

SERVICE MANUAL

cardiofax Q **ELECTROCARDIOGRAPH**

ECG-9110K, ECG-9130K
ECG-9130P, ECG-9132K

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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, requirements, alternative methods or supplemental information.





















Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.
















Cardiograph

 Attention, consult operator's manual	 Input terminal for analog signal	 Type CF applied part
 Equipotential terminal	 Output terminal for analog signal	 The CE mark is a protected conformity mark of European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.
 Serial input/output terminal	 Eject (magazine release button)	
 Battery	 Memory card slot	


Operation panel (for ECG-9110K only)

 Alternating current	 Rhythm recording	 Filter
 “On” only for a part of equipment	 Age	 Copy
 “Off” only for a part of equipment	 Paper speed	 Calibration
 Battery charging	 Gain	 START/STOP recording
 Battery check lamp	 Reset	 Automatic control
 QRS sync lamp	 Paper feed	 Manual control
 Periodic recording	 Mark	



Operation panel (for ECG-9130K only)

 Alternating current	 Mode	 Copy
 “On” only for a part of equipment	 Rhythm	 Calibration
 “Off” only for a part of equipment	 Paper feed	 START/STOP recording
 Battery charging	 Mark	 Automatic control
 Battery check	 Filter	 Manual control

Display (for ECG-9130K only)

 QRS sync mark

Patient cable

 Attention, consult operator’s manual	 Defibrillation-proof Type CF applied part
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Introduction

This service manual provides useful information to qualified service personnel to understand, troubleshoot, service, maintain and repair the ECG-9110K, ECG-9130K/P and ECG-9132K Electrocardiograph (referred to in this service manual as “the instrument”, “ECG-9110K” or “ECG-9130K” which includes ECG-9130P and ECG-9132K).

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 “System Test and Setting” and “Adjustment” sections in this service manual describe the maintenance that should be performed by qualified service personnel. The “Maintenance” section in the operator’s manual describes the maintenance that can be performed by the user.

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.

Service Policy

Nihon Kohden Corporation's basic policy for technical service is to replace faulty units, printed circuit boards or parts. We do not support component-level repair of boards and units outside the factory for the following reasons:

- A special facility is necessary to repair multi-layer boards because most of the components on the board are SMD (surface mount devices) and most of the circuits employ a gate array method.
- To fulfill safety certification requirements, a special facility is necessary to verify safety as medical equipment after the power unit is repaired.

NOTE

- **When ordering parts or accessories from your nearest Nihon Kohden Corporation's distributor, please quote the NK 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	10 M Ω or more
Electrode offset tolerance	± 500 mV or more
Input unit protection	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
Standard sensitivity	10 mm/mV $\pm 2\%$
Common mode rejection ratio	100 dB or more
Frequency response	0.05 to 150 Hz -3 dB or more

Waveform data processor

Sample rate	500 samples/s (input unit: 8,000 samples/s)
AC line filter	50/60 Hz
High-cut filter	75, 100, 150 Hz
EMG filter	25/35 Hz
Time constant	3.2 s or more
Waveform status detection	Electrode detachment (polarization voltage), Noise (high frequency)

LCD (monochrome with CCFT backlight) (for ECG-9130K/P, ECG-9132K only)

Size	5.6 inch
Number of dots	320 \times 240
ECG waveform	2.8 seconds simultaneous 12 lead ECG waveforms
Displayed data	Waveform, patient information, recording settings, operation mode, heart rate, QRS sync mark, error message, electrode detachment, noise, patient information, hospital name

Recorder

Printing method	High resolution thermal printer head
Printing density	200 dpi (8 dots/mm)
Scanning line density	1 ms 2 ms at paper speed 50 mm/s
Recording width	210 mm
Number of recording channels	3, 4, 6, 12
Sensitivity selection	1.25*, 2.5*, 5, 10, 20 mm/mV *Automatically selected in automatic recording only
Paper speed	5, 10, 12.5, 25, 50 mm/s
Printed data	Program type, version, date and time, paper speed, sensitivity, lead name, filter, hospital name**, patient information**, timing mark, event mark, electrode detachment, noise, RESET mark* *Printed only when ECG-9110K is used **Printed only when ECG-9130K is used
Mechanical noise	48 dB or less at paper speed 25 mm/s

1. GENERAL

External input/output

External input	10 mm/0.5 V $\pm 5\%$, input impedance 100 k Ω or more, 2 channel
Signal output	0.5 V/1 mV $\pm 10\%$, output impedance 100 Ω or less
Serial I/O	Communication method: RS-232C
	Baud rate: 2400, 4800, 9600, 19200, 38400, 57600, 115200

Power requirement

Line voltage	100 to 127V, 220 to 240V AC $\pm 10\%$
Line frequency	50 or 60 Hz
Power input	Up to 150 VA
Power consumption	60 W or less
Built-in battery	Voltage: 12 V
(LCT-1912ANK)	Current consumption: 8 A or less
	Battery operation time: Approx. 30 minutes

Environment

Operating temperature	10 to 40°C (50 to 104 F)
Operating humidity	25 to 90% RH
Operating atmospheric pressure	70 to 106 kPa
Storage duration and temperature	2 weeks or less: -20 to 60°C (-4 to 140 F)
(Depends on the battery)	Between 2 weeks and one year: -15 to 40°C (5 to 104 F)
	Over one year: -15 to 25°C (5 to 77 F)
Storage humidity	15 to 95% RH (non condensing)
Storage atmospheric pressure	70 to 106 kPa
Recording paper storage temperature	-20 to 50°C (-4 to 122 F)
Recording paper storage humidity	25 to 80% RH
Electromagnetic compatibility	IEC60601-1-2
	CISPR11 Second Edition 1990-1999 Group 1 Class B
Other	Indoor portable

Dimensions and weight

Dimensions	240 W \times 104 H \times 324 D mm (excluding protrusions)
Weight	ECG-9110K: Approx. 3.8 kg (without battery)
	ECG-9130K: Approx. 4.2 kg (without battery)
	ECG-9130P: Approx. 4.2 kg (without battery)
	ECG-9132K: Approx. 4.2 kg (without battery)

Safety

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)

Type of protection against electric shock:

AC power: Class I

Battery power: Internally powered equipment

Degree of protection against electric shock:

Defibrillator proof type CF applied part when patient cable BJ-901D, BJ-902D or BJ-903D is used

Degree of protection against harmful ingress of water:

Ordinary equipment

Degree of safety of application in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide:

Not suitable for use in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide

Mode of operation:

Continuous

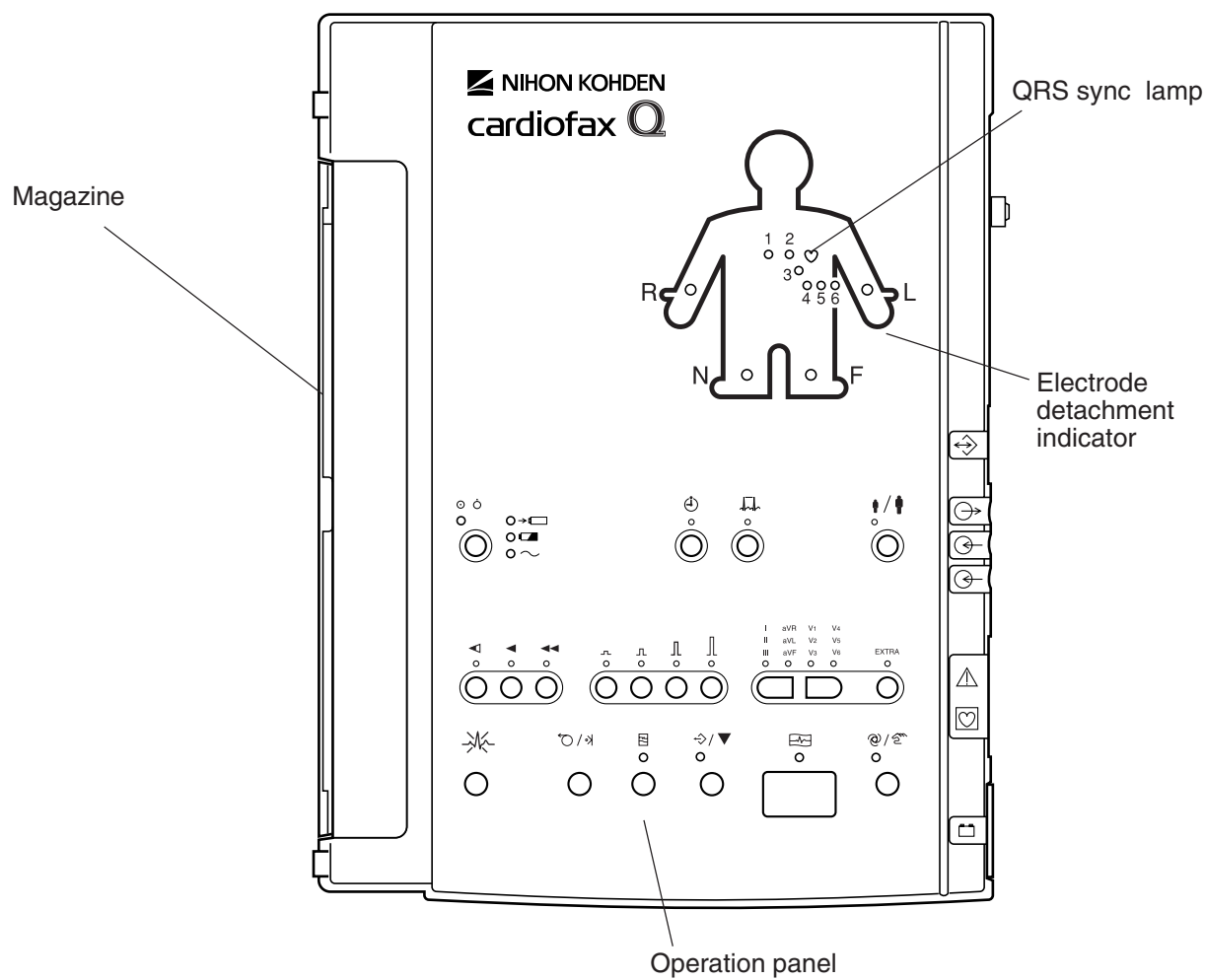
Performance

Performance standard: IEC 60601-2-51 (2003)

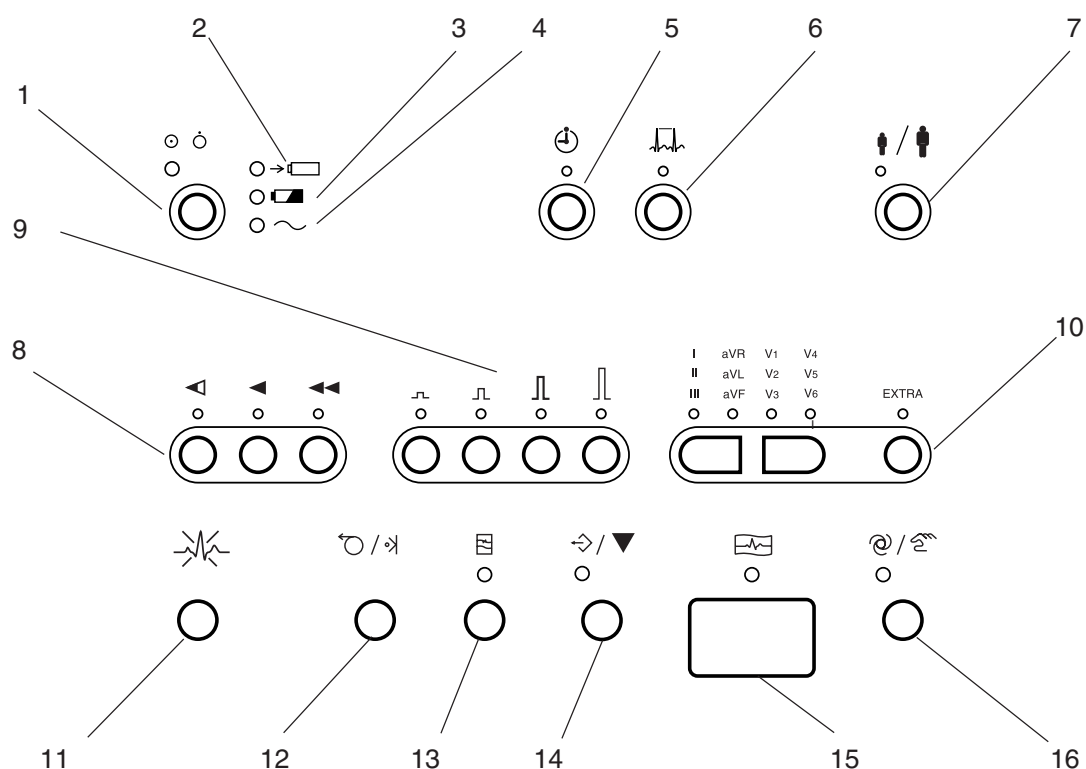
Panel Description

ECG-9110K Electrocardiograph

Top Panel




Operation Panel

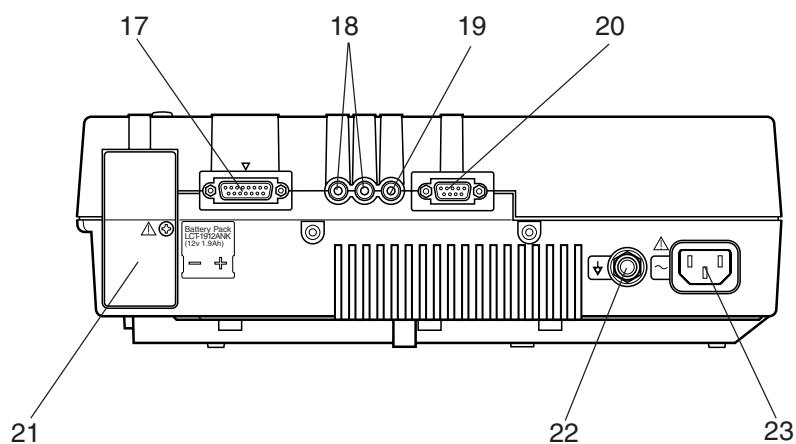


Name

1. POWER key
2. Battery charge lamp
3. Battery operation lamp
4. AC power lamp
5. PERIODIC key/lamp
6. RHYTHM key/lamp
7. AGE key/lamp
8. SPEED key/lamp
9. GAIN key/lamp
10. LEAD keys/lamp
11. RESET key
12. FEED/MARK key
13. FILTER key/lamp
14. COPY/CAL key/lamp
15. START/STOP key/lamp
16. AUTO/MANUAL key/lamp

Right Side Panel

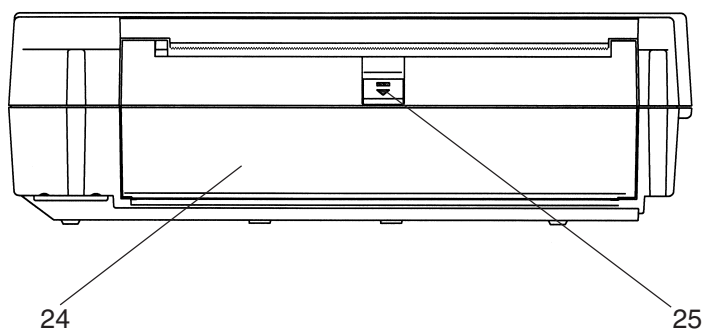
For the  mark, refer to the descriptions for the Right Side Panel in Section 1 “Panel Descriptions” of the ECG-9110K Operator’s Manual.



Name

- 17. Patient input connector
- 18. EXT-IN 1, 2 connector
- 19. CRO-OUT connector
- 20. SIO connector
- 21. Battery compartment
- 22. Equipotential ground terminal
- 23. AC power cord socket

Left Side Panel

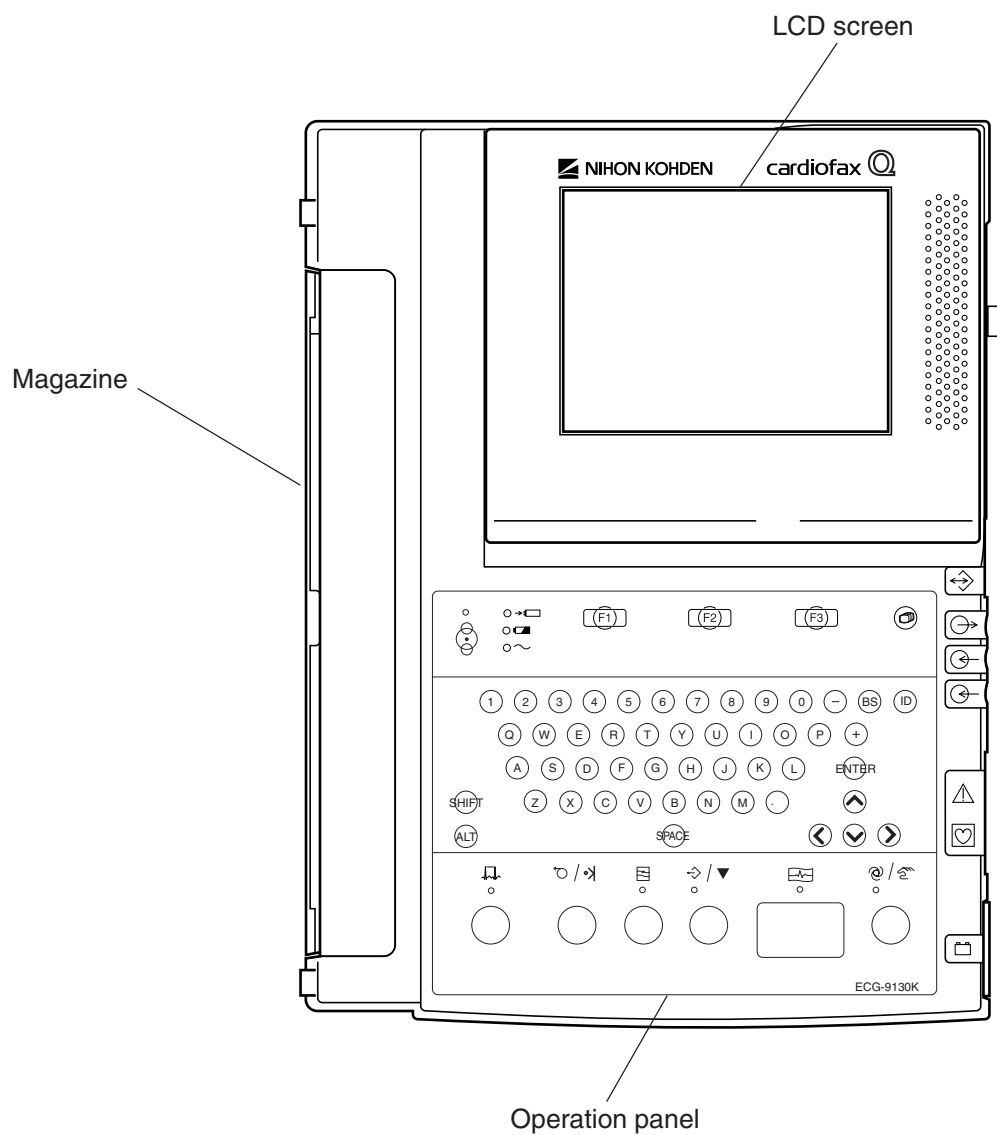


Name

- 24. Magazine
- 25. Magazine release button

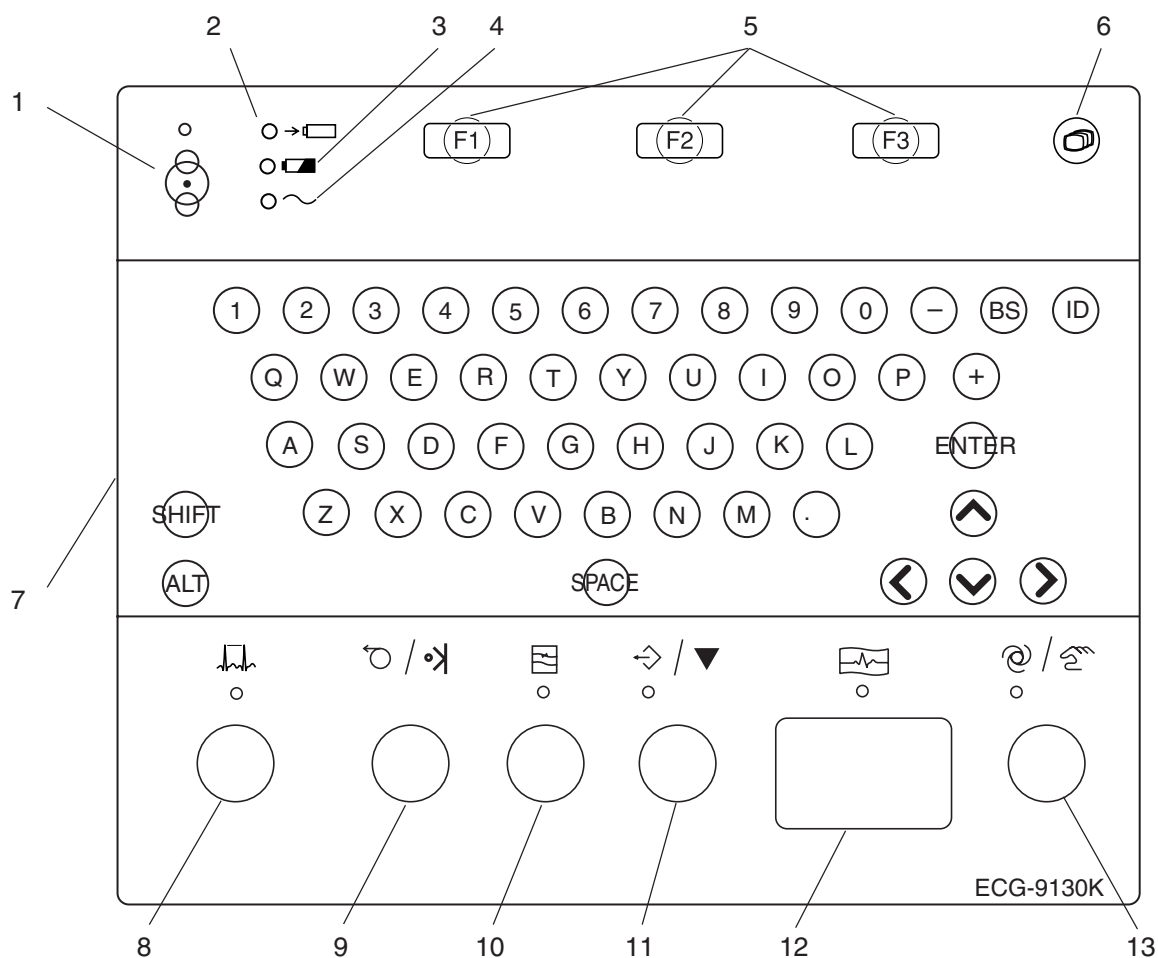
ECG-9130K/P Electrocardiograph

Top View



The keyswitches on the ECG-9130P have a name label instead of the symbol.

Operation Panel

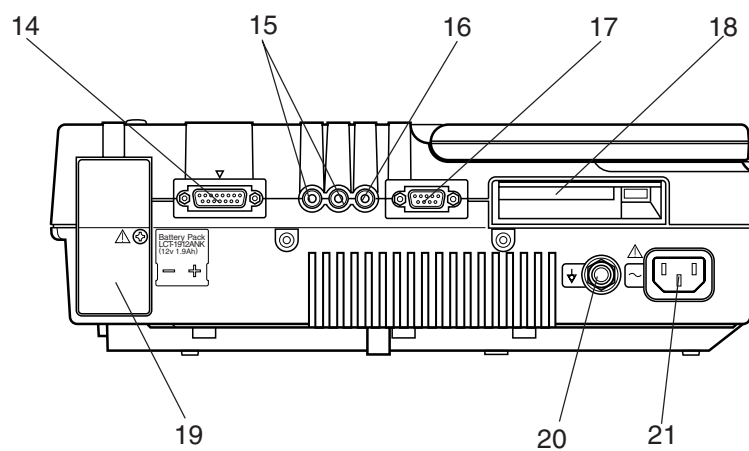


Name

1. POWER key/lamp
2. Battery charge lamp
3. Battery operation lamp
4. AC power lamp
5. F1, F2, F3 function keys
6. MODE key
7. Keyboard
8. RHYTHM key/lamp
9. FEED/MARK key
10. FILTER key/lamp
11. COPY/CAL key/lamp
12. START/STOP key/lamp
13. AUTO/MANUAL key/lamp

Right Side Panel

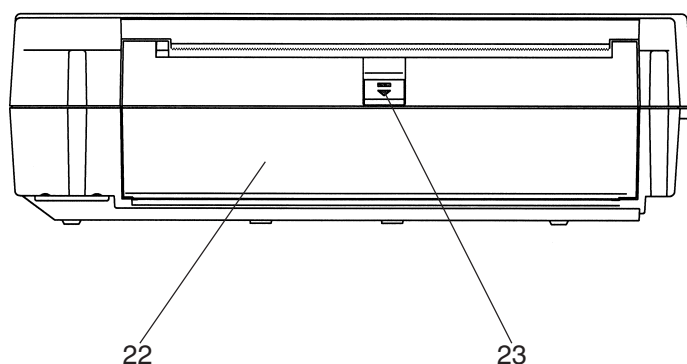
For the  mark, refer to the descriptions for the Right Side Panel in Section 1 “Panel Descriptions” of the ECG-9130K or 9130P Operator’s Manual.



Name

- 14. Patient input connector
- 15. EXT-IN 1, 2 connector
- 16. CRO-OUT connector
- 17. SIO connector
- 18. Memory card slot
- 19. Battery compartment
- 20. Equipotential ground terminal
- 21. AC power cord socket

Left Side Panel

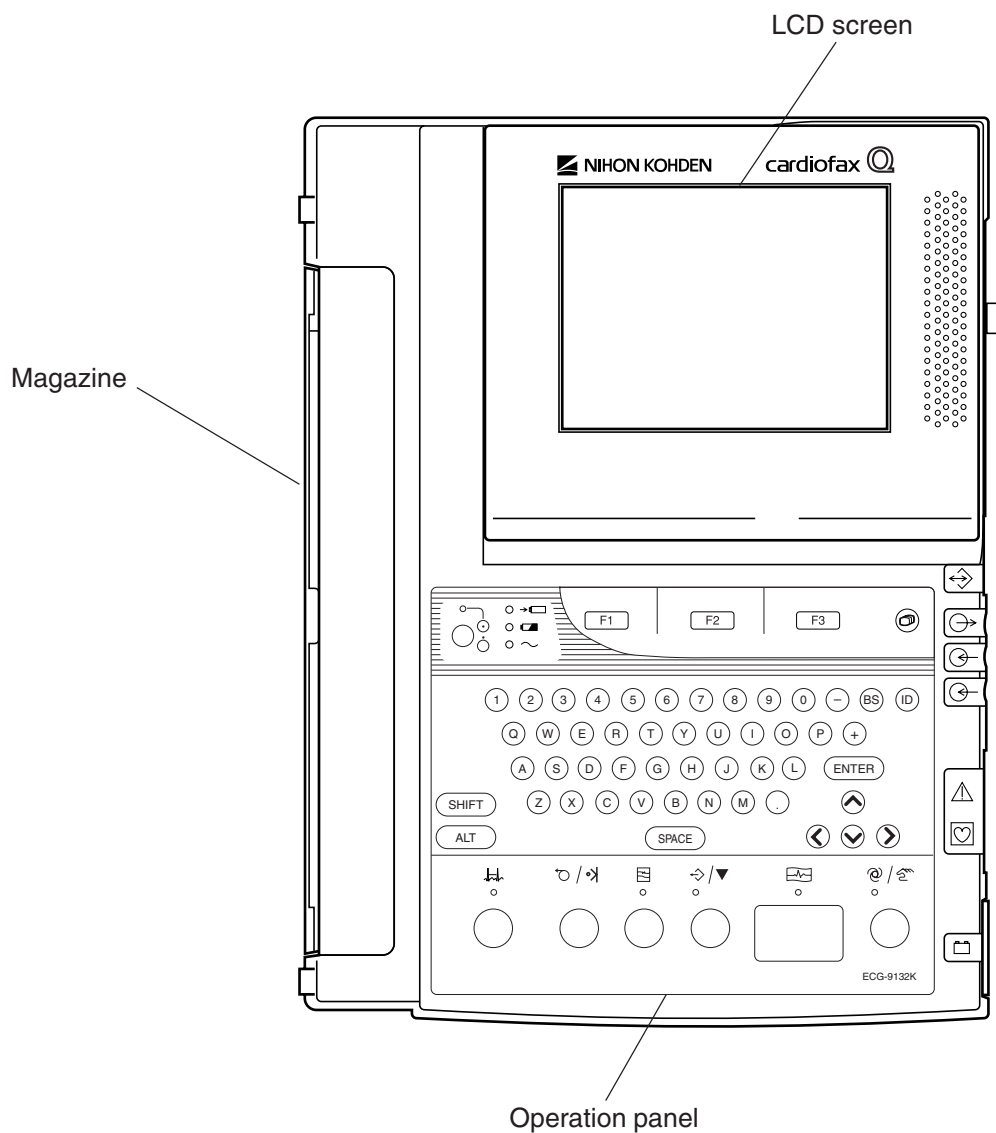


Name

- 22. Magazine
- 23. Magazine release button

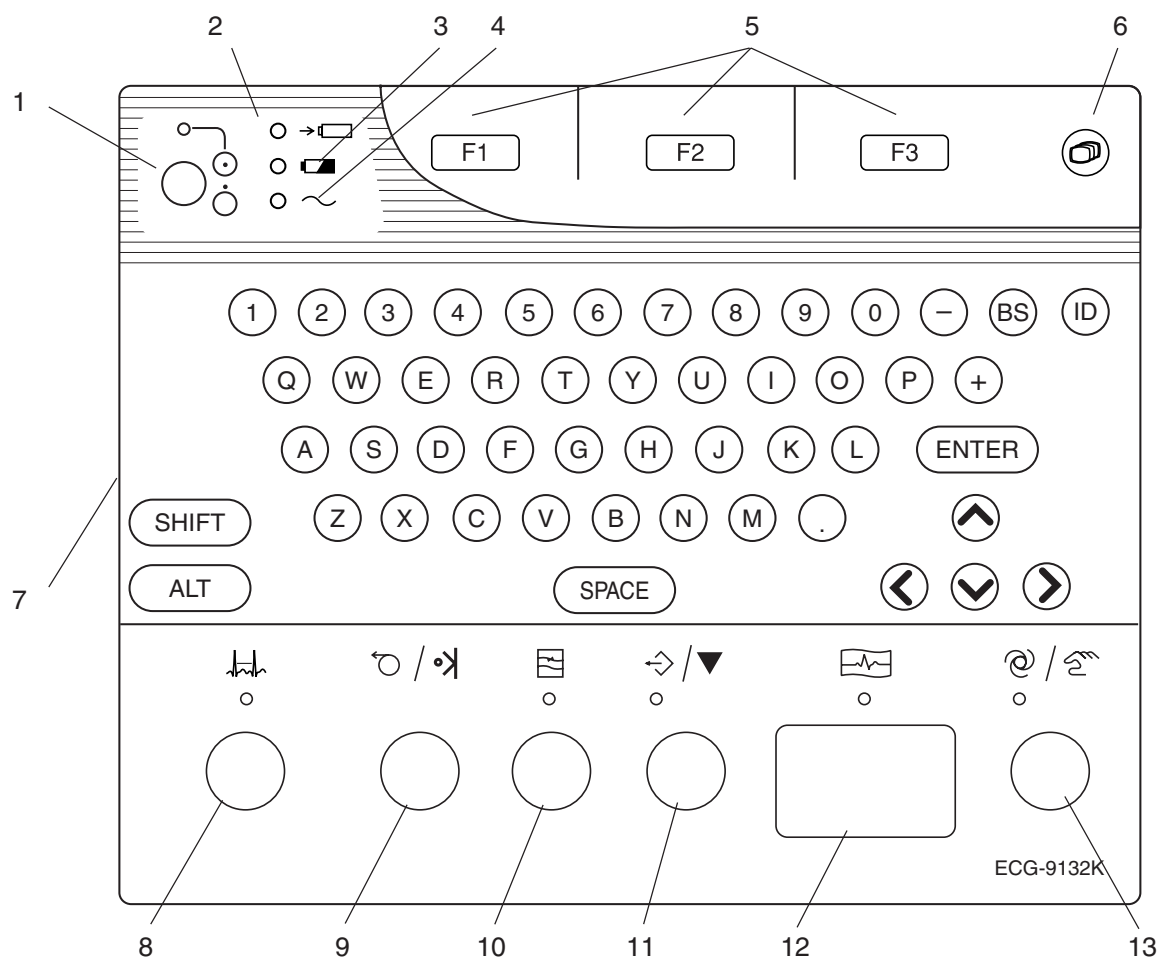
ECG-9132K Electrocardiograph

Top View



The keyswithes on the ECG-9130P have a name label instead of the symbol.

