cardiofax S

Electrocardiograph

ECG-1250

ECG-1250A
ECG-1250K

If you have any comments or suggestions
on this manual, please contact us at:
www.nihonkohden.com

0634-900121C

Trademark

The mark printed on the SD memory card that is used in this instrument is a trademark. The company name and model name are trademarks and registered trademarks of each company.

Contents

GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.
Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, dust, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.
   (5) All circuitry used for direct patient connection must be doubly checked.
   (6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. **During Operation**
   (1) Both the instrument and the patient must receive continual, careful attention.
   (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
   (3) Avoid direct contact between the instrument housing and the patient.

5. **To Shutdown After Use**
   (1) Turn power off with all controls returned to their original positions.
   (2) Remove the cords gently; do not use force to remove them.
   (3) Remove the power cord from the AC SOURCE socket to isolate the instrument from the AC supply mains.
   (4) Clean the instrument together with all accessories for their next use.

6. **The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**

7. **The instrument must not be altered or modified in any way.**

8. **Maintenance and Inspection**
   (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
   (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.

(3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your Nihon Kohden representative.

9. When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.

10. When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident, fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

In the USA and Canada other warranty policies may apply.

CAUTION

United States law restricts this device to sale by or on the order of a physician.

EMC RELATED CAUTION

This equipment and/or system complies with IEC 60601-1-2 International Standard for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in IEC 60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location. Keep the emitter source such as cellular phone away from the equipment and/or system, or turn off the cellular phone.

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

5. **Interference of lightning:**
   When lightning occurs near the location where the equipment and/or system is installed, it may induce an excessive voltage in the equipment and/or system. In such a case, disconnect the AC power cord from the equipment and/or system and operate the equipment and/or system by battery power, or use an uninterruptible power supply.

6. **Use with other equipment:**
   When the equipment and/or system is adjacent to or stacked with other equipment, the equipment and/or system may affect the other equipment. Before use, check that the equipment and/or system operates normally with the other equipment.

7. **Use of unspecified accessory, transducer and/or cable:**
   When an unspecified accessory, transducer and/or cable is connected to this equipment and/or system, it may cause increased electromagnetic emission or decreased electromagnetic immunity. The specified configuration of this equipment and/or system complies with the electromagnetic requirements with the specified configuration. Only use this equipment and/or system with the specified configuration.

Caution - continued

8. **Use of unspecified configuration:**
   When the equipment and/or system is used with the unspecified system configuration different than the configuration of EMC testing, it may cause increased electromagnetic emission or decreased electromagnetic immunity. Only use this equipment and/or system with the specified configuration.

9. **Measurement with excessive sensitivity:**
   The equipment and/or system is designed to measure bioelectrical signals with a specified sensitivity. If the equipment and/or system is used with excessive sensitivity, artifact may appear by electromagnetic interference and this may cause mis-diagnosis. When unexpected artifact appears, inspect the surrounding electromagnetic conditions and remove this artifact source.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden representative for additional suggestions.

For EMC compliance, refer to "Specifications - Electromagnetic Compatibility" in the Reference section.

The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.

The CE mark only applies to the ECG-1250K Electrocardiograph.

NOTE about Waste Electrical and Electronic Equipment (WEEE) directive 2002/96/EEC
For the member states of the European Union only:
The purpose of WEEE directive 2002/96/EEC is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such waste so as to reduce the disposal of waste.
Contact your Nihon Kohden representative for disposal at the end of its working life.

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Section 1 General

Introduction

This service manual provides useful information to qualified service personnel to understand, troubleshoot, service, maintain and repair the ECG-1250A/K Electrocardiograph (referred to in this service manual as “the instrument”, “ECG-1250A/K”).

All replaceable parts or units of this instrument and its optional units are clearly listed with exploded illustration to help you locate the parts quickly.

The information in the operator’s manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator’s manual and service manual before starting to troubleshoot, service, maintain or repair this instrument. This is because service personnel needs to understand the operation of the instrument in order to effectively use the information in the service manual.

General Information on Servicing

Note the following information when servicing the instrument.

CAUTION

Safety

- **There is the possibility that the outside surface of the instrument, such as the operation keys, could be contaminated by contagious germs, so disinfect and clean the instrument before servicing it. When servicing the instrument, wear rubber gloves to protect yourself from infection.**
- **There is the possibility that when the lithium battery is broken, a solvent inside the lithium battery could flow out or a toxic substance inside it could come out. If the solvent or toxic substance touches your skin or gets into your eyes or mouth, immediately wash it with a lot of water and see a physician.**

Liquid ingress

The instrument is not waterproof, so do not install the instrument where water or liquid can get into or fall on the instrument. If liquid accidentally gets into the instrument or the instrument accidentally drops into liquid, disassemble the instrument, clean it with clean water and dry it completely. After reassembling, verify that there is nothing wrong with the patient safety checks and function/ performance checks. If there is something wrong with the instrument, contact your Nihon Kohden representative for repair.

Environmental safeguards

Depending on the local laws in your community, it may be illegal to dispose of the lithium battery in the regular waste collection. Check with your local officials for proper disposal procedures.

Disinfection and cleaning

To disinfect the outside surface of the instrument, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Do not use any other disinfectants or ultraviolet rays to disinfect the instrument.

- **Chlorohexidine gluconate solution: 0.5%**
- **Benzethonium chloride solution: 0.2%**
- **Glutaraldehyde solution: 2.0%**
- **Benzalkonium chloride: 0.2%**
- **Alkyldiaminoethylglycine hydrochloride: 0.5%**

Caution - continued

Transport

- **Use the specified shipment container and packing material to transport the instrument. If necessary, double pack the instrument. Also, put the instrument into the shipment container after packing so that the buffer material does not get inside the instrument.**
- **When transporting a board or unit of the instrument, be sure to use a conductive bag on. Never use an aluminum bag to transport a board or unit which a lithium battery is mounted. Also, never use a styrene foam or plastic bag which generates static electricity to wrap the board or unit of the instrument.**

Handling the instrument

- **Because the outside surface of the instrument is made of resin, the outside surface of the instrument is easily damaged. So when handling the instrument, remove clutter from around the instrument and be careful to not damage the instrument or get it dirty.**
- **Because most of the boards in the instrument are multilayer boards with surface mount electrical devices (SMD), when removing and soldering the electrical devices, a special tool is required. To avoid damaging other electrical components, do not remove and solder SMD components yourself.**

Measuring and test equipment

Maintain the accuracy of the measuring and test equipment by checking and calibrating it according to the check and calibration procedures.

Maintenance

Turn off the power of the instrument before doing maintenance, cleaning or disinfecting. Otherwise you may get an electrical shock or the instrument may malfunction.

Preventing infection

Follow the local laws or regulations to prevent infection.

Service Policy and Service Parts

Service Policy

Our technical service policy for this instrument is to replace the faulty unit, board or part or damaged mechanical part with a new one. Do not perform electrical device or component level repair of the multilayer board or unit. We do not support component level repair outside the factory for the following reasons:

- Most of the boards are multilayer boards with surface mount electrical devices, so the mounting density of the board is too high.
- A special tool or high degree of repair skill is required to repair the multilayer boards with surface mount electrical devices.

Only disassemble the instrument or replace a board or unit in an environment where the instrument is protected against static electricity.

As background knowledge for repair, pay special attention to the following:

- You can reduce the repair time by considering the problem before starting repair.
- You can clarify the source of most of the troubles using the information from the error massage and troubleshooting in the “Troubleshooting” section of this manual.

Service Parts

NOTE

When ordering parts or accessories from your Nihon Kohden representative, please quote the code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your instrument.

Specifications

ECG Input

Input impedance:	≥ 20 MΩ
Electrode offset tolerance:	≥ ±550 mV
Defibrillation-proof:	Isolated and defibrillator protected only when the following specified patient cable is connected Patient cable: BJ-901D, BJ-902D, BJ-903D, BA-901D, BA-903D Recovery time: ≤ 10 s (IEC 60601-2-25: 1993 51.102 compatible)
Common mode rejection ratio:	≤ –100 dB
Patient leakage current:	≤ 5×10^{-8} A
Standard sensitivity:	10 mm/mV ±5%
Internal noise:	≤ 20 μVp-v
Interference between channels:	≤ –40 dB
Frequency response:	150 Hz (≥ 71%, high-cut filter: 150 Hz)
Sample rate:	8000 sample/s

Waveform Data Processor

Sample rate:	500 samples/s, 1.25 μV/LSB
Response to minimum signal:	≤ 20 μVp-v
EMG filter:	25, 35 Hz (–3 dB)
High cut filter:	75, 100, 150 Hz (–3 dB)
AC line filter:	50, 60 Hz
Drift filter:	Weak: 0.1 Hz (–20 dB), Strong: 0.1 Hz (–34 dB)
Time constant:	≥ 3.2 s

Recorder

Recording speed accuracy:	≤ ±5%
Printing density:	200 dpi (8 dots/mm), 320 dot/mm^2 (25 mm/s)
Scanning line density:	1 ms
Number of recording channels:	3, 4, 6
Paper speed:	10, 12.5, 25, 50 mm/s
Recording paper:	110 mm width, 20 m long Z fold
Mechanical noise:	≤ 48 dB at paper speed 10, 12.5, 25 mm/s
Printed data:	Program type, version, date and time, paper speed, sensitivity, lead name, filter, Patient information (ID number, sex, age), event mark, electrode detachment, noise

External Input/Output

External input:	10 mm/0.5 V ±5%, input impedance ≥ 100 kΩ
Signal output:	0.5 V/1 mV ±5%, output impedance ≤ 100 Ω

Power Requirement

Line voltage:	100 to 127 V, 220 to 240 V AC ±10%
Line frequency:	50, 60 Hz
Power input:	120 VA

Battery operation time: ≥ 60 minutes
IEC 60601-2-51: 2003.2 56.7
Under the conditions of operating temperature 25°C, 4 ch recording

Color LCD (with backlight)

Display size: 5.7 inch
Resolution: 320 × 240 dots
Displayed data: Waveform, patient information, recording settings, operation mode, heart rate, QRS sync mark, error message, electrode detachment, noise

Environment

Operating environment
- Temperature: 5 to 40°C (41 to 104°F)
- Humidity: 25 to 95% RH (noncondensing)
  25 to 80% RH (recording paper)
- Atmospheric pressure: 700 to 1060 hPa

Storage environment
- Temperature: –20 to +65°C (–4 to +149°F)
  –20 to +50°C (–4 to +122°F) (recording paper)
- Humidity: 10 to 95% RH
  10 to 90% RH (recording paper)
- Atmospheric pressure: 700 to 1060 hPa

Other: Indoor portable

Performance

Performance standard: IEC 60601-2-51: 2003

Dimensions and Weight

Dimensions: 210 W × 69 H × 280 D mm (excluding protrusions)
Weight: Approx. 2.0 kg (without battery or recording paper)

Safety Standard

Safety standard:
IEC 60601-1: 1988
IEC 60601-1 Amendment 1: 1991
IEC 60601-1 Amendment 2: 1995
IEC 60601-2-25: 1993
IEC 60601-2-25 Amendment 1: 1999
IEC 60601-1-1: 2000
IEC 60601-1-2: 2001
C22.2 No.601-1-M90: 1990*
C22.2 No.601-1S1-94:1994*
C22.2 No.601-1-1-94: 1994*
CAN/CSA-C22.2 No.601.1.2-94: 1994*
CAN/CSA-C22.2 No.601.2.25-94: 1994*
* These standards only apply to the ECG-1250A Electrocardiograph.

According to the type of protection against electrical shock:
CLASS I EQUIPMENT (AC Powered)
Internally Powered EQUIPMENT (BATTERY Powered)

According to the degree of protection against electrical shock:
Defibrillator-proof type CF applied part when patient cable BJ-901D, BJ-902D, BJ-903D, BA-901D or BA-903D is used

According to the degree of protection against harmful ingress of water:
IPX0 (ordinary EQUIPMENT)

According to the degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:
Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

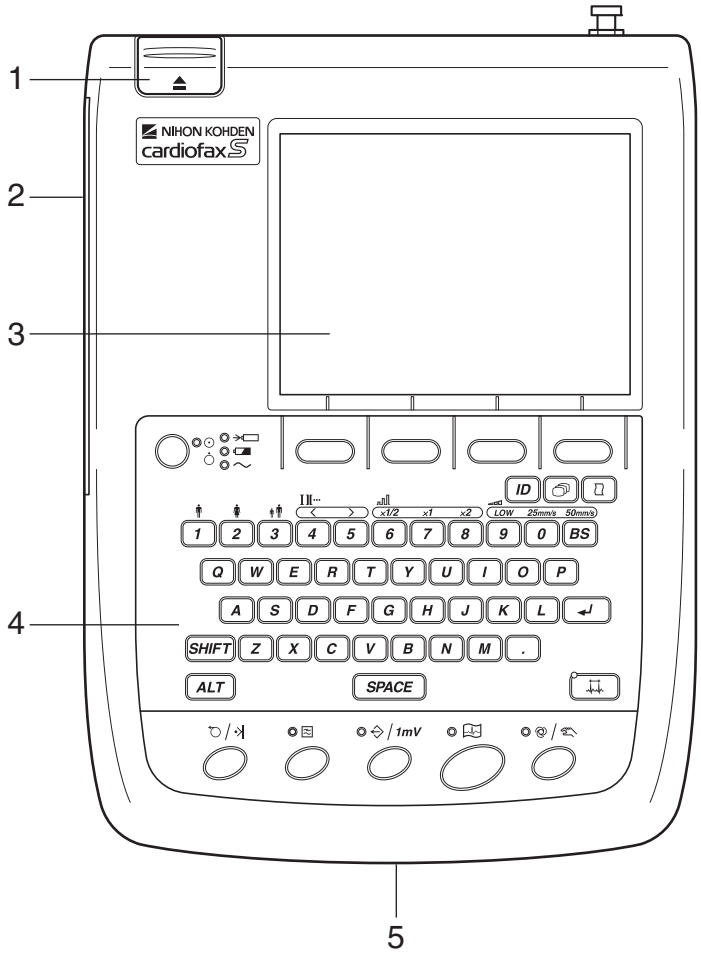
According to the mode of operation: CONTINUOUS OPERATION

Electromagnetic Compatibility

IEC 60601-1-2: 2001
CAN/CSA C22.2 No.60601-2-51-04: 2004*
ANSI/AAMI EC11-1991*
* These standards only apply to the ECG-1250A Electrocardiograph.

Panel Descriptions

Top View



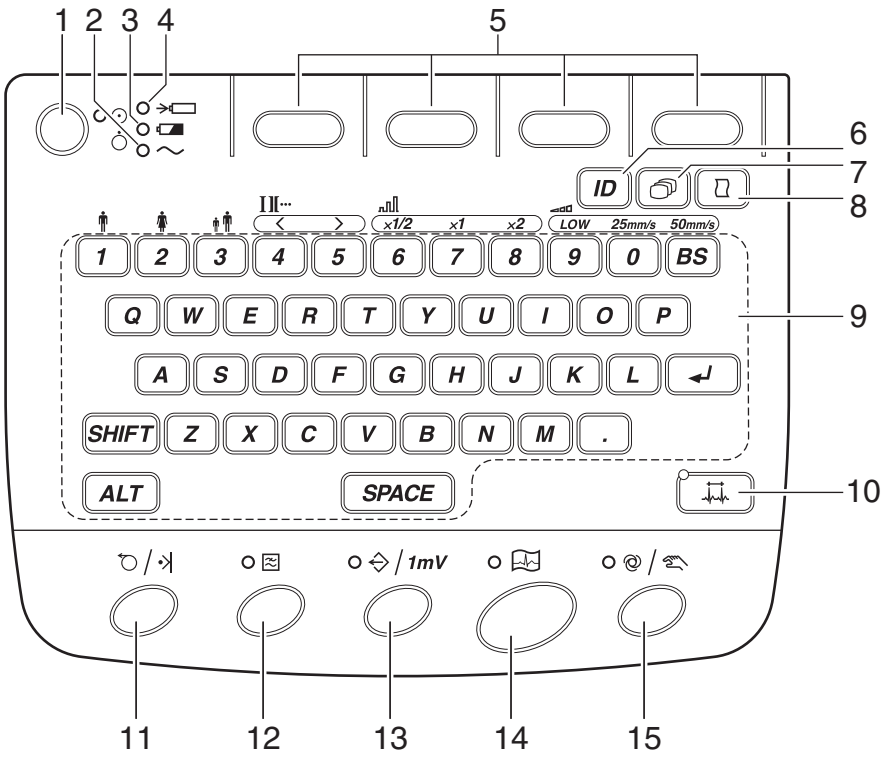
Name

1. Paper magazine release button
2. Paper magazine (Recording paper container)
3. LCD screen
4. Operation panel
5. Battery compartment

CAUTION

Always install the battery even when the electrocardiograph operates on AC power. Otherwise sudden power down occurs when an electrode is detached during recording.

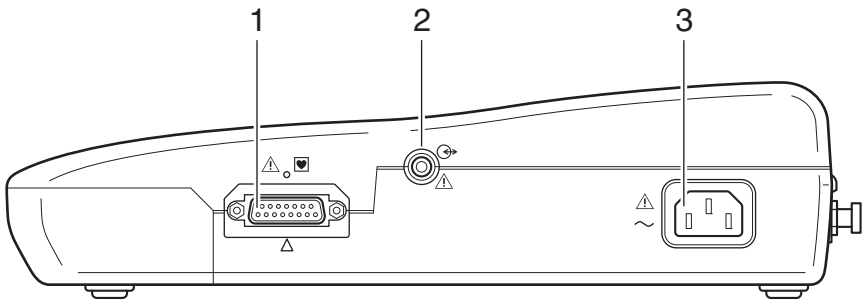
Operation Panel



Name

1. POWER key/lamp
2. AC power lamp
3. Battery operation lamp
4. Battery charge lamp
5. Function keys
6. ID key
7. MODE key
8. REVIEW key
9. Keyboard
10. RHYTHM key/lamp
11. FEED/MARK key
12. FILTER key/lamp
13. COPY/1 mV key/lamp
14. START/STOP key/lamp
15. AUTO/MANUAL key/lamp

Right Side Panel



Name
1. Patient cable connector
2. EXT-IN/CRO-OUT connector
3. AC power cord socket

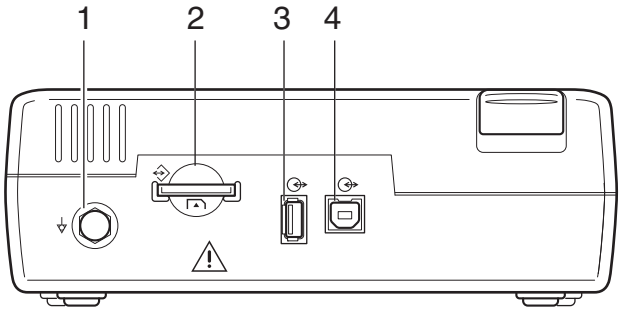
WARNING

- **Connect only the specified instrument to the electrocardiograph and follow the specified procedure. Failure to follow this warning may result in electrical shock or injury to the patient and operator, and cause fire or instrument malfunction.**
- **When the external instrument does not comply with the IEC 60601-1, use a local purchase medical isolation transformer unit between the external instrument and the AC socket.**
- **When connecting the electrocardiograph to other instruments, the connection must comply with IEC 60601-1-1: 2000. Refer to "General Requirements for Connecting Medical Electrical System" in Section 11 in the Operator's Manual.**

CAUTION

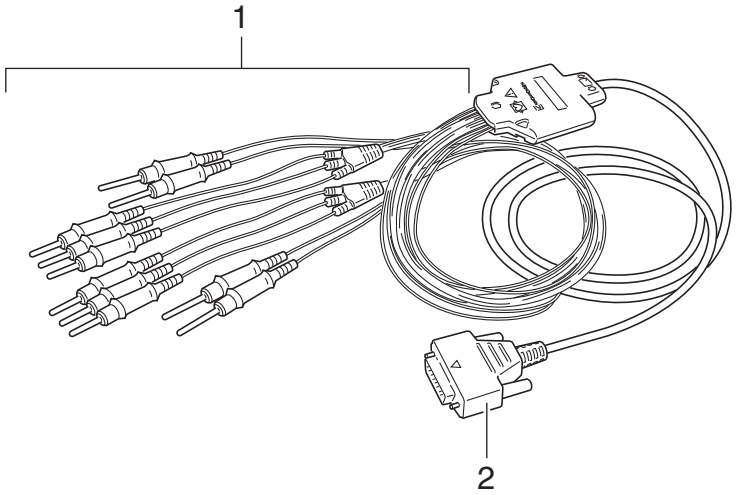
Do not use the output signal from the output connector of the electrocardiograph for a synchronization signal on a defibrillator. There is a time delay between the input signal and output signal. When using the output signal from the electrocardiograph for the synchronization signal on other instrument, always consider this time delay.

