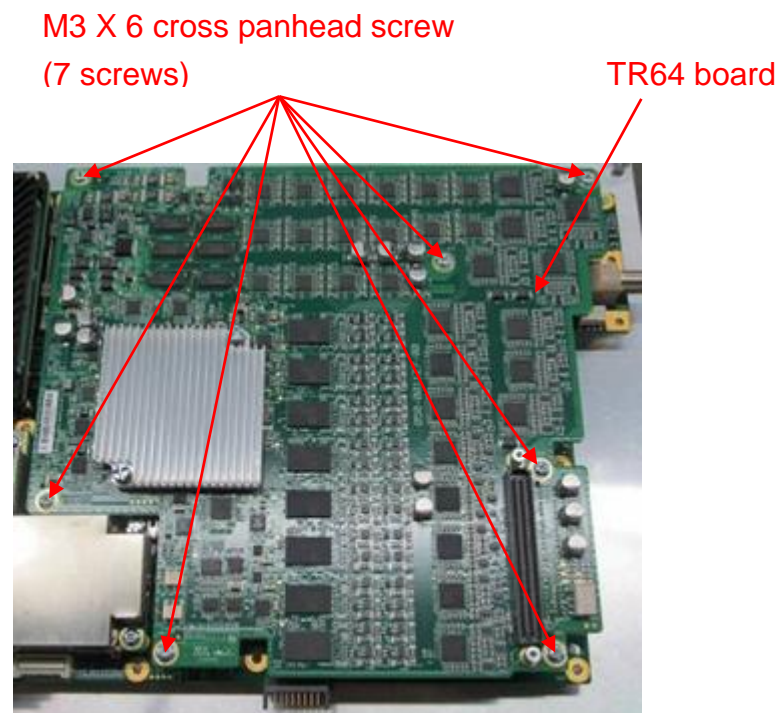
4. Disassemble PHV power supply board

    Unscrew one screw on grounding elastic sheet (M2.5 X 12 cross panhead screw)

M2.5 X 12 cross panhead
screw (1 screw)   Grounding elastic sheet
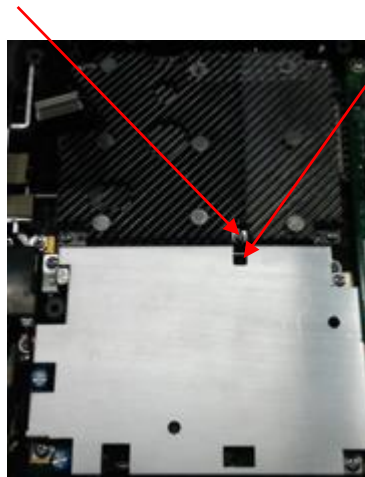
Unscrew 4 screws on larger shield cover of PHV board (M3 X 6 cross panhead screw).
Remove the larger shield cover of PHV board.

M3 X 6 cross
panhead screw   Larger shield
(4 screws)   cover of PHV
                        board
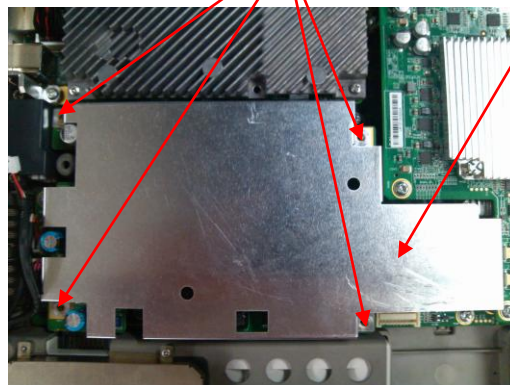
Unscrew 1 screw on smaller shield cover of PHV board (M3 X 6 cross panhead screw).
Remove the smaller shield cover of PHV board and PHV board.

M3 X 6 cross panhead screw (1 screws)

Smaller shield cover of PHV board
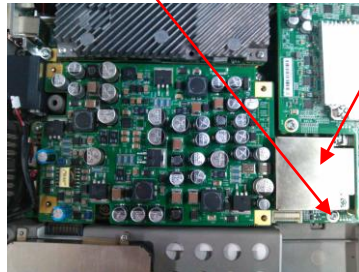
5. Disassemble CPU assembly.

Unscrew four screws (M2.5 X 12 cross slot bolt) on CPU assembly, and then remove the CPU assembly.

M2.5X12 cross slot bolt (4 screws)
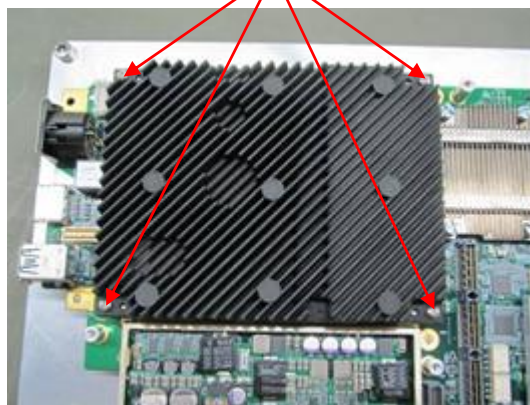
NOTE	Do not open the BIOS base shown in the following figure when disassembling the CPU board assembly. Ensure the BIOS base is closed before re-assembling the CPU board assembly. Press it until closed if it is opened. Otherwise, it fails to boot the device up.

The BIOS base (The BIOS base is closed)
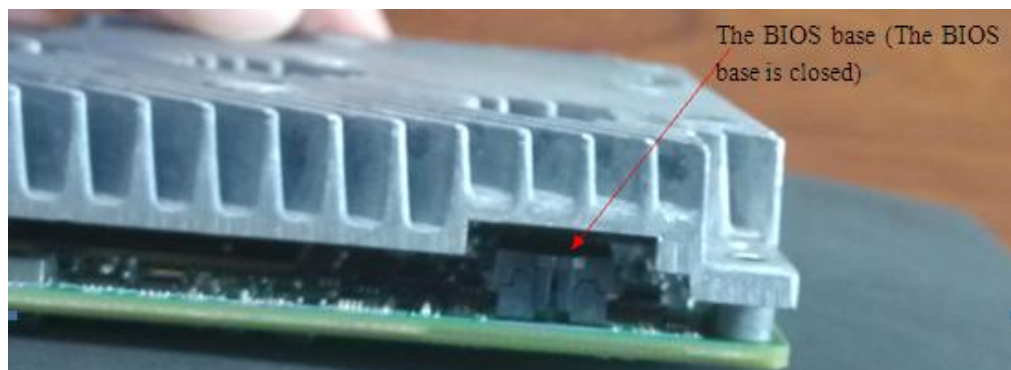
8.2.11 Control Panel Assembly

1. Remove control panel. See step 1 to step 3 in *Chapter 9.2.4* for details.

2. Remove standard small keyboard

a) Unscrew 4 screws on water-proof plate (M3 X 6 cross panhead screw). Remove the water-proof plate. Push the socket clasp towards the blue arrow, and then take out flexible PCB.
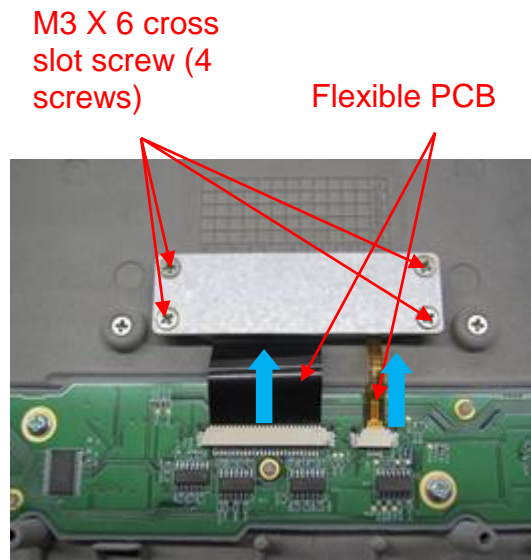
b) Remove the water-proof plate of standard small.
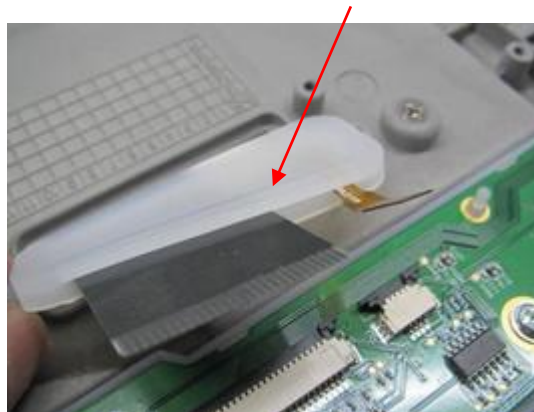
c) Unscrew 6 screws locking the standard keyboard. Take out the small keyboard upwards.

M3X6 cross slot screw (6 screws)
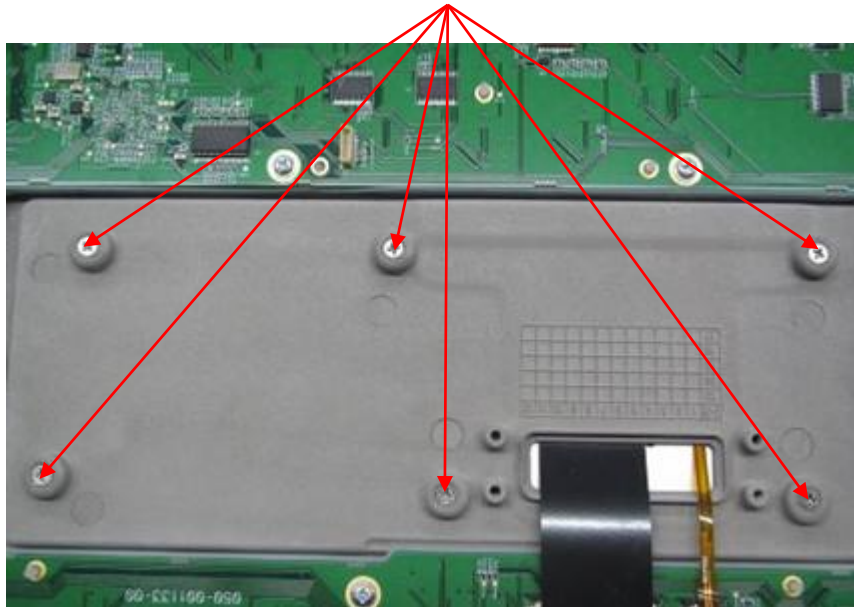
3. Remove the caps on the control panel.

   Pull out the cap upwards. Caps for: small encoder button (Zoom), TCG cap (8 caps), large encoder button (Auto Correct), large encode button (iTouch).

Large encoder button (Auto Correct)

Large encoder button (iTouch)

Small encoder button (Zoom)

TGC cap (8 caps)

4. Disassemble the buzzer.

Unscrew 2 screws locking the buzzer (M2 X 6 cross panhead screw). Unplug the connecting cables of the buzzer from PCB board, and remove the buzzer.

M2 X 6 cross panhead screw with pad (2 screws)   Connecting cable of buzzer
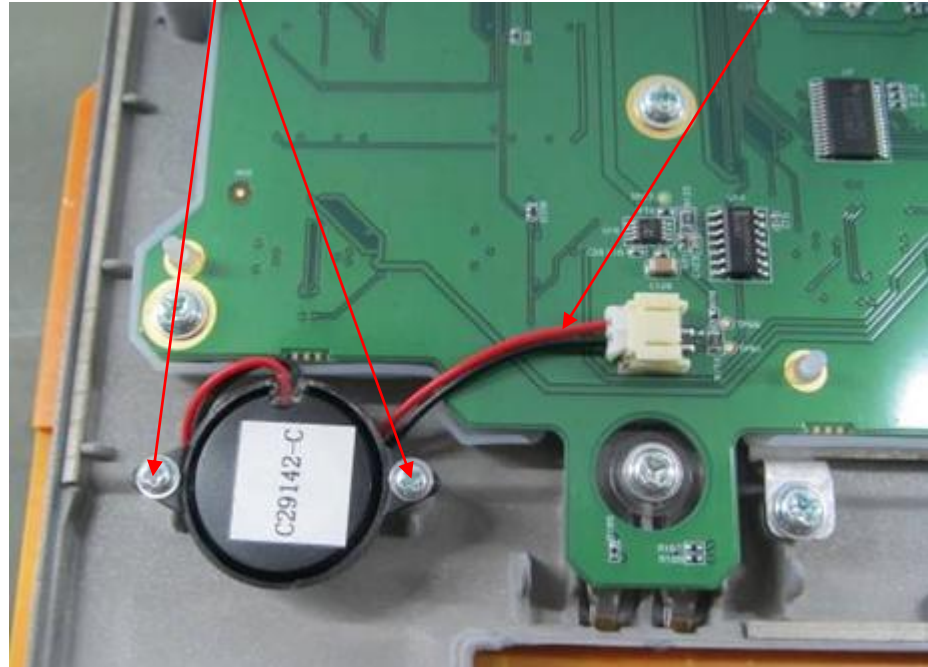
5. Disassemble the trackball.

Unscrew two screws as shown in the following figure (M3 X 20 cross panhead screw). Unplug the connecting cable of the trackball, and take out the trackball.

Connecting cable of trackball   M3 X 20 cross panhead screw (2 screws)

8-20 Structure and Assembly/Disassembly

6. Disassemble TGC board

Unscrew 4 screws on TGC board (M3 X 6 stainless steel cross panhead screw). Unplug STC connecting cables. Remove TCG board.

M3 X 6 stainless steel cross panhead screw (4 screws)   STC connecting cable
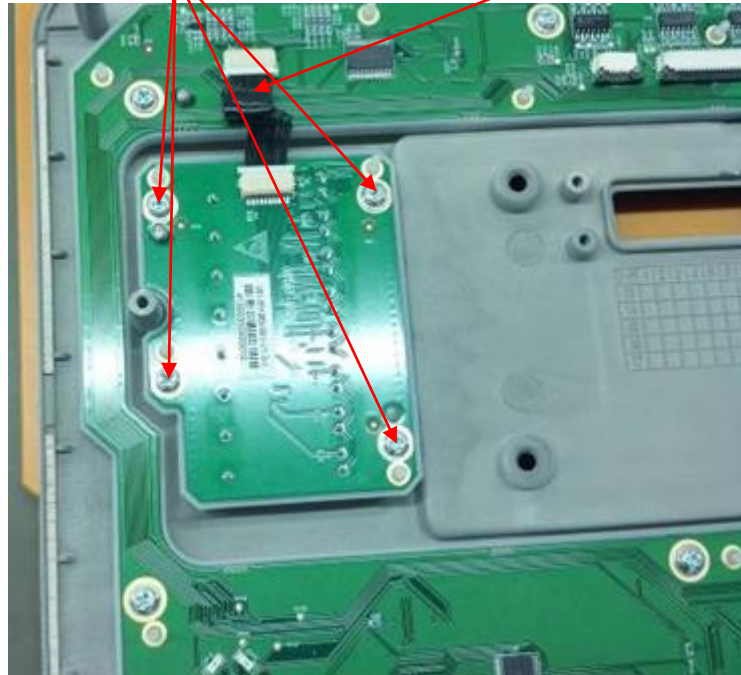
7. Disassemble the control panel PCBA

Unscrew 20 screws (M3 X 6 stainless steel cross panhead screw) on control panel PCBA. Remove control panel PCBA.

M3 X 6 stainless steel cross panhead screw (20 screws)
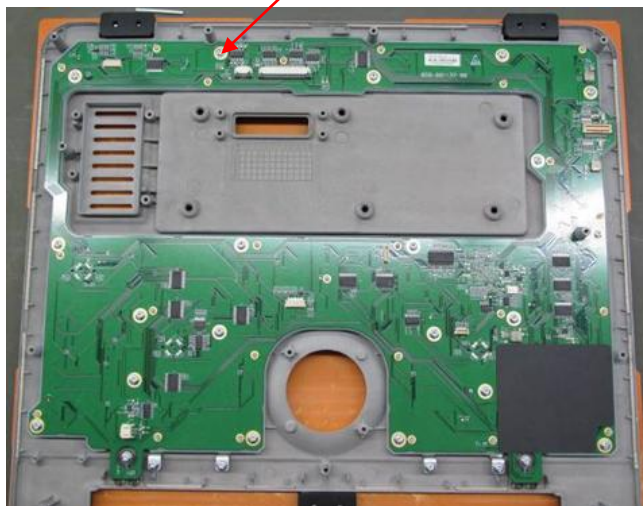
8. Disassemble caps

Remove button caps on the control panel.

Disassemble button caps

9. Disassemble magnetic induction chip and status indicator.

Unscrew 4 screws (M3 X 6 cross panhead screw, 2 screws for each left and right side) from magnetic induction clip. Take out the magnetic chip. Unscrew 2 screws (M3 X 6 cross panhead screw, 1 screw for each left and right side) from status indicator. Take out the status indicator.

M3 X 6 cross panhead screw (4 screws, 2 screws for each left and right side)

Magnetic induction chip

Status indicator

M3 X 6 cross panhead screw (2 screws, one screw for each left and right side)
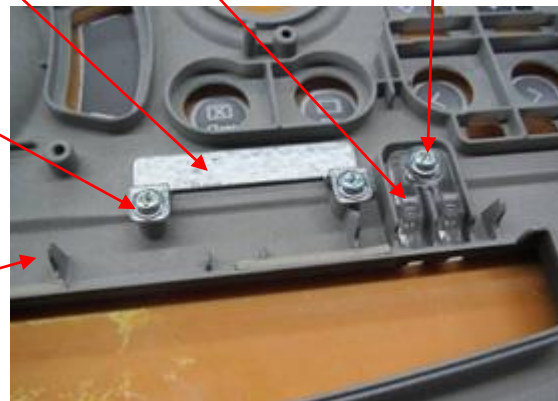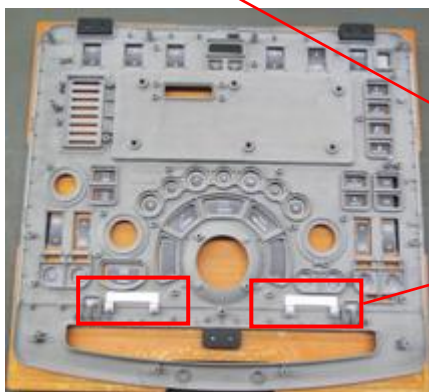
10. Disassemble silicon keyboard

Silicon keyboard is installed on the control panel PCBA via interference fit of silicon bearings (back of PCBA). Remove the silicon keyboard from control panel.

8-22 Structure and Assembly/Disassembly

Silicon keyboard   Control panel PCBA   Silicon bearing (24 bearings)
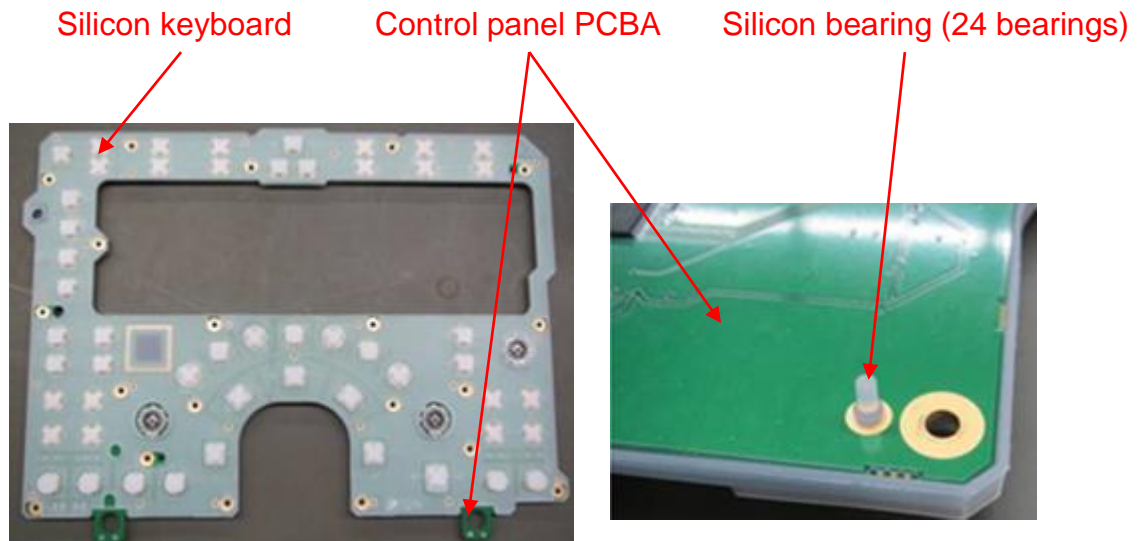
11. TGC dust-proof cover

    TGC dust-proof cover is installed on TGC board via interference fit of silicon bearings. Remove TGC dust-proof from TGC board.

TGC dust-proof cover   TGC board   Silicon bearing (4 bearings)
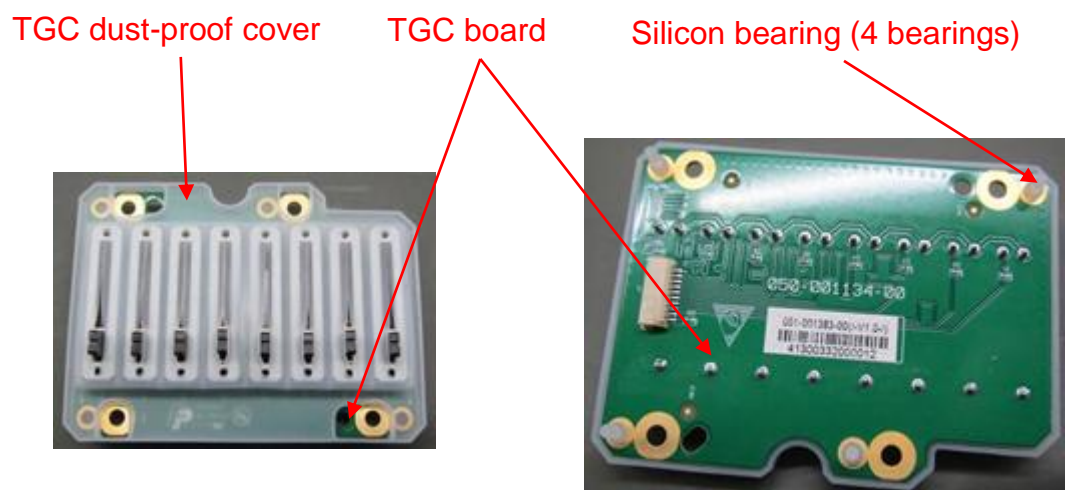
8.2.12 Display (monitor) Assembly

1.   Remove the monitor assembly. See *Chapter 9.2.4* for details.
2.   Disassemble front cover of the monitor.

    Take out 4 screw caps from 4 corners of the monitor. Unscrew four screws inside.

    Note: keep screw caps properly.

Take out the front cover along the left side (or right side), and then take out it along the frame of the monitor.

Take out the front cover form both sides

3. Unscrew 1 screw on the cable harness (M2.5 X 5 cross slot screw), and remove the cable harness. Take out the cables from channel.

M2.5 X 5 cross slot screw (1 screw)

Cable harness

8-24 Structure and Assembly/Disassembly
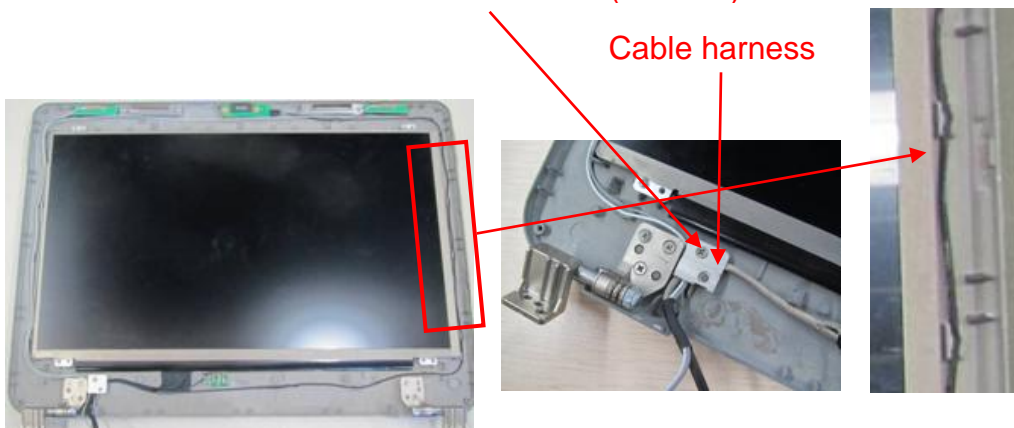
4. Disassemble WIFI cables

WIFI cables stick to the back cover of the monitor. Tear the WIFI cables and aluminum foil off.

WIFI cables and aluminum foil

5. Disassemble light sensor board

Unscrew 2 screws on light sensor board (M2.5 X 4 cross panhead screw). Take out the light sensor board.