Operation Panel

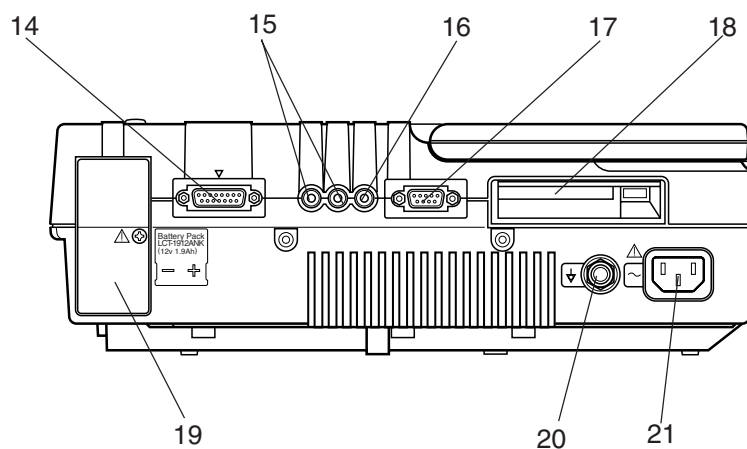


Name

1. POWER key/lamp
2. Battery charge lamp
3. Battery operation lamp
4. AC power lamp
5. F1, F2, F3 function keys
6. MODE key
7. Keyboard
8. RHYTHM key/lamp
9. FEED/MARK key
10. FILTER key/lamp
11. COPY/CAL key/lamp
12. START/STOP key/lamp
13. AUTO/MANUAL key/lamp

Right Side Panel

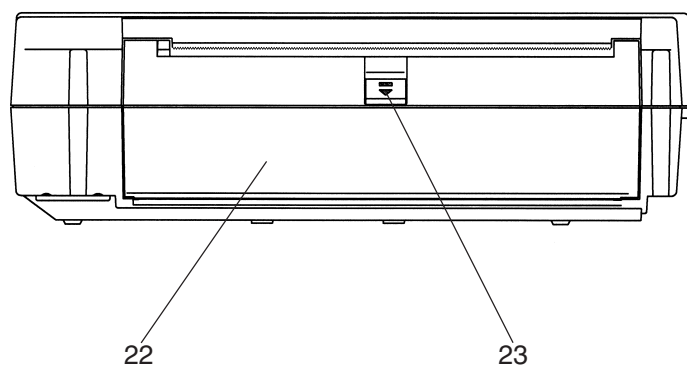
For the ⚠ mark, refer to the descriptions for the Right Side Panel in Section 1 “Panel Descriptions” of the ECG-9132K Operator’s Manual.



Name

- 14. Patient input connector
- 15. EXT-IN 1, 2 connector
- 16. CRO-OUT connector
- 17. SIO connector
- 18. Memory card slot
- 19. Battery compartment
- 20. Equipotential ground terminal
- 21. AC power cord socket

Left Side Panel

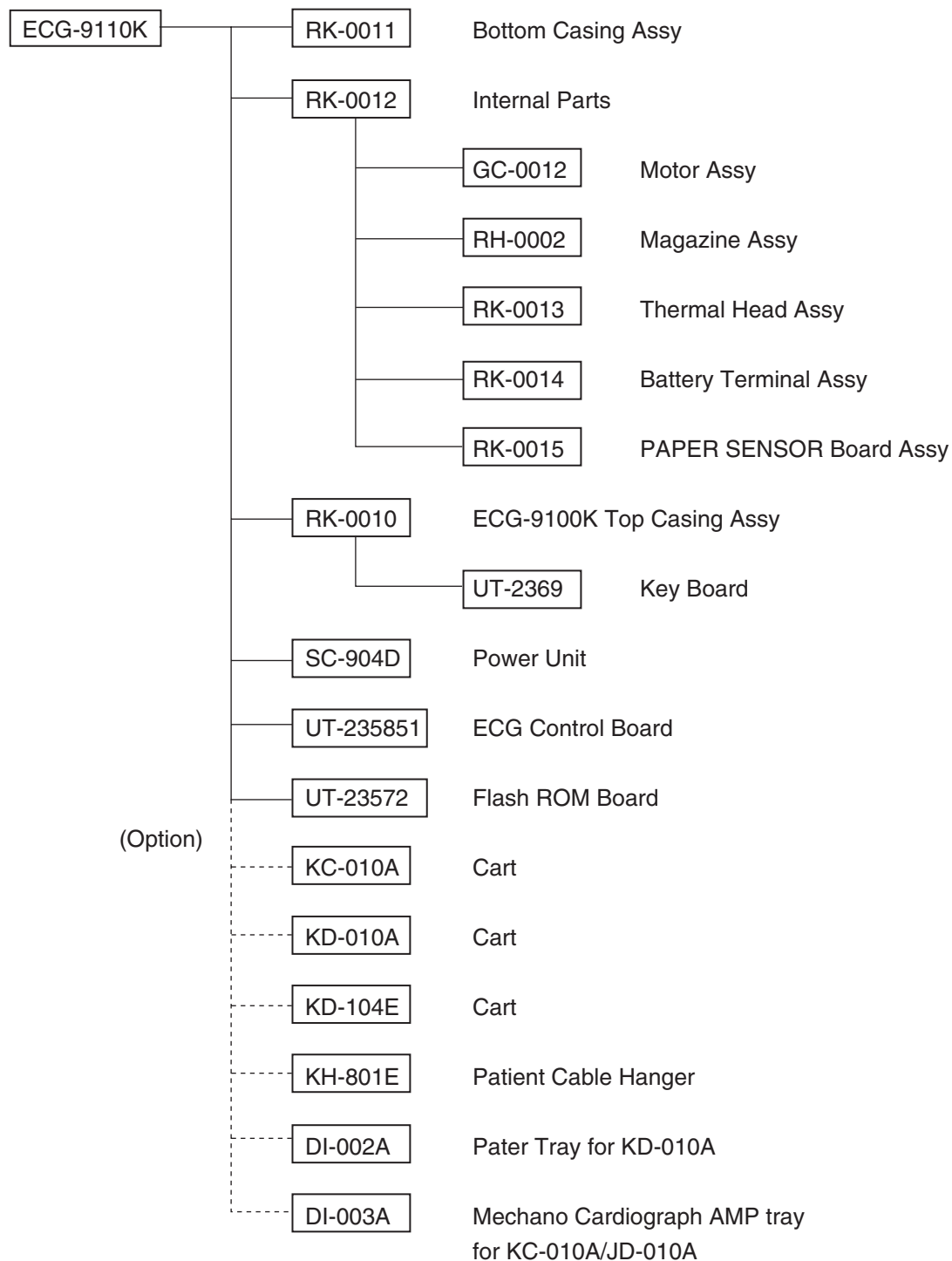


Name

- 22. Magazine
- 23. Magazine release button

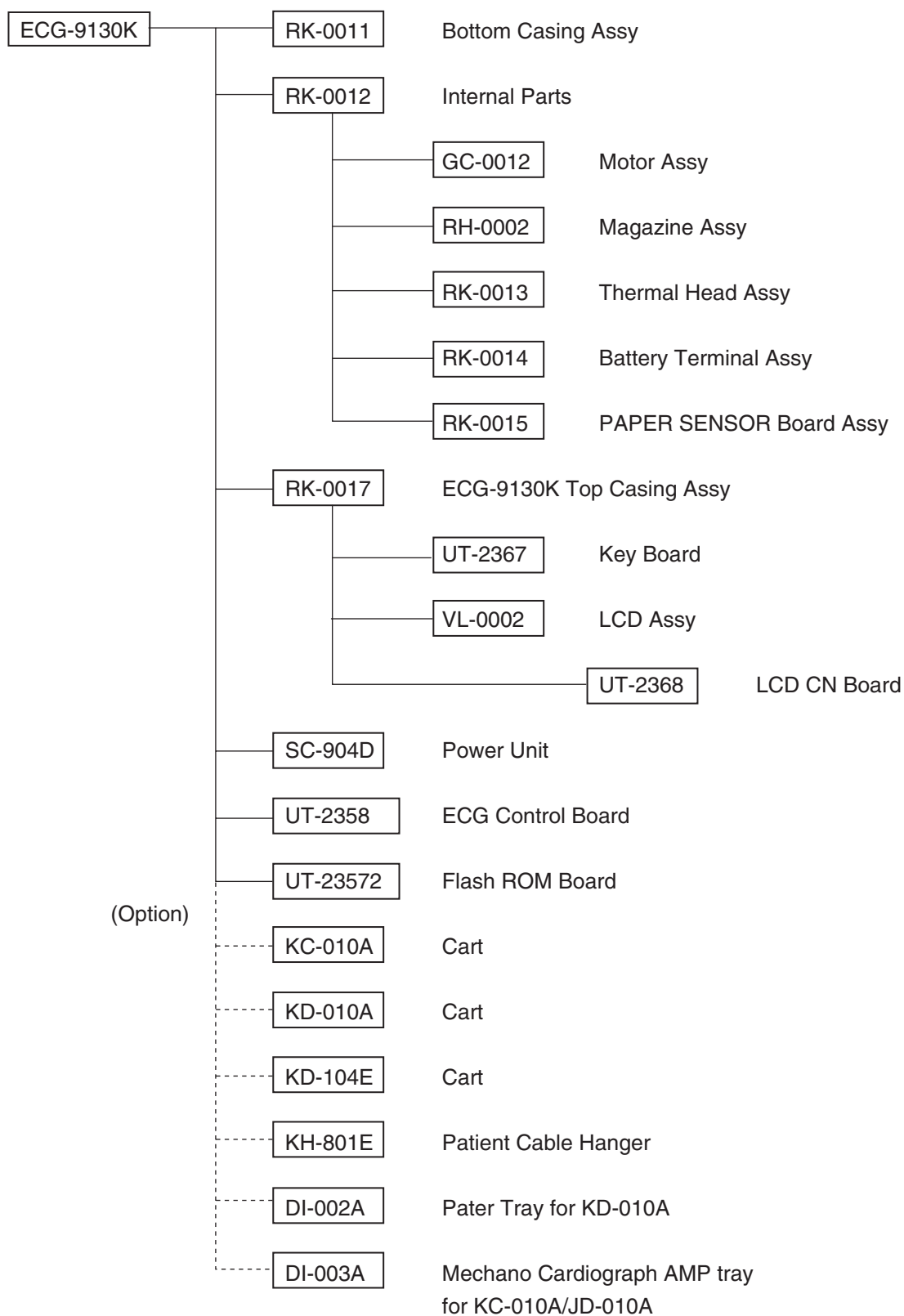
Composition

ECG-9110K Electrocardiograph



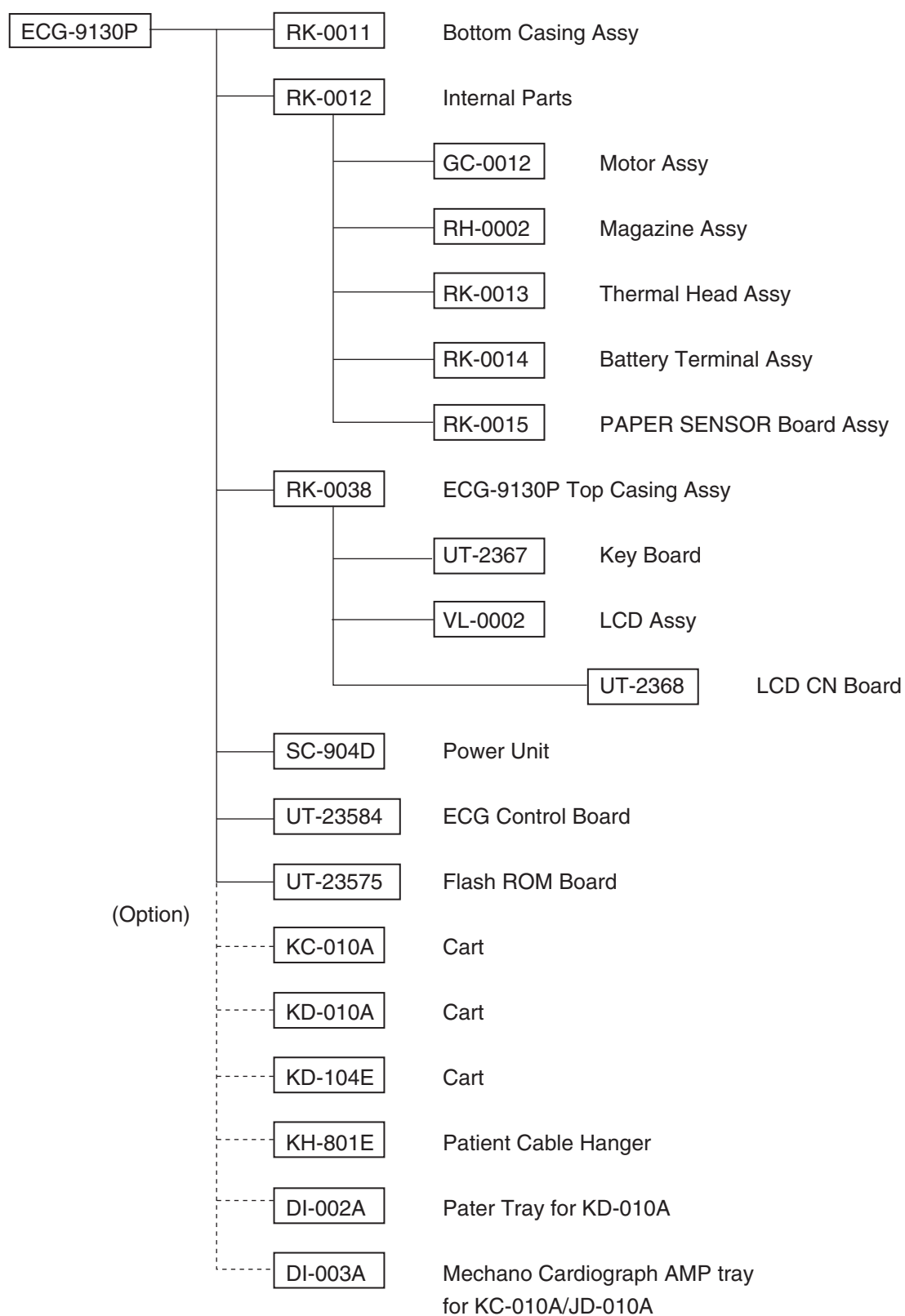
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 8 Replaceable Parts List”.

ECG-9130K Electrocardiograph



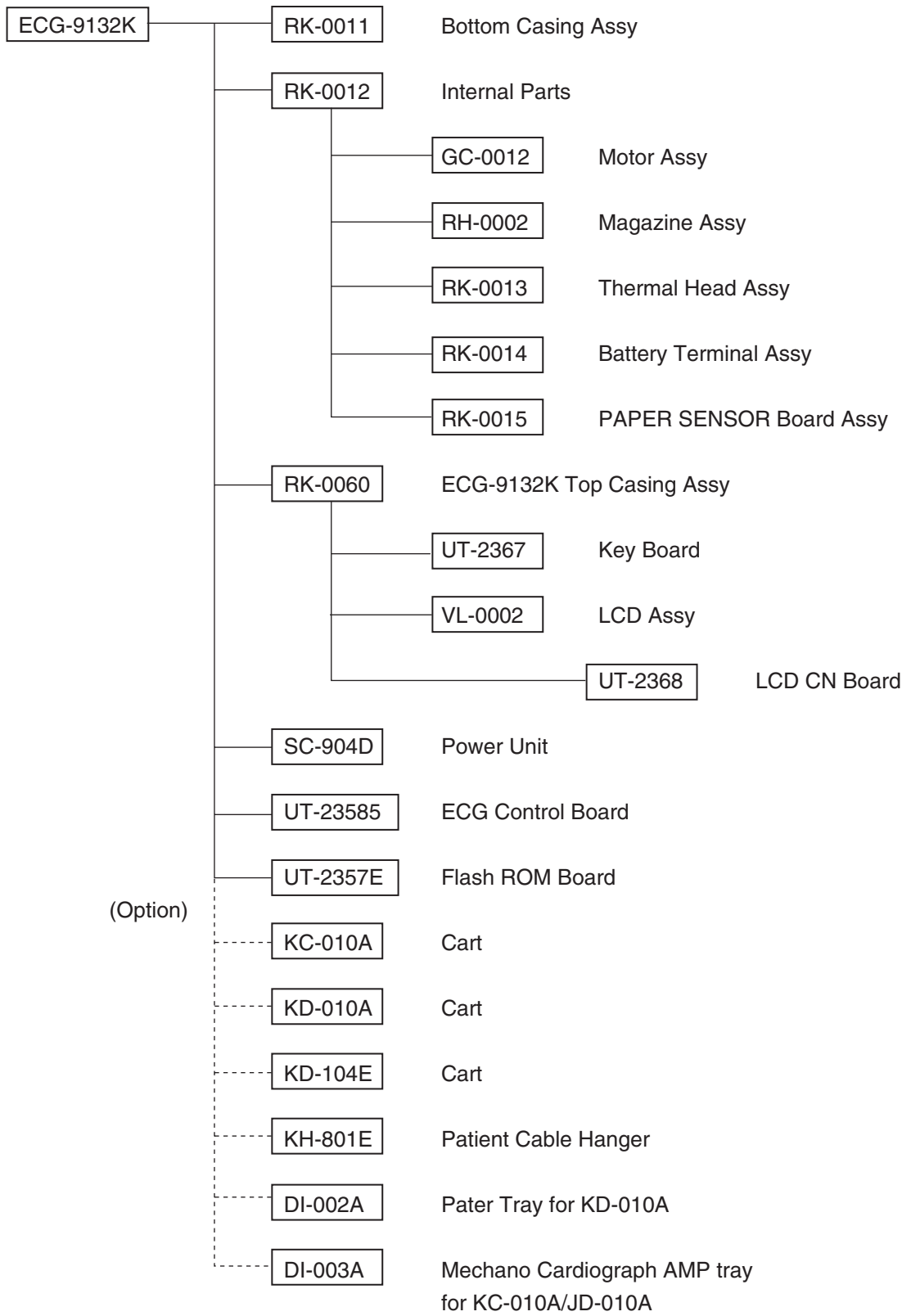
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 8 Replaceable Parts List”.

ECG-9130P Electrocardiograph



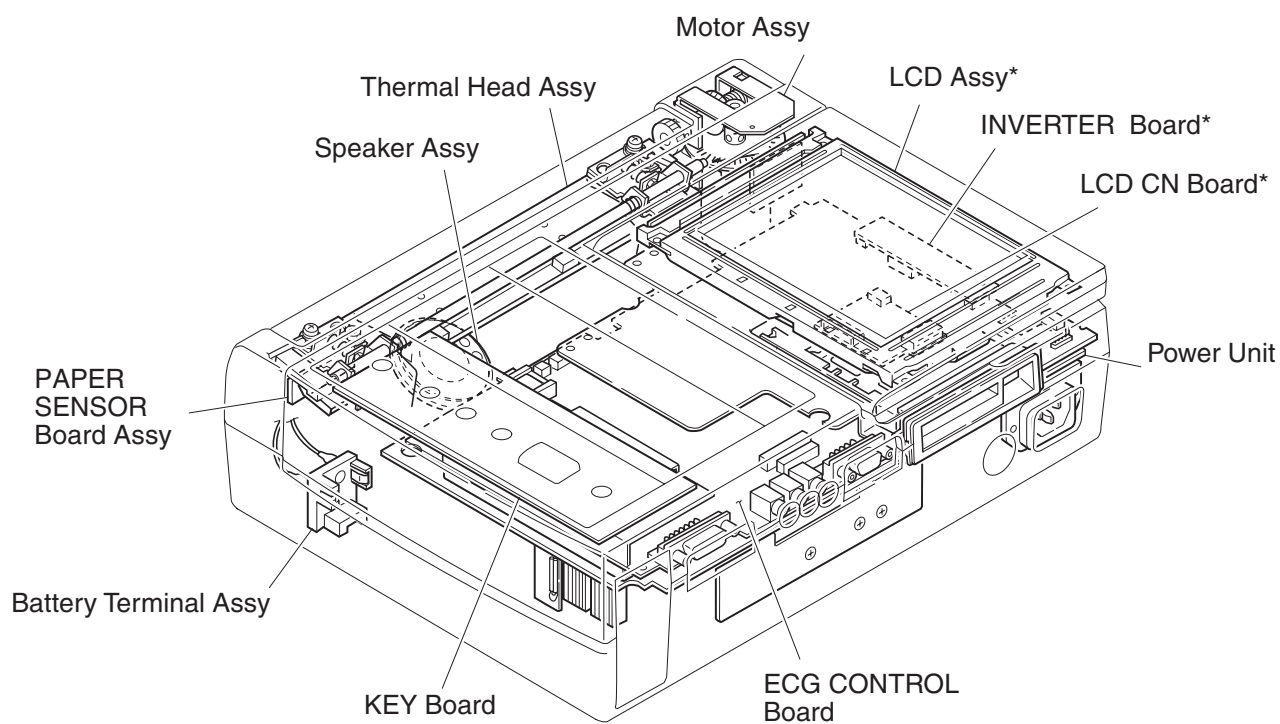
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to "Section 8 Replaceable Parts List".

ECG-9132K
Electrocardiograph



- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 8 Replaceable Parts List”.

Location

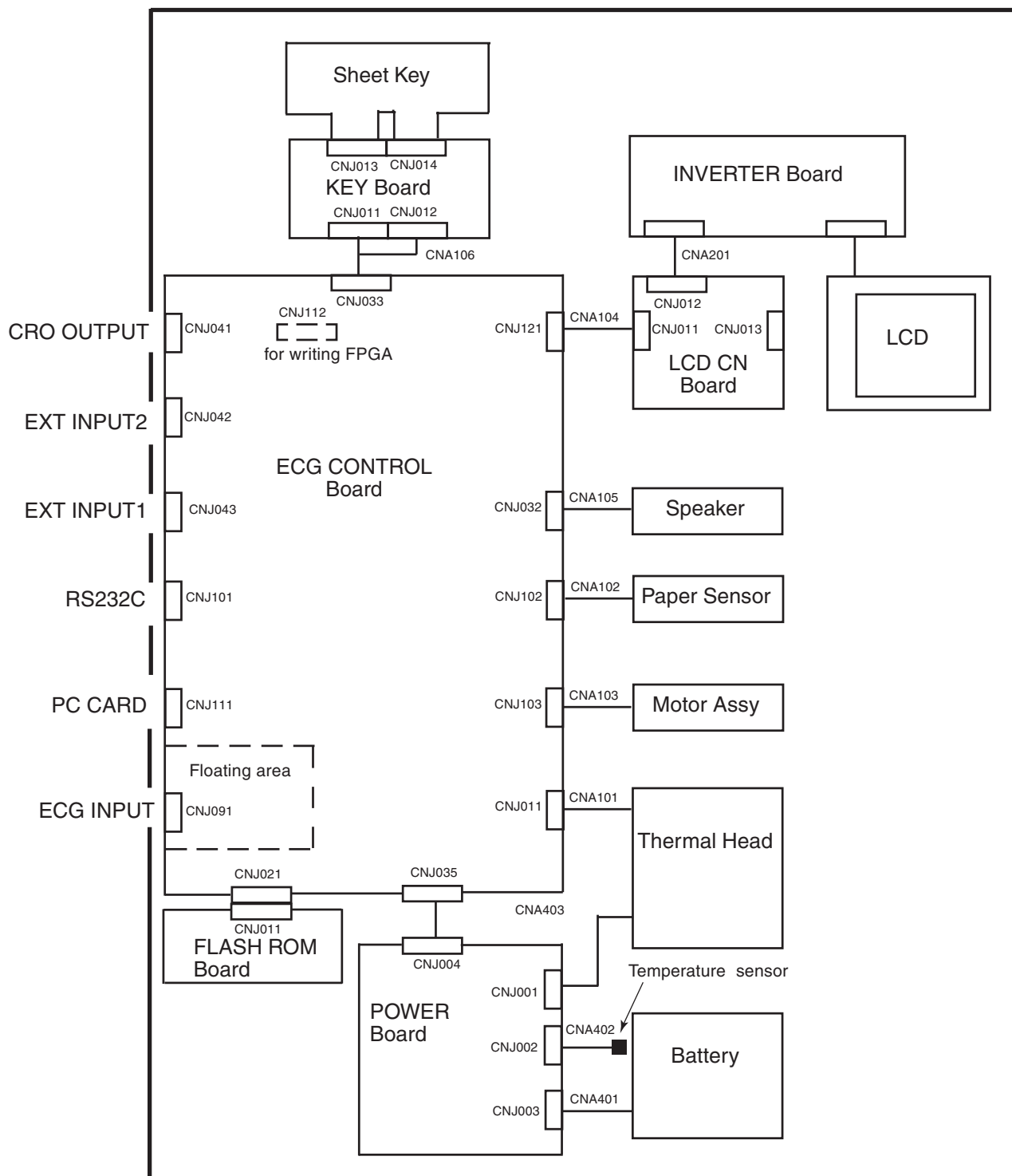


* for ECG-9130K/9130P/9132K only

Block Diagram

NOTE

The sheet key, LCD module, LCD CN board, INVERTER board and KEY board are used for the ECG-9130K, ECG-9130P and ECG-9132K only.

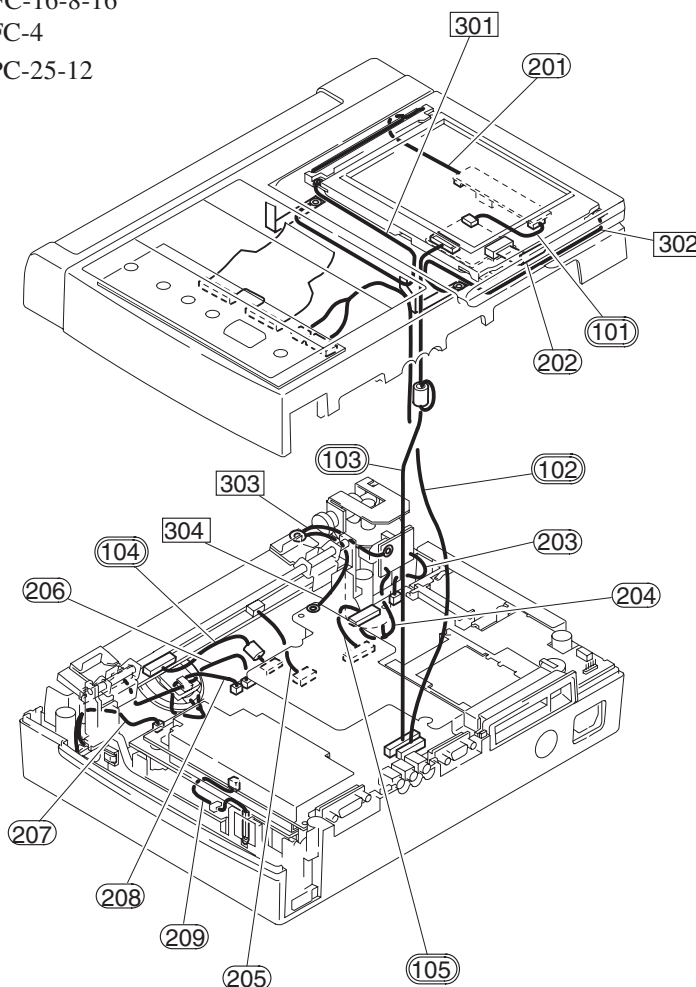


Connection Diagram

<u>Index</u>	<u>NK Code No.</u>	<u>Description</u>	<u>Remarks</u>
101		51021-0500 L=60	
102	547597A	DF11-18DS-2C/51021-05 14 L=140	
103	547588A	DF11-16DS-2C/51021-1500 L=250	Not contain ferrite.* ¹
104	547579A	PHR-11/51021-1400 L=100	Not contain ferrite.* ²
105	547632	DF11-20DS-2C L=50	
201			Directly attached to LCD
202			Directly attached to LCD. Not contain ferrite.* ³
203	547561A	DF11-6DS-2C L=55	
204			
205			Directly attached to power unit
206	547623	DF-11-6DS-2C L=140	
207	547614A	EHR-6 L=95	
208	547605	50-8B-04D/DF11-4DS-2C L=60	
209			Directly attached to power unit
301		Ground lead	
302		Ground lead	
303		Ground lead	
304		Ground lead	

* The following is the description with regard to the ferrites used in the instrument.

	<u>NK Code No.</u>	<u>Description</u>
*1	550851	TFC-16-8-16
*2	442077	SFC-4
*3	550102	FPC-25-12



Section 2 Maintenance

- Replacement 2.1
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 - Cleaning the Motor Rotation Sensor and Greasing the Motor Gear and Gear Meshed with Motor Gear 2.4

This section describes the periodic replacement and cleaning of parts which are required to maintain the instrument in good working condition.

Replacement

This subsection only describes replacement schedule for parts that need to be periodically replaced. The actual replacement procedures are described in the section for Disassembly and Assembly. Read the whole “Disassembly and Assembly” section, especially its Warnings and Cautions, before replacing any of the parts described here.

Periodic Replacement Schedule

To maintain the performance of the instrument, the parts listed in the table below must be periodically replaced by qualified service personnel.

<u>Part</u>	<u>NK Code No.</u>	<u>Description</u>	<u>Recommendation</u>
LCT-1912ANK	332543B	Battery	* See below.
KTJ-216-8MPF1-NK	357035	Thermal head	After 30 km of recording
LM32019T	545946	LCD Module	After 10000 hours
Motor ASSY	GC-0012	Motor ASSY	After 1000 hours
BR2032/1F2	390765	Lithium battery	** See below.

* Replace the battery when it cannot last for 15 minutes during battery operation at the temperatures between 20 and 30°C.

** Replace the lithium battery on the ECG CONTROL board when the No. 08 or 09 system error message appears or after the lithium battery is used for 7 years. The life time of the battery is 7 years.

Cleaning and Greasing

This subsection describes the cleaning and greasing procedures for parts that must be cleaned and greased by qualified service personnel. The cleaning procedures for parts that can be cleaned by the user are described in the Operator’s Manual.

Cleaning and Greasing Schedules

To maintain the performance of the instrument, the parts listed in the table below must be regularly cleaned or greased.

<u>Part</u>	<u>Frequency</u>	<u>Performed by</u>
Instrument (external)	After each use	User
Thermal Head	Once a month	User
Platen Roller assy	Once a year	User
Paper Mark Detection Sensor	Once a month	Qualified service personnel
Paper Empty Sensor	Once a month	Qualified service personnel
Motor Sensor	Once a year	Qualified service personnel
Motor Gear and Gear Meshed with Motor Gear	Once a year	Qualified service personnel

Cleaning the Thermal Head

CAUTION

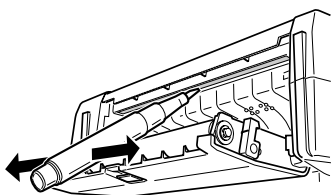
Before cleaning, turn the power off and disconnect the AC power cord from the instrument.
Do not clean the thermal head just after recording because the head is still hot.

Before setting the recording paper, clean the thermal head with the thermal head cleaner. If the thermal head is dirty, printing quality is reduced.

When used for a long time, the thermal head may become dirty. If the thermal head surface is touched with a dirty hand or if the recording paper is contaminated with chlorides (CardioCream or physiological salt solution), these will be missing dots on the recording. In this case, the thermal head requires cleaning.

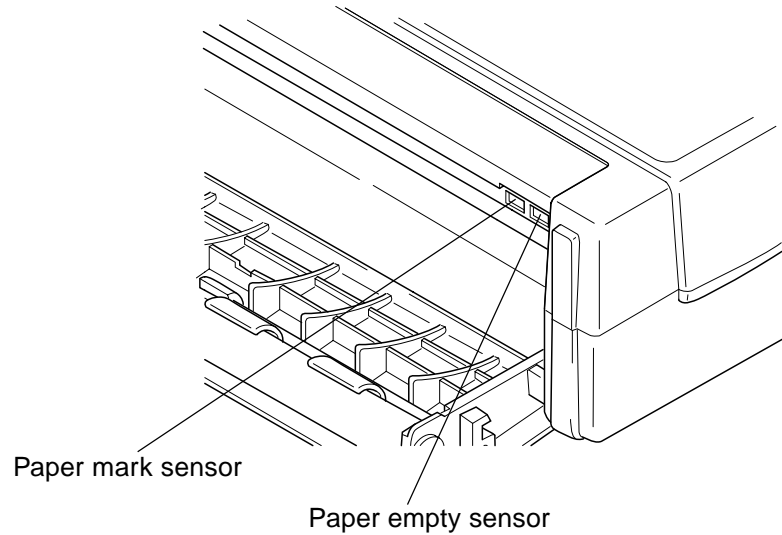
Wipe the head section (copper color) behind the paper cutter with the thermal head cleaner.

If the wheel gears are dirty, clean the gears with cotton moistened with alcohol.



Cleaning the Paper Mark Sensor and Paper Empty Sensor

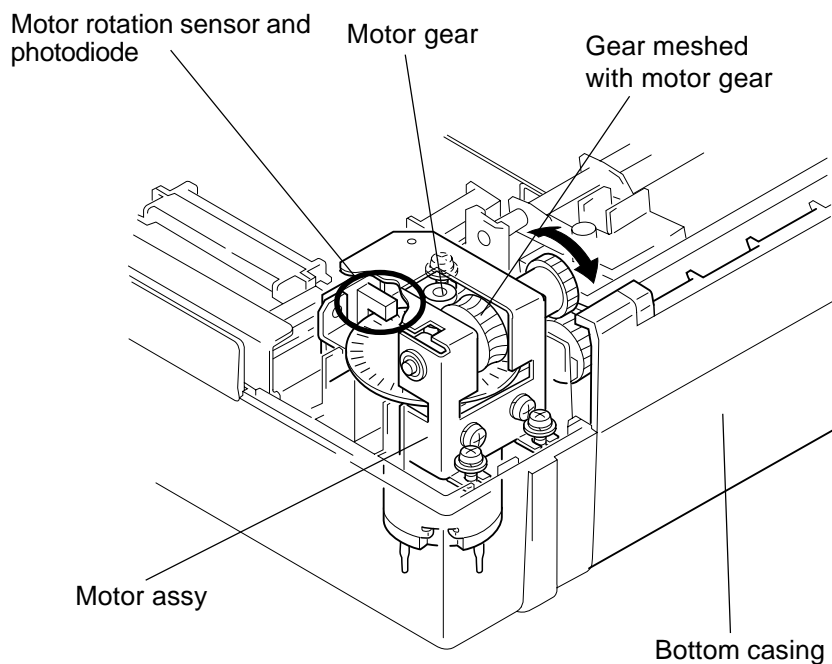
1. Remove the magazine. The illustration below shows the location of the paper mark sensor and paper empty sensor.
2. Use a piece of cotton moistened with alcohol to clean both sensors.



2. MAINTENANCE

Cleaning the Motor Rotation Sensor and Greasing the Motor Gear and Gear Meshed with Motor Gear

1. Detach the top casing from the bottom casing as described in the “Disassembly and Assembly” section.
2. Remove the three screws holding the motor assy to the bottom casing and remove the motor assy.
3. Remove the two screws to expose the motor rotation sensor and photodiode.



4. Use a piece of cotton moistened with alcohol to clean the sensor and photodiode.
5. Use a brush to clean the holes in the worm assy.
6. Use EM-50L (NK code No. 547712) grease to grease the motor gear and the gear which directly meshes with the motor gear as shown below.
7. Reattach the MOTOR SENS board to the motor with the two screws.
8. Reattach the motor assy to the bottom casing with the two screws.
9. Reattach the top casing to the bottom casing as described in the “Disassembly and Assembly” section.