Rear Panel



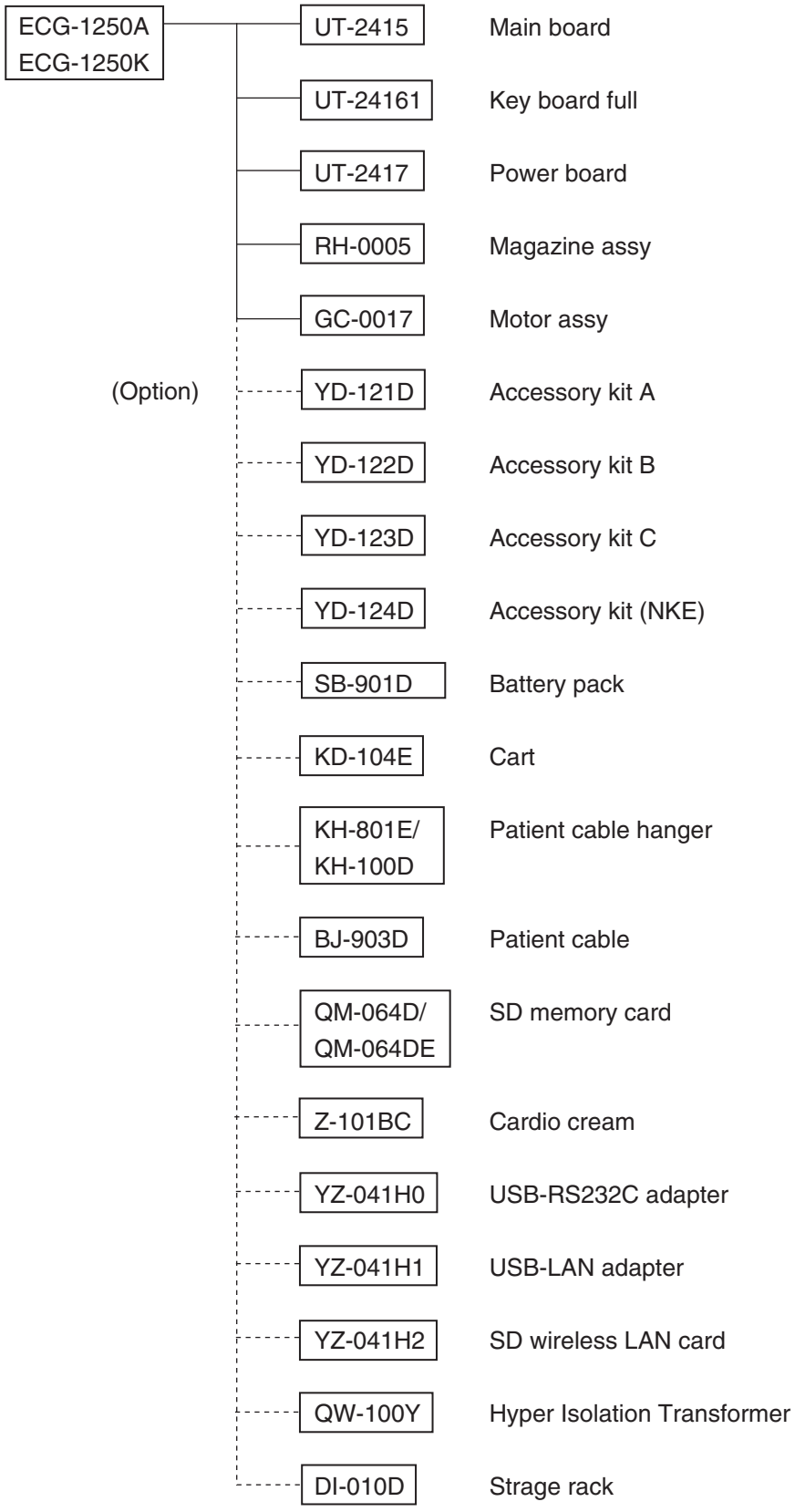
Name
1. Equipotential grounding terminal
2. SD card slot
3. USB connector type A
4. USB connector type B

Patient Cable



Name
1. Electrode leads
2. Connector

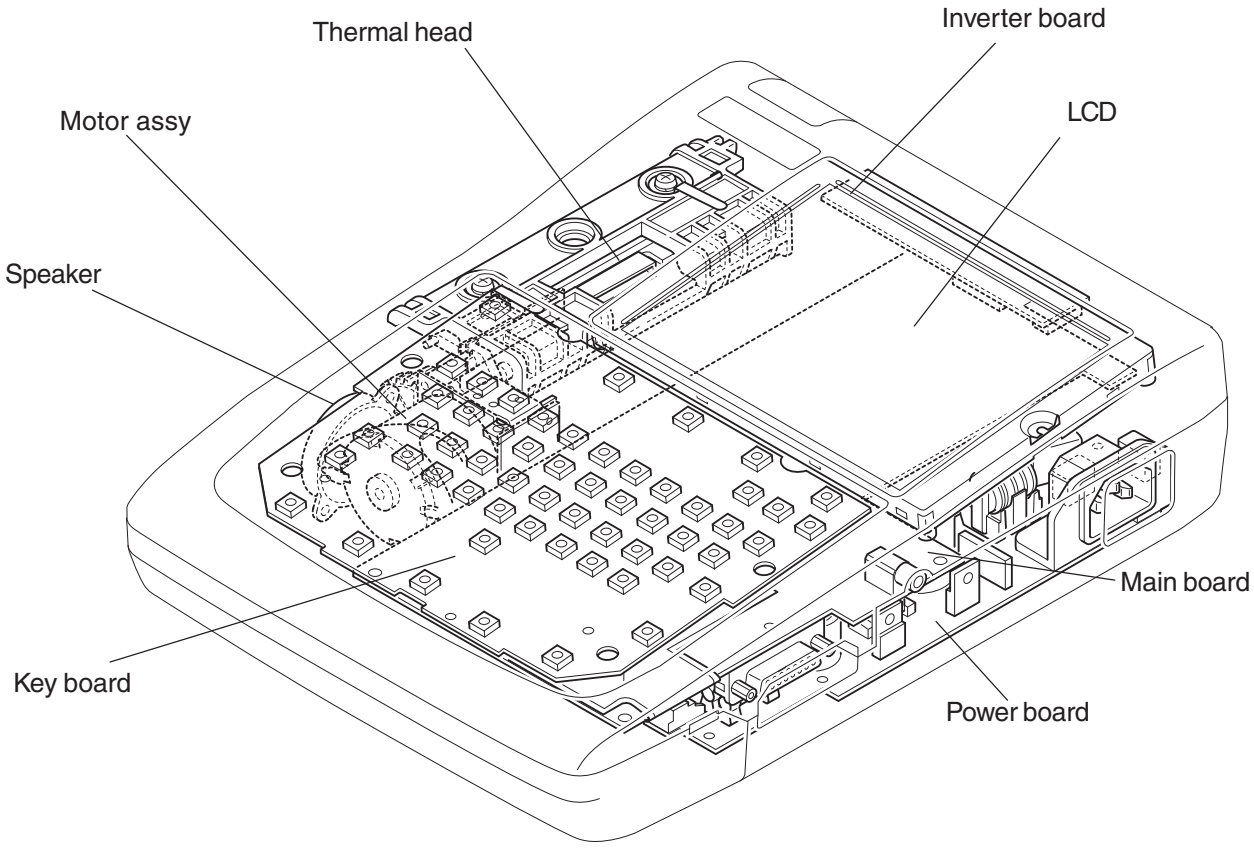
Composition



Locally purchase

- USB hub
- Bar code reader
- Magnetic card reader

Location


Thermal head
Inverter board
Motor assy
LCD
Speaker
Main board
Key board
Power board

Connector Pin Assignment

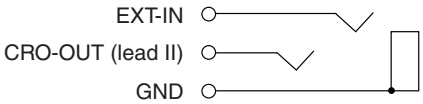
EXT-IN/CRO-OUT Connector

CAUTION

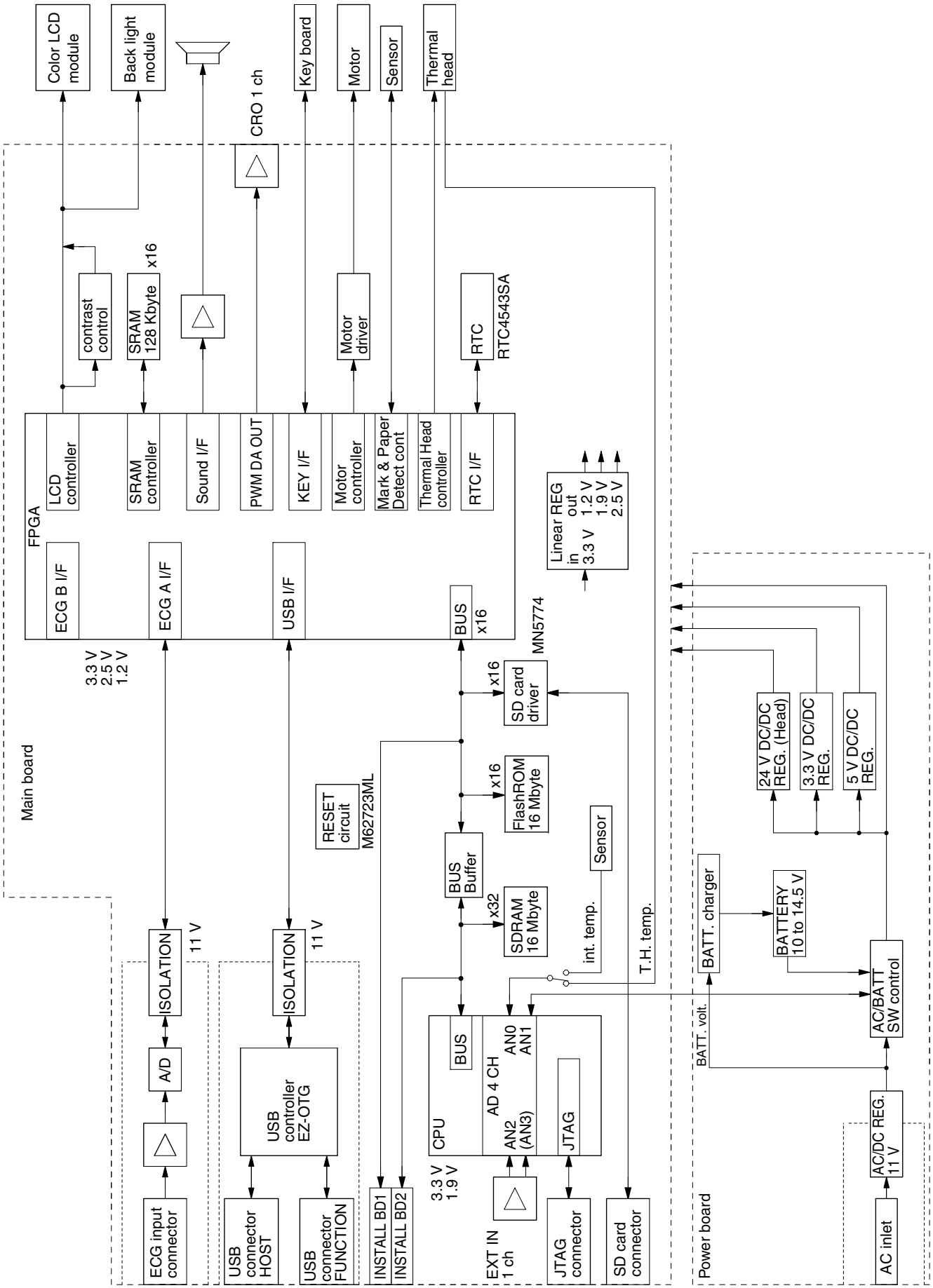
Do not use the output signal from the output connector of the electrocardiograph for a synchronization signal on a defibrillator. There is a time delay between the input signal and output signal. When using the output signal from the electrocardiograph for the synchronization signal on other instrument, always consider this time delay.

Using connector: LGY6502-0900 (Code No. 690584)
Mating connector: MP-012L 3.5 mm ϕ right angle miniature stereo plug (Code No. 696346)

Input sensitivity: 10 mm/0.5 V
Input impedance: 100 kΩ or more
Output sensitivity: 0.5 V/1 mV



Block Diagram



Outline of Operation

Main Board

The main board consists of the following components.

CPU: SH7706 (Operating frequency: 25 MHz)
D RAM: 16 MB
Input unit:
- R/L/F/RF/C1 to C6 (10 channel analog signal) is input.
- Converts inputs to digital signal of 8000 samples/second by A/D converter.

ECG data processing unit:
- Processes input signal at 500 samples/second (1.25 µV/LSB).
- Processes hum filter, EMG filter and drift filter.

FPGA unit:
- Controls motor, paper sensor, mark sensor, thermal head, speaker and CRO.
- Processes data from the keyboard.
- Saves file data to external memory.

USB unit:
- USB-serial/USB-LAN adapter can be connected to the unit.
- You can enter the patient information from a bar code reader and magnetic card reader through the unit.

Other units:
- EXT-IN1 is processed digitally in the A/D converter of the CPU.
- INSTALL BD1/2 or JTAG connector is only used when repairing the board at the factory.

Power Board

DC voltage is produced in the switching transformer. The AC-DC converter unit allows automatic switching between AC and battery power. The voltage is converted to 24 V for the thermal head and 3.3 V/5 V for digital circuits, then fed to the main board.

Key Board

The key board controls LED blinking in the LED controller and sends information of the keys to the main board.

Power

When the power key is pressed, the software controls power off to prevent turning power off during data writing.

If a problem occurs in the system, all the LEDs light and the keys do not work. Press and hold the POWER key for 5 seconds to turn the power off. When the power is turned on again, the system information is printed.

NOTE

Normally, do not press and hold the POWER key for 5 seconds. Pressing and holding the POWER key for 5 seconds turns the power off even while data is being written. If power is cut off while data is being written, the file may be damaged and the electrocardiograph might not operate.

Section 2 Troubleshooting

How to Troubleshoot

This section explains how to locate, identify and solve a problem in the instrument. The troubleshooting tables in this section are divided into general problems and error messages.

How to Troubleshoot

1. Determine which troubleshooting table to use.

2. In the “Problem” column, find the trouble item that matches the problem or error message.

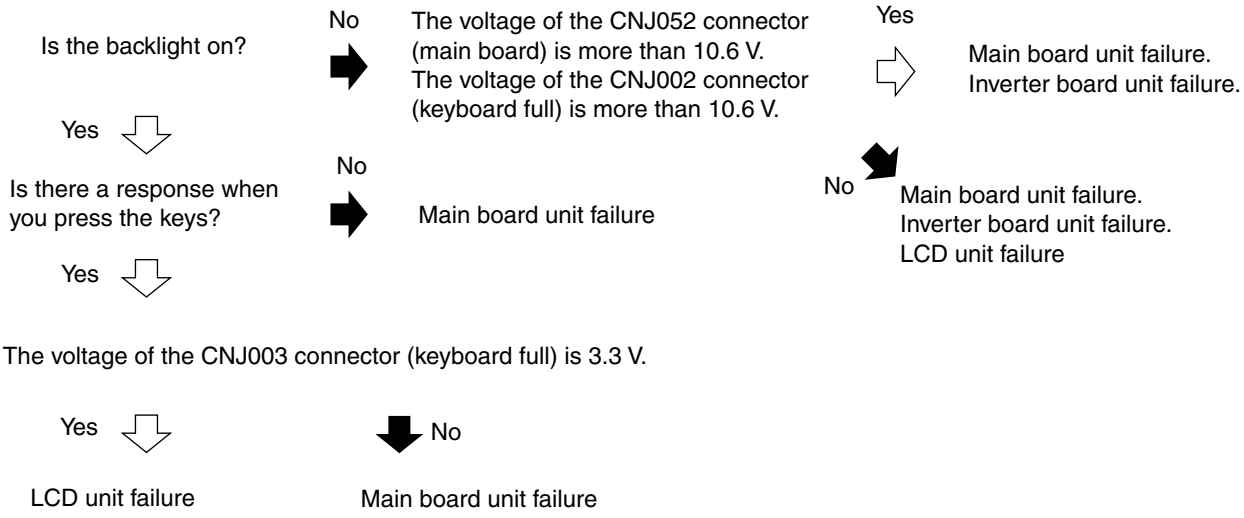
3. Do the first action recommended in the “Action” column.

4. If the problem is not solved, do the next action recommended in the “Action” column. (If this does not solve the problem, do the next recommended sections.)

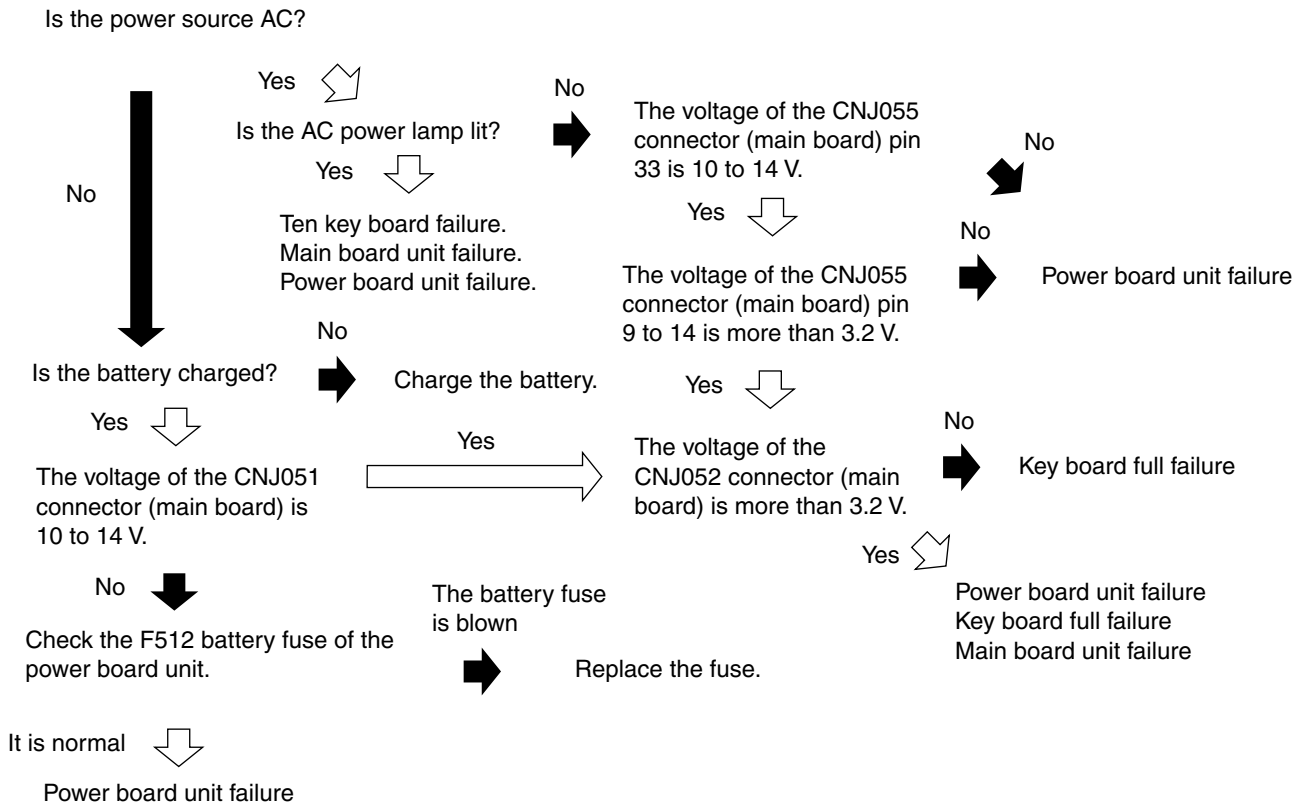
5. If none of the actions solve the problem, contact your Nihon Kohden distributor or representative.