M2.5 X 4 cross panhead screw (2 screws)   Light sensor board
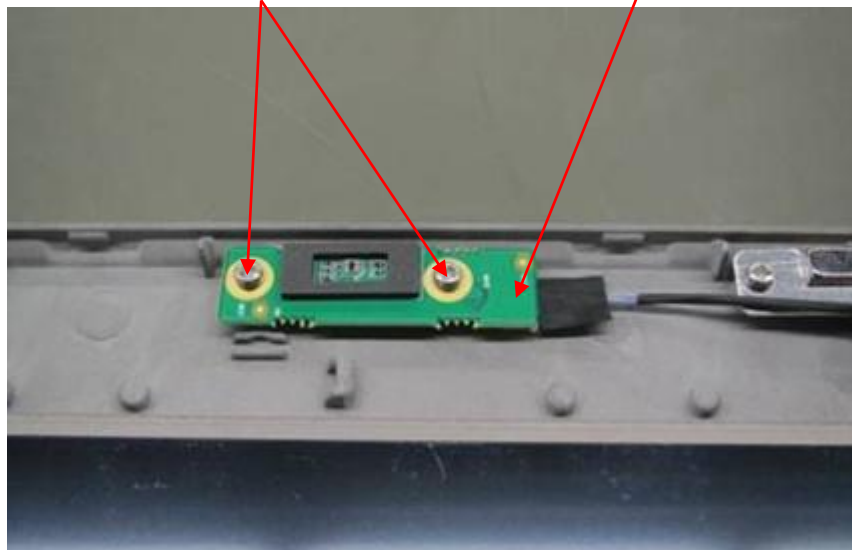
6. Disassemble LCD Monitor

Unscrew 6 screws from LCD monitor's six corners (M2 X 4 cross panhead screw), and remove LCD monitor.

M2 X 4 cross panhead screw (2 screws)
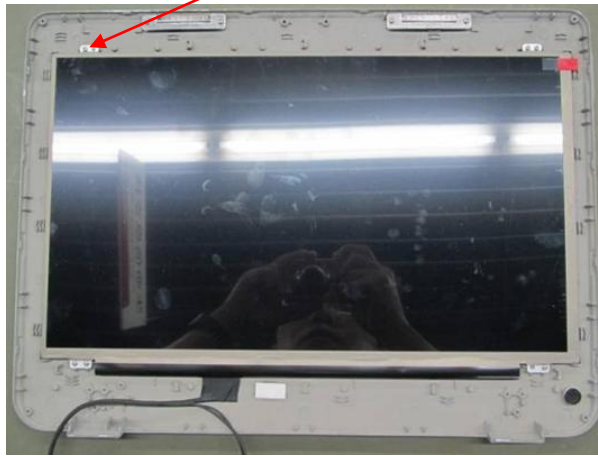
7. Disassemble left/right damping axis

Unscrew 6 screws on damping axes from left and right sides (M2.5 X 5 cross slot screw, 3 screws for each left and right side), and remove damping axis.

M2.5 X 5 cross slot screw (6 screws, 3 screws for each left and right side
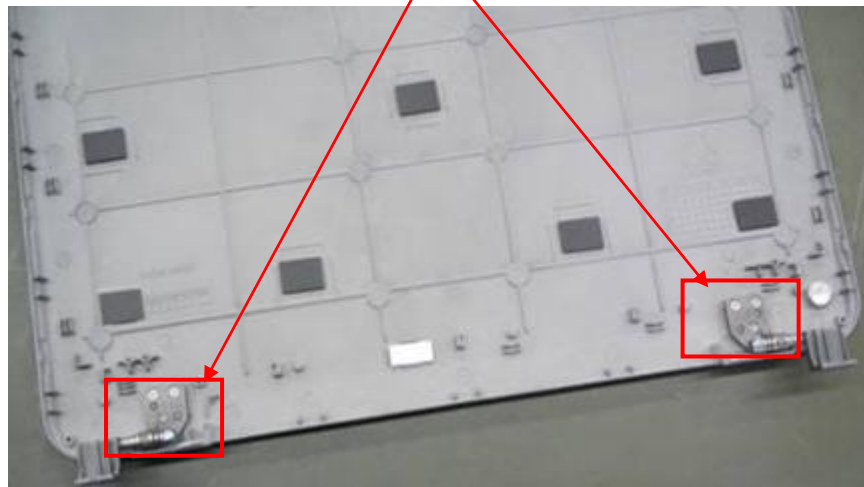
8. Disassemble the magnetic snap closure of the monitor.

Unscrew four screws on the magnetic snap closure (M2.5 X 4 cross panhead screw, 2 screws for each left and right side), and remove the metal part and the magnet.

M2.5X4 cross panhead screw, 4 screws; 2 screws for each left and right side

Fixing metal part to magnet

Magnet
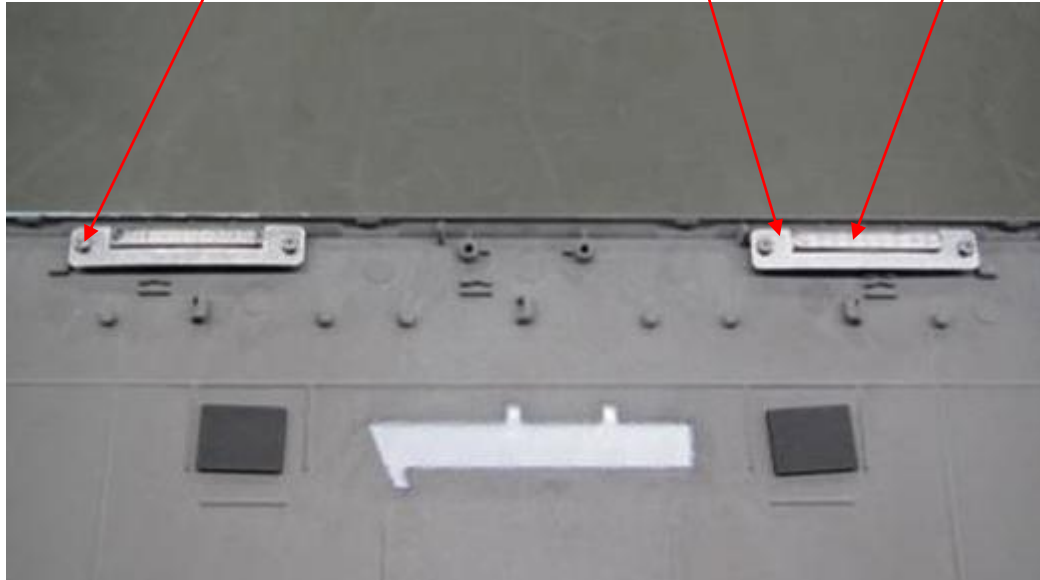
8.3   Trolley Assembly/Disassembly

8.3.1   Preparation

8.3.1.1   Disassembly Tools Required

Name	Type	Material No.	Remarks
Cross-headed screwdriver	107*75	/	M2
Cross-headed screwdriver	102*100	0000-10-10884	M3、M4
Inner hexagon spanner	369H(1.5-6.0mm)	095-000062-00	M5
Spanner	1PK-H024	095-000063-00	4″
Diagonal cutting pliers	N-206S	095-000077-00	/
Anti-electrostatic glove: 1 pair.	/	/	/

8.3.1.2   Engineers Required

The disassembly should be performed by professionals from Mindray or the staff who are trained to be qualified for the maintenance.

8.3.1.3   Disassembly Requirements

Be prepared before disassembling ultrasound device.

1. Stop scanning the patient and capturing images. Shut down the device and cut off AC power

    supply. Unplug AC power supply cable.

2. Lock the casters to prevent the device from moving in the disassembly.

3. Get the disassembly tools prepared.

8.3.2   Storage Box

1. Remove the storage box upwards.

Storage box

2. Unscrew 2 screws on bracket of storage box (M4 X 12 cross panhead screw), and remove the bracket of the storage box.

M4X12 cross panhead screw (2 screws)

Bracket of storage box
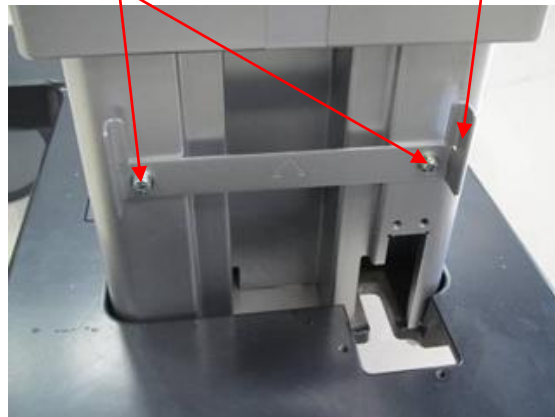
8.3.3　Power Supply Assembly

1. Unscrew two M4X10 stainless steel round inner head screws (with the pad) on the front of the main unit, and then disassemble two M4X10 stainless steel round inner head screws (with the pad) on the back of the main unit. Pull out the power supply assemble by the metal handle.

Two M4X10 stainless steel round inner head screws (with the pad)

Two M4X10 stainless steel round inner head screws (with the pad)

Metal handle of power supply assembly

2. Remove dust-proof mesh

    Press the clip outwards (arrow 1). Pull out the plastic clasp towards the arrow 2's direction.

Clip

The plastic clasp
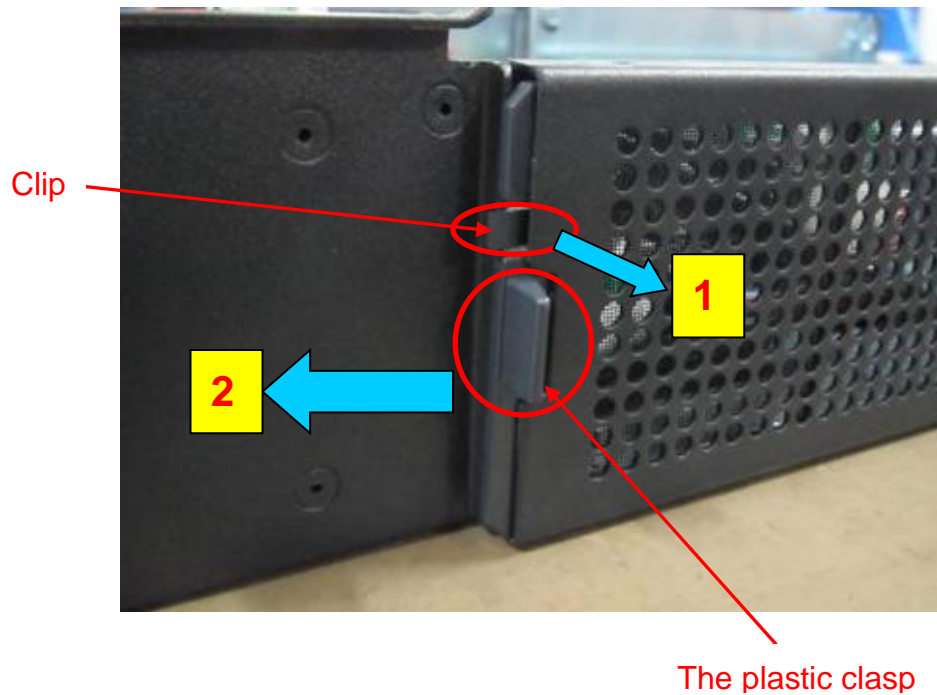
3. Remove the battery

Unscrew 3 screws (M4 X 12 cross panhead screw) on the battery baffle board. Remove the battery baffle battery, and then take out the battery.

M4X12corss panhead screw (3 screws)   Battery
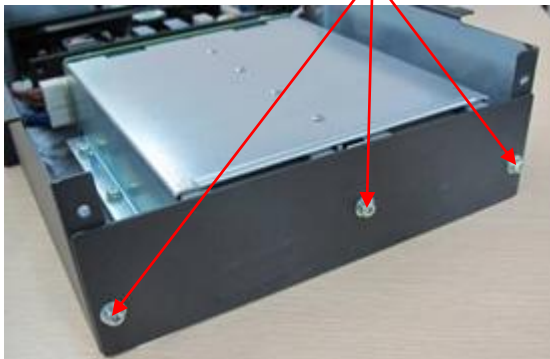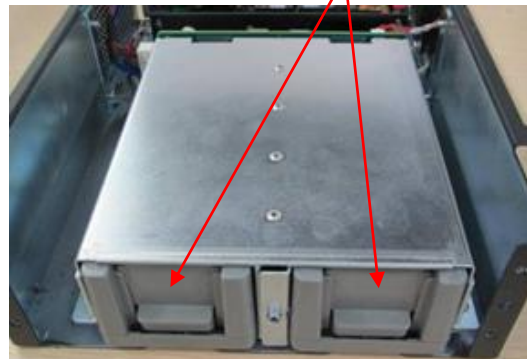
4. Remove the battery compartment and battery management board

Unscrew 6 screws (M4 X 12 cross panhead screw, 3 screws for each left and right side) on the battery compartment, and then take out the battery compartment.

M4X12cross panhead screw (6 screws, 3 screws for each left and right side)
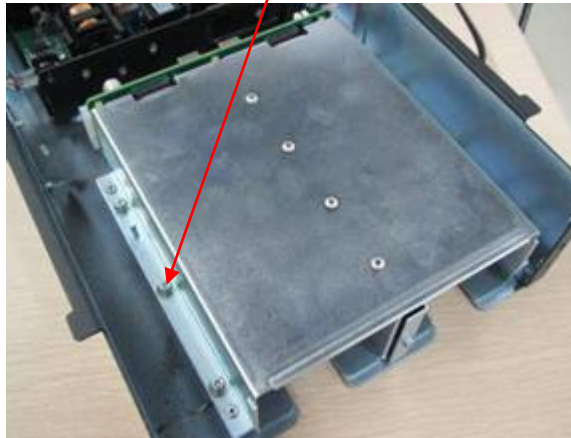
Unscrew 6 screws (M3 X 8 cross panhead screw) on the battery management board, and then remove the battery management board.

M3X8 cross panhead screw (6 screws)
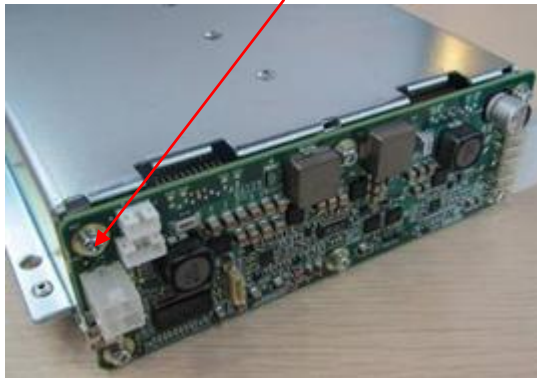
5. Remove AC-DC power supply assembly

Unscrew 4 screws (M4 X 8 cross panhead screw) on AC-DC supporting board, and take out AC-DC assembly.

M4X8 cross panhead screw (4 screws)

Unscrew 4 screws (M4 X 8 cross panhead screw) on the back of AC-DC supporting board, and take out AC-DC power supply board.

M3X6 cross panhead screw (4 screws)
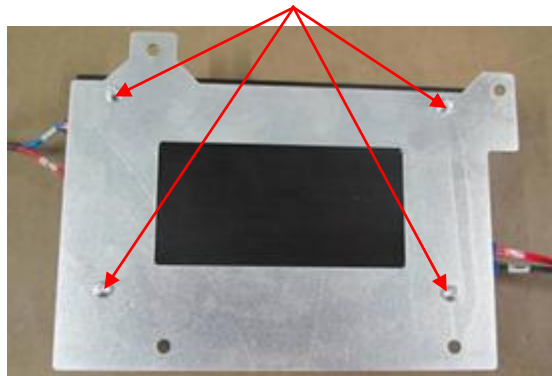
6. Unscrew 4 screws on the power supply fan (M4 X16 cross panhead with the pad and the clip). Take out the fan.

M4X16 cross panhead with the pad and the clip (4 screws)
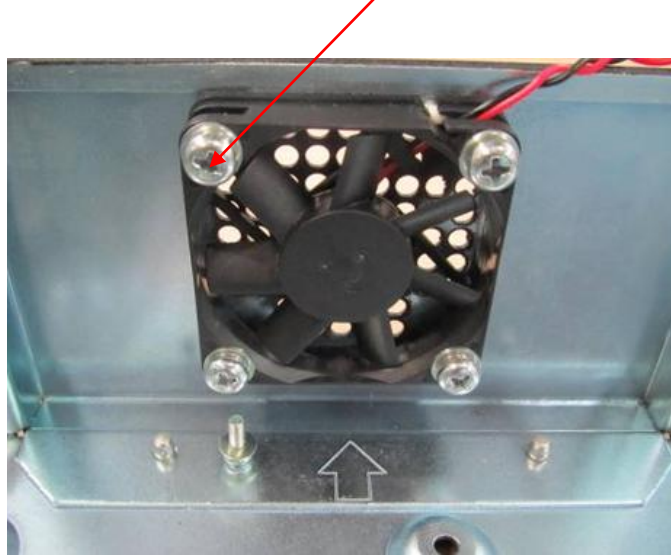
8.3.4　Trolley Panel Board Assembly

1.　Unscrew 10 screws (M4 X 12 cross panhead screw) on the back of trolley panel's base, and take out the panel cover.

M4X12 cross panhead screw
(10 screws)

2.　Remove the rotatable clasp

Unscrew 2 screws on the fixing bracket for the spring (M4 X 12 cross panhead screws), and take out the fixing bracket and the spring.

Fixing bracket for the spring

M4X12 cross panhead screw (2 screws)
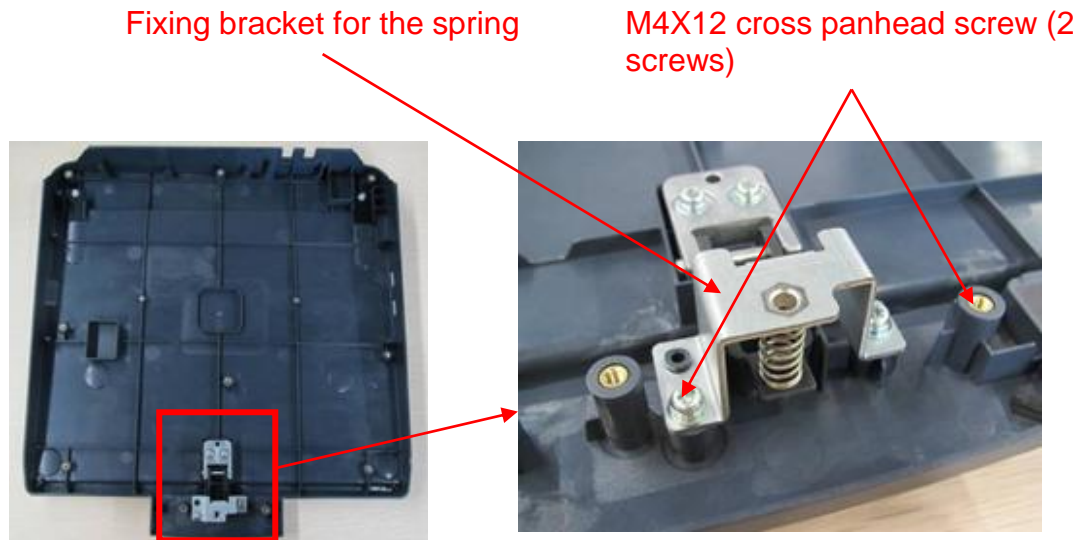
Unscrew 2 screws (M4 X 12 cross panhead screw) on the fixing base of the pivot, and remove the fixing base of the pivot, then take out the rotatable clasp.

M4X12 cross panhead screw (2 screws)

Fixing base of the pivot

Rotatable clasp
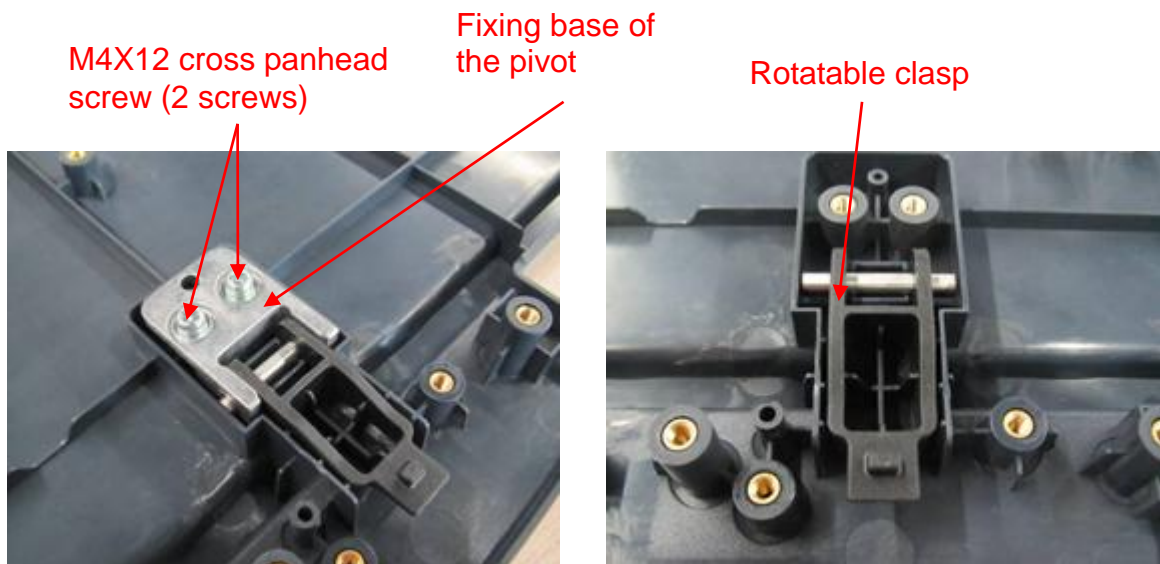
8.3.5   Spring Assembly

1. Remove the assembly of trolley panel cover. See Chapter 9.3.2.3 for details.
2. Remove LED board, USB board, fixing bracket of power supply cable, etc.

    Unscrew 2 screws (M3 X 8 cross panhead screw) on LED board, and take out LED board.

    Unscrew 4 screws (M3 X 8 cross panhead screw) on USB board, and take out USB board.

    Unscrew 1 screw (M4 X 12 cross panhead screw) on wiring fixation, and then take out the wiring fixation.

    Unscrew 2 screws on the fixing bracket that outlet line passes through (M4 X 12 cross panhead screw), and remove the bracket.

M3X8 cross panhead screw (2 screws)

M3X8 cross panhead screw (4 screws)

M4X12 cross panhead screw (1 screw)

M4X12 cross panhead screw (2 screws)
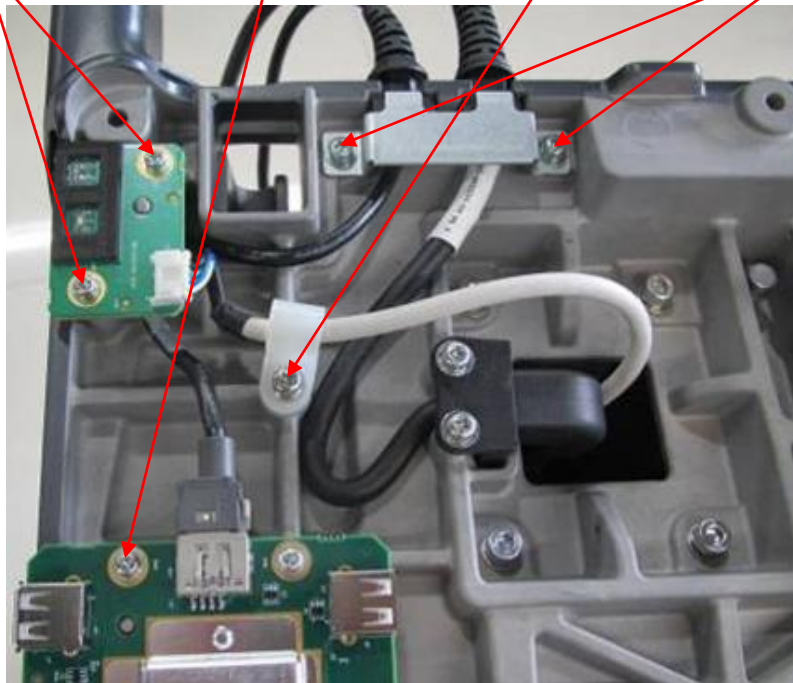
3. Remove the drawer lock.

    a) Unscrew the screws on the drawer lock. Remove the connecting plate between the screw and the key lock.

Connecting plate of key lock

Screw on the drawer lock

    b) Take out the drawer lock by unscrewing hexagon screw.

Hexagon screw

Drawer lock

4. Remove spring cable
   a) Remove the fixing bracket of spring cable

   Unscrew 2 screws (M4 X 12 cross panhead screw) on the base, and take out the bracket of spring cable.

Trolley base

M4X12 cross panhead screw (2 screws)

The socket of spring cable

Fixing bracket of spring cable

   b) Remove spring cable

   Press gas spring button. Press the device to the lowest by the handle.

Gas spring

Handle
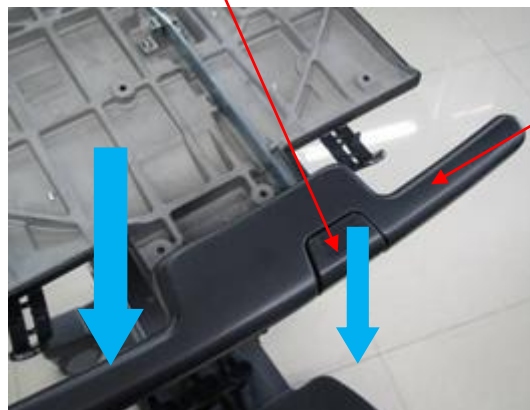
Unscrew 2 screws (M4 X 12 cross panhead screw) on the injection-molding clasp of spring cable on the base.

