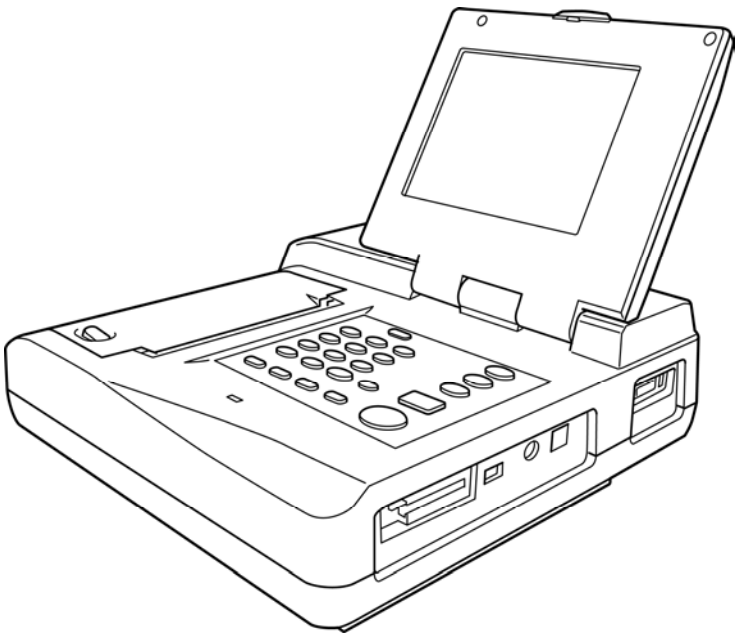
Sphygmomanometer and Sphygmograph

VaSera VS-1500

Service Manual



Confidential

CE 0086

- Before setting up/maintenance, please read this service manual thoroughly.
- Keep this manual where it can be always referred to.

FUKUDA DENSHI

CE 0086 This device bears the CE label in accordance with the provisions of Medical Device Directive 93/42/EEC.

THE PERSONS RESPONSIBLE FOR PLACING DEVICES ON THE EC MARKET UNDER MDD 93/42/EEC

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Printed in Japan

Notice

This manual contains technical information on the VS-1500 aimed at Fukuda Denshi service representatives and professional engineers.
Before performing maintenance or troubleshooting the unit, read the manual carefully and use it to help you work correctly and safely.
When you have finished using the manual, store it carefully in a designated location.

Safety

- The following lists show dangers, warnings, and cautions regarding information contained in this service manual. When servicing this instrument, read this service manual thoroughly, paying close attention to the items labeled with danger, warning, and caution notations.

Indication of warning items: The following warning items indicate the extent of injury or damage that may result from incorrect handling of the equipment not observing warning precautions.

DANGER	Failure to follow this message may result in death or serious injury to the patient or operator, damage to the equipment, or create a fire hazard
WARNING	Failure to follow this message may result in death or serious injury to the patient or operator.
CAUTION	Failure to follow this message may cause injury to the patient or operator, or may cause damage to the equipment.

NOTE	A note is not related to product safety. A note provides information about the proper use and operating methods to prevent incorrect operation and trouble with the equipment.

Indication of graphic symbols: The following graphic symbols indicate prohibition or compulsion of acts.

	Indicates prohibited actions.
	Indicates a matter of Danger, Warning, or Caution that calls attention for safety.
	Indicates mandatory or instructed actions.

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Pay special attention to the following.

DANGER	
Never modify or change the instrument. Otherwise, the safety of the instrument cannot be ensured and the patient or the operator may be exposed to dangerous situation.	

WARNING
● Be careful with the high-voltage circuit contained in the equipment.

CAUTION	
● This service manual is intended for use by authorized Fukuda Denshi service personnel. Repairing, disassembly, and internal adjustment shall be carried out only by authorized Fukuda Denshi service personnel.	
● Use proper tools for repair and disassembly.	
● Be sure to follow the instructions of the operation manual for handling of the equipment. Refer also to the operation manual for cautions on safety.	

CAUTION
● For repairs requiring disassembly, please contact Fukuda Denshi.

Make sure to read the following cautions before the service procedure.

⚠ CAUTION

When checking the power supply, be cautious not to short-circuit the power.

⚠ CAUTION

Before checking the power fuse, make sure to turn OFF the power and unplug the power cable.

⚠ CAUTION

Do not repeatedly plug and unplug the key connector as it is made of carbon.

⚠ CAUTION

Before any replacement procedure, make sure to turn OFF the power and unplug the power cable.

⚠ CAUTION

Precaution for Disassembly/Assembly Procedure

- Make sure to turn OFF the power and unplug the power cable before the disassembly/assembly procedure.
- Remove the battery before removing any PC board.
- Do not frequently remove the control panel and print circuit boards, as it may cause contact failure or damage to the equipment.
- When assembling the product, make sure that the screws are fixed on appropriately to the correct position.
- Make sure that there are no foreign substances remaining inside the equipment.

Handling of the Print Circuit Board

- Be cautious when handling the print circuit board, as the components are very sensitive to static electricity.
- Store the removed print circuit board in a conductive bag or take other appropriate measures as it is a sensitive elelctric circuit component.
- Do not apply unnecessary force to the print circuit board as it may cause damage.
- Do not insert/remove any print circuit board with the power turned ON as it may cause damage.

⚠ CAUTION

If the threshold value is exceeded during the safety inspection, make sure to stop using the equipment. Otherwise, it may cause injury to the patient or operator.

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Overview of the Manual

This manual consists of the following 13 chapters. Contents of each chapter are briefly explained below.

Chapter 1 Features
Provides information on the features of this equipment.

Chapter 2 Specifications
Provides information on the specifications of this equipment.

Chapter 3 Composition of the Product
Lists the name, model type, and its function of each accessory/optional accessory of this equipment.

Chapter 4 Names of Parts of Equipment
Describes the location and each function of the control panel, connector, LCD, recorder, etc.

Chapter 5 Maintenance
Explains about parts replacement, cleaning, disinfection, software upgrade, self-diagnosis, and maintenance procedures.

Chapter 6 Troubleshooting
Explains how to resolve problems for each symptom.

Chapter 7 Messages
Lists the messages displayed on this equipment and how to deal with each message.

Chapter 8 Assembly Diagram
Describes the assembly procedure for replacing failure parts.

Chapter 9 Wire Connection Diagram / Block Diagram and Explanation
Provides wire connection diagram of each block, block diagram of each board, and explains the operation flow of the block diagram.

Chapter 10 Checkpoints and Waveform
Indicates the checkpoint locations of each block, and explains the waveform, voltage, measuring method of each checkpoint. This information is used for troubleshooting.

Chapter 11 Spare Parts List
Lists the spare parts of this equipment.

Chapter 12 Information of the electromagnetic compatibility (EMC)
Explains the information concerning the electromagnetic compatibility (EMC) of the VS-1500

Chapter 13 Reference
Lists the reference data such as connector signal arrangement.

■ Symbol Used in This Manual

☞ This symbol is used when there is a reference.

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1.1 Features

1.1.1 What the Instrument Can Do

■ **VS-1500N**

The instrument measures the non-invasive blood pressure in all four limbs to simultaneously obtain ECG, PCG, carotid pulse tracing, femoral pulse tracing and four limb pulse tracing. This makes it possible to examine arterial extensibility and the degree of blood circulation disorders in blood vessels in the lower limbs of a patient.

■ **VS-1500N with ECG Upgrade Package**

In addition to the above, by installing the optional standard 12-lead ECG testing software (ECG Upgrade Package: VSC-150), the 12-lead ECG examination function is enabled. This package allows 12-lead ECG testing, to record ECG and analysis results both for screening patients with heart disease and for general ECG testing.

1.1.2 Major Features

■ **VS-1500N**

●CAVI (Cardio Ankle Vascular Index)

Independent of blood pressure, the Cardio Ankle Vascular Index calculates the specific hardness of arterial walls. As an index for early detection of arteriosclerosis diseases, CAVI provides a means to diagnose arteriosclerosis in patients with hypertension, hyperlipemia, diabetes, myocardial infarction and cerebral infarction. The CAVI is also useful for time-serial observation of medication effects.
The index is compatible with the PWV method, a classical index for measuring aortic stiffness.
This instrument measures the following 4 types of CAVI.

(1) R-CAVI: CAVI between the heart valve and right ankle artery, calculated from measurements of PCG (heart sound Ⅱ) and plethysmograms taken using cuffs applied to the right brachial and right ankle.

(2) L-CAVI: CAVI between the heart valve and left ankle artery, calculated from measurements of PCG (heart sound Ⅱ) and plethysmograms taken using cuffs applied to the right brachial and left ankle.

(3) R-kCAVI: CAVI between the heart valve and right popliteal artery, calculated from measurements of PCG (heart sound Ⅱ) and plethysmograms taken using a cuff applied to the right brachial and a sensor applied to the right knee joint.

(4) L-kCAVI: CAVI between the heart valve and left popliteal artery, calculated from measurements of PCG (heart sound Ⅱ) and plethysmograms taken using a cuff applied to the right brachial and a sensor applied to the left knee joint.

●Simultaneous Measurement of Blood Pressures of Brachial's and Ankles

The instrument measures non-invasive blood pressures of brachial's and ankles simultaneously. It also allows selection of any brachial and ankle for measurement.

●BPB (BP Balance)

BPB is a two-dimensional graphic indication of blood pressure measured at ankles and brachial's. It makes it easy to establish the BP balance of upper and lower limbs and helps to indicate arterial stenosis and blockage of the lower limbs.

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●ABI (Ankle-Brachial Pressure Index)
The ABI is an index indicating the degree of stenosis or occlusion of the lower limb artery due to arteriosclerosis obliterans (ASO). A value of 0.90 or less indicates the probable presence of occlusion or stenosis.

●TBI (Toe Brachial Index)
TBI is an index to evaluate blood circulation disorders from the ankles to the peripheral arteries.

●Post ABI Examination
During ABI examination, Post-stress interval recording are executed.

●Calculation of aortic PWV (Pulse Wave Velocity)
The VS-1500 can measure the following two kinds of PWV:
PWV and PWV*: Aortic PWV measured from carotid pulse tracing, femoral pulse tracing and PCG (heart sound Ⅱ).
PWV* is a value corrected with diastolic BP.

●R-R ECG Examination
This examination measures the R-R intervals of an ECG and output the examination reports on the trend graphs and histograms.

●Color LCD
The color LCD provides crisper images of ECG, PCG and pulse wave waveforms. The display also makes it possible to easily check patient, electrode and recording status.

●Built-in thermal array recorder
The 145 mm built-in thermal array recorder provides easily interpretable waveforms, detailed measurement values, patient data and time-serial data on chart paper.

●Connectable to Color Printer
The instrument can be connected to an optional color printer to enable direct printouts of examination result reports in color without the need for a PC. When combined with our designated printer, the LCD indicates how much ink remains and paper status.

●Filing
The instrument comes with a CF card slot to enable storage of pulse wave examinations and ECG examinations with waveforms and measurement values. Stored data can be located and printed at any time.

●Data Management with Personal Computer
By connecting multiple VS-1500 units and a PC to a network, you can centrally manage data recording, searches, display and printing of all units on the PC.

MEMO **This requires optional data management software (DMS) (VSS-10).**

■ VS-1500N with ECG Upgrade Package

In addition to the above features explained for the VS-1500N, the following features will be also available by installing the optional standard 12-lead ECG testing software (ECG Upgrade Package: VSC-150).

●Standard 12-lead ECG

The instrument enables standard 12-lead ECG for highly accurate waveform measurements and analysis of disorder categories. Analysis results and ECG can be recorded and printed. A 12-lead analysis function is provided for interpretation of ECG data. This analysis program uses a clinically improved diagnosis standard classified according to Minnesota code, disease name, age and sex to raise the accuracy of diagnosis. Analysis results employ a new report format that lends itself to the multifaceted aspects of ECG diagnosis.

●Arrhythmia ECG Examination

This examination analyzes a 1 to 3 min 3-lead ECG waveform and records the result under the arrhythmia examination report.

●Master Test Exercise

This is an exercise stress test called the Master's two-step exercise test. The exercise stress test is followed by post stress interval recording using 12-lead ECG.

●Series Examination

This examination enables the operator to perform a series of examination that combines any of the following examinations: pulse wave examination, 12-lead ECG examination, R-R ECG examination, and arrhythmia ECG examination. This series examination will speed up the testing.

MEMO This requires optional data management software (DMS) (VSS-10, EFS-200).

1.1.3 Examination mode

■ **VS-1500N**

(1) Pulse wave examination (Vascular distensability)

The instrument can measure and provide printouts for CAVI and Aortic PWV.

(2) Pulse wave examination (Four Limbs and Toe Blood pressure)

The instrument can measure and provide printouts for simultaneous measurement of blood pressure of brachial’s and ankles, toe blood pressure, ABI and TBI.

(3) R-R ECG examination

The instrument captures 1-lead rhythm induced waveforms to print rhythm induced measurement reports (R-R histograms and R-R trend graphs).

■ **VS-1500N with ECG Upgrade Package**

(1) Pulse wave examination (Vascular distensability)

The instrument can measure and provide printouts for CAVI and Aortic PWV.

(2) Pulse wave examination (Four Limbs and Toe Blood pressure)

The instrument can measure and provide printouts for simultaneous measurement of blood pressure of brachial’s and ankles, toe blood pressure, ABI and TBI.

(3) R-R ECG examination

The instrument captures 1-lead rhythm induced waveforms to print rhythm induced measurement reports (R-R histograms and R-R trend graphs).

(4) Arrhythmia ECG examination

The instrument can perform a 1 to 3 min 3-lead arrhythmia analysis and print an arrhythmia

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analysis report.

(5) Standard 12-lead ECG

The instrument automatically analyzes and records standard 12-lead ECG. Manual recording enables recording using a variety of lead, sensitivity and recording speed settings.
It can also record post-stress interval recording using post-stress 12-lead analysis.

(6) Master test exercise

This is an exercise stress test called the Master's two-step exercise test. The exercise stress test is followed by post interval recording using 12-lead ECG.

(7) Series Examination

This examination mode enables the operator to sequentially perform a combination of any of the following examinations: pulse wave examination, 12-lead ECG examination, R-R ECG examination, and arrhythmia ECG examination. The unit can store data for up to five series examinations.

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Chapter 2 Specifications

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2.1 VS-1500N Specifications

Display		Color LCD
		640 (W) x 480 (H) pixels
Recorder	Recording method	Thermal print head 8 dots/mm
	Paper speed	5, 10, 12.5, 25, 50 mm/s ±3%
ECG	Leads	BP/Pulse wave test: Lead I ECG test: Standard 12-lead ECG (Option)
	Standard sensitivity	10 mm/mV
	Sensitivity changes	1/4, 1/2, 1, 2, auto
	Differential and common-mode offset voltage (electrode-skin voltage)	±550 mV or more
	Sine wave characteristics	0.05 - 150 Hz within -3 dB
	Low frequency characteristics (time constant)	3.2 s or more
	CMRR	103 dB or more
	Input impedance	50 MΩ or more
	Internal noise	RTI, 30μVp-p max.
	Filters	AC: 50 Hz/60 Hz (-20 dB max)
		Muscle: 25 Hz/35 Hz -3 dB (-6 dB/oct)
		Drift: 0.25 Hz/0.5 Hz within -3 dB
		High frequency characteristics: 75 Hz/100 Hz/150 Hz
PCG	Frequency response	L filter: 50 Hz (-6 dB/oct)
		PWV filter: 165 - 280 Hz within -3 dB
Sphygmograph	Frequency response	0.08 - 20 Hz within -3 dB
NIBP	Measuring range	0 - 300 mmHg
	Scale interval	1 mmHg
	Pressure accuracy	±3 mmHg
	Pressure detection	Semiconductor pressure sensor
	Zero balancing	Automatic balancing
	Measuring method	Oscillometric
	NIBP measuring range	20 - 280 mmHg
	Inflation method	Automatic inflation by pump
	Deflating method	Automatic by electromagnetic valve
	Safety device	330 mmHg or more, or 10 mmHg or more for 130 s or longer operation
CF card drive		Compact flash card Type I/II
Serial connector		RS-232C compatible
LAN connector		IEEE 802.3, 10BASE-T
Printer connector		Color printer
Safety standard		IEC 60601-1: 1988
Protection against electrical shock		Class I
Degree of protection against electrical shock		NIBP: Type CF Applied part
		ECG input: Type CF Applied part
		PCG input: Type CF Applied part
		Sphygmograph input: Type CF Applied part
Power supply		100 -240V AC 50/60 Hz, 120 VA
Dimensions		LCD closed: 340 (W) x 342 (D) x 109 (H) mm LCD open: 340 (W) x 342 (D) x 314 (H) mm
Mass		Approx. 8.0kg
Operating environments	Temperature	10 - 40°C
	Humidity	25 - 95% (no condensation)
Storage environment	Temperature	-10 - +60°C
	Humidity	10 - 95% (no condensation)
Service life		6 years, provided that regular maintenance and inspection is made (based on company standard)

NOTE: Specifications are subject to change without prior notice for quality improvement.