Section 3 Troubleshooting and System Error Message

Troubleshooting Flowchart	3.1
Troubleshooting Table	3.4
Troubleshooting General Operation Problem	3.4
Troubleshooting Recording Problem	3.6
System Error Message	3.7

This section describes how to troubleshoot the instrument, using the following:

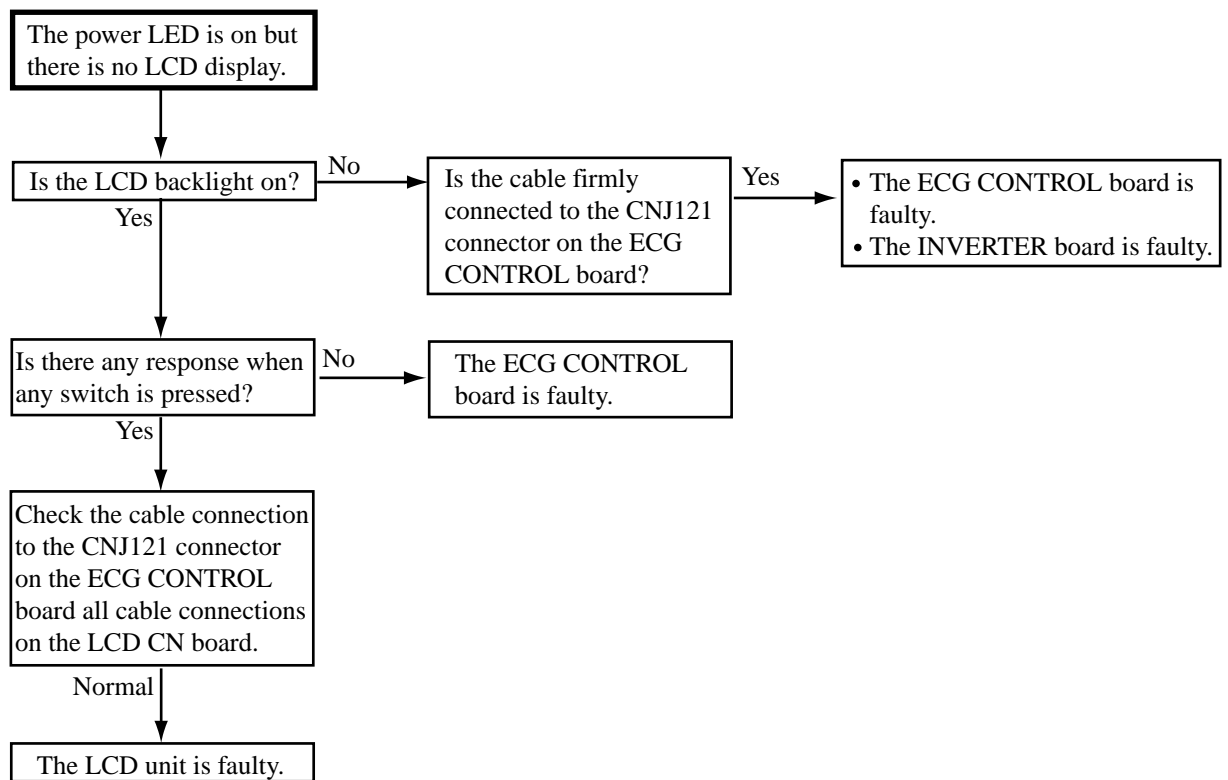
- flowchart
- troubleshooting table
- system error messages at power-up

Troubleshooting Flowchart

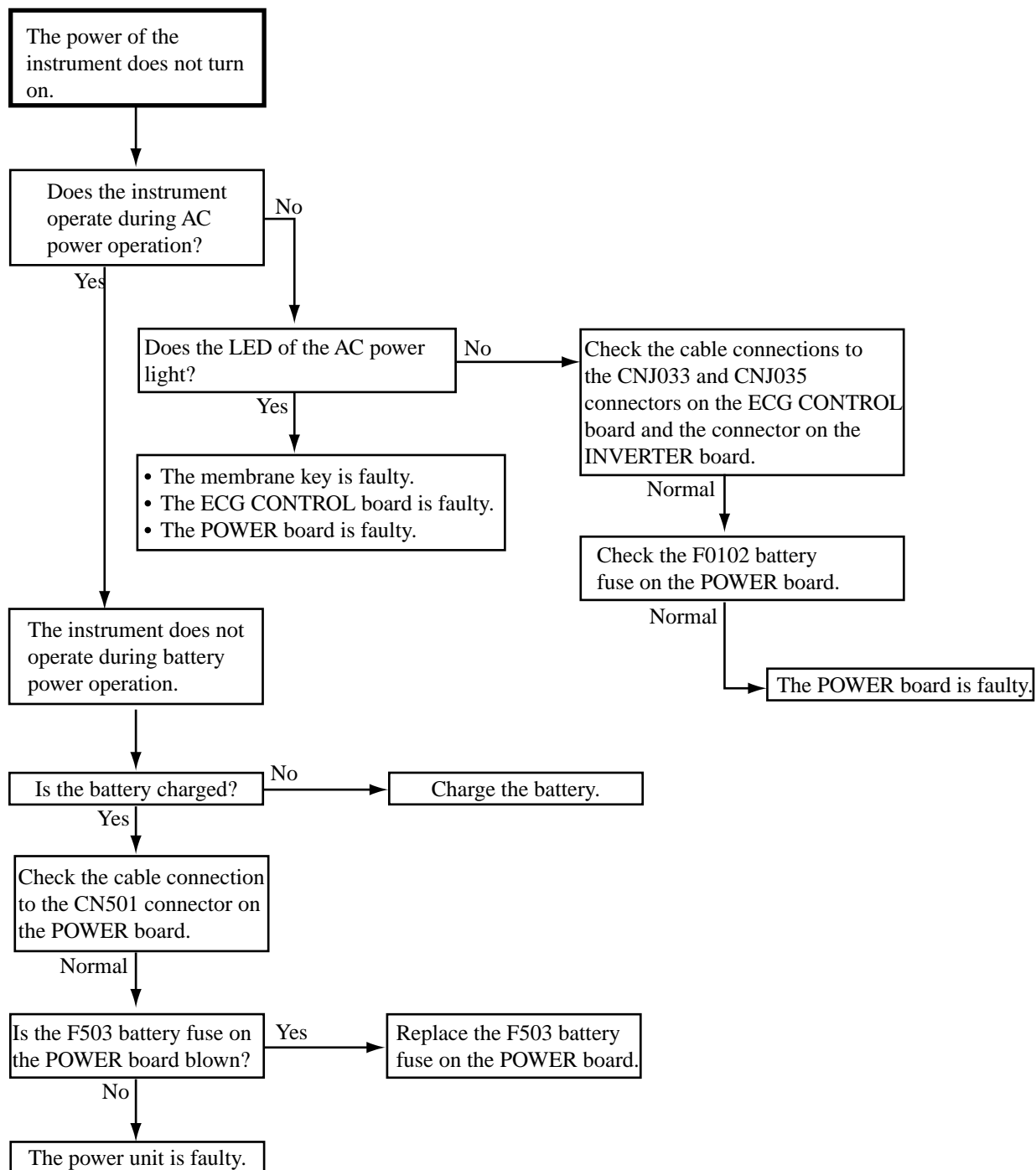
Use the troubleshooting flowchart to find the possible sources of a problem.

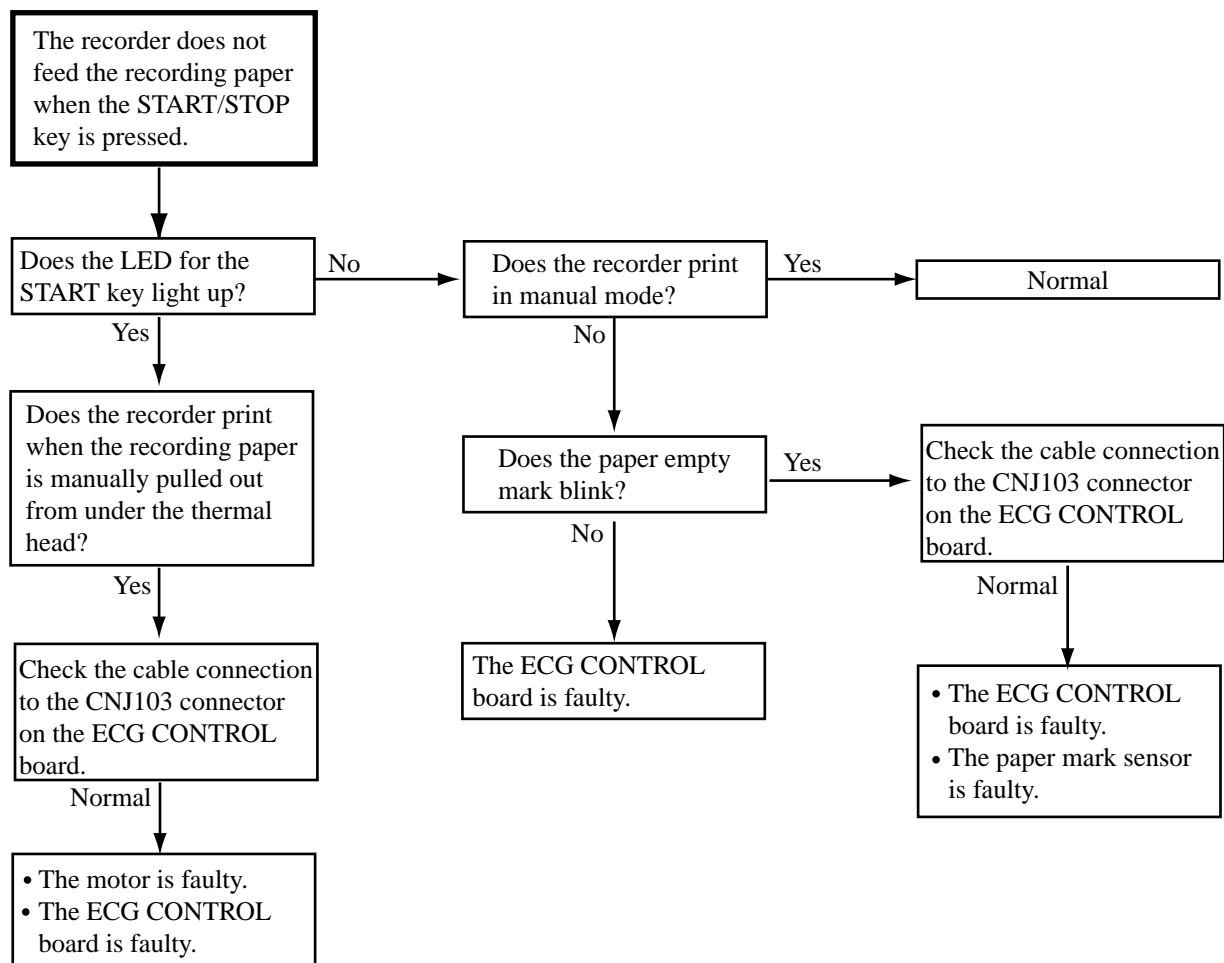
Troubleshooting Flowchart

<ECG-9130K only>



3. TROUBLESHOOTING AND SYSTEM ERROR MESSAGE





Troubleshooting Table

Use the troubleshooting table to locate, identify and solve a problem in the instrument. The problems are divided into general operation and recording. Each category has its own troubleshooting table for fast and easy troubleshooting.

How to use the troubleshooting table

1. Determine which troubleshooting table to use.
2. In the “Problem” column find the trouble item that matches the problem.
3. Do the action recommended in the “Corrective Action” column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your nearest Nihon Kohden dealer.

Troubleshooting General Operation Problem

Problem	Possible Cause/Criteria	Action
The power LED lights but there is no display or backlight on the LCD screen.	Faulty connection to the CNJ121 connector on the ECG CONTROL board.	Check the connection to the CNJ121 connector on the ECG CONTROL board.
	Faulty INVERTER board.	Replace the INVERTER board.
	Faulty LCD module.	Replace the LCD module.
The instrument does not operate on AC power.	Blown F011 or F012 power unit fuse.	Replace the F011 or F012 power unit fuse.
	Faulty connection to the CN033 or CNJ035 connector on the ECG CONTROL board.	Check the connection to the CNJ033 and CNJ035 connector on the ECG CONTROL board.
	Damaged power cord.	Replace the power cord.
	Faulty power unit.	Replace the power unit.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
	Faulty KEY board.	Replace the KEY board.
The instrument does not operate on battery power.	The battery is not charged.	Charge the battery.
	Blown F051 battery fuse.	Replace the F051 battery fuse.
	Damaged battery.	Replace the battery.
	Faulty connection to the CNJ033 or CNJ035 connector on the ECG CONTROL board or the CN201 or CN501 connector on the power unit.	Check the connection to the CNJ033 and CNJ035 connector on the ECG CONTROL board and the CN201 and CN501 connector on the power unit.

3. TROUBLESHOOTING AND SYSTEM ERROR MESSAGE

Problem	Possible Cause/Criteria	Action
No key operation.	Damaged membrane key.	Replace the membrane key.
	Faulty connection to the CNJ033 connector on the ECG CONTROL board.	Check the connection to the CNJ033 connector on the ECG CONTROL board.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
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 instrument is not properly connected.	Make sure that all electrodes and cables connection from the patient to the instrument are properly connected.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
No electrode lead waveforms are displayed on the screen or noise appears on all waveforms.	Electrodes not attached to the patient.	Make sure that the electrodes are properly attached to the patient.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
Vertical and horizontal strips appear on the LCD screen at constant intervals.	Faulty connection to the CNJ121 connector on the ECG CONTROL board.	Check the connection to the CNJ121 connector on the ECG CONTROL board.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
	Faulty LCD unit.	Replace the LCD unit.
No sound.	Check the connection to the CNJ032 connector on the ECG CONTROL board.	Check the connection to the CNJ032 connector on the ECG CONTROL board.
	Faulty speaker.	Replace the speaker assy.

3. TROUBLESHOOTING AND SYSTEM ERROR MESSAGE

Troubleshooting Recording Problem

Problem	Possible Cause/Criteria	Action
The recorder does not feed the recording paper when the Start switch is pressed.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ102 or CNJ103 connector on the ECG CONTROL board.	Check the connection to the CNJ102 and CNJ103 connectors on the ECG CONTROL board.
	Faulty KEY board.	Replace the KEY board.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
	Faulty motor.	Replace the motor.
The recording paper is fed but there is no printing.	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Faulty connection to the CNJ011 connector on the ECG CONTROL board or the CN301 connector on the power unit.	Check the connection to the CNJ011 connector on the ECG CONTROL board and the CN301 connector on the power unit.
	Faulty thermal head.	Replace the thermal head.
	Faulty power unit.	Replace the power unit.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
The paper mark cannot be detected.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ102 connector on the ECG CONTROL board.	Check the connection to the CNJ102 connector on the ECG CONTROL board.
	Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
	Faulty PAPER SENSOR board.	Replace the PAPER 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 like 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
	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Inaccurate or worn out platen roller.	Replace the magazine assy.

System Error Message

During power-up and operation the instrument continuously checks itself for system failure. If a failure is detected, system information and error history are printed on the recording paper and all operations are stopped. System information and error history are also displayed (ECG-9130 only) or printed due to transient noise. After printing the system information and error history, the power of the instrument is automatically turned off.

NOTE

If the same system information appears again after restarting the instrument, do not use the instrument until service personnel has corrected the cause of the problem. Sending a copy of the system information to your nearest Nihon Kohden distributor helps us to troubleshoot your problem quickly.

System Information

Indicates an error number to identify the problem. To solve the problem, do the corrective action described below.

Error No.	Meaning	Corrective Action
"00"	Input unit error: An interrupt signal of 2 ms is generated.	Replace the ECG CONTROL board.
"01"	Input unit error: There is no response to the host.	Replace the ECG CONTROL board.
"02"	Input unit error: Communication protocol error.	Replace the ECG CONTROL board.
"03"	4 bit CPU error: Initialization error.	Replace the ECG CONTROL board.
"04"	4 bit CPU error: "No response" error.	Replace the ECG CONTROL board.
"05"	A key on the operation panel is short-circuited.	Replace the KEY board.
"06"	RTC error: No interrupt signal of 125 ms.	Replace the ECG CONTROL board.
"07"	RTC error: Incorrect data in SRAM.	Replace the ECG CONTROL board.
"08"	All the system setup settings other than the items described in the following note are returned to the factory initial settings. This is because the lithium battery is replaced.	"Error 08" appears once after the lithium battery is replaced. Corrective action is not required.
"09"	Lithium battery is completely discharged.	Replace the lithium battery.
"10"	Bus error.	Replace the ECG CONTROL board.
"11"	Address error.	Replace the ECG CONTROL board.

3. TROUBLESHOOTING AND SYSTEM ERROR MESSAGE

Error No.	Meaning	Corrective Action
"12"	Illegal command.	Replace the ECG control board.
"13"	Zero division error.	Replace the ECG control board.
"14"	Power off time out.	Replace the ECG control board.
"15"	EEPROM error: This occurs due to the EEPROM check error, installed language error or communication error between the host and EEPROM.	Replace the ECG control board.
"16"	Local language flash memory error.	Replace the ECG control board.
"17"	ECG model error.	Replace the ECG control board.
"18"	Local language is not installed.	Install the local language.
"19"	Local language is not installed.	Install the local language.
	Error in memory area for local language.	Re-install the local language.
"20"	Local language text file version does not match the ECG software version.	Install the local language text file which is the same version as the ECG software.
"21"	ECG interpretation error (Time over).	Check the input waveforms. If any noise is superimposed on the waveforms, find and eliminate the cause. If no noise is superimposed on the waveform, replace the ECG control board.
"22"	The entered information does not match the data in the flash memory.	Replace the ECG control board.

NOTE

- “Error 05” also appears when any key on the operation panel is pressed and held down.
- When “Error 08” appears, the following settings are not reset to the factory initial settings even if the instrument is initialized.
 - display language
 - hospital name
 - recording resolution setting
 - elapsed time
 - saved ECG data
 - hum filter
 - direct/modem connection
 - cue mark position
 - local language font

Error History

Indicates the latest three errors and the date of the latest error, as in the example below.

***** System Information *****

Error number: 15
Date: Apr 20, 1998 10:41 AM
Program: 9130K
Version: 01-00 01-01 01-01

***** Error History *****

No.1 Error number: 15 Apr 20, 1998 10:30 AM
No.2 Error number: 15
No.3 Error number: 15

NIHON KOHDEN Mon Apr 20, 10:41 11 JST 1998

Section 4 System Test and Setting

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Exiting the System Test Mode	4.6
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Date and Time Setting	4.28
Setting the Date and Time	4.28

This section describes:

- how to check the operation of the instrument in the System Test mode.
- how to output the ECG findings list in the System Test mode.
- how to initialize the system in the System Test mode.
- how to adjust the thermal head recording resolution and recording paper cutting position in the System Test mode.
- how to set date and time in the System Setup mode.

System Test

Overall

The instrument has two System Test modes: **Test level 1 for operator** and **Test level 2 for qualified service personnel**. The test items marked with * perform the same test in Test levels 1 and 2. Each Test level consists of the following system test items:

Test level 1

- Demonstration
- Recorder
- Key*
- Memory*
- LCD/LED*⁽¹⁾
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- CRO/EXT2*
- System Setup Initialization*
- ECG Findings List Recording

Test level 2

- Recorder
- Thermal head
- Recording resolution setting
- Key*
- Memory (single)*
- Memory (continuous)
- LCD/LED*⁽¹⁾
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- CRO/EXT2*
- System Setup Initialization*
- Cue mark adjustment

⁽¹⁾ LCD is checked for the ECG-9130K only.

NOTE

In the description of some test items in this section, whenever it is appropriate, a description of the source of problem and its corrective action will be described in table form for fast and easy troubleshooting. If none of the actions solve the problem, contact your Nihon Kohden representative.

Calling up the Test Level 1

- 1. If the power is on, turn it off.

NOTE

Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information “Error 05” at the end of printing.

- 2. Press the POWER key while pressing the FEED/MARK key. Hold the FEED/MARK key until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 1 is called up and the instrument is in standby mode for entering the system test number. (The System Test screen appears for the ECG-9130K only as shown below.)

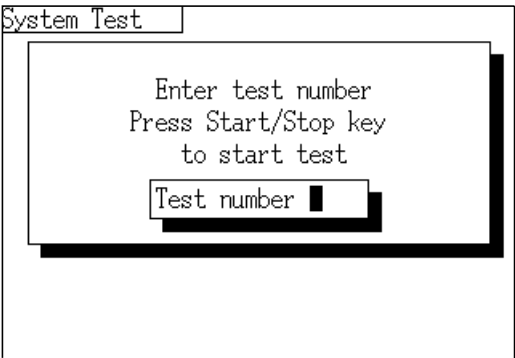
To cancel printing the following information, press the START/STOP key.

The only difference between the ECG-9110K and ECG-9130K printouts is the description of the key explanation.

Printout (ECG-9130K)

System Test		Test level 1	
1:		Demonstration	[00]
	To check system, press system	Recorder	[01]
	test number, then press	Key	[02]
	START/STOP key.	Memory	[03]
2:		LCD/LED	[04]
	To quit the test, press	Input unit	[05]
	AUTO/MANUAL key.	Calibration	[06]
Key Explanation		Communication	[07]
0:	0	CRO/EXT1	[08]
1:	1	CRO/EXT2	[09]
2:	2	System Setup Initialization	[10]
3:	3	ECG Findings List Recording	[11]
4:	4		
5:	5		
6:	6		
7:	7		
8:	8		
9:	9		

Sytem Test Screen (ECG-9130K)



Calling up the Test Level 2

1. If the power is on, turn it off.

NOTE

Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information “Error 05” at the end of printing.

2. Press the POWER key while pressing the FEED/MARK and AUTO/MANUAL keys together. Hold the FEED/MARK and AUTO/MANUAL keys until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 2 is called up and the instrument is in standby mode for entering the system test number. (The System Test screen appears for the ECG-9130K only as shown in the previous page.)

To cancel printing the following information, press the START/STOP key.

The only difference between the ECG-9110K and ECG-9130K printouts is the description of the key explanation.

Printout (ECG-9130K)

System Test	Test level 2	
1:	Recorder	[00]
To check system, press system	Thermal head	[01]
test number, then press	Recording resolution setting	[02]
START/STOP key.	Key	[03]
2:	Memory (single)	[04]
To quit the test, press	Memory (continuous)	[05]
AUTO/MANUAL key.	LCD/LED	[06]
	Input unit	[07]
Key Explanation	Calibration	[08]
0: 0	Communication	[09]
1: 1	CRO/EXT1	[10]
2: 2	CRO/EXT2	[11]
3: 3	System Setup Initialization	[12]
4: 4	Cue mark adjustment (−4.0 mm)	[13]
5: 5	Cue mark adjustment (−3.5 mm)	[14]
6: 6	Cue mark adjustment (−3.0 mm)	[15]
7: 7	Cue mark adjustment (−2.5 mm)	[16]
8: 8	Cue mark adjustment (−2.0 mm)	[17]
9: 9	Cue mark adjustment (−1.5 mm)	[18]
	Cue mark adjustment (−1.0 mm)	[19]
	Cue mark adjustment (−0.5 mm)	[20]
	Cue mark adjustment (0 mm)	[21]
	Cue mark adjustment (−0.5 mm)	[22]
	Cue mark adjustment (−1.0 mm)	[23]
	Cue mark adjustment (−1.5 mm)	[24]
	Cue mark adjustment (−2.0 mm)	[25]
	Cue mark adjustment (−2.5 mm)	[26]
	Cue mark adjustment (−3.0 mm)	[27]
	Cue mark adjustment (−3.5 mm)	[28]
	Reset elapsed time	[31]
	Font Down Load (RS-232C)	[32]
	Font Down Load (PC CARD)	[33]
	Flash memory initialization	[34]

Entering the System Test Number

Use the following keys on the operation panel to enter a 2-digit number for executing the desired system test.

- ECG-9110K: Refer to ECG-9110K keys and corresponding number values shown below.
- ECG-9130K: Use the number keys.

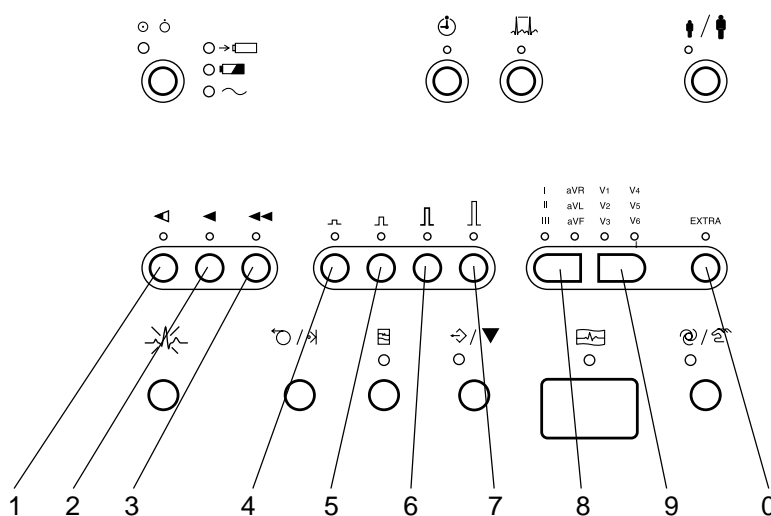
The specified system test numbers are indicated in the [xx] bracket at the right of each system test item on the printout when the Test level 1 or 2 is called up. Refer to the “Calling up the Test Level X” section.

To delete the entered number, press the AUTO/MANUAL key. To delete a 2-digit number, press the AUTO/MANUAL key twice. At this time, the ones digit number is deleted before the tens digit number is deleted.

ECG-9110K Keys and Corresponding Number Values

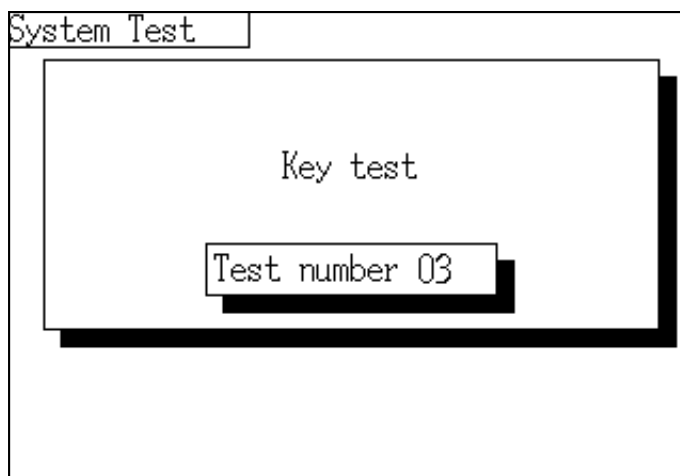
Number	Key	Number	Key
0	EXTRA key	5	$\times 1/2$ (5 mm/mV) GAIN key
1	5, 10, 12.5 mm/s SPEED key	6	$\times 1$ (10 mm/mV) GAIN key
2	25 mm/s SPEED key	7	$\times 2$ (20 mm/mV) GAIN key
3	50 mm/s SPEED key	8	LEAD key (left)
4	$\times 1/4$ (2.5 mm/mV) GAIN key	9	LEAD key (right)

ECG-9110K operation panel



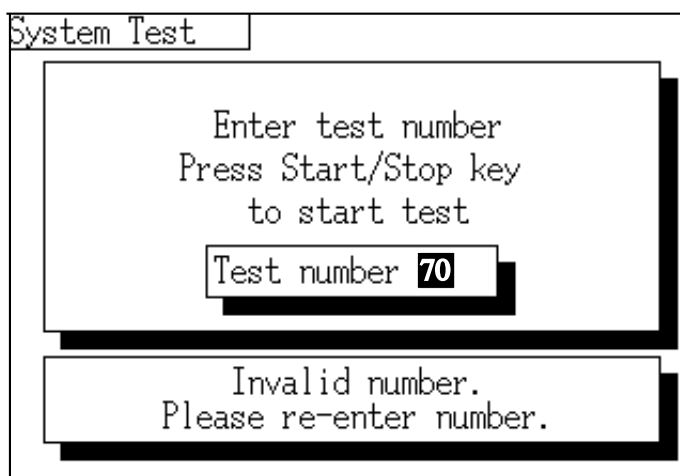
Executing the System Test

Press the START/STOP key. For some tests, the System Test screen is displayed during the test as shown below (ECG-9130K only).

System Test Screen (ECG-9130K)

If you entered an unspecified number, an alarm occurs. The alarm indication is different between the ECG-9110K and ECG-9130K as follows:

- ECG-9110K: 8 repeating “pips” alarm sound is generated.
- ECG-9130K: 8 repeating “pips” alarm sound and the “Invalid number. Please re-enter number” error message is displayed as shown below.



To re-enter the system test number, do either of the following:

- Delete the previously entered number by pressing the AUTO/MANUAL key.
- Enter the system test number by overwriting the previously entered number.

4. SYSTEM TEST AND SETTING

Quitting the System Test

The procedures to quit each system test vary from test to test. Some tests automatically end after an alarm sound is generated or a printout is output. Refer to the following explanations for each test. After quitting each test, the instrument returns to the standby mode for entering the system test number.

After a system test is completed, you can execute other system test without exiting the System Test mode .

Exiting the System Test Mode

After all desired system tests are finished, press the POWER key.

Demonstration

This is used to learn or teach instrument operation.

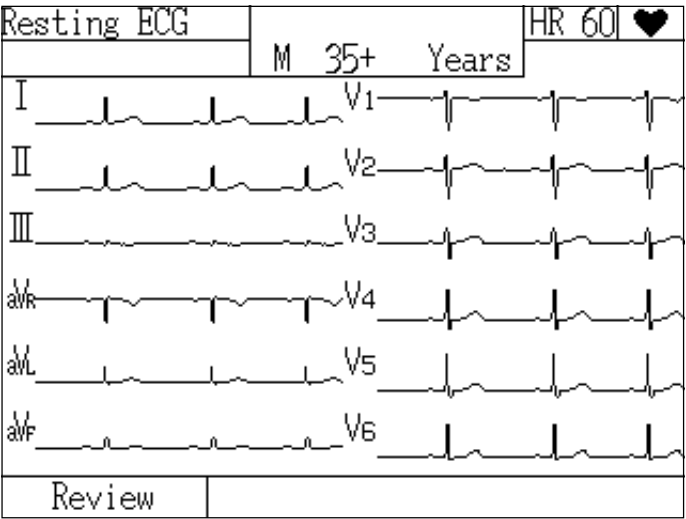
While executing this test item, the instrument generates dummy 12 lead ECG resting waveforms until the power of the instrument is turned off. The ECG waveforms can be recorded and also displayed as shown below (ECG-9130K only).

Procedure

Enter the system test number [00] (Test level 1) and press the START/STOP key.

To quit the test, turn the power of the instrument off by pressing the POWER key.

Dummy 12 lead ECG resting waveforms on LCD



Recorder

This is used to check the condition of the recorder by printing test patterns. The recording test patterns consist of the following and are printed in the following order:

1. Diagonal lines
2. Characters H and X (Test level 1 only)
3. Grid
4. Paper speed scales (10, 12.5, 25 and 50 mm/s)
5. Paper mark detection

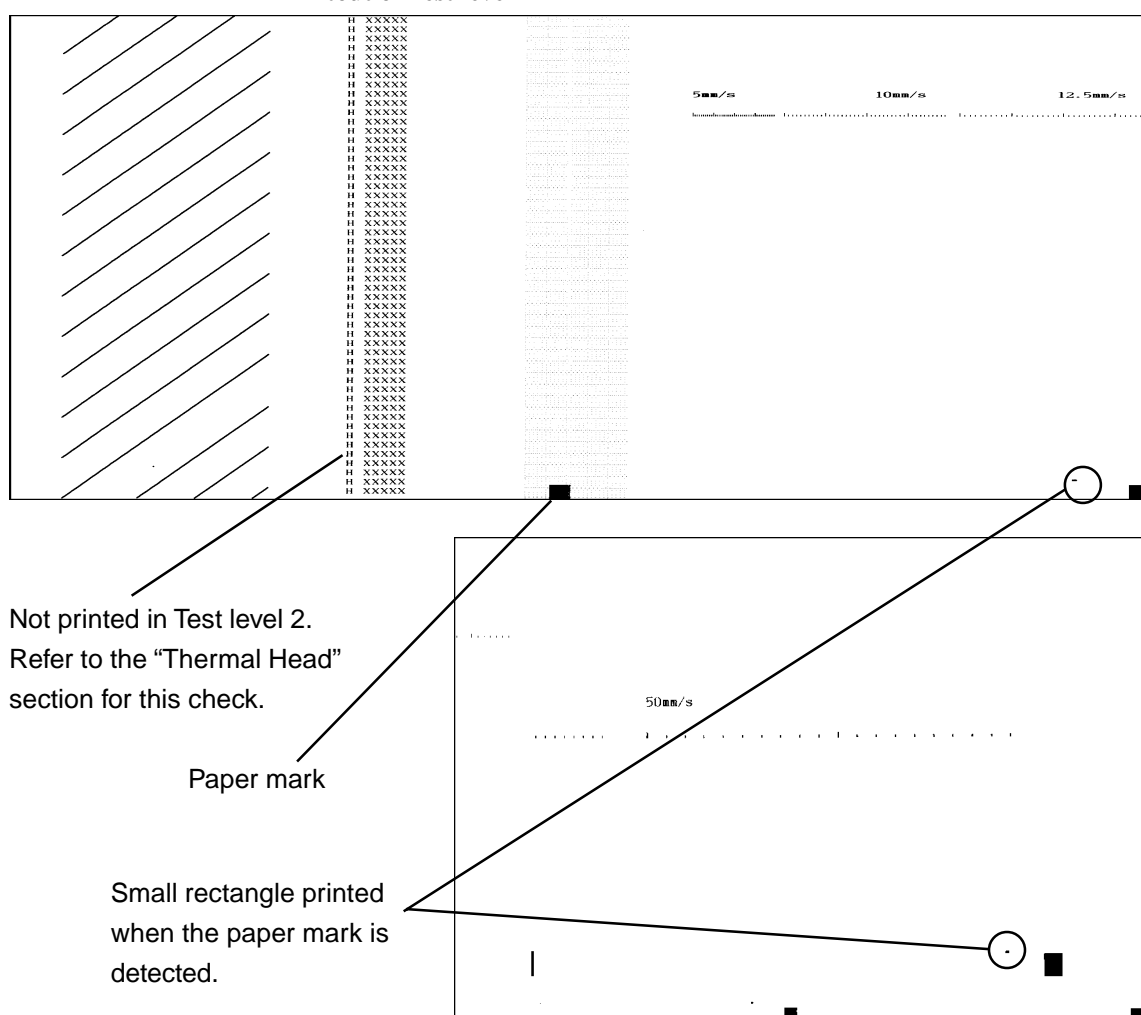
The recorder test of Test level 1 contains the same recorder test and thermal head test as Test level 2. With regard to the check procedure for characters H and X, refer to the “Thermal Head” section.