M4X12 cross panhead screw
(2 screws)
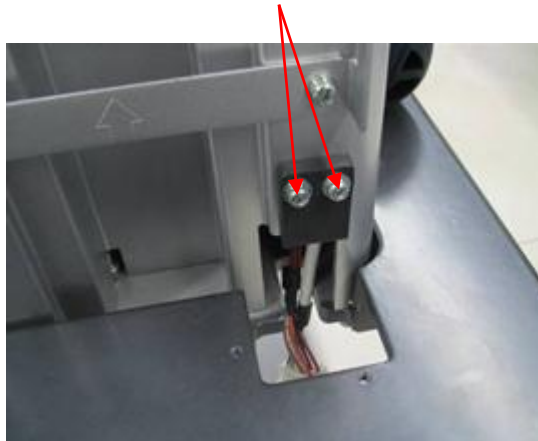
Unscrew 2 screws (M4 X 12 cross panhead screw) on the base of control panel, and take out the panel cover.

M4X12 cross panhead screw (2 screws)

Take out the spring cable upwards

5. Remove the connecting rod of gas spring.

Press gas spring button (the sixth step), remove the handle upwards. Release the spring to the maximum length (operable to remove gas spring assembly). Put the auxiliary tool (M5 screw or screw driver) into the spacing hole on the back of the device (operable to remove trolley panel board).

Put auxiliary tool (M5 screws or screw driver) into spacing hole

Unscrew 2 screws (M4 X 12 cross panhead screw) on the connecting rod of gas spring.

M4X12 cross panhead screw (2 screws)

Lift up the connecting rod of gas spring, and take out the spring of the connecting rod, then remove the connecting rod towards arrow's direction.

Remove the connecting rod towards arrow's direction
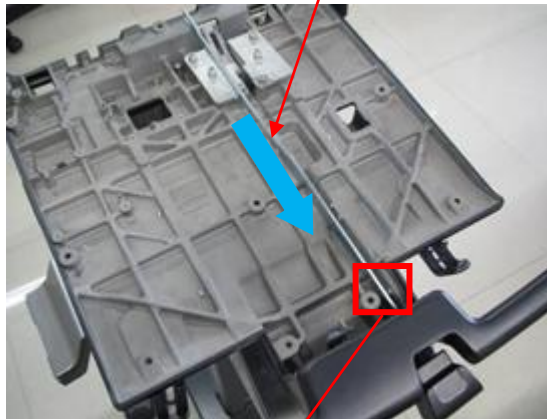
Spring of the connecting rod

6. Remove gas spring

Unscrew 6 screws (M5 X 25 Allen screw with the pad and the clip) on the connecting base of the gas spring.

M5X25 Allen screw with the pad or the clip (6 screws)

Connecting base
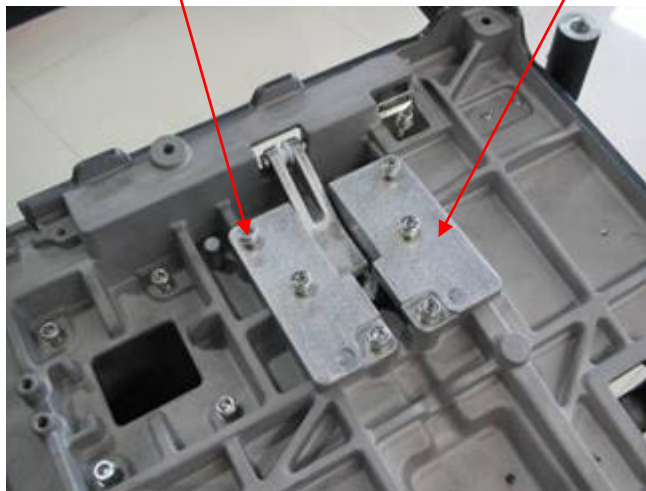
Remove the latch of the gas spring at the bottom of the lifting column. Take out the gas spring upwards.

Latch of gas spring   Trolley base   Gas spring
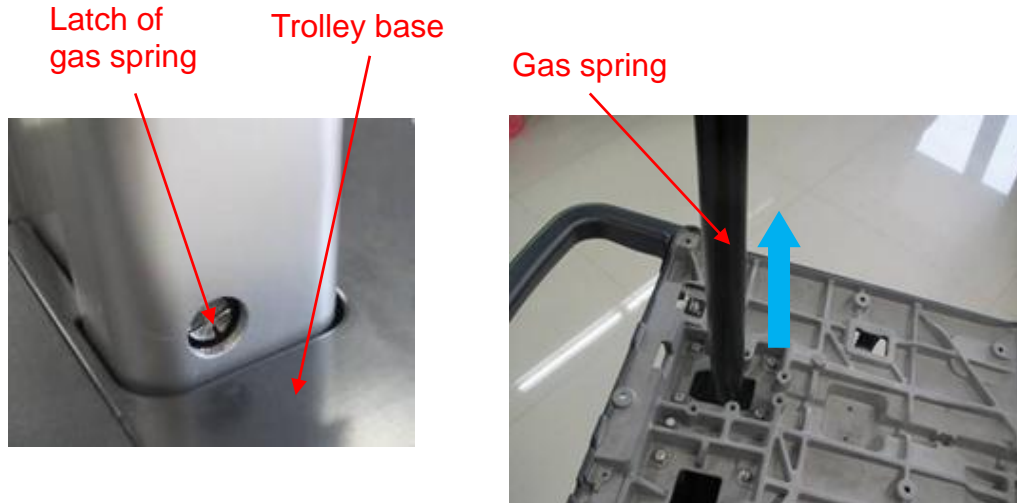
8.3.6   Cast-aluminum Base of Trolley Panel

1. Remove the assembly of trolley panel cover and spring assembly. See *Chapter 9.3.2.3* and *Chapter 9.3.2.4* for details.
2. Unscrew 8 screws (M5 X 25 Allen screw with the pad and the clip) on the cast-aluminum base, and remove the panel' base upwards.

M5X25 inner head screw with the pad and the clip (8 screws)   Cast-aluminum base of trolley panel

3. Remove the printer tray

   Unscrew 4 screws (M4 X 12 cross panhead screw) on the printer tray, and take out the printer tray.

M4X12cross panhead screw (4 screws; 2 screws for each left and right side)
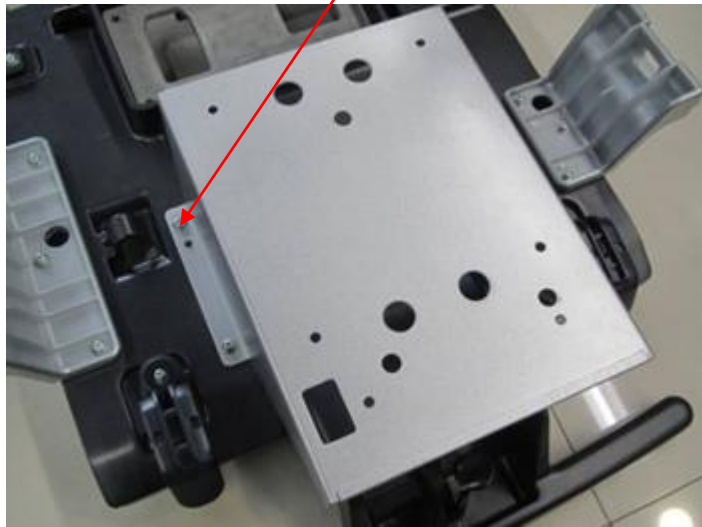
4. Remove holder bracket, hook base of probe cable, moveable cable hook.

Unscrew 6 screws (M4 X 12 cross panhead screw, 3 screws for each left and right side) on the holder bracket, and then take out the holder bracket.

Unscrew 2 screws (M4 X 12 cross panhead screw) on the base of probe holder, and take out the base of probe holder.

Unscrew 2 screws (M4 X 12 cross panhead screw, 1 screw for each left and right side) on the cable hook, and then take out the cable hook.

Base of probe holder

M4X12 cross panhead screw (10 screws)

Holder bracket (one for each left and right side)

Cable hook (one for each left and right side)
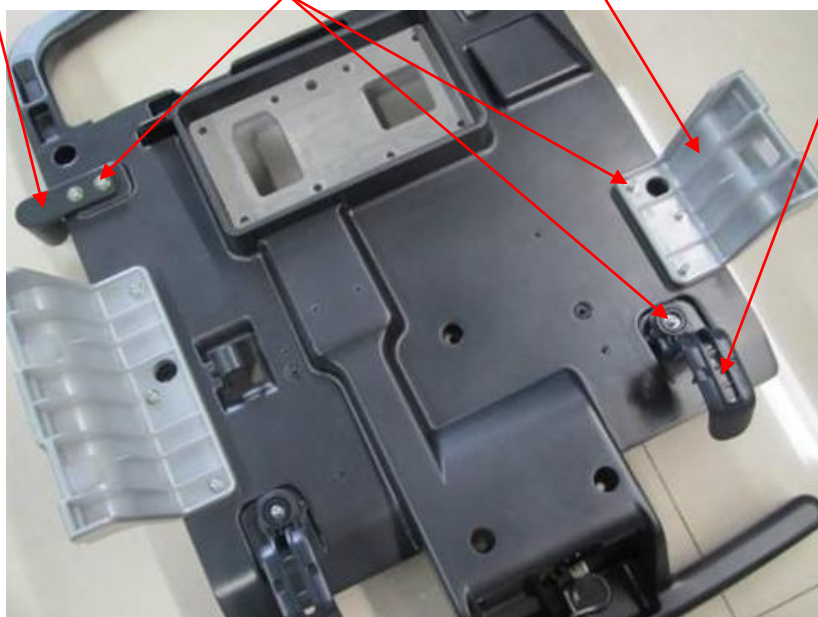
8.3.7   Lifting Column

1. Remove cast-aluminum base of trolley panel. See *Chapter 9.3.2.5* for details.

2. Lay the device flat. Remove 8 screws (M5 X 25 Allen screw with the pad and the clip) on the base. Take out the lifting column towards arrow's direction.

M5X25 Allen screw with the pad and the clip (8 screws)

Take out the lifting column towards arrow's direction
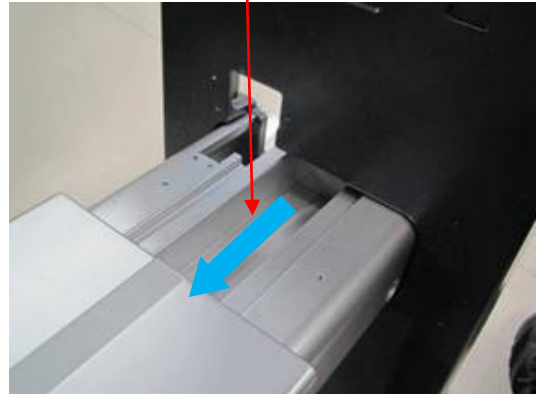
3. Remove external lifting column

    Pull the lifting column to the maximum position towards arrow's direction. Unscrew 8 screws (M6 X 16 Allen screw with the pad and the clip) on the external lifting column. Take out the external lifting column.

    Note: there is a piece of strip on the screw. Remove the strip before unfastening the screws.

M6X16 Allen screw with the pad and the clip (8 screws)
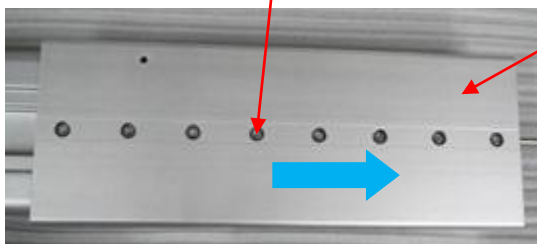
External lifting column
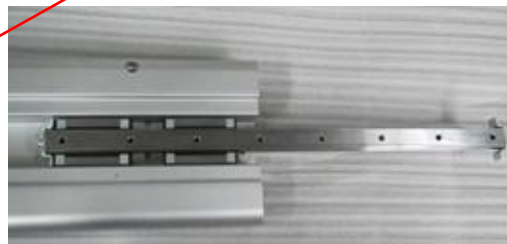
4. Remove the straight track.

    Unscrew 8 screws (M5 X 12 Allen screw with the pad and the clip) on internal lifting column, and take out the straight track.

Straight track

M5X12 Allen screw with the pad and the clip (8 screws)

8.3.8   Trolley Base Assembly

1. Remove the lifting column. See *Chapter 6.3.7* for details.

2. Remove the clip of gas spring.

    Unscrew 3 screws (M5 X 25 Allen screw with the pad and the clip) on the connecting base of gas spring. Remove the connecting base of the gas spring. Unscrew 2 screws (M3 X 8 cross panhead screw) on the clip, and then take out the clip.

M5X25 Allen screw with the pad and the clip (3 screws)

M3X8 cross panhead screw (2 screws)
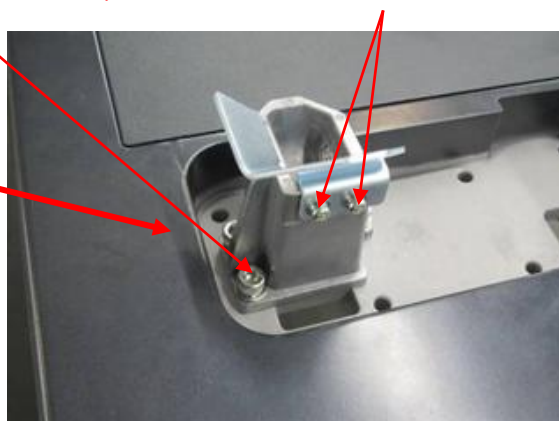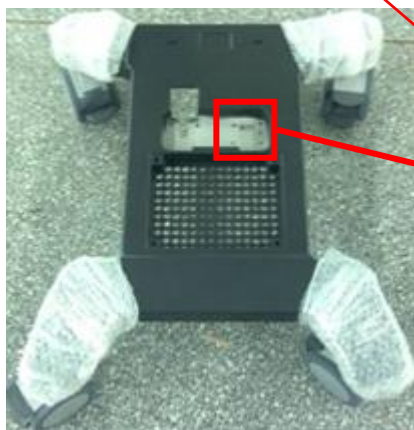
3. Remove the casters

    Unscrew the hexagon screw between the casters and the base with dedicated jig.

Cast-aluminum base   Unscrew the screws   Caster
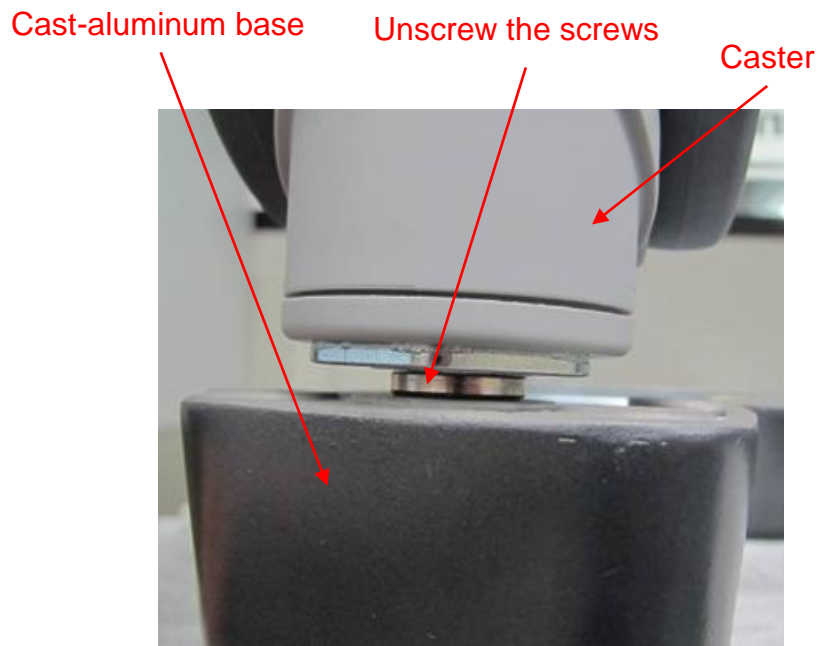
4. Remove metal strips

   Unscrew 14 screws (M4 X 12 cross panhead screw) at the bottom of cast-aluminum base. Remove the front pegboard, back pegboard and the strip of power supply box (one piece for each left and right side).

Front pegboard   M4X12 cross panhead screw (14 screws)   Strip of power supply box (one piece for each left and right side)   Back pegboard
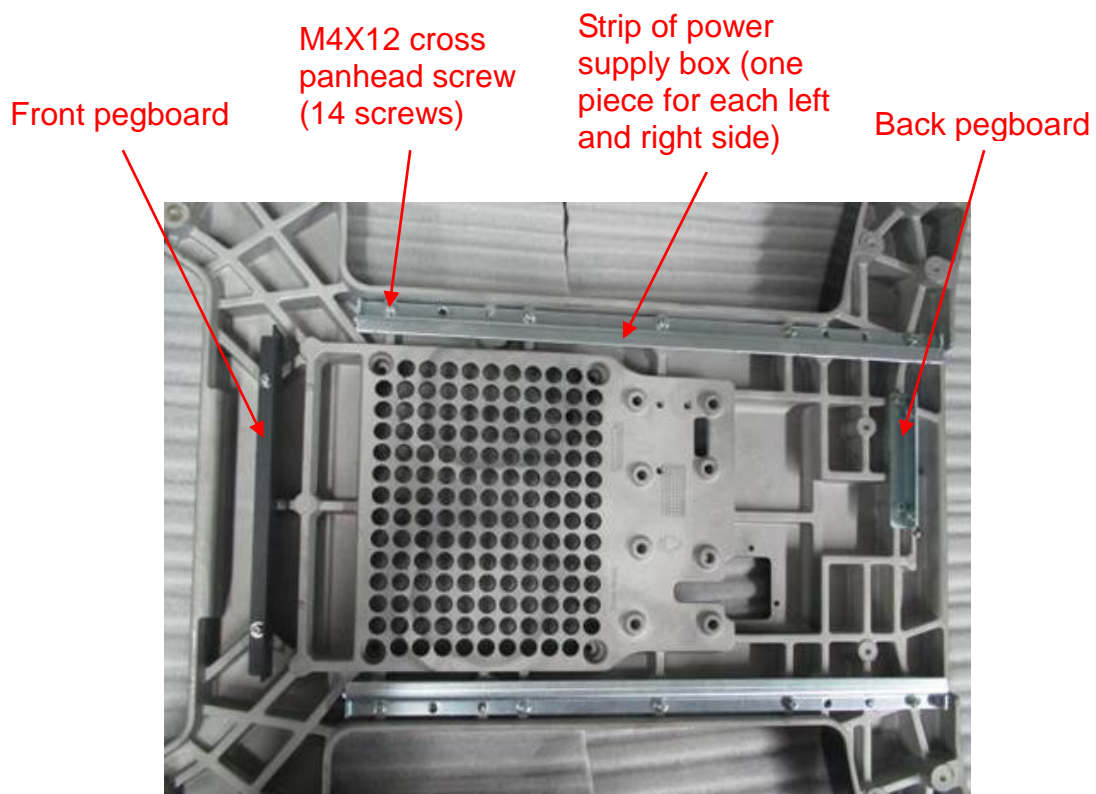
5. Remove the decorative cover of the base.

   Unscrew 4 screws (M3 X 8 cross panhead screw) on cast-aluminum base. Remove the decorative cover upwards.

M3X8 cross panhead screw (4 screws)
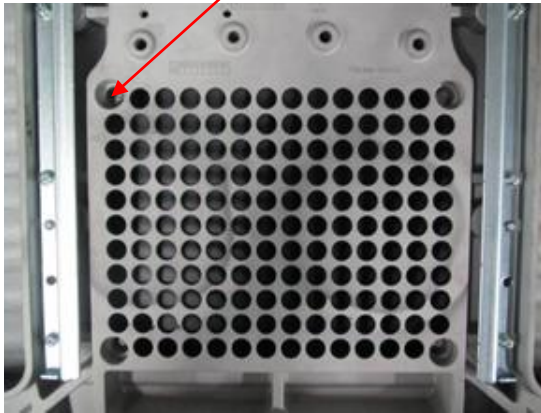
Remove the decorative cover towards arrow's direction
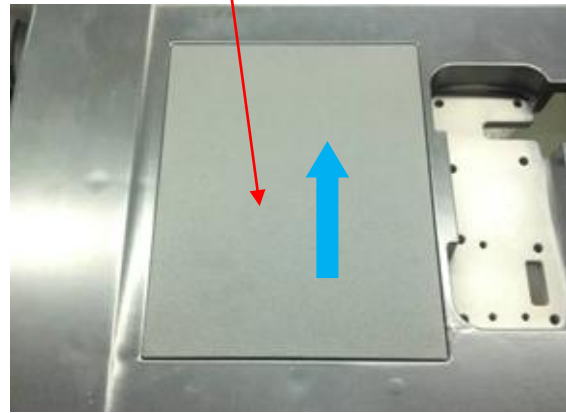
8.3.9   Installation of probe holder

1. Two hooks of probe holder are inserted into holder bracket diagonally.

2. Press the probe holder inward as well as downward at the same time.
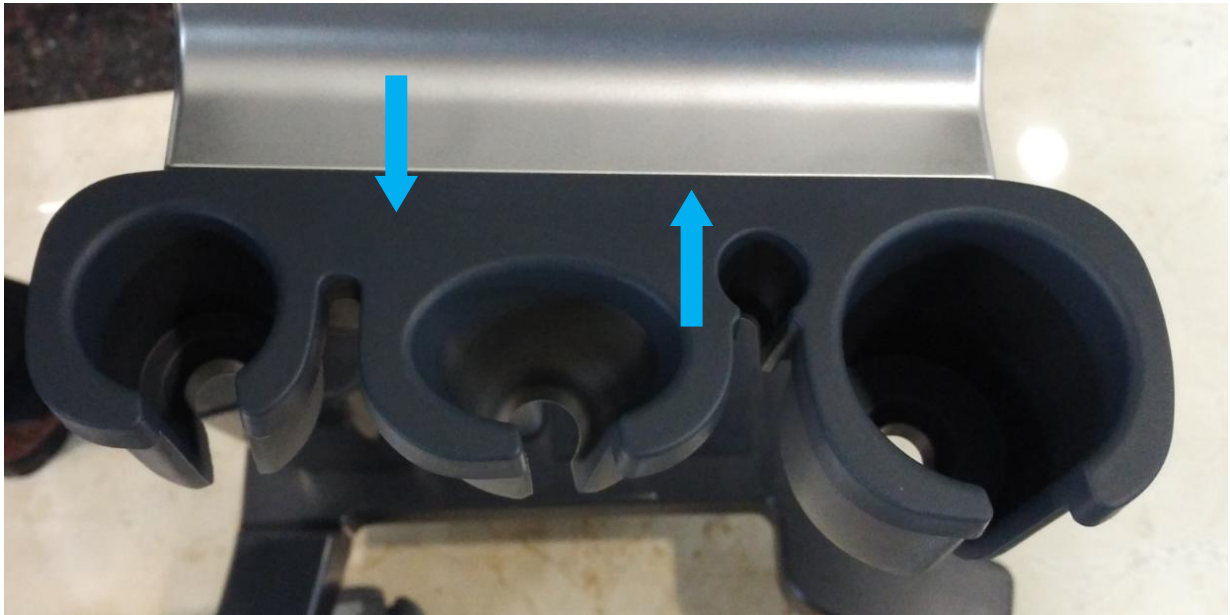
3. Stuff two screws behind the holder bracket (cross panhead screw M3X6)

Fasten two cross panhead screws M3X6

8.3.10 Disassembly of the probe holder

Disassemble the probe holder and three screws (M4X12 Philips pan headed screws) connected with the base of control panel, then remove the probe holder and holder bracket as a whole.