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Chapter 3 Composition of the Product

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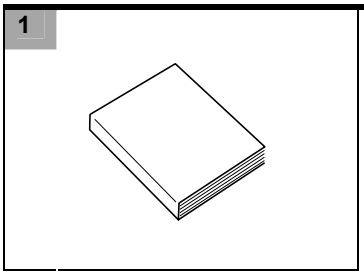
3.1 Accessories

3.1.1 VS-1500N

The following is a list of accessories.
The common accessories of the VS-1500N are included in the same box as the main unit. The special accessories used under a different environment are provided in a separate box. There are two special accessory packages, (1) AB-200GN General Accessories Package, (2) AB-200CN Accessories Package for Europe. Make sure that you have the correct accessory package.

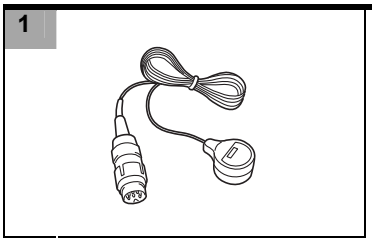
Common Accessories

No.	Accessory	Model	Quantity	Remarks
1	Operation manual		1	



PCG Microphone

No.	Accessory	Model	Quantity	Remarks
1	PCG Microphone	MA-300HDS(V)	1	



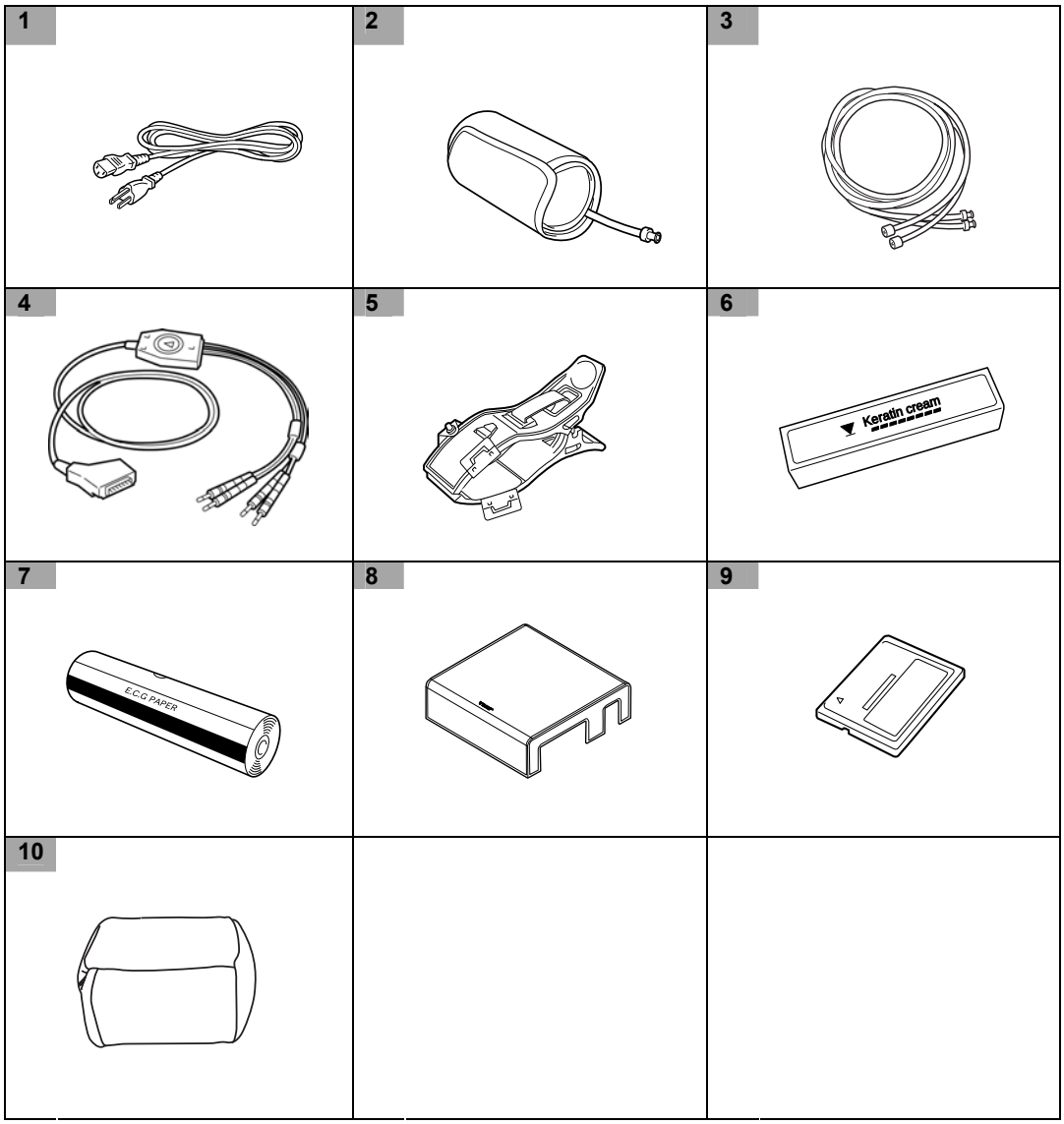
AB-200GN General Accessories Package

No.	Accessory		Model	Quantity	Remarks
1	Power cable (3 m)		CS-18, CS-24	1	
2	NIBP cuffs	(Right Brachial)	CUF-129MR	1	
		(Left Brachial)	CUF-129ML	1	
		(Right Ankle)	CUF-138MR	1	
		(Left Ankle)	CUF-138ML	1	
3	Air hose (2.5 m)	(Lower limbs)	OA-500A	1	
		(Upper limbs)	OA-500B	1	
4	ECG cable		CPV-01AKP	1	
5	Limb electrode		TE-45	1 set (2)	Wrist
6	Keratin cream		OJ-02	1	
7	Chart paper (145 mm x 30 m, roll paper)		OP-358TE	1	
8	Instrument cover			1	
9	Compact flash card (128 MB)		FCF-128	1	
10	Limb cushion		OA-461	1 set (4)	

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AB-200CN Accessories Package for Europe

No.	Accessory		Model	Quantity	Remarks
1	Power cable (3 m)		CS-18	1	
2	NIBP cuffs	(Right Brachial)	CUF-129MR	1	
		(Left Brachial)	CUF-129ML	1	
		(Right Ankle)	CUF-138MR	1	
		(Left Ankle)	CUF-138ML	1	
3	Air hose (2.5 m)	(Lower limbs)	OA-500A	1	
		(Upper limbs)	OA-500B	1	
4	ECG cable		CPV-01BKPU	1	
5	Limb electrode		TEE-45RG	1 set (2)	Wrist
6	Keratin cream		OJ-02	1	
7	Chart paper (145 mm x 30 m, roll paper)		OP-358TE	1	
8	Instrument cover			1	
9	Compact flash card (128 MB)		FCF-128	1	
10	Limb cushion		OA-461	1 set (4)	



3.1.2 VSC-150 ECG Upgrade Package

The following is a list of VSC-150 (ECG Upgrade Package) accessories.

VSC-150

No.	Accessory	Model	Quantity	Remarks
1	12-Lead ECG software (CF card)	VFP-1	1	
2	Program cartridge	PC-1500	1	
3	ECG+ Mark Label		1	
4	Program guide book	PI-20E	1	
5	Operation manual (this book)		1	
6	Installation manual		1	

3.1.3 ASE-02 ECG Accessories Package

The following is a list of ASE-02 (ECG Accessories Package) accessories.

ASE-02G for General

No.	Accessory	Model	Quantity	Remarks
1	Power cable (3 m)	CS-18, CS-20	1	
2	ECG cable	CP-104J	1	
3	Limb electrode	TE-43	1 set (4)	
4	Chest electrode	TE-01	1 set (6)	
5	Keratin cream	OJ-02	1	

ASE-02E for Europe

No.	Accessory	Model	Quantity	Remarks
1	Power cable (3 m)	CS-18	1	
2	ECG cable	CP-104T	1	
3	Limb electrode	TEE-43RG	1 set (4)	
4	Chest electrode	TEE-01RA	1 set (6)	
5	Keratin cream	OJ-02	1	

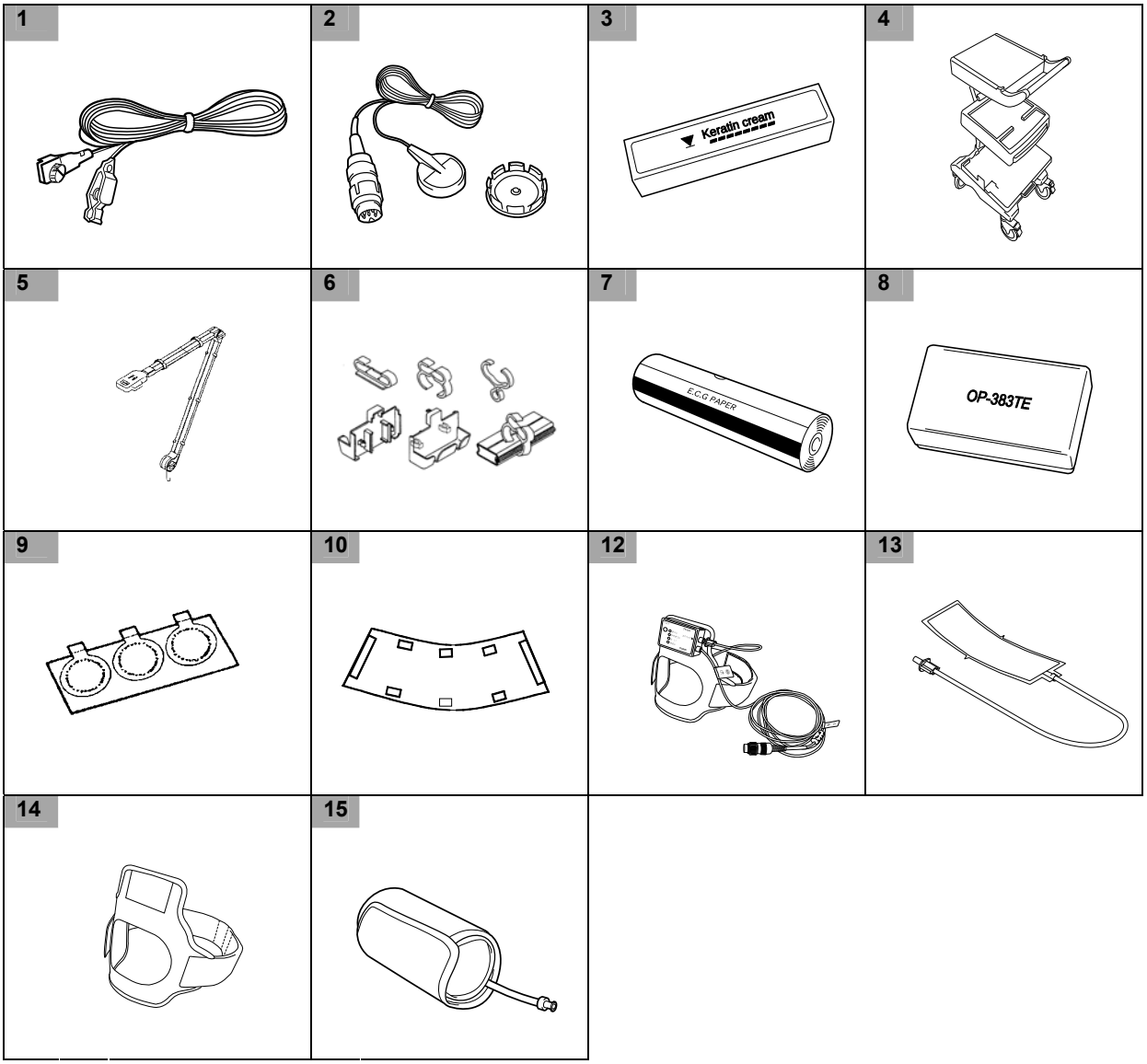
NOTE

Do not use the Power cable in the ASE-02 for the VS-1500.

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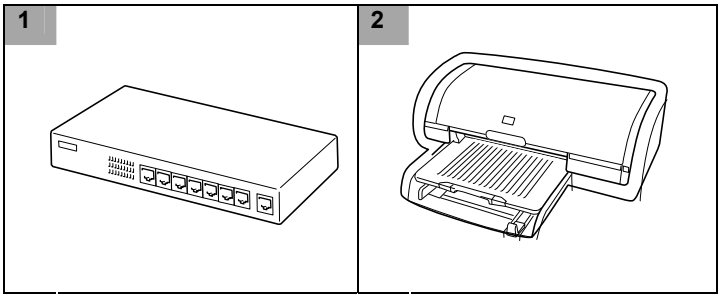
3.2 Optional Accessories

No.	Accessory	Model Remarks
1 Potential equalization cable	CE-12	5m
2 Amorphous pulse wave sensor	TY-501A	
Amorphous cap	OA-256	Amorphous caps 20 pieces per pack
3 Keratin cream	OJ-01	
4 Trolley	OTV-01	
5 Cable hanger	OA-300A	
6 Hose hanger kit	OA-130	(Purchase the hose hanger kit with the cable hanger.)
7 Roll paper	OP-358TE	
8 Z-fold paper	OP-383TE	
9 Dual-side adhesive tape	DA-30	For PCG microphone, 150 pieces/pack
10 Cuff cover (for upper limb)	OA-1129M	
Cuff cover (for lower limb)	OA-1130M	
11 Toe blood pressure kit	ASV-2	Toe cuffs, air hoses and extension hoses
Toe cover (M)	OA-459M	50 pieces per box
Toe cuffs	CUF-139M2	color: Blue, size: M
Toe cuffs	CUF-139S2	color: Brown, size: S
Air hose (2.5 m)	OA-400C	1
Extension hose	OA-400D	1 set
12 Pulse wave sensor with air bag	TY-101	
13 Air bag for pulse wave sensor	TR-13M	
14 Belt for pulse wave sensor	OB-33	
15 NIBP cuffs		
(for right brachial, S)	CUF-129SR	17 - 22cm (6.7” – 8.7”)
(for left brachial, S)	CUF-129SL	
(for right brachial, L)	CUF-129LR	30 - 39cm (11.8” – 15.4”)
(for left brachial, L)	CUF-129LL	
(for right ankle, L)	CUF-138LR	30 – 42cm (11.8” – 16.5”)
(for left ankle, L)	CUF-138LL	
16 Cuff holder	OAV-01A	
17 Limb cushion cover	OA-463	
18 Pulse wave test data Management software	VSS-10	
19 Printer shelf	OAV-03A	



Recommended peripheral devices

No.	Accessory	Model	Remarks
1 Ethernet hub	UL 1950 compliant	CentreCom FS708XL (switching hub)	
2 Color printer	VSP-15		



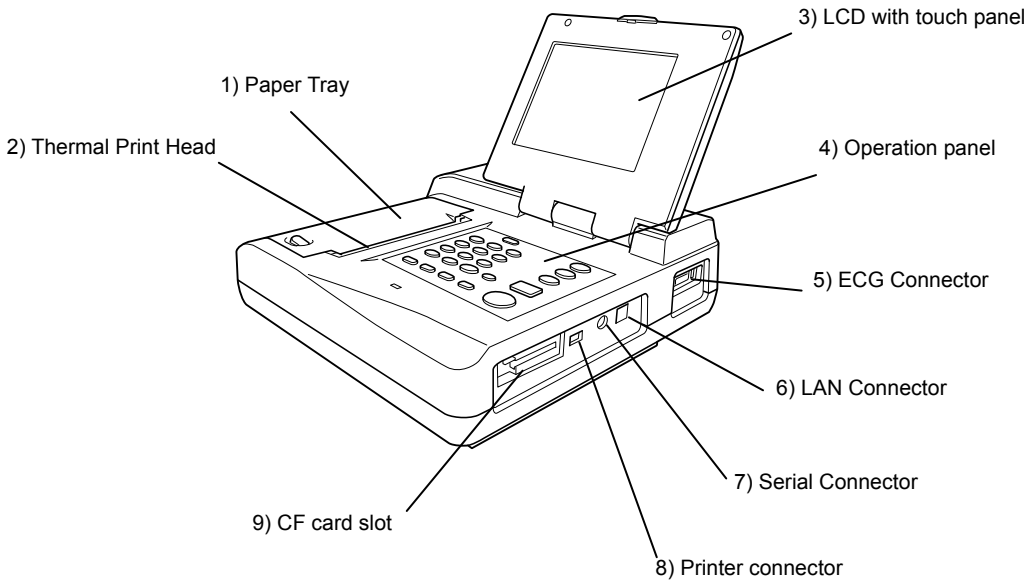
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4

Chapter 4 Names of Parts of Equipment

4.1 Front 4-2
4.2 Rear 4-3
4.3 Bottom 4-4
4.4 Operation panel 4-5

4.1 Front



1) Paper Tray
Contains the loaded chart paper.