Check Flow for Power Problem

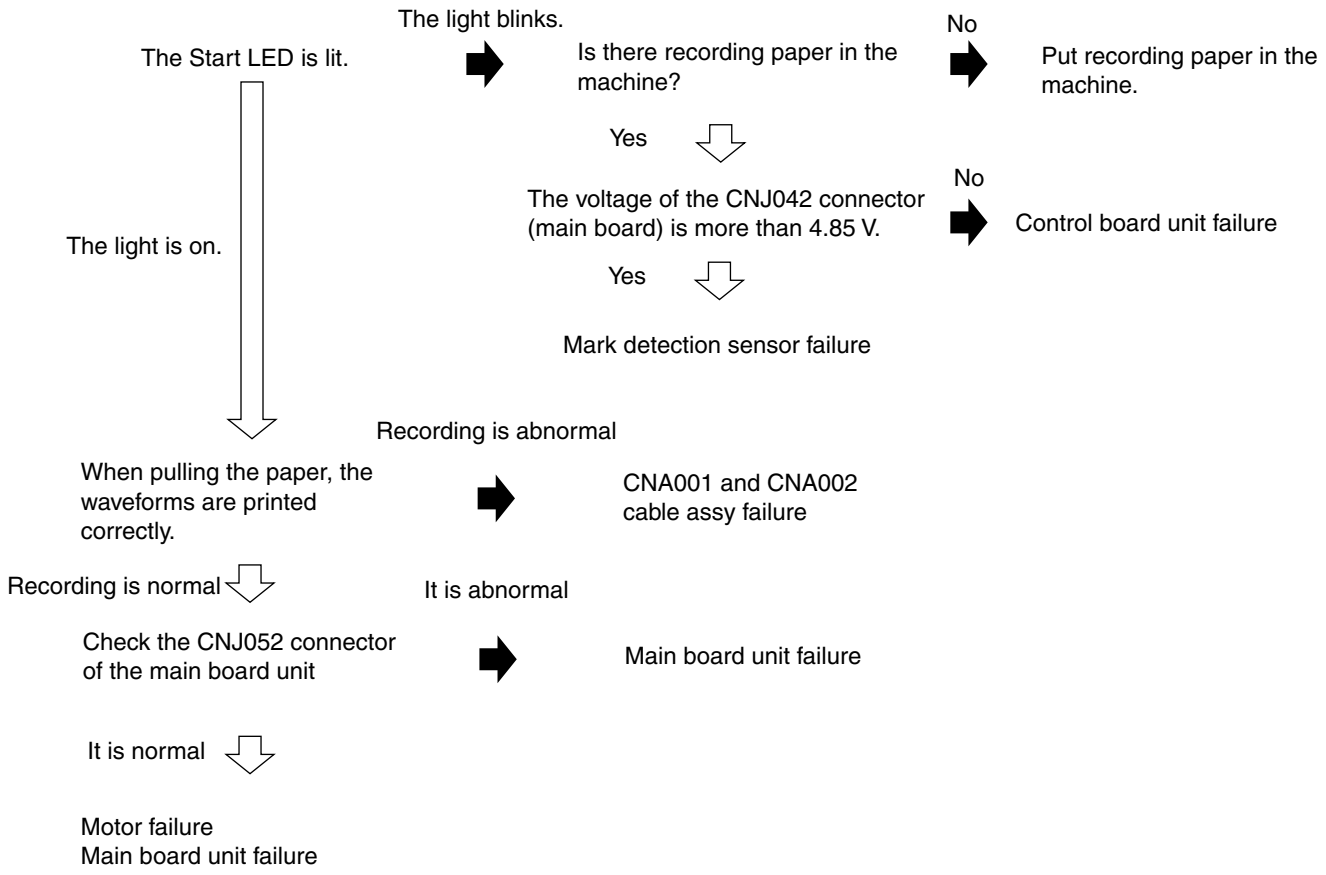
When the POWER lamp is lit but the LCD does not display



When the power can't be turned on



When there is no response even when the START key is pressed



Operation

Problem	Possible Cause/Criteria	Action
The power LED lights but there is no display or backlight on the LCD screen.	Faulty connections of connectors.	Check the connection to the CNA004 and CNA005 connectors on the key board, the connectors between inverter board and LCD unit, and the connector on the LCD unit.
	Faulty inverter board.	Replace the inverter board.
	Faulty LCD unit.	Replace the LCD unit.
The instrument does not operate during AC power operation.	Damaged power cord.	Replace the power cord.
	Faulty power board.	Replace the power board.
	Faulty main board.	Replace the main board.
	Damaged key board.	Replace the key board.
The instrument does not operate on battery power.	The battery is not charged.	Charge the battery.
	Faulty F512.	Replace the F512 on the power board.
	Damaged battery.	Replace the battery.
	Faulty connection of the battery connector.	Check the connection between CNJ511 connector on the power board and the battery.
	Faulty power board.	Replace the power board.
No key or switch operation.	Faulty connections of connectors.	Check the connection between CNJ052 connector on the main board and CNJ001 connector on the key board.
	Faulty key board.	Replace the key board.
	Faulty main board.	Replace the main board.
	The electrocardiograph is affected by static electricity.	Press the POWER key for 5 seconds to turn the power off. When the power is turned on again, the system information is printed. Show the information to Nihon Kohden representative.
The power does not turn off.	The electrocardiograph is affected by static electricity.	Press the POWER key for 5 seconds to turn the power off. When the power is turned on again, the system information is printed. Show the information to Nihon Kohden representative.
Only certain electrode lead waveforms are displayed on the screen or noise appears on the waveform.	The electrodes or cables connections from the patient to the instruments are not properly connected.	Make sure that all electrodes and cables connections from the patient to the instrument are properly connected.
	Faulty main board.	Replace the main board.
No electrode lead waveforms are displayed on the screen or noise appears on all waveforms.	Electrodes are not attached to the patient.	Make sure that the electrodes are properly attached to the patient.
	Faulty main board.	Replace the main board.

Problem	Possible Cause/Criteria	Action
Vertical and horizontal strips appear on the LCD screen at constant intervals.	Faulty connection to the CNJ052 connector on the main board, CNJ001 and CNJ003 connectors on the key board.	Check the connection to the CNJ052 connector on the main board, CNJ001 and CNJ003 connectors on the key board.
	Faulty main board.	Replace the main board.
	Faulty LCD unit.	Replace the LCD unit.
No sound.	Check the connection to the CNJ051 connector on the main board.	Check the connection to the CNJ051 connector on the main board.
	Faulty speaker.	Replace the speaker assy.

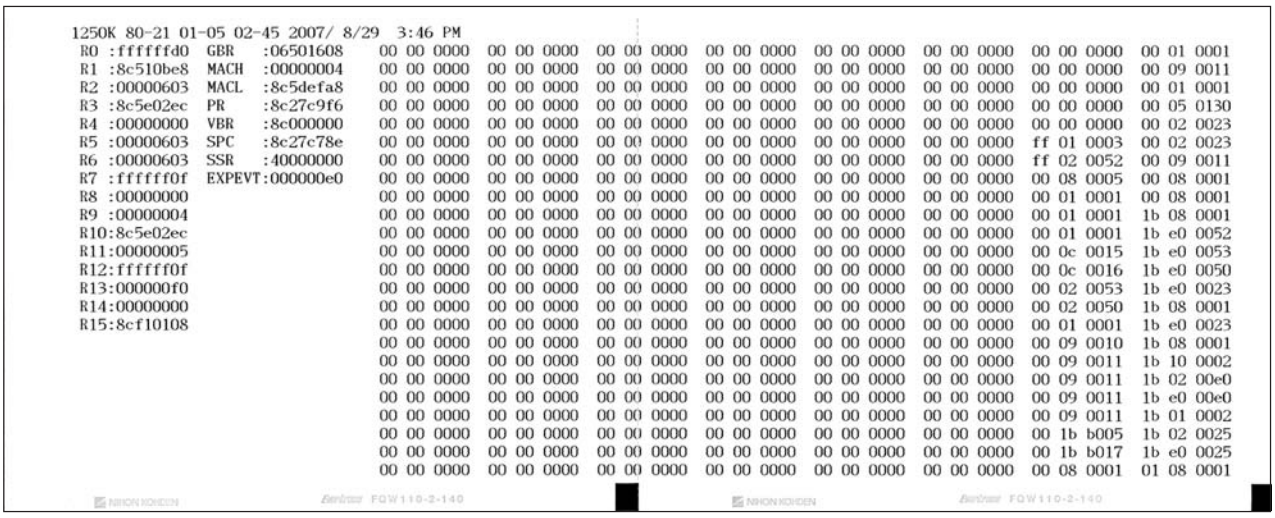
Recording

Problem	Possible Cause/Criteria	Action
The recorder does not feed the recording paper when the START/STOP key is pressed.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ042 connector on the main board.	Check the connection to the CNJ042 connector on the main board.
	Damaged key switch.	Replace the key board.
	Faulty main board.	Replace the main board.
	Faulty motor.	Replace the motor assy.
The recording paper is fed but there is no printing.	Faulty connection to the CNJ043 connector on the main board.	Check the connection to the CNJ043 connector on the main board.
	Faulty thermal head.	Replace the thermal head.
	Faulty power board.	Replace the power board.
	Faulty main board.	Replace the main board.
The paper mark cannot be detected.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ042 connector on the main board.	Check the connection to the CNJ042 connector on the main board.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty paper mark sensor board.	Replace the paper mark sensor board.
Sometimes the recorder does not print and blank recording paper is fed from the recorder.	The input protection circuit which protects the thermal head from strong noise, such as hum, is rejecting noisy waveforms.	Check the electrode attachment to the patient, and if necessary, re-position the electrodes so that a good ECG waveform is displayed.
The recording paper tracks zigzag or to one side.	Dirty thermal head.	Clean the thermal head.
	The recording paper is not properly set in the instrument.	Make sure that the recording paper is aligned with the lower recording paper guide.
	Inaccurate or worn out platen roller.	Replace the magazine assy.

System Information

If a problem occurs in the system, all the LEDs light and keys do not work. Press the POWER key for 5 seconds to turn the power off. When the power is turned on again, the system information is printed.

System information example



```
1250K 80-21 01-05 02-45 2007/ 8/29  3:46 PM
 R0 :fffffd0  GBR    :06501608    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001
 R1 :8c510be8 MACH   :00000004    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0011
 R2 :00000603 MACL   :8c5defa8    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001
 R3 :8c5e02ec PR     :8c27c9f6    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 05 0130
 R4 :00000000 VBR    :8c000000    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 02 0023
 R5 :00000603 SPC    :8c27c78e    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  ff 01 0003  00 02 0023
 R6 :00000603 SSR    :40000000    00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  ff 02 0052  00 09 0011
 R7 :ffffff0f EXPEVT:000000e0     00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 08 0005  00 08 0001
 R8 :00000000                     00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001  00 08 0001
 R9 :00000004                     00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001  1b 08 0001
R10:8c5e02ec                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001  1b e0 0052
R11:00000005                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 0c 0015  1b e0 0053
R12:ffffff0f                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 0c 0016  1b e0 0050
R13:000000f0                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 02 0053  1b e0 0023
R14:00000000                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 02 0050  1b 08 0001
R15:8cf10108                      00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 01 0001  1b e0 0023
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0010  1b 08 0001
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0011  1b 10 0002
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0011  1b 02 00e0
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0011  1b e0 00e0
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 09 0011  1b 01 0002
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 1b b005  1b 02 0025
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 1b b017  1b e0 0025
                                  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 00 0000  00 08 0001  01 08 0001
```

NOTE

The system information is necessary for repair. Save it.

Section 3 Maintenance

Periodic Replacement Schedule

To maintain the performance of the electrocardiograph, the following parts must be periodically replaced by qualified service personnel.

Built-in battery **One year**

When the battery deteriorates, the battery operation time is less than 30 minutes after 10 hours charging. Replace the battery with a new one if operation time is less than 30 minutes after charging.

LCD **75,000 hours**

When the LCD deteriorates, the screen display becomes darker. The initial screen brightness is reduced to half after 75,000 hours.

Built-in lithium battery **6 years**

This battery backs up system settings and system clock. When the battery power is low, the time is not accurately recorded and the system settings returns to the factory default settings.

Thermal head **30 km continuous recording**

When the thermal head wears out, the recording density gets weaker due to missing dots.

Feeder motor **1,000 hours continuous operation**

When the motor wears out, the recording paper may feed unevenly or at unstable speed.

For inspection and replacement of the above parts, consult your Nihon Kohden representative.

Cleaning the Parts

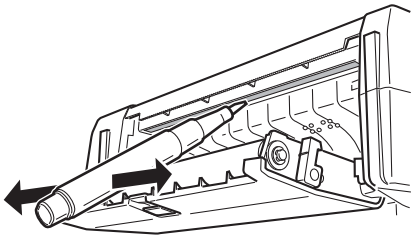
Cleaning the Thermal Head

CAUTION

- **Do not clean the thermal head right after recording because the head is still hot.**
- **Only use the provided thermal head cleaner pen. Otherwise the thermal head may be damaged.**

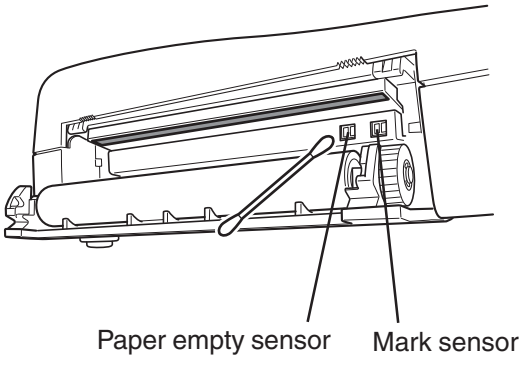
To protect the thermal head from abrasion or damage and assure optimum performance and long service life, clean the surface of the head with the provided thermal head cleaning pen after every 10 sets of recording paper.

1. Turn off the electrocardiograph before cleaning the thermal head.
2. Push the paper magazine release button and open the paper magazine.
3. Clean the gray colored part of the thermal head with the thermal head cleaner pen.



Cleaning the Sensors

The paper empty sensor and mark sensor are located as shown below. Clean the sensor surfaces with a cotton swab moistened with alcohol.



Cleaning the Motor and Adding the Grease

Clean the motor sensor assy and add grease once a year.
The motor revolutions detector is attached to the lower casing.

1. Remove the upper casing of the unit. Refer to “Removing the Top Case” in Section 4.

2. Remove the motor assy. Refer to “Removing the Motor Assy” in Section 4.

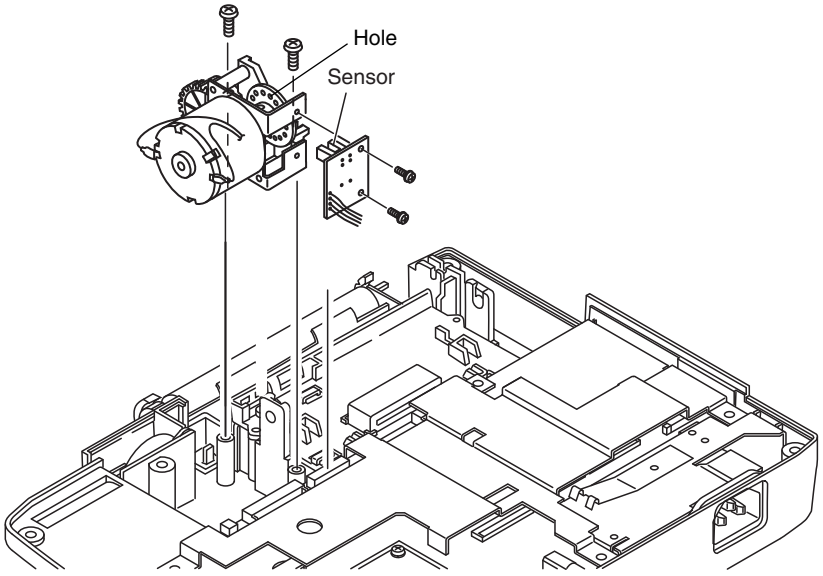
3. Remove the motor sensor board with the two screws.

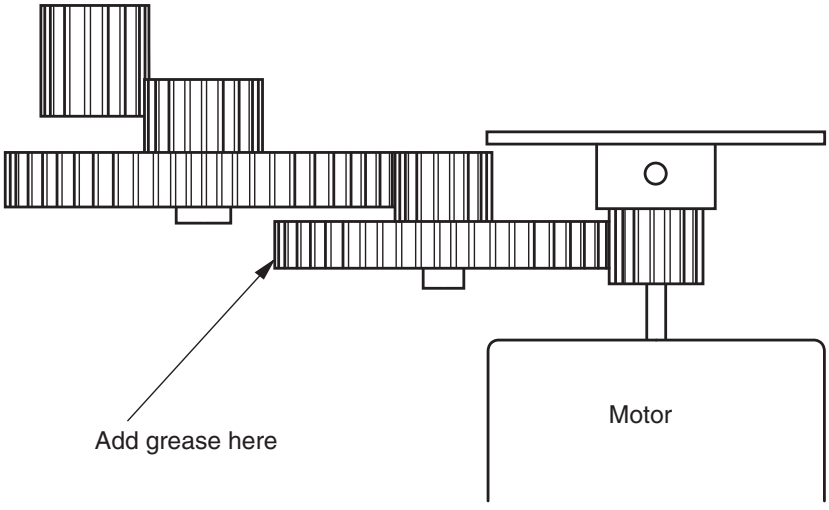
4. Wipe off the hole in the rotating plate attached to the motor with a brush.

5. Clean the light emitter and detector of the sensor on the printing plate with an alcohol soaked cotton swab.

6. After cleaning, reinstall the motor sensor board. Install it so the rotating plate is exactly in the middle between the sensor units.