NOTE: Don't remove those two screws (cross panhead screw M3X6) of probe holder and holder bracket.
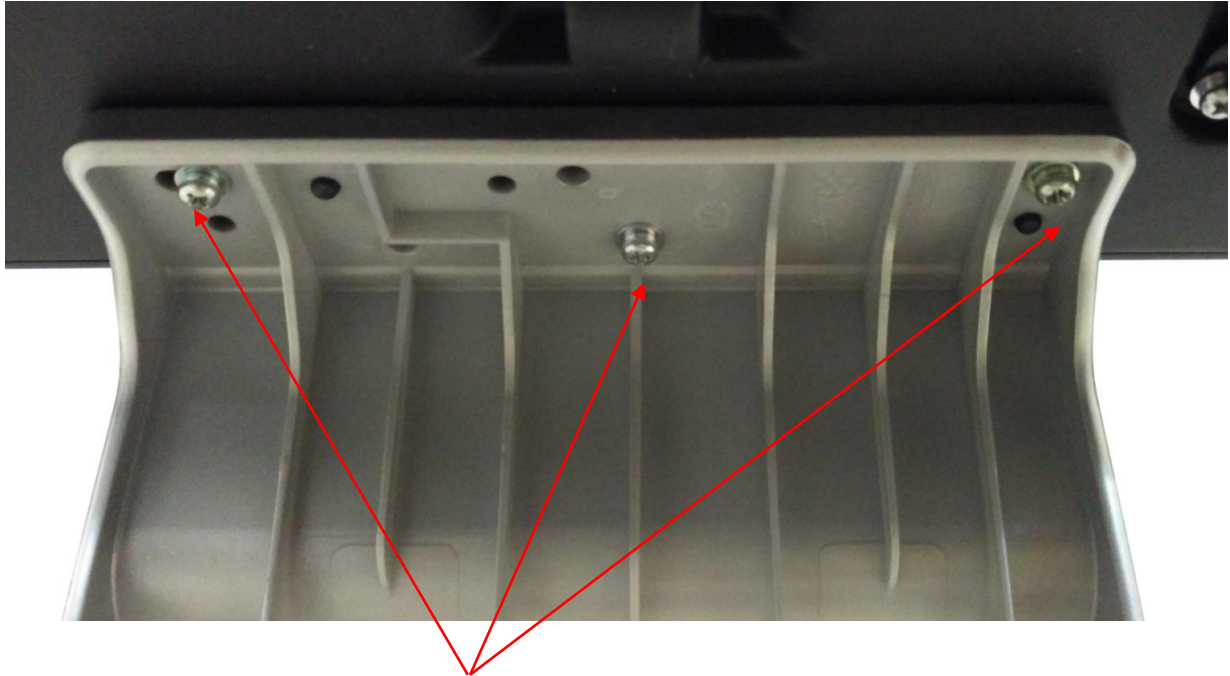
Unscrew M4X12 Philips Pan headed screws (3pcs)

8.3.11 Disassembly of intracavity probe holder

1. Disassemble intracavity probe holder

    Pull out the intracavity probe holder as the arrow's direction.

Intracavity probe holder

2. Disassemble intracavity probe holder bracket
   Unscrew two screws (cross panhead screw M3X12)

Intracavity probe holder bracket

cross panhead screw M3X12(2pcs)
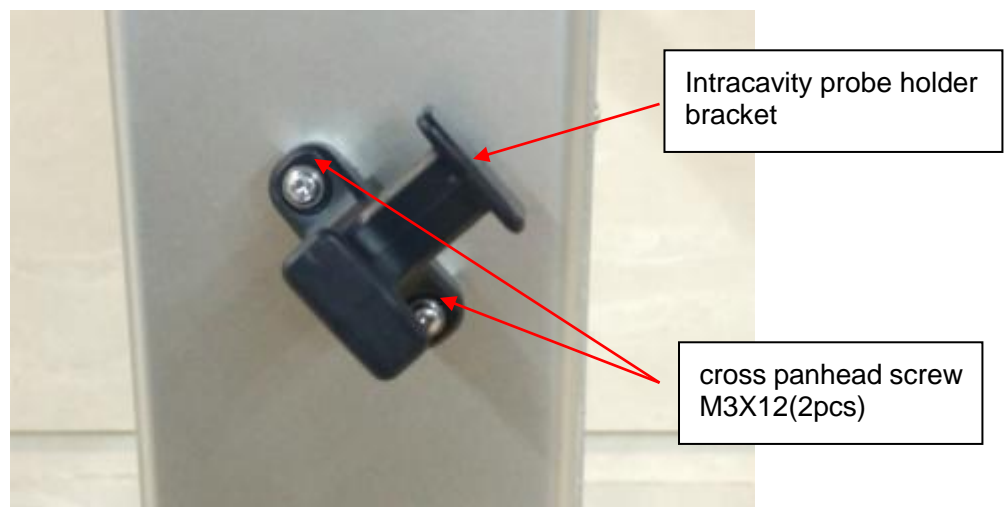
3. Disassemble padding block
   Unscrew two screws (cross panhead screw M3X12)

Padding block

Cross panhead screw
M3X12(2pcs)
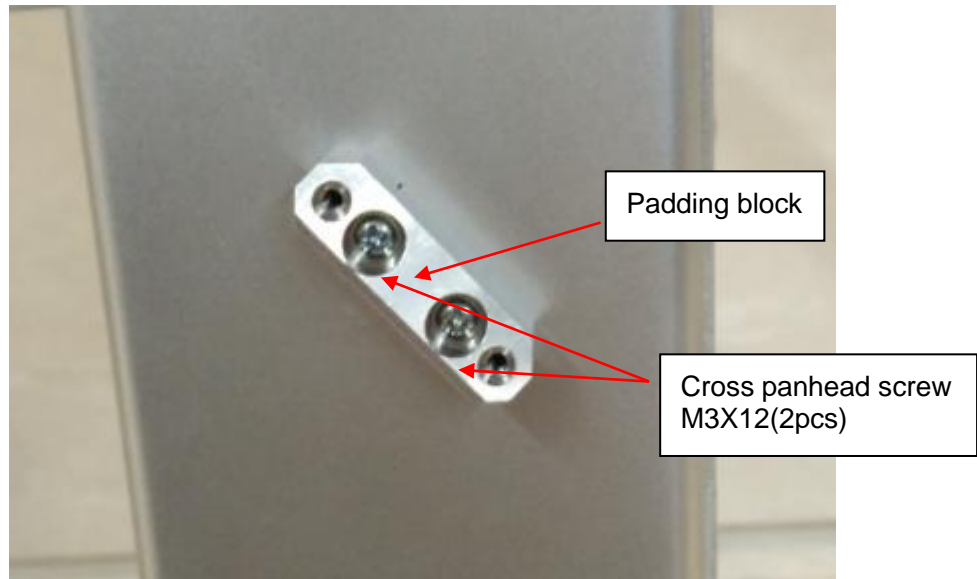
9 Installation of Option Modules

9.1 Installation of Optional Devices to Software

◆ **Install**

1. Copy optional key file to USB flash disk and plug USB flash disk to the port.

2. Open [Preset] menu. Click [Maintenance]-[Option]. Select the software package to be installed from the list.
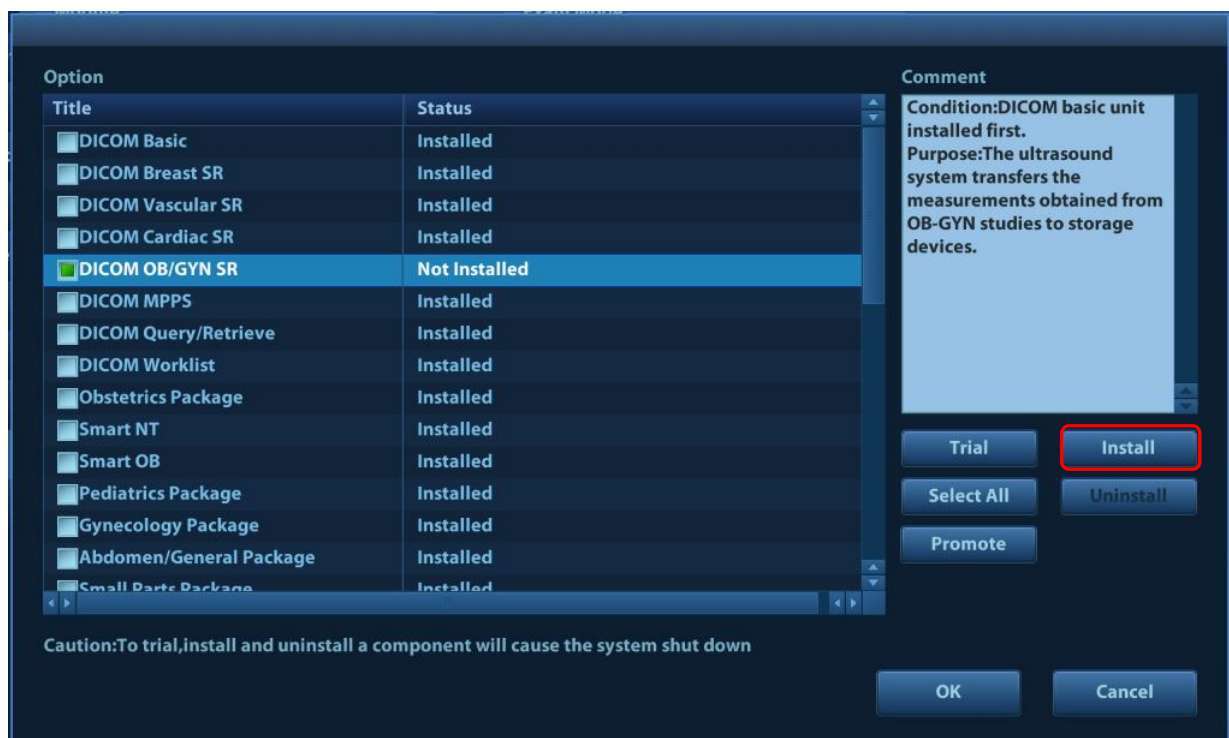
3. Click [Install]. Select key file from the dialog box, and then click [OK].

4. The optional assembly becomes "Installed" after the key file is installed. The corresponding function is activated after return from preset.

5. Option trial: select the corresponding software package, and then lick [Trial].

Note: for each component, you can activate trial version only once. The trial lasts 180 days for each key.

Note:	1.	The optional assembly is limited to single key. If the module is installed or there are 2 or more than 2 groups of the modules are selected, the installation button appears dimmed and disabled.
	2.	After all modules are installed, please go to the previous interface to confirm.

◆ **Promote**

1. Click [Promote]. The following image appears:
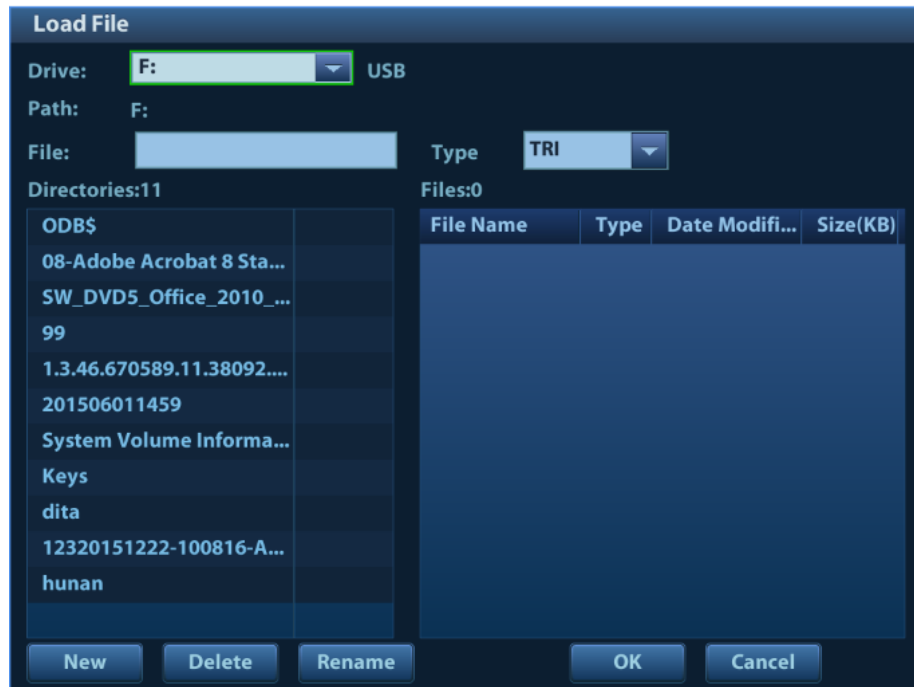
Note: the promotion function is only applied to the uninstalled key. If the optional key is installed, the promotion function is disabled.

2. Select the key to be promoted.

3. Click [OK] to complete the promotion.

9-2 Installation of Option Modules
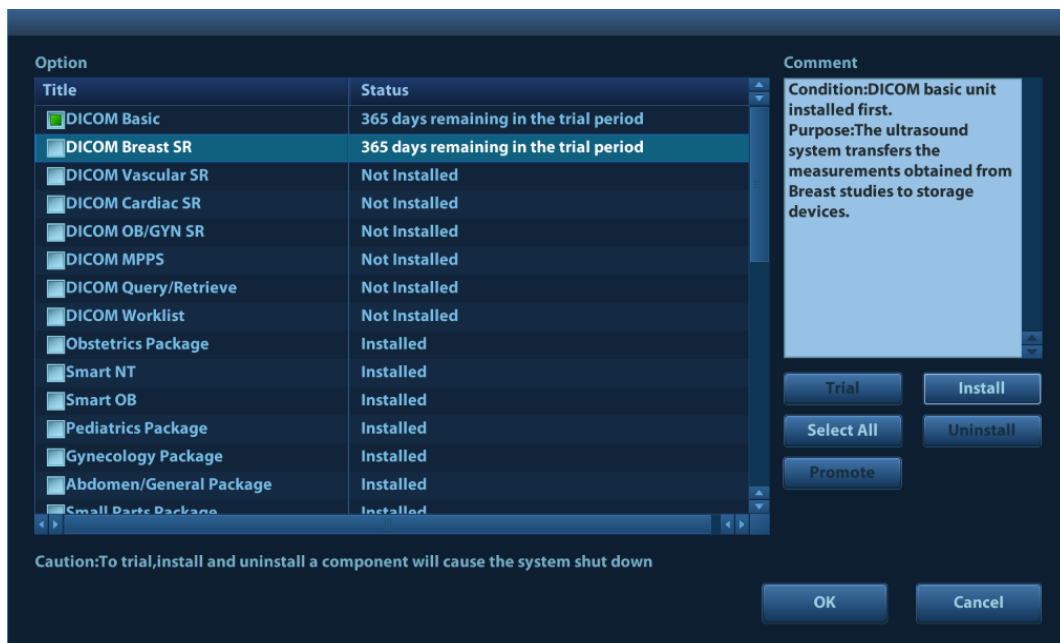
Note: it is unavailable to use promotion for multiple optional keys. For the optional key which is promoted, it can also be installed. The installation to promotion key is same with these in *Chapter 9.1 Install* above.

◆ **Uninstall**

1. Select the software package to be uninstalled from option list.
2. Click [Uninstall] and it pops up the [Confirm] dialogue box. Click [OK];
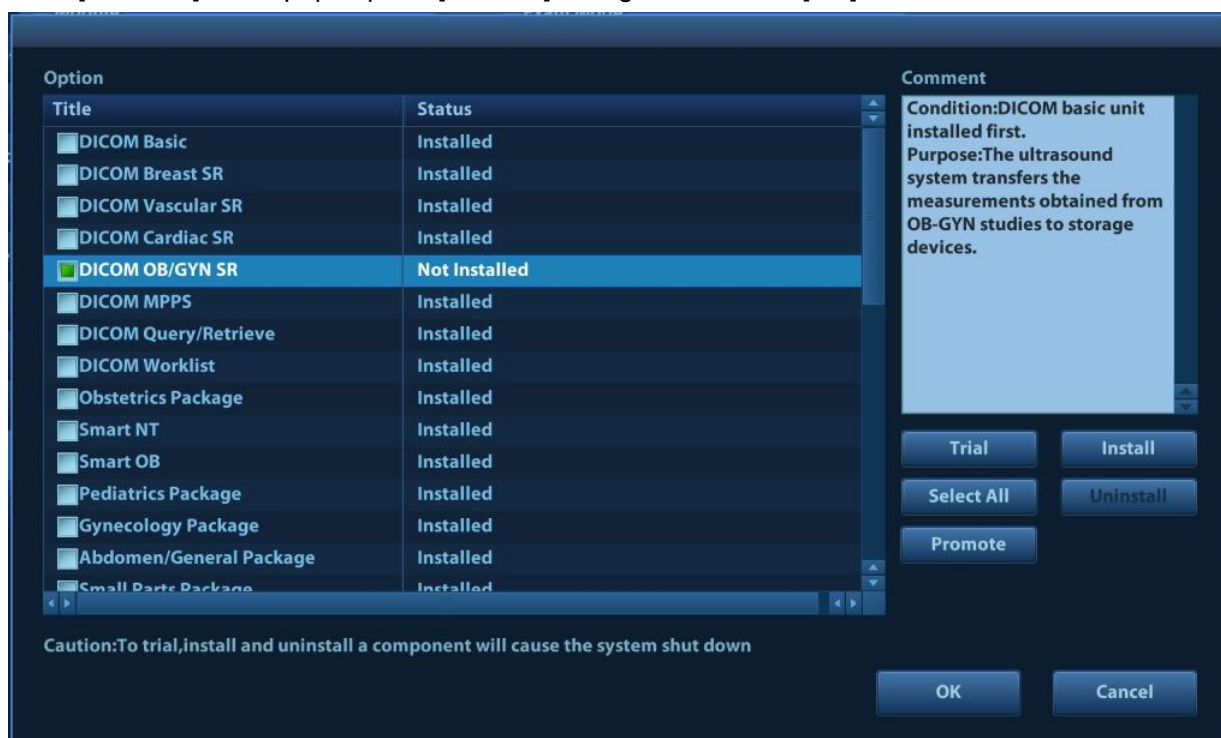
3. Return to the system preset interface. The optional devices status changes into "installed".

Note:	The removal function is exclusive to internal users. The service engineers must log in the system with the account of "Service", and then perform the installation.

9.2 Installation of the Accessory Kits and Optional Devices to Hardware

Hardware configuration list the system supports is displayed as shown below:

No.	Material No.	Descriptions	Material and pictures	Installation Reference
1	115-020354-01	Audio/Video extend module	/	9.2.3
2	115-023076-00	Probe extend module		9.2.2

9.2.1   Storage Tray

Remove the storage tray downwards. Take out the tray.

9.2.2   Probe Extender Assembly

1. Unscrew 4 screws (M4 X 12 cross panhead screw) on the pegboard of probe extender assembly.

M4X12 cross panhead screw
(4 screws)   Pegboard
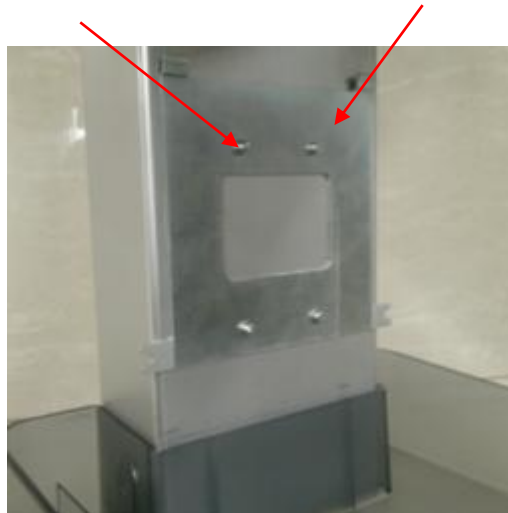
Figure **9-1**

2. Install the probe extender assembly towards arrow's direction.

Install the assembly towards arrow's direction

Figure **9-2**

3. Screw 2 screws (M4 X 12 cross panhead screw) on the back of probe extender assembly.

M4 X 12 cross panhead screw (2 screws; one screw for each left and right side)

Figure **9-3**

9.2.3   Audio/Video Extender Assembly

Push the metal clip on the left side to the bottom. Take put the audio/video extender assembly rightwards.

Metal clip   Audio/video extender assembly

9.2.4   Trolley Installation

The service staff installs the trolley according to the following steps after receiving the package:

1.   Open the package. See Chapter 3.2.1.1 for details.
2.   Install the holders on right and left sides.

As shown in the following figure a) and b), place the probe holder into the holes of the left and right plate of the trolley. The probe holders that are installed are shown in figure c.

Holder on left side

Holder on right side

a)

b)

c)

Figure 9-4 Installation for holders on right and left sides

3.   Install cable hook

As shown in figure 1, aim the installation axis's rabbet of probe hook assembly at the screw of fixing base, and then insert the probe hook assembly to the fixing base. Rotate the assembly anticlockwise to fix it (see figure b).The probe holders that are installed are shown in figure c.

Probe hook assembly

Rotate probe hook assembly anticlockwise

Screw

Fixing base

a)   b)

d)
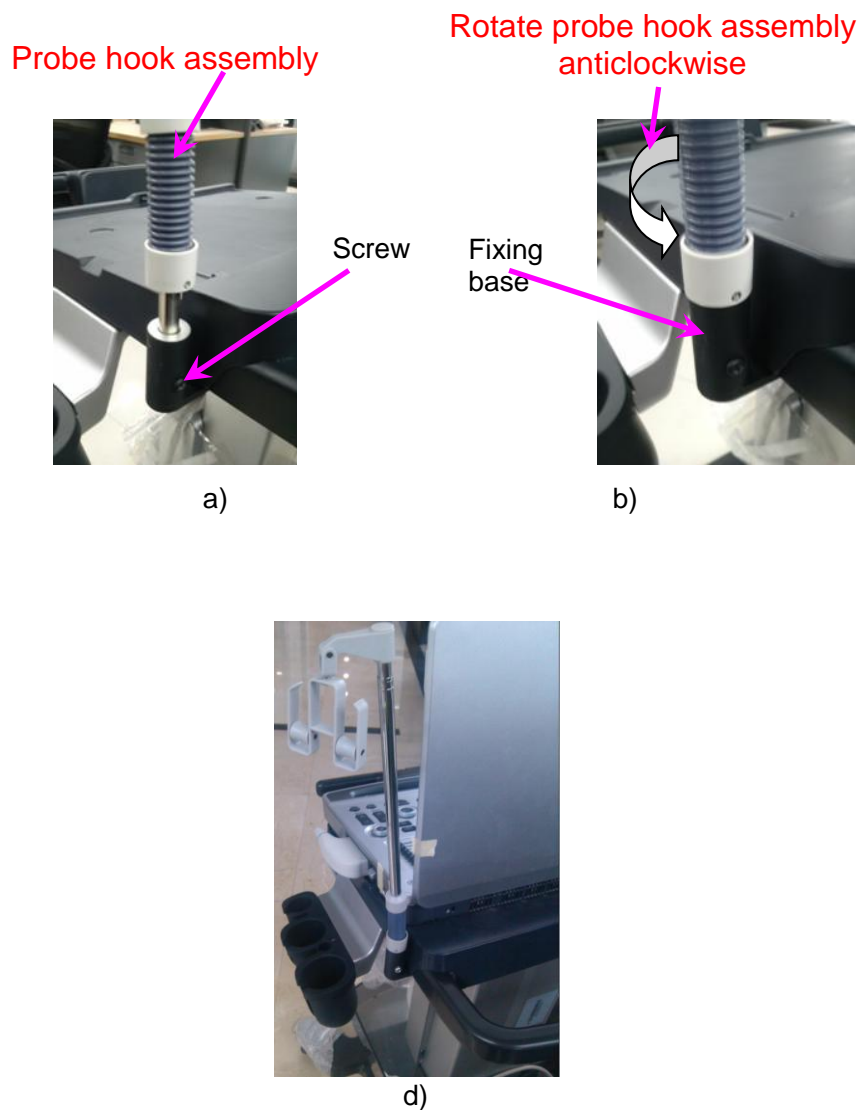
Figure **9-5** -Installing probe hook assemblyInstall storage tray. See *Chapter 0* for details.

Install the option modules if there are relevant modules for options: probe extend module, audio/video extend module. See *Chapter 9.2.2* and *Chapter 9.2.3* for details.

10 System Diagnosis and Support

10.1 General Status Indicator

10.1.1 Indicators of Control Panel

Status indicators	Icon	Status definition and indicators
Power-on status indicator		Off: System turned off; When pressing the key, the indicator blinks green first and then blinks orange; After powering on, the indicator is green.
Battery status indicator		1 It illuminates in orange color when batteries are charging; 2 It illuminates in green color when batteries are charged to full capacity; 3 The battery discharges with more than 20% electricity, and the indicator is green. 4 The battery discharges with less than 20% electricity, and the indicator blinks orange. 5 The battery discharges with less than 5% electricity, and the indicator blinks orange quickly. 6 When the battery is in non-charge/discharge status, the indicator is not on.
AC indicator		The indicator is green at AC supply. The indicator is off when batteries supplied.
Standby status indicator		The standby indicator blinks orange. Other status: light off
Hard disk indicator		The indicator light flashes in green when the hard disk is reading or writing. The indicator is off automatically in other situations.

10.1.2 Status of Whole Machine

Status of whole machine	Status definition and indicators	To enter the Patient Info interface	To exit the Patient Info interface
Scan status	In power status, the indicator is green; in Freeze status, the indicator is white or off.	Enter or exit the scan status via [Freeze] key	
Frozen status	In power status, the indicator is green; in Freeze status, the indicator is orange.	Enter or exit the frozen status via [Freeze] key	
Standby status	The standby indicator blinks orange.	1 short press the power button, then, the system enters into the standby status by choosing from the status popped on the screen. 2 If there is no operation for a period of time, the system would enter into the standby status automatically.	The system restores to the frozen status after restarting by pressing the power button for a short time.
Screen-saver status	The brightness of the monitor keeps the same; The logo "mindray" moves around the screen. the indicator of the control panel is off. The system is frozen. Ultrasound imaging hardware system is in the dormancy mode.	There is no operation for the time set firstly, and then the system would enter into the screen-saver status from the frozen status automatically.	When you press any keys on the control panel, the system would return to the frozen status, the brightness and the backlight of the control panel restore to the previous status.
Power-off status	The system is on the power-off status (AC power is plugged in), and only the AC indicator is on. See battery indicator's description for battery indicator status.	Press the power button for a short time, and then the system is turned off by choosing from the status popped on the screen	Start the system by pressing the power button for a short time

10.2   Get Whole Machine Started

Power-on to the machine

Press power button on control panel

Temporary black screen

Power-on indicator is on

Power-on completes. BIOS starts.