2) Thermal head
Prints patient information and examination results on chart paper.

3) LCD with touch panel
Displays patient information, pulse waves, cuff pressures, etc. For details, refer to "LCD Layout" on page 1-8 or use the buttons on the display to operate the instrument.

4) Operation panel
Controls instrument operations.

5) ECG Connector
Connects the ECG lead cable.

6) LAN connector
Connects the instrument to a network via a LAN cable enabling the management of instrument data on a PC.

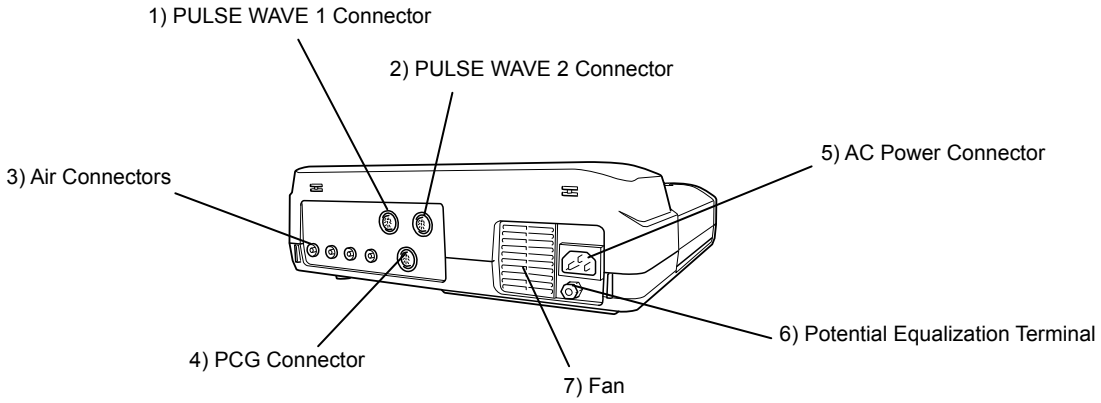
7) Serial Connector
Connects a serial cable.

8) Printer connector
Connects to a color printer recommended by Fukuda Denshi.

9) CF card slot
Enables saving of examination results and patient information on a CF card.

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4.2 Rear



1) PULSE WAVE 1 Connector (left)

Connects an optional pulse wave sensor with air bag that measures the left knee pulse wave.
Also connects an optional amorphous carotid pulse wave sensor when measuring the aortic PWV.

2) PULSE WAVE 2 Connector (right)

Connects an optional pulse wave sensor with air bag that measures the right knee pulse wave.
Also connects an optional amorphous femoral pulse wave sensor when measuring the aortic PWV.

3) Air connector

Connects a cuff air hose. As viewed from the rear panel, the air connectors from left to right are: left ankle (L-A), right ankle (R-A), left brachial (L-B) and right brachial (R-B).

4) PCG Connector

Connects the PCG microphone.

5) AC power connector

Connects the AC power cable.

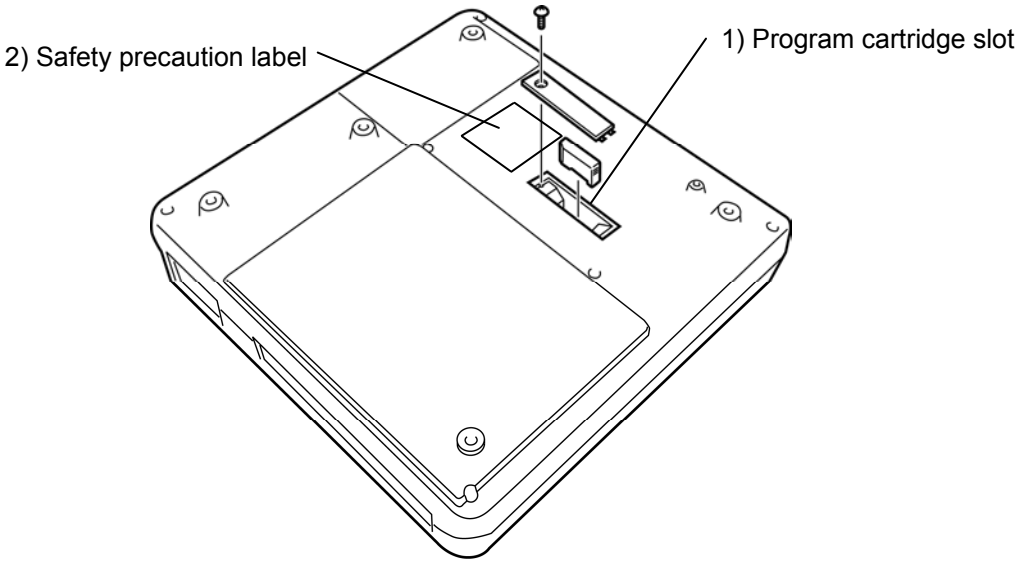
6) Potential equalization terminal

Connects an optional ground cable to equalize the potential between all connected instruments.

7) Fan

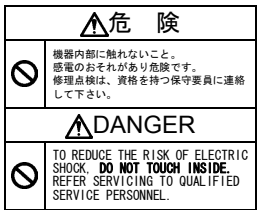
Internal cooling fan.

4.3 Bottom



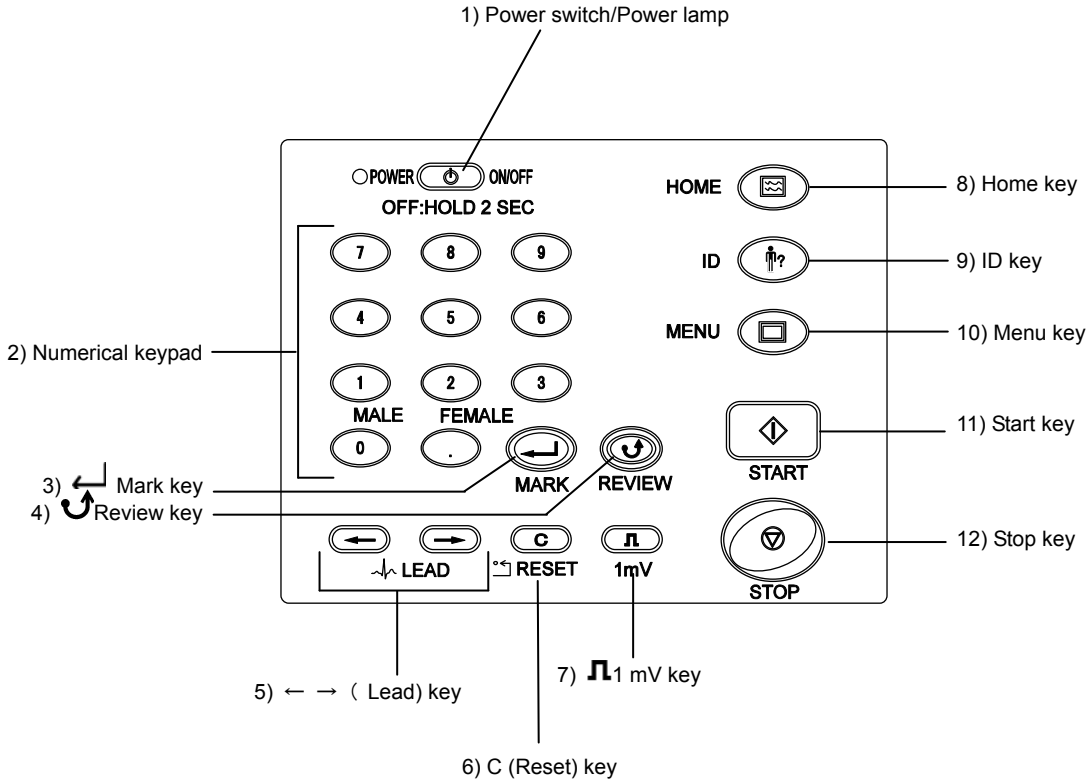
1) Program cartridge slot
Install the program cartridge in this slot to add optional functionality.

2) Safety precaution label



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4.4 Operation panel



1) Power switch/Power lamp

Turns the instrument on and off. Hold down the button 2 seconds or longer to turn off. The lamp goes on when the instrument is turned on.

2) Numerical keypad

Enters numbers.

Use "." to enter a decimal point.

3) ↵ Mark key

Enters settings.

Prints marks during manual ECG recording.

4) ↺ Review key

Serves as a start key for reviewing the recording of an ECG examination.

5) ← → (Lead) key

Moves entered item.

Switches lead during manual ECG recording.

6) C (Reset) key

Deletes entered characters.

Resets an input pulse while pressed. Pulse input resumes when the key is released.

7) ⎍ 1 mV key

Displays and records a 1 mV calibration wave.

8) Home key

Calls up the basic window.

9) ID key

Calls up the patient data input window.

10) Menu key

Calls up the menu window.

11) Start key

Start measurements.

12) Stop key

Stops measuring and printing.

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5

Chapter 5 Maintenance

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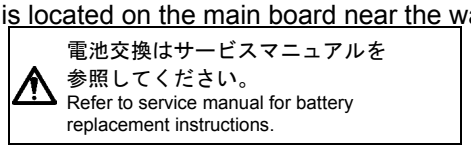
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5.1 Replacing Lithium Battery for Maintaining Clock and Settings

⚠ DANGER	
⊘	Be sure to turn off the power and disconnect the power plug during battery replacement. **Do not short-circuit the lithium battery. This may result in a fire hazard.**

This instrument contains a lithium battery that powers the memory that stores the clock and other settings. When the battery voltage becomes low, the message "Replace backup battery" appears on the display panel. Follow the steps below to replace the battery when this message appears. The clock may not work properly and set values may be initialized when battery voltage goes low.

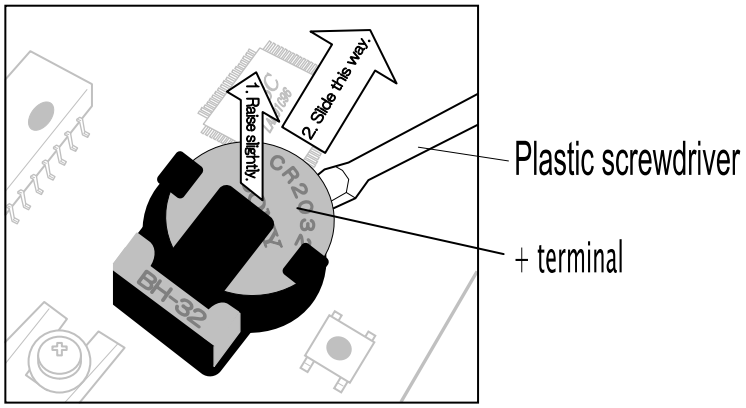
(1) Save settings to the CF card.
Touch [Menu] → [Other Setup] → [Next], then touch [Save Setup Data to Card] and [Execute]. Be sure to perform this step since replacing the battery will initialize all settings.
(2) Remove the upper case of the instrument.（☞8.1.1）
(3) Free the MAIN-LCD cable and key cable.（☞8.1.2(1)）
(4) Remove the five screws and center shield plate.（☞8.1.2(4)）
The lithium battery is located on the main board near the warning label.



Warning label

(5) Insert the tip of a plastic screwdriver under the lithium battery to raise it slightly. Then slide it in the direction of the arrow to remove it.

⚠ CAUTION
Be sure to use a plastic screwdriver or other nonmetallic screwdriver to prevent short-circuiting the lithium battery.



(6) Insert a new lithium battery. (type: CR2032) Place the battery with the + terminal facing up.
(7) Install the center shield plate, replace the removed cables, attach the upper case and tighten the screws properly.
(8) Load the settings from the CF card.
Touch [Menu] → [Other Setup] → [Next], then touch [Load Setup Data from Card] and [Execute].

⚠ CAUTION
Take care to avoid pinching the cables when replacing the center shield plate and the upper case.

5.2 Cleaning and Disinfecting

5.2.1 Cleaning and Disinfecting the Enclosure

Use the following procedures to clean and disinfect the enclosure of the instrument.

- **Cleaning**
  Wipe the instrument with a cloth that has been thoroughly wrung out after immersion in a solution of domestic neutral detergent and water.
  Do not use ether and benzine as they may damage the enclosure.
- **Disinfection**
  Wipe the instrument with a cloth that has been thoroughly wrung out after being sprayed with a solution of alcohol and water or glutaraldehyde. Then, wipe the enclosure with a soft lint cloth.

⚠ DANGER	
⊘	• Pay attention not to have medical solution enter the equipment or connectors. The electrical parts may short-circuit and cause damage to the equipment. • Never use organic solvents, thinner, toluene or benzene as it may damage the resin. • Never use abrasive or chemical cleaner. • When sterilizing the entire room using a spray solution, pay close attention not to have liquids get into the equipment or connectors. The electrical parts may short-circuit and cause damage to the equipment or poor electrical contact of the connector may cause malfunction.

5.2.2 Cleaning the Built-in Recorder

Printing residue adhering to the thermal print head lowers the print quality. Use a cleaning kit recommended by Fukuda or a cotton swab dampened in alcohol to wipe away print residue.

⚠ CAUTION	
⊘	Never use sandpaper as it will damage the heating element.

5.2.3 Cleaning the Display Unit

Use the supplied silicon cloth to remove dust and stains from the LCD screen. If the screen is severely stained, wipe it with a cloth that has been dampened in ethanol or other alcohol and thoroughly wrung out.

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5.2.4 Cleaning the Accessories

- **Toe cuffs**
  Wipe cuffs gently using water or alcohol for disinfection. Do not use organic solvents such as thinner or toluene.

- **Cuffs and air hoses**
  Wipe gently with gauze or other soft cloth moistened in alcohol for disinfection. Do not use organic solvents such as thinner or toluene.

- **Pulse wave sensor with air bag**
  Wipe gently with alcohol for disinfection. Do not use organic solvents such as thinner or toluene.

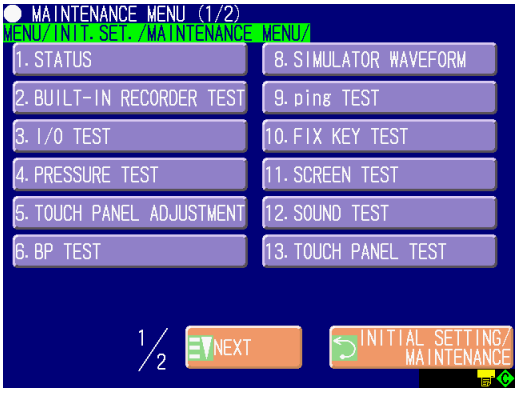
- **PCG microphone**
  Wipe gently with neutral detergent or alcohol. Do not use organic solvents such as thinner or toluene.

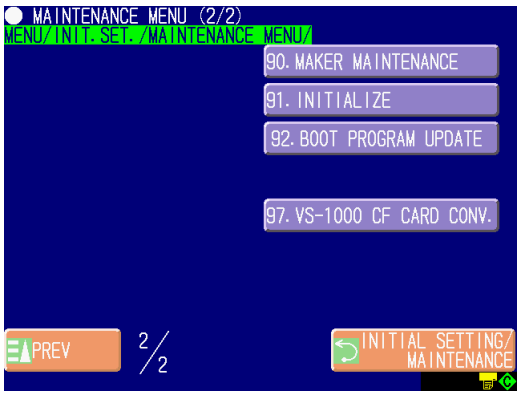
- **ECG lead cables**
  Wipe gently with neutral detergent or 70% isopropyl alcohol. Do not use organic solvents such as thinner or toluene.

- **Clip electrodes**
  Wipe gently with neutral detergent or alcohol. Do not use organic solvents such as thinner or toluene.

5.3 Self-diagnosis (User Maintenance)

To start self-diagnosis on this instrument, press the (Menu) key to open the [Top Menu] and touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] to open the [Maintenance Menu (1/2)]. Touch [Next] to open [Maintenance Menu (2/2)] and touch [Prev] to return to [Maintenance Menu (1/2)]. Or, touch [Return] to return to the [Initial Setting/Maintenance] window.