Procedure

Enter the system test number [01] (Test level 1) or [00] (Test level 2) and press the START/STOP key. The following test patterns are printed.

This test automatically ends after the following has been printed. The instrument returns to the standby mode for entering the system test number.

Printout of Test level 1



Check Procedure for Diagonal Lines

Check that all the diagonal lines are evenly and completely printed.

Possible Source of Problem	Corrective Action
A dirty thermal head can cause some parts to be unevenly or incompletely printed.	<ol style="list-style-type: none"> 1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.
A faulty thermal head can cause some parts at a certain position to be unevenly or incompletely printed.	<ol style="list-style-type: none"> 1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.

Check Procedure for Grid

Check that all the parts of the grid are clearly, evenly and completely printed.

Possible Source of Problem	Corrective Action
A faulty ECG CONTROL board can cause all or some parts to be unclear, unevenly or incompletely printed.	Replace the ECG CONTROL board.

Check Procedure for Paper Speed Scales

Check that the accuracy of each paper speed during actual recording is within 5%.

The scales for 4 seconds at 10 mm/s and 12.5 mm/s paper speeds and the scales for 2 seconds at 25 mm/s and 50 mm/s paper speeds are consecutively printed. For example, the length for 4 seconds on the time scale printed at 10 mm/s paper speed must be within 38.0 mm to 42.0 mm.

Possible Source of Problem	Corrective Action
Badly positioned thermal head.	<ol style="list-style-type: none"> 1. Adjust the thermal head position. 2. If this does not fix the problem, replace the thermal head.
Damaged, deformed or badly positioned motor gear.	<ol style="list-style-type: none"> 1. Check the motor gear and its position. 2. If this does not fix the problem, replace the motor gear.
Dirty motor rotation sensor.	Clean the motor rotation sensor as described in the "Maintenance" section.
Loose or damaged axle.	Tighten and check the axle as described in the "Disassembly and Assembly" section.
Faulty motor.	Replace the motor.
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

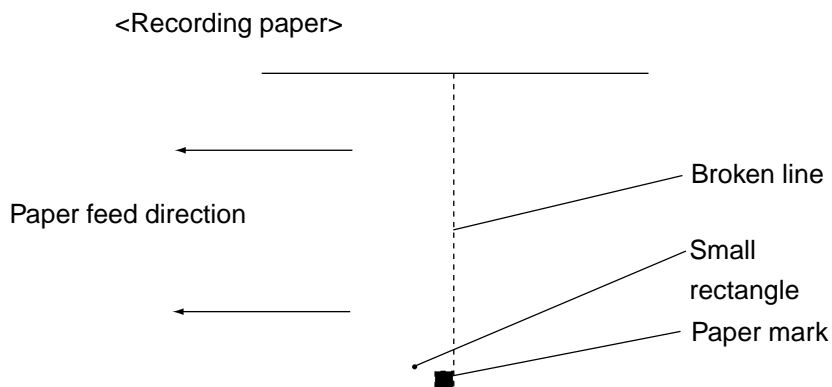
Check Procedure for Paper Mark Detection

In one complete recorder test, a small rectangle is printed near each paper mark if the paper mark is correctly detected by the mark sensor. (Refer to “Cleaning and Greasing” in Section 2 for the location of the mark sensor.) Check that a small rectangle is printed before each paper mark on the second and third pages only.

Possible Source of Problem	Corrective Action
If the paper mark is not occasionally detected, the paper mark sensor is dirty.	Clean the paper mark sensor as described in the "Maintenance" section.
If the paper mark is not detected at all, the PAPER SENSOR board is faulty.	Replace the PAPER SENSOR board.

About paper mark

Every page of recording paper has a paper mark at the lower right corner. Pages are divided by broken lines. In the automatic recording, the recording stops after the paper mark is detected by the mark sensor. This enables the next printing to start from the beginning of the next page.



Thermal Head

This is used to check the condition of the thermal head by printing out the characters “H” and “X” continually.

Procedure

Enter the system test number [01] (Test level 2) and press the START/STOP key. The characters “H” and “X” are printed as follows.

To quit the test, press the AUTO/MANUAL key and the instrument returns to the standby mode for entering the system test number.

Printout of Thermal Head Test Result

```

H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX
H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX  H  XXXXX

```

Check Procedure for Characters H and X

Check that all the parts of the characters “H” and “X” are clearly, evenly and completely printed and that the characters are not printed zigzag or diagonally.

Possible Source of Problem	Corrective Action
Incorrectly set thermal head recording resolution setting.	Adjust the thermal head recording resolution as described in this section.
Faulty cable connection to the CNJ011 connector on the ECG CONTROL board or the CN301 connector on the power unit.	Check the cable connections to the CNJ011 connector on the ECG CONTROL board and the CN301 connector on the power unit.
Faulty power unit.	Replace the power unit.
Badly positioned recorder component.	Check and adjust the recorder component position.

Key

This is used to check the condition of the keys on the operation panel.

Procedure

1. Enter the system test number [02] (Test level 1) or [03] (Test level 2) and press the START/STOP key.
2. Press the key on the operation panel. The name of the pressed key is printed if the key is functioning correctly.

To quit the test, press the AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

NOTE

The **POWER** and **AUTO/MANUAL** keys cannot be checked by this test. To check if these two keys are functioning correctly, do the following:

- **POWER key**
Check that the power of the instrument is on or off when the **POWER** key is turned on or off.
- **AUTO/MANUAL key**
Check that the Key test is stopped by pressing the **AUTO/MANUAL** key.

Check Procedure for Operation Panel Key

Check that the name of the pressed key is printed.

Possible Source of Problem	Corrective Action
Faulty KEY board.	Replace the KEY board.

Memory

This is used to check the condition of the memory by comparing the data of the test patterns written to and read from each memory area.

The instrument provides two memory test modes: single and continuous. When single memory test mode is selected, entire memory is tested once. When continuous memory test mode is selected, the memory is continuously tested until the AUTO/MANUAL key is pressed. The number of "Count of test" increases by one each time the entire memory test is tested. One complete memory test takes about 30 seconds.

If no fault is detected, an "OK" message appears for each memory. If a fault is detected, an "Error" message appears and the number of "Error count" for each memory increases by one.

Printout of Memory Test Result

Memory test result (Count of test: 1)		
		Error count
Main memory (BIT/ADR)	OK	0
Recorder memory (BIT/ADR)	Error (E88004/000000h)	1
VRAM (BIT/ADR)	Error (C10000h/C10004h)	1
Program ROM	OK	0
Flash memory	NONE	0
Input unit SRAM	Error	1
Input unit ROM	OK	0
Input unit EEPROM	OK	0
File memory	Error	1
RTC SRAM	OK	0
Hospital	NIHON KOHDEN HOSPITAL	
Model	9130K	
Version	01-05	
Input unit version	01-01	
Analysis version	01-03	
Date	Oct 16, 1998 10:41 AM	
Cardiograph internal temp	46.5 C	
Elapsed time	9 hours	
Thermal head temperature	27.0 C	
Battery voltage	12.4 V	

Single Memory Test Mode

This mode tests the entire memory once. You can use this mode to fully check all memory if a memory problem frequently occurs.

Procedure

Enter the system test number [03] (Test level 1) or [04] (Test level 2) and press the START/STOP key.

After the test, the test result and system setup settings are automatically printed. When the test result and system setup settings are completely printed, a “bing bong” alarm sound is generated and instrument returns to the standby mode for entering the system test number.

To cancel the test or cancel printing the test result and system setup settings, press the AUTO/MANUAL key.

Check Procedure for Single Memory Test Mode

Check that no “Error” messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG CONTROL board.	Replace the ECG CONTROL board. Each memory mounted on the ECG CONTROL board cannot be replaced at memory component level.

Continuous Memory Test Mode

This mode continues testing the entire memory until the AUTO/MANUAL key is pressed. You can use this mode to check an intermittent memory problem.

Procedure

Enter the system test number [05] (Test level 2) and press the START/STOP key.

To print the test result and system setup settings without quitting the test, press the START/STOP key. All results of the tests performed until the START/STOP key are pressed is printed on one page.

To cancel the test, press the AUTO/MANUAL key. All results of the tests performed until the START/STOP key is pressed are printed on one page. When the test result and system setup settings are completely printed, 8 repeating “pips” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Continuous Memory Test Mode

Check that no “Error” messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG CONTROL board.	Replace the ECG CONTROL board. Each memory mounted on the ECG CONTROL board cannot be replaced at memory component level.

LCD/LED

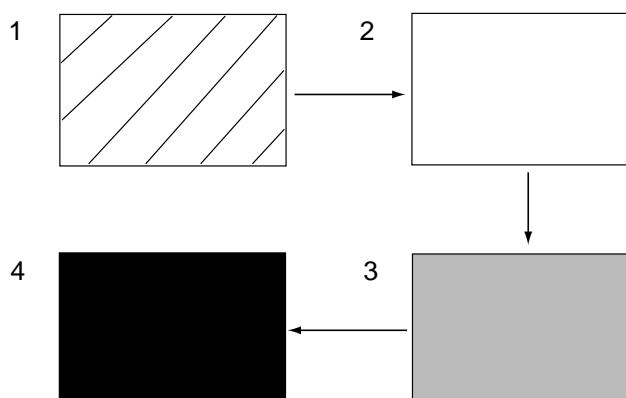
This is used to check all LEDs on the operation panel, LED/LCD control circuit and all dots on the LCD (ECG-9130K only). First, the LCD test starts and after the LCD test is complete, the LED test starts. The LCD test is not performed for the ECG-9110K.

LCD Test (ECG-9130K only)

The LCD displays the following four types of test patterns every two seconds in the following order:

1. Diagonal lines are displayed.
2. Entire LCD lights up.
3. LCD is completely dark but backlight lights.
4. Backlight does not light.

The LCD image for each pattern changes as follow:



LED Test

The LEDs on the operation panel light up by one and remain lit until all LEDs light up. After all LEDs light up, they go out at a time.

NOTE

With regard to the LEDs of Battery charge lamp, AC power lamp and POWER lamp, check if they are in the following condition during the LED/LCD test:

- **Battery charge lamp:** Not lit (This lamp indicates the remaining battery power before and after the LED test during battery operation.)
- **AC power lamp:** Lit
- **POWER lamp:** Lit when AC power is used

4. SYSTEM TEST AND SETTING

Procedure

Enter the system test number [04] (Test level 1) or [06] (Test level 2) and press the START/STOP key.

After the test, the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the AUTO/MANUAL key.

Check Procedure for LCD Test

Check that all the dots on the screen light up and go out according to the test pattern.

Possible Source of Problem	Corrective Action
Faulty cable connection to the CNJ121 or CNJ013 connector on the ECG CONTROL board.	Check the cable connections to the CNJ121 and CNJ013 connectors on the ECG CONTROL board.
Faulty LCD module.	Replace the LCD module.
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

Check Procedure for LED Test

Check that all the LEDs on the operation panel light up.

Possible Source of Problem	Corrective Action
Faulty cable connection to the CNJ121 or CNJ013 connector on the ECG CONTROL board.	Check the cable connections to the CNJ121 and CNJ013 connectors on the ECG CONTROL board.
Faulty KEY board.	Replace the KEY board.
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

Input Unit

This is used to check if the input analog signal processing circuit detects the lead off condition correctly, using the provided input check jig. If each lead is connected when the input analog signal processing circuit works correctly, the “Normal” message is printed at the right of each electrode lead name in the test result. If a lead is not connected, the “Error” message is printed.

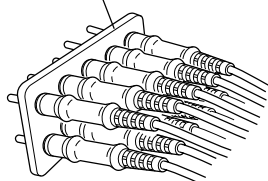
The following is an example printout of the input unit test result when the R(RA) lead is disconnected.

Input unit test result	
RF (RL)	Normal
R (RA)	Error
L (LA)	Normal
F (LL)	Normal
C1	Normal
C2	Normal
C3	Normal
C4	Normal
C5	Normal
C6	Normal

Procedure

1. Connect the electrode lead to the instrument.
2. Attach all tips of each electrode lead to the input check jig.
3. Enter the system test number [05] (Test level 1) or [07] (Test level 2).
4. Disconnect one of the leads from the check jig and press the START/STOP key. The disconnected lead name is printed out.
5. Repeat steps 3 and 4 for all leads by one.

Input check jig



To quit the test, press the AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

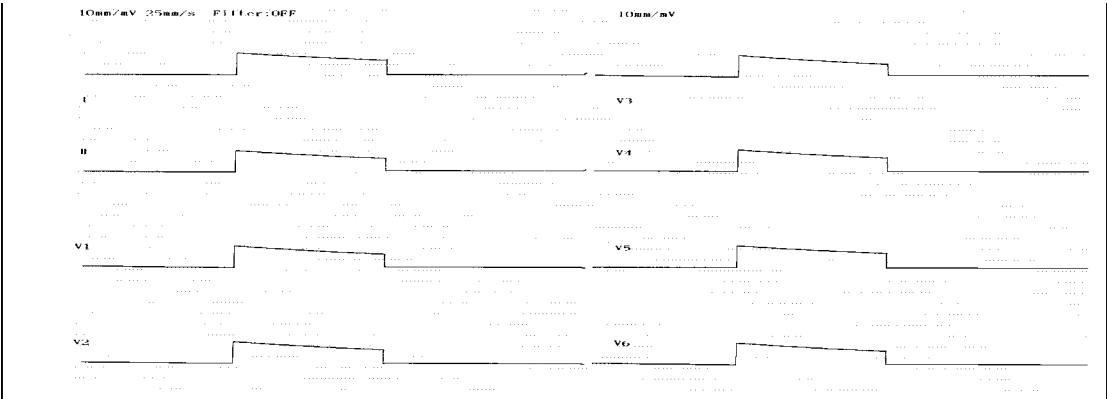
Check Procedure for Input Unit Test

Check that the lead off condition is detected correctly.

Possible Source of Problem	Corrective Action
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.
Faulty input check jig.	Replace the input check jig.

Calibration

This is used to check the sensitivity and time constant of the input analog signal processing circuit. After starting the test, the CAL waveforms for leads I, II and V1 to V6 are printed as shown below. If all the rectangular printed CAL waveforms have the amplitude of 1 mV and time constant of more than 3.2 seconds, the sensitivity and time constant of the input analog signal processing circuit are normal.



Procedure

- 1. Connect the electrode lead to the instrument.
- 2. Attach all tips of each electrode lead to the input check jig.
- 3. Enter the system test number [06] (Test level 1) or [08] (Test level 2) and press the START/STOP key.

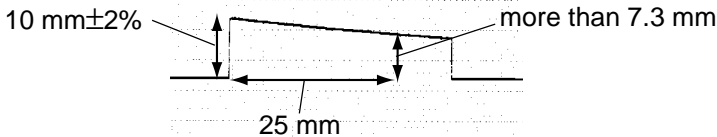
After all CAL waveforms for eight leads are printed, the test automatically ends and the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

Check Procedure for Calibration Waveforms

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: more than 7.3 mm from the rising point of the CAL waveform



Possible Source of Problem	Corrective Action
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

Communication

This is used to check the external communication input/output line of the instrument, using the check jig. The instrument has one standard communication connector (SIO). This test is performed by comparing the original test patterns sent from the output line with the test patterns received at the input line. If any received test pattern is different from its original, a “Error” message is printed. A “Normal” message is printed if the communication line is normal. With regard to TxD-RxD line, if the same data is printed, the line is normal.

Every time the test of one set is repeated, the number of “Count of test” increases by one. Every time the error is detected during continuous test, the “Error count” increases by one. The test of one set takes about 5 seconds.

The following is an example printout of the communication test result.

Communication test result (Count of test:	1)	Error count
		0
DTR-DSR:	Normal	
RTS-CTS:	Normal	
TxD:	00	
RxD:	00	
Hospital	NIHON KOHDEN HOSPITAL	
Model	9130K	
Version	01-05	
Input unit version	01-01	
Analysis version	01-03	
Date	Oct 16, 1998 10:41 AM	
Cardiograph internal temp	37.0 C	

Preparation

A locally made check jig is required for the test. To make the check jig, short-circuit the pins as shown below.

Connector Pin Assignment

- | | | |
|----|-----|--------------|
| 1. | FG | |
| 2. | TXD | ┌───┐ |
| 3. | RXD | |
| 4. | RTS | ┌───┐ |
| 5. | CTS | |
| 6. | DSR | ┌──────────┐ |
| 7. | GND | |
| 8. | HS | |
| 9. | DTR | |

Mating Connector

Connector: HDEB-9PF (05)
Case: HDE-CTH

4. SYSTEM TEST AND SETTING

Procedure

1. Connect the check jig to the SIO socket of the instrument.
2. Enter the system test number [07] (Test level 1) or [09] (Test level 2) and press the START/STOP key.

The instrument prints the test result of each test if the instrument detects an “Error”.

To print the test result without quitting the test, press the START/STOP key. The results of all tests performed until the START/STOP key are pressed are printed. You can see the number of tests and the number of errors on “Count of test” and “Error count” on the printout, respectively.

To quit the test, press the AUTO/MANUAL key. The instrument prints the results of all tests performed until the AUTO/MANUAL key is pressed. When the test result is completely printed, 8 repeating “pips” sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Serial Communication

Check that no error messages appear.

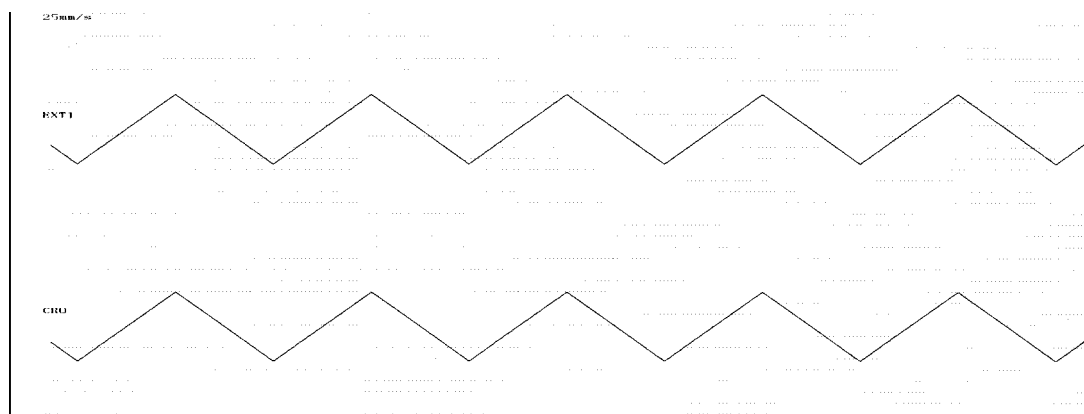
Possible Source of Problem	Corrective Action
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

CRO/EXT1 & CRO/EXT2

This is used to check the external output/input terminal, using the check jig. The instrument has two input signal terminals (EXT-IN connector) and the output signal terminal (CRO-OUT connector) at the rear of the instrument.

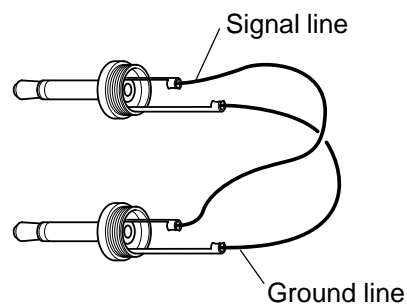
In this test, the instrument prints the known triangular waveform signals generated inside the instrument at the lower trace on the recording paper the moment the instrument outputs the signals from the CRO-OUT terminal to the EXT-IN connector. At the same time, the instrument prints the triangular waveform signals input to the EXT-IN connector at the upper trace on the recording paper. There is no delay time between the printed waveforms on the upper and lower traces.

The following is an example printout of the CRO/EXT1 test result.



Preparation

A locally made check jig is required for the test. To make the check jig, use the two 3.5 ϕ monaural jacks and leads and solder the signal line and ground line of the two jacks with leads as shown below.



4. SYSTEM TEST AND SETTING

Procedure

1. Connect the check jig to the CRO-OUT/EXT-IN sockets of the instrument.
2. To check the signal line between the CRO-OUT and EXT-IN1, enter the system test number [08] (Test level 1) or [10] (Test level 2) and press the START/STOP key.

To check the signal line between the CRO-OUT and EXT-IN2, enter the system test number [09] (Test level 1) or [11] (Test level 2) and press the START/STOP key.

To quit the test, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

Check Procedure

Check that the shape of the two printed triangular waveforms are the same and there is no delay time between them.

Possible Source of Problem	Corrective Action
Faulty ECG CONTROL board.	Replace the ECG CONTROL board.

System Setup Initialization

This is used to reset all the system settings to the factory initial settings.

NOTE

The following settings are not reset to the factory initial settings even if the instrument is initialized.

- date and time*
- recording resolution setting*
- cue mark position*
- elapsed time
- saved ECG data
- display language**
- hospital name**
- direct/modem connection**
- local language font

For settings marked with *, refer to the following corresponding subsection in this section; for settings marked with **, refer to “Changing Settings Before Measurement (System Setup Screen)” in the ECG-9110K/9130K operator’s manual.

Procedure

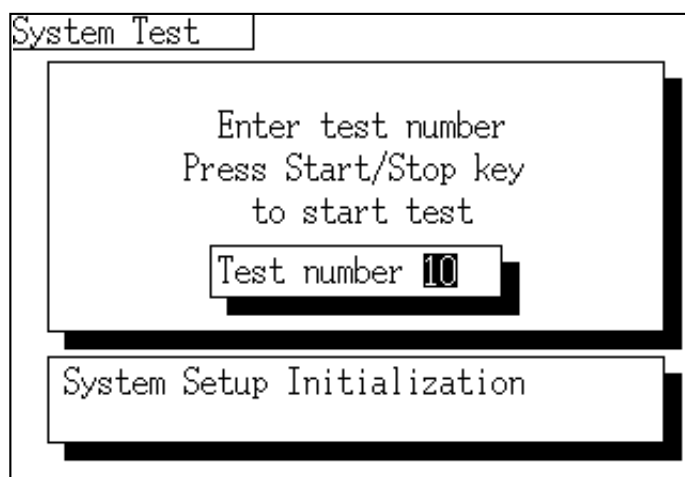
Enter the system test number [10] (Test level 1) or [12] (Test level 2) and press the START/STOP key.

If the initialization is completed, the following occurs:

- ECG-9110K: One “bing bong” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.
- ECG-9130K: A “System Setup Initialization” message appears with one “bing bong” alarm sound and the instrument returns to the standby mode for entering the system test number.

Refer to the ECG-9110K/9130K operator’s manual for the factory initial settings.

Following is the LCD display after the system has been initialized.



ECG Findings List Recording

This is used to print out the list of all ECG findings used for the instrument. The instrument informs you of the ECG finding as a result of the ECG interpretation when analyzing the ECG.

Procedure

Enter the system test number [11] (Test level 1) and press the START/STOP key.

When the list is completely printed, one “bing bong” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

To cancel printing the list, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

Recording Resolution Setting

This is used to adjust the thermal head recording resolution after the thermal head is replaced with a new one or when the printout is not clearly, evenly and completely printed.

Normally, the resistor value of the heating element on the thermal head is a specific value which varies from thermal head to thermal head. Even if the same energy is applied to the thermal head, the recording quality varies due to the difference of the thermal head resistor value. Therefore, adjusting the thermal head recording resolution is required to evenly print regardless of the thermal head resistor value.

Do the following procedure to automatically adjust the thermal head recording resolution.

Procedure

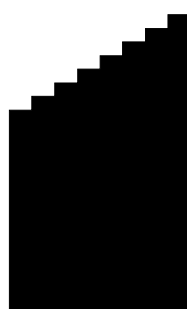
Enter the system test number [02] (Test level 2) and press the START/STOP key.

After adjustment is completed, the instrument prints out the test result as shown below and returns to the standby mode for entering the system test number.

A number of 1 to 8 is printed at the right of “Thermal head level” if the thermal head resolution is adjusted correctly. An “Error” is printed when it is necessary that the thermal head is replaced with a new one.

The following is an example printout of the Recording Resolution Setting system test.

Thermal head level: 4

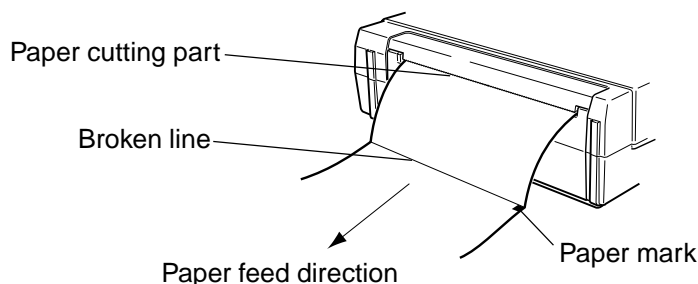


Cue Mark Adjustment

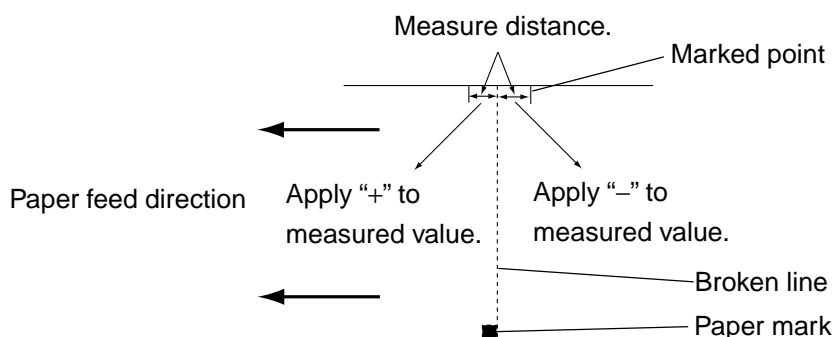
This is used to adjust the distance (mm) between the broken line on the recording paper and paper cutting part on the top casing so that the paper can be just cut at the broken line. The ideal adjustment is that the broken line on the paper lines up with the cutting part on the top casing when cutting the paper.

Procedure

1. Enter the system test number [21] (Test mode 2) and press the START/STOP key to verify the distance between the broken line on the paper and the paper cutting part. The instrument feeds the recording paper with the "Cue mark adjustment (0.0 mm)" message and stops feeding it after a paper mark is detected. The right edge of the paper mark against the paper feed direction lines up the broken line on the paper.
2. Put the paper to the paper cutting part as if the paper was cut as shown below. If the broken line lines up the paper cutting part, you do not have to perform this adjustment. If there is a deviation between the broken line and paper cutting part, go to step 3.



3. Mark the point where the paper is at the paper cutting part.
4. Measure the distance (mm) between the broken line and marked point.



5. Apply the plus symbol "+" to the measured value when the marked point is before the broken line against the paper feed direction or minus symbol "-" to the measured number when the marked point is behind the broken line. The resulting value is recognized as the adjustment value.

The following is a list of the relationship between the adjustment value and its corresponding system test number you should execute.

System Test No.	Adjustment Value (mm)	System Test No.	Adjustment Value (mm)
[13]	– 4.0	[21]	0.0
[14]	– 3.5	[22]	+ 0.5
[15]	– 3.0	[23]	+ 1.0
[16]	– 2.5	[24]	+ 1.5
[17]	– 2.0	[25]	+ 2.0
[18]	– 1.5	[26]	+ 2.5
[19]	– 1.0	[27]	+ 3.0
[20]	– 0.5	[28]	+ 3.5

6. Enter the appropriate system test number [xx] and press the START/STOP key. The “Cue mark adjustment [xxx mm]” message is printed and the instrument returns to the standby mode for entering the system test number. The adjustment is completed.
7. Verify that the broken line on the paper lines up with the cutting part on the top casing.

Date and Time Setting

The date and time of the instrument are set in the System Setup mode. In the System Setup mode, you can also set the entire system settings of the instrument which determines the operation conditions of the instrument. Refer to the ECG-9110K/9130K operator's manual for details.

This setting is necessary when the back-up battery (lithium battery) is completely or almost completely discharged or replaced with a new one. The life time of the back-up battery is about 7 years. You can note whether the back-up battery is completely or almost discharged by the system error message. Refer to the "System Error Message" section in Section 3.

Setting the Date and Time

1. Call up the System Setup mode
 - 1) If the power is on, turn it off.

NOTE

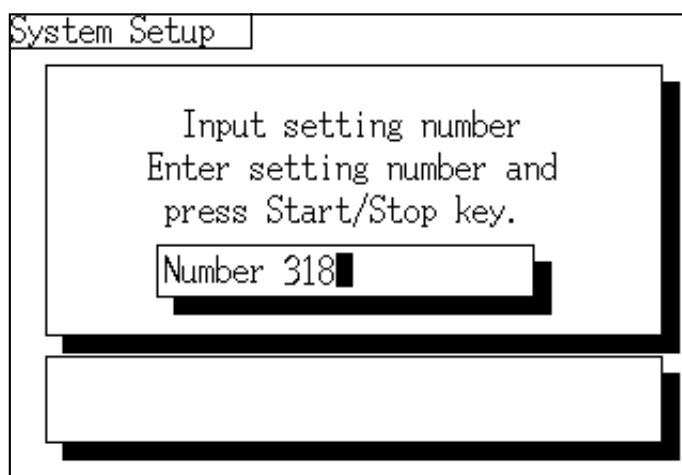
Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information "Error 05" at the end of printing.

- 2) Press the POWER key while pressing the COPY/CAL key. Hold the COPY/CAL key until the instrument begins to print the list of the system setup settings. The System Setup mode is called up.

To cancel printing the list, press the START/STOP key.

2. Enter a 3-digit number to call up the standby mode for entering the new numbers for year, month/date, hour/minute or second, respectively. Refer to the "Entering the System Test Number" in this section for entering the numbers.

Following is the LCD screen when the year setting mode is called up.



Year

Enter the system setup number [318].

Month/date

Enter the system setup number [319].

Hour/minute

Enter the system setup number [320].

Second

Enter the system setup number [322].

To cancel the entered number, press the AUTO/MANUAL key.

NOTE

You cannot enter numbers for “second” setting.

3. Enter a 4-digit number to enter the new numbers of the year, month/date or hour/minute. The range of the number which is possible to enter is as follows:

Year

[1980] to [2079]

Month/date

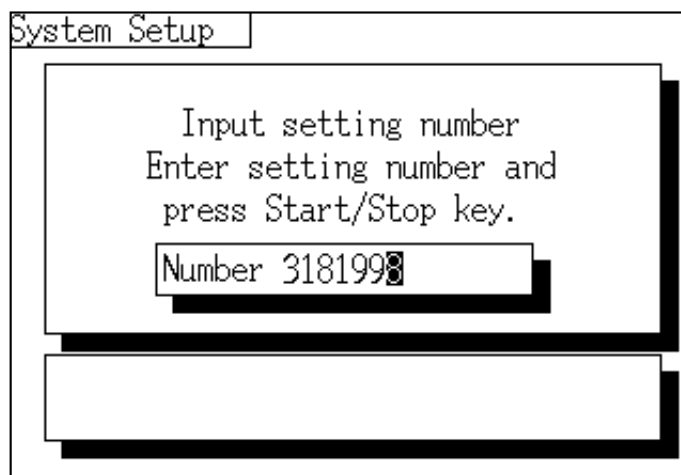
[0101] to [1231]

Hour/minute

[0000] to [2359]

To cancel the entered number, press the AUTO/MANUAL key.

Following is the LCD screen when the year “1998” is entered.



NOTE

- When the START/STOP key is pressed in the “second” setting mode, the second is reset to “00” seconds and the instrument starts working from “00” seconds.
- If the power of the instrument is turned off before the START/STOP key is pressed, the newly entered numbers are invalid.

4. Press the START/STOP key to save the new numbers. The newly entered numbers are automatically printed.

Following is the LCD screen when year “1998” is saved.



If you entered an unspecified number, an alarm occurs. The alarm indication is different between the ECG-9110K and ECG-9130K as follows:

- ECG-9110K: 8 repeating “pips” alarm sound is generated.
- ECG-9130K: 8 repeating “pips” alarm sound and the “Invalid number. Please re-enter number” error message is displayed.

To re-enter the system test number, do either of the following:

- Delete the previously entered number by pressing the AUTO/MANUAL key.
- Enter the system test number by overwriting the previously entered number.

5. Repeat steps 2 to 4 to enter the new numbers for the other setting.
6. Turn the power of the instrument off to exit the System Setup mode.