7. Put grease on the gear.

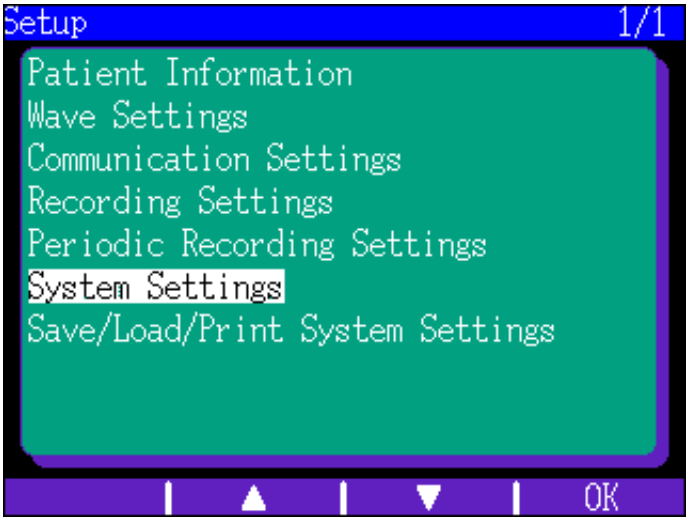




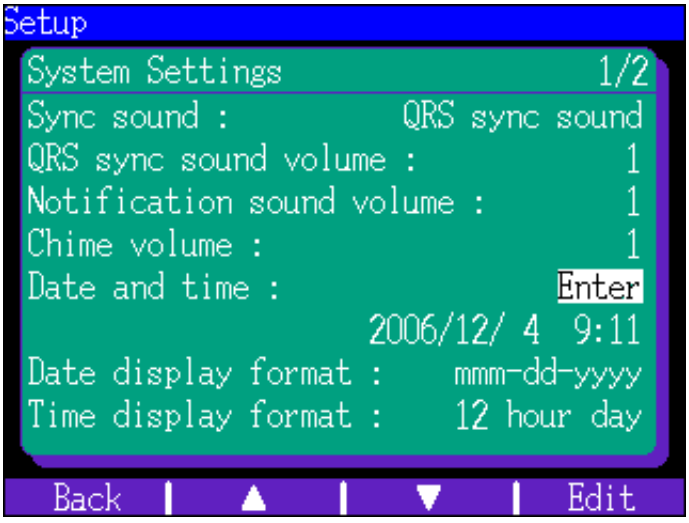
Setting the Date and Time

1. Display the System Setup screen. Refer to the “Changing the System Settings” in Section 3 of the Operator’s Manual.

2. Press the ▲ or ▼ function key to select System Settings.

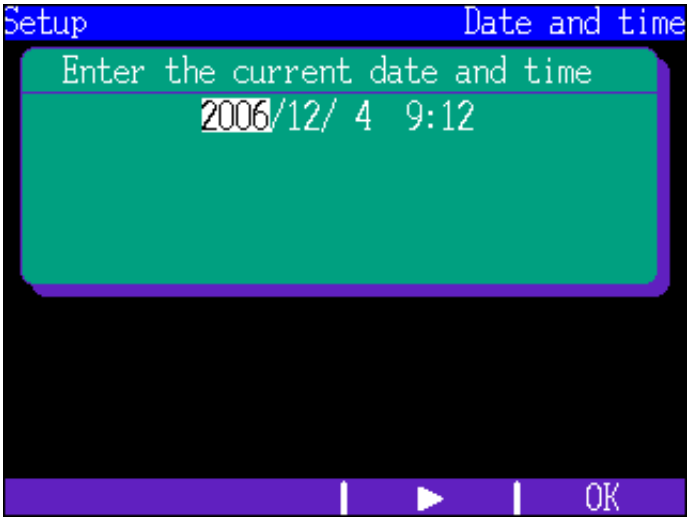


3. Press the OK function key. The System Settings screen is displayed.



4. Select the Date and time with the ▲ or ▼ function key.

5. Press the Edit function key. The Date and time setting window is displayed.



6. Enter the current date and time with the keyboard on the operation panel. The order of the date setting is always yyyy/mm/dd.

7. Press the OK function key or START/STOP key. The changed setting is saved.

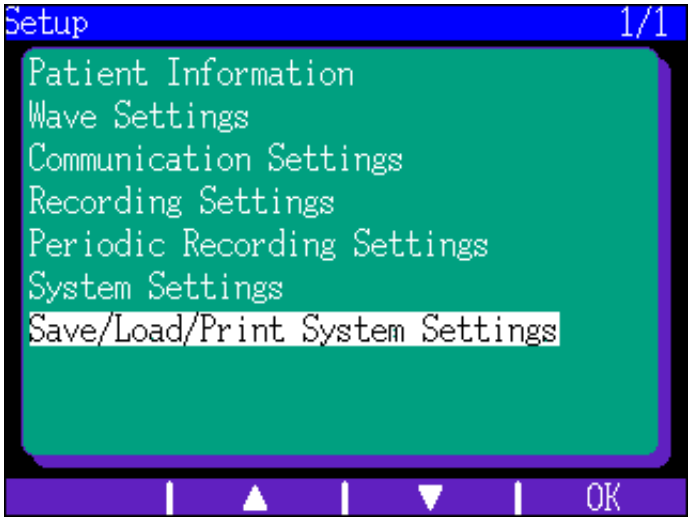
8. Press the Back function key to return to the previous screen.

9. Turn the power off and on again to return to the Resting ECG recording screen.

Saving the System Settings

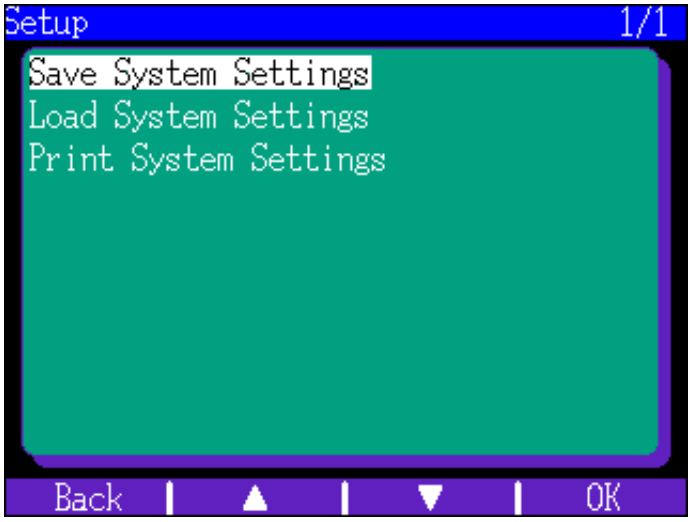
You can save all system settings to an SD memory card. Insert the SD memory card into the SD card slot on the rear panel of the electrocardiograph before saving the system settings.

1. Display the System Setup screen. Refer to the "Changing the System Settings" in Section 3 of the Operator's Manual.

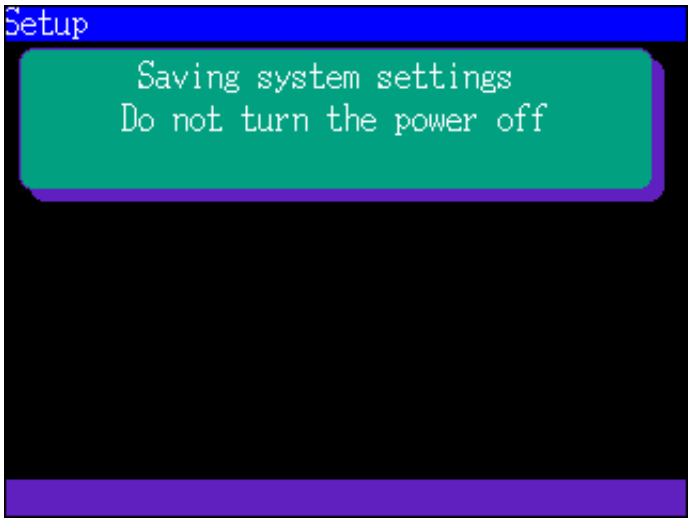


2. Press the ▲ or ▼ function key to select Save/Load/Print System Settings.

3. Press the OK function key. The Setup screen is displayed.



4. Select Save System Settings and press the OK function key. The “Saving system settings. Do not turn the power off” message appears and the system settings are saved.



5. Turn the power off and on again to return to the Resting ECG recording screen.

Loading the System Settings

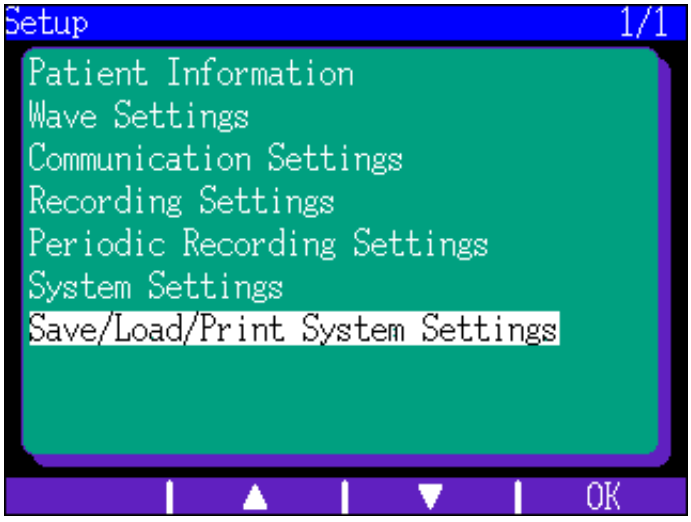
You can load previously saved system settings from the SD memory card. Insert the SD memory card in the SD card slot on the rear panel of the electrocardiograph before loading the system settings.

NOTE

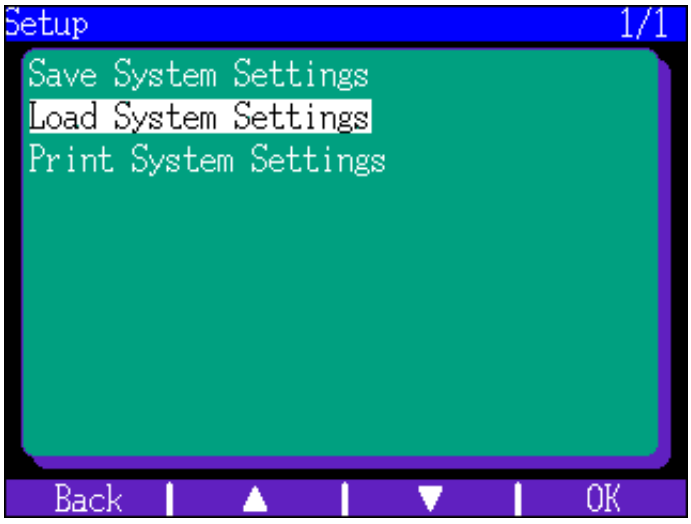
The terminal number and IP address are not loaded.

1. Display the System Setup screen. Refer to the "Changing the System Setting" in Section 3 of the Operator's Manual.

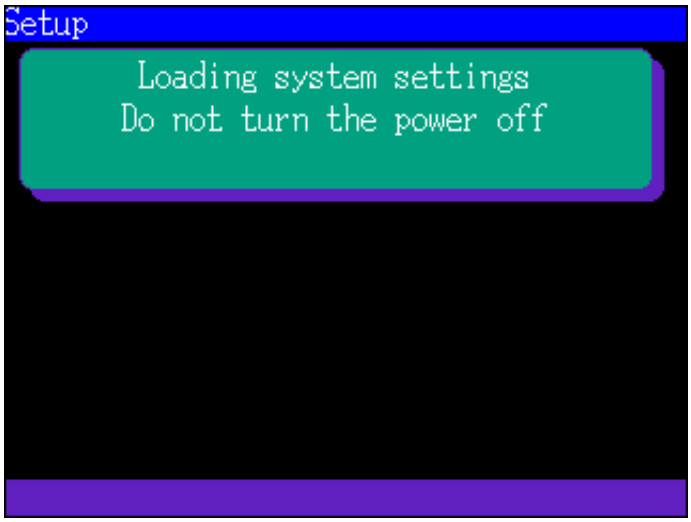
2. Press the ▲ or ▼ function key to select Save/Load/Print System Settings in the System Setup screen.



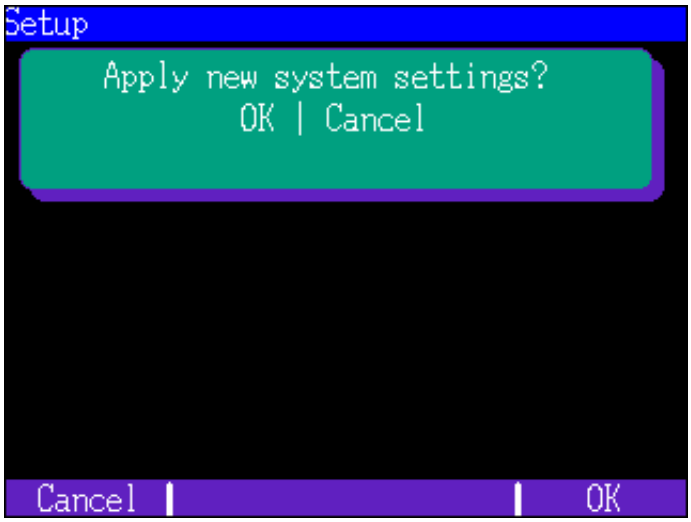
3. Press the OK function key. The Setup screen is displayed.



4. Select Load System Settings and press the OK function key. The “Loading system settings. Do not turn the power off” message appears.



5. The “Apply new system settings?” message appears. Press the OK function key. The new system settings are loaded.



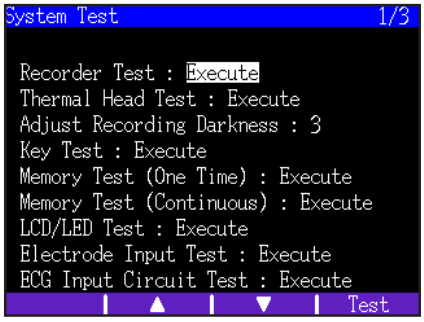
6. Turn the power off and on again to return to the Resting ECG recording screen.

System Test

You can check the system with the system test functions.

Displaying the System Test Screen

There are two modes for the System Test screen: user mode and service mode.



User Mode

The user mode checks the condition of the electrocardiograph. To display the user mode System Test screen, press the POWER key while pressing the FEED/MARK key. You can check the 12 items below.

- Demonstration Waveform
- Recorder Test
- Key Test
- Memory Test
- LCD/LED Test
- Electrode Input Test
- ECG Input Circuit Test
- CRO/EXT1 Test
- USB Test
- Initialize System Settings
- Display Internal Information
- Display Model Information

Service Mode

The service mode is used for repairing the electrocardiograph and changing the parts. To display the service mode System Test screen, press the POWER key while pressing the FEED/MARK key and AUTO/MANUAL key. The following 22 items are available.

- Recorder Test
- Thermal Head Test
- Adjust Recording Darkness
- Key Test
- Memory Test (One Time)
- Memory Test (Continuous)
- LCD/LED Test
- Electrode Input Test
- ECG Input Circuit Test
- CRO/EXT1 Test
- USB Test
- Initialize System Settings
- Display Internal Information
- Display Model Information
- Adjust Cue Mark
- Load Local Language
- Initialize Flash Memory
- Display SD Card Information

- Update Program
- Initialize All Memory
- Feed roller setting
- Area setting

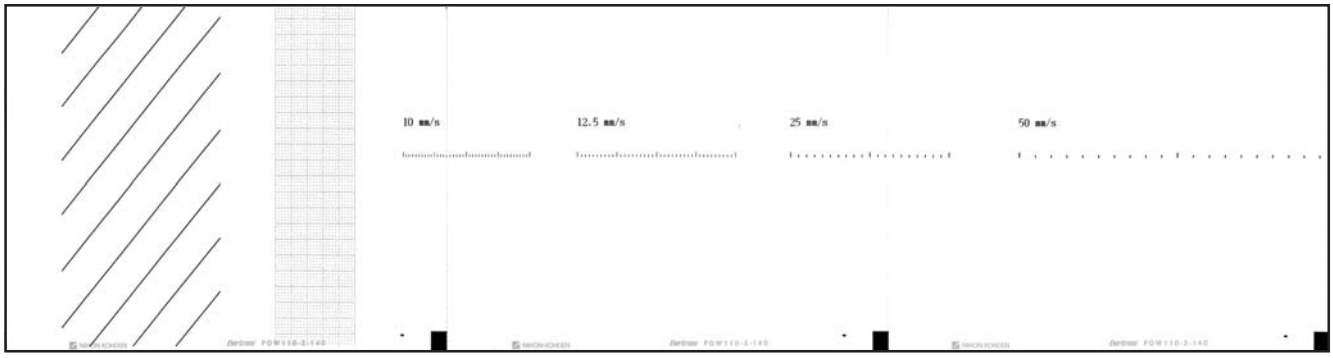
Demonstration Waveform

This item displays the demonstration waveform. Select Demonstration Waveform and press the Test function key or the START/STOP key.

Recorder Test

This item checks the recorder function. Select Recorder Test and press the Test function key or the START/STOP key. This test prints the following figures:

(1) Diagonal line
(2) Thermal head check pattern
(3) Paper speed scale
(4) Paper mark detection mark



(1) Diagonal Line

<Check>

Check that there are no missing points in the diagonal lines that are recorded.

<Possible causes and countermeasures>

If there is a problem with the thermal head, the points that are missing will always appear in the same place(s). If some foreign matter is on the thermal head, use the cleaner pen to remove it. If cleaning the head does not improve recording, the thermal head is faulty, so replace the thermal head.

(2) Thermal head check pattern

<Check>

Check that the printing of the grid is uniform.

<Possible causes and countermeasures>

If the unit fails to print or the printing is abnormal, the main board may be faulty.

(3) Paper speed scale

<Check>

Check whether the unit is maintaining a precise feed speed.

The standard for the feed speed is within ±5%.

<Possible causes and countermeasures>

- Check that the thermal head is installed properly.
- Check for missing gears, warping and or improper installation.
- Check whether the motor RPM detector is clogged; if so, clean it.
- Check for looseness or damage to the drive parts.
- Replace a malfunctioning motor.
- Replace a malfunctioning main board.

(4) Paper mark detection mark

<Check>

Check that the detection mark is printed before each paper mark.

<Possible causes and countermeasures>

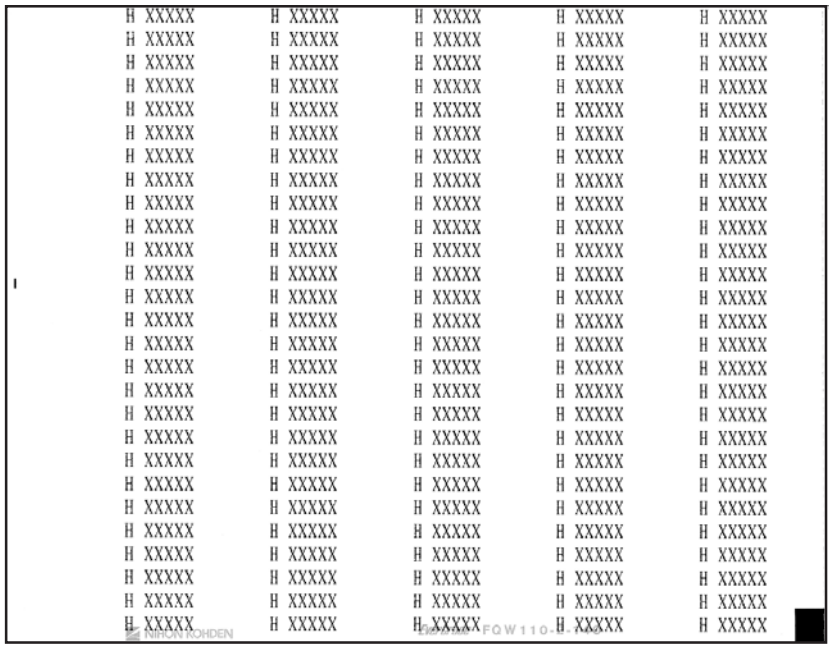
- Check for foreign matter on the mark sensor; if it is dirty, clean it.
- Replace the motor assy.
- Replace a malfunctioning main board.