BIOS start-up graphics appears

mindray
Healthcare Within Reach

1. Backlight of control panel is on.
2. Power status indicators of IO back board are on.
3. The fan starts running.

Windows operating system starts

Windows start-up graphics appears

mindray

Windows logging graphics appears

mindray
healthcare within reach

Diagnostic Ultrasound System

Hard disk indicator blinks

Doppler starts

Temporary black screen. Doppler start-up graphics appears (including progress bar)

mindray
healthcare within reach

Diagnostic Ultrasound System

Some mode buttons become orange (B mode button)

User interface

10.2.1 Power-on Process of Whole Machine Supplied by AC

Basic operations	Phenomenon
Plug the power supply into line voltage	Power indicator of minor control panel is on; battery indicator is on (battery); hard disk indicator and standby indicator are off.
Power button on the main control panel	Power-on indicator of main control panel blinks in green, and then is green.
Power-on is completed.	1: The control panel backlight lights on. 2: The fan starts to run.
After finishing hard disk initialization and logic configuring, PC enters into BIOS stage.	The monitor appears in black screen for about 1 second.

10.2.2 The Start-up Process of BIOS

Basic Procedures	Basic phenomenon
Self-test after the system power-on	The LCD is in blank screen and the speed is fast during the stage.
Initialization process & record system settings & provide the resident program library	Display BIOS start-up display
Load the operation system	Display BIOS interface when loading. After completing the loading, the black screen appears. Then, WINDOWS interface appears.

10.2.3 Windows Start-up

Basic Procedures	Basic phenomenon
Guiding the course of program loading	The monitor appears in black screen now, and the time of the course is short.
The course of testing and hard disk configuration	The monitor appears in black screen now, and the time of the course is short.
The course of the internal core loading	The logo "mindray" appears.
The course of logging on	Same as the above
Starting DOPPLER	The company logo appears, and simultaneously progress bar displays the related information.

10.2.4 The Start-up of Doppler

10.2.4.1 Procedure of Startup

```
┌─────────────────────┐
│  Windows    app     │
│  initialization     │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐        ┌──────────────────────────┐
│     Initialize      │────────│   Peripherals owned by    │
│     hardware        │        │   PC; initialization.     │
└─────────────────────┘        └──────────────────────────┘
           │
           ▼
┌─────────────────────┐
│   Initialize PC     │
│     software        │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐        ┌──────────────────────────┐
│ Initialize ultrasound│───────│   Initialization to       │
│     hardware        │        │   ultrasound software     │
└─────────────────────┘        └──────────────────────────┘
           │
           ▼
┌─────────────────────┐        ┌──────────────────────────┐
│     Initialize      │────────│ Start-up, operations and  │
│     ultrasound      │        │ applications related to   │
│     software        │        │ ultrasound software are   │
└─────────────────────┘        │ performed on this step.   │
           │                    └──────────────────────────┘
           ▼
┌─────────────────────┐
│ Initialization ends │
└─────────────────────┘
```
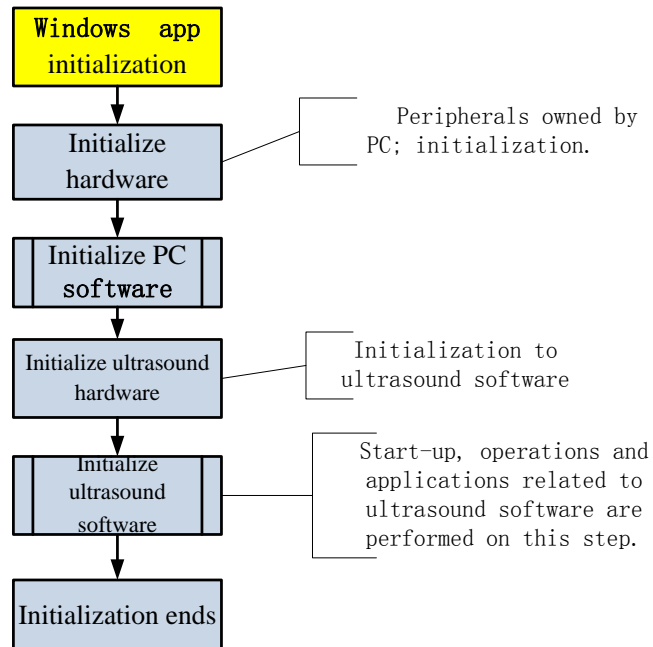
10.2.4.2 Details of Procedures

Step	Procedures	Increment	Description	Possible reason for starting stagnation
No tips	Window start-up appmon starts Doppler Attach the path to configuration files Set Windows attributes Initialize display device, main interface, vocal, USB device representative Start bus device Backbone Dev and LPC Initialize the time and multi-language functions. Initialize the external file system, network and drive Enumerate peripheral ports Configure timer, initialize soft interrupt, construct maintenance server, configure system static data Configure system font Load layout information Initialize UI manager and UI icon library	In increments of 7.	Start-up configuration, XP system	
Initializing hardware	Load boot-trap graphics, display progress bar; release package of configuration data; maintain data server		Boot-trap graphics	/
Loading system preset	Generate the server of local preset and system preset	In increment of 1.	Configure preset data	
Loading common exam preset	Generate general data management of the exam mode	In increment of 1.		
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 area information, language, Font library, input method create control factory Config GUI layer Set menu item Initialize function library Create UICenter	In increment of 1.	Configure hard disk data	/
Initializing gui	Configure application layer Keyboard initialization Configure user's access and remote desktop management	In increment of 1.	Be careful of the keyboard	/

Step	Procedures	Increment	Description	Possible reason for starting stagnation
Initializing ultrasound peripheral	Configure file dialog box Initialize print library Battery monitoring, PHV monitoring Load print task icon Configure low consumption Configure USB manager and burn manager Initialize video review device	In increment of 1.	Configure the external. Be careful of the battery.	
Initializing ultrasound image	Create ECG receiving thread Set virtual machine; initialize virtual machine Create front-back object tree (ultrasys, etc)	In increments of 2.	Pod data	
Initializing ultrasound application	Add function package of measurement menu Register application interface for the patient to be measured	In increment of 1.	Patient information library	/
Initialization completed	Configure the architecture of patient information management (UPatientApp)	In increment of 1		/
/	Enter Doppler interface	In increment of 1	Doppler interface	/

10.3   Alarming and Abnormal Information

The system has also alarming function, when the machine fails, it would pop up the alarming dialogue box, and simultaneously generate LOG file saved in the system log, which is saved in D disk: \M9\Log.

Description:	The asterisk "***" represents the time in LOG record. The format is: 2011-6-12 14:15:15

10.3.1   Power Error

Alarming tips	LOG record	Suggestion
"Warning! Battery operation error! The battery may be damaged"	*** "Battery hot unplug during operation."	Avoid hot swapping of battery.
"Battery communication error! Battery may not be used or battery capacity may not be displayed correctly"	*** "Left/Right Battery I2C error"	The battery error occurs when the power is supplied by AC. Check the battery connection or replace the battery.
"Battery communication error, Please	***"Left/Right Battery I2C	The battery error

connect AC power supply, or Power-off"" System will Power-off in 60s "	error, Battery supply"	occurs when the power is supplied by AC. Check the battery connection or replace the battery.
"Battery over-temperature, Please connect AC power supply, or Power-off"" System will Power-off in 60s "	*** "Left/Right Battery over-temperature, Current left/right temperature:?℃,Battery Manufacture Access value: left:0x????,right: 0x????"	Use the adaptor to supply the power or shut down the device to make the battery cooler.
"Battery error! Battery cannot be used!"	***"Left/Right Battery error! Battery Manufacture Access value: left:0x????,right: 0x????"	Right or left battery is damaged or protected. It can be recognized via Manufacture Access value. If it is under protection, it would restore after a time period. If it is damaged, it needs to replace the battery.
N/A	*** "Battery cycle is more than 300, Current cycle: left:??, right:??"	The usage time of batteries is too long. It is recommended to replace the battery.

The battery status is displayed in "Preset"-"System Information". See the table below.

Battery status	Condition	Description
"GOOD"	No damage to the battery or the protection recoverable. The fully charged battery capacity (FCC) is larger than 40% of rated voltage.	The battery status is good, and can be used normally.
"WEAK"	No damage to the battery or the protection recoverable. The fully charged battery capacity (FCC) is less than 40% of rated voltage. Cycling times of the battery< 300	Discharge or charge the battery fully. Restore some of the battery capacity.
"RELACED"	No damage to the battery or the protection recoverable. The fully charged battery capacity (FCC) is less than 40% of rated voltage. Cycling times of the battery > 300	Battery capacity goes down after long-time use. It affects the battery performance and endurance time. Replace the battery as necessary.

"INVALID"	Unrecoverable destructive protection of battery	Permanent damage to the battery. Remind the user of replacing the battery.
"PROTECTED"	Recoverable protection of the battery	The recoverable protection occurs to the battery. The battery recovers after a time period. Contact the service engineer for any questions.

10.3.2 Abnormal Voltage of System Power
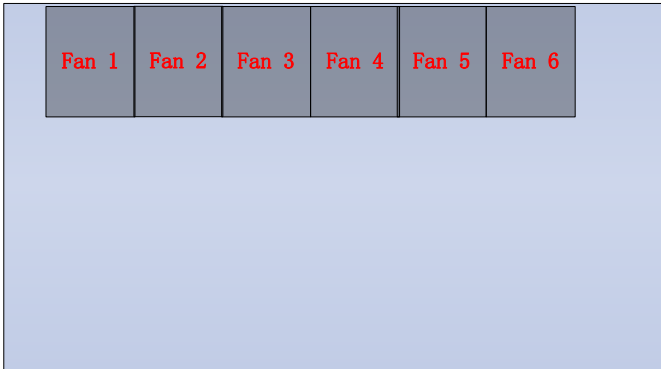
Alarming tips	LOG record	Suggestion
The real-time battery will be out of power, please replacing it.	*** System Monitor: Power supply alert! [XXX], Current voltage: [VVV] V, Limit voltage:[LLL]~[HHH]V	Replace button battery
N/A	*** System Monitor: Power supply alert! [XXX], Current voltage: [VVV] V, Limit voltage:[LLL]~[HHH]V [XXX] represents voltage name, [VVV] represents the current value, and [LLL]-[HHH] represents the upper and lower limits. The voltage names respectively are: P2V5、N11V7、P3V3、P5V、 P1V2、P1V8 、AP5V6、AP3V6、P12V、P1V5、 AP2V、AP2V8、P1V、P1V35	If a certain segment of the circuit is abnormal, or goes higher or lower, it should replace main board.

10.3.3 Abnormal Temperature

Alarming tips	LOG record				Suggestion
"Temperature Alert" "Temperature Alert" The software starts the shut-down after the alert appears.		*** System Monitor: Temperature Alert! [XXX], Current temperature: [VVV] ℃, Limit temperature: [LLL]-[HHH] ℃。[XXX] represents voltage name, [VVV] represents the current value, and [LLL]-[HHH] represents the upper and lower limits. The temperature names respectively are: FPGA, CPU	Temperature name		Turn the device off if the software is over-heated. Restart the device Check fan log record D: \M9\Log \ M9_Log.20XX-XX-XX.xml 20XX-XX-XX represents LOG's date. Fan works well or not/check cooling conditions.

thermal sensor Hot spot name	
DSP F GA	FPGA
PC module	CPU thermal sensor

10.3.4 Fan Error

Alarming tips	LOG record	Suggestion
"Ventilator requires maintenance, please contact the service!"	*** System Monitor: Fan alert！[XXX], Current speed : [VVV] rpm, Limit speed: [LLL] rpm The number of the fan is shown below (from left to right): Fan 1　Fan 2　Fan 3　Fan 4　Fan 5　Fan 6	Replace the fan/re-connect the circuit/clear off fan blocking.

10.3.5 PHV Error

Alarming tips	LOG record	Suggestion
Alarm! High-voltage transmission is abnormal, and images display normally!	*** HARDWARE_WAR(0xB1).PHV hardware protection, HV_PRN_N (+-100V)	Cut off the power supply after shutting down the device. Check the restoration of the system. Otherwise, it is necessary to replace PHV power supply board of the front end.
	*** HARDWARE_WAR(0xB1).PHV hardware protection, PHV_OVP_N (OverVoltage Protection)	
	*** HARDWARE_WAR(0xB1).PHV hardware protection, PHV_OCP_N (OverCurrent Protection)	

*** [CCC]([HH]).[XXX] supply voltage error. [XXX] volt is [PPP] V (upper limit is [LLL]V). in which [CCC] refers to the frame name of current alarming protocol and [HH] refers to frame header. [XXX] refers to the name of high voltage, such as: PHV-1P, PHV-1N, PHV-2P, PHV-2N, CW-P and CW-N. [PPP] refers to absolute value of current voltage. [LLL] refers to upper limit of preset voltage.	Restart the device to check whether the system can work again. Otherwise, it is necessary to cut off the power supply after shutting down the device. If the problem still exists, replace front power supply board.	
*** [CCC]([HH]).[XXX] supply voltage error. Current volt is [PPP] V, out of range 95V~105V. in which [CCC] refers to the frame name of current alarming protocol and [HH] refers to frame header. [XXX] refers to the name of high voltage, the range of which is from +100 V to -100 V. [PPP] refers to absolute value of current voltage.		
*** PHVCURRENT_WAR（0xB2）.Channel [XXX] supply current error. Channel [XXX] current is [PPP]mA. [XXX] refers to channel number of voltage: 0-3. [PPP] refers to current value of current voltage channel.		
*** [CCC]([HH]).PHV volt abnormal protection. {PHV-1P volt:[PPP]V, PHV-1N volt: [PPP]V,} PHV-2P volt: [PPP]V, PHV-2N volt: [PPP]V. in which [CCC] refers to frame name of current alarming protocol and [HH] refers to frame header of protocol. [PPP] refers to absolute value of current voltage. {..} indicates that PHV-1P and PHV-1N voltage are not used (such as CW-Multiplex mode). It can be ignored.	Cut off the power supply after shutting down the device. Then, restart the device. Check the restoration of the system. Otherwise, it is necessary to replace PHV power supply board.	
*** [CCC]([HH]).CW volt abnormal protection. CW-P volt: [PPP]V, CW-N volt: [PPP]V. in which [CCC] refers to frame name of current alarming protocol and [HH] refers to frame header of protocol. [PPP] refers to absolute value of current voltage.		

10.3.6 Other Errors

Alarming tips	LOG record	Suggestion
Fail to open the file "SystemConfiguration.ini", and please check HDD data!	N/A	Re-install the system software.

10.4 Self-test

10.4.1 Self-test Introduction

The self-test function, adopted by M9 series products, is used to test the connection of hardware board, running status of the device. According to the access authority and tests, there are three

types of tests: production self-test, maintenance self-test and user self-test. This chapter describes the maintenance self-test and user self-test in details.

10.4.2 Operation Procedure of Maintenance Self-test

Note:	Before entering system self-test, all tasks running on Doppler should be completed, otherwise the self-test system fails to respond. It is recommended to start self-test software to perform the test after the system is generated.

1. Switch account, type service password and service account to log in.

2. Select [Preset]-[Maintenance]-[Setup].
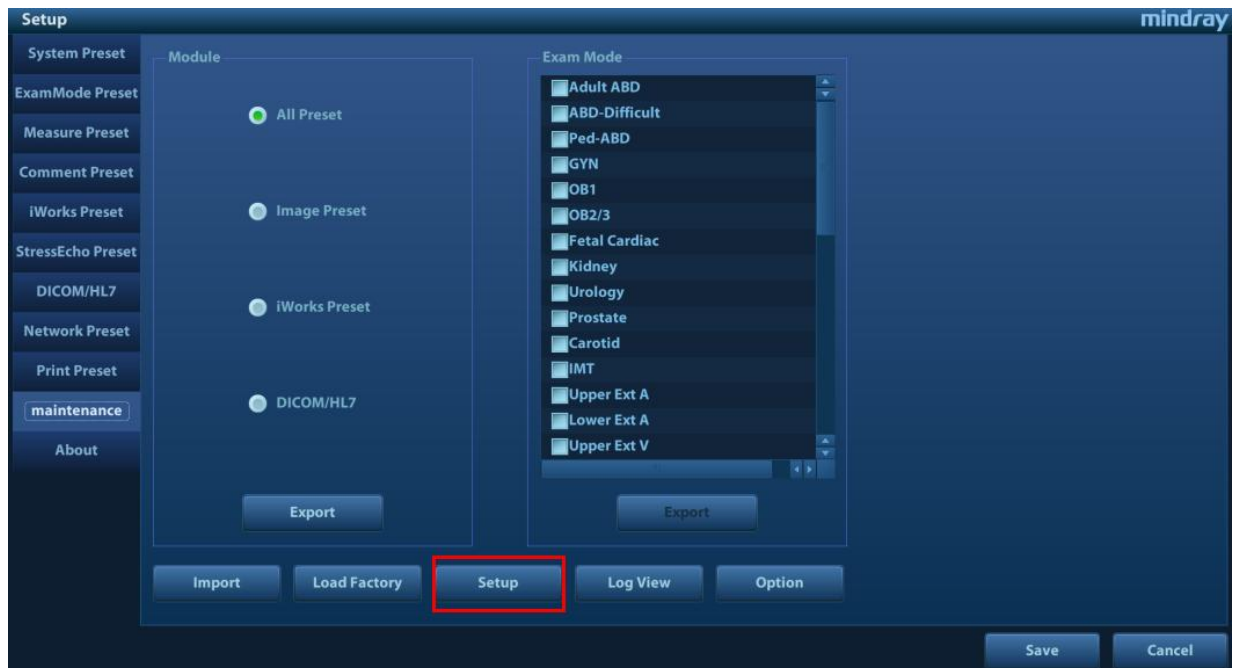
Click [Self Test] out of dialog box.

Note: If the system is in Chinese, the self-test performs Chinese system self-test.

If the system is not in Chinese, the self-test performs English system self-test.
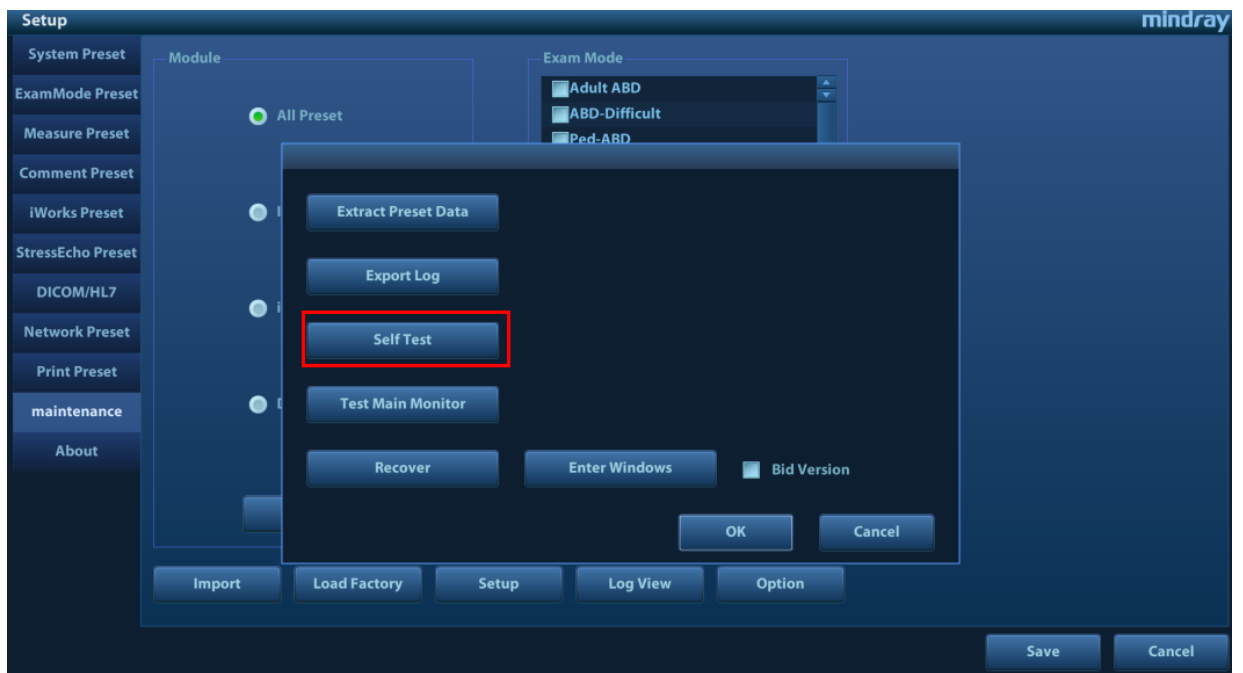
3. The booting screen of system self-test appears.
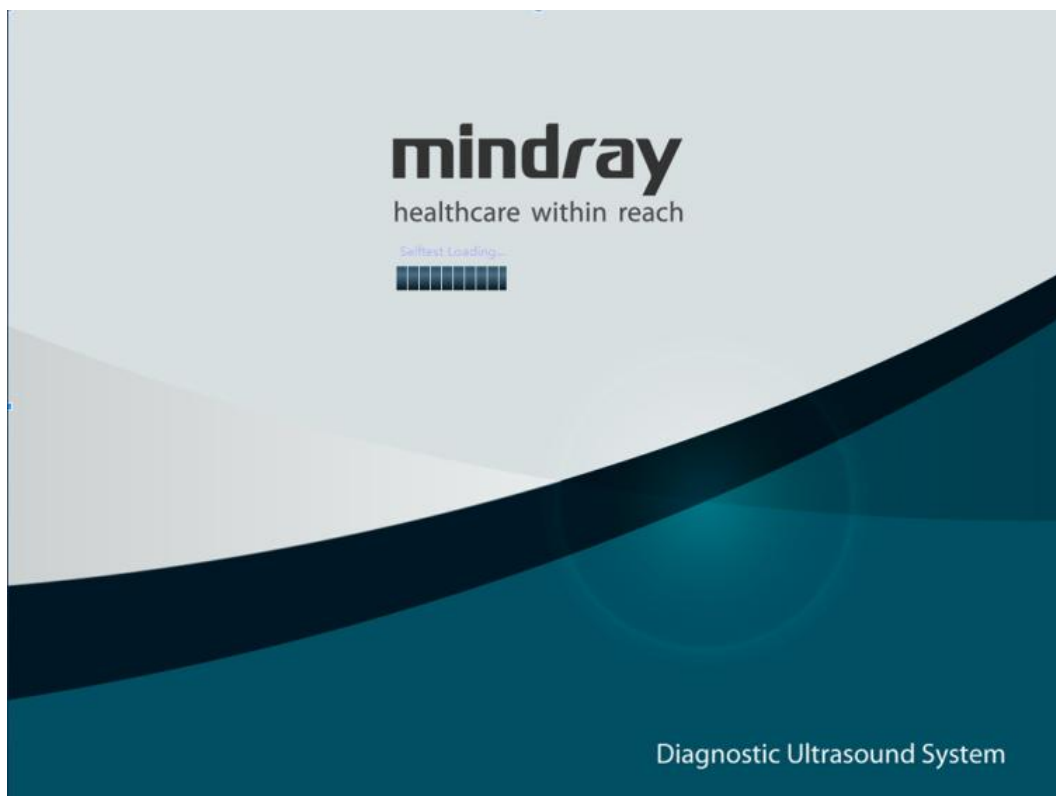
Figure 10-1 **Booting screen of system self-test**

4. Configure corresponding preset items on maintenance self-test interface. After finishing the configuration, click [Start] to perform self-test. See the table below:

Button Name	Description
[Open All]	Click to unfold all items that are folded.
[Close All]	Click to fold all items that are unfolded.

[Default]	The system performs item tests by clicking it.
[Select All]	Select all test items by clicking it.
[Select None]	Cancel the test item by clicking it.
[Continue/Stop]	One button for two operations [Continue] and [Stop]. If you click [Continue], the test continues even though a test item fails during the test; however if you click [Stop], the test stops once a test item fails during the test.
[Start]	Click to perform tests for checked items one by one while the button turns to [Stop]. During the test, if you click [Stop], the test stops. After the test is completed, the [Stop] button turns to [Start], and waits for the next test.
[Next Fail]	After completing the test, click [Next Fail]. The program searches for the failed test item from message list, and rearrange it to the top of the test information list. If the program reaches the bottom, it starts to search from the top of the list again.
[Clear History]	Click to clear off the test data in *Testitems* and *Messages* and to initialize the system structure diagram to original status.
[Loops]	It is used to perform loop test. Select the check box and type the times for loop test in the box on the right of screen, and perform the test according to the times typed. If the loop times are less than 0, it continues the loop test before the user stops it or encounters the error.
[Save Report]	The dialog box to remind the user of exporting the report appears by clicking the button. Plug the removable storage device, and select corresponding logic drive, and then click [OK]. The test data is saved to the selected root directory. The button is disabled if the removable storage device is not plugged in.
[Shut Down]	Close the program, and shut down the device. The system reminds the user of saving the test report to removable storage device when shutting down the device.
Remarks: the test item includes parent-test item according to the board from the test area. There are sub-test items belonging to parent test item. It can be customized according to the requirement. If the test item is ticked (☑), this item is in the test list; otherwise, this item is not in the test list. When a parent item is selected, all the sub items of this item are selected by default; otherwise, when deselecting a parent item, all the sub items of this item are deselected by default.	