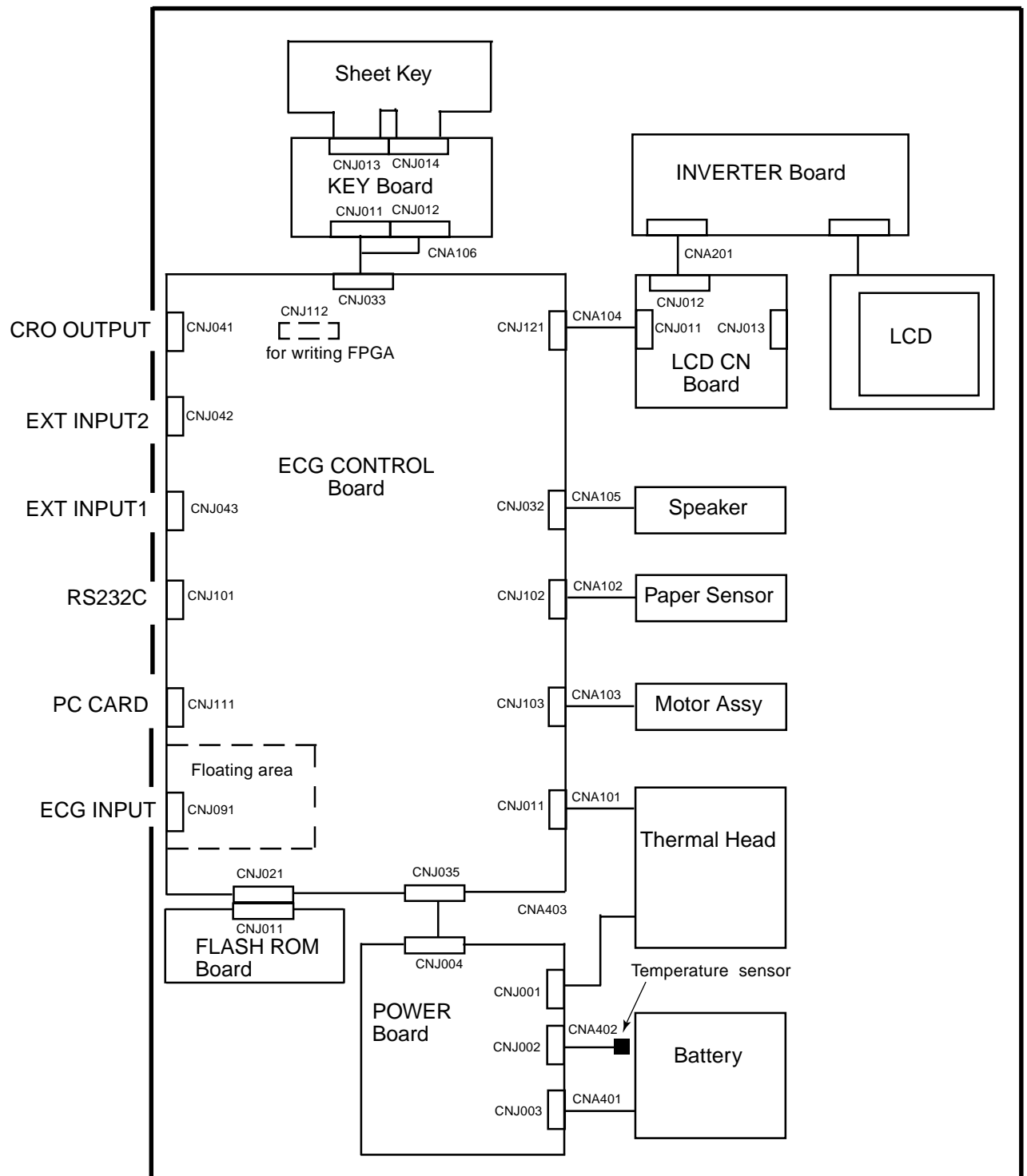
Section 5 Board/Unit Description

Block Diagram	5.1
Power Unit.....	5.2
ECG CONTROL Board	5.2
FLASH ROM Board	5.3
INVERTER Board	5.3

Block Diagram

NOTE

The sheet key, KEY board, LCD module, LCD CN board and INVERTER board are used for the ECG-9130K only.



Power Unit

The power unit consists of the power source, battery charging and control circuits. The power unit uses the switching regulation method to produce the power required for the instrument.

ECG CONTROL Board

The ECG CONTROL board consists of the following components:

<u>Component</u>	<u>Description</u>
CPU:	MC68EC020 (Operating frequency: 25 MHz)
ROM:	For system software, 2 MB
DRAM:	Main memory, 1 MB
Flash memory:	For font of local language, 1 MB For filing data, 256 KB
Real time clock:	For monitoring back-up battery, built-in 140 B SRAM
Timer:	1 ms timer Interrupt request signal ON/OFF: selectable Operation mode: fixed
Serial interface:	Equivalent to RS-232C, 1 channel Baud rate: 2,400 to 115,200 bps selectable
Speaker circuit:	Beep sound, Sound by noise generator
Interrupt request:	Auto-vector method
Interface:	To ECG input section
Recorder:	8 dots/mm
LCD:	320 × 240 dots
Controller:	For keyboard
A/D converter:	8,000 samples/s, 10 bits

FLASH ROM Board

The FLASH ROM board has a 2 MB flash ROM for writing the control program, analysis program, Japanese font and English font to the ROM. Also, there is a space for mounting an EEPROM.

INVERTER Board

The INVERTER board produces the power for the LCD backlight module using +12 VDC power from the power unit, and turns on/off the power of the instrument according to the signal from the ECG CONTROL board.

Section 6 Disassembly and Assembly

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

Before You Begin

Removing, replacing and installing major components should be done by qualified service personnel.

Warnings and Cautions

WARNINGS

- To avoid the possibility of injury to yourself or damage to the instrument, do not install or remove any component or change switch settings while the power is on and wait 10 minutes before installing to or removing any component from the instrument after the power is off.
 - To avoid accidental discharge of static electricity which could damage the instrument components, use a wrist ground strap when installing or removing any component of the instrument.
-
-

CAUTIONS

- Before connecting or disconnecting any cables, turn off the instrument, unplug the AC power cord from the instrument and remove the rechargeable battery.
 - Fuses cut off the power when an abnormality occurs in the instrument. Eliminate the malfunction before replacing the fuse. Use the correct fuse only. The fuse rating is shown on the holder.
 - Removal and replacement of any component in the instrument should be done by qualified service personnel.
 - Use only parts recommended by Nihon Kohden to assure maximum performance from your instrument.
-
-

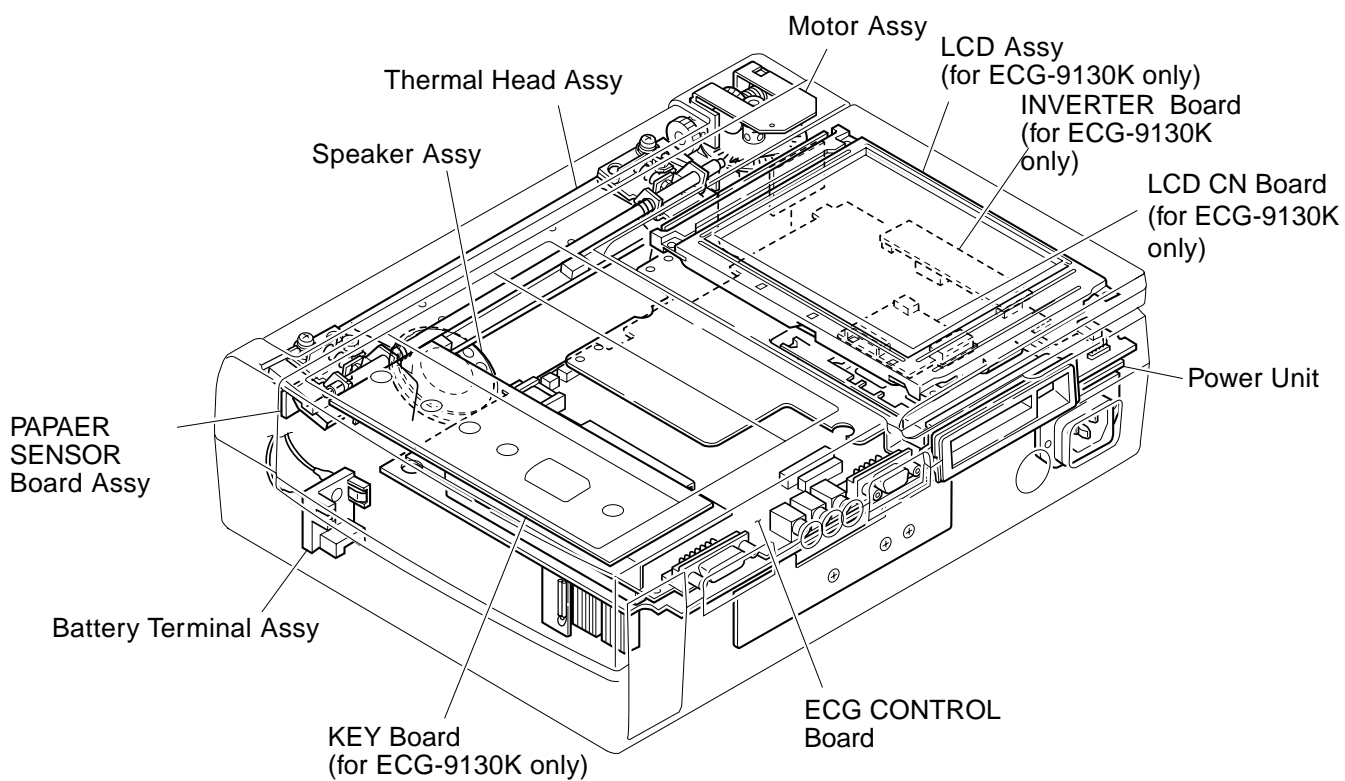
Required Tools

- Anti-static bench mat
- Wrist ground strap
- Phillips screwdriver (insulated type)
- Flat-blade screwdriver (insulated type)
- Hex (Allen) wrench or hex keys
- Hex driver
- Tweezers

Board and Unit Location

The following see-through diagram shows the location of the boards and units in the instrument.

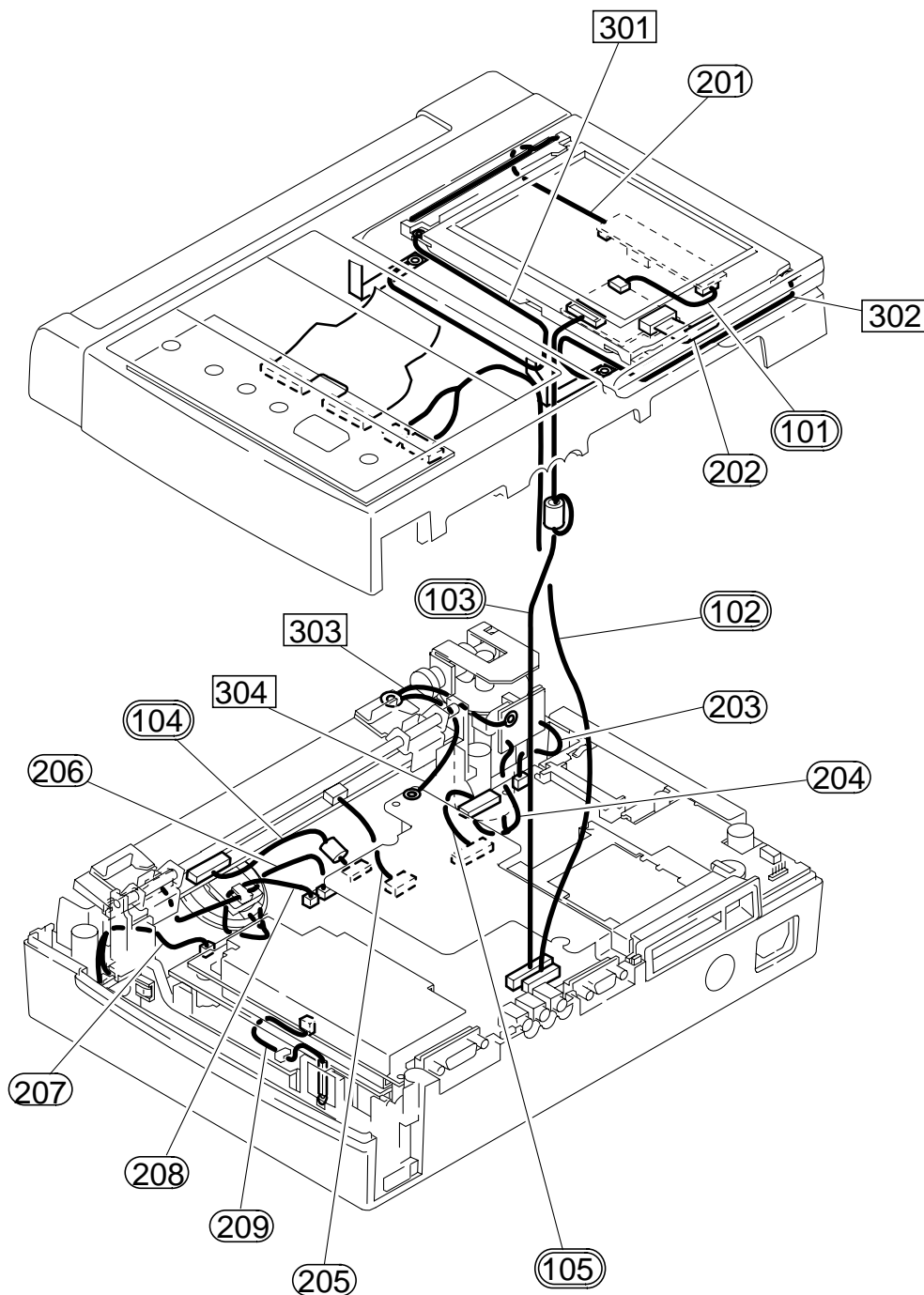
See-through Diagram



Cable Connection

The following cable connection diagram shows the connection of the cables in the instrument. Refer to “Connection Diagram” in Section 1 for details with regard to each cable.

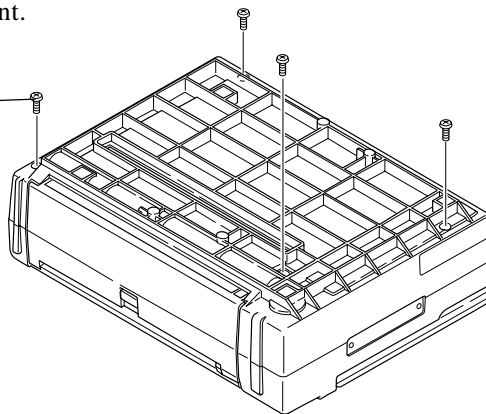
Cable Connection Diagram



Removing the Top Casing Assy

1. Turn off the instrument, unplug the AC power cord and remove the rechargeable battery.
2. Remove the four M3 pan head screws with spring washers from the bottom of the instrument.

M3 pan head screw
with spring washer

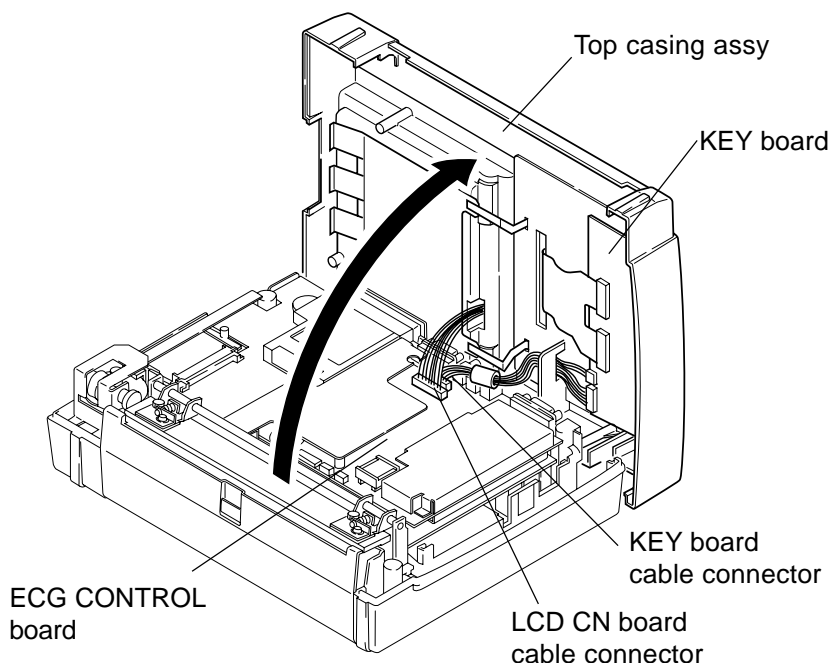


CAUTION

When opening the top casing assy, be sure not to let the top casing assy fall off. Otherwise, the two cables which connect the following boards and the their connectors may be damaged.

- LCD CN board and ECG CONTROL board
- KEY board and ECG CONTROL board

-
3. Open the top casing assy in the direction of the arrow shown below. Be careful not to pull the cables between the top and bottom casings.
 4. Disconnect the LCD CN board cable connector and KEY board cable connector from the ECG CONTROL board.

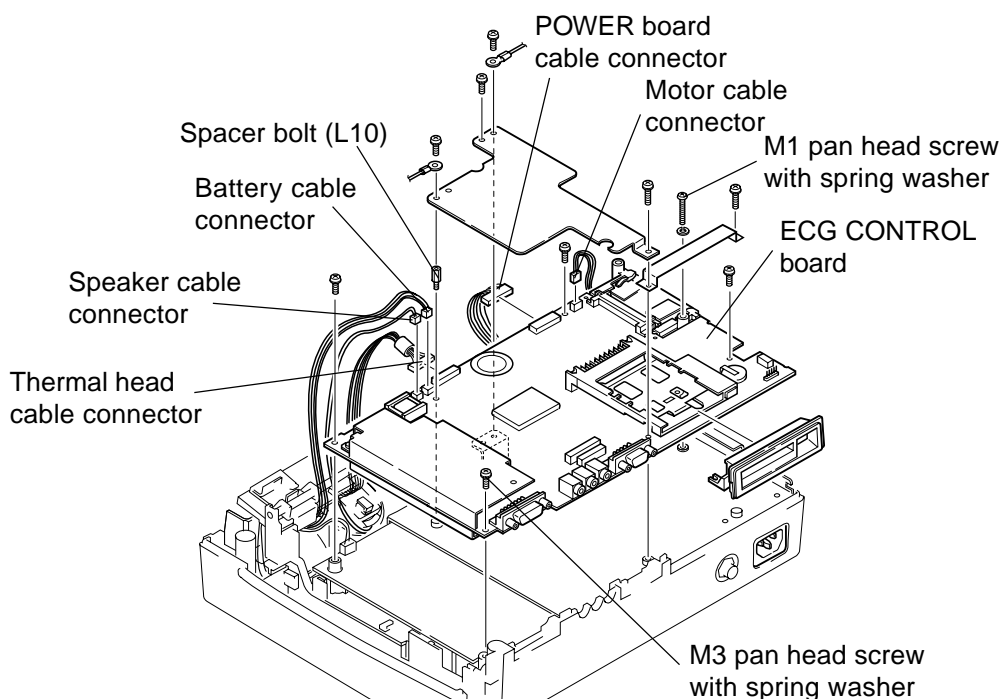


Removing the ECG CONTROL Board

CAUTION

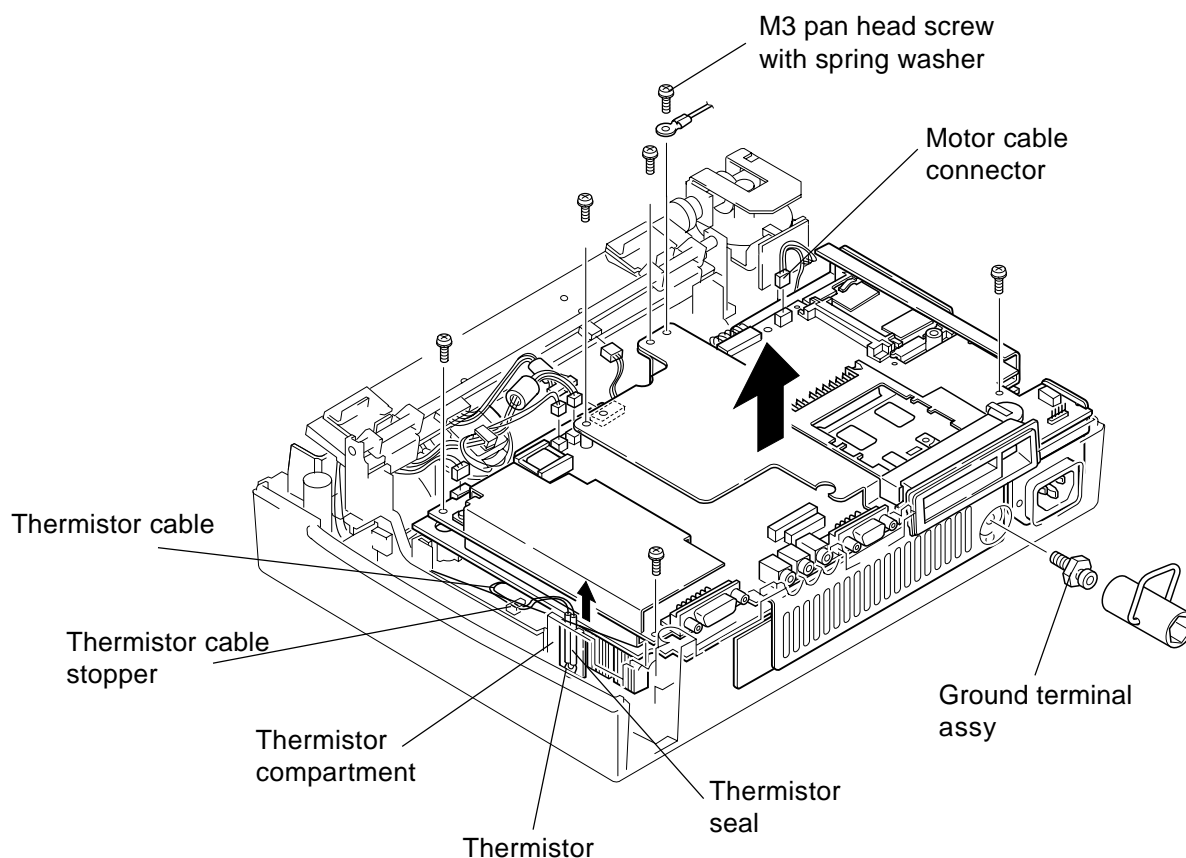
Local language text is stored in the flash memory on the ECG CONTROL board. When the ECG CONTROL board is replaced, local language text is not available; only English text is available. To use the ECG with your own language after the ECG CONTROL board is replaced, you must reload the local language files to the ECG. Refer to the YZ-012H6 Translator Support Tool operator's manual.

1. Remove the top casing assy as described in the "Removing the Top Casing Assy" section.
2. Remove the nine M3 pan head screws with spring washers and M1 pan head screw with spring washer.
5. Remove the spacer bolt (L10).
6. Disconnect the following five connectors from the ECG CONTROL board.
 - Motor cable connector
 - POWER board cable connector
 - Battery cable connector
 - Speaker cable connector
 - Thermal head cable connector
7. Lift off the ECG CONTROL board from the POWER board.

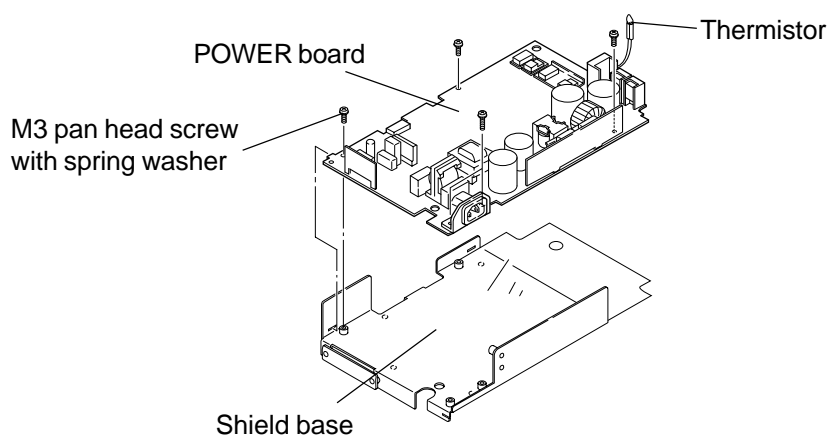


Removing the Power Unit and POWER Board

1. Remove the top casing as described in the “Removing the Top Casing Assy” section.
2. Remove the ECG CONTROL board as described in the “Removing the ECG CONTROL Board” section.
3. Remove the ground terminal assy.
4. Remove the five M3 pan head screws with spring washers holding the power unit to the bottom casing.
5. Remove the thermistor cable from the thermistor cable stopper and pull out the thermistor compartment.
6. Lift off the power unit from the bottom casing in the direction of the arrow.



6. Remove the five M3 pan head screws with spring washers to separate the POWER board from its shield base.



Replacing the Thermistor

CAUTION

To prevent incorrect temperature measurement, the thermistor must be positioned so that only the tip is just past the edge of the transparent thermistor seal.

1. Replace the thermistor so that only the tip of the thermistor is just past the edge of the transparent thermistor seal.

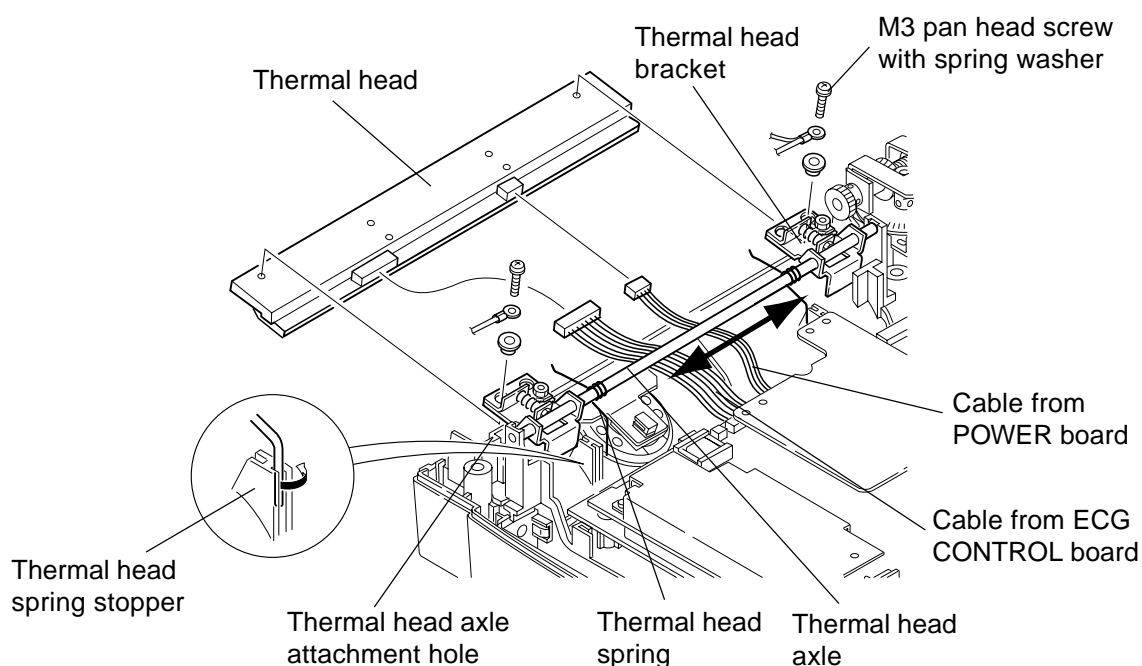
Removing the Thermal Head

CAUTION

- Do not touch the surface of the thermal head with your bare hands. This can cause some dots of the thermal head to malfunction. If you touch the surface of the thermal head, clean it with the provided thermal head cleaner pen or cotton moistened with alcohol.
- After replacing the thermal head, the following two adjustments are required.
 - Thermal head position. Refer to “Adjusting Thermal Head Position” in Section 7.
 - Recording resolution. Refer to “Recording Resolution Setting” in Section 4.

Removing the Thermal Head Only

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Use a flat-blade screw driver to pry out the two thermal head springs from each thermal head spring stopper as shown in the expanded illustration below.
3. Remove the two pan head screws with spring washers holding the thermal head to the thermal head bracket.
4. Disconnect the two cables from the POWER board and ECG CONTROL board.
5. Pull out the thermal head.



Removing the Thermal Head with the Thermal Head Bracket, Thermal Head Spring and Thermal Head Axle

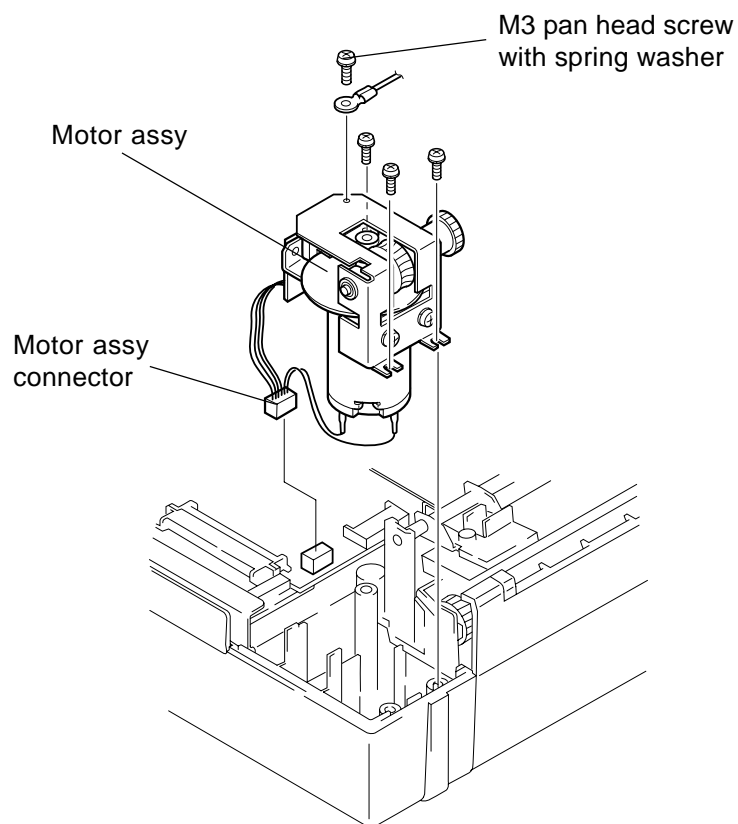
1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Use a flat-blade screw driver to pry out the two thermal head springs from the thermal head springs stopper as shown in the expanded illustration below.
3. Disconnect the two cables from the POWER board and ECG CONTROL board.
4. Push the thermal head axle in either direction of the two-way arrow shown in the previous page and lift off the one end of the thermal head axle from its attachment hole.
5. Lift off the other end of the thermal head axle from its attachment hole.

Removing the Motor Assy

CAUTION

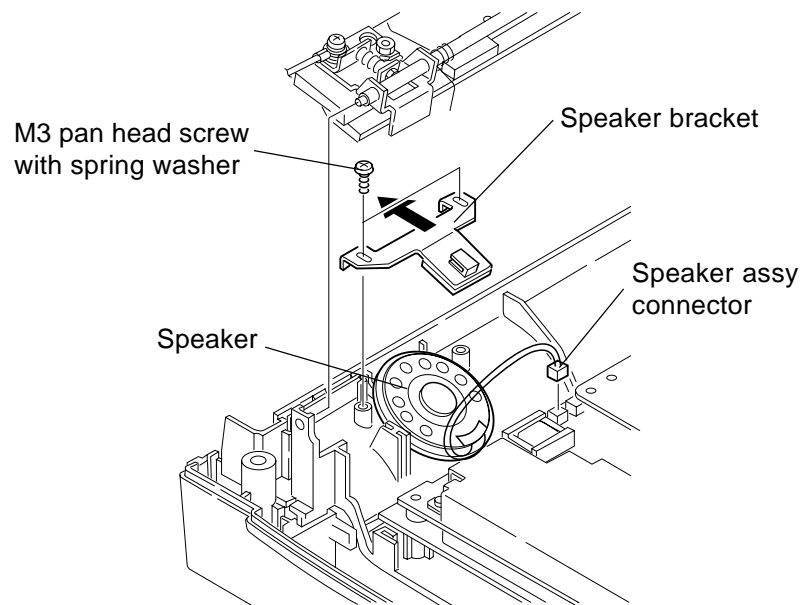
Adjusting the motor assy position is required when the motor assy is replaced. Refer to “Adjusting Backlash between Motor Gear and Platen Axle Assy Gear” in Section 7.

1. Remove the top casing as described in the “Removing the Top Casing” section.
2. Remove the three M3 pan head screws with spring washers holding the motor assy to the bottom casing.
3. Disconnect the motor assy connector from the ECG CONTROL board.
4. Lift off the motor assy from the bottom casing.



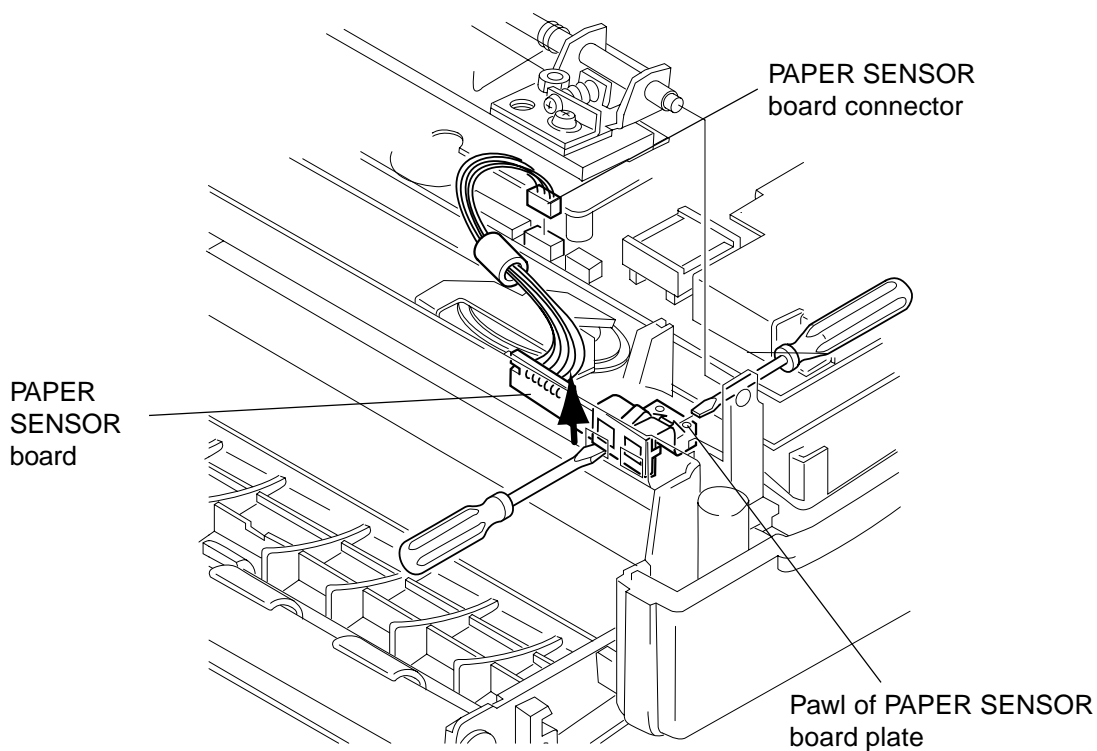
Removing the Speaker Assy

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the two M3 pan head screws with spring washers holding the speaker bracket to the recorder base.
3. Disconnect the speaker assy connector from the ECG CONTROL board.