Thermal Head Test

This item checks the thermal head contact.

1. Select the Thermal Head Test on the System Test screen and press the Test function key or the START/STOP key.
   The recorder prints a continuous series of H's and X's.

2. To stop the test, press the AUTO/MANUAL key.



<Check>

Check that the recorded letters are uniform and clear. In particular, look for any unevenness or smudging in the vertical parts of the letter H.

When recording for 1 m or more, check for any meandering or slanting.

<Possible causes and countermeasures>

- After replacing the head, print level adjustment may have been forgotten. Adjust the print level.
- Problem with connector contacts.
- Replace a faulty power board.
- Problem with the installation of parts of the recorder.

Adjust Recording Darkness

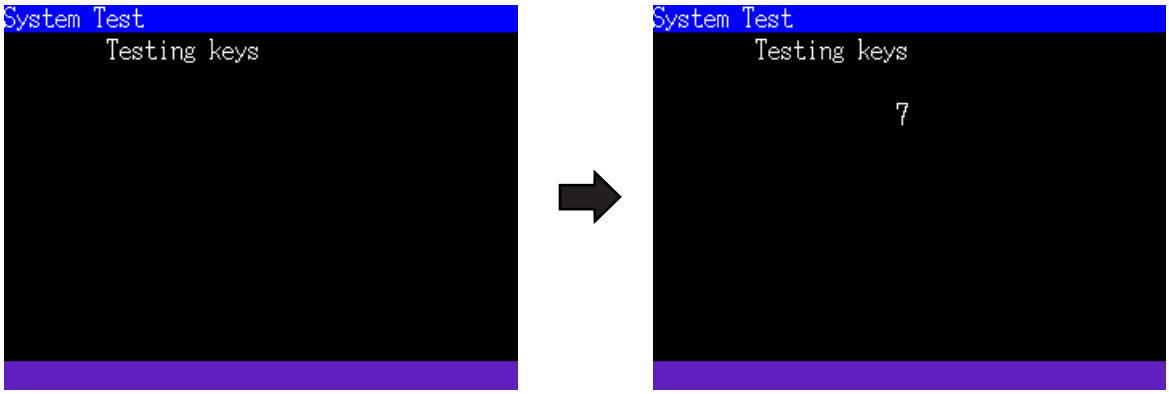
Refer to “Adjusting the Recording Darkness” later in this section.

Key Test

This item checks the functions of the keys.

1. Select Key Test and press the Test function key or the START/STOP key to start the test.

   Press any key other than the POWER key or the AUTO/MANUAL key. The name of any key is shown on the screen.



2. To end the test, press the POWER key.

   - The functioning of the POWER key is confirmed by its ability to turn the power on/off.
   - The function of the AUTO/MANUAL key is confirmed by its ability to close this mode. The POWER key and AUTO/MANUAL key are not checked in this test.

   <Check>

   Check and make sure that the name of the pressed key is displayed correctly on the screen.

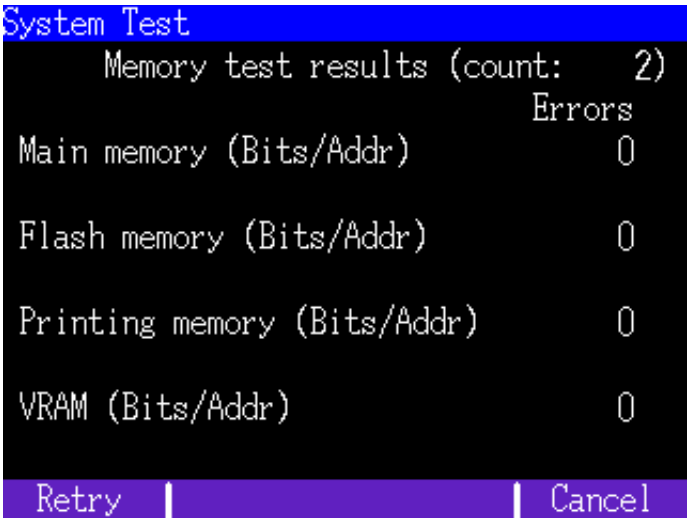
   <Possible causes and coutermeasures>

   Replace the key board.

Memory Test

This item checks the memory.

Select a Memory Test (One Time or Continuous), and press the Test function key or the START/STOP key to start the test. The memory is tested one time (for the continuous test, it is tested until it terminates). If a problem occurs frequently due to the memory, you can confirm it by this test.



<Check>
Check that “0 Times” is indicated for Errors in all the tests.
<Possible causes and countermeasures>
Replace the main board.

LCD/LED Test

This item checks the LCDs and LEDs.

Select LCD / LED Test and press the Test function key or the START/STOP key to start the test. In the LED test, the LEDs light up one by one until all are lit up and then they go out; then it proceeds to the LCD test. In the LCD test, the screen lights up in the order blue--green --yellow--violet --white, repeating two times, and then the backlight turns off.

During the LED test, the battery charge lamp only lights if the battery is charged. The Power lamp is lit continuously while the power is ON. The AC power lamp is lit when power is taken from AC power. The AC power lamp is directly controlled by hardware, so this test cannot check it.

LED Test

<Check>
The LEDs light up one by one in order.
<Possible causes and countermeasures>
- Check the connections of the connector.
- Replace a faulty key board.
- Replace a faulty main board.

LCD Test

<Check>

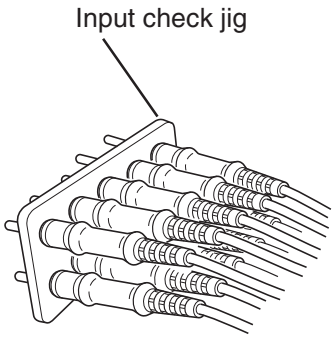
During the LCD test, check that nothing is abnormal with the LCD.

<Possible causes and countermeasures>

- Check the connections of the connector.
- Replace a faulty LCD unit.
- Replace a faulty main board.

Electrode Input Test

This item checks the ECG input circuit by using the electrode leads and the input check jig.



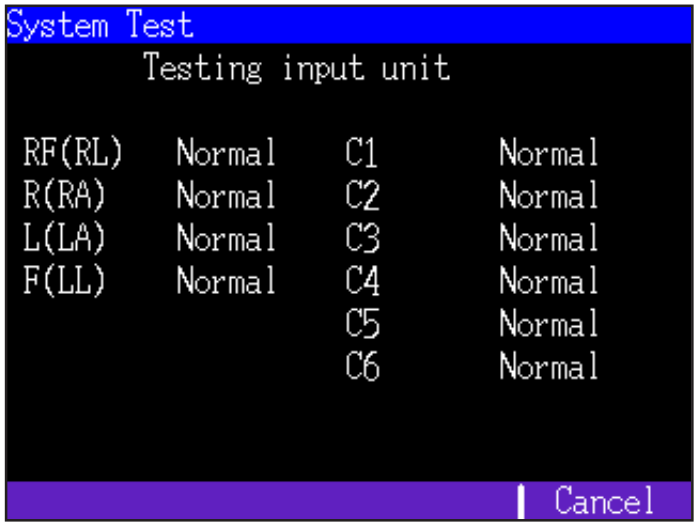
1. Connect the electrode lead to the electrocardiograph.

2. Insert the tip of the electrode lead in the input check jig. If it is a clip type induction lead, pinch the edge of the input check jig.

3. Select Electrode Input Test and press the Test function key or the START/STOP key to start the test.

<Check>

Check that when you remove an electrode, the display for the removed electrode automatically changes to “Error”. Be sure to remove the electrodes one by one.



<Possible causes and countermeasures>

Replace the faulty main board.

ECG Input Circuit Test

This item checks the sensitivity, accuracy and operation of the ECG Input circuit (amp) by using the electrode leads and the input check jig.

1. Connect the electrode leads to the electrocardiograph.

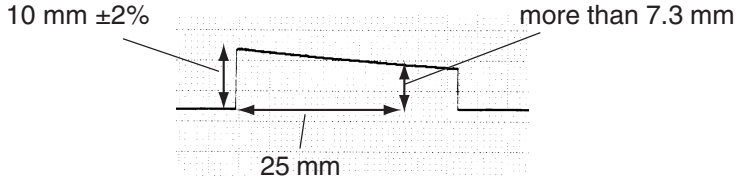
2. Insert the tips of all the electrode leads into the input check jig. If they are clip type electrode leads, pinch the edge of the testing tool.

3. Select ECG Input Circuit Test and press the Test function key or the START/STOP key to start the test.

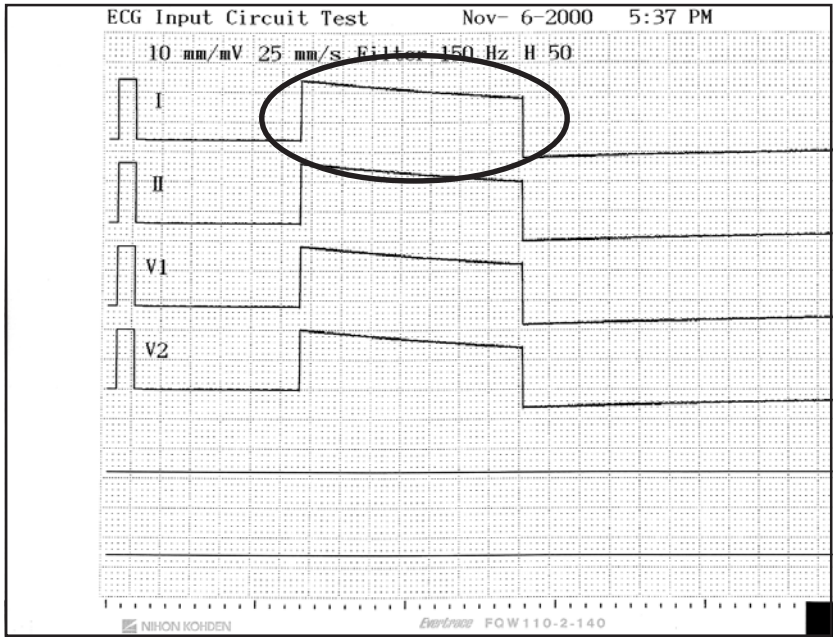
   The electrocardiograph sends a standard signal from the beginning of the ECG input circuit and prints the waveform.

   When all the waveforms are printed, the test is finished and the System Test screen is displayed. To cancel the test, press the Cancel function key or START/STOP key.

4. Judging the Results
   Check that all the rectangular printed CAL waveforms match the following conditions in the illustration below:
   - Amplitude when CAL waveform is risen: 10 mm ±2%
   - Amplitude of point which is 25 mm from the rising point of the CAL waveform: more than 7.3 mm



Example



<Possible causes and countermeasures>

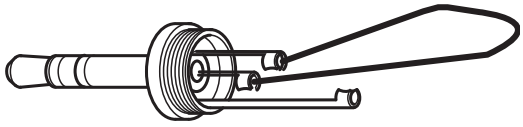
Replace the faulty main board.

CRO/EXR1 Test

This item checks the EXT-IN/CRO-OUT connector.

Preparation

A locally made check jig is required for the test. To make the check jig, use a 3.5 diameter monaural jack and lead. Solder the leads to the jack as shown below.



Procedure

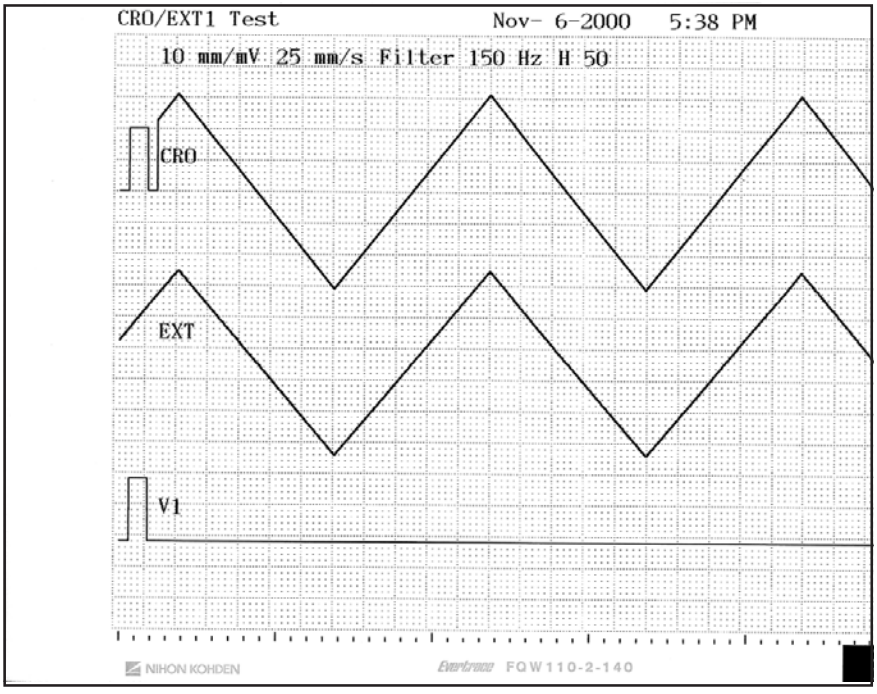
1. Put the check jig into the EXT-IN/CRO-OUT connector.

2. Select the CRO/EXT1 Test and press the START/STOP key or the Test function key. The waveforms are printed.

   To quit the test, press the START/STOP key or the Test function key. The System Test screen is displayed.

   <Check>
   Check that the CRO waveform and EXT1 waveform are the same.
   <Possible causes and countermeasures>
   Replace the main board.

Example

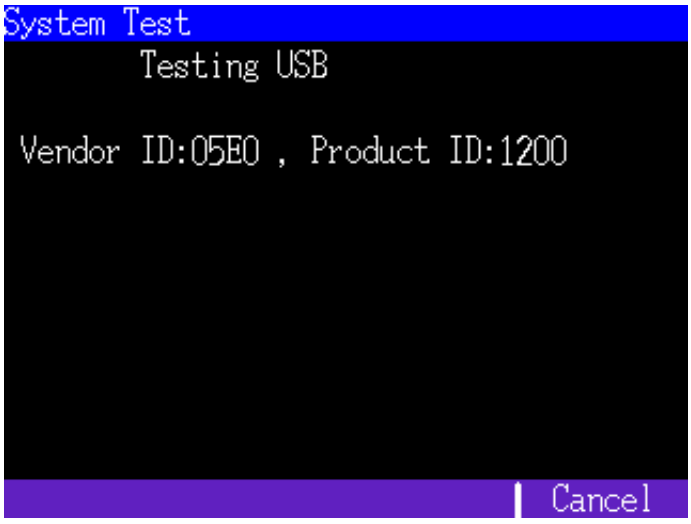


USB Test

This item checks the USB devices function.

1. Connect YZ-041H0 USB-RE232C Adapter or YZ-041H1 USB-LAN Adapter to one of the USB connector of the electrocardiograph.

2. Select USB Test on the System Test screen and press the START/STOP key or Test function key. The 4 digits of Vender ID and Product ID are displayed and a chime sounds.



3. Press the START/STOP key or the Cancel function key to return to the System Test screen.

   To cancel the test, press the START/STOP key or the Cancel function key. The System Test screen is displayed.

When you connect an unspecified USB adapter, the 4 digits of Vender ID and Product ID are not displayed and an error sounds. Use a specified USB adapter and test again.

Initialize System Settings

Refer to “Initializing Settings” later in this section.

Display Internal Information

Refer to “Displaying Information” later in this section.

Display Model Information

Refer to “Displaying Information” later in this section.

Adjust Cue Mark

Refer to “Adjusting the Cure Mark” later in this section.

Load Local Language

Refer to “Changing the Language” later in this section.

Initialize Flash Memory

Refer to “Changing the Language” later in this section.

Display SD Card Information

Refer to “Displaying Information” later in this section.

Update Program

Refer to “Upgrading the Software” later in this section.

Initialize All Memory

Refer to “Initializing Settings” later in this section.

Feed Roller Setting

Refer to “Setting the Diameter of the Platen Roller” later in this section.

Area Setting

Refer to “Setting the Area for Wireless LAN” later in this section.

Adjusting the Recording Darkness

The impedance value of the heat elements of thermal heads is a fixed value that is differ for each thermal head. Even if the same amount of energy is applied, the difference in impedance results in a differing print quality.

The setting is adjusted in a System Test by matching the width of the print pulse applied to the thermal head with the impedance and making the print darkness of each head nearly the same.

NOTE

Be sure to adjust the recording level after replacing the thermal head. Always perform this adjustment using AC power.

Procedure for Adjusting the Print Level

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Select Adjust Recording Darkness.

3. Check the impedance value printed on the label that is attached to the thermal head and press the Change function key until the applicable number from 1 to 8 from the table below is displayed. This sets the adjusted value of the print level for the thermal head.

Adjustment Value	Impedance Value
1	680 to 709 Ω
2	710 to 739 Ω
3	740 to 769 Ω
4	770 to 799 Ω
5	800 to 829 Ω
6	830 to 859 Ω
7	860 to 889 Ω
8	890 to 920 Ω

4. Turn off the power to finish the adjustment.

   If the print darkness still fails to become uniform, even after changing the thermal head and adjusting the recording darkness, repair or replace the power board and/or the main board.

Initializing Settings

There are two procedures for initializing settings, Initializing System Settings and Initializing All Memory.

Initializing System Settings

Initialization Items and Default Settings
Initializes the settings for system setup and user setup. For details about the default settings, refer to the Operator's Manual.

This does not initialize "Date and Time", "Adjust Recording Darkness" and "Adjust Cue Mark" settings.

Procedure

1. Display the service mode System Test screen. Refer to "System Test" in this section.

2. Select Initialize System Settings (general use / factory defaults for both) and press the START/STOP key or Test function key.

3. When initialization is complete, a chime sounds, the "System settings have been initialized." message appears and it returns to the system test screen.

Initializing All Memory

Initialization Items and Default Settings
The following items and the flash memory are initialized and changes to the factory default settings.

Item	Settings Value
• Adjust Recording Darkness	3
• Adjust Cue Mark	0
• Feed roller setting	4

When the power is turned On next time, the following items are initialized.

• All the system settings	Default Settings
• Date and Time	2000/1/1 00:00:00

Procedure

1. Display the service mode System Test screen. Refer to "System Test" in this section.

2. Select "Initialize All Memory" and press either the START/STOP key or the Test function key.

3. When the "Initialize all the memory OK?" message appears, press the Yes function key to initialize the flash memory.

4. When initialization is complete, a chime sounds and the "All memory initialized." message appears. The System Test screen is displayed.

Displaying the Software Version, Internal Voltage and SD Card Information

Displaying the Software Version

1. Display the service mode System Test screen. Refer to “System Test” in this section.
2. Select Display Model Information and press the START/STOP key or Test function key.
3. The model name of this electrocardiograph and the software version are displayed on the screen.
4. Press the START/STOP key or Cancel function key to return to the System Test screen.

Displaying the Internal Voltage

1. Display the service mode System Test screen. Refer to “System Test” in this section.
2. Select Display Internal Information and press the Test function key or START/STOP key. The internal voltage is displayed.
3. Press the Cancel function key or START/STOP key. The System Test screen is displayed.

Displaying the SD Card Information

1. Display the service mode System Test screen. Refer to “System Test” in this section.
2. Insert the SD memory card into the SD card slot.
3. Select Display SD Card Information and press the Test function key or START/STOP key. The information of the SD memory card is displayed.