Description:

The user can see production, maintenance and user self-test interface from the screen. The production and maintenance self-test interfaces can be divided into five areas.

Figure 10-2 **Maintenance self-test interface**

5. Self-test status display:

    When the program is running, the version and release date, *M9 SelfTest Software for Manufacture Version: xx; Release Date: YYYYMMDDXX*, will be displayed on the left side of the status bar. During the test, the software version in the status bar becomes the name of current test. The current test progress and overall test progress are displayed on the status bar.

    Beyond that, the status bar tests the rest time in real-time.

Figure 10-3 **Sketch of test status bar**

6. Monitoring information bar

    Current time, CPU ocCPUation rate, CPU 1 temperature, CPU 2 temperature, CPU 3 temperature, CPU 4 temperature, DC-DC temperature, AFE temperature and DSP FPGA junction temperature display on monitoring information bar.

    If the temperature exceeds the working temperature, the temperature status in progress bar appears in red.

7. System dialog box

    The element in the system dialog box changes as the color of test result changes in the test process. If the test fails, the color of the element becomes red; if the test succeeds, it becomes green. If the color of the element does not change, it indicates the test does not proceed.

8. Test information

    The test result is displayed after the test is completed. Green *PASS* indicates the pass of the sub-item. Red *FAIL* indicates the failure of the sub-item. If the item has not been tested, it appears in grey *Skip.* If the board and the assembly are absent, it appears in grey *NaN*. Red *Error* appears as the test item error occurs. The test result of parent test item is the aggregate for the test result of all selected sub-test items. If there is *FAIL* test in the selected list, the test result of parent test item is *FAIL*. As long as the test result of the selected item is *PASS*, the test result of parent test item is *PASS*.As shown in the following figure.

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Figure 10-4 **Display of test result in Testitems table**

Click each test item in *Testitems* list. The program search for corresponding test result of test item and displays it in details, as shown below.

Figure10-5 **Display of test result in Messages table**

The number to the test item appears in front of the name of test item. The number format is: ZXXYY and all test items are started with "Z". XX represents sequence number of the first level for item test and YY represents the second level. For example: the number of *System Voltage Test* is *Z0210*, in which *02* is the second test item of the first level directory in *Main Board,* and *10* is the tenth test item of *System Voltage Test* in *Main board*.

10.4.3 User Self-test

Start the device. Press <Setup> button. Select [Maintenance]-[Setup]-[Self Test] to perform the operation.
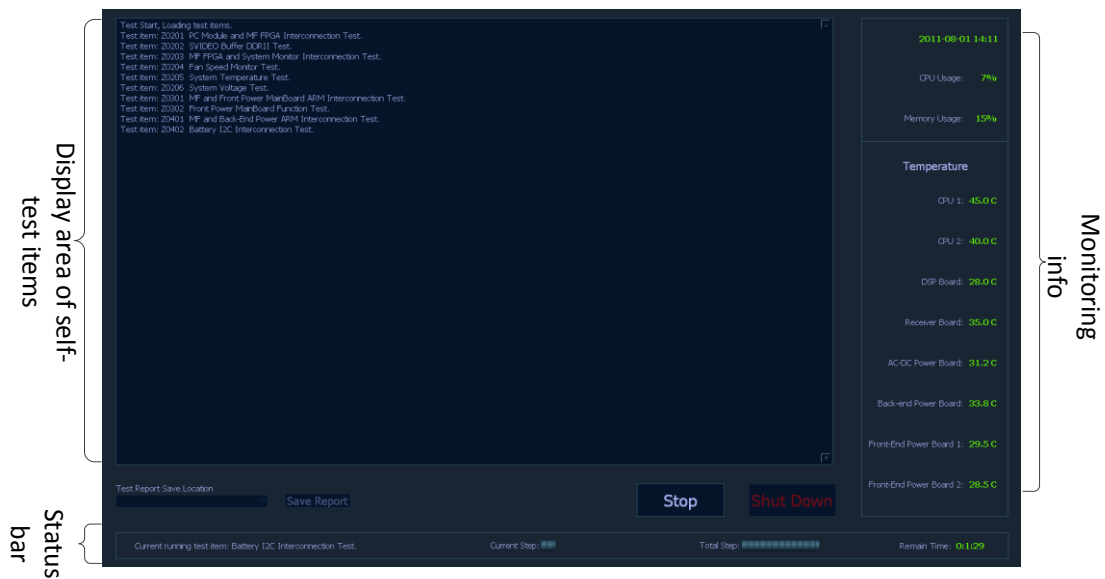
Figure 10-6 **User self-test interface**

There are three divisions in user self-test interface: display area of self-test item, monitoring information bar and status bar. The functions on monitoring information bar are same with those on user self-test interface. The self-test area only displays the item that has been tested, but not the test result.

Item	Description
[Start/Stop] button	Click to perform tests for checked items one by one while the button turns to [Stop]. During the test, if you click [Stop], the test stops. After the test is completed, the [Stop] button turns to [Start], and waits for the next test.
[Test Report Save Location] Check box	Displays the logic drive of removable storage medium (USB flash disk, removable hard disk, etc) connecting to the system. The check box is disabled in test process.
	If there is no removable storage medium, click the control which reminds the user of inserting the removable storage medium.
[Save Report] button	Save the test data to the root directory of selected logic drive. The button is disabled when the logic drive is deselected or in test process.
[Shut Down] button	Close the program, and shut down the device. The system reminds the user of saving the test report to removable storage device when shutting down the device.

Start the test when entering user self-test. After finishing the test, the number of test item only displays on the screen if there is *FAIL* test item. For example, if *System Voltage Test* fails, only does Z0210 display on the screen. It is available for user to notice that Z0210 corresponds with test item *System Voltage Test* by viewing Appendix.

The dialog box of PASS appears only with all test items passing, as shown below:

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10.4.4 Test Report

10.4.4.1 Test Report

The default format of test report is HTML. The test report can be browsed via Internet Explorer. The format is shown below:

The test item list lies on the left side of the report and is classified according to test results. Click the test item on the left side of the report. The test data of the item displays in the report.

The test information lies on the right side and includes:

1. Report name;
2. The time that report generates, and software version information;
3. Screenshot of system structure diagram;
4. System information;
5. Highest temperature;
6. Test item data of *FAIL* test (if there is no FAIL test item, the directory does not unfold);
7. Test item data of *PASS* test (if there is no *PASS* test item, the directory does not unfold);
8. Test item data of *Skip* test (if there is no *Skip* test item, the directory does not unfold).

Test data format of each test item is shown below:

Z0202 DSP FPGA DDRIII Test

Board/Module   Main Board
Test Result   **PASS**
Message   DSP buffer DDRIII test PASS;
SCAN buffer DDRIII test PASS;
IQ buffer DDRIII test PASS;
Gather buffer DDRIII test PASS.

In which, [Z0202] refers to the index of test item;

[Board/Module] refers to the board and the module that test item lies in;

[Test Result] refers to the result of test item;

[Information] refers to the information of test item.

10.4.4.2 Test Data Storage

Take the time as the report name, and compress it into Zip file.

The test report is saved under the directory of *D:\M9\Log\SelftestReport.* 20 copies of test reports at most.

● Non-loop test

The test result will be compressed into Zip file and saved under the directory of *D:\M9\Log\SelftestReport* to non-loop test. One Zip file owns one report.

● Loop test

Click [Save Report] after finishing the test. The loop test is compressed into a Zip file package and saved under the directory of *D:\M9\Log\SelftestReport.* There are N reports in Zip file package where the reports are put into the folder of *Test Report Loop_N.* The test results are *PASS* and *FAIL.* N is the loop times of the test.

10.4.4.3 Test Data Export

1. Plug USB flash disk or removable storage medium to the port of the device.

2. The user chooses the logic drive of removable storage medium. Click [Save Report] on test interface to export the test data to root directory of the drive, and name it as *Test Report.* The dialog box appears after the test report is saved successfully.

Successful to copy test reports to removable disk.

OK
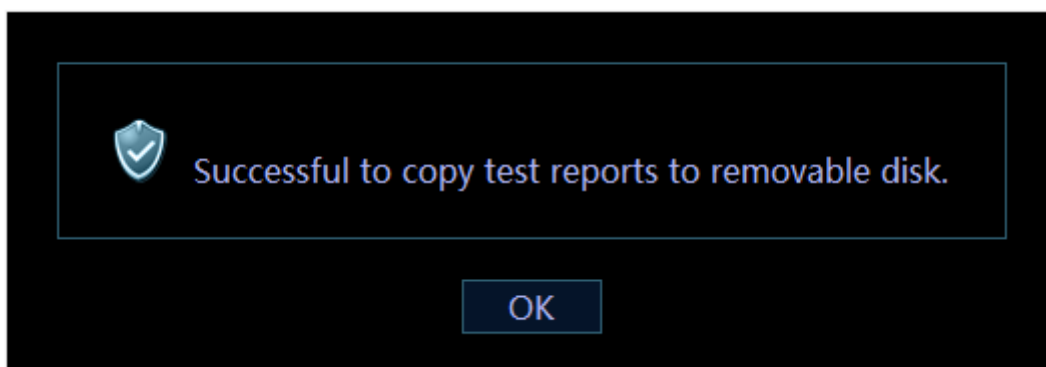
3. See *Appendix C* for details of test items.

Note:	It is not operational for users if there is no removable storage medium to the computer.

11 Care and Maintenance

11.1 Overview

The maintenance procedure in this chapter is for recommendation.

11.1.1 Tools, Measurement Devices and Consumables

Table 11-1 List for Tools and Measurement Devices

Tools/Measurement Devices	Qty.	Remarks
Plastic and resin container	1	Used to contain the physiological saline and two probes available in the container.
Soft brush	1	The size is similar to that of the brush. The material of the brush should be soft.
Small plastic bowl	1	Used to contain soap-suds
Safety testing device	1	See *Appendix A* for details
Inner hexagon spanner	2	Inner hexagon spanner 8 and inner hexagon spanner 6

Table 11-2 Consumable List

Consumable	Qty.	Remarks
Aluminum foil	About 1 meter long	
Physiological saline	About 1000 mL	Reach the half of the container to submerge the probe in the saline. (See *Appendix A* for details) (Concentration 0.85% to 0.95%)
Mild soap-suds	About 400 mL	
Dry soft cloth	5 pieces	

11.1.2 Routine Maintenance Items

Table 11-3 The list for maintenance items and maintenance frequency

No.	Item	Frequency	Method
1	Dust-proof cover cleaning	1 time/month	See *Chapter 12.2.1*
2	The monitor cleaning	1 time/month	Ditto
3	Trackball cleaning	1 time/month	Ditto
4	Control panel cleaning	1 time/month	Ditto
5	Probe cleaning (head of the probe)	Every time after use	Ditto
6	Probe cable and connector cover cleaning	1 time/month	Ditto
7	Holder cleaning (including probe holder and ultrasound gel holder)	1 time/month	Ditto
8	Cover cleaning	1 time/month	Ditto
9	Peripherals cleaning	1 time/month	See *Chapter 11.2.2*
10	Probe appearance check	1 time/day	See *Chapter 11.3.1*
11	Check for power supply cable, power supply plug and circuit breaker.	1 time/month	See *Chapter 11.3.1*
12	Battery check	1 time/3-6 month	See *Chapter 11.3.1*
13	Check for peripherals and optional functions	1 time/year	See *Chapter 11.3.3*
14	Mechanical safety check	1 time/year	See *Chapter 11.3.4*
15	Check for electrical safety	1 time/year	See *Appendix A*

11.2 Cleaning

11.2.1 System Cleaning

11.2.1.1 Flow of Cleaning

```
┌─────────────────────────────┐
│  Shut down the system; unplug │
│     power supply cable        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│     Clean dust-proof mesh     │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│       Clean the monitor       │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│      Clean the trackball      │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│    Clean the control panel    │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│        Clean the probe        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│       Clean the holder        │
└─────────────────────────────┘
              │
              ▼
        ╭─────────────────╮
        │  Clean the cover  │
        ╰─────────────────╯
```
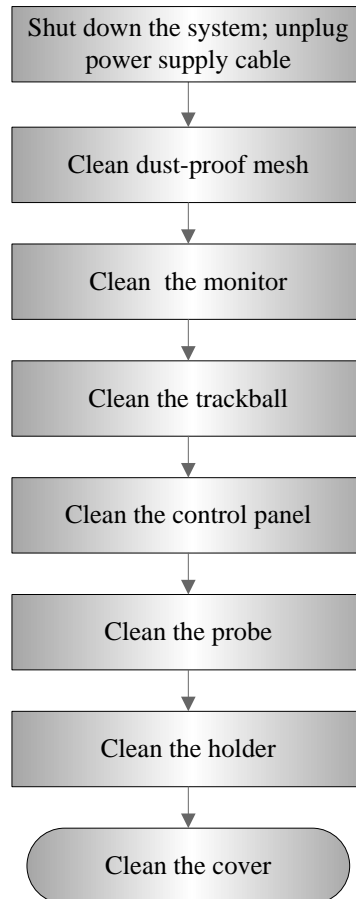
Fig 11-1 The View of cleaning maintenance

> ⚠️ **WARNING:** **Before cleaning the system, be sure to turn off the power and disconnect the power cord from the outlet. Otherwise electric shock may result.**

11.2.1.2 Content

1. Dust-proof cover cleaning

    Include system dust-proof mesh of main unit and dust-proof mesh of trolley.

    ● Tool: soft brush

    ● Method:

    a) Disassemble dust-proof cover before cleaning.

    Dust-proof mesh of trolley: open the clasp of dust-proof mesh. Push the dust-proof mesh towards the arrow to let it fall off completely form dust-proof slot. Then, take it out.
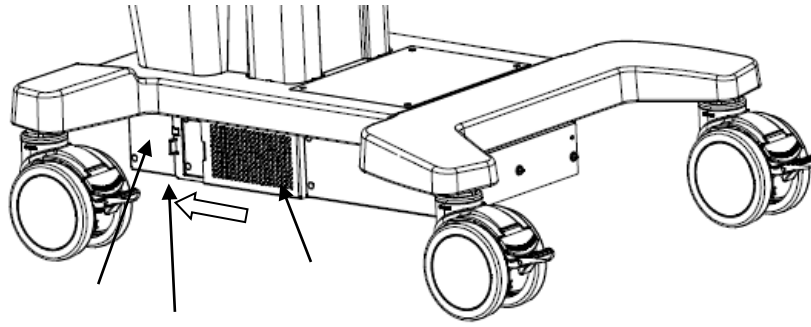
Dust-proof mesh of main unit: take out the dust-proof mesh of the main unit.

Dust-proof mesh of main unit on the right side

> **⚠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 the monitor (touch screen)

- Tool: dry soft cloth, clean water and soap-suds.

- Method:

Use dry clean soft cloth to clean monitor and touch screen. If there are any stains, use dry soft cloth or mild soap-suds to clean off. Then, air dry it.

3. Trackball cleaning

As a part of human-computer interaction, the trackball is easy to get the dust into internal module in the usage. It is necessary to perform the routine maintenance to ensure the performance. If the cursor does not work well, it would be possibly contaminated by dust.

- Tool: tissue, dry soft cloth, mild soap-suds

- Method:

a) Disassembling the trackball:

Turn the trackball ring about 35°counterclockwise until it lifts. Take out the ring and the rotary ball (Be careful not to drop the ball).If it fails to hold the trackball by hand, it is possible to use adhesive tape to remove it. The disassembly procedures are shown below:
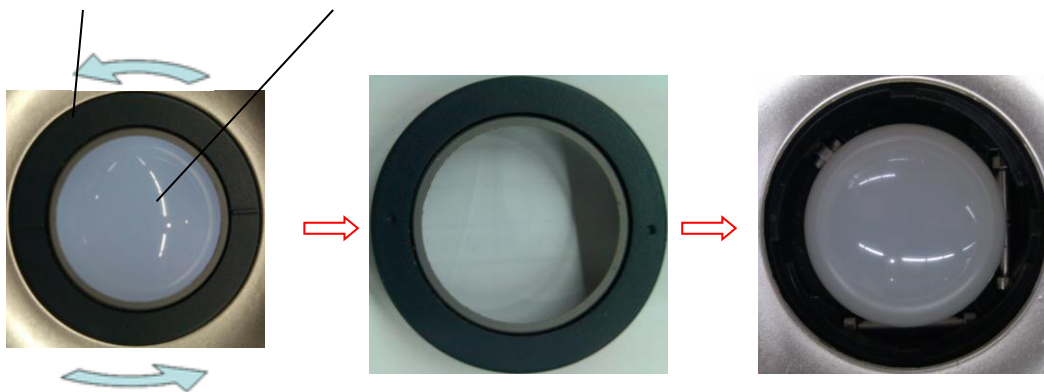
b) Cleaning:

Clean the two long shafts, the bearing, plastic cover and the internal area of clamping ring (see the illustration below) with clean soft dry cloth or tissue.
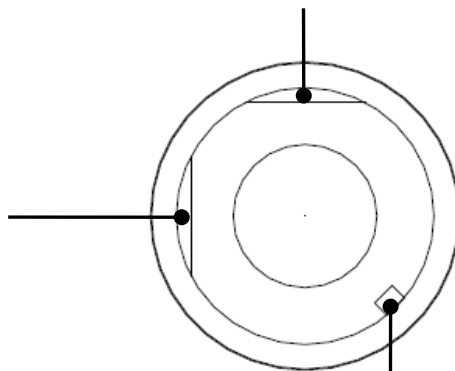
c) Restoration installation:

Put the trackball into that. The long axis of clamping ring aims at the slot of trackball's cover. Press the bulges of the clamping ring with fingers. Rotate the ring 35 degrees clockwise to lock it. The ring is installed well if the position of two bulges on the ring is perpendicular to device's panel. See the illustrations below.

Clamping ring clasp

4. Control Panel Cleaning

- Tool: dry soft cloth, mild soap-suds
- Method:

Use dry soft cloth to clean control panel (including keystroke, encoder, locking lever).Or use mild soap-suds to clean off the stains, and then use dry clean soft cloth to dry it. If it is difficult to clean the control panel, please remove the caps of the encoders, and then use mild soap-suds to clean off.

> **Note:** Keyboard on the control panel should be cleaned periodically; otherwise, keys maybe blocked by dirt and buzzer dings. Keys don't work.

5. Cleaning the probe
◆ Tool: dry soft cloth, mild soap-suds
◆ Method:
   a) Use dry soft cloth to clean off the dust on probe head, connector cover and its cables.
   b) Use soft brush to clean off the dust on the terminal of the probe connector.
   c) If there are any stains, use the mild soap-suds to clean off the dust on the appearance of the cables and connector cover. Then air dry it.

   Note: the probe connector cannot be clean with wet cloth.

6. Holder cleaning
◆ Tool: dry soft cloth, soft brush, mild soap-suds
◆ Method:
   a) Use soft dry cloth to clean off the dust on probe and gel holder and its gap; use the soft brush to clean off the dust from gaps and probe holders of smaller intracavity probes.
   b) If there are ant stains, remove the probe holder. Use mild soap-suds to clean off the stains. Reinstall it after being air dried.
   c) Gel heater: unplug the cable of gel heater, and take off the heater. Use the mild soap-suds to clean the heater. Use soft brush to clean the holes. Use soap-suds to clean off the stains, and reinstall it after air-dry.

7. Device cover cleaning
- Tool: dry soft cloth, mild soap-suds
- Method:

   Use soft cloth to clean off the dust on the device cover (the part exposed).Or use mild soap-suds to clean off the stains and air dry it.

   Note: it is preferred to use soft brush to clean off the dust on the port or socket rather than wet cloth (such as probe socket, IO board and ports on power supply board).

11.2.2 Peripherals Cleaning

Perform the cleaning according to the reality. The test items without the configurations can be ignored.

Table 11-4 List for peripherals cleaning

Item	Content	Process Description
1	Color/Black/White video printer	Use soft dry cloth to clean off the dust and stains on the cover. Remove the cover to clean the internal of the printer. It is necessary to abide by the operation procedures in *Operator's Manual* to clean the printer.
2	Graph/text printer	Use soft dry cloth to clean off the dust and stains on the cover. Remove the cover to clean the internal of the printer. It is necessary to abide by the operation procedures in *Operator's Manual* to clean the printer.
3	Footswitch	Use the dry soft cloth and soap-suds to clean off the dust and stains on footswitch and the cables.
4	Barcode reader	Use dry soft cloth to glass board of the scanner, and the clean off the dust o the cables and the bracket. Please abide by the operation manual on the scanner to perform the cleaning.

11.3 Check

11.3.1 General Check

Table 11-5 The list for general check

No.	Content	Method
1	Probe	Visual estimation, check whether there are any cracks and distention to probe head. Visual estimation, check whether there is aging or peeling; Visual estimation, check whether there is bending, damage or missed stitch to the probe's connector.
2	Power supply cable and socket	Visual estimation, check whether there are creases, cracks or aging to the power supply cable; Manual operation, check whether the plug of the power supply is fixed enough. No loose or crack occurs to it. The retaining clamp of power supply cable works well.
3	Battery	Checking battery performance routine: Charge the battery when the device is powered on: if the battery capacity reaches 100% or the battery continues to be charged, it indicates the battery works well. If the battery capacity is less than 90%, the time to increase 1% of battery capacity is less than 5 minutes. If the battery capacity is more than 90%, it need more to time to charge the battery. In stand-by status, the standby indicator shows the status of the battery.

11.3.2 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 11-6 System function list

No.	Content	Method
1	B mode	Verify the basic operation in B mode. Check the basic software and hardware assembly affecting B-mode operation.
2	Color mode	Check the basic operation in Color mode. Check the basic software and hardware assembly affecting Color mode operation.
3	Doppler mode (PW/CW)	Verify basic operation in Doppler mode. Check the basic software and hardware assembly affecting Doppler mode operation.
4	M mode	Check the basic operation in M mode. Check the basic software and hardware assembly affecting M-mode operation.
5	Measurement (General measurement, optional application measurement for 2D, M, Doppler)	Gray scale scanning on the body mark mode verifies distance and the accuracy of calculation using the test assembly and checks test precision along with performance test.
6	Keyboard test	Starting the keyboard test is used to check if all control keys are normal.
7	LCD	Please refer to LCD checking methods to check LCD display and parameters adjustments are normal.
8	Software menu testing	Testing software menu display is to see if they works normally after entering interfaces and menus
See *Chapter 5.4~5.5*		

11.3.3 Check for Peripherals and Optional Functions

If there is no relevant module or option in the system configuration, the relevant check can be ignored.

Table 11-7 Peripheral and option checking list

Item	Content	Method
1	Color/Black/White video printer	Check whether the output of video printer works well.
2	Graph/text printer	Check whether the output of graph/text printer works well.
3	Footswitch	Check whether the footswitch works as the system configures.
4	DVD-R/W	Check whether DVD-R/W works well (burning, read/write and openness).
5	Barcode reader	Check whether the reader works well and whether the output is correct.
6	DICOM	Check whether DICOM works well, and verify if sending images to DICOM server by shortcut key is normal.