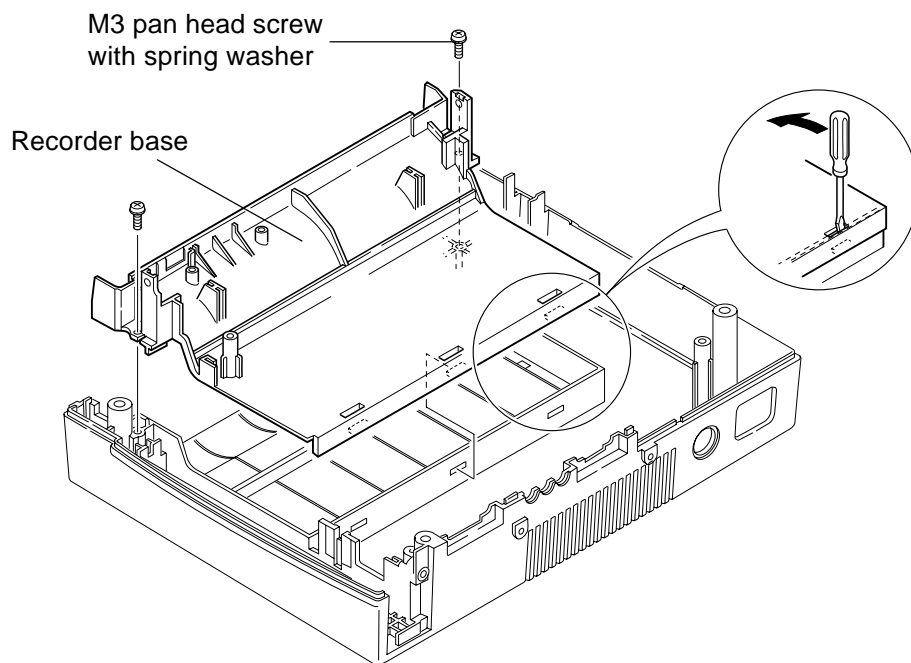
Removing the PAPER SENSOR Board Assy

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the thermal head with the thermal head bracket, thermal head spring and thermal head axle as described in the “Removing the Thermal Head with the Thermal Head Bracket, Thermal Head Spring and Thermal Head Axle” section.
3. Disconnect the PAPER SENSOR board connector from the ECG CONTROL board.
4. Use a flat-blade screwdriver to pry out the pawl of the PAPER SENSOR board plate from the recorder base.
5. Hold up the PAPER SENSOR board to make a space between the PAPER SENSOR board and recorder base so that the tip of the flat-blade screwdriver can be inserted in the space as shown below.
6. Move the flat-blade screwdriver in the direction of the arrow shown below to lift off the PAPER SENSOR board from the recorder base.



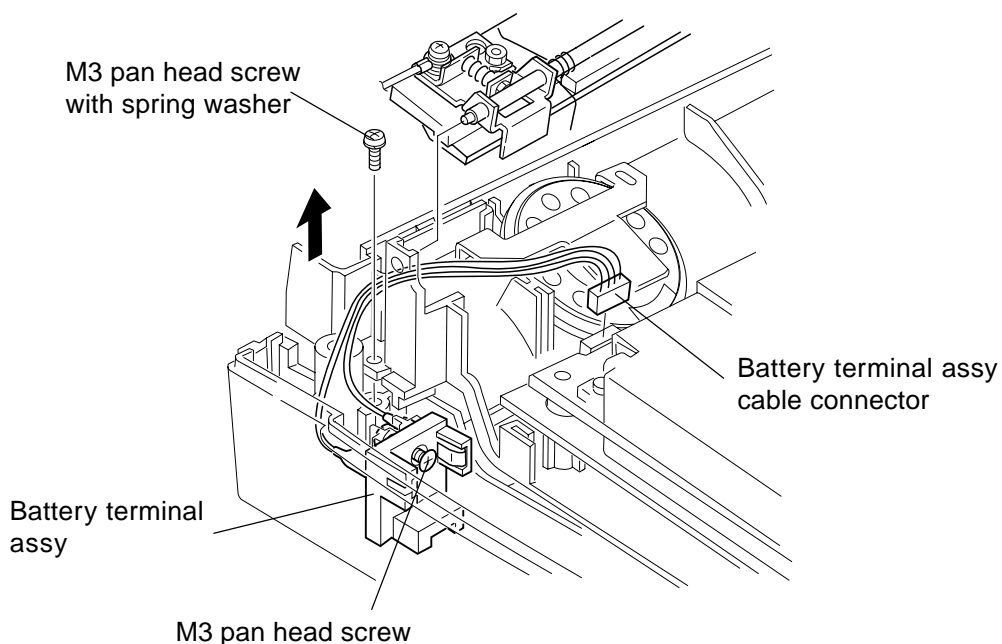
Removing the Recorder Base

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the ECG CONTROL board as described in the “Removing the ECG CONTROL Board” section.
3. Remove the power unit as described in the “Removing the Power Unit and POWER Board” section.
4. Remove the thermal head with the thermal head bracket, thermal head spring and thermal head axle as described in the “Removing the Thermal Head with the Thermal Head Bracket, Thermal Head Spring and Thermal Head Axle” section.
5. Remove the two M3 pan head screws with spring washers holding the recorder base to the bottom casing.
6. Use a flat-blade screwdriver to pry out the three pawls of the recorder base from the bottom casing as shown in the expanded illustration below to separate the recorder assy from the bottom casing.



Removing the Battery Terminal Assy

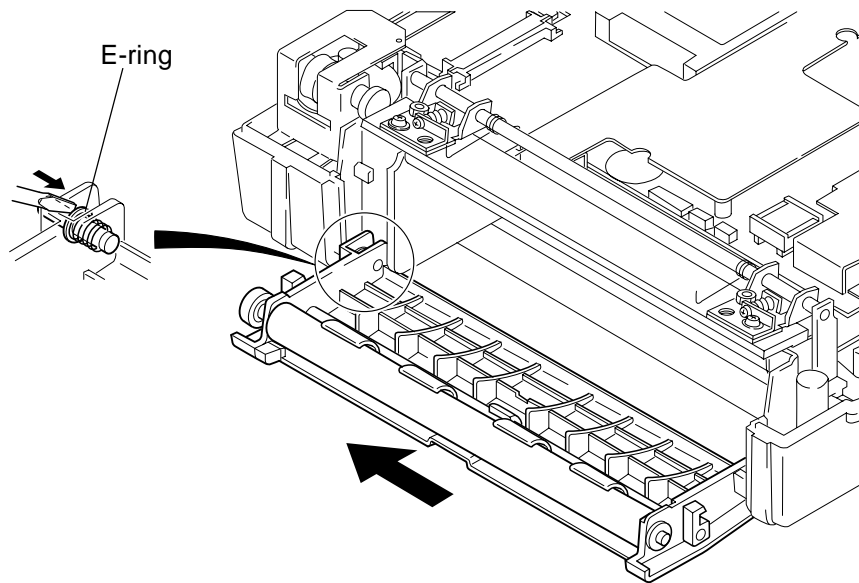
1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the thermal head with the thermal head bracket, thermal head spring and thermal head axle as described in the “Removing the Thermal Head with the Thermal Head Bracket, Thermal Head Spring and Thermal Head Axle” section.
3. Remove the motor assy as described in the “Removing the Motor Assy” section.
4. Remove the Motor assy as described in the “Removing the Motor Assy” section.
5. Remove the recorder base as described in the “Removing the Recorder Base” section.
6. Remove the two M3 pan head screws with spring washers holding the battery terminal assy to the bottom casing.
7. Remove the battery terminal assy cable connector from the POWER board.
8. Remove the two M3 pan head screws holding the battery terminal assy to the bottom casing.
9. Lift off the battery terminal assy from the bottom casing.



Removing the Magazine Assy

Removal

Put the tip of the small flat-blade driver in the space between the E-ring and magazine chassis then push the E-ring in the direction of the smaller arrow and pull off the magazine assy in the direction of the bigger arrow.



Replacement

Put the plastic magazine shaft into the attachment hole and put the metal magazine shaft with the E-ring and spring into the attachment hole while pressing and holding down the shaft in the direction of the smaller arrow.

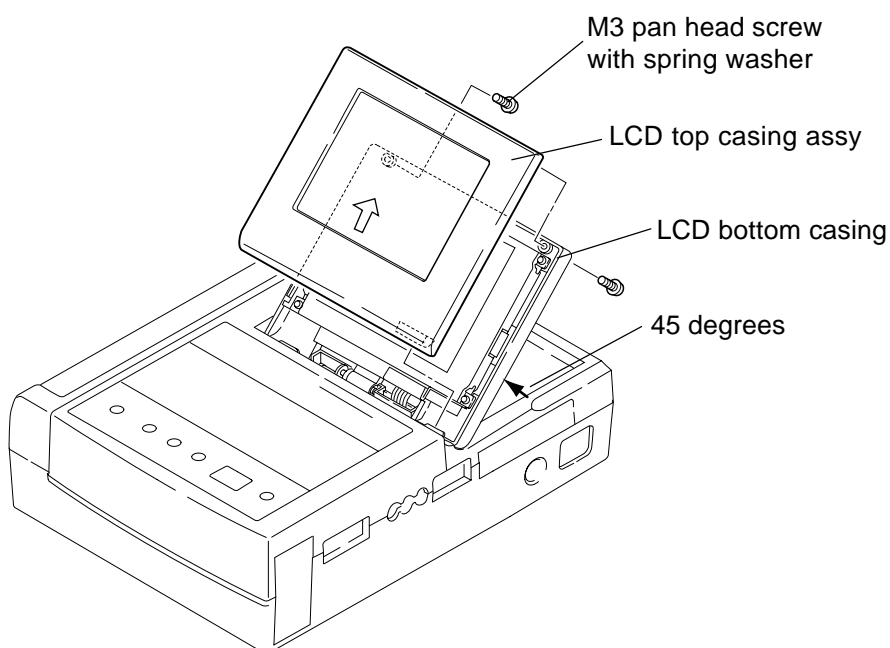
Removing the LCD Assy, INVERTER Board and LCD CN Board

NOTE

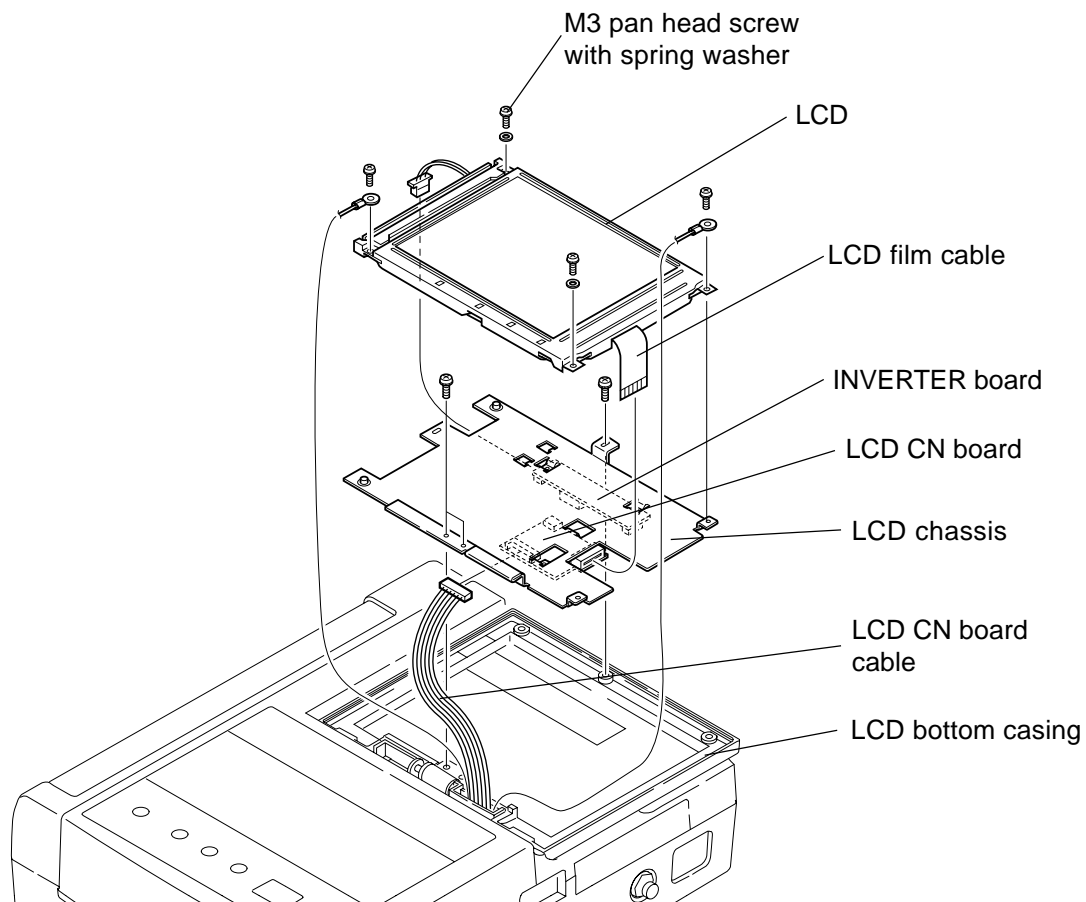
This procedure is for the ECG-9130K only.

Removing the LCD Assy

1. Tilt the LCD with an angle of 45 degrees.
2. Remove the two M3 pan head screws with spring washers holding the LCD bottom casing to the LCD top casing assy.
3. Lift off the top casing assy from the bottom casing in the direction of the



4. Remove the three M3 pan head screws with spring washers holding the LCD chassis to the LCD bottom casing.
5. Remove the four M3 pan head screws with spring washers to separate the LCD and LCD chassis.
6. Disconnect the LCD film cable and LCD CN board cable from the LCD CN board.



Removing the INVERTER Board

1. Remove the M3 pan head screw holding the INVERTER board to the LCD chassis.

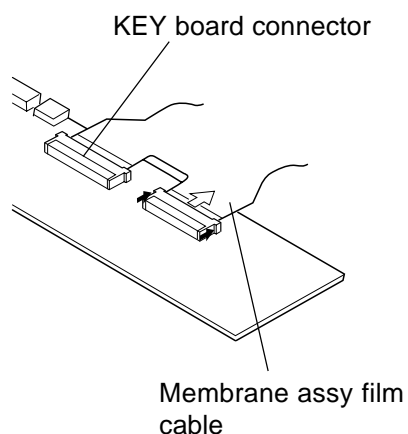
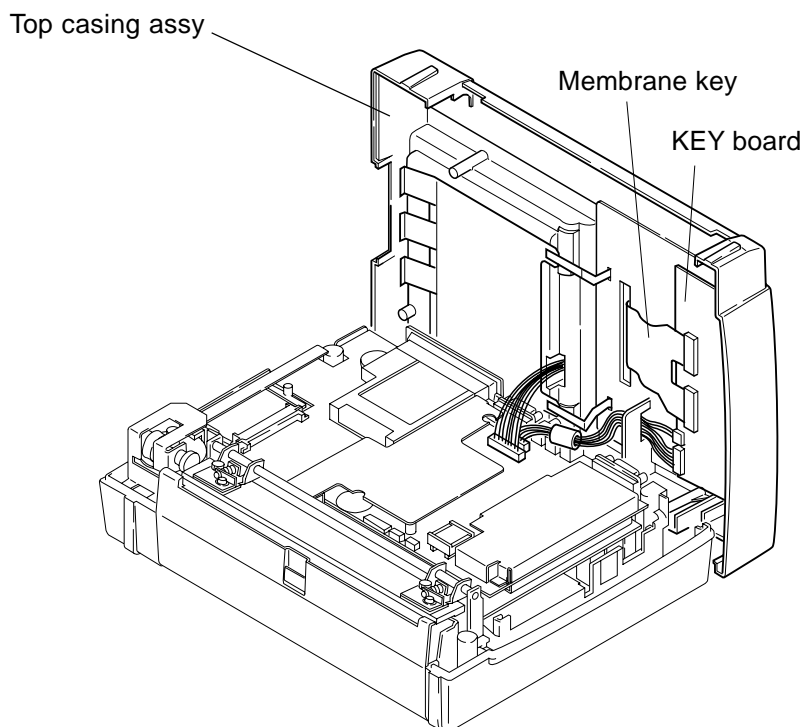
Removing the LCD CN Board

1. Remove the M3 pan head screw holding the LCD CN board to the LCD chassis.

Removing the Membrane Assy Film Cable and KEY Board

Removing the Membrane Assy Film Cable and KEY Board

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.

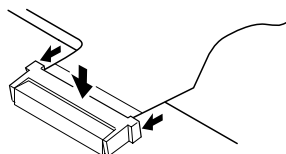


2. Release the locks at both edges of each key board connector in the direction of the black arrows with your fingers as shown to the left.
3. Pull out each membrane assy film cable from each key board connector in the direction of the white arrow as shown to the left.
4. Remove the six M3 pan head screws with spring washers holding the KEY board to the top casing assy.

Replacing the Membrane Assy Film Cable

CAUTION

Before each membrane assy film cable is connected to the connector on the KEY board, tilt each connector with about 20 degrees. Otherwise, each membrane assy film cable cannot be sufficiently inserted into each innermost key board connector.



1. After the KEY board is replaced, tilt each KEY board connector about 20 degrees as shown to the left.
2. Insert each membrane assy film cable into the innermost KEY board connector and push down each key board connector to lock it as shown by the bigger arrow.
3. Push the locks at both edges of each KEY board connector in the direction of the two smaller arrows to lock it.

Removing the Bottom Casing

NOTE

The instrument label is not attached to the bottom of the provided new bottom casing. If you want to attach the instrument label to the new bottom casing, send us the damaged bottom casing, and we will provide the same instrument label at cost price.

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the ECG CONTROL board as described in the “Removing the ECG CONTROL Board” section.
3. Remove the power unit as described in the “Removing the Power Unit and POWER Board” section.
4. Remove the Motor assy as described in the “Removing the Motor Assy” section.
5. Remove the thermal head with the thermal head bracket, thermal head spring and thermal head axle as described in the “Removing the Thermal Head with the Thermal Head Bracket, Thermal Head Spring and Thermal Head Axle” section.
6. Remove the recorder base as described in the “Removing the Recorder Base” section.
7. Remove the battery terminal assy as described in the “Removing the Battery Terminal Assy” section.
8. Remove the magazine assy as described in the “Removing the Magazine Assy” section.

Replacing the Fuse on the POWER Board

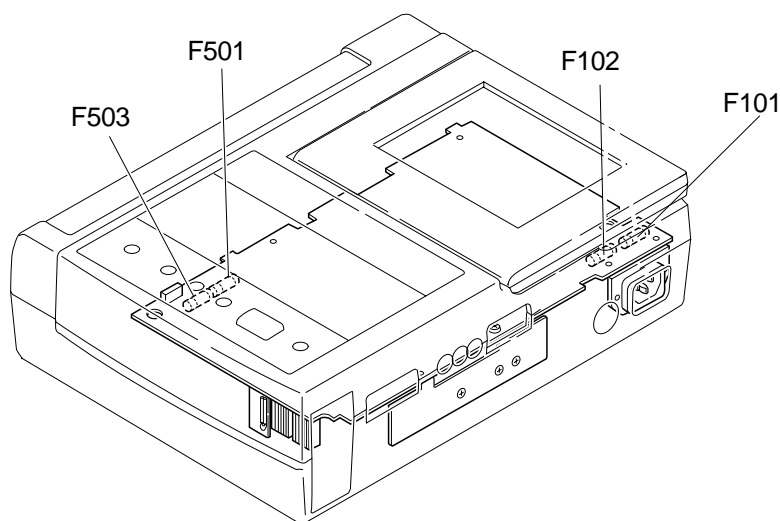
NOTE

A blown fuse indicates that there may be a faulty circuit in the instrument. Always fix the cause of the blown fuse before replacing the fuse.

The illustration below shows the location of the four fuses inside the instrument. Use the correct fuse only. The fuse rating is shown on the fuse holder.

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the ECG CONTROL board as described in the “Removing the ECG CONTROL Board” section.
3. Remove the power unit as described in the “Removing the Power Unit and POWER Board” section.
4. Remove the blown fuse from the fuse bracket with the small flat-blade screwdriver.

<u>Symbol</u>	<u>NK Code No.</u>	<u>Description</u>
F101	273999	2.5A, 250V
F102	273999	2.5A, 250V
F501	322893	2A, 250V
F503	323241	8A, 250V



Replacing the Lithium Battery on the ECG CONTROL Board

The lithium battery is used for backing up the system setup setting.

NOTE

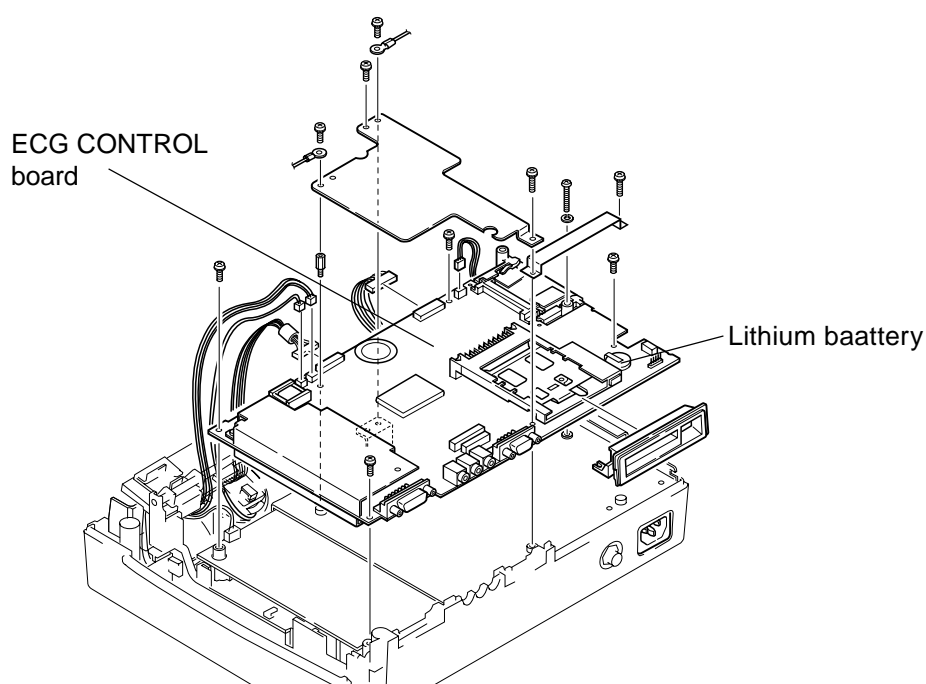
Replace the lithium battery when the No. 08 or 09 system error message appears or after the lithium battery is used for 7 years.

1. Remove the top casing assy as described in the “Removing the Top Casing Assy” section.
2. Remove the ECG CONTROL board as described in the “Removing the ECG CONTROL Board” section.
3. Remove the expired lithium battery with a soldering iron and a pair of tweezers.

CAUTION

Be careful of the polarity of the lithium battery when soldering it. Incorrect attachment of the lithium battery causes the instrument to malfunction.

4. Solder a new lithium battery to the ECG CONTROL board, observing correct polarity of the battery.



Section 7 Adjustment

Adjusting Thermal Head Position 7.1

Changing Magazine Paper Width 7.5

Adjusting Backlash between Motor Gear and Platen Axle Assy Gear 7.6

This section describes:

- how to adjust the thermal head position.
- how to change the magazine paper width.
- how to adjust the backlash of the motor gear.

Required Tools:

Flat-blade screwdriver (insulated type)

Phillips screwdriver (insulated type)

Adjusting Thermal Head Position

Adjust the thermal head position when the printing is not even, some characters or part of a graphic is not printed, or skewing occurs. This adjustment has two parts; the first part adjusts the height of the thermal head, and the second part adjusts the alignment of the printing edge perpendicular to the direction of printing.

When the height of the thermal head over the recording paper is not the same over the entire length of the printing head, printing density differs along the length of the thermal head. A thermal dot that is nearer to the recording paper gives a denser printing than one that is further away. If the thermal dot is too far from the recording paper, no printing can occur on the recording paper below this thermal dot.

When the printing edge of the thermal head is not perpendicular to the direction of printing, skewing occurs because some part along perpendicular width of the recording paper is printed earlier than the other part. This distorts the printed information to one side of the recording paper.

Preparation

1. Remove the top casing assy as described in the "Disassembly and Assembly" section.
2. Do not remove the CNA106 cable from the KEY board.
3. Reattach the magazine with the recording paper set.
4. Call up the test level 2. Refer to "Calling up the Test Level 2" in Section 4.

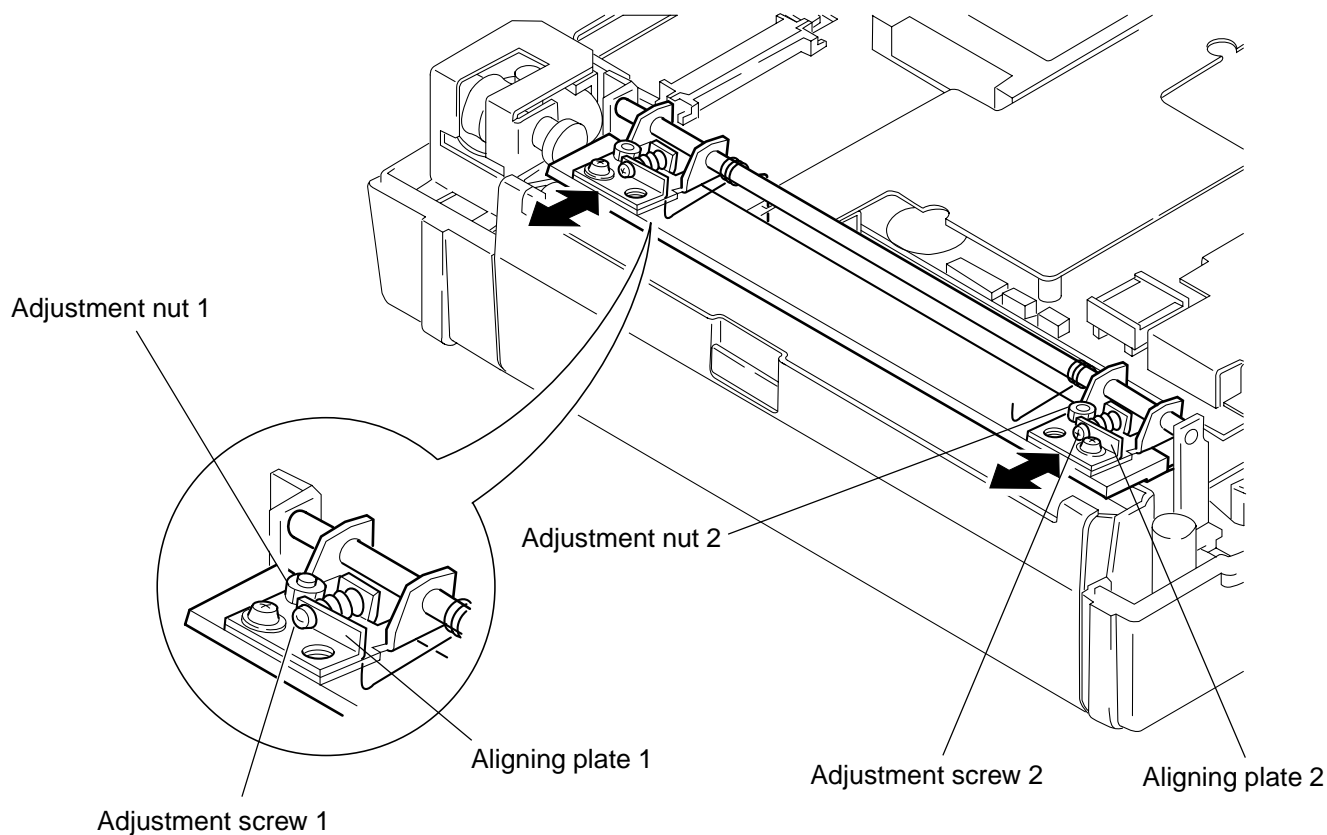
Printing Evenness Check and Correction Procedure

If the printing is uneven with loss of recording information, the following correction procedure allows the instrument to correctly print the recording information.

1. Print the characters “H” and “X”: From the System Test mode (Test level 2), enter the system test number [01] and press the START/STOP key. Refer to “Thermal Head” in Section 4.

To end printing, press the AUTO/MANUAL key.

2. Check the printed test patterns for evenness of recording and no loss of recording information.
3. If the printed test patterns are not even or some information is not printed, adjust the printing evenness using the adjustment nut and screw as shown below. There are two pairs of adjustment nuts and screws at both edges of the thermal head.



- i) If the printed test patterns in the upper area of the recording paper are uneven or blurred, loosen the adjustment nut 1 and turn the adjustment screw 1.

If the adjustment screw 1 is turned, the aligning plate 1 (one end of the thermal head) moves as shown by the two-way arrow in the illustration in the previous page. Turning the screw one full revolution clockwise moves one end of the thermal head 0.5 mm towards the magazine. Turning the screw one full revolution counterclockwise moves one end of the thermal head 0.5 mm away from the magazine.

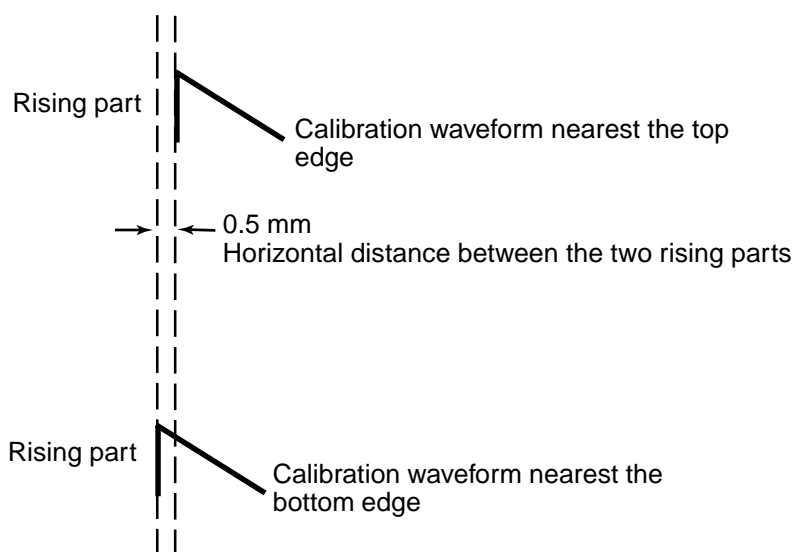
If the test patterns in the lower area of the recording paper are uneven or blurred, loosen the adjustment nut 2 and turn the adjustment screw 2.

- ii) Check the printed test patterns for evenness of recording and no loss of recording information. If the unevenness and blur of the printed test patterns are further worse than before, turn the adjustment screw oppositely against the direction of the screw rotation in the above step i).
- iii) Repeat the printing evenness check and correction procedure until the recording is evenly printed with no loss of recording information.
- iv) If the test patterns are evenly printed with no loss of recording information, go to the following "Skew Check and Correction Procedure" section to print the recording information with no skewing.

Skew Check and Correction Procedure

If the printing skews to one side, do the following correction procedure.

1. Print the calibration waveforms: From the System Test mode (Test level 2), enter the system test number [08] and press the START/STOP key. Refer to "Calibration" in Section 4.
2. To check whether the printing has skewed or not, look at the calibration waveform nearest the top of the recording paper and the calibration waveform nearest the bottom of the recording paper. The printing is considered skewed if the horizontal distance between the two rising parts of these two calibration waveforms is more than 0.5 mm.



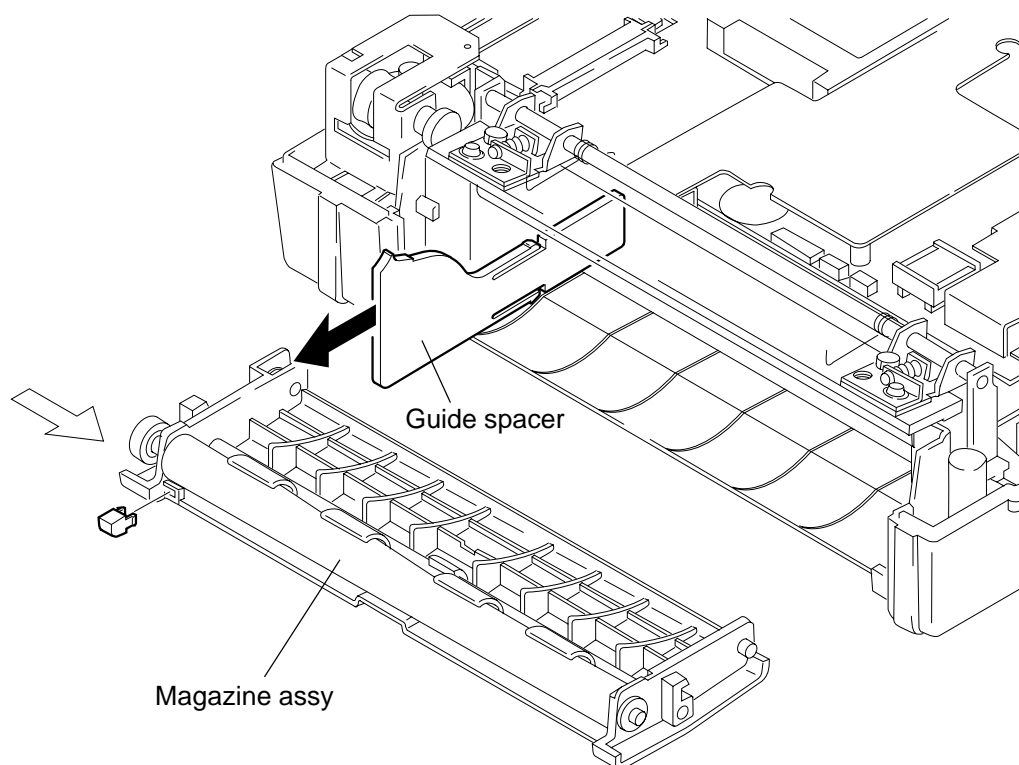
3. To correct the skew, turn the two adjustment screws 1 and 2 until the length of the thermal head is perpendicular to the direction of printing. Turning the screw one full revolution clockwise moves one end of the thermal head 0.5 mm towards the magazine. Turning the screw one full revolution counterclockwise moves one end of the thermal head 0.5 mm away from the magazine.
4. Repeat the printing evenness check and correction procedure and skew check and correction procedure until the recording is evenly printed with no loss of recording information and no skewing.