   When displaying the information of another card, change the card and press the Retry function key.
4. Press the Cancel function key or START/STOP key. The System Test screen is displayed.

Adjusting the Cue Mark

Align the position of the mark on the recording paper with the cutter on the upper casing.

Adjusting the Location of the Perforated Line

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Select Adjust Cue Mark. Check that the setting is 0 and press the Test function key to execute feeding with a fine adjustment value of 0.

3. The recording paper is fed and stopped at the mark position. Measure the difference between the cutter of the upper casing of the frame and the mark on the recording paper.

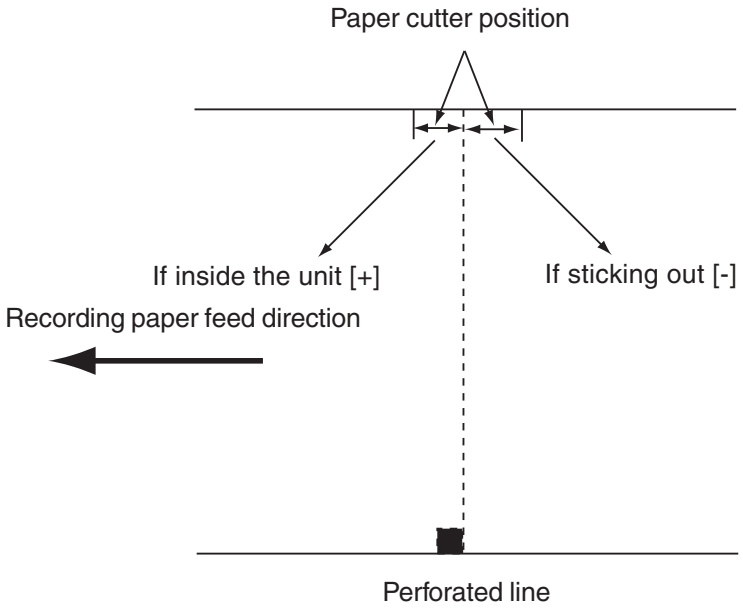
4. Push and hold the Change function key or the START/STOP key until it reaches the number corresponding with the value measured in 3. It has a negative value if the recording paper is sticking out from the cutter and a positive value if it is inside the unit.

5. After setting the changed value, press the Test function key again and check that the perforated line is aligned with the unit.

6. Turn off the power to finish the adjustment.

Fine adjustment (mm)

–4.0
–3.5
–2.5
–2.0
–1.5
–1.0
–0.5
0.0
+0.5
+1.0
+1.5
+2.0
+2.5
+3.0
+3.5



Changing the Language

Changing the Language to Local Language

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Insert the SD memory card which contains local language software into the SD card slot.

3. Select “Load Local Language” and press the Test function key or START/STOP key. The local language is installed and System Test screen is displayed.

Returning the Language to English

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Select “Initialize Flash Memory” and press the Test function key or START/STOP key. The language returns to English and System Test screen is displayed.

Upgrading the Software

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Insert the SD memory card which contains upgrade program.

3. Select Update Program and press the Test function key or START/STOP key. The update starts and AUTO/MANUAL lamp blinks.

4. After about 15 minutes, the electrocardiograph restarts and upgrade is finished.

For details, refer to the upgrade software installation guide.

Setting the Diameter of the Platen Roller

When changing the platen roller, set the diameter of the platen roller on the System Test screen.

1. Display the service mode System Test screen. Refer to “System Test” in this section.

2. Select “Feed Roller Setting”.

3. Press the Change function key or START/STOP key. The diameter of the platen roller is toggled.

Setting the Area for Wireless LAN

NOTE

When using a wireless LAN, set the Area setting to comply with your country's radio frequency regulations.

1. Display the service mode System Test screen. Refer to "System Test" in this section.

2. Select the Area setting with the ▲ or ▼ function key.

3. Press the Change function key. The Area setting screen is displayed.

4. Enter the country code of your country by referring to the table below.

Code	Country	Code	Country
AT	Austria	IT	Italy
BE	Belgium	JP	Japan
CA	Canada	KR	Korea (Republic of)
CH	Switzerland	LT	Lithuania
CY	Cyprus	LU	Luxembourg
CZ	Czech Republic	LV	Latvia
DE	Germany	MT	Malta
DK	Denmark	NL	Netherlands
EE	Estonia	NO	Norway
ES	Spain	PL	Poland
FI	Finland	PT	Portugal
FR	France	SE	Sweden
GB	United Kingdom	SI	Slovenia
GR	Greece	SK	Slovakia (Slovak Republic)
HU	Hungary	TW	Taiwan (Province of China)
IE	Ireland	US	United States
IS	Iceland		

5. Confirm the country name and press the OK key. The country is set and the System Test screen is displayed.

6. Press the POWER key on the operation panel for one second to turn the power off.

7. Press the POWER key to turn the power on. The operation starts with the new setting.

Maintenance Check Sheet

The maintenance check sheet is provided at the end of this subsection. Make a copy of this check sheet before using it. The check sheet contains the check items grouped as follows:

- Overview
- Input circuit
- Screen
- Power
- Operation
- Safety
- Memory card and accessories

Refer to the following lists to check the items.

Overview

Item	Check Procedure	Action
Dirt	Check if the outside of the cardiograph and input box is dirty.	If the outside of the cardiograph or input box is dirty, clean it with a cotton moistened with warm water, then dry it.
Loose Screws	Check if there are any loose screws.	If any screw is loose, tighten it.
Damaged or Bent Parts	Check if there are any physically damaged or bent parts. This includes the pins on the connector or socket, key switch on the operation panel and power switch.	If any part is damaged or bent, replace it.
Cable connection	Check if the input box is connected to the cardiograph firmly.	If the input box is not connected to the cardiograph, connect them firmly
Battery pack	Check if the battery pack is used over one year.	If it is used over one year, replace it.

Operation

Item	Check Procedure	Action
Electrode detachment detection	Check if an error message appears on the screen when an electrode is detached,	If the error message does not appear, check the input box with the System Test screen – Electrode Input Test.
Manual recording	Check if the manual recording is available.	If the manual recording is not available, do the following. • Check the CNA003 cable connection between the key board and ECG control board. • Replace the key board. • Replace the ECG control board.
Automatic recording	Check if the automatic recording is available.	If the automatic recording is not available, do the following. • Check the CNA003 cable connection between the key board and ECG control board. • Replace the key board. • Replace the ECG control board.
LED	Check that all LEDs on the operation panel light when the System Test screen – LCD/LED Test is performed.	If any LED does not light, replace the key board.
Key on the operation panel.	Check the key response with the System Test screen – Key Test.	If there is a key which does not respond, do the following. • Check the CNA003 cable connection between the key board and ECG control board. • Replace the key board • Replace the ECG control board
Speaker	Check if the speaker operates correctly with the System Test screen – Speaker test	If the speaker does not operate correctly, replace the speaker.
Memory	Check the internal memory with the System Test screen – Memory Test	If the check result fails, replace the ECG control board.
SD memory card	Check if a SD memory card has no problem with the System Test screen – Display SD Card Information.	If the information is not displayed, replace the SD memory card.

LCD

Item	Check Procedure	Action
LCD		
Brightness adjustment	Check if the screen is visible in bright place.	If the screen is not visible, adjust the brightness.
Display quality	Check the display quality with the System Test screen – LCD/LED test.	If the display quality is low, replace the LCD.
Color pattern	Check if the color pattern is correct with the System Test screen – LCD/LED test.	If the color pattern is not correct, replace the LCD.
Backlight	Check backlight function with the System Test screen – LCD/LED test.	If the backlight function is not correct, replace the inverter board or LCD.

Recorder

Item	Check Procedure	Action
Recorder		
Dirt	Check if the thermal head is dirty.	If the thermal head is dirty, clean it with a thermal head cleaner pen.
	Check if the paper empty sensor is dirty.	If the paper empty sensor is dirty, clean it with a cotton swab moistened with alcohol.
	Check if the mark sensor is dirty.	If the mark sensor is dirty, clean it with a cotton swab moistened with alcohol.
	Check if the paper feeding roller is dirty	If the paper feeding roller is dirty, clean it with a cotton swab moistened with alcohol.
Magazine	Check if the magazine opens by pushing up the magazine release lever.	If the magazine does not open, check the magazine release lever attachment and correct it.
Paper skew	Check that there is no paper skew (after 100 cm recoding, paper skews less than 0.5 mm per 50 cm).	If paper skews, do the following. 1. Set the recording paper so that it aligns with recording paper guide correctly. 2. Clean the thermal head. 3. Clean the feeding roller. 4. Readjust the thermal head position.
Paper speed	Check if the paper speed is correct with the System Test screen – Recorder Test.	If the paper speed is not correct, do the following • Clean the paper feeding roller • Replace the motor assy. • Replace the ECG control board
Paper empty detection	Check that the “Check paper or recorder” message appears when there is no recording paper.	If the message does not appear, do the following. • Clean the paper empty sensor. • Check that the paper sens board cable is connected to the recorder board firmly.
Paper mark detection	Check if the paper feeding is correct and stops at the paper mark or do the System Test screen – Recorder Test.	If the paper does not stop at the paper mark, clean the mark sensor.
Thermal head		
Print intensity	Check if there is any unevenly or incompletely printed part with the System Test screen – Recorder Test.	If there is any unevenly or incompletely printed part, do the following. • Clean the thermal head with a thermal head cleaner pen. • Readjust the thermal head attachment. • Replace the thermal head.
Baseline width	Check if the baseline width is 1 mm or less with the System Test screen – Recorder Test.	If the baseline width is more than 1 mm, do the following. • Replace the thermal head. • Replace the ECG control board.
Missing dots	Check if there are any missing dots with the System Test screen – Recorder Test.	If there are any missing dots, do the following. • Clean the thermal head with a thermal head cleaner pen. • Readjust the thermal head attachment. • Replace the thermal head.

Safety

Item	Check Procedure	Action
Power Cord	Check that a 3-prong power cord which has three terminals (hot, neutral and ground) is used.	If the 3-prong power cord is not used, replace it.
Power Cord and Connection Cable	Check if the power cord or connection cable is damaged.	If the power cord or connection cable is damaged, replace it.
Equipotential Grounding	Check if the cardiograph is grounded to a dedicated equipotential ground terminal in the facility.	If the cardiograph is not grounded, use the provided ground cable to ground the system to a dedicated equipotential ground terminal.
Protective earth resistance	Check that the protective earth resistance is within 0.1 Ω of the prescribed range.	If the protective earth resistance is out of range, find the cause and reduce it to within range.
Earth leakage current	Check that the earth leakage current is within 500 μA of the prescribed range.	If the earth leakage current is out of range, find the cause and reduce it to within range.
Enclosure leakage current	Check that the enclosure leakage current is within 100 μA of the prescribed range.	If the enclosure leakage current is out of range, find the cause and reduce it to within range.
Patient leakage current	Check that the patient leakage current is within 10 μA of the prescribed range.	If the patient leakage current is out of range, find the cause and reduce it to within range.
Withstand voltage	Check that the cardiograph can withstand the following prescribed withstand voltage. - (A-a1): 1,500 V AC for one minute - (B-d): 1,500 V AC for one minute	If the cardiograph cannot withstand the prescribed voltage, find the cause and fix it.

Maintenance Check Sheet

Date: _____

Customer: _____

Customer Address: _____

Service Personnel: _____ Service Company: _____

Instrument Name: _____ Instrument Model: _____

Instrument Serial Number: _____ Hardware Revision: _____

Software Revision: _____

Overview	Instrument is not dirty, damaged or rusty.	Yes ☐	No ☐
	No peeling or tear on the operation panel	Yes ☐	No ☐
	Power key is not broken.	Yes ☐	No ☐
Input circuit	Patient cable is not dirty and damaged.	Yes ☐	No ☐
	The patient cable is not broken.	Yes ☐	No ☐
	The sensitivities and time constant are correct.	Yes ☐	No ☐
	AC filter and high-cut filter operate correctly.	Yes ☐	No ☐
Screen	Contrast and backlight brightness are correct.	Yes ☐	No ☐
	Battery charge lamp operate correctly.	Yes ☐	No ☐
	Waveform display and screen display are correct.	Yes ☐	No ☐
Power	AC power cord and DC power cord of the AC adapter are not frayed or damaged.	Yes ☐	No ☐
	Battery is fully charged.	Yes ☐	No ☐
Operation	Automatic ECG measurement function is correct.	Yes ☐	No ☐
	Electrode detachment detection function is correct.	Yes ☐	No ☐
	Instrument passes all check items in the System Test screen.	Yes ☐	No ☐
	QRS synchronization sound and system information sound are correct.	Yes ☐	No ☐
	System settings are correct and are saved correctly.	Yes ☐	No ☐
	Date and time setting are correct.	Yes ☐	No ☐
Safety	No current leakage. (Less than 500 microA between metal part and ground)	Yes ☐	No ☐
	Fuse rating is correct (AC adapter)	Yes ☐	No ☐
SD memory card and accessories			
	SD memory card operates correctly.	Yes ☐	No ☐
	Enough accessories	Yes ☐	No ☐

Section 4 Disassembly and Assembly

The procedures in this section explain how to remove, replace and install major components in the cardiograph.

Before You Begin

Warnings, Cautions and Notes

WARNING

- **Removal and replacement of any components in the cardiograph should only be done by qualified service personnel.**
- **To avoid the possibility of injury to yourself or damage to the cardiograph, do not install or remove any component while the power is on. When disassembling, make sure that the cardiograph is off (The power lamp and standby lamp do not light), the AC power cord is disconnected from the cardiograph and the battery pack is removed from the cardiograph.**
  There are several high voltage units inside the cardiograph: Inverter board, LCD backlight (LCD display) and switching regulator (power unit).

CAUTION

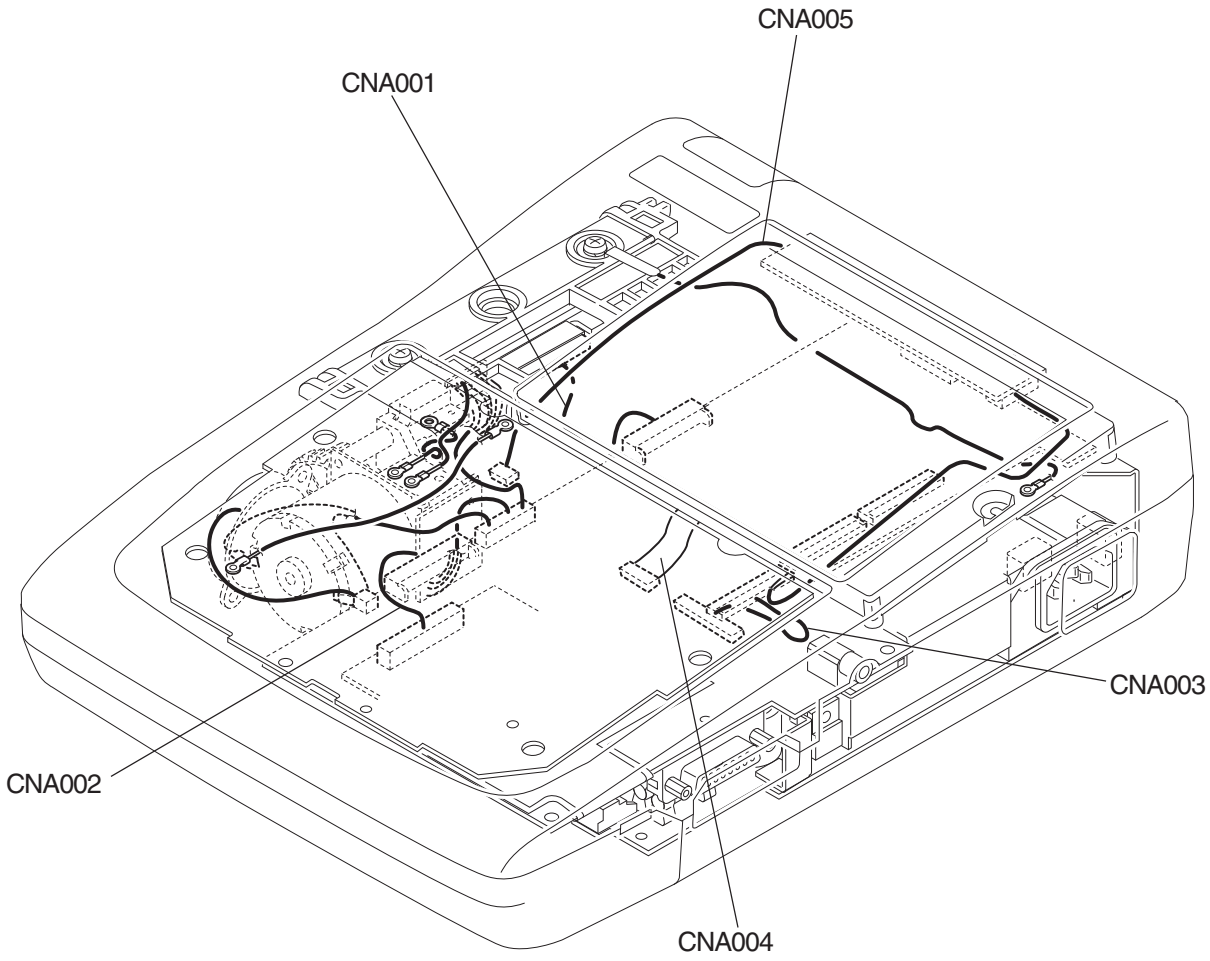
- **To avoid accidental discharge of static electricity which could damage the components of the cardiograph, use a grounded wrist strap when installing or removing any component of the cardiograph.**
- **Use only parts recommended by Nihon Kohden to assure maximum performance from your cardiograph.**

Required Tools

- Anti-static bench mat
- Wrist ground strap
- Phillips screwdriver (insulated type, for M3 and M4 screws)
- Hexagon socket driver (for 3 mm spacer bolt and nut)
- Torque wrench (for 4 mm hexagon socket head bolt)
- Allen wrench
- Tweezers

Connection Diagram

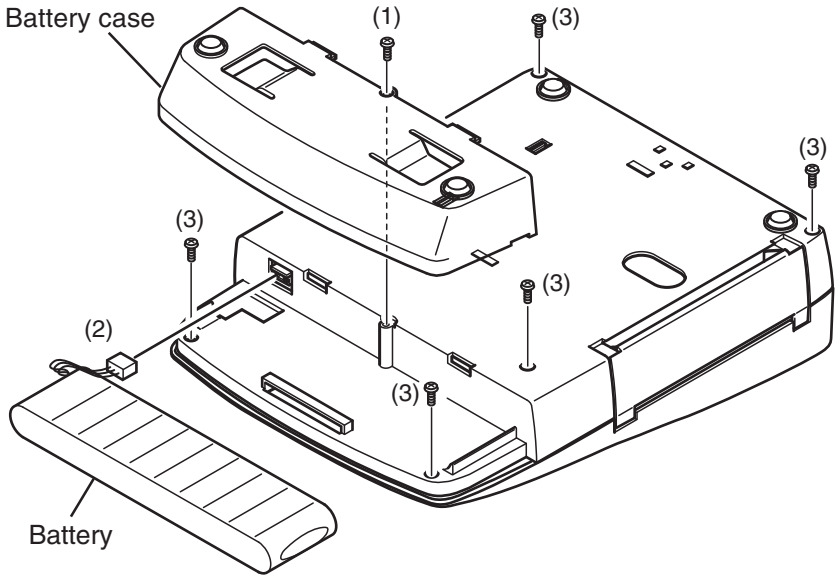
Connector No.	NK Code No.	Description
CNA001	691093	PHDR-26VS(W52) with core
CNA002	691084	PHDR-28VS(W30)
CNA003	690717	SML2CD-50x160-BDx6BL-P05-S4M-
CNA004	690789	SML2CD-20x45-ADX6BL-P05-S4-M-
CNA005	695204	51021-0500(W165)



Removing the Top Case

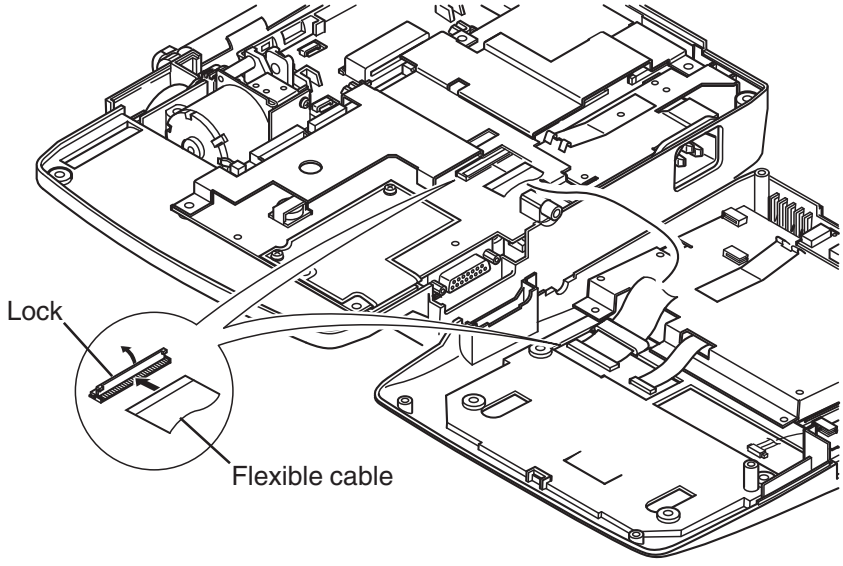
1. Turn the unit over, remove the screw (BH3 × 8) at (1), remove the battery case, disconnect the cable (2) from the bottom case and then remove the battery.