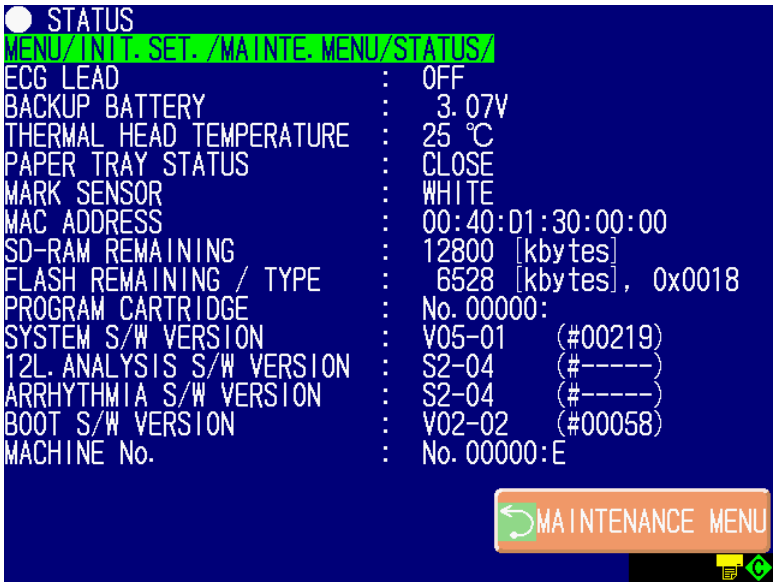
5.3.1 Checking Instrument Status

The following functions are provided to enable real-time checks of instrument status, temperature and other parameters.

5.3.1.1 Check Method

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Status] to open the [Status] window. Touch [Return] to return to the [Maintenance (1/2)] window.

5.3.1.2 Check Screen



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5.3.1.3 Check Items

(1) ECG Lead
Indicates whether or not electrodes have come loose.
[On]: electrodes are properly attached. [Off]: one or more electrodes are loose.

(2) Backup Battery
Indicates the battery voltage of the backup lithium battery.
The message [Replace backup battery] appears when the voltage drops below 2.2 V. Replace the battery when this happens. (☞5.1)

(3) Thermal Head Temperature
Indicates the temperature of the thermal print head.
The message [Thermal head heat up] appears when thermal print head temperature exceeds 63°C. When this happens, turn the power off to let it cool.

(4) Paper Tray Status
Indicates paper tray status of the built-in thermal array recorder.
Displays “Open” when the paper tray is open and “Close” when it is closed.

(5) Mark Sensor
Indicates Z-fold page mark status of the built-in thermal array recorder.
“Black” is indicated when the mark is detected during Z-fold paper feed, otherwise “White”.

(6) MAC Address
Indicates the LAN MAC address of the instrument.
The MAC address is a unique address, each device has a different address.

(7) SD-RAM Remaining
Indicates remaining SDRAM capacity.

(8) Flash Remaining/Kind
Indicates remaining Flash ROM capacity and type.

(9) Program Cartridge
Displays "Exist" when a program cartridge is inserted and "Not Exist" when it is not.

(10) System Version
Indicates software version.

(11) 12L. Analysis Version
Indicates the version of the 12-lead analysis software.

(12) Arrhythmia Version
Indicates the version of the arrhythmia analysis software.

(13) Boot Version
Indicates the version of the boot software.

5.3.2 Testing Built-in Thermal Array Recorder

This function tests chart paper feed and recorder printing.

5.3.2.1 Test Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Built-in Recorder Test] to open the [Built-in Recorder Test] window.
(2) Select print type (square waves, diagonal lines, stripes) and record speed (5 mm/s, 10 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s) and press the (Start) key to start printing.
To stop printing, press the (Stop) key. Touch [Return] to return to the [Maintenance menu].

- **[Square Wave]**
  Sets the printer to output square waves.

- **[Diagonal Line]**
  Sets the printer to output diagonal lines.

- **[Stripe]**
  Sets the printer to output stripes.
  Used to check head contact.

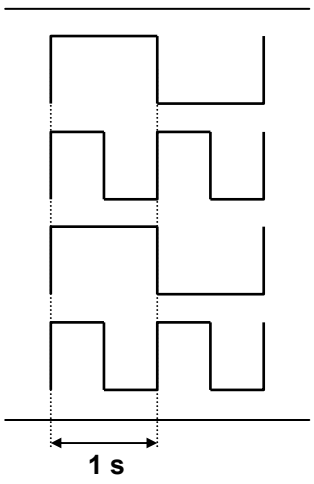
- **[5 mm/s], [10 mm/s], [12.5 mm/s], [25 mm/s], [50 mm/s]**
  Use this function to set the record speed.

- **[Execute]**
  Starts an automatic test. Sets the printer to print square waves → diagonal lines → square waves → stripes at 5 mm/s, 10 mm/s, 12.5 mm/s, 25 mm/s and 50 mm/s record speed. To stop printing, press the (Stop) key.

5.3.2.2 Criteria

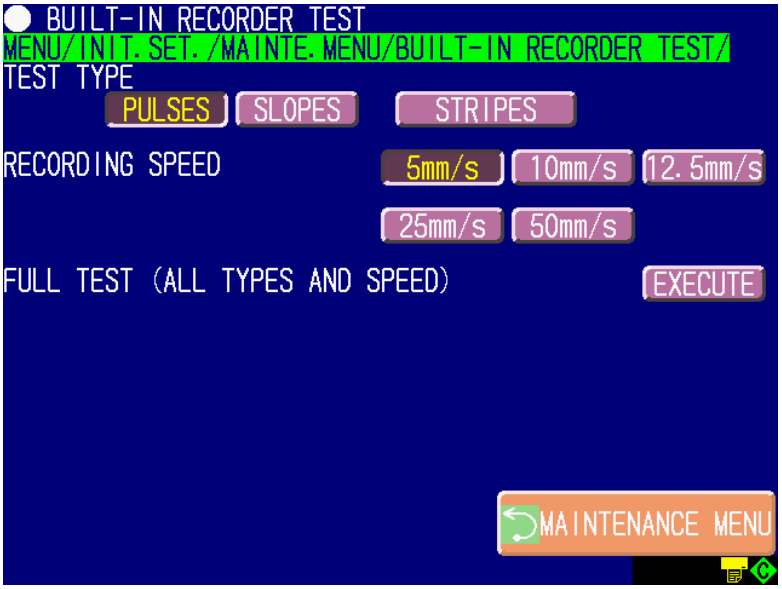
The test print must meet the following conditions.

- The chart paper must be fed without meandering.
- There must be no bent at either edge of chart paper.
- There must be no uneven recording, uneven density or fogging.
- There must be no missing dots.
- Paper speed deviation
  5, 10, 12.5, 25, 50 mm/s ±3%
  Print square waves to check record speed.



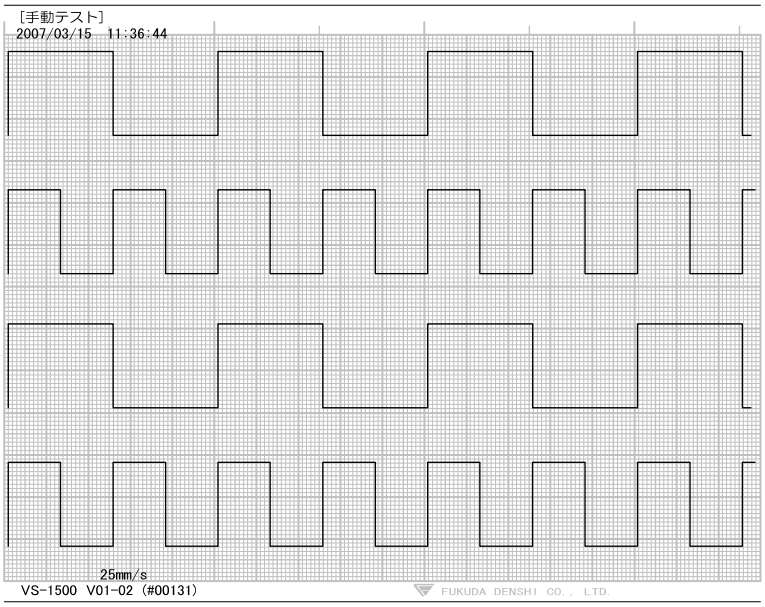
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5.3.2.3 Test Window



5.3.2.4 Print Example

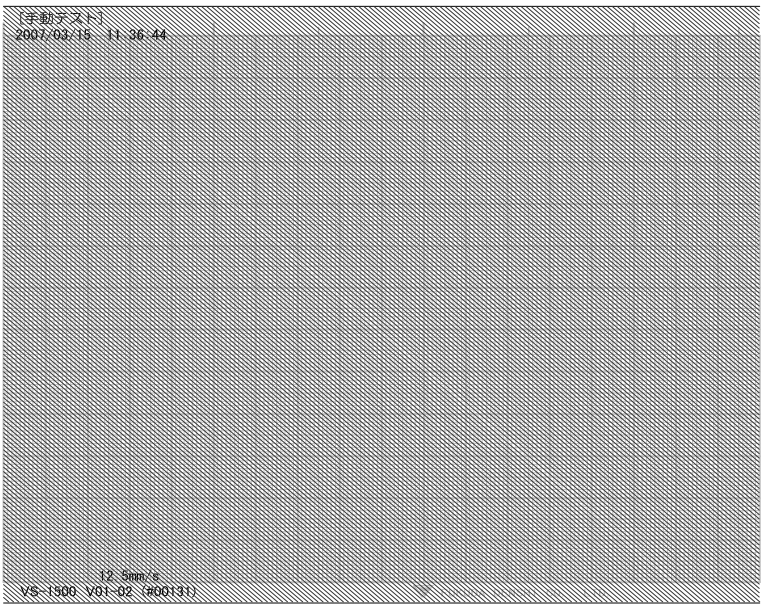
● Square Wave



● Diagonal Line



● Stripe



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5.3.3 Complete I/O Test

Use this function to test all VS-1500 I/O devices (LAN, serial, CF card, printer, PGM CTRG) including VS-1500 SRAM. The test is performed in the [I/O Test] window.

5.3.3.1 Test Method

(1) Make the connections required by the particular test. (☞5.3.4～5.3.9)
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(3) Touch [Test All] to start the test. To stop the test, touch [Test All] again. Touching [Test All] again allows you to successively perform frequency and error count checks. Touching any of the following keys ([LAN], [Serial], [CF Card], [Printer], [SRAM], [PGM.CTRG]) during a test makes it possible to stop or restart individual tests.
(4) Touch [Reset] to reset frequency and error count to "0".
(5) Touch [Return] to return to the [Maintenance menu].

5.3.3.2 Criteria

The error count after 100 tests must be "0".

5.3.3.3 Test Window



5.3.4 Testing LAN Communications

Use this function to test LAN communications. The test is performed in the [I/O Test] window. (☞5.3.3.3)

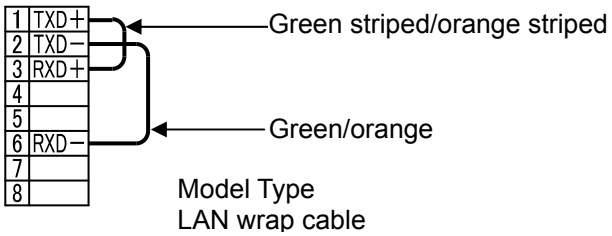
5.3.4.1 Test Method

(1) Use a LAN wrap cable to connect to the VS-1500 LAN connector.
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(3) Touch [LAN] to start the test. To stop the test, touch [LAN] again. Touching [LAN] again allows you to successively perform frequency and error count checks.
(4) Touch [Reset] to reset frequency and error count to "0".
(5) Touch [Return] to return to the [Maintenance menu].

5.3.4.2 Criteria

The error count after 100 tests must be "0".

Reference The following shows an example of a wrap cable.
Cut open a LAN cable to bare the core wires and connect the green wire to the orange wire and the green striped wire to the orange striped wire.



Model Type
LAN wrap cable

5.3.5 Testing Serial Communications

Use this function to test serial communications. The test is performed in the [I/O Test] window. (☞5.3.3.3)

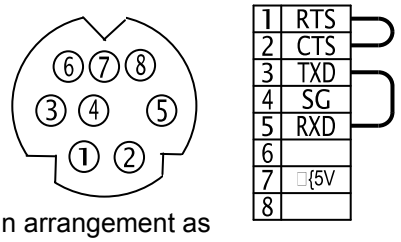
5.3.5.1 Test method

(1) Use a serial wrap cable to connect to the VS-1500 SERIAL connector.
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(3) Touch [Serial] to start the test. To stop the test, touch [Serial] again. Touching [Serial] again allows you to successively perform frequency and error count checks.
(4) Touch [Reset] to reset frequency and error count to "0".
(5) Touch [Return] to return to the [Maintenance menu].

5.3.5.2 Criteria

The error count after 100 tests must be "0".

Reference The following shows an example of a wrap cable.
Cut open a CJ-325 or other serial cable and make the following connections.



Pin arrangement as seen from the front

Serial wrap cable

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5.3.6 Testing CF Card

Use this function to test CF cards. The test is performed in the [I/O Test] window. (☞5.3.3.3)

5.3.6.1 Test Method

(1) This test requires an initialized CF card. Select [CF Card Initialize] in [Initial Setting/Maintenance] to initialize a CF card.
(2) Insert the CF card to be tested in the CF card drive of the VS-1500.
(3) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(4) Touch [CF Card] to start the test. To stop the test, touch [CF Card] again. Touching [CF Card] again allows you to successively perform frequency and error count checks.
(5) Touch [Reset] to reset frequency and error count to "0".
(6) Touch [Return] to return to the [Maintenance menu].

5.3.6.2 Criteria

The error count after 100 tests must be "0".

⚠ CAUTION	
⃠	Use a CF card which is intended for testing.

5.3.7 Testing Printer Connection

Use this function to test data communications with a printer connected to the VS-1500 via USB. The test is used to check whether the printer and instrument connection is operating normally. The test is performed in the [I/O Test] window. (☞5.3.3.3)

5.3.7.1 Test Method

(1) Connect the printer to the PRINTER connector on the VS-1500.
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(3) Touch [Printer] to start the test. To stop the test, touch [Printer] again. Touching [Printer] again allows you to successively perform frequency and error count checks.
(4) Touch [Reset] to reset frequency and error count to "0".
(5) Touch [Return] to return to the [Maintenance menu].

5.3.7.2 Criteria

The error count after 100 tests must be "0".

5.3.8 Testing SRAM

Use this function to test VS-1500 SRAM. The test is performed in the [I/O Test] window. (☞ 5.3.3.3)

5.3.8.1 Test Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(2) Touch [SRAM] to start the test. To stop the test, touch [SRAM] again. Touching [SRAM] again allows you to successively perform frequency and error count checks.
(3) Touch [Reset] to reset frequency and error count to "0".
(4) Touch [Return] to return to the [Maintenance menu].

5.3.8.2 Criteria

The error count after 100 tests must be "0".

5.3.9 Testing Program Cartridge Connection

Use this function to test data communications with a program cartridge connected to the VS-1500. The test is performed in the [I/O Test] window. (☞5.3.3.3)

5.3.9.1 Test Method

(1) Insert a program cartridge in the program cartridge slot on the VS-1500.
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [I/O Test] to open the [I/O Test] window.
(3) Touch [PGM.CTRG] to start the test. To stop the test, touch [PGM.CTRG] again. Touching [PGM.CTRG] again allows you to successively perform frequency and error count checks.
(4) Touch [Reset] to reset frequency and error count to "0".
(5) Touch [Return] to return to the [Maintenance menu].

5.3.9.2 Criteria

The error count after 100 tests must be "0".

⚠ CAUTION	
⊘	This test can be performed only on the instrument which VSC-150 ECG Upgrade Package is installed.

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5.3.10 Testing Pump Unit

Use this function to test the pump unit.

5.3.10.1 Test Method

(1) Set up the following equipment and make the connections shown below to the VS-1500.
・Four 500ml air tanks
・2.5 m air hose (OA-400A, OA-400B)
Connect one end of the air hose to an air tank and connect the other end to an air connector on the instrument. Connect all four tanks as functionality for all four limbs will be tested simultaneously.
Consult our head office for information on how to set up the air tanks.

(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Pressure Test] to open the [Pressure Test] window.

(3) Touch [Auto Test Start] to perform [1. Pressure Upper Limit] to [7. Time Limit] test items in order. Press the (Stop) key to end testing.

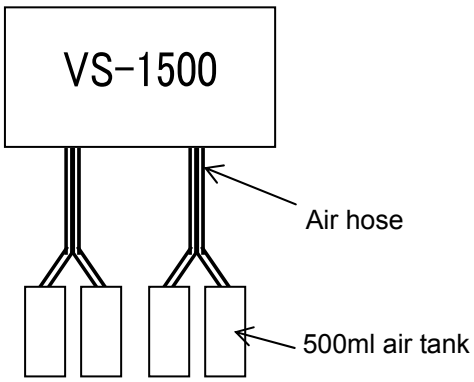
(4) To perform an individual test, touch any of the keys between [1. Pressure Upper Limit] to [7. Time Limit].

(5) Touching [High Speed] to perform tests at [High Speed] changes the time limit set by [6) Time Limit] to shorten test time from 130 s to 8 s. Touching [High Speed] again, returns [High Speed] to normal speed mode.