Changing Magazine Paper Width

The paper width of the magazine can be changed from 210 mm to 216 mm. When the paper width changes, the printing width remains the same.

Changing Procedure

1. Remove the magazine assy as described in the “Disassembly and Assembly” section.
2. Pull out the guide spacer in the direction of the black arrow shown in the illustration below.
3. Attach the magazine assy as described in the “Disassembly and Assembly” section.



Adjusting Backlash between Motor Gear and Platen Axle Assy Gear

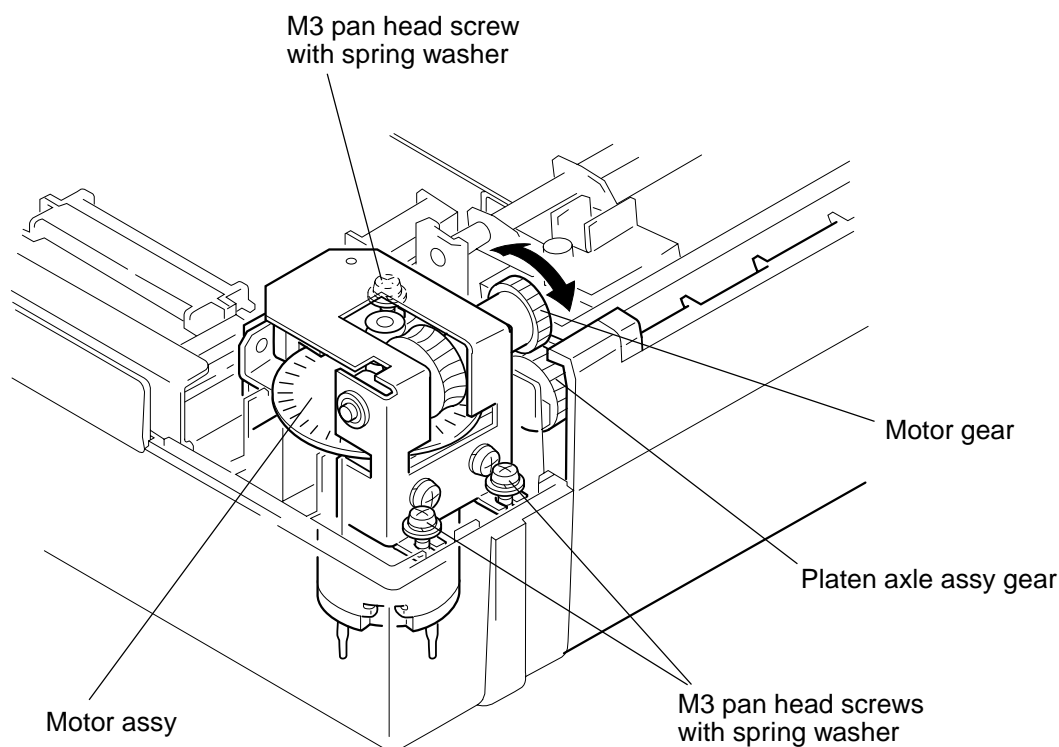
Adjusting the backlash between the motor gear and platen axle assy gear is required for the following:

- After the motor assy is replaced.
- When the recording paper does not feed correctly.

Correct backlash allows the gear to smoothly rotate and the recording paper to correctly feed. If backlash between the motor gear and platen axle is not correct, the recording paper is not fed because the motor does not rotate.

Adjustment Procedure

1. Remove the top casing assy as described in the “Assembly and Disassembly” section.
2. Loosen and fasten the three M3 pan head screws with spring washers holding the motor assy to the bottom casing so that the backlash between the motor gear and platen axle assy gear is 0.2 to 0.3 mm. If the backlash of 0.2 to 0.3 mm correctly exists between the motor gear and platen axle assy gear, the motor gear finely moves as shown by the two-way arrow in the illustration below when you move the motor gear with your finger.



Section 8 Replaceable Parts List

General Parts List	8.2
Top Casing Assy	8.6
Top Casing Assy, YZ-015H3 for ECG-9110K	8.6
Top Casing Assy, YZ-014H4 for ECG-9130K	8.7
Top Casing Assy, YZ-022H2 for ECG-9130P	8.8
Top Casing Assy, YZ-035H7 for ECG-9132K	8.9
Motor Assy, YZ-014H1	8.10
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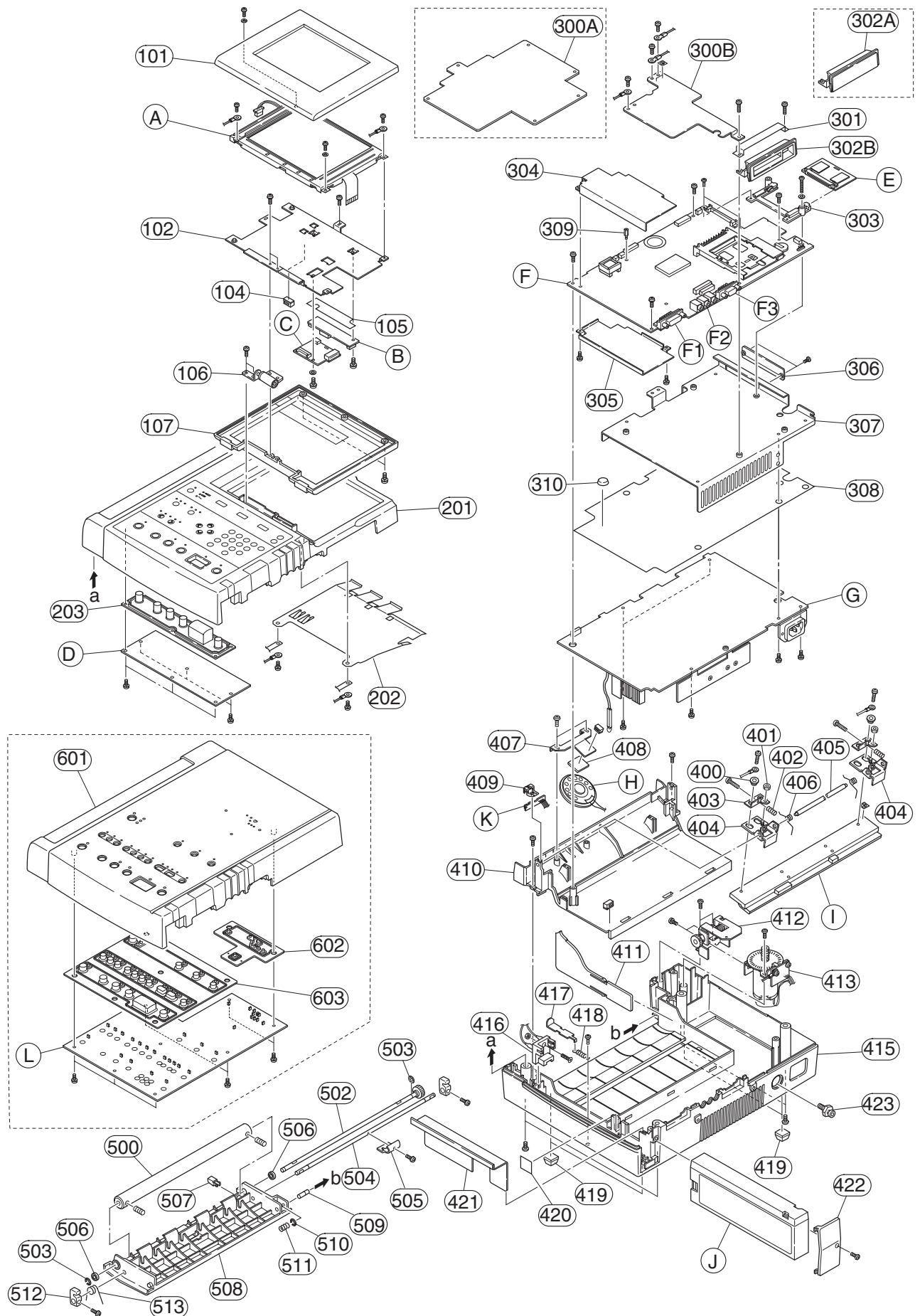
8. REPLACEABLE PARTS LIST

When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are 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 Nihon Kohden parts and accessories to assure maximum performance from your instrument.

General Parts List

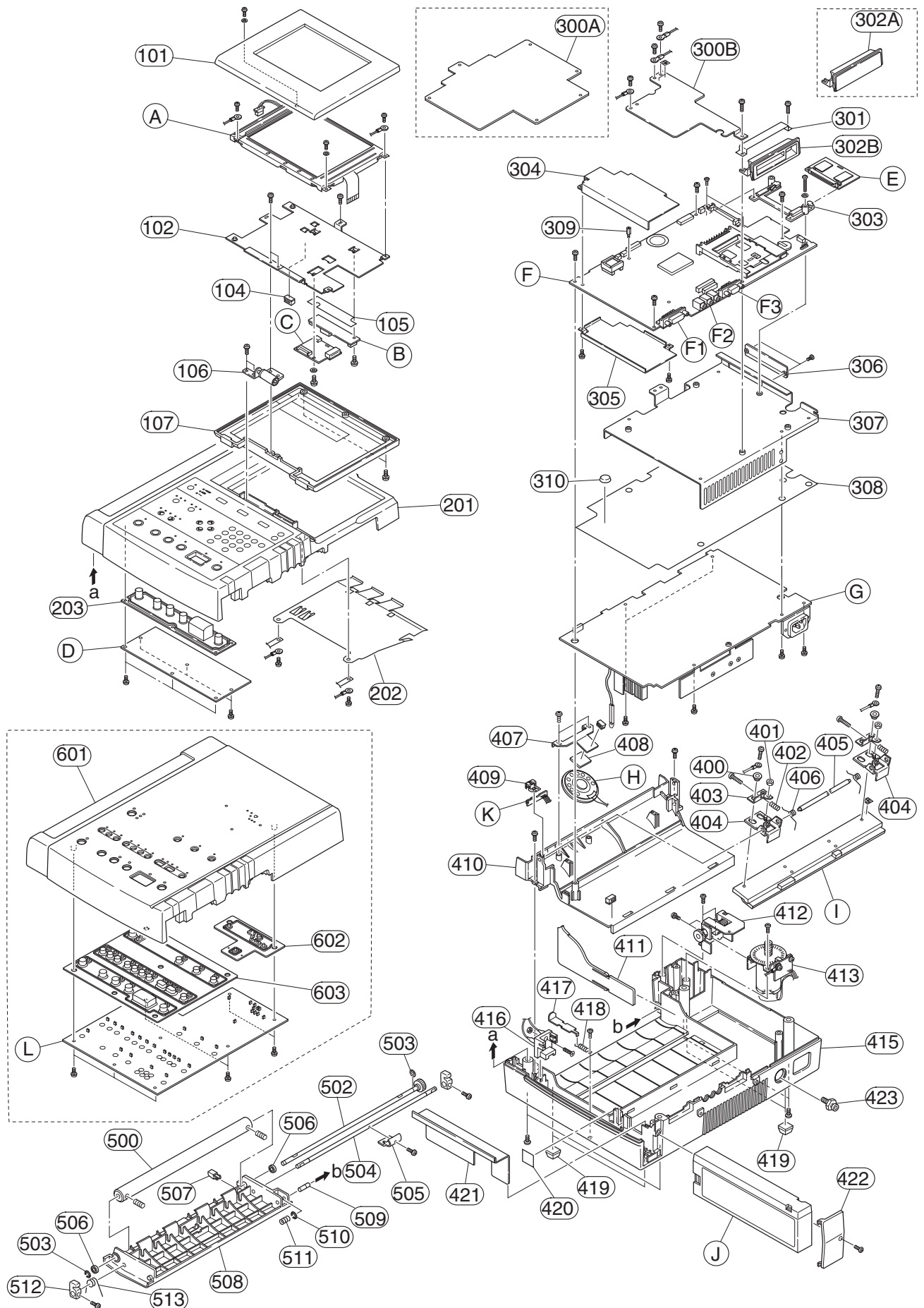
Index	NK Code No.	Qty	Description
101	YZ-013H9	1	LCD top casing Assy
102	6113-029713C	1	LCD chassis
104	547507	1	Mini clamp TMC-6
105	6114-088371A	1	Inverter insulation sheet
106	551877	1	Hinge assy TH-122-3
107	6112-010851A	1	LCD bottom casing
201	YZ-014H4	1	ECG-9130K top casing assy
202	6113-029731C	1	Top casing earth plate
203	6113-029722A	1	Rubber Switch (9100)
300A	6113-032763	1	CPU board EMI plate
300B	6114-094587A	1	CPU board EMI plate
301	6114-094578	1	IC socket EMI plate
302A	6113-030506A	1	Card blank panel
302B	6112-010887A	1	Card holder
303	6113-028492B	1	FLASH ROM board guide
304	6113-028741B	1	Input unit shield plate
305	6113-029927A	1	CPU shield plate
306	6114-087764A	1	Flash ROM board cover
307	6112-010869C	1	Shield base
308	6113-029918B	1	Insulation sheet
309	127925	3	Spacer bolt (L10)
310	547516	1	Rubber spacer TM-166-12
400	515284	2	Bearing B-F3-27
402	551859	2	Ultra spring (No. 5542)
403	6114-091287A	2	Aligning plate
404	6114-091296C	2	Thermal head bracket
405	6114-091198A	1	Thermal head axle
406	6114-091189A	2	Thermal head spring
407	6114-094596	1	SP bracket
408	6114-016921A	1	Coil cushion
409	6114-091224B	1	Mark sensor board plate
410	6111-004708A	1	Recorder base
411	6113-029758	1	Guide spacer
412	YZ-014H0	1	Gear assy
413	YZ-014H1	1	Motor assy
415	6111-004673B	1	Bottom casing
416	YZ-014H5	1	Battery terminal assy
417	6114-091233B	1	Battery spring bracket
418	551868	1	Ultra spring (No. 6544)
419	379742A	4	Rubber foot
420	6114-088398A	1	Thermistor seal
421	6114-091242A	1	Battery holder
422	6112-010878A	1	Battery case cover
423	2144-005598B	1	Ground terminal assy

8. REPLACEABLE PARTS LIST



8. REPLACEABLE PARTS LIST

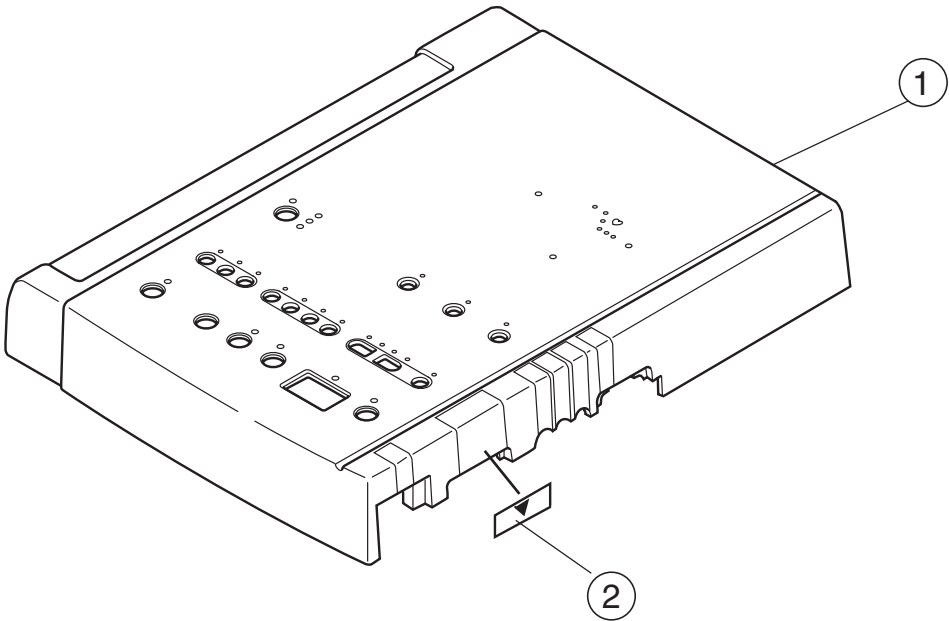
Index	NK Code No.	Qty	Description
500	2249-000983B	1	Platen roller
502	6114-008437A	1	Platen axle assy
503	294397	2	E-ring E-32
504	6114-091171A	1	Magazine lock axle
505	6114-091117A	1	Magazine release lever
506	294949	2	Bearing SS5-8ZZ
507	6114-091126A	1	Magazine spacer
508	6111-004691B	1	Magazine
509	6114-088353A	1	Magazine shaft
510	294397	1	E-ring E-32
511	547534	1	Ultra spring C147
512	6114-091135A	2	Magazine lock
513	6114-071932A	1	Magazine lock spring
601	YZ-015H3	1	ECG-9110K top casing
602	6113-031497A	1	ECG-9110K LED rubber
603	6112-011618A	1	ECG-9110K rubber switch
A	545946	1	LCD module
B	543984	1	INVERTER board
C	UT-2368	1	LCD CN board
D	UT-2367	1	KEY board for ECG-9130K
E	UT-23572	1	FLASH ROM board
F	UT-23581	1	ECG CONTROL board for ECG-9110K
	UT2358	1	ECG CONTROL board for EG-9130K
F1	534771	1	Patient input connector
F2	SG8036	3	EXT-IN 1, 2, CRO OUT connector
F3	JEY-9S-1A2B	1	SIO connector
G	SC-904D	1	Power unit
H	547605	1	Speaker assy
I	357035	1	Thermal head
J	332543B	1	Battery
K	RK-0015	1	PAPER SENSOR board
L	UT-2369	1	KEY board for ECG-9110K



Top Casing Assy

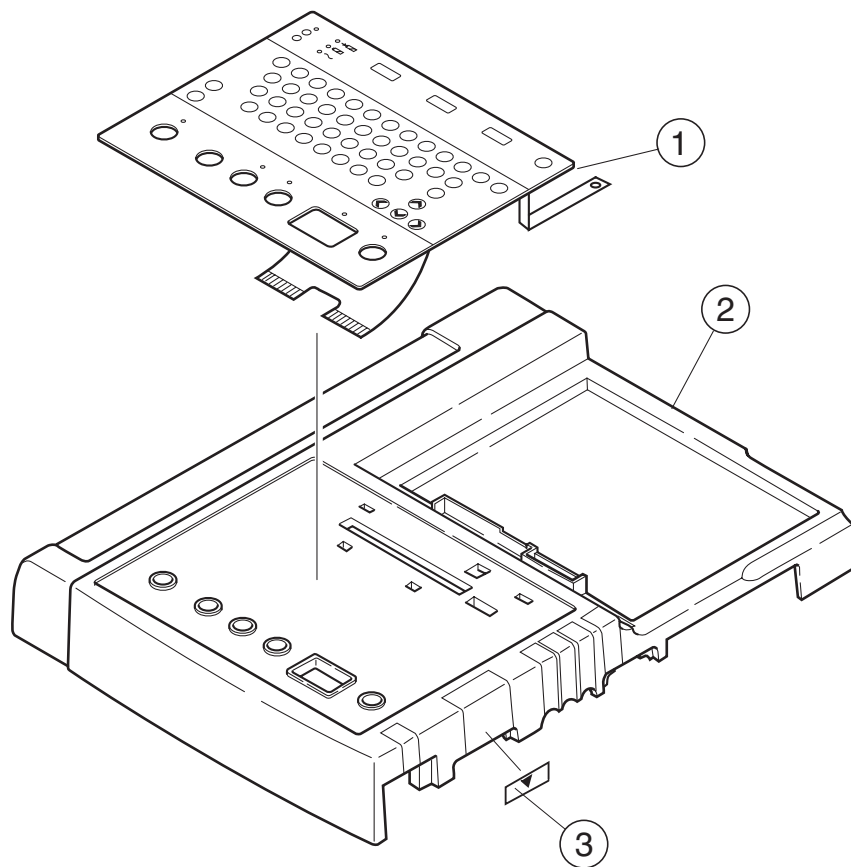
Top Casing Assy, YZ-015H3 for ECG-9110K

Index	NK Code No.	Qty	Description
1	6122-004091A	1	ECG-9110K top casing
2	6124-029113	1	Connector mark label



Top Casing Assy, YZ-014H4 for ECG-9130K

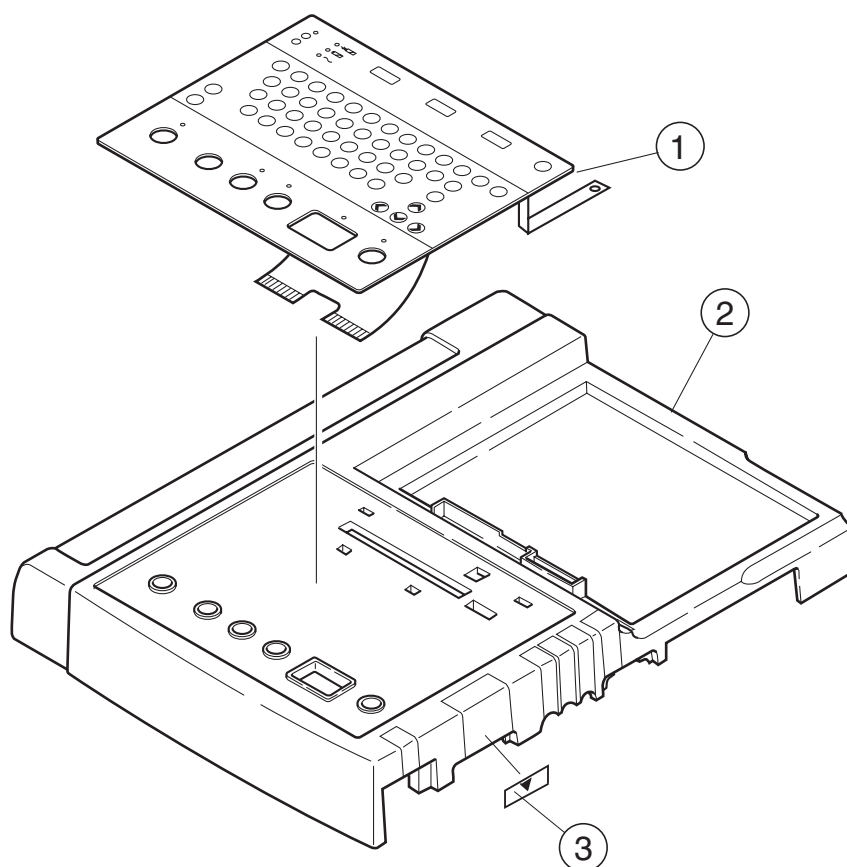
Index	NK Code No.	Qty	Description
1	6143-008493C	1	Membrane key
2	6111-004655B	1	ECG-9130K top casing
3	6124-029113	1	Connector mark label



8. REPLACEABLE PARTS LIST

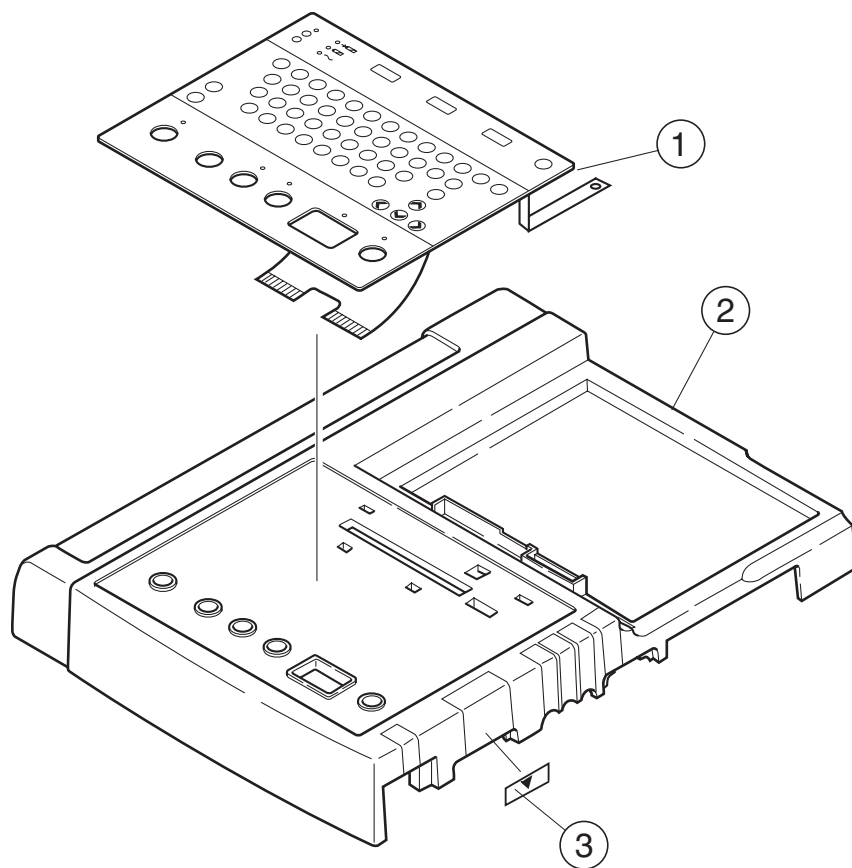
Top Casing Assy, YZ-022H2 for ECG-9130P

Index	NK Code No.	Qty	Description
1	6143-010748	1	Membrane key
2	6111-004655B	1	ECG-9130K top casing
3	6124-029113	1	Connector mark label



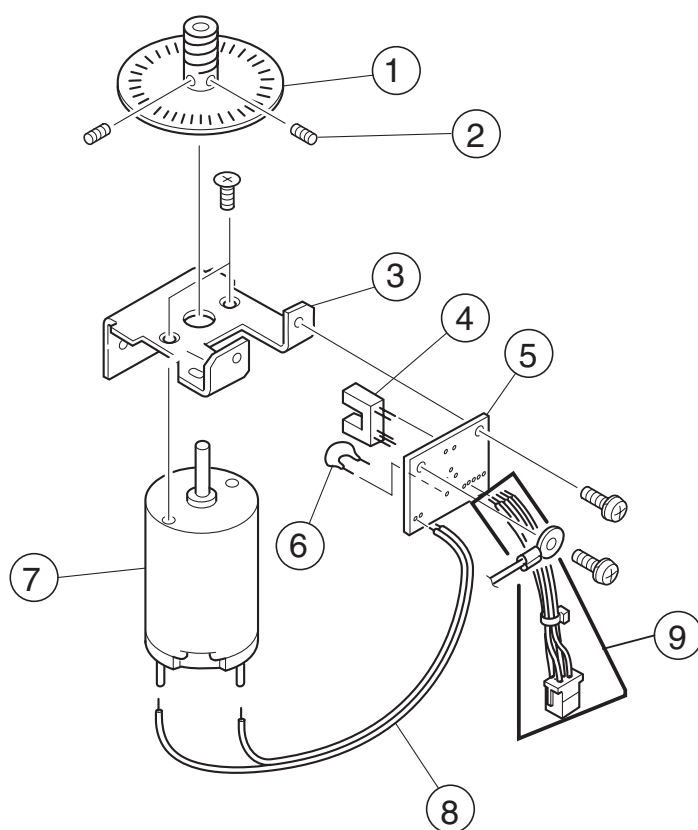
Top Casing Assy, YZ-035H7 for ECG-9132K

Index	NK Code No.	Qty	Description
1	6143-012719	1	Membrane key
2	6111-004655B	1	ECG-9130K top casing
3	6124-029113	1	Connector mark label



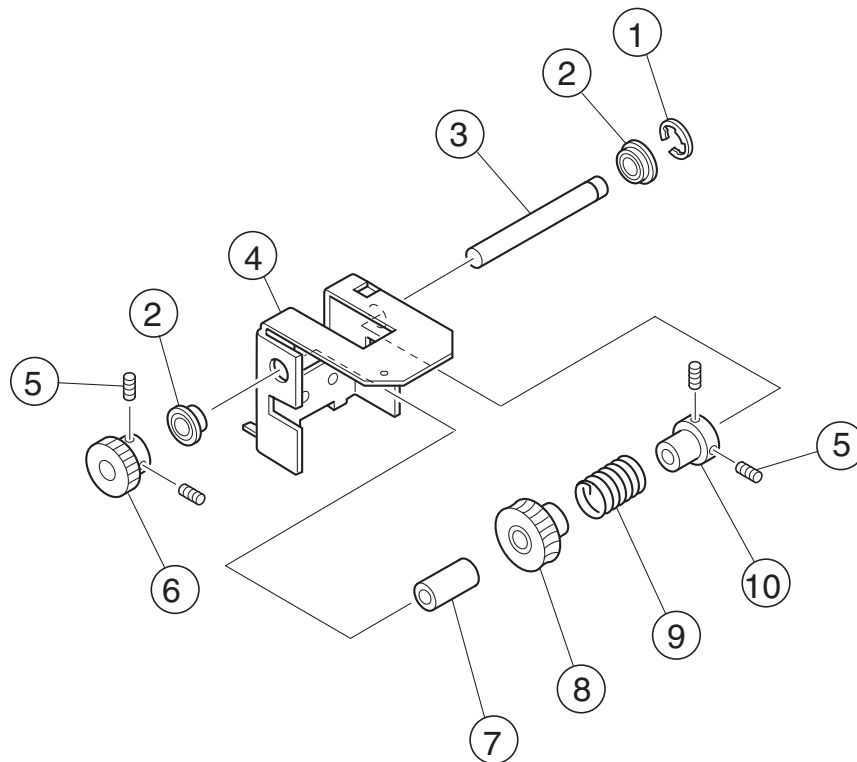
Motor Assy, YZ-014H1

Index	NK Code No.	Qty	Description
1	6144-005752A	1	Worm assy
2	355091	2	Hexagon socket screw
3	6114-091162B	1	Motor bracket
4	387626A	1	Photo-interruptor GP1A53HR
5	6190-018768	1	MOTOR SENS board
6		1	
7	343986	1	DC motor FN30-T253N1E
8	-----	1	Motor cable
9	547561A	1	Motor assy cable



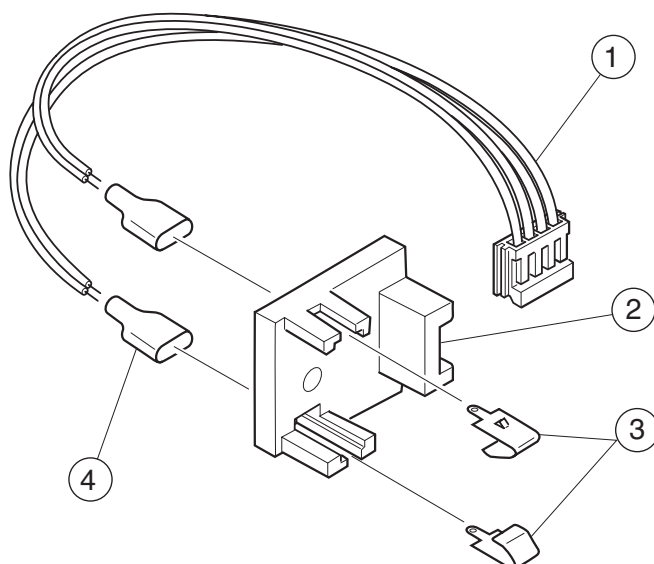
Gear Assy, YZ-014H0

Index	NK Code No.	Qty	Description
1	293479	1	E-ring E-24
2	295164A	2	Miniature DDLF-850ZZH
3	6114-091251A	1	Drive axle
4	6114-091153B	1	Motor holder
5	355126	4	Hexagon socket screw
6	2219-010333	2	Gear A
7	6114-091269A	1	Drive axle collar
8	2144-000103A	1	Worm foil assy
9	1114-012094	1	Clutch spring
10	1114-011888	1	Clutch boss



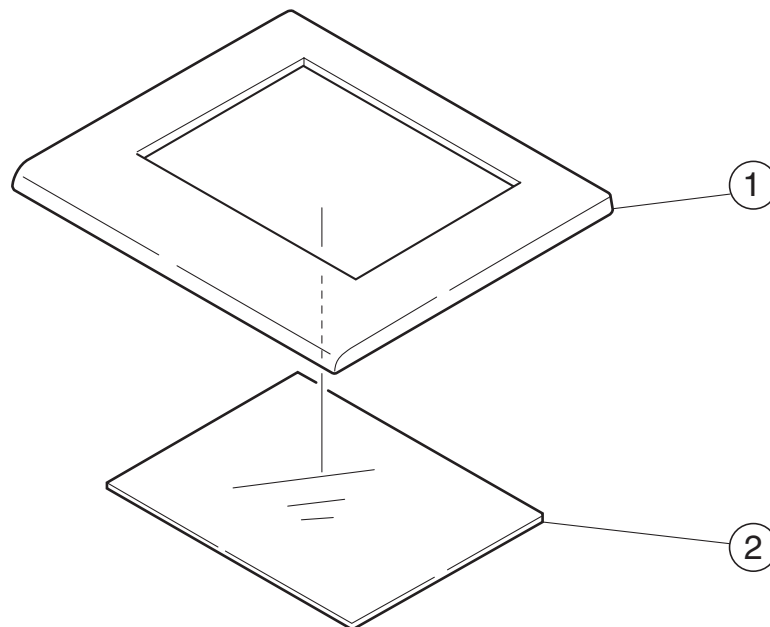
Battery Terminal Assy, YZ-014H5

Index	NK Code No.	Qty	Description
1	547614A	1	EHR-6 battery terminal cable (L95)
2	2113-013175B	1	Battery bracket
3	2114-040865A	2	Battery terminal
4	-----	1	Battery cable tube



LCD Top Casing Assy, YZ-013H9

Index	NK Code No.	Qty	Description
1	6122-003787A	1	LCD top casing
2	6114-088362A	1	LCD filter



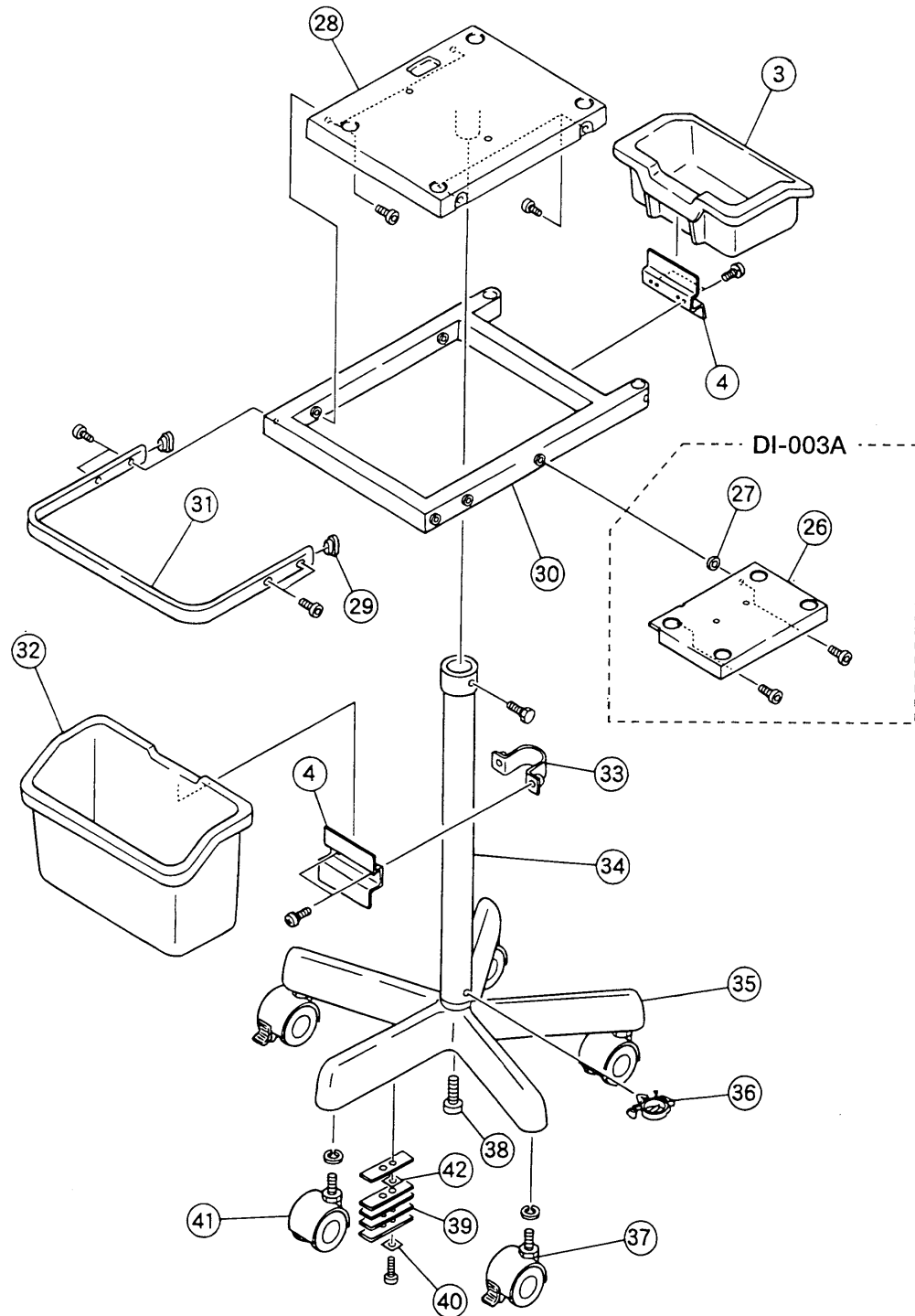
Cart

KC-010A Cart

Index	NK Code No.	Qty	Description
3	6112-006785B	1	Tray 3
4	6114-059901D	2	Basket holder
26*	6113-024193C	1	AS-101D attachment
27*	6114-074528	1	AS-101D spacer
28	6113-024166E	1	Top plate
29	506855A	2	Frame cap
30	6112-009737	1	Frame 400A
31	6113-023996A	1	Handle S (2)
32	6112-006606B	2	Basket
33	6114-024574E	1	KD pole holder
34	6113-011456D	1	Pole 1 (KD) assy
35	6112-007338A	1	Cart base
36	548373	1	Cable tie
37	6143-006949C	2	Caster NKC-60S
38	6114-070773A	1	M10 hexagon socket head bolt
39	6114-034135A	25	Weight
40	506837A	5	Plain washer
41	6143-006931B	3	Caster NKC-60
42	292211	10	Spring washer SW12PB (nickel)

NOTE

The parts marked with * are available as parts for the mechano cardiograph AMP tray, DI-003A. The mechano cardiograph, DI-003A is an option of the cart.