Item	Content	Method
7	ECG module	Check user's basic operation. Verify the implementation of ECG module.
See *Chapter 5.3*		

11.3.4 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:

```
┌──────────────────────────┐
│   Check casters of cart   │
│        (optional)         │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│ Check the connection of cart │
│          casters          │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│   Check the handle of cart │
│        (optional)         │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│  Check the supporting part of │
│           cart            │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│  Check enclosure of main unit │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│  Check handle of main unit │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│  Check control panel And  │
│     turning mechanism     │
└──────────────────────────┘
             │
             ▼
   (  Check other mechanics  )
```
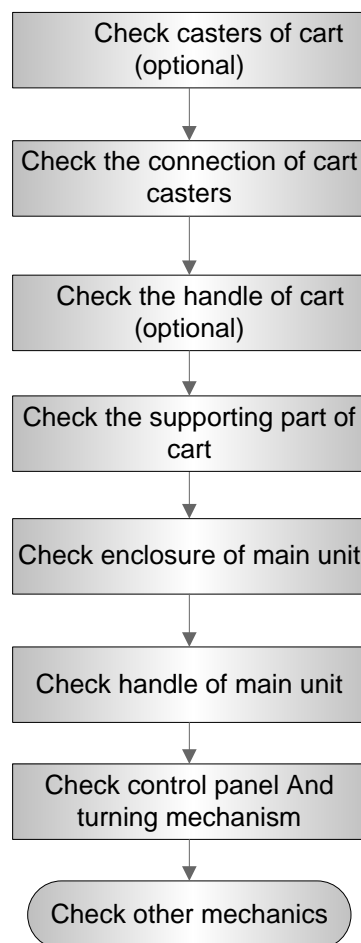
Fig Mechanical Safety Inspection Flow

The table of Mechanical Safety Check:

NO.	Item	Method	Tool
1.	Casters of cart	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 cart casters	a) Visually check to confirm that there is no skewness and the connecting screws are free of breakage or falling off. b) Check with the spanner to make sure that there is no looseness between the caster and the base connection screw.	Inner hexagon wrench 6
3.	Handle of cart	a) Check by sight if the handle has cracks.	
		b) Use a wrench to check if the handle is loose.	
4.	Cart supporting parts	a) Use hands to check if the supporting parts are loose.	none
5.	Enclosure of main unit	b) Check by sight if there is any crack.	none
6.	Handle	a) Visually check to confirm there is no any crack. b) Rock the handle gently and then lift the ultrasound machine to confirm that the handle is free of looseness and it can accept normal force.	none
7.	Control panel and turning mechanism	Open and close the control panel to see if it is free of looseness or separated from the main unit.	none
8.	Other mechanical structures	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 Troubleshooting of Regular Malfunctions

12.1 Troubleshooting as the System is Disabled to Power On

12.1.1 Related Modules or Boards

No.	Descriptions	Remarks
1	Power supply adapter	/
2	Battery assembly	/
3	Main board	/
4	CPU assembly	/

12.1.2 Key Points Supporting Troubleshooting

No.	Key points supporting troubleshooting	Remarks
1	Power-on status indicator	Backlight of the power button ⏻
2	AC indicator	Located on control panel ∿

12.1.3 Troubleshooting as the System is Disabled to Power On

No.	Fault Description	Cause Analysis	Solution
1	System power supply adaptor AC power indicator remains off; The system starts to work, but it turns out that the battery supplies the power for the system.	1 No AC input 2 Error from power supply adaptor	1 Re-check the connection of AC 2 Replace the power supply adaptor

2	AC indicator: on; Power on/off indicator: the indicator is off or blinks after pressing the button.	Error from main board of power supply;	Replace the main board.
3	AC indicator: on; Power on/off indicator: blinks after pressing the power button;	Main board of power supply responds to the power on/off, but CPU module does not respond to the power on/off module. The possibility for CPU module error is comparatively higher.	Replace CPU module
4	When connecting to the power supply adaptor, the system works well. If not connecting to the power supply adaptor, the system does not work only with the supply of the battery.	1 Low battery capacity 2 Battery module error	1 Charge the battery module; 2 Replace the battery module

12.2 The System Cannot Perform Troubleshooting

12.2.1 Related Modules or Boards

No.	Descriptions	Remarks
1	Main board	/
2	CPU assembly	/
3	SSD	/

12.2.2 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 during power on the control panel	/
4	Display mode of the LCD	/

12.2.3 The System Cannot Perform Troubleshooting

No.	Fault Description	Cause Analysis	Solution
1	The backlight on the control panel appears normal. The monitor is in black screen. There is no display when connecting to peripherals via HDMI.	System powers on normally, enters BIOS self-checking but BIOS screen does not display. CPU module failure.	Replace CPU module
2	BIOS start-up graphics is normally displayed, but it cannot be kept on	CPU module error	Replace CPU module
3	"OPERATING SYSTEM NOT FOUND" appears.	Loading operation fails. SSD and root directory of SSD in operation system are damaged.	Restore the operating system. If fails, replace SSD.
4	BIOS start-up graphics appears, and then in black screen.	Unavailable to load the system. The system directory of SSD may be damaged.	Restore the operating system. If fails, replace SSD.
5	System Doppler start-up graphics displays but cannot be kept on.	Fails to load Doppler software. SSD or system software of SSD may be damaged.	Restore the operating system. If fails, replace SSD.

12.3   Image Troubleshooting

12.3.1 Related Modules or Boards

No.	Descriptions	Remarks
1	PHV power supply board	/
2	TP64 board	/
3	Main board	/

12.3.2 Key Points Supporting Troubleshooting

No.	Key points supporting troubleshooting	Remarks
1	Image feature, including dark strips and noise	/
2	The imaging features of various probes	/

12.3.3 Image Troubleshooting

No.	Fault Description	Cause Analysis	Solution
1	No echo to ultrasound image. The probe can recognize but without the echo.	PHV power supply board error	Replace PHV power supply board
2	Dark strips appear on B image	Probe malfunction, e.g., array damage, etc. Replace the probe to eliminate the error.	Replace the probe;
		If dark strips appear in the near field and distribute regularly, transmission channels cannot generate transmission waveforms;	Replace TR64 or main board;
		If dark strips appear in the far field and distribute regularly, Receiving channel error. Some channels do not receive or produce echo signal.	Replace TR64 or main board;
3	Noise appears in B image	Probe malfunction. Replace with different probes to check the problem.	Replace the probe;
		Other electrical equipment in the voltage is working, so that the probe may be interfered on the floor; Displays ripple-shaped interference signal on the image	Confirm the cause of failure by turning off electrical equipment of all peripherals connected to the system

12.4 Troubleshooting Control Panel

12.4.1 Related Modules or Boards

No.	Descriptions	Remarks
1	Control panel assembly	/
2	2116 keyboard	/
3	TGC Board	/
4	Trackball	/
5	Silicon keystroke of keyboard	/

12.4.2 Key Points Supporting Troubleshooting

No.	Key points supporting troubleshooting	Remarks

1	Backlight of control panel	To confirm if the control panel is powered on normally;
2	Key sound of the control panel.	To confirm if the buzzer works normally
3	Response to function keys on control panel	/
4	2116 general response to the buttons on small keyboard	To confirm if it is digital keyboard error or control panel assembly error.
5	Response to trackball operation	/
6	Response to the sliding potentiometer	To confirm if it is TGC board error or control panel assembly error.

12.4.3 Troubleshooting Control Panel

No.	Fault Description	Cause Analysis	Solution
1	Buzzer alarms	Key blocked;	Check the control panel for key block
2	Some or a certain key fails	Control panel PCBA error or silicon button error;	Replace the control panel assembly or replace silicon buttons;
3	Some or a certain key on the small keyboard fails.	Small keyboard	Replace the small keyboard
4	Trackball failed or abnormal	Dirt or obstacles jam in the trackball groove	Open and clean the groove
		Improper setting of trackball speed in system preset;	Make a proper preset
		Degenerated trackball performance	Replace the trackball
5	Control panel buttons work well, but individual TGC button fails.	TGC board error	Replace TGC board.
	TGC buttons all fail	Control panel error	Replace control panel

12.5 Troubleshooting LCD Display

12.5.1 Related Modules or Boards

No.	Descriptions	Remarks
1	Display (monitor) assembly	Attached
2	Main board	
3	CPU assembly	

12.5.2   Key Points Supporting Troubleshooting

No.	Key points supporting troubleshooting	Remarks
1	Backlight of the LCD	More evident in the darkness
2	Display the status via HDMI connecting to peripherals;	/

12.5.3   Troubleshooting Monitor

No.	Fault Description	Cause Analysis	Solution
1	The power-on of the control panel is normal. Response to operation buttons. No display (blank screen) on the LCD; Displays normally via HDMI connecting to peripherals;	LCD error	Replace the LCD.
2	The power-on of the control panel is normal. Response to operation buttons. No display (blank screen) on the LCD; Displays normally via HDMI connecting to peripherals;	Main board error	Replace the main board.
3	The power-on of the control panel is normal. No response to operation buttons. No display (blank screen) on the LCD; No display appears via HDMI connecting to peripherals;	CPU assembly error	Replace CPU module

12.6   Troubleshooting for ECG Module

12.6.1   Related Modules or Boards

No.	Descriptions	Remarks
1	ECG board	/
2	Main board	/

12.6.2   Key Points Supporting Troubleshooting

No.	Key points supporting troubleshooting	Remarks
1	Wave features of ECG signal	/

12.6.3 Troubleshooting for ECG Module

No.	Fault Description	Cause Analysis	Solution
1	Fail to open ECG related functions	ECG board error	Replace ECG board.
2	Open the corresponding ECG function, and the wave form is displayed as a line or abnormal wave shape.	Abnormal ECG lead or ECG module	Replace ECG lead or ECG module.

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$_{XL}$ 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.

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

NOTE: "4-protective grounding impedance" testing item is applicable for M9 portable ultrasound system with UMT-500Plus trolley (configured with power supply), and is not applicable for unaccompanied M9 system or M9 system with UMT-500 trolley (without power supply).

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

ELECTRICAL SAFETY INSPECTION

4- Protective Earth Resistance

front panel outlet.

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

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

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


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


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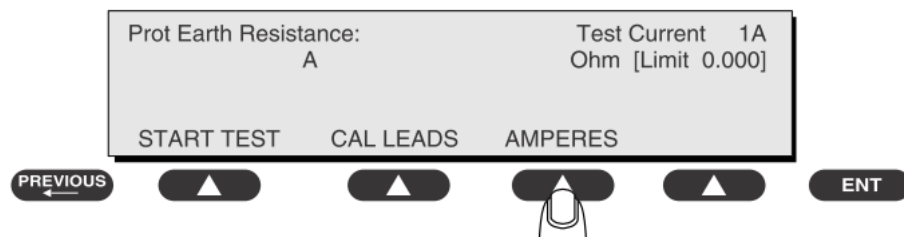
5) Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.

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:

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

    DUT OFF          EARTH          NO L2       AP-EARTH
```

PREVIOUS ▲ ▲ ▲ ▲ ENT
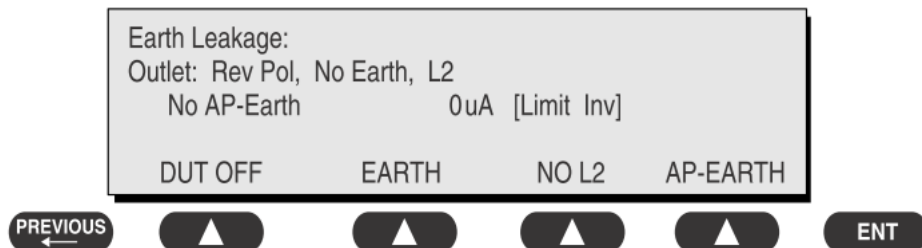
➢ SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
➢ SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
➢ SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
➢ SOFT KEY 4 toggles the AP to Earth to No AP to Earth.

4) Press the print data key at any time to generate a printout of the latest measurement.
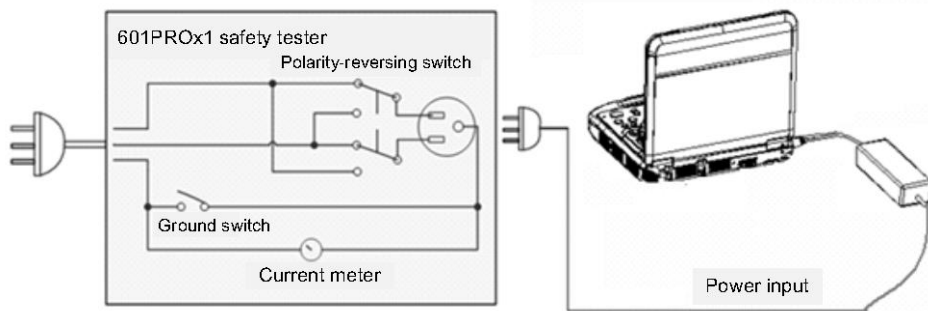
Figure 1   Earth leakage test

ELECTRICAL SAFETY INSPECTION

5- 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

IEC60601-1：   500 µA Normal Condition

1000 µA 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.

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.

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

    DUT OFF          NO EARTH        L2    APPLIED PART
```
PREVIOUS   ▲   ▲   ▲   ▲   ENT
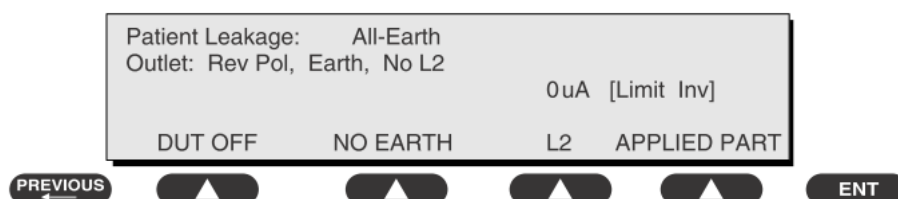
4) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.

5) Modify the configuration of the front panel outlet by pressing the appropriate SOFT

KEY on the 601PRO.

6) Press the print data key at any time to generate a printout of the latest measurement.
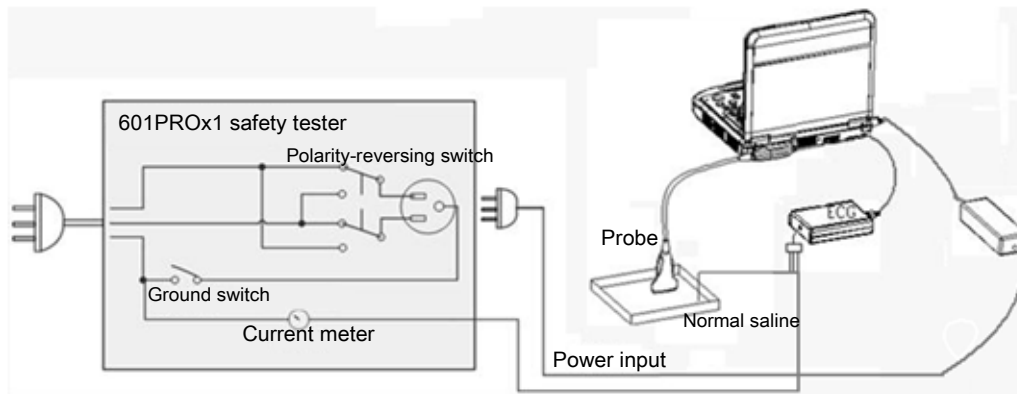
Figure 2   patient leakage Current

◆ 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 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

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

All countries

For BF ECG input and transducer

      100µA Normal Condition

      500µA 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:
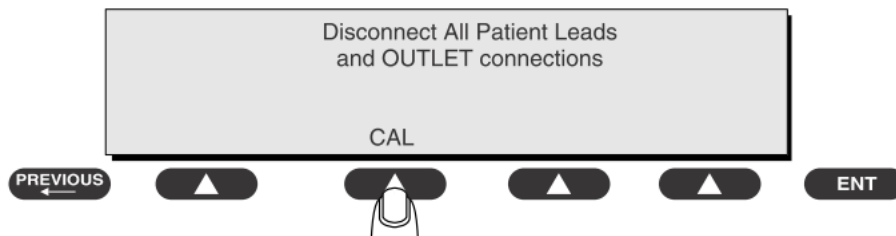
If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

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

```
Mains on Applied Part:     All-Earth
Outlet: Norm Pol, Earth, L2
Norm        uA      Rev        uA     [Limit Inv]

 START TEST            CAL          DUT OFF  APPLIED PART
```

PREVIOUS ▲ ▲ ▲ ▲ ENT
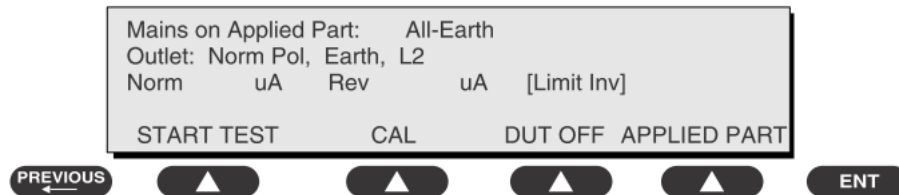
4) Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:
5) Press START TEST (SOFT KEY 1) to begin the test.
6) Press the print data key to generate a printout of the latest measurement.
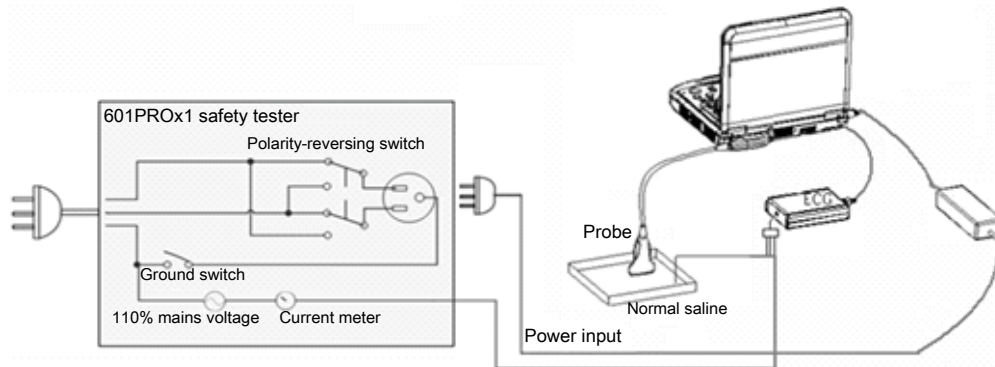
Figure 3   Mains on Applied part leakage

◆ 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 or owner to correct any deviations. As a work around, check the other

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

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 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

All countries:

For BF ECG input and transducer:

5000μA

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.