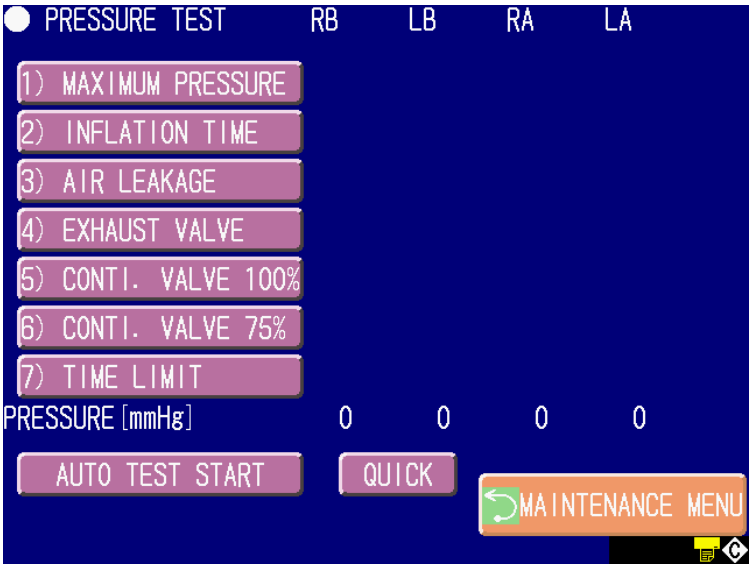
(6) Any test result outside the allowable range is highlighted.

(7) Touch [Return] to return to the [Maintenance menu].





5.3.10.2 Test Window



5.3.10.3 Test Parameters and Criteria

- **0 point check**
  This test indicates the pressure value at atmospheric pressure when no connection is made to the air connectors.
  Criteria: A pressure value of 0 mmHg should be indicated.

- **Safety mechanism** [Pressure upper limit]
  Pressurize the 500ml tanks to measure the pressure when the hardware overpressure safety mechanism is activated.
  Criteria: The quick exhaust valve should activate at a pressure of 320 ±10 mmHg.

- **Inflation time** [Inflation time]
  Pressurize the 500ml tanks and measure the time it takes to raise the pressure from 0 to 300 mmHg.
  Criteria: 9 s or less

- **Air leakage (Leakage)** [Air leakage]
  Raise the pressure in the 500ml tanks to 300 mmHg and let it stabilize for 15 s. Then measure air leakage during a 1-minute period.
  Criteria: The pressure drop should be 6 mmHg/min or less.

- **Quick exhaust** [Exhaust characteristics]
  Pressurize the 500ml tanks and open the quick exhaust value to measure the time it takes to lower the pressure from 260 to 15 mmHg.
  Criteria: 10 s or less

- **Slow-leak valve performance** [100% open]
  Raise the pressure in the 500ml tanks to 300 mmHg, add a 100% control pressure voltage to the flow control valve for testing. Then open the valve and measure the exhaust speed until the pressure drops to 180 mmHg.
  Criteria: a speed in the 20 to 60 mmHg/s range

- **Slow-leak valve performance** [75% open]
  Raise the pressure in the 500ml tanks to 300 mmHg, add a 75% control pressure voltage to the flow control valve for testing. Then open the valve and measure the exhaust speed until the pressure drops to 180 mmHg.
  Criteria: a speed of 10 mmHg/s or more.

- **Safety mechanism** [Time limit]
  Apply a constant pressure of 10 mmHg or more to the 500ml tanks to test the hardware safety device that controls time of pressure application.
  Criteria: The quick exhaust valve should activate within 130 ±10 s.
  The time value should be 8 ±1 s when [High Speed] is engaged.

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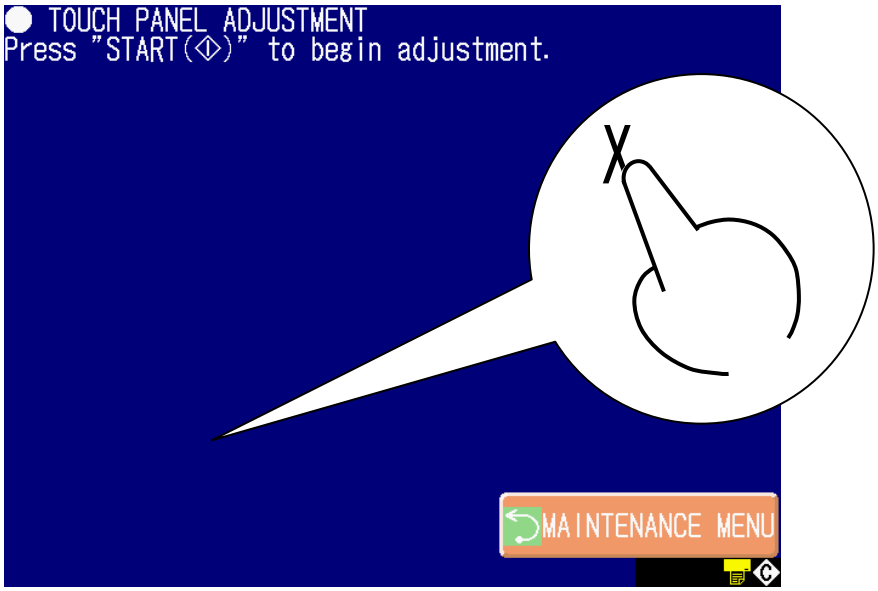
5.3.11 Adjusting the Touch Panel

Use this function to adjust the touch panel .

5.3.11.1 Adjustment Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Touch Panel Adjustment] to open the [Touch Panel Adjustment] window.
(2) Press the (Start) key and touch the point on the screen intersected by the "X" that appears.
(3) Touching the point intersected by a second "X" that appears again completes the adjustment.
(4) Touch [Return] to return to the [Maintenance menu].

5.3.11.2 Adjustment Window



5.3.12 Confirming Pressure Accuracy

Use this function to confirm pressure accuracy.

5.3.12.1 Check Method

⚠ CAUTION	
⊘	Be sure not to apply excessive pressure when applying pressure. The pressure gauge could break.

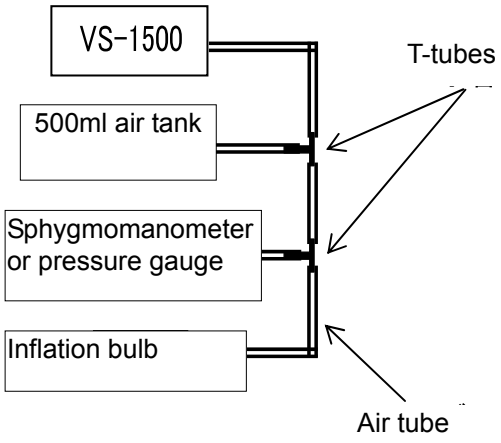
(1) Connect the following items to the VS-1500.
- A calibrated sphygmomanometer or pressure gauge
- 500ml air tanks
- Inflation bulb
- T-tubes
- Air tubes

Connect the air tubes to the air connectors on the instrument. Perform a test for each site.
Consult our head office for information on how to set up the air tanks and the T-tubes.

(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Official Approval Mode] to open the [Official Approval Mode] window.
(3) Disconnect one air tube connection to confirm that the pressure measurement units on the VS-1500 and pressure gauge return to atmospheric pressure.
(4) Touch [Sensor Offset] to check that the pressure value in the [Official Approval Mode] window indicates 0 mmHg.
(5) Reconnect the disconnected air tube.
(6) Use the inflation bulb to apply a pressure of 50 mmHg and maintain this pressure. Compare the pressure value in the [Inspection Mode] window with that indicated by the pressure gauge.
(7) Confirm that the pressure difference is ±3 mmHg or less.
(8) Also compare the pressure values at 100, 150, 250 and 280 mmHg pressure.
(9) Touch [Return] to return to the [Maintenance menu].

⚠ CAUTION
If the pressure difference is ±3 mmHg or more, return the instrument to our factory for repair.



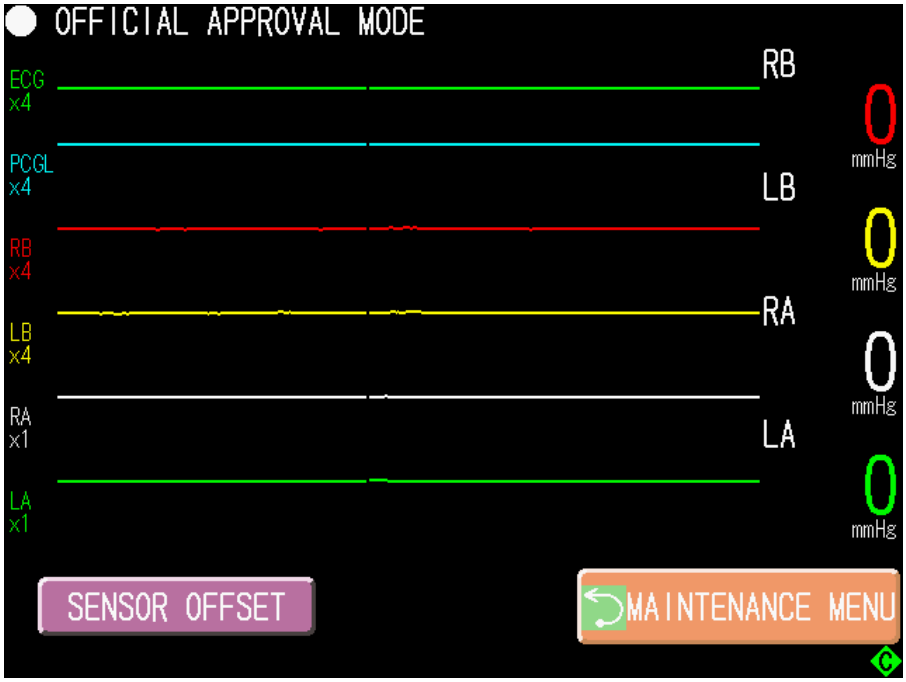


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5.3.12.2 Criteria

The difference between each pressure value on the screen and that on the pressure gauge must be ±3 mmHg or less.

5.3.12.3 Test Window

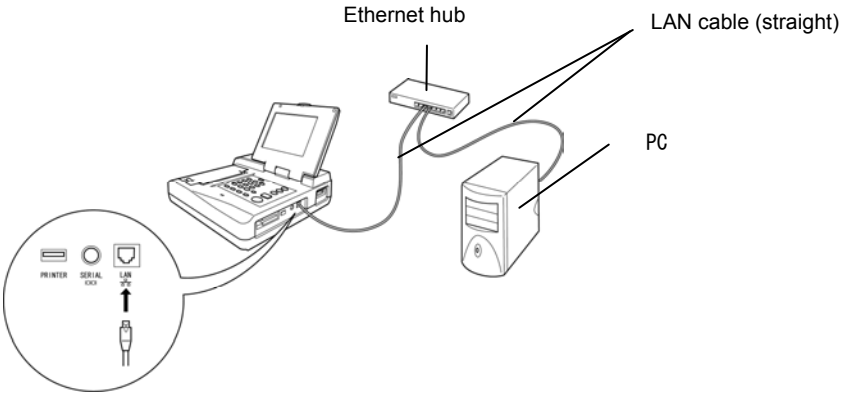


5.3.13 Testing PC Connection

Use this function to perform a ping test on the PC connected to the instrument to check if it is properly connected.

5.3.13.1 Test Method

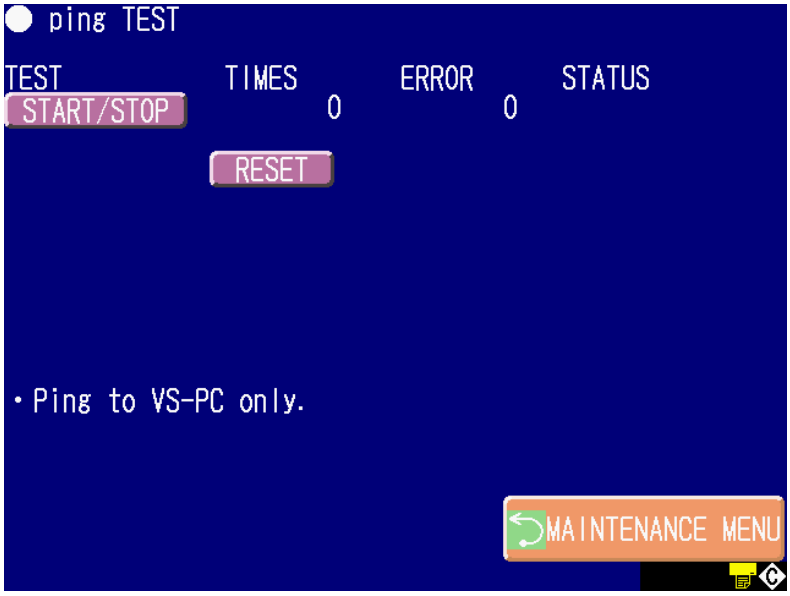
(1) Connect the VS-1500 to the network as described below.
(2) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Network and Master ID Setting]. Enter the IP address for the VS-1500 and VS-PC in the setup window that appears.
(3) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [ping Test] to open the [ping Test] window.
(4) Touch [Start/End] to start the test. Touching [Start/End] during a test will cancel the test. Touching [Start/End] again allows you to successively perform frequency and error count checks.
(5) Touch [Reset] to reset frequency and error count to "0".
(6) Touch [Return] to return to the [Maintenance menu].



5.3.13.2 Criteria

The error count after 100 tests must be "0".

5.3.13.3 Test Window



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5.3.14 Testing Operation Panel Fixed Keys

Use this function to test the fixed keys on the operation panel.

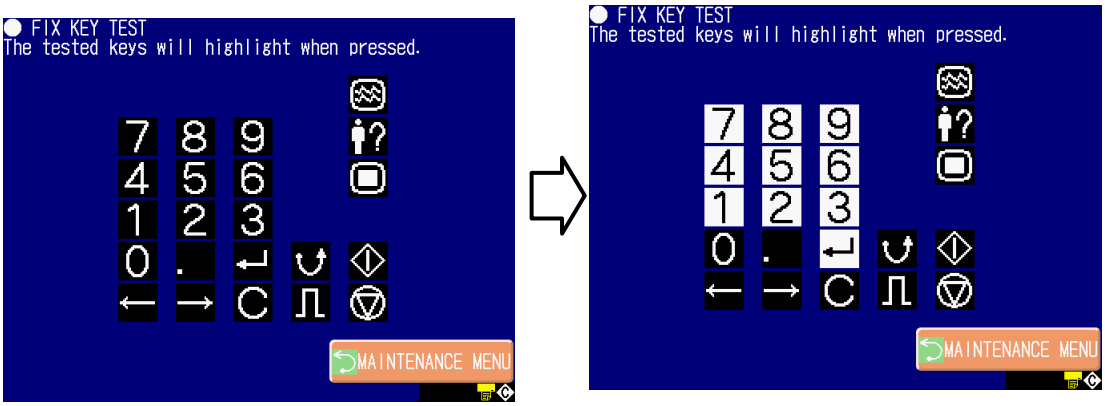
5.3.14.1 Test Method

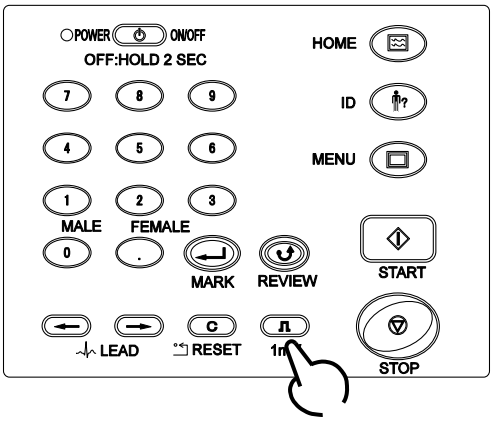
(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Fix Key Test] to open the [Fix Key Test] window.
(2) Press each fixed key on the operation panel to check that the corresponding symbol highlights on the [Fix Key Test] window.
(3) Touch [Return] to return to the [Maintenance menu].

5.3.14.2 Criteria

The symbol corresponding to the pressed key must be highlighted.

5.3.14.3 Test Window





5.3.15 Testing the Display

Use this function to check that the display is operating normally.