2. Remove the 5 screws (BH3 × 8) at (3).



3. Open the top case carefully because the top case and the bottom case are connected with a flexible cable.

4. As shown in the expanded view, release the connector lock, disconnect the flexible cable and separate the top case from the bottom case.



Attaching the Top Case

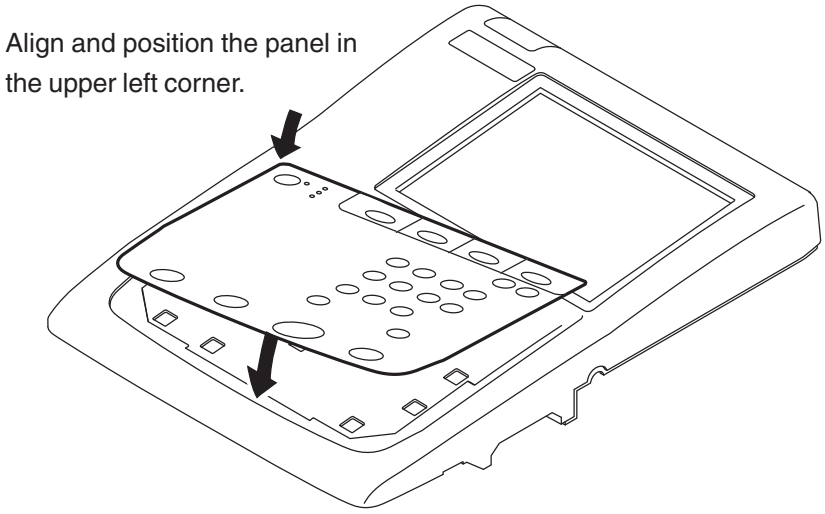
To reattach the top case, reverse the above procedure.

Removing the Key Board

1. Remove the top case and peel off the key panel full from the front surface. Refer to the “Removing the Top Case”.

NOTE

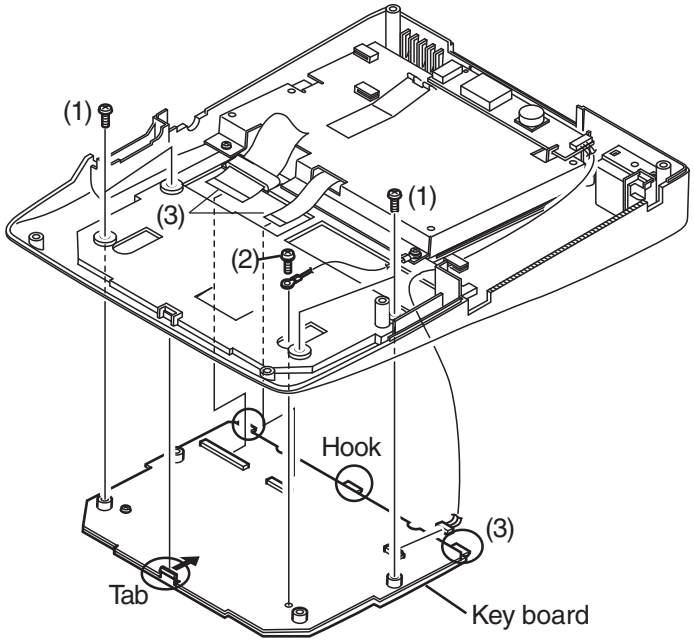
The key panel full cannot be reused. When repairing, prepare a new panel. When attaching the panel, it is easiest to stick it on by aligning it with the upper left corner as shown in the illustration.



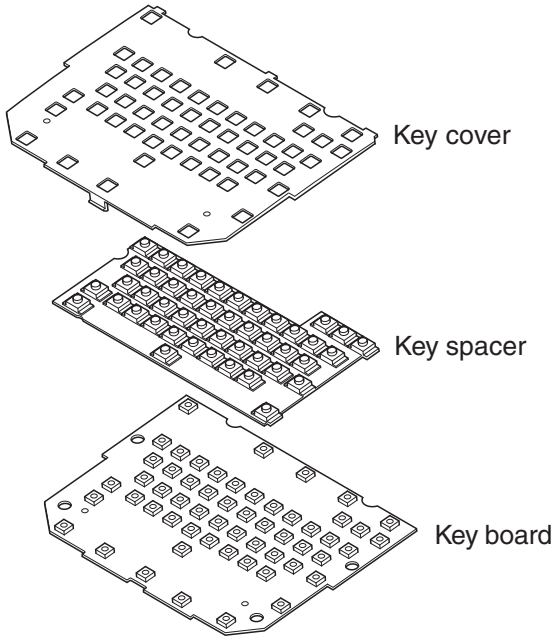
2. Turn over the top case and remove the 4 screws (BH3 × 8) at (1) and the one screw (PS3 × 6) at (2).

3. Disconnect the 3 cable connectors shown at (3).

4. Remove the key cover, key spacer and key board all together from the top case. Be careful with the hook.

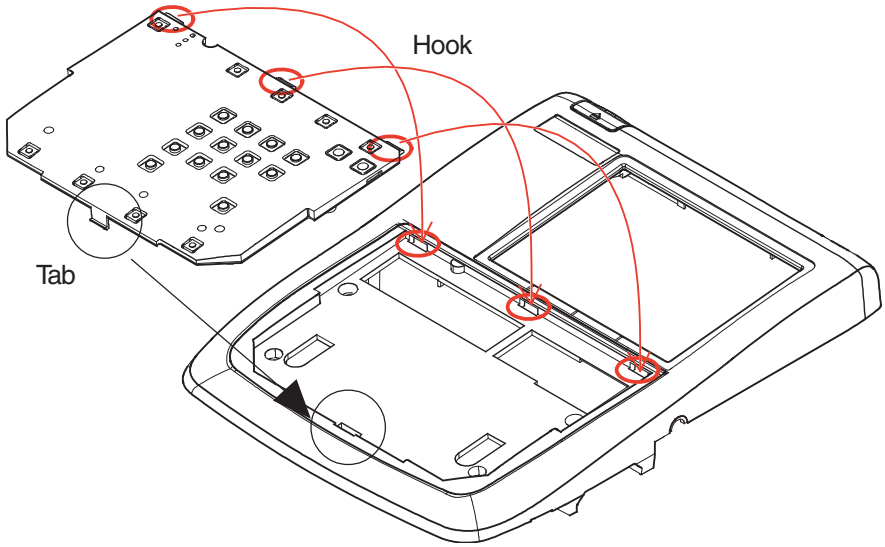


5. Separate the layered key cover, key spacer and key board.



Attaching the Key Board

To reattach the key board (including key cover and key spacer), reverse the above procedure. When attaching the key board to the top case, align the hooks first and insert the tab.

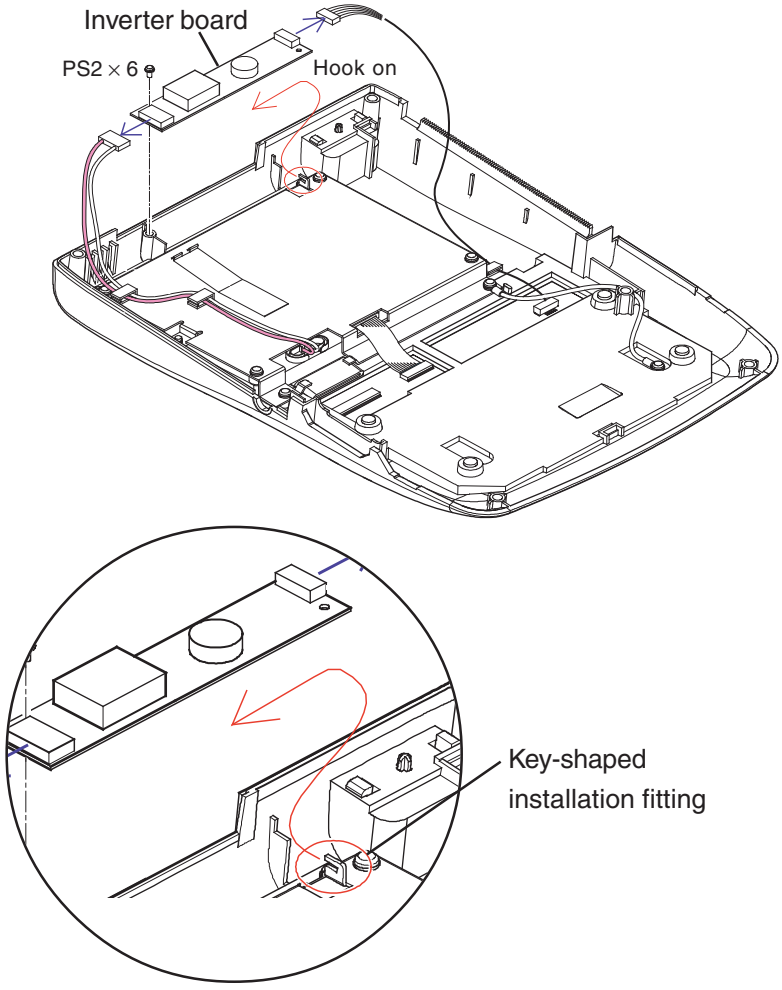


Removing the Inverter Board

1. Remove the top case and turn it over. Refer to the “Removing the Top Case” in this section.

2. Disconnect the 2 cables from the inverter board.

3. Remove the one screw (PS2 × 6) and slide the unit to the left, removing it from the key-shaped installation fitting.



Attaching the Inverter Board

To reattach the inverter board, reverse the above procedure. Hook the edge of the unit on the key-shaped installation fitting and fasten it with the screw (PS2 × 6).

NOTE

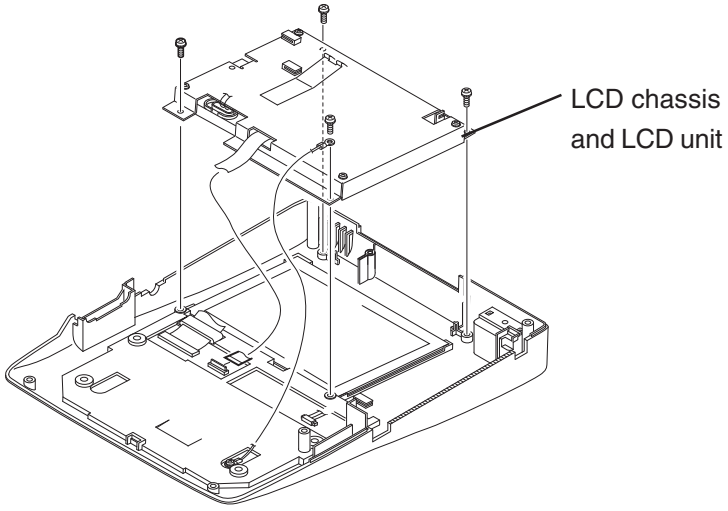
When attaching the inverter board, take care not to touch any parts around the screw hole. It may damage the board.

Removing the LCD Unit

1. Remove the inverter board. Refer to “Removing the Inverter Board” in this section.

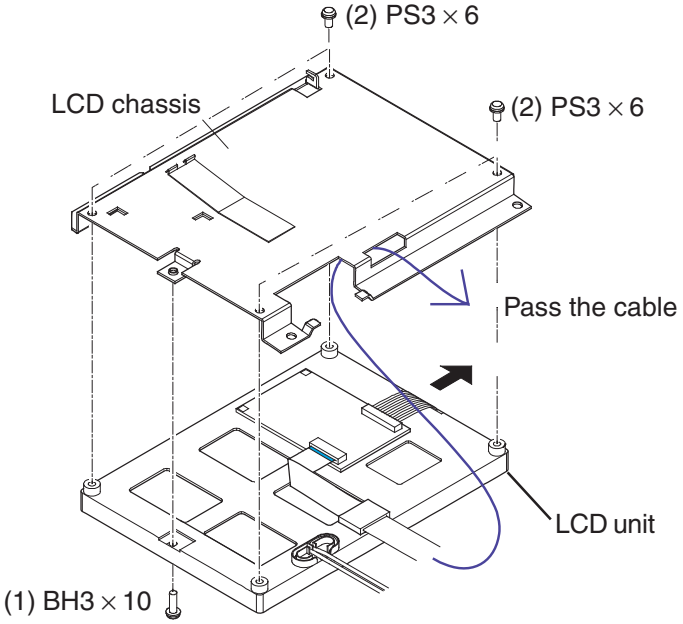
2. Remove the four screws (PS3 × 6) that hold the LCD chassis to the top case.

3. Remove the LCD chassis and the LCD unit together.



4. Remove the one screw (BH3 × 10) at (1) from the LCD side that fastens the LCD chassis and the LCD unit.

5. Remove the four screws (PS3 × 6) at (2) on the LCD chassis side that fasten the LCD unit and then separate the LCD unit and the LCD chassis.



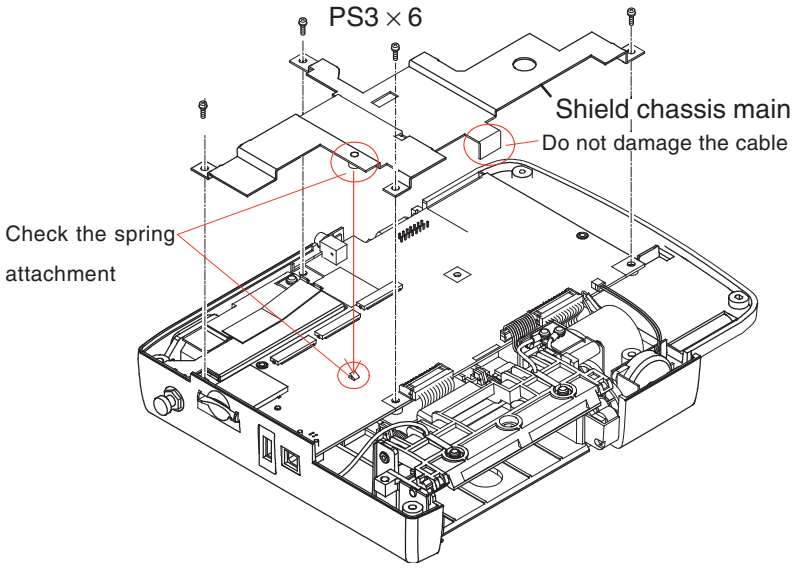
Attaching the LCD Unit

When attaching the LCD unit, pass the cable sticking out from the LCD unit through the cutout in the LCD chassis as shown in the figure and reverse the above procedure.

Removing the Main Board

1. Remove the top case from the bottom case. Refer to the “Removing the Top Case” in this section.

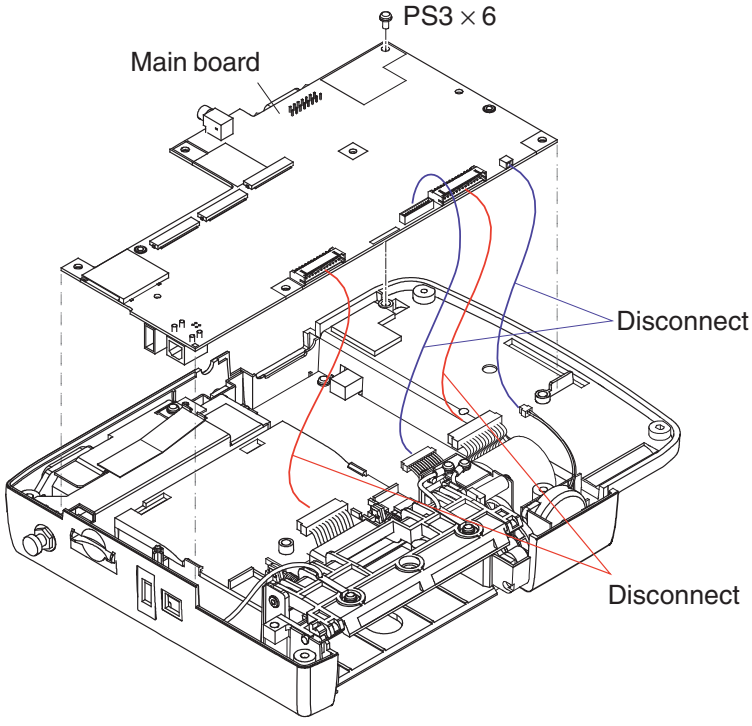
2. Remove the four screws (PS3 × 6) that hold the shield chassis main to the bottom case.



3. Remove the four cables from the main board.

4. Remove the one screw (PS3 × 6) from the main board side.

5. Remove the main board.



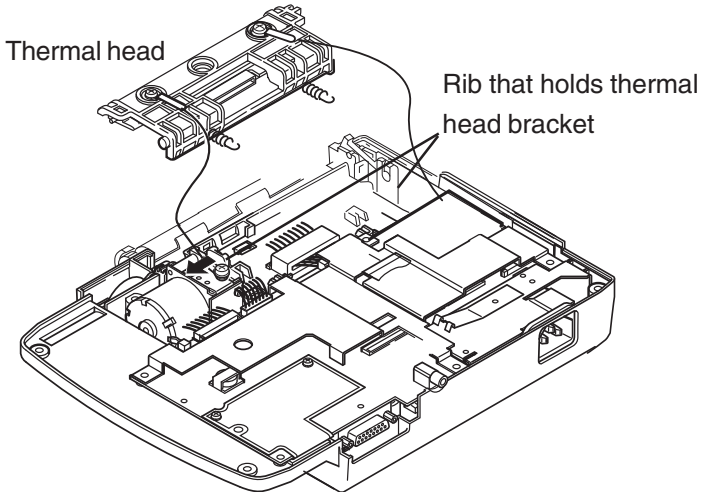
Attaching the Main Board

To reattach the main board, reverse the above procedure.