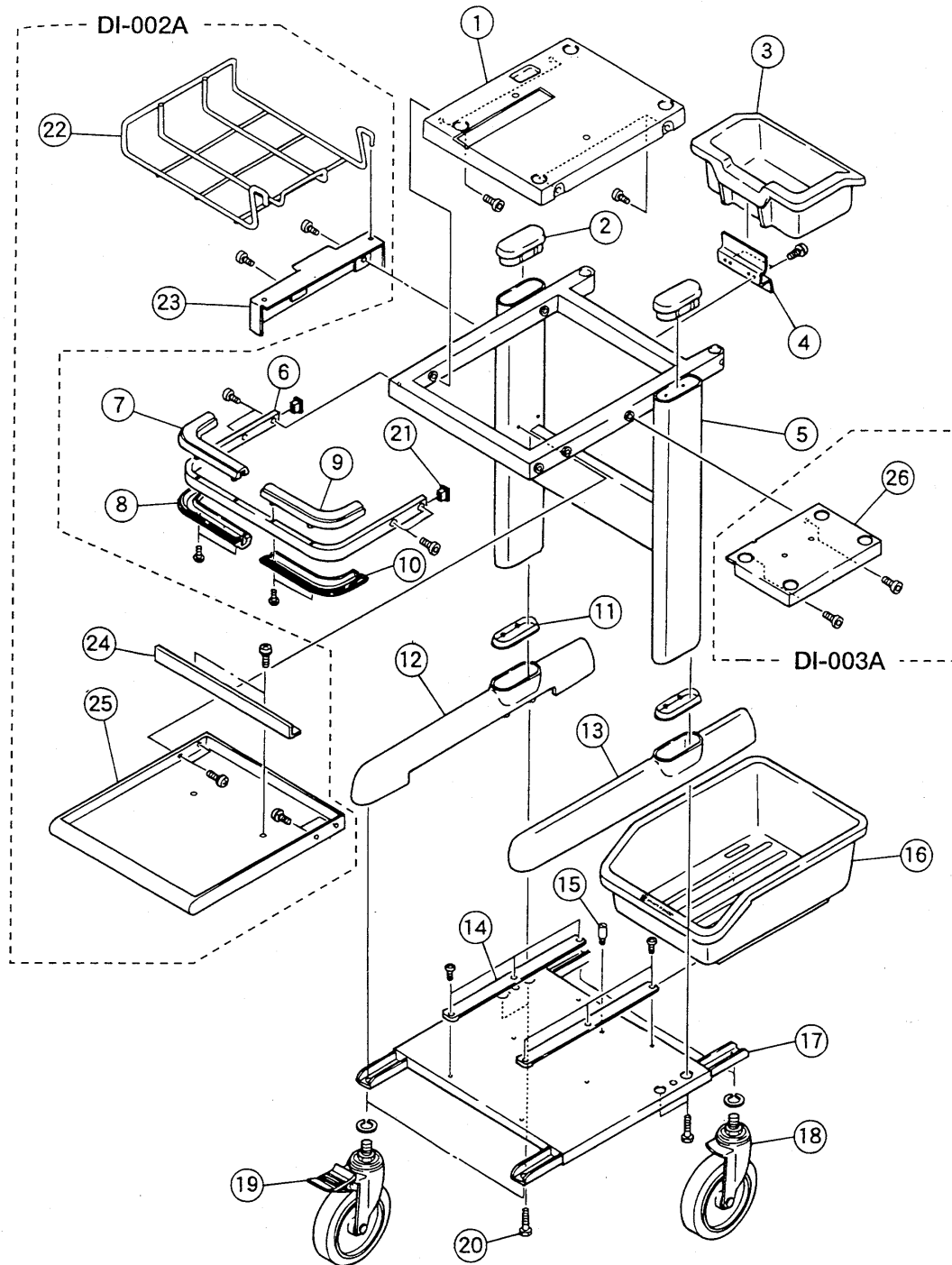
8. REPLACEABLE PARTS LIST

KD-010A Cart

Index	NK Code No.	Qty	Description
1	6112-008827D	1	Top plate
2	6113-011465	2	Fram assy cap
3	6112-006785B	1	Tray 3
4	6114-059901D	1	Basket holder
5	6141-000424B	1	Frame assy 400-750
6	6113-023559B	1	Handle 400B
7	6113-021971C	1	Handle grip R2
8	6113-021962C	1	Handle grip R1
9	6113-021953C	1	Handle grip L2
10	6113-021944C	1	Handle grip L1
11	6114-040182A	2	Base cover
12	6112-007302A	1	Base L
13	6112-007311A	1	Base R
14	6113-019234B	2	Guide rail
15	6114-076009	1	Fixing screw
16	6112-006598D	1	Tray 1
17	6112-006615F	1	Base plate 400
18	6143-006958A	2	Caster NKC-150
19	6143-006967A	2	Caster NKC-150S
20	6114-057271B	4	Screw 1
21	6114-040289A	2	Handle cap
22*	6113-012758A	1	Paper tray
23*	6113-024184B	1	Paper tray holder
24*	6114-074519B	1	Paper stopper
25*	6113-024201D	1	Frame B paper attachment
26**	6113-024193C	1	AS-101D attachment

NOTE

- The parts marked with * are available as as parts for the paper tray DI-002A. The paper tray, DI-002A is an option of the cart.
- The part marked with ** is available as parts for the mechano cardiograph AMP tray, DI-003A. The mechano cardiograph, DI-003A is an option of the cart.

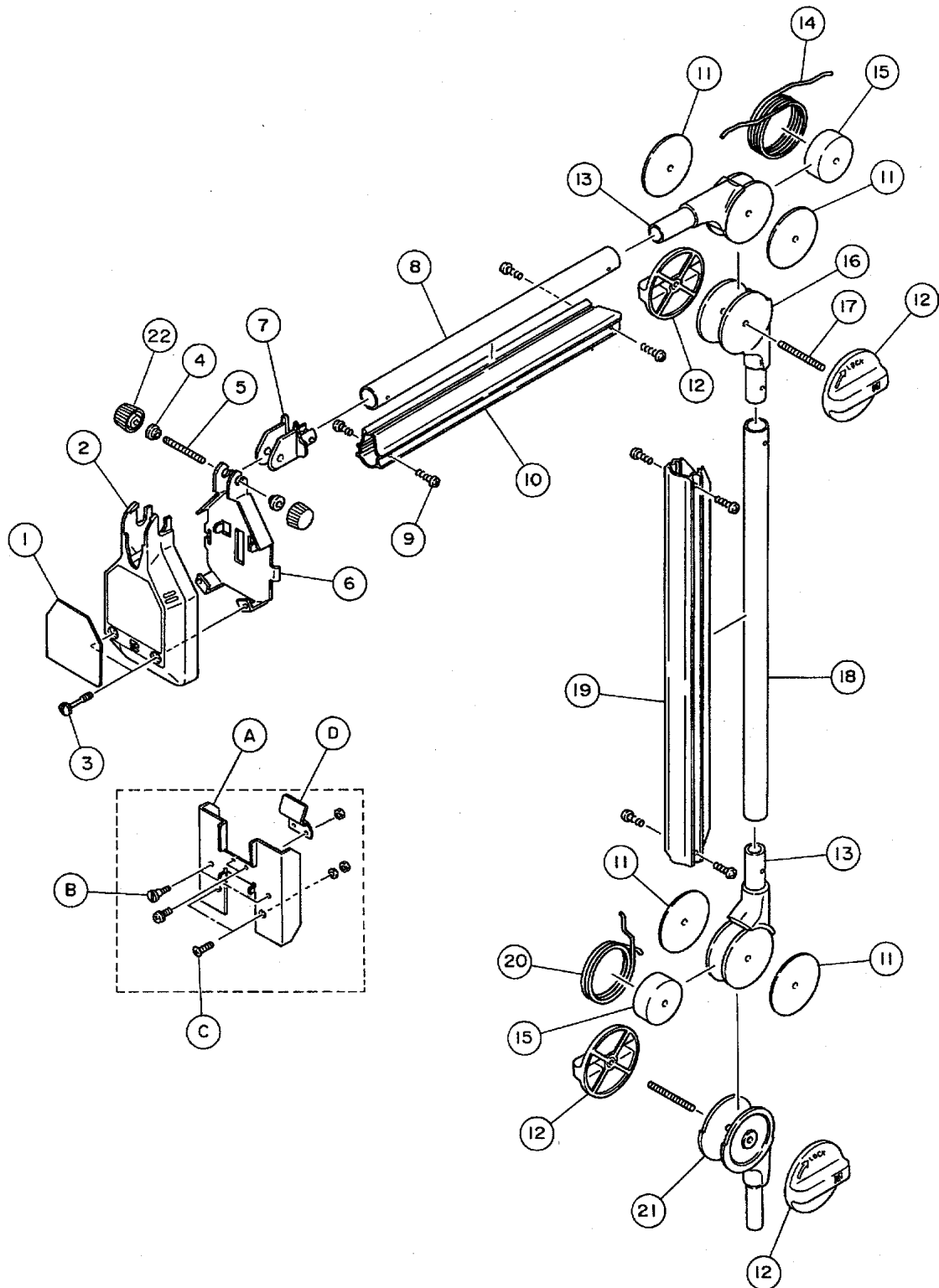


Patient Cable Hanger

Index	NK Code No.	Qty	Description
1*	6124-202372	1	CH panel N
2*	6112-00 6045	1	CH cover N
3*	2219-013205	2	CH cover screw
4	2219-013214	2	CH knob spacer
5	2114-038707A	1	CH arm screw
6	6113-016941	1	CH base plate N
7	6113-016879A	1	CH joint DN
8	6113-016888	1	CH pipe 3N
9	398855	8	Taping screw M3×8
10	6113-016905	1	CH pipe cover. 1N
11	2114-038814B	4	CH joint spacer
12	6113-016923	4	CH knob not. 3N
13	6114-052392	2	CH joint AN
14	2114-038672B	1	CH top arm screw
15	2219-011858	1	CH spring axle. 3
16	6114-052409	1	CH joint BN
17	289768	2	CH hexagon socket bolt M4×50
18	6113-016897	1	CH pipe. 4N
19	6113-016914	1	CH pipe cover. 2N
20	2114-038681B	1	CH bottom arm screw
21	6114-052427	1	CH joint CN
22	6113-016932	1	CH knob nut. 4N
A	6113-011901	1	CH input box connector
B	6114-035999	2	CH guide pin
C	283702	2	ISO flat-head screw (M3×6)
D	6114-036008	1	Bracket spring

NOTE

The parts marked with * are replaced by parts A, B, C and D when the JC-901D input box for ECG-9320 is used. When the BJ-901D, BJ-902D or BJ-903D patient cable is used, the parts A, B, C and D are not available.



Section 9 Connector Pin Assignment

Power Unit.....	9.1
CN101 (to AC Inlet)	9.1
CN21 (to ECG CONTROL Board)	9.1
CN301 (to Thermal Head).....	9.1
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ECG CONTROL Board	9.2
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CNJ021 (to FLASH ROM Board)	9.2
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CNJ033 (to KEY Board)	9.4
CNJ035 (to Power Unit)	9.5
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CN2 (to LCD Module)	9.10
External Input/Output Socket	9.11
SIO Socket	9.11
EXT Input and CRO Output	9.11

Power Unit

CN101 (to AC Inlet)

<u>Pin No.</u>	<u>Signal name</u>	<u>Description</u>
1	AC	AC power
2	DGND	Ground
3	AC	AC power

CN21 (to ECG CONTROL Board)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	+5 V	Input	+5 V for digital circuit
2	+5 V	Input	+5 V for digital circuit
3	+5 V	Input	+5 V for digital circuit
4	NC		Not connected
5	AGNDSND		Ground for sound analog circuit
6	DGND		Ground for digital circuit
7	DGND		Ground for digital circuit
8	DGND		Ground for digital circuit
9	+12 V	Input	+12 V for analog circuit and motor
10	+12 V	Input	+12 V for analog circuit and motor
11	CHGLEDA	Input	Battery charge lamp LED input
12	CHGLEDK	Input	Battery charge lamp LED input
13	NC		Not connected
14	POFF	Output	Power off output
15	PWOVER	Input	Power overheat input
16	HDOVER	Input	Thermal head power excessive current input
17	ACLEDA	Input	AC power lamp LED input
18	DCXAC	Input	Battery operation start input
19	PSW	Output	Power on/off switch
20	OFFKEY	Input	Power off input

CN301 (to Thermal Head)

<u>Pin No.</u>	<u>Signal name</u>	<u>Description</u>	<u>Pin No.</u>	<u>Signal name</u>	<u>Description</u>
1	+24 V	+24 V for thermal head	3	+24VGND	GND for thermal head
2	+24 V	+24 V for thermal head	4	+24VGND	GND for thermal head

CN501 (to Battery)

<u>Pin No.</u>	<u>Signal name</u>	<u>Description</u>	<u>Pin No.</u>	<u>Signal name</u>	<u>Description</u>
1	BATT+	Battery power (+)	4	BATT-	Battery power (-)
2	BATT+	Battery power (+)	5	BATT-	Battery power (-)
3	BATT+	Battery power (+)	6	BATT-	Battery power (-)

ECG CONTROL Board

CNJ011 (to Thermal Head)

Model: 63261-1490

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	THLATCH	Output	Data latch output to thermal head
2	THDATA	Output	Print data to thermal head
3	XSTROPE1	Output	Thermal head driver enable output
4	XSTROPE1	Output	Thermal head driver enable output
5	XSTROPE1	Output	Thermal head driver enable output
6	XSTROPE1	Output	Thermal head driver enable output
7	XSTROPE1	Output	Thermal head driver enable output
8	XSTROPE1	Output	Thermal head driver enable output
9	THERM	Input	Thermal head temperature input detected by thermistor
10	DGND		Ground for digital circuit
11	+5 V		+5 V for digital circuit
12	+5 V		+5 V for digital circuit
13	THSCLK	Output	Data shift output to thermal head
14	NC		Not connected

CNJ021 (to FLASH ROM Board)

Model: 87BFN-080R

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	DGND		Ground for digital circuit
2	DGND		Ground for digital circuit
3	+5 V		+5 V for logic circuit
4	XCSRO1	Output	Chip select 1 for ROM (Address: \$000000 to \$0FFFFFF)
5	XCSRO2	Output	Chip select 2 for ROM (Address: \$100000 to \$1FFFFFF)
6	SROMC	Output	Serial ROM clock output
7	SROMR	Output	Serial ROM clock output
8	LA [00]	Output	Address bus
9	LA [01]	Output	Address bus
10	LA [02]	Output	Address bus
11	LA [03]	Output	Address bus
12	LA [04]	Output	Address bus
13	LA [05]	Output	Address bus
14	LA [06]	Output	Address bus
15	LA [07]	Output	Address bus
16	LA [08]	Output	Address bus
17	LA [09]	Output	Address bus
18	LA [10]	Output	Address bus
19	LA [11]	Output	Address bus

20	LA [12]	Output	Address bus
21	LA [13]	Output	Address bus
22	LA [14]	Output	Address bus
23	LA [15]	Output	Address bus
24	LA [16]	Output	Address bus
25	LA [17]	Output	Address bus
26	LA [18]	Output	Address bus
27	LA [19]	Output	Address bus
28	LD [08]	Input/Output	Data bus
29	LD [09]	Input/Output	Data bus
30	LD [10]	Input/Output	Data bus
31	LD [11]	Input/Output	Data bus
32	LD [12]	Input/Output	Data bus
33	LD [13]	Input/Output	Data bus
34	LD [14]	Input/Output	Data bus
35	XRESET	Output	Reset
36	XDSACK0	Output	Output for system test
37	XDSACK1	Output	Output for system test
38	XOE	Output	Read output
39	XWE	Output	Write output
40	XBERR	Output	Output for system test
41	LA [22]	Output	Address bus
42	LA [21]	Output	Address bus
43	SROMD	Input	Serial ROM data
44	LA [20]	Output	Address bus
45	LA [23]	Output	Address bus
46	FC [0]	Out put	Output for system test
47	FC [1]	Out put	Output for system test
48	FC [2]	Out put	Output for system test
49	LA [26]	Output	Address bus
50	LA [25]	Output	Address bus
51	LA [24]	Output	Address bus
52	SIZ0	Output	Output for system test
53	SIZ1	Output	Output for system test
54	XAS	Output	Output for system test
55	RXW	Output	Output for system test
56	LD [07]	Input/Output	Data bus
57	LD [06]	Input/Output	Data bus
58	LD [05]	Input/Output	Data bus
59	LD [04]	Input/Output	Data bus
60	LD [03]	Input/Output	Data bus
61	LD [02]	Input/Output	Data bus
62	LD [01]	Input/Output	Data bus
63	LD [00]	Input/Output	Data bus
64	LD [23]	Input/Output	Data bus
65	LD [22]	Input/Output	Data bus
66	LD [21]	Input/Output	Data bus
67	LD [20]	Input/Output	Data bus
68	LD [19]	Input/Output	Data bus

8. CONNECTOR PIN ASSIGNMENT

69	LD [18]	Input/Output	Data bus
70	LD [17]	Input/Output	Data bus
71	LD [16]	Input/Output	Data bus
72	LD [27]	Input/Output	Data bus
73	LD [28]	Input/Output	Data bus
74	LD [29]	Input/Output	Data bus
75	LD [30]	Input/Output	Data bus
76	LD [31]	Input/Output	Data bus
77	LD [15]	Input/Output	Data bus
78	+5 V		+5 V for digital circuit
79	DGND		Ground for digital circuit
80	DGND		Ground for digital circuit

CNJ032 (to Key Connector)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	SPKOUT	Output	Speaker output
2	AGNDSND		Ground for speaker
3	BUZOUT	Output	Piezo-electric buzzer output
4	AGNDSND		Ground for piezo-electric buzzer

CNJ033 (to KEY Board)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	+5 V	Output	+5 V for digital circuit
2	DGND		Ground for digital circuit
3	ACLED	Output	AC power lamp LED output
4	CHGLEDK	Output	Battery charge lamp LED cathode output
5	CHGLEDA	Output	Battery charge lamp LED anode output
6	QRS	Output	QRS sync lamp LED output
7	LEDDAT	Output	LED display control output
8	LEDLCLK	Output	LED display control output
9	LEDSCLK	Output	LED display control output
10	PSW	Input	Power on/off switch
11	KEYCLK	Output	KEY board scan output
12	KEYDAT	Output	KEY board scan output
13	KEYR0	Input	KEY board input
14	KEYR1	Input	KEY board input
15	KEYR2	Input	KEY board input
16	KEYR3	Input	KEY board input
17	XRESET	Output	Reset
18	DGND		Ground for digital circuit

CNJ035 (to Power Unit)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	+5 V	Input	+5 V for digital circuit
2	+5 V	Input	+5 V for digital circuit
3	+5 V	Input	+5 V for digital circuit
4	NC		Not connected
5	AGNDSND		Ground for sound analog circuit
6	DGND		Ground for digital circuit
7	DGND		Ground for digital circuit
8	DGND		Ground for digital circuit
9	+12 V	Input	+12 V for analog circuit and motor
10	+12 V	Input	+12 V for analog circuit and motor
11	CHGLEDA	Input	Battery charge lamp LED input
12	CHGLEDK	Input	Battery charge lamp LED input
13	NC		Not connected
14	POFF	Output	Power off output
15	PWOVER	Input	Power overheat input
16	HDOVER	Input	Thermal head power excessive current input
17	ACLED	Input	AC power lamp LED input
18	DCXAC	Input	Battery operation start input
19	PSW	Output	Power on/off switch
20	OFFKEY	Input	Power off input

CNJ091 (to ECG Connector)

Model: JAY-15S-1A28

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	C2	Input	ECG signal input
2	C3	Input	ECG signal input
3	C4	Input	ECG signal input
4	C5	Input	ECG signal input
5	C6	Input	ECG signal input
6	SHIELD		Cable shield
7	NC		Not connected
8	NC		Not connected
9	R	Input	ECG signal input
10	L	Input	ECG signal input
11	F	Input	ECG signal input
12	C1	Input	ECG signal input
13	NC		Not connected
14	RF	Input	ECG signal input
15	NC		Not connected

8. CONNECTOR PIN ASSIGNMENT

CNJ101 (to SIO Connector)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	FG		Ground for main unit
2	TXD	Output	Data transmission
3	RXD	Input	Data receiving
4	RTS	Output	Request to send
5	CTS	Input	Clear to send
6	DSR	Input	Data set ready
7	GND		Ground for signal
8	DCD	Input	Data channel receiving Carrier detection
9	DTR	Output	Data terminal ready

CNJ102 (to PAPER SENSOR Board)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	+5 V		+5 V for paper empty/mark sensor
2	PAEMP	Input	Paper empty sensor input
3	PAMARK	Input	Mark sensor input
4	DGND		Ground for paper empty/mark sensor
5	M	Output	Paper empty sensor LED output
6	+5 VR301	Output	Mark sensor LED output

CNJ103 (to Motor Assy)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	+12 V		
2	DGND		Ground for digital circuit
3	+12 VR		LED signal for sensor which detects number of motor rotation
4	MOTRET		Detection input of number of motor rotation
5	MOTPP		Motor power (+)
6	MOTPM		Motor power (−)

CNJ111 (to PC Card)

Model: FCN-565P068-G/0422-E4

CNJ121 (to LCD CN Board)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	VIN	Output	+10.4 to 12 V for backlight
2	GND		Ground
3	VREMOTE	Output	Backlight on/off output (0 V: Not light, +5 V: Light)
4	VBRIGHT	Output	Backlight brightness control output (0 V: when bright is set to maximum)
5	S	Output	Scanning start output
6	CP1	Output	Input data latch output
7	CP2	Output	Data input clock output
8	NC		Not connected
9	LCDON	Output	Display control output ("L"= OFF)
10	LCD[0]	Output	Display data output [0]
11	LCD[1]	Output	Display data output [1]
12	LCD[2]	Output	Display data output [2]
13	LCD[3]	Output	Display data output [3]
14	+5 V	Output	+5 V for digital circuit
15	DGND		Ground for digital circuit
16	+28 V	Output	+17 to 26 V for driving LCD

CNJ401 (to CRO Connector)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	CRO		External signal output (0.5 V/10 mm)
2	AGND		Ground for analog circuit

CNJ402 (to EXT INPUT1 Connector)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	EXT-IN		External signal input (10 mm/0.5 V)
2	AGND		Ground for analog circuit

CNJ403 (to EXT INPUT2 Connector)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	EXT-IN		External signal input (10 mm/0.5 V)
2	AGND		Ground for analog circuit

FLASH ROM Board

CNJ021 (to ECG CONTROL Board)

Model: 87BMN-080R

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	DGND		Ground for digital circuit
2	DGND		Ground for digital circuit
3	+5 V		+5 V for logic circuit
4	XCSRO1	Output	Chip select 1 for ROM (Address: \$000000 to \$0FFFFFF)
5	XCSRO2	Output	Chip select 2 for ROM (Address: \$100000 to \$1FFFFFF)
6	SROMC	Output	Serial ROM clock output
7	SROMR	Output	Serial ROM clock output
8	LA [00]	Output	Address bus
9	LA [01]	Output	Address bus
10	LA [02]	Output	Address bus
11	LA [03]	Output	Address bus
12	LA [04]	Output	Address bus
13	LA [05]	Output	Address bus
14	LA [06]	Output	Address bus
15	LA [07]	Output	Address bus
16	LA [08]	Output	Address bus
17	LA [09]	Output	Address bus
18	LA [10]	Output	Address bus
19	LA [11]	Output	Address bus
20	LA [12]	Output	Address bus
21	LA [13]	Output	Address bus
22	LA [14]	Output	Address bus
23	LA [15]	Output	Address bus
24	LA [16]	Output	Address bus
25	LA [17]	Output	Address bus
26	LA [18]	Output	Address bus
27	LA [19]	Output	Address bus
28	LD [08]	Input/Output	Data bus
29	LD [09]	Input/Output	Data bus
30	LD [10]	Input/Output	Data bus
31	LD [11]	Input/Output	Data bus
32	LD [12]	Input/Output	Data bus
33	LD [13]	Input/Output	Data bus
34	LD [14]	Input/Output	Data bus
35	XRESET	Output	Reset
36	XDSACK0	Output	Output for system test
37	XDSACK1	Output	Output for system test
38	XOE	Output	Read output

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
38	XOE	Output	Read output
39	XWE	Output	Write output
40	XBERR	Output	Output for system test
41	LA [22]	Output	Address bus
42	LA [21]	Output	Address bus
43	SROMD	Input	Serial ROM data
44	LA [20]	Output	Address bus
45	LA [23]	Output	Address bus
46	FC [0]	Out put	Output for system test
47	FC [1]	Out put	Output for system test
48	FC [2]	Out put	Output for system test
49	LA [26]	Output	Address bus
50	LA [25]	Output	Address bus
51	LA [24]	Output	Address bus
52	SIZ0	Output	Output for system test
53	SIZ1	Output	Output for system test
54	XAS	Output	Output for system test
55	RXW	Output	Output for system test
56	LD [07]	Input/Output	Data bus
57	LD [06]	Input/Output	Data bus
58	LD [05]	Input/Output	Data bus
59	LD [04]	Input/Output	Data bus
60	LD [03]	Input/Output	Data bus
61	LD [02]	Input/Output	Data bus
62	LD [01]	Input/Output	Data bus
63	LD [00]	Input/Output	Data bus
64	LD [23]	Input/Output	Data bus
65	LD [22]	Input/Output	Data bus
66	LD [21]	Input/Output	Data bus
67	LD [20]	Input/Output	Data bus
68	LD [19]	Input/Output	Data bus
69	LD [18]	Input/Output	Data bus
70	LD [17]	Input/Output	Data bus
71	LD [16]	Input/Output	Data bus
72	LD [27]	Input/Output	Data bus
73	LD [28]	Input/Output	Data bus
74	LD [29]	Input/Output	Data bus
75	LD [30]	Input/Output	Data bus
76	LD [31]	Input/Output	Data bus
77	LD [15]	Input/Output	Data bus
78	+5 V		+5 V for logic circuit
79	DGND		Ground for digital circuit
80	DGND		Ground for digital circuit

INVERTER Board

CN1 (to ECG CONTROL Board)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	VIN	Input	+10.4 to 12 V for backlight
2	GND		Ground
3	VREMOTE	Input	Backlight on/off input (0 V: Not light, +5 V: Light)
4	VBRIGHT	Input	Backlight brightness control input (0 V: when bright is set to maximum)
5	NC		Not connected

CN2 (to LCD Module)

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	Iout	Output	Power for backlight
2	NC		Not connected
3	Ioutreturn	Input	Power for backlight

External Input/Output Socket

SIO Socket

<u>Pin No.</u>	<u>Signal name</u>	<u>Direction</u>	<u>Description</u>
1	FG		Ground for main unit
2	TXD	Output	Data transmission
3	RXD	Input	Data receiving
4	RTS	Output	Request to send
5	CTS	Input	Clear to send
6	DSR	Input	Data set ready
7	GND		Ground for signal
8	HS	Input	Data channel receiving Carrier detection
9	DTR	Output	Data terminal ready

Main Unit Side Connector on ECG CONTROL Board

Connector model: NK code No. JEY-9S-1A2B

Mating Connector

Connector: DE-9P (NK Code No. 079362)

Case: DE-C1-J6 (NK Code No. 080788)

EXT Input and CRO Output

Main Unit Side Connector on ECG CONTROL Board

Connector model: NK code No. SG8036

Mating Connector

Mini plug: AP-313 (NK Code No. 355456A)



Manufacturer

NIHON KOHDEN CORPORATION

1-31-4 Nishiochiai, Shinjuku-ku
Tokyo 161-8560, Japan
Phone +81 (3) 5996-8036
Fax +81 (3) 5996-8100

上海维修站

上海市徐汇区南丹路 169 号 新旺大厦 3008 室
电话：021-6469-9016 传真：021-6486-7218

北京维修站

北京市南礼士路甲 3 号 海通大厦 601 室
电话：010-6804-9531 传真：010-6804-7366

广州维修站

广州市环市东路 371~375 号 世贸中心南塔 2516 室
电话：020-8777-9108 传真：020-8778-1882

沈阳维修站

沈阳市和平区太原北街 20 号
电话：024-2340-2565 传真：024-2383-2557

成都维修站

成都市一环路西二段 25 号 华立大厦 420 室
电话：028-773-6236 传真：028-773-6236

NIHON KOHDEN AMERICA, INC.

90 Icon Street, Foothill Ranch, CA 92610, USA
Phone +1 (949) 580-1555
Fax +1 (949) 580-1550

EC REP European Representative

NIHON KOHDEN EUROPE GmbH

Raiffeisenstrasse 10
D-61191 Rosbach, Germany
Phone +49 6003 827-0
Fax +49 6003 827-599

NIHON KOHDEN ITALIA S.r.l.

Via San Tomaso 78
I-24121 Bergamo, Italy
Phone +39 035 219 543
Fax +39 035 232 546

NIHON KOHDEN IBERICA S.L.

C/ Ulises 75A
E-28043 Madrid, Spain
Phone +34 917 161 080
Fax +34 913 004 676

NIHON KOHDEN SINGAPORE PTE LTD

70 Shenton Way, #14-05 Marina House
Singapore 079118
Phone +65 6224-6700
Fax +65 6224-6216

The model and serial number of your instrument are identified on the rear or bottom of the unit. Write the model and serial number in the spaces provided below. Whenever you call your distributor concerning this instrument, mention these two pieces of information for quick and accurate service.

Model _____

Serial number _____

Your Distributor

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