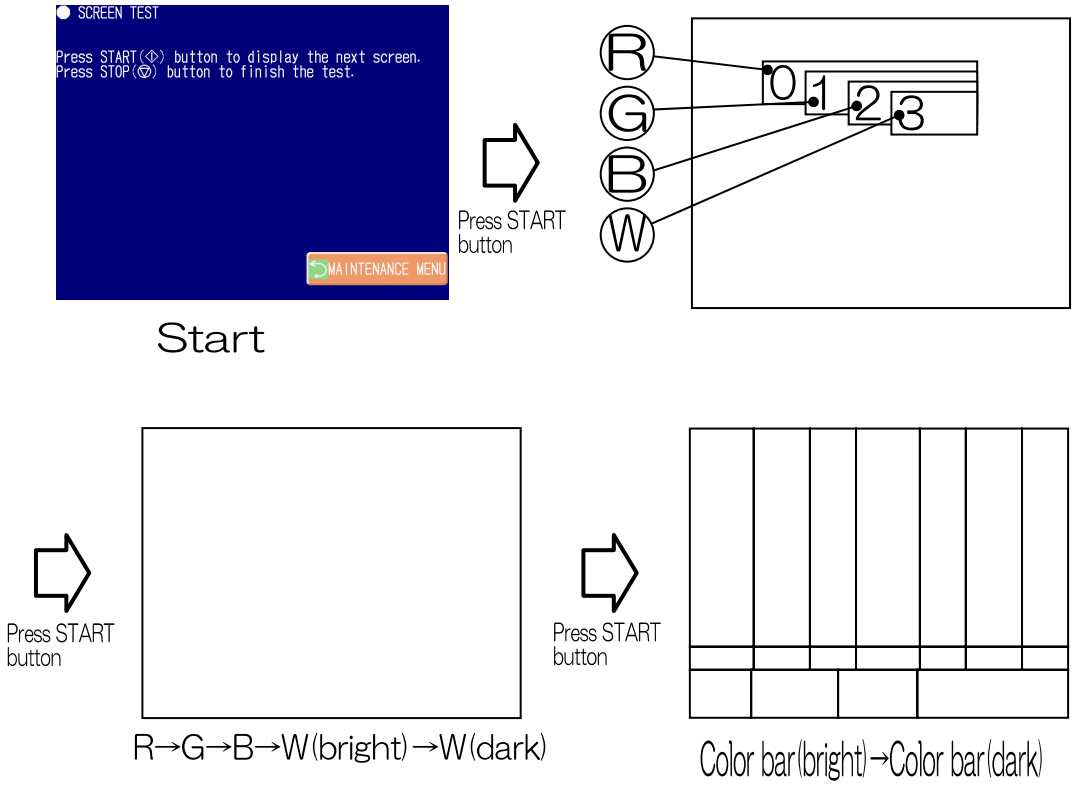
5.3.15.1 Test Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Display Test] to open the [Display Test] window.
(2) The screen changes each time the (Start) key is pressed. To cancel the test, press the (Stop) key.
(3) Touch [Return] to return to the [Maintenance menu].

5.3.15.2 Criteria

Color must not be uneven, the display must not flicker and the brightness should go down when ambient light is dimmed.

5.3.15.3 Test Window



Note
Although LCD is manufactured using high-precision technology, there may still be dead pixels, (pixels that are black) and pixels that are constantly lit, which appear as red, blue or green dots. These latter pixels may appear as uneven color depending on the line of sight. This is an inherent characteristic of LCD and not a malfunction.

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5.3.16 Testing Sound and Tone

Use this function to test sound and tone.

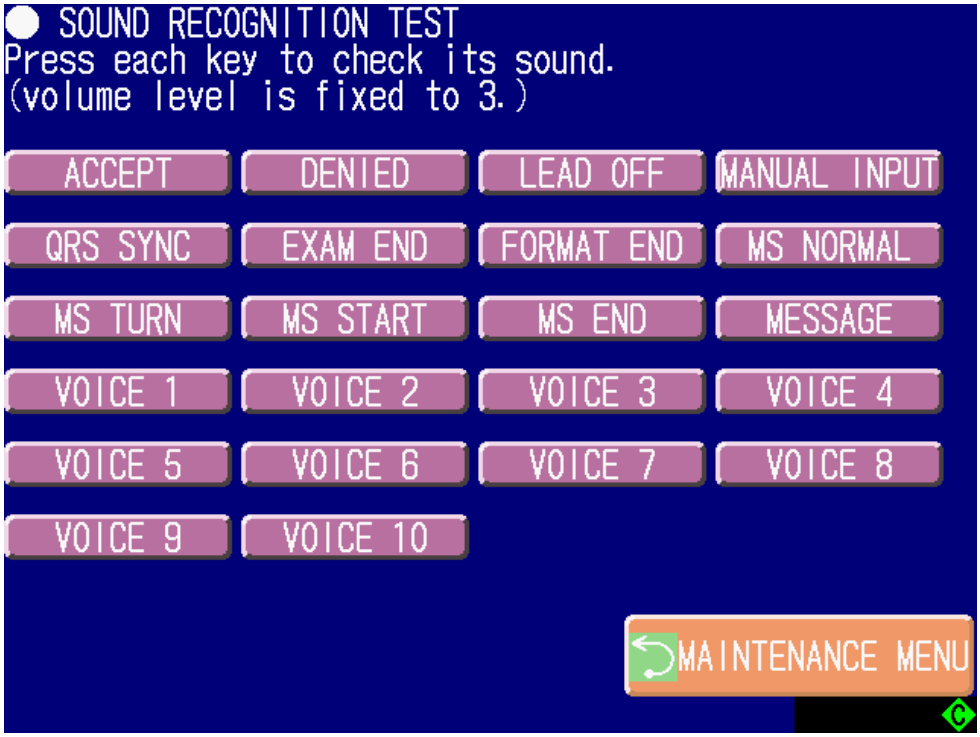
5.3.16.1 Test Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Sound Test] to open the [Sound Test] window.
(2) Touching a display key generates a sound or tone.
(3) Touch [Return] to return to the [Maintenance menu].

5.3.16.2 Criteria

Each key must generate the corresponding sound or tone.

5.3.16.3 Test Window



5.3.17 Testing the Touch Panel

Use this function to test the touch panel.

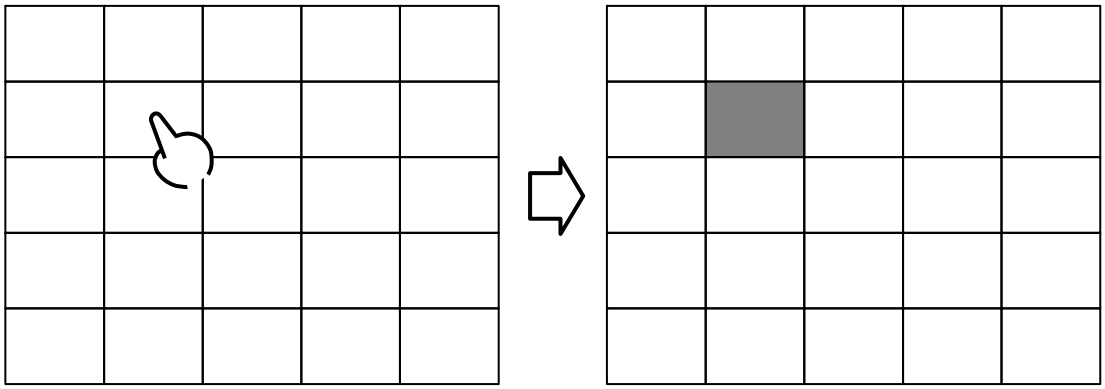
5.3.17.1 Test Method

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Touch Panel Test] to open the [Touch Panel Test] window.
(2) Touch the (Start) key to display a 5 x 5 grid on the screen.
(3) Touching the screen changes the color of the square that is touched.
(4) To end the test, press the (Stop) key.
(5) Touch [Return] to return to the [Maintenance menu].

5.3.17.2 Criteria

The touched square must change color.

5.3.17.3 Test Window



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5.3.18 Initializing Set Values

Use this function to initialize instrument settings.
Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Initialize] → [OK (↵)] to initialize.

5.3.19 Making VS-1000 CF Cards usable on the VS-1500

Use this function to convert cards used on a VS-1000 for use on a VS-1500.

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [VS-1000 CF Card Conversion] → [OK (↵)] to convert.

⚠ CAUTION
A CF card that has been converted using this function will no longer work in the VS-1000.

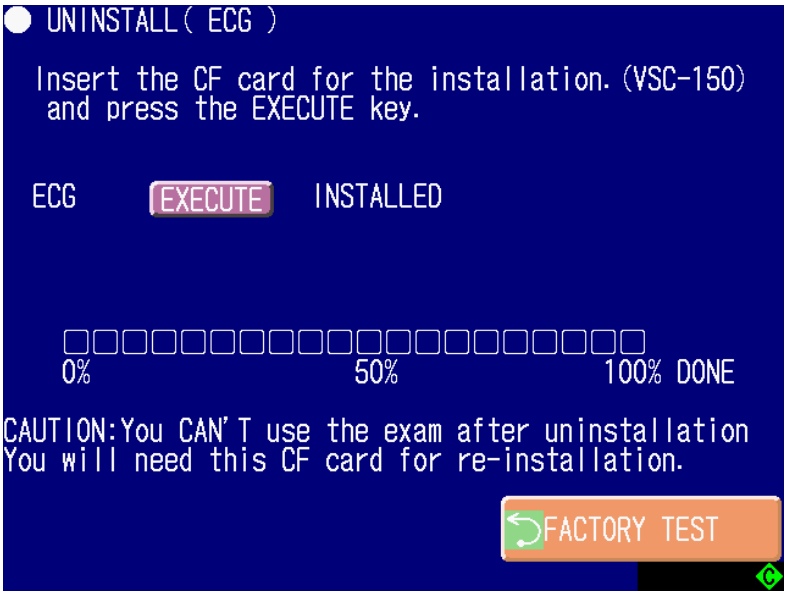
5.3.20 Uninstalling ECG

Use this function to uninstall the ECG function from the VS-1500.

5.3.20.1 Method

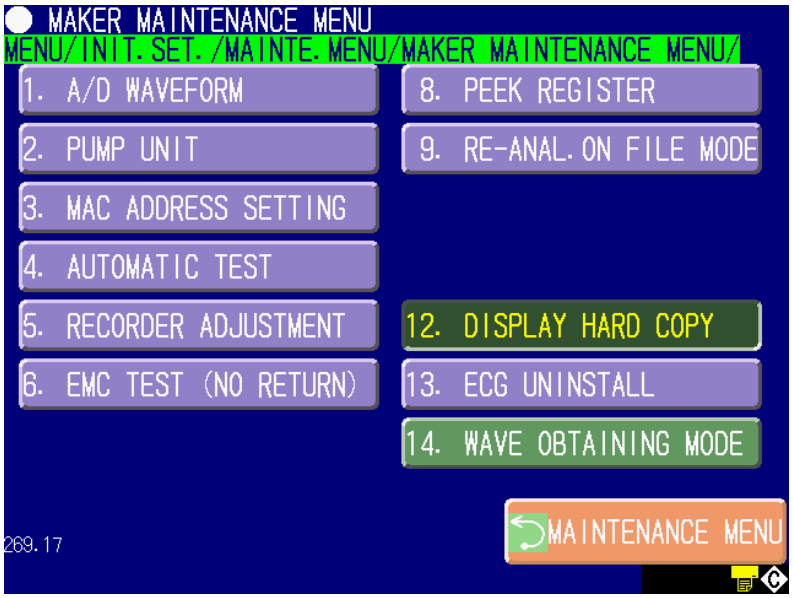
⚠ CAUTION
The ECG functions can no longer be used if uninstalled.

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [ECG Uninstall] to open the [ECG Uninstall] window.
(2) Insert a VSC-150 CF card in the CF card drive and touch [Execute] → [OK (↵)] to uninstall.



5.4 Self-diagnosis (Manufacturer Maintenance)

To open the [Manufacturer Maintenance Menu], first press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] →[3] →[9] →[4] → [↵].



⚠ CAUTION
[3. MAC Address Setting], [6. EMC Test (No Return)] [9. Reanalyze on File Mode] [12. Screen Hard Copy] are maintenance tools to be used at the factory and for development purposes. Do not use any of these functions.

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5.4.1 Recording Various Waveforms Manually

Use this function to display a variety of waveforms on the display and manually print them using the built-in thermal array recorder.
Perform this operation in the [AD Waveform] window.
Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [A/D Waveform] to open the [A/D Waveform] window.

5.4.1.1 Description of Operation Keys

- **(Start) key**
  Starts printing.

- **(Stop) key**
  Stops printing.

- **C (Reset) key**
  Resets waveforms.

- **←→ (Lead) key**
  Switches displayed waveform in single waveform display.

- **[Function ▼], [Function ▲]**
  Switches between [1 Waveform Display], [4ch Cuff Pulse (PWV) Display], [4ch Cuff Pulse (OSC) Display] and [AMP-B 4 ch Display].

- **[CH ▼], [CH ▲]**
  Switches displayed waveform in single waveform display.

- **[Filters]**
  Controls filters.

- **[Valve]**
  Controls the pump block valve.

- **[H/G ×1] ([H/G ×4])**
  Changes hardware gain. Gain changes in the following order: ×1 → ×4 → ×1

- **[▲], [▼]**
  Changes software gain.(×1/16, ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8, ×16)

- **[25mm/s]([5mm/s], [10mm/s], [12.5mm/s], [50mm/s])**
  Switches recorder sweep speed. Changes speed in the following order: 5 mm/s → 10 mm/s → 12.5 mm/s → 25 mm/s → 50 mm/s → 5 mm/s.

5.4.1.2 Displayed Waveform

● Waveforms displayed for [1 Waveform Display] (Switch display using [CH ▼], [CH ▲] key)

Label	Signal	Label	Signal
PCG	PCG (PWV characteristic)	aV_R	Lead aV_R
PCGL	PCG (L characteristic)	aV_L	Lead aV_L
PW0	Pulse Wave (PULSE WAVE 1)	aV_F	Lead aV_F
PW1	Pulse Wave (PULSE WAVE 2)	V_1	Lead V_1
ECG	ECG for BP-pulse measurement	V_2	Lead V_2
PW0DC	Pulse Wave + DC Component (PULSE WAVE 1)	V_3	Lead V_3
PW1DC	Pulse Wave + DC Component (PULSE WAVE 2)	V_4	Lead V_4
I	Lead I	V_5	Lead V_5
II	Lead II	V_6	Lead V_6
III	Lead III		

● Waveforms displayed for [4ch Cuff Pulse (PWV) Display]

Label	Signal	Label	Signal
RBPW	Cuff Pulse 0 (PWV) (Right Brachial)	RAPW	Cuff Pulse 2 (PWV) (Right Ankle)
LBPW	Cuff Pulse 1 (PWV) (Left Brachial)	LAPW	Cuff Pulse 3 (PWV) (Left Ankle)

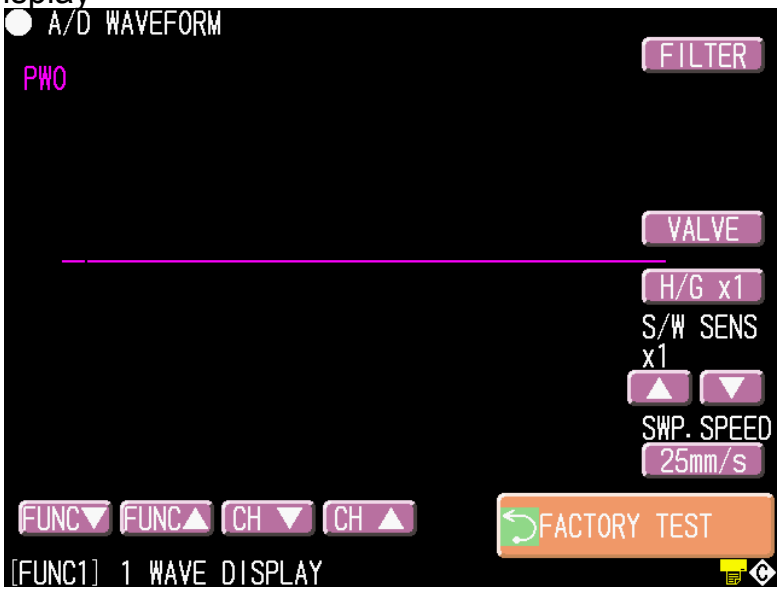
● Waveforms displayed for [4ch Cuff Pulse (OSC) Display]

Label	Signal	Label	Signal
RBPA	Cuff Pulse 0 (OSC) (Right Brachial)	RAPA	Cuff Pulse 2 (OSC) (Right Ankle)
LBPA	Cuff Pulse 1 (OSC) (Left Brachial)	LAPA	Cuff Pulse 3 (OSC) (Left Ankle)

● Waveforms displayed for [AMP-B 4ch Display]

Label	Signal	Label	Signal
PCG	PCG (PWV characteristic)	PW0	Pulse Wave (PULSE WAVE 1)
PCGL	PCG (L characteristic)	PW1	Pulse Wave (PULSE WAVE 2)

5.4.1.3 Display



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5.4.2 Checking Cuff Pressure

Use this function to check the pressure sensor used in cuff measurements.

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [Pump Unit] to open the [Pump Unit] window.