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

        DUT OFF         NO EARTH      NO L2    APPLIED PART
```
PREVIOUS ▲ ▲ ▲ ▲ ENT
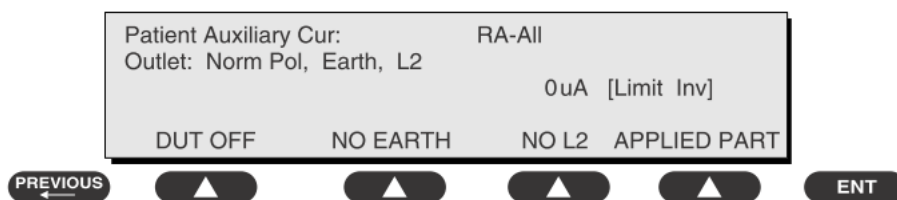
5) Press SOFT KEYS 1-4 to select leakage tests
6) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
7) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
8) Press the print data key at any time to generate a printout of the latest measurement.
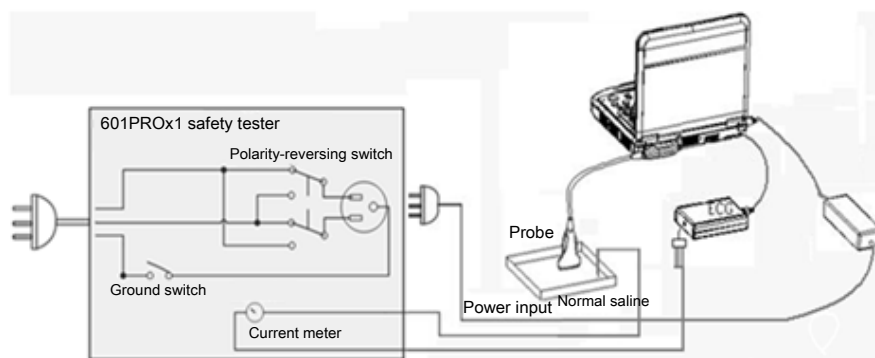
Figure 4   patient Auxiliary Current

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 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

All countries

For BF ECG input and transducer

   100µA Normal Condition

   500µA 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 including transformer or patient circuit board	Test item: 1, 2, 3, 4, 5
□	Opened repair type, modify the power part including transformer or patient circuit board	Test item: 1, 2, 3, 4, 5, 6, 7, 8

Location:			Technician:	
Equipment:			Control Number:	
Manufacturer:		Model:	SN:	
Measurement equipment /SN:			Date of Calibration:	

INSPECTION AND TESTING				Pass/Fail /NA	Limit
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	____μA		Max: NC: 300μA(refer to UL60601-1) * NC: 500μA(refer to IEC60601-1) * SFC: 1000μA
		Single Fault condition(SFC)	____μA		
6	Patient Leakage Current	Normal condition(NC)	□BF___μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	□BF___μA		
7	Mains on Applied Part Leakage		□BF___μA		Max: BF applied part: 5000μA
8	Patient Auxiliary Leakage Current	Normal condition(NC)	□BF___μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	□BF___μA		

Note:

● 4-protective grounding impedance testing is applicable for M9 + UMT-500Plus trolley and is not applicable for unaccompanied M9 system or M9 system with UMT-500 trolley (without power supply).

● **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

Note: as an option, the phantom usage is not required to perform the routine maintenance. It can be used to guarantee the quality of the test.

Note:	Best storage and working temperature for phantom: 10℃ to 35℃. The test performance may be affected if the temperature goes beyond the range.

⚠**WARNING:**	1.	Lay the probe gently on the acoustic window in the use. In case of acoustic window and TM damage, do not press acoustic window.
	2.	Do not let the phantom fall off or bump. Do not put the phantom upside down except for the maintenance.

Targets disposal- KS107BD
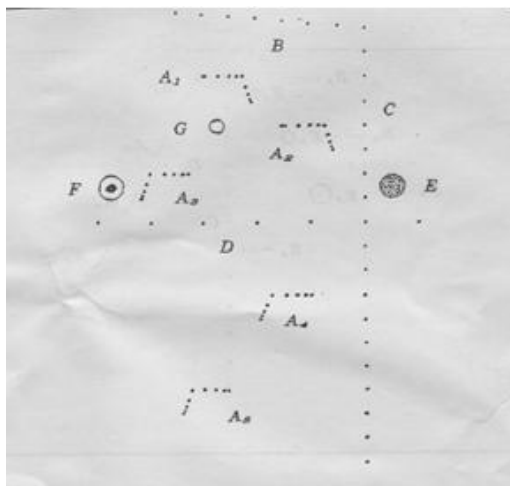
Targets disposal- KS107BG
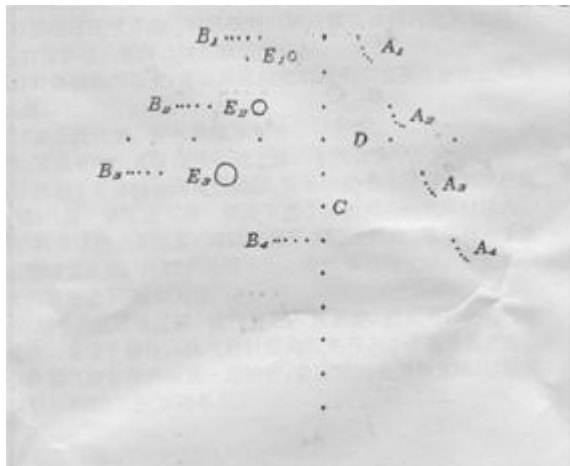
Appendix C Description of Self-test Test Items

C.1.1 Z0101 Hard Disk Verify Test

- Top test items

  N/A

- Test content

  Traverse all hard disk files from Doppler installation directory, compare and verify the files with the archived hard disk data.

- Analysis to test failure

  If the system prompts "*Failed to open the result file*", the verification file does not exist. If the system prompts *"The failed CRC: current verification value (failed file path, correct verification value)"*, the hard disk data is damaged.

- Suggestion to test failure

  Restore the hard disk data; replace the file from M9 directory in C local disk with the *CRC_Result.txt* from the restore package.

C.1.2 Z0201 PC Module and DSP FPGA Interconnection Test

- Top test items

  N/A

- Test content

  Test whether PCIe communication between PC module and DSP FPGA works well.

- Analysis to test failure

  Check whether *Windows* device manager recognizes *Ultrasound Backbone Device*. If the drive is not installed properly, it cannot be recognized.

  The drive goes wrong if the test result appears *Error*.

  PC module and DSP FPGA has communication error if the test result is *FAIL*.

- Suggestion to test failure

  a) Restore the device if the drive is not recognized.

  b) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  c) It is recommended to replace CPU if the test result is *FAIL*.

C.1.3 Z0202 DSP FPGA DDRIII Test

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

Perform read and write tests for entire space of four types of DDRs that DSP FPGA plugs in. The program displays the test results of DSP buffer DDR (transmitting DSP processing result data), SCAN buffer DDR (transmitting scan control frame), IQ buffer DDR (transmitting IQ data) and Gather buffer DDR (collecting data).

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The connection error between FPGA and plug-in DDR occurs if the test result is *FAIL*.

- Suggestion to test failure

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace CPU if the test result is *FAIL*.

C.1.4 Z0203 DSP FPGA and TRA Interconnection Test (Control Interface)

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

  Test whether the control bus communication between DSP FPGA and XCVER of TRA FPGA works well via reading the register.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The connection error between DSP FPGA and TRA FPGA occurs if the test result is *FAIL*.

- Suggestion to test failure

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to change CPU if the test result is *FAIL*.

C.1.5 Z0204 TRA AFE SPI Interface Test

- Top test items

  DSP FPGA and TRA Interconnection Test (Control Interface)

- Test content

  Test whether the SPI control bus communication between TRA FPGA and AFE works well via reading the registering.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  TRA FPGA and AFE's SPI bus have communication error if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to change CPU if the test result is *FAIL*.

C.1.6　Z0205 TRA AFE Digital Interface Test

- Top test items

  TRA AFE SPI Interface Test

- Test content

  Enter system test mode, write the data to TRA AFE, input delay RAM, re-read the data from delay-channel memory and make the judgment to locate the channel and AFE clip.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  AFE clip goes wrong if the test result is *FAIL*.

- Suggestion to failure test

  a)　Restart the device and perform the self-test if the test result appears *Error*, which indicates the logic error of DSP FPGA occurs. It is necessary to restore the device if *Error* re-appears.

  b)　It is recommended to replace CPU if the test result is *FAIL*.

C.1.7　Z0206 ATGC Function Test

- Top test items

  TRA AFE Digital Interface Test

- Test content

  Control a channel to transmit 2V waveform. Collect the waveform that AFE receives as setting ATGC to max, min and medium value. Judge whether the amplitude of waveform changes as ATGC increases according to the analysis on RMS value.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The circuit of ATGC gain adjustment goes wrong if the test result is *FAIL*.

- Suggestion to failure test

  a)　Restart the device and perform the self-test if the test result appears *Error*. It is necessary to restore the device if *Error* re-appears.

  b)　It is recommended to change CPU if the test result is *FAIL*.

C.1.8　Z0207 TRA Transmission and Reception Function Test

- Top test items

  ATGC Function Test

- Test content

  Test the coherence of 64 channels (from 65th channel to 128th channel) in transmitting and receiving: one channel transmits 2V 1M PHV1 waveform each time, and analyzes whether the waveform belongs to PHV1, and compares the signal-to-noise ratio of the channel with others.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

The waveform that the channel transmits is incorrect if the information "Open circuit emit receive channel: XXX" appears.

The transmission of the channel affects others' if the information "Open circuit emit receive channel: XXX" appears.

- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) It is recommended to change CPU if the test result is *FAIL*.

C.1.9 Z0208 DSP FPGA and EC ARM Interconnection Test

- Top test items
    PC Module and DSP FPGA Interconnection Test
- Test content
    Test whether UART communication between DSP FPGA and EC ARM works well. Send the data which is written on the register to serial port EC data, and then send the data of the register from serial port EC data to re-read it. Then, judge the coherence of the sending data.
- Analysis to test failure
    The drive goes wrong if the test result appears *Error*.
    UART interconnection between DSP FPGA and EC ARM goes wrong if the test fails.
- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) It is recommended to change CPU if the test result is *FAIL*.

C.1.10 Z0209 DSP FPGA and SM ARM Interconnection Test

- Top test items
    PC Module and DSP FPGA Interconnection Test
- Test content
    Test whether UART communication between DSP FPGA and SM ARM works well. Send the order through SM serial port drive, and re-read the data via the serial port.
- Analysis to test failure
    The drive goes wrong if the test result appears *Error*.
    UART interconnection between DSP FPGA and SM ARM goes wrong if the test fails.
- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) It is recommended to replace CPU if the test result is *FAIL*.

C.1.11 Z0210 System Voltage Test

- Top test items

  DSP FPGA and SM ARM Interconnection Test

- Test content

  Read the voltage values of P2V5, N11V7, P3V3, P5V, P1V2 and P1V8 via SM serial port drive. Read the voltage values of AP5V6, AP6V6, N5V6, AP3V6, P12V, P1V5, AP2V, AP2V8, VBAT, P1V and P1V35 via ADT7462 drive. Judge whether they meet the requirements.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The voltage value does not meet the requirement if the test result appears *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace CPU if the test result is *FAIL*.

  c) It is recommended to replace with new button battery if VBAT voltage is *FAIL*.

C.1.12 Z0211 System Temperature Test

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

  Read DC-DC module and AFE temperature value via ADT7462 drive and read four CPU temperature values via bottom drive. Judge whether they meet the requirements.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The temperature value does not meet the requirement if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to check the fan condition first and replace PC module or CPU if the test result is *FAIL*.

C.1.13 Z0212 Fan Speed Test

- Top test items

  DSP FPGA and SM ARM Interconnection Test

- Test content

  Read rotational speed values of six monitoring fans via SM serial port drive, and judge whether they meet the requirements. From left to right, there lie fan 0 to fan 5 respectively.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The fan rotational speed does not meet the requirement if the test result is *FAIL*.

- Suggestion to failure test
  a) Restart the device and perform the self-test if the test result appears *Error*, which indicates the error of SM serial port occurs. It is necessary to restore the device if *Error* re-appears.
  b) It is recommended to repair the fan, which does not meet the requirements of rotational speed, if the test result is *FAIL*.

C.1.14 Z0213 Speaker Test

- Top test items
  N/A
- Test content
  Play the music by pressing the speaker from left or right side. Test whether audio clip, amplifier circuit or speaker function works well.

  The dialog box appears from either left or right side to inquire the audibility of the speaker. If it is inaudible, click [Retry] to re-play the track of the music. If it fails after many times play, click [No, I Can't]. If it is audible, click [Yes, I Can].
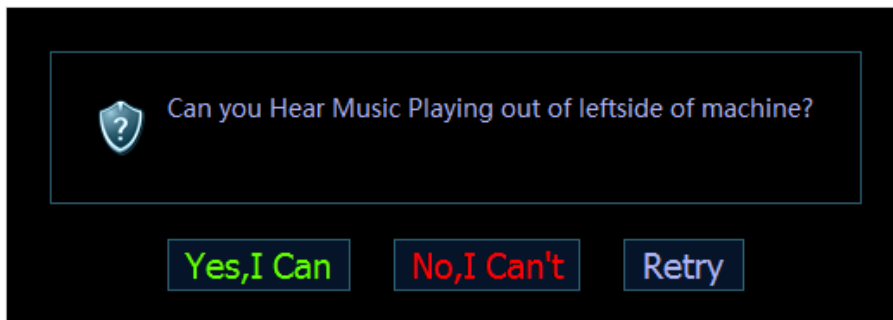
- Analysis to test failure
  The audio module or the speaker does not work well if the test result is *FAIL*.
- Suggestion to failure test
  It is recommended to check the speaker and wire material first, and audio module, and then replace CPU.

C.1.15 Z0214 WIFI Function Test

- Top test items
  N/A
- Test content
  Judge whether the wireless network adapter exists, and then search for SSID list.
- Analysis to test failure
  The wireless network adaptor cannot be recognized if information "There is no wireless device" appears.

  WIFI hotspot cannot be found if information "WIFI Function test FAIL" appears.
- Suggestion to failure test
  a) Check whether the connection of wireless network adaptor is fixed well and wireless network adaptor is not forbidden if the information "There is no wireless device" appears.
  b) Check whether there is WIFI hotspot if the information "WIFI Function test FAIL" appears. If there is a hotspot, replace the wireless network adaptor.

C.1.16 Z0125 4D Overcurrent Protecting Status Test

- Top test item

   PC module and DSP FPGA communication test
- Test content

   Read 4D circuit overcurrent protecting status.
- Analysis to Test Failure

   "Not under overcurrent protection" prompting indicates that 4D circuit is normal.

   "Under overcurrent protection" prompting indicates that 4D circuit is abnormal

   with excessive current.
- Suggestion to Test Failure

   It is recommended to change main board if the test result is *FAIL*.

C.1.17 Z0216 4D Drive Circuit Test

- Top test item

   4D Overcurrent Protecting Status Test
- Test content

   Set 4 driving signals to be sine wave. AD collects signal and decide frequency
   and amplitude after amplification.
- Analysis to Test Failure

   The drive goes wrong if the test result appears *Error*.
   "XXX drive signal failure" indicates corresponding drive circuit malfunction.
- Suggestion to Test Failure

   a)   Restart the device to perform the self test if the test result appears *Error.* It is
        necessary to restore the device if *Error* re-appears.

   b)   It is recommended to change main board if the test result is *FAIL*.

C.1.18 Z0217 TEE Temperature Signal Test

- Top test item

   PC module and DSP FPGA communication test
- Test content

   Read TEE temperature value. If it is not 0 or FF, TEE temperature signal is normal.
- Analysis to Test Failure

   The drive goes wrong if the test result appears *Error*.

   If test result is FAIL, then TEE temperature signal collecting link has a malfunction.
- Suggestion to Test Failure

   a)   Restart the device to perform the self test if the test result appears *Error.* It is
        necessary to restore the device if *Error* re-appears.

   b)   It is recommended to change main board if the test result is *FAIL*.

C.1.19 Z0218 TEE Angle Signal Test

- Top test item

   PC module and DSP FPGA communication test
- Test content

Read TEE angle value. If it is not 0 or FF, TEE angle signal is normal.

- Analysis to Test Failure

The drive goes wrong if the test result appears *Error*.

If test result is FAIL, then TEE angle signal collecting link has a malfunction.

- Suggestion to Test Failure

a) Restart the device to perform the self test if the test result appears Error. It is necessary to restore the device if Error re-appears.

b) It is recommended to change main board if the test result is FAIL.

C.1.20 Z0301 DSP FPGA and TRB Interconnection Test (Control Interface)

- Top test items

PC Module and DSP FPGA Interconnection Test

- Test content

Test whether the XCVER control bus communication between DSP FPGA and TRB FPGA works well via reading the registering.

- Analysis to test failure

The drive goes wrong if the test result appears *Error*.

The connection error between DSP FPGA and TRB FPGA occurs if the test fails.

- Suggestion to failure test

a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

b) It is recommended to replace TR64 board if the test result is *FAIL*.

C.1.21 Z0302 TRB AFE SPI Interface Test

- Top test items

DSP FPGA and TRB Interconnection Test (Control Interface)

- Test content

Test whether the SPI control bus communication between TRA FPGA and AFE works well via reading the registering.

- Analysis to test failure

The drive goes wrong if the test result appears *Error*.

TRA FPGA and AFE's SPI have communication error if the test result is *FAIL*.

- Suggestion to failure test

a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

b) It is recommended to replace TR64 board if the test result is *FAIL*.

C.1.22 Z0303 TRB AFE Digital Interface Test

● Top test items

TRB AFE SPI Interface Test

● Test content

Enter system test mode, write the data to TRB AFE, input delay RAM, re-read the data from delay-channel memory and make the judgment to locate the channel and AFE clip.

● Analysis to test failure

The drive goes wrong if the test result appears *Error*.

AFE clip goes wrong if the test result is *FAIL*.

● Suggestion to failure test

a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

b) It is recommended to replace TR64 board if the test result is *FAIL*.

C.1.23 Z0304 DSP FPGA and TRA&TRB Interconnection Test (Data Interface)

● Top test items

a) DSP FPGA and TRA Interconnection Test (Control Interface)

b) DSP FPGA and TRB Interconnection Test (Control Interface)

● Test content

Test whether XCVER data bus between TRB FPGA of TR64 board and TRA FPGA works well. Test whether XCVER data bus between TRA FPGA on the main board and DSP FPGA works well.

● Analysis to test failure

The drive goes wrong if the test result appears *Error*.

XCVER data bus on the connection of TRB FPGA-TRA FPGA-DSP FPGA goes wrong if the test result is *FAIL*.

● Suggestion to failure test

a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

b) It is recommended to replace TR64 board if the test result is *FAIL*. If the error still exists, it is recommended to replace CPU.

C.1.24 Z0305 TRB Transmission and Reception Function Test

● Top test items

ATGC Function Test

● Test content

Test the coherence of 64 channels (from 1st channel to 64th channel) in transmitting and receiving: one channel transmits 2V 1M PHV1 waveform each time, and

analyzes whether the waveform belongs to PHV1, and compares the signal-to-noise ratio of the channel with others'.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The waveform that the channel transmits is incorrect if the information "Open circuit emit receive channel: XXX" appears.

  The transmission of the channel affects others' if the information "Open circuit emit receive channel: XXX" appears.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace TR64 board if the test result is *FAIL*.

C.1.25 Z0401 DSP FPGA and PHV ARM Interconnection Test

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

  Test whether UART communication between DSP FPGA and PHV ARM works well. Send the order through PHV serial port, and re-read the data via the port.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  UART interconnection between DSP FPGA and SM ARM goes wrong if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace PHV board if the test result is *FAIL*.

C.1.26 Z0402 CW Mode Test

- Top test items

  DSP FPGA and PHV ARM Interconnection Test

- Test content

  Adjust the voltage of CW mode linearly, and set four voltage values. Read PHV1P and PHV1N voltage value via PHV serial port.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The voltage value of CW mode does not meet the requirement if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace PHV board if the test result is *FAIL.*

C.1.27 Z0403 PHV Mode Test

- Top test items

  DSP FPGA and PHV ARM Interconnection Test

- Test content

  Adjust PHV voltage linearly, and set five voltage values. Read PHV1P, PHV1N, PHV2P and PHV2N voltage value via PHV serial port.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The voltage value of PHV mode does not meet the requirement if the test result appears *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace PHV board if the test result is *FAIL*.

C.1.28 Z0404 HV Test

- Top test items

  DSP FPGA and PHV ARM Interconnection Test

- Test content

  Read positive and negative high-voltage value via PHV serial port drive.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The positive and negative 100 V does not meet the requirement if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace PHV board if the test result is *FAIL*.

## C.1.29 Z0501 Light Sensor Auto Adjust Function Test

- Top test items

  PC Module and DSP Interconnection Test

- Test content

  Ensure the device be in non-dark room conditions when performing the self-test. Otherwise, the test will fail.
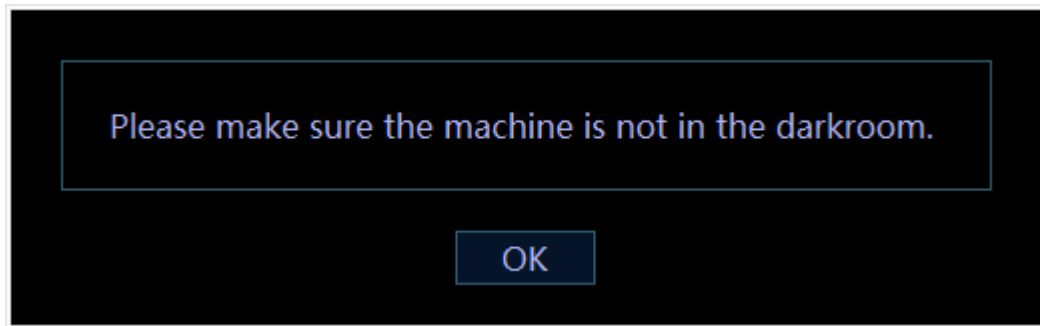
Put the hand over the light sensor which lies in the center of the screen for at least 5 seconds. If the screen becomes darker, it indicates it works well. Then, take the hand off the light sensor; the screen becomes brighter in 5 seconds, it indicates it works well. If the two operations work well, please click "Yes, I can", otherwise, click "No, I can't". See the figure below:
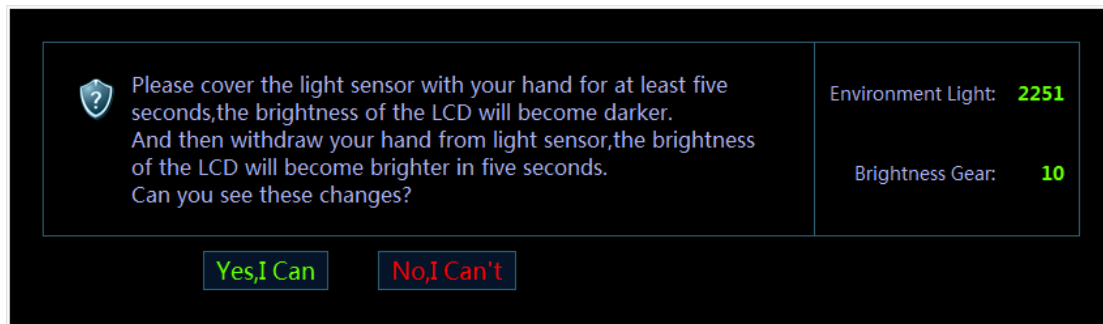
- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  Light sensor goes wrong if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) Check whether the connecting material of light sensor is fixed well, and then replace light sensor board if the test result is *FAIL*.

C.1.30 Z0601 Keyboard USB Interconnection Test

- Top test items

  N/A

- Test content

  Test USB communication between control panel and main unit works well via reading internal USB disk drive.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  Control panel and main unit have communication error if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace control panel if the test result is *FAIL*.

C.1.31 Z0602 Keyboard Key, Encoder, TGC, Trackball Test

- Top test items

  Keyboard USB Interconnection Test

- Test content

  It mainly tests whether the buttons, encoders, TGCs, trackball, backlight LEDs and indicating LEDs in the keyboard are normal, and reads board ID, keyboard FPGA and version of program as well.

- Test description

  The keyboard testing interface is shown as follows:

As shown in the figure above, click [Start] to perform the keyboard test. The controls on the simulation keyboard correspond with those on the real keyboard assembly.

As for the button, the button on the simulation keyboard blinks while pressing the button on real keyboard. If the button continues blinking, it is being tested. If the color of the button changes, it finishes the test.

As for the trackball, the cursor moves as roll the trackball on the keyboard. Meanwhile, the icon on the simulation keyboard blinks, which indicates that the system receives data from the trackball and the trackball has been tested already.

The encoder rotation test: the icon on the simulation keyboard corresponds to the encoder on the real keyboard. When the user rotates the encoder towards one direction, the corresponding green ball around the encoder on the simulation keyboard will rotate to the same direction. The encoder panel turns to white when pressing the encoder.

Encoder button test: encoder panel turns to white when pressing the encoder.

All orange controls indicate that all buttons have the corresponding orange indicators.

TGC test: 8 TGC sliders on the keyboard correspond to controls on the simulation keyboard. When sliding TGC sliders on the keyboard, the corresponding controls on the simulation keyboard move as well.

Keyboard backlight test: when the simulation keyboard initializes, all dual-color lights highlight in green on the keyboard. When a key is tested, the dual-color backlight automatically becomes orange after being pressed.

After all tests for the keyboard assembly are finished, the keyboard screen is shown below:

After finishing the tests, if functions of the keyboard assembly are normal, click "Keyboard is OK"; otherwise, click "Keyboard is Bad".

● Suggestion to failure test

  a) Replace the trackball if the trackball does not respond.

  b) Replace TGC board if TGC slider does not respond.

  c) Replace the keyboard if the keyboard does not respond.

C.1.32 Z0603 Keyboard Key and Trackball LED Test

● Top test items

  Keyboard USB Interconnection Test

● Test content

  The system automatically adjusts the color of LED (white and orange) and the brightness of trackball. The user can identify the changes.

● Test description

The following dialog box appears when performing test. The system changes the brightness of LED (white and orange) and trackball respectively and check whether the brightness of LED on the keyboard changes accordingly. If LED brightness of the keyboard keeps identical as configured, click "LED and Traceball is OK" to quit the dialog box. If not, click "LED and Traceball is Bad" to quit the dialog box.

- Suggestion to failure test
    a) Replace the trackball if the trackball brightness does not respond.
    b) Replace the control panel if LED brightness does not respond.

C.1.33 Z0701 LCD Monitor I2C Interconnection Test

- Top test items

    PC Module and DSP FPGA Interconnection Test

- Test content

    Read the display data from 12C bus, and judge whether it belongs to non 0 or non F, and then parse LCD model, panel sequence number and LCD version number.

- Analysis to test failure

    The drive goes wrong if the test result appears *Error*.

    The interconnection between DSP FPGA and LCD monitor goes wrong if the test result is *FAIL*.

- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) Check whether the connecting material between LCD monitor and main unit is fixed well, and then replace LCD EEPROM if the test result is *FAIL*.

C.1.34 Z0702 LCD Monitor Adjust Data Check Test

- Top test items

    LCD Monitor I2C Interconnection Test

- Test content

    The logic judges the progress status of the monitor and judges whether FLASH data is consistent with the data on EEPROM via reading the register.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  FLASH data is inconsistent with that on EEPROM if the information "The data in the FLASH and EEPROM is inconsistent" appears.

  FLASH is empty if the information "There is no data in the FLASH".

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) Check whether the screen is calibrated, and then replace EEPROM or CPU board if the test result is *FAIL*.

## C.1.35 Z0703 LCD Monitor Brightness Control Test

- Top test items

  LCD Monitor I2C Interconnection Test

- Test content

  The dialog box appears when performing the test. The program controls the brightness of LCD via 12C bus. The brightness goes down to the lowest, and then goes up to the highest, then gets back to normal. If the brightness changes, click "Yes, I Can", otherwise click "No, I Can't". If the user clicks "Retry" the system will repeat the procedure mentioned above.
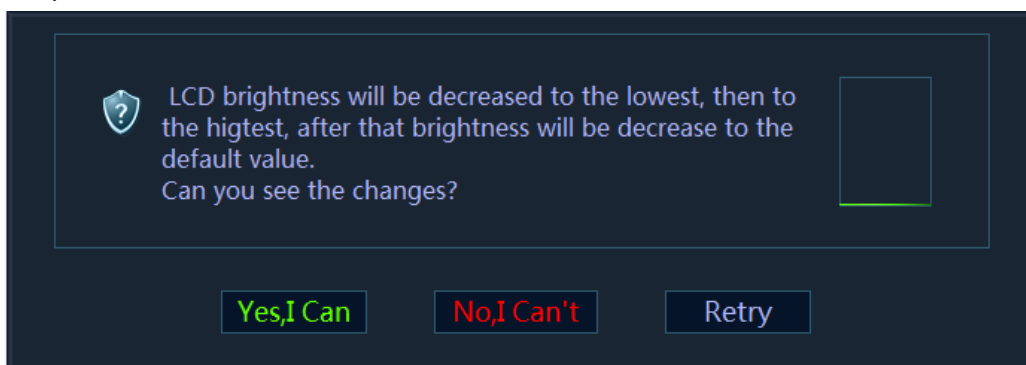
- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  Brightness control of LCD monitor goes wrong if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace CPU if the test result is *FAIL*.

C.1.36 Z0704 LCD Monitor Backlight Control Test

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

  The dialog box appears when performing the test. The program turns the backlight off for 3 seconds, and then goes back to normal. If backlight changes, click "Yes, I Can", otherwise click "No, I Can't". If the user clicks "Retry" the system will repeat the procedure mentioned above.
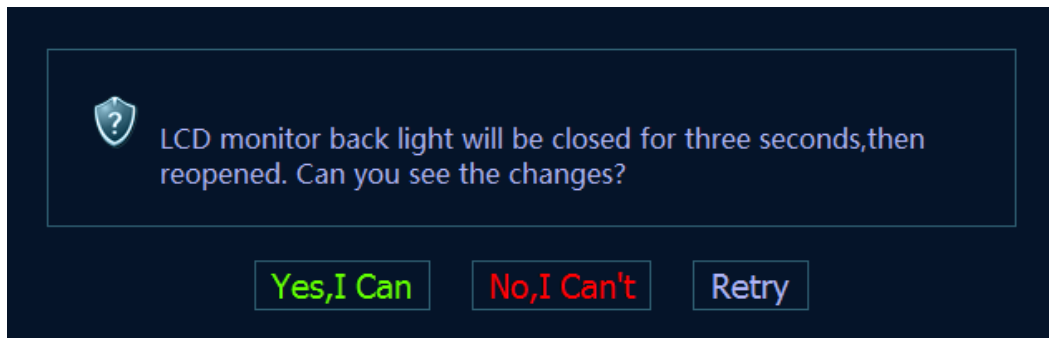
- Analysis to test failure

   The drive goes wrong if the test result appears *Error*.

   Backlight control of LCD monitor goes wrong if the test fails.

- Suggestion to failure test

   a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

   b) It is recommended to replace CPU if the test result is *FAIL*.

C.1.37 Z0801 Left Battery I2C Interconnection Test

- Top test items

   DSP FPGA and SM ARM Interconnection Test

- Test content

   Read the left battery status when it is on the site via SM serial port, and test whether 12C bus communication between left battery and SM ARM works well.

- Analysis to test failure

   The drive goes wrong if the test result appears *Error*.

   The left battery and SM ARM go wrong if the test result is *FAIL*.

- Suggestion to failure test

   a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

   b) It is recommended to replace the left battery, and then replace CPU board if the test result is *FAIL*.

C.1.38 Z0802 Right Battery I2C Interconnection Test

- Top test items

   DSP FPGA and SM ARM Interconnection Test

- Test content

   Read right battery status when it is on the site via SM serial port, and test whether 12C bus communication between right battery and SM ARM works well.

- Analysis to test failure

   The drive goes wrong if the test result appears *Error*.

   The right battery and SM ARM go wrong if the test result is *FAIL*.

- Suggestion to failure test

   a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

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b) It is recommended to replace the right battery, and then replace CPU if the test result is *FAIL*.

C.1.39 Z0803 Left Battery Test

- Top test items

  Left Battery I2C Interconnection Test

- Test content

  Read the voltage, temperature, current, volume and charging times, etc, via SM serial port.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The left battery and SM ARM interconnection go wrong if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace the left battery if the test result is *FAIL*.

C.1.40 Z0804 Right Battery Test

- Top test items

  Right Battery I2C Interconnection Test

- Test content

  Read the voltage, temperature, current, volume and charging times, etc from the right battery, via SM serial port.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  The right battery and SM ARM interconnection go wrong if the test result is *FAIL*.

- Suggestion to failure test

  a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.

  b) It is recommended to replace the right battery if the test result is *FAIL*.

C.1.41 Z0901 ECG Module Information Read Test

- Top test items

  PC Module and DSP FPGA Interconnection Test

- Test content

  The program decides whether ECG is on the site, sends orders via ECG serial port, judges the returned data, and parses Bootloader version, board ID and software version.

- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  ECG is not located or the located circuit goes wrong if the information "ECG Module is not on the site" appears.

The communication error between ECG board and main board goes wrong if the information "ECG Module information read test FAIL" appears.

- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) It is recommended to replace ECG board if the test result is *FAIL*.

C.1.42 Z0902 ECG Module Self Test

- Top test items

  ECG Board Information Read Test
- Test content

  ECG sends self-test order when it is on the site via ECG serial port and analyzes the self-test result, and judges the status for A/D, Flash, DRAM, CPU, Watchdog, and Voltage 33
- Analysis to test failure

  The drive goes wrong if the test result appears *Error*.

  ECG board goes wrong if the test result is *FAIL*.
- Suggestion to failure test
    a) Restart the device and perform the self-test if the test result appears *Error.* It is necessary to restore the device if *Error* re-appears.
    b) It is recommended to replace ECG board if the test result is *FAIL*.