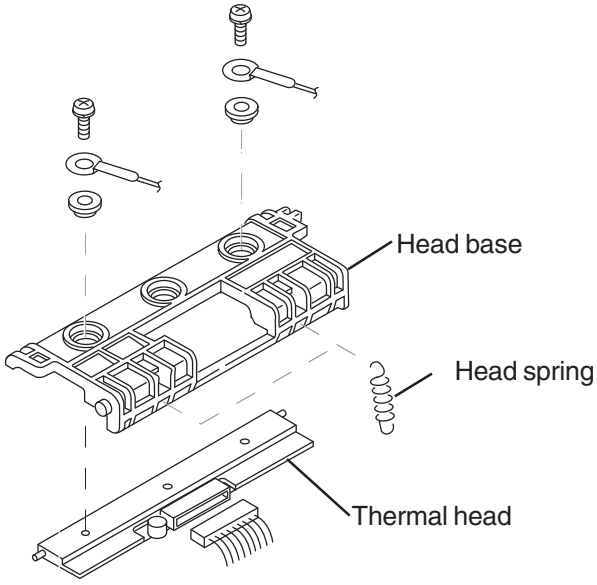
Removing the Thermal Head

1. Remove the top case. Refer to the “Removing the Top Case”.

2. Pull the rib that holds the thermal head bracket to outside and remove the head.



3. Remove the two screws (PS3 × 8) and remove the thermal head from the head base.



Attaching the Thermal Head

1. Attach the head base to the thermal head.

2. Attach the thermal head to the top case. Be careful not to break the metal plate of the paper board earth plate.

3. After attaching the thermal head, hook the head spring.

NOTE

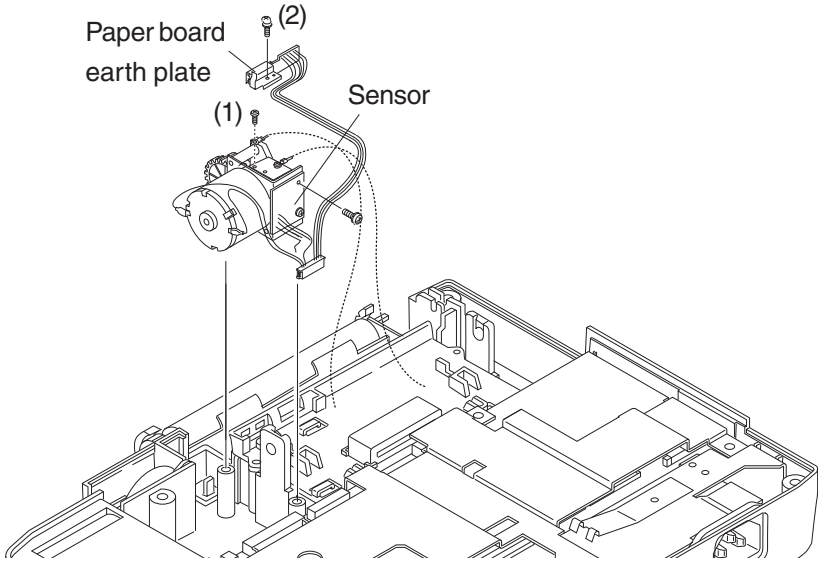
When replacing the thermal head, be sure to check the impedance value (print level) written on the head (KPC-108-8TA01-SKH) unit and then adjust the print level by referring to “Adjusting the Recording Darkness” in Section 3.

Removing the Motor Assy

1. Remove the top case. Refer to “Removing the Top Case”.

2. Remove the thermal head. Refer to “Removing the Thermal Head”.

3. Remove the one screw (BH3 × 8) at (1) and the connector and remove the motor assy. The paper board earth plate is not included in the motor assy.



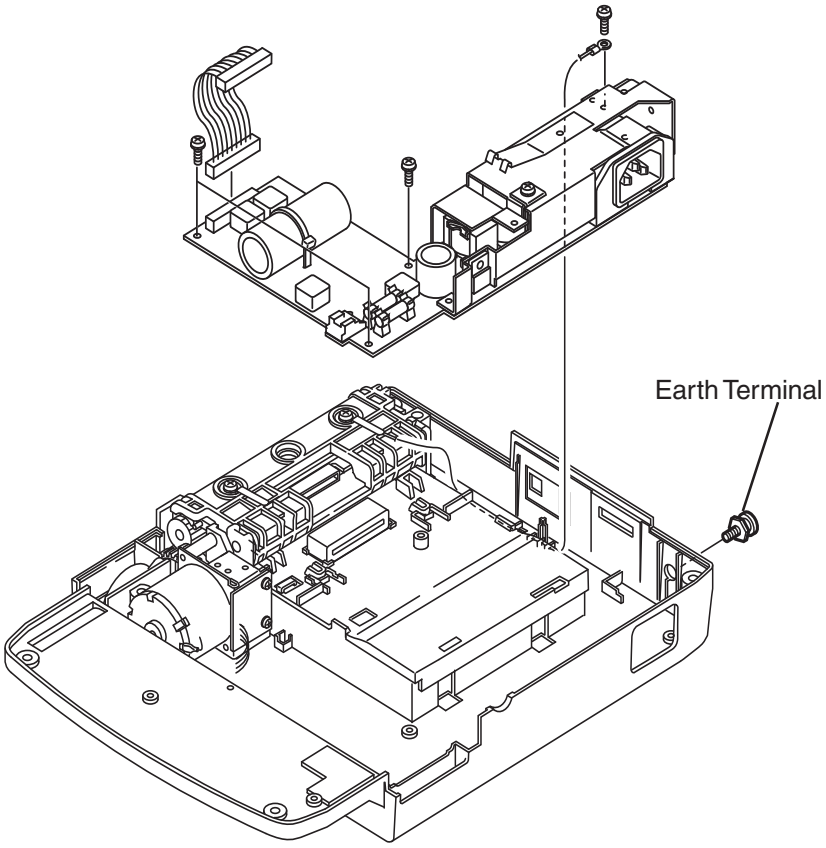
4. Remove the one screw (PS2 × 4) at (2) and remove the paper board earth pan.

Attaching the Motor Assy

To reattach the motor assy, reverse the above procedure.

Removing the Power Board

1. Remove the top case. Refer to “Removing the Top Case”.
2. Remove the main board. Refer to “Removing the Main Board”.
3. Remove the earth terminal.
4. Remove the four screws (PS3 × 6) and then remove the cable.
5. Holding the power board on the thermal head side, remove it while it is tilted.

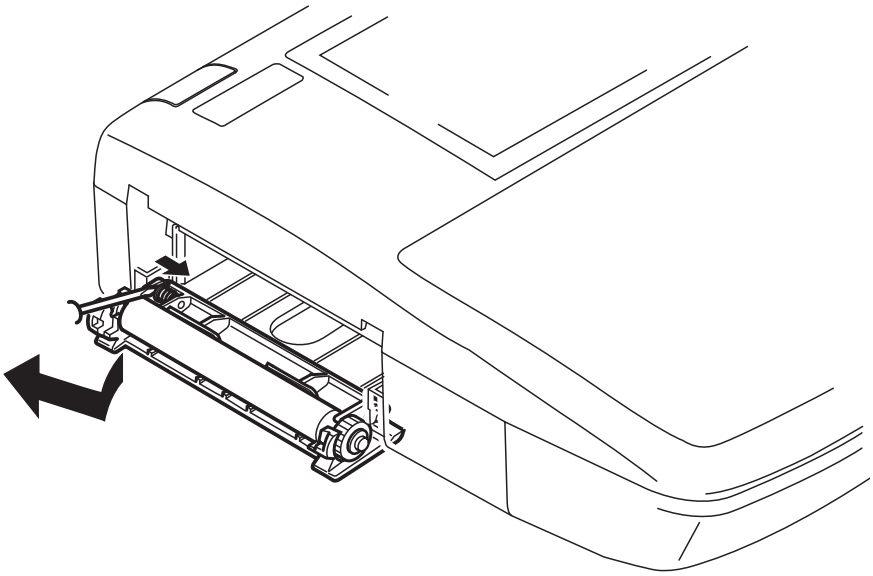


Attaching the Power Board

To reattach the power board, reverse the above procedure.

Removing the Magazine Assy

Press the E-ring in the direction of the arrow as in the illustration and then pull the magazine assy toward you and remove it.



Attaching the Magazine Assy

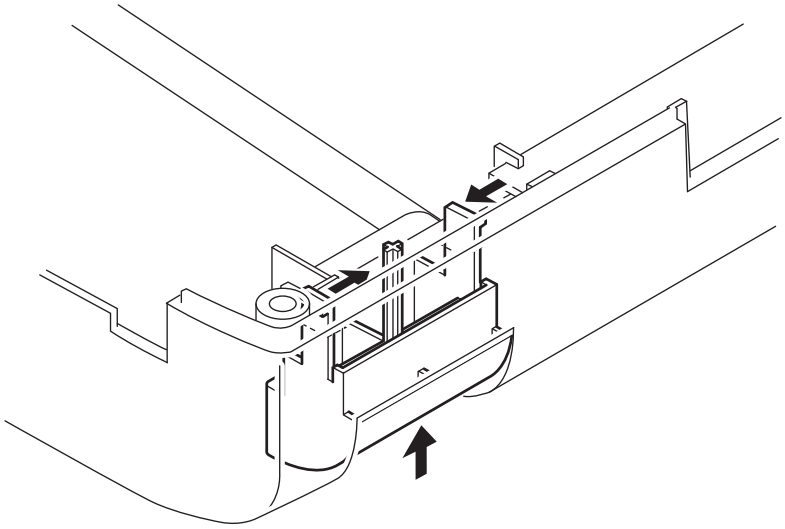
Press the E-ring in the direction of the arrow as in the illustration and reattach the magazine assy.

Removing the Open Button

1. Remove the top case and turn it over. Refer to “Removing the Top Case” in this section.

2. Press the open button on the back of the top case. By pressing the hooks together, remove the key-shaped part from the top case.

3. Remove the open button. Take care that the spring on the inside does not pop out.

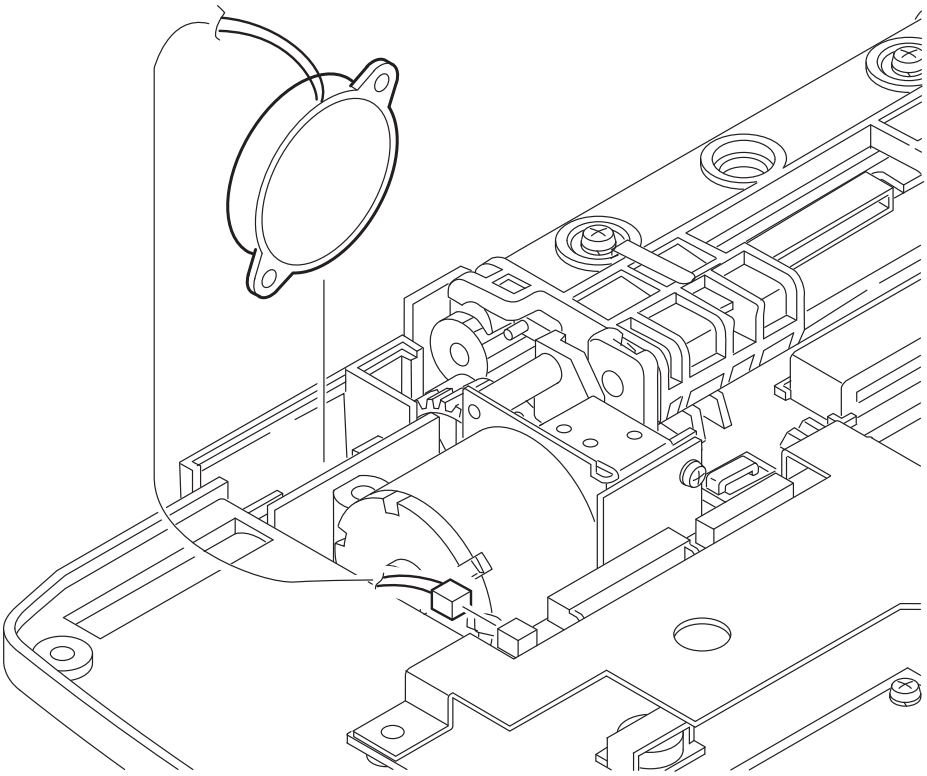


Attaching the Open Button

To reattach the open button, reverse the above procedure.

Removing the Speaker

Disconnect the cable of the speaker from the main board and remove the speaker.

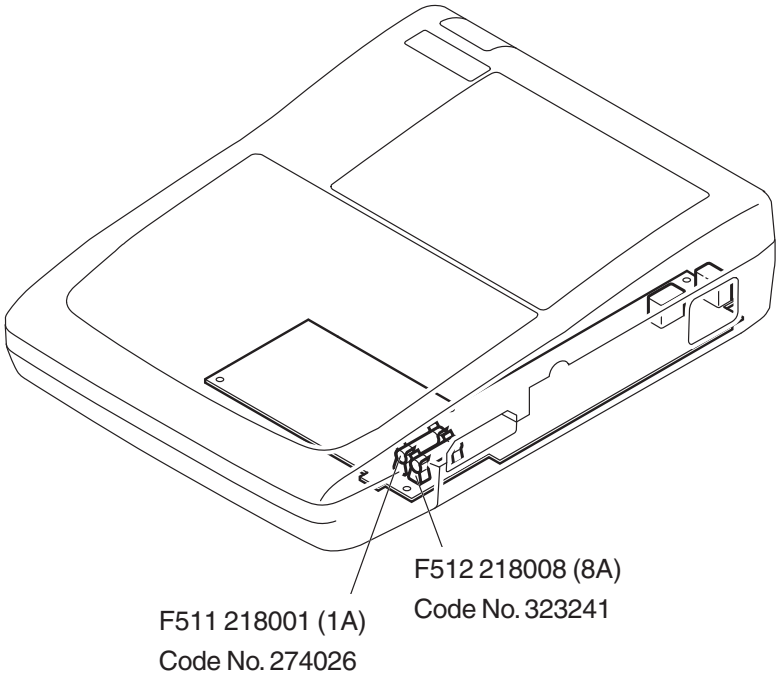


Attaching the Speaker

To reattach the speaker, reverse the above procedure.

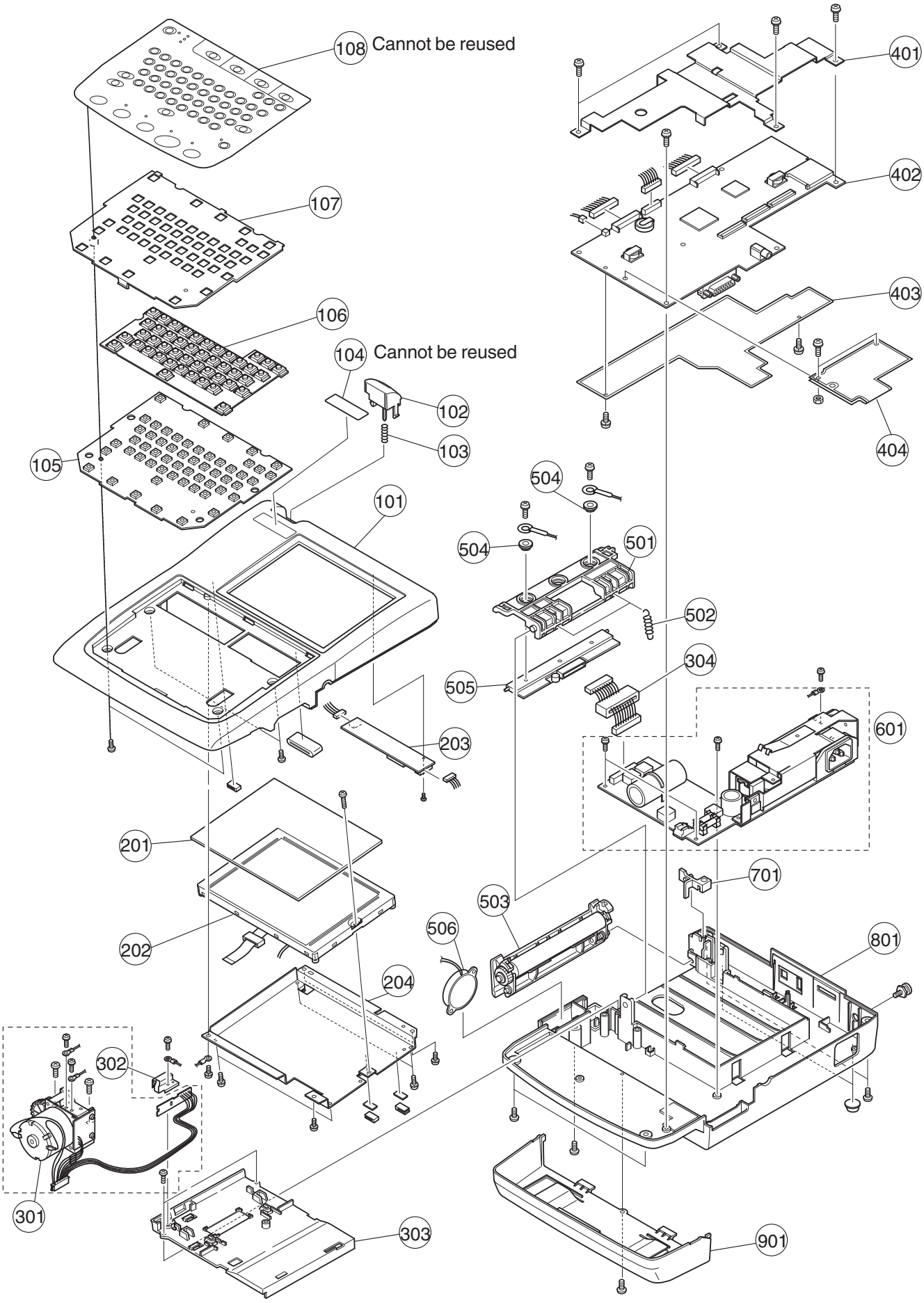
The Fuse Locations

There are two battery charge-discharge fuses on the power board.



Section 5 Replaceable Parts List

No.	Code No.	Q'ty	Description
101	6111-900472C	1	Top case 110
102	6113-902065C	1	Open button
103	295422A	1	Spring C139
104	6124-900465A	1	ECG-1250 Logo mark panel
106	6112-901103A	1	Key spacer full
107	6112-901531B	1	Key cover full
108	6122-900273C	1	Key panel full
201	6114-903561B	1	LCD filter 110
202	912514	1	LCD unit
203	669599	1	Inverter board
204	6112-900773B	1	LCD chassis 110
302	6114-088308A	1	Paper board earth plate
303	6112-900755B	1	Recorder base
304	691093A	1	Cable connecting main board and thermal head, PHDR-26VS (W52)
401	6112-901585B	1	Shield chassis main
403	6113-902109B	1	Shield sheet ECG
404	6113-902118B	1	Shield sheet digital
501	6112-901246B	1	Head base
502	6114-088291A	2	Head spring 046
504	6114-097094	2	Head collar bearing
505	691823	1	Thermal head, KPC-108-8TAO1-SKH
506	910285	1	Speaker, PKM34EWH/ZHR-2 (W80)
701	6113-902163B	1	Open lever
801	6111-900463C	1	Bottom case 110
901	6112-900764B	1	Battery cover 110
105	UT-24162	1	Key board full
301	GC-0017	1	Motor assy
402	UT-24151	1	Main board
503	RH-0005	1	Magazine assy
601	UT-2417	1	Power board


108 Cannot be reused
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