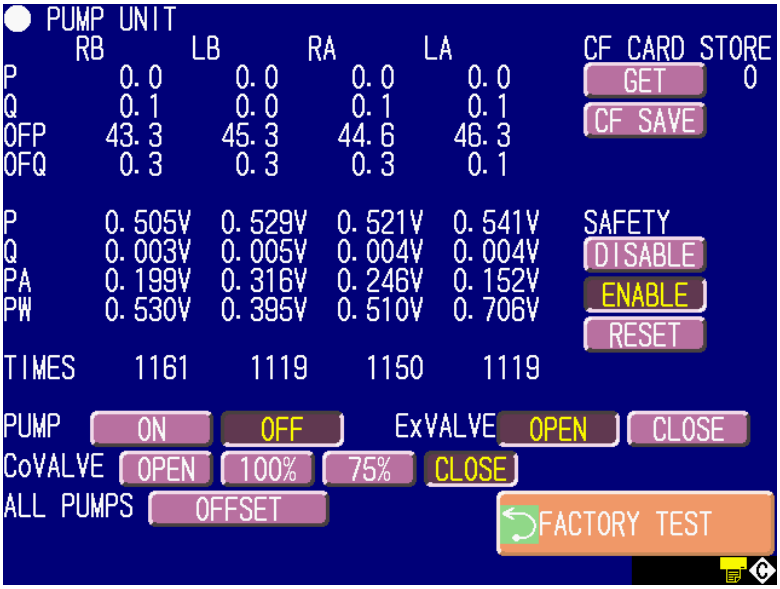
⚠CAUTION

The [Pump Unit] window is a factory maintenance tool. Do not use any function other than the [Offset] function.

5.4.2.1 Description

- **P (Top of the screen)**
  Pressure value (unit: mmHg) for positive pressure sensor
- **Q (Top of the screen)**
  Pressure value (unit: mmHg) for supplementary pressure sensor
- **P (Bottom of the screen)**
  Output voltage value (unit: V) for positive pressure sensor
- **Q (Bottom of the screen)**
  Output voltage value (unit: V) for supplementary pressure sensor
- **[Offset]**
  Zero point correction for P and Q pressure values

5.4.2.2 Display



5.4.3 Performing Automatic Tests

Use this function to automatically test the built-in thermal array recorder, display, PC connections, serial connections, printer connections, CF cards, program cartridge connections and SRAM and display the results on the screen.

5.4.3.1 Test Method

(1) Load chart paper in the built-in thermal array recorder.
(2) Connect a PC to the LAN connector of the VS-1500. (☞5.3.13)
(3) Use a serial wrap cable to connect to the VS-1500 SERIAL connector. (☞5.3.5)
(4) Connect a printer to the PRINTER connector on the VS-1500. (☞5.3.7)
(5) Load a CF card and program cartridge. (☞5.3.6)
(6) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [Automatic Test] to open the [Automatic Test] window.
(7) Touch [Start] to start the test. To end the test, touch [End].
(8) Touch [Return] to return to the [Manufacturer Maintenance menu].

- [Not Yet] Prior to testing
- [Test in Progress] Now testing
- [Test Passed] Test result indicates pass
- [No Good] Test result indicates fail

5.4.3.2 Criteria

All tests must produce a [Test Passed] result.

5.4.3.3 Test Window



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5.4.4 Adjusting Mark Sensor

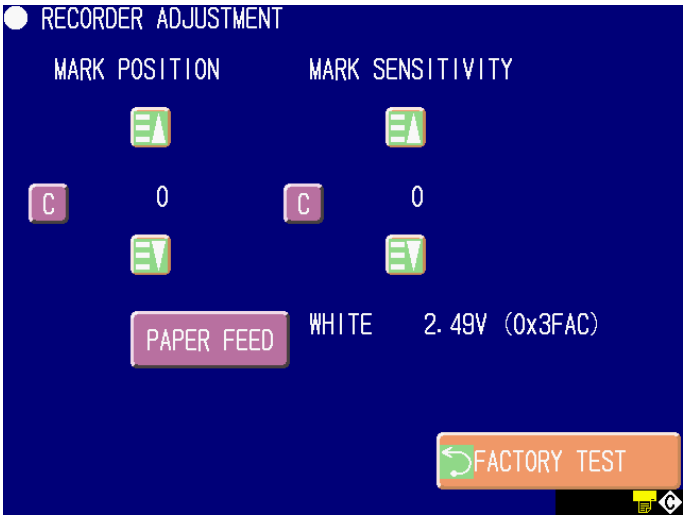
Use this function to adjust the mark position and sensitivity of the mark sensor.

5.4.4.1 Operation Method

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [Built-in Recorder Adjustment] to open the [Built-in Recorder Adjustment] window.

- **Mark Position**
  Adjusts the position of the perforation in Z-fold paper relative to the chart paper cut location of the built-in thermal array recorder.
  - When the perforation exceeds the cut-off location
    → Adjusts the paper towards the - side
  - When the perforation does not reach the cut-off location
    → Adjusts the paper towards the + side

- **Mark sensitivity**
  Adjusts mark sensor sensitivity. The sensitivity threshold rises when adjusted in the + side direction.



Note
Do not adjust the mark sensor under normal conditions.

5.4.5 Referencing the Register

Use this function to view the error log.
Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [Reference Register] to open the [Reference Register] window.
You can save the most recent 30 instances of the log and print it out by pressing the (Start) key.

5.5 Installation

5.5.1 Installing Software

Use this function to install software updates.

⚠ CAUTION	
	Do not turn off the power or remove the CF card during installation as it will make it impossible to start up the instrument.

(1) With the power off, load the CF card with the software that is to be installed on the VS-1500.
(2) Installation starts automatically as soon as the power is turned on. Installation takes a few minutes.
(3) When the buzzer sounds and the message "Installation Finished" appears on the screen, turn off the power.
(4) Remove the CF card.

Turn on the power and check the system version in the [Status] window in the Maintenance menu.
(☞5.3.1.2)

5.5.2 Boot (Installation Software) Program Installation

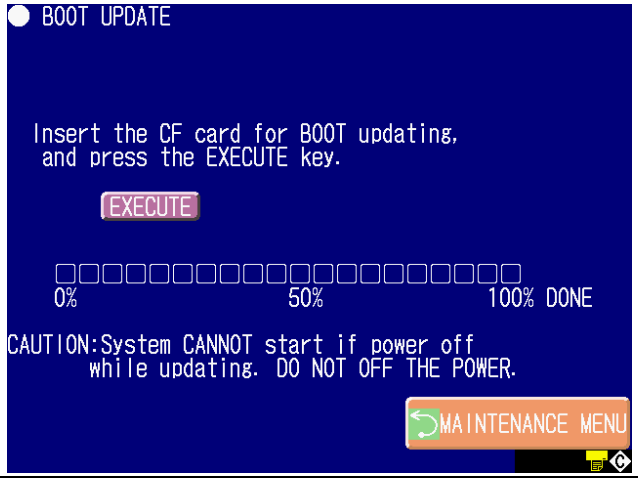
Use this function to rewrite the boot program.

5.5.2.1 Method

⚠ CAUTION	
	Do not turn off the power or remove the CF card during installation as it will make it impossible to start up the instrument.

(1) Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [Manufacturer Maintenance] → [3] → [3] → [9] → [4] → [↵] → [Boot Update] to open the [Boot Update] window.
(2) Load the CF for rewriting the boot program in the VS-1500 and touch the [Execute] key.
(3) When the boot program rewrite completes, remove the CF card and turn off the power.
(4) Turn on the power and check the boot program version in the [Status] window in the Maintenance menu.
(☞5.3.1.2)

5.5.2.2 Display



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5.5.3 Installing Standard 12-lead ECG Testing Software

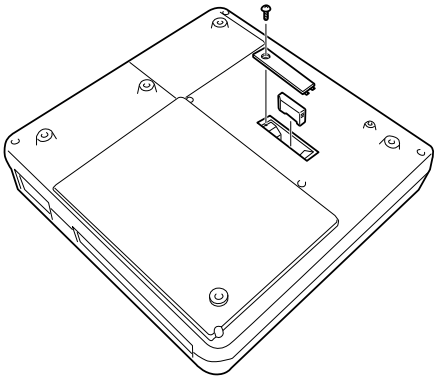
Use this function to install the VSC-150 ECG Package (standard 12-lead ECG testing software) on the VS-1500N.

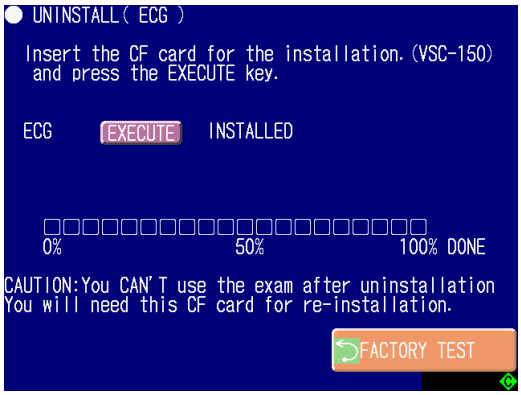
5.5.3.1 Method

⚠ CAUTION

- Turn off the power and disconnect all cords and hoses during installation.
- Be sure to screw the cover back on.
- Be sure to orient the cartridge correctly before insertion.
- Do not touch the electrodes on the cartridge.

(1) Power down the instrument (but leave it plugged in) and touch the metal of the air connectors on the back panel to remove any static electricity that might be on your body.
(2) Power down the instrument and disconnect the power cord, lead cables and all other cords and air hoses.
(3) Use a screwdriver to remove the screws in the program cartridge cover on the bottom of the instrument and open it.
(4) Install the PC-1500 Program Cartridge. Be sure to orient the cartridge correctly and make sure it is properly seated in the connector.
(5) Close the cover. Insert the screws and tighten them properly using a screwdriver.
(6) Turn on the power, press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Next] → [ECG Install] to open the [ECG Install] window.
(7) Load the CF card with the ECG program in the CF card drive. Touch [Execute] → [OK (↵)] to start installation.
(8) When the installation completes, remove the CF card and turn off the power.
(9) Turn on the power, touch [Mode Change] and make sure that Standard 12-Lead ECG Test, Arrhythmia ECG Test, Master Test and Sequential Test appear on the screen.





Note

- Be sure to remove the program card after completing the installation.
- Only the Power key is available after a completed installation.

⚠ CAUTION

- Do not turn off the power during installation.
- Do not perform an installation without loading a program cartridge.
- Do not perform an ECG uninstall.
- The ECG function will not operate if the program cartridge is removed.

NOTE: All settings made on the VS-1500N (Record Setting, BP/Pulse Test Condition Setting, R-R ECG Trend Test Mode Setup, ECG Common Setup, Storage Setting, Network and Master ID Setting, Order System Setting, Patient Data Setup, ID Card Reader Setup, Energy Save Setup and other settings) will remain after this installation. New ECG test functions are added in their default values.

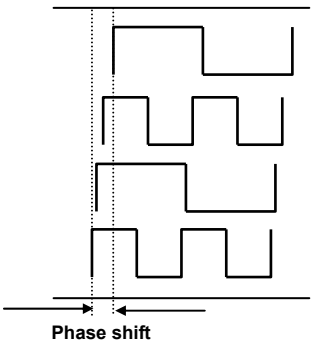
Note
Settings stored on a CF card before installation cannot be used after this installation. When the software has been installed and new ECG test functions have been set up, save the instrument settings to a CF card. Operation procedure: See page 17-2 in the VS-1500E and VS-1500N (with ECG package) instruction manual.

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5.6 Adjusting the Built-in Thermal Array Recorder

Use this function to optimize the thermal print head and chart paper of the built-in thermal array recorder.

(1) Remove the upper case of the unit. (☞8.1.1)
(2) Open the [Built-in Recorder Test] window (☞5.3.2) in the maintenance menu.
(3) Loosen the two hexagon socket head cap screws. Use a 2.5 mm Allen wrench to optimize head contact by turning the two adjusting screws during test printing. (Use a 5.5 mm hexagon box screwdriver)
    (1) Perform stripe printing and find the densest location.
    (2) Print square waves to make phase adjustment. (Phase shift must be 0.5 mm or less)



(4) Tighten the bolts loosened in step (2).
(5) Print square waves and confirm that phase shift is 0.5 mm or less.
    Repeat steps (3) to (6) if the shift is 0.5 mm or more.

5.7 Maintenance of the Color Printer

This section explains about the maintenance of the VSP-15 color printer which can be connected to this instrument.

5.7.1 Loading the Paper

(1) Lift the output tray and pull it out to remove.

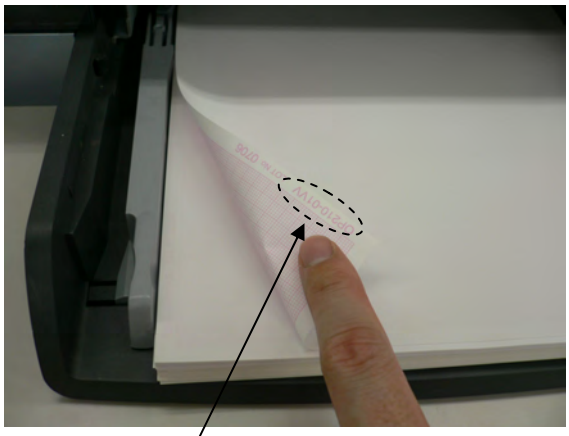


(2) Load the paper in the input tray and push the paper all the way in. Adjust the side and rear guides according to the size of the paper. Do not load paper above the height of the side guide. Up to 150 sheets of plain paper can be loaded.





<When Using the OP210-01VV>
When installing the OP210-01VV, face the grid side downward and have the model type printed on the paper come to the left.

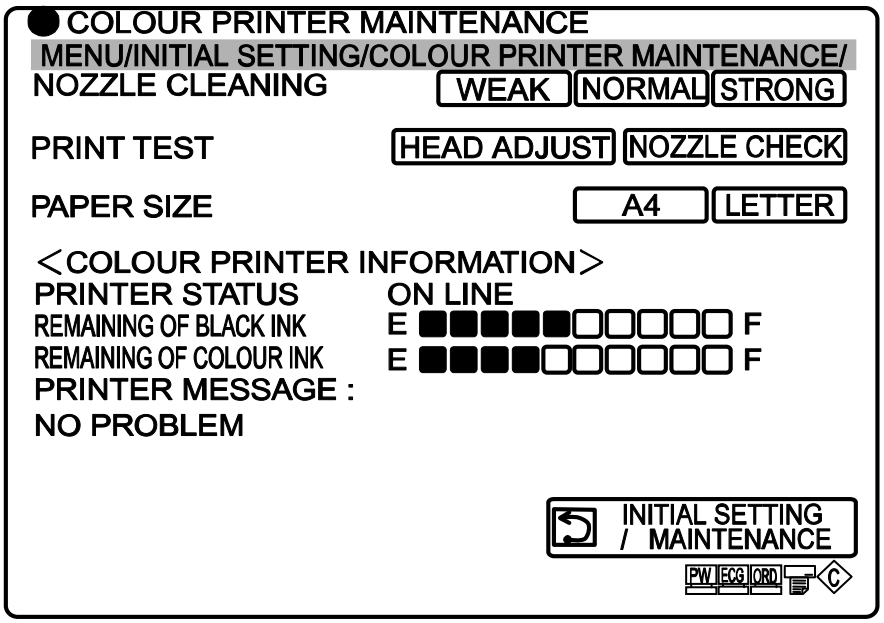


Model Type

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5.7.2 Maintenance Function

Press the (Menu) key to open the [Top Menu], then touch [Printer] to open the [Color Printer Maintenance] window.



- **Nozzle Cleaning**
  This function forces ink through the nozzles to clear them. There are three cleaning levels: [WEAK], [NORMAL] and [STRONG].

NOTE
Unnecessary nozzle cleaning will result in quicker ink depletion.

- **Print Test**
  This function performs [HEAD ADJUST] to adjust printing positions of color ink and black ink, and [NOZZLE CHECK] to check clogging of ink nozzles.

Head Adjust	Performs test print by automatically adjusting printing position of the color ink and black ink.
Nozzle Check	Performs test print by forcing ink through the color ink and black ink nozzles. Check the printed output for missed spot or thin spot.

- **Color Printer Information**
  - **Printer Status**
    The connection status of the color printer (online/offline) will be displayed.
  - **Remaining of Black Ink / Remaining of Color Ink**
    The estimated remaining amount of black ink and color ink will be displayed.
    For replacement procedure of ink cartridge, refer to “5.7.3 Replacing the Print Cartridges”.
  - **Printer Message**
    The following messages will be displayed according to the printer status.
    “No problem.”
    “Color printing in progress.”
    “Front cover of color printer open.”
    “Ink is not installed in the printer.”
    “Nozzle cleaning in progress.”
    “Nozzle failure. Please check.”
    “Test Print in progress”
    “Nozzle check pattern printing in progress.”

5.7.3 Replacing the Print Cartridge

Follow the procedure below to replace the print cartridge of the VSP-15.

⚠CAUTION

This printer uses the following type of Hewlett-Packard print cartridges. Use only the specified print cartridges.

Black ink: hp56(C6656A) (for HP Deskjet 5160, 5650, 5680)
Color ink: hp57(C6657A) (for HP Deskjet 5160, 5650, 5680)

(1) Press the Power button to turn on the printer.
(2) Open the printer cover.
(3) Pull the print cartridge lever up to open, and remove the cartridge.



(4) Gently remove the tape from the cartridge.
At this time, take care not to touch the ink nozzle or electrical contacts. Doing so may cause clogging, damage or contact failure.



(5) Insert the cartridge gently under the cartridge lever.
Lower the cartridge lever. Press down until it clicks and locks in place.



(6) Close the printer cover.
(7) Perform test print. (☞5.7.2)

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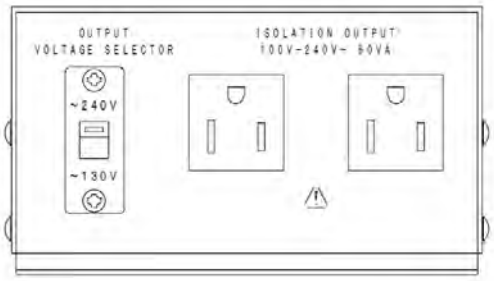
NOTE
● For the purpose of environmental protection and conservation and effective utilization of resources, Hewlett-Packard collects, disassembles and recycles used print cartridges. For details of the collection method, refer to the Hewlett-Packard website. http://www.hp.com/jp/supply_recycle ● The print cartridge should be installed before the expiry date printed on the box. The expiration date for use after installation is within 6 months.

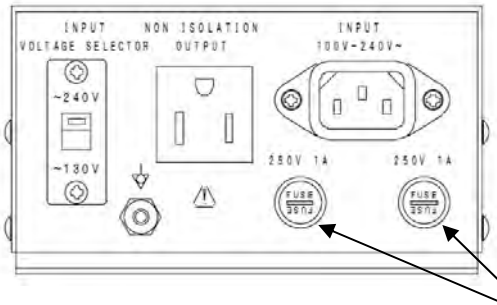
5.8 Optional Accessories

5.8.1 Replacing the Fuse on the Printer Shelf

Follow the procedure below to replace the fuse for multiple portable socket-outlet with isolation transformer on the OAV-03A Printer Shelf.

(1) Remove the fuse holder with straight slot screwdriver.
(2) Replace the fuse with a new one (Time-lag fuse 250V 1A).
(3) Attach the fuse holder.





Turn left and pull out the fuse.

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5.9 Maintenance and Inspection

5.9.1 About Maintenance and Inspection

To maintain the safety and the reliable function and performance, daily inspection before use and periodical inspection are indispensable. Fukuda Denshi is not responsible for troubles caused by failure to observe the instructions described in this section.

⚠ CAUTION

- Never disassemble or remodel the instrument.
  It may result in fire hazard or electric shock.
- Do not perform the Maintenance menu procedure which is not described in this manual.
  It may result in malfunction.
- Be careful not to have liquids such as alcohol or water enter the instrument.
- Inspect the mainframe and all connectors and cables for any external damage.
  If any of the following events occurs, immediately perform maintenance and inspection.
  - The instrument receives a strong impact due to dropping, etc.
  - Any liquid or flowing object falls on or inside the instrument.
  - The instrument does not function normally.
  - The enclosure of the instrument is cracked, broken or damaged.
  - Cables including the power cable and leadwires are deteriorated in performance.

● Daily Check

Prepare a copy of the “Daily Check List” and perform the daily check everyday according to the “Daily Check Procedure” below.

- If the instrument fails any inspection item on the daily inspection list, the general assessment must be "failed". Repair the instrument so that it passes all inspection items.
- Use the instrument only when it has passed all inspection items.

● Periodic Check

There are 2 periodic inspections that needs to be performed. “Periodic Inspection (1)" can be performed without using any special jig or measurement device, and “Periodic Inspection (2)" needs to use special jig and measurement device. Perform inspections according to the procedure explained.

- If the instrument fails any inspection on the periodic inspection list (1), (2), the overall judgment will be "Fail". Repair the instrument so that it passes all inspection items.
- Use the instrument only when it has passed all inspection items.

5.9.2 Daily Inspection Procedure

● Visual Inspection (Perform the following inspection visually.)

Item	Inspection Item		Procedure	Criteria
Main Unit	1	Enclosure	Verify that there is no scratch, crack, deformation or rust.	No scratch, crack, deformation or rust should be found.
	2	Labels and panel	Verify that labels and panels are not peeled off or stained.	No peel or stain should be found.
	3	Keys	Verify that the keys are not damaged.	No damage should be found.
Accessories	1	Power cable	Verify that there is no scratch or damage.	No scratch or damage should be found.
	2	Lead cable	Verify that there is no scratch or damage.	No scratch or damage should be found.
	3	Clip electrode	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	4	Chest electrode	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	5	Cuff	Verify that there is no scratch or damage.	No scratch or damage should be found.
	6	Air hose	Verify that there is no scratch or damage.	No scratch or damage should be found.
	7	PCG microphone	Verify that there is no scratch or damage.	No scratch or damage should be found.
	8	Amorphous PW sensor	Verify that there is no scratch or damage.	No scratch or damage should be found.
	9	Air bag pulse wave sensor	Verify that there is no scratch or damage.	No scratch or damage should be found.
	10	Chart paper	Verify that paper is properly loaded.	Paper should be properly loaded.
	11	Operation manual	Verify that the operation manual is kept in a specified location.	It must be kept in a specified location.

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● Mechanical Inspection (Perform the following inspection by actually operating the instrument.)

Item		Inspection Item	Procedure	Criteria
Main Unit	1	Keys	Verify that key operation is smooth.	Operation should be smooth.
	2	Recorder	Verify that recorder operation is smooth, and no abnormal sound is heard.	Operation should be smooth and no abnormal sound should be heard.
Accessories	1	Power cable	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	2	Lead cable	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	3	Clip electrode	Verify proper connection to the lead cable.	Should be properly connected.
	4	Chest electrode	Verify proper connection to the lead cable.	Should be properly connected.
	5	Cuff	Verify that it can be connected / disconnected to the air hose smoothly.	Smooth connection / disconnection to the air hose should be possible.
	6	Air hose	Verify that it can be connected / disconnected to the main unit and cuff smoothly.	Smooth connection / disconnection to the main unit and cuff should be possible.
	7	PCG microphone	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	8	Amorphous PW sensor	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	9	Air bag pulse wave sensor	Verify that it can be connected / disconnected to the main unit smoothly, and sufficient air is inside the air bag.	Smooth connection / disconnection to the main unit should be possible, sufficient air should be inside the air bag.

● Electrical Inspection

Item		Inspection Item	Procedure	Criteria
Performance	1	Power supply	Turn the power ON and check the display.	Display turns ON at power ON.
	2	Display	Verify if any abnormality or flickering.	No abnormality or flickering should be found. Waveforms should be properly displayed.
	3	Printout	Verify that waveforms can be printed.	Waveforms should be properly printed.
	4	Zero balance	With each air connector open to the atmosphere, check the displayed pressure value.	Should be within ±1mmHg.
	5	BP measurement	Perform test measurement with cuffs applied to both brachial and ankles.	Proper BP value should be measured.

● Maintenance Test

Inspection Item	Procedure	Criteria
Built-in recorder test	Check according to “5.3.2 Testing Built-in Thermal Array Recorder”.	There should be no zigzag, missing dots, uneven prints. Recording speed should be within 25, 50mm ±3%.

5.9.3 Periodic Inspection Procedure (1)

● General Inspection

Inspection Item	Procedure	Criteria
Visual Inspection	Check according to “Daily Inspection Procedure” (☞5.9.2)	Refer to “Daily Inspection Procedure”
Mechanical Inspection	Check according to “Daily Inspection Procedure” (☞5.9.2)	Refer to “Daily Inspection Procedure”
Electrical Inspection	Check according to “Daily Inspection Procedure” (☞5.9.2)	Refer to “Daily Inspection Procedure”

● Status Check

Item		Inspection Item	Criteria
Status	1	ECG Electrodes	LOF shall be displayed when electrode is detached.
	2	Backup battery	It shall be 2.2V or more
	3	Thermal print-head temperature	It shall be within the room temperature ±10°C
	4	Paper tray status	OPEN/CLOSE status should be properly displayed.
	5	Mark sensor	When a mark is detected on the paper, “Black” should be displayed.

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Status] to open the [Status] window.

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● Maintenance Test

Inspection Item		Procedure	Criteria
1	Pressure accuracy	Check the pressure accuracy at 150/280mmHg±10mmHg. Check according to “5.3.12 Confirming Pressure Accuracy”.	Should be within ±3mmHg.
2	Air leakage	Check according to “5.3.10 Testing Pump Unit”.	Should be 6mHg/min or below.
3	Built-in recorder	Check according to “5.3.2 Testing Built-in Thermal Array Recorder”.	No zigzag running, irregular recording and missed dots. Recording speed should be within 25/50mm±3%.
4	Display	Check according to “5.3.15 Testing the Display”.	All dots should be displayed in correct colors.
5	Touch Panel	Check according to “5.3.17 Testing the Touch Panel”.	The touched point should properly respond.
6	Fixed Key	Check according to “5.3.14 Testing Operation Panel Fixed Keys”.	Symbol corresponding to the pressed key should highlight.
7	Sound	Check according to “5.3.16 Testing Sound and Tone”.	Proper sound or tone should generate.

● Others

Inspection Item		Procedure	Criteria
1	Clock Setting	Press the (Menu) key, and touch [Initial Setting/Maintenance] → [Clock Setting], and check the Clock Setting menu.	Current date/time should be displayed.
2	Network Setting	Press the (Menu) key, and touch [Initial Setting/Maintenance] → [Network and ID Reader Setting], and check the Network and ID Reader Setting menu.	Correct network should be set.
3	Power Supply Cable	Perform continuity test using the tester.	Should pass continuity test.

5.9.4 Periodic Inspection Procedure (2)

5.9.4.1 Visual, Mechanical, Electrical Inspection Procedure

● Visual Inspection (Perform the following inspection visually.)

Item	Inspection Item		Procedure	Criteria
Main Unit	1	Enclosure	Verify that there is no scratch, crack, deformation or rust.	No scratch, crack, deformation or rust should be found.
	2	Labels and panels	Verify that labels and panels are not peeled off or stained.	No peel or stain should be found.
	3	Keys	Verify that the keys are not damaged.	No damage should be found.
Accessories	1	Power cables	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	2	Lead cables	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	3	Clip electrodes	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	4	Chest electrodes	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	5	Cuffs	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	6	Air hoses	Verify that there is no stain, rust, scratch or damage.	No stain, rust, scratch or damage should be found.
	7	PCG microphone	Verify that there is no stain, scratch or damage.	No stain, scratch or damage should be found.
	8	Amorphous PW sensors	Verify that there is no stain, scratch or damage.	No stain, scratch or damage should be found.
	9	Air bag pulse wave sensor	Verify that there is no stain, scratch or damage.	No stain, scratch or damage should be found.
	10	Chart paper	Verify that paper is properly loaded.	Paper should be properly loaded.
	11	Operation manual	Verify that the operation manual is kept in a specified location.	It must be kept in a specified location.

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● Mechanical Inspection (Perform the inspection by actually operating the instrument.)

Item	Inspection Item		Procedure	Criteria
Main Unit	1	Keys	Verify that key operation is smooth.	Operation should be smooth.
	2	Recorder	Verify that recorder operation is smooth, and no abnormal sound is heard.	Operation should be smooth and no abnormal sound should be heard.
Accessories	1	Power cables	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	2	Lead cables	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	3	Clip Electrodes	Verify proper connection to the lead cable.	Should be properly connected.
	4	Chest electrodes	Verify proper connection to the lead cable.	Should be properly connected.
	5	Cuffs	Verify that it can be connected / disconnected to the air hose smoothly, and there is no air leakage or breakage of center plate.	Smooth connection should be possible, and no air leakage or breakage of center plate should be found.
	6	Air hoses	Verify that it can be connected / disconnected to the main unit and cuff smoothly.	Smooth connection should be possible and no leakage should be found.
	7	PCG microphone	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	8	Amorphous PW sensors	Verify that it can be connected / disconnected to the main unit smoothly.	Smooth connection / disconnection to the main unit should be possible.
	9	Air bag pulse wave sensor	Verify that it can be connected / disconnected to the main unit smoothly, and sufficient air is inside the air bag.	Smooth connection / disconnection to the main unit should be possible, sufficient air should be inside the air bag.

● Electrical Inspection

Item	Inspection Item		Procedure	Criteria
Power	1	Power supply	Turn the power ON and check the screen.	Display turns ON at power ON.
Display	1	Display test	Verify if any abnormality or flickering.	No abnormality or flickering should be found. Waveform should be properly displayed.
	2	Display test	Check according to “5.3.15 Testing the Display”.	All dots should be displayed in correct colors.
Touch Panel	1	Touch panel test	Check according to “5.3.17 Testing the Touch Panel”.	The touched point should properly respond.
Contro l Panel	1	Fixed key test	Check according to “5.3.14 Testing Operation Panel Fixed Keys”.	Symbol corresponding to the pressed key should highlight.
Sound	1	Sound test	Check according to “5.3.16 Testing Sound and Tone”.	Proper sound or tone should generate.
Built-in Recorder	1	Print	Check if waveforms are properly printed.	Waveform should be properly printed
	2	Built-in recorder test	Check according to “5.3.2 Testing Built-in Thermal Array Recorder”.	No zigzag running, irregular recording and missed dots. Recording speed should be within 5/10/12.5/25/50mm±3%.
I/O	1	I/O test	Check according to “5.3.3 Complete I/O Test”.	No error should be found after performing 100 tests.
BP	1	Zero point	Check the pressure value when no connection is made to the air connectors.	Should be within 0±1mmHg.
	2	Pressure accuracy	Check according to “5.3.12 Confirming Pressure Accuracy”.	Should be within ±3mmHg.
	3	BP test	Measure the BP of the limbs.	Should be proper value.
	4	Maximum pressure	Check according to “5.3.10 Testing Pump Unit”.	Should be 320±10mmHg.
	5	Inflation time		Should be 9 sec. or less.
	6	Air leakage		Should be 6mmHg/min or less.
	7	Quick exhaust		Should be 10 sec. or less.
	8	100% open		Should be 20 to 60mmHg/sec.
	9	75% open		Should be 10mmHg/sec or above.
	10	Time limit		Should be 130±10 sec. Should be 8±1 sec. at high speed.

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Item	Inspection Item		Procedure	Criteria
ECG	1	Sensitivity	(1) Select [Calibration Device Auto] on the SG-2000 and apply a standard 1 mV test voltage to check sensitivity 1 of record amplitude. (2) Switch sensitivity to 1/2, 1/4 and 2 and check record amplitude.	(1) Record amplitude must be 10 ±0.2 mm or less (2) Each sensitivity must be ±5% or less
	2	Time constant	Select [Calibration Device Manu.] and apply a 1 mV step signal. Measure the time it takes to reach 37% amplitude.	This value must be in the range 3.2 to 3.84 s
	3	Frequency response	Select [High Frequency Spot] on the SG-2000 and add a sine wave voltage to the input. Set the record amplitude of 10 mm at 10 Hz as 100% and measure the amplitude at 0.67 Hz, 40 Hz, 100 Hz and 150 Hz.	Make sure the following amplitudes are obtained: 0.67 Hz: +5, -10% 40 Hz: +5, -10% 100 Hz: +10, -30% 150 Hz: +10, -50%
	4	Common-mode signal suppression	Select [Common-mode Signal] to enter a 50 Hz or 60 Hz 20 Vrms signal. Measure the lead deviation at sensitivity 2.	Record amplitude should be 4.0 mmp-p or less. (103 dB or more)
	5	Polarization voltage	Select [Offset Voltage] on the SG-2000 and measure record amplitude when a 1 mV standard waveform is superimposed on a ±550 mV DC voltage.	Record amplitude must be 10 ±0.5mm or less. (Changes in record sensitivity must be 5% or less)
	6	Internal noise	Select [Noise Level] on the SG-2000 to measure lead noise level at sensitivity 2.	Noise level must be 0.4 mmp-p or less. (Input conversion must be 20 µVp-p or less)
PCG	1	PCG filter characteristics (PWV)	Input sine-wave signals to the PCG connector to measure the amplitude at 165 Hz and 280 Hz when an amplitude of 10 mm at 200 Hz is 100%.	Must be 70% or greater.
	2	PCG filter characteristics (L)	Input sine-wave signals to the PCG connector to measure the amplitude at 30 Hz, 50 Hz and 80 Hz when an amplitude of 10 mm at 100 Hz is 100%.	50% or more at 30 Hz 70% or more at 50 Hz 90% or more at 80 Hz
Pulse Wave 1/2	1	Frequency response	Input a 10 Hz sine-wave signal to the Pulse Wave 1 and 2 connectors to measure the amplitude at 0.5 Hz and 20 Hz when a 10 mm amplitude is 100%.	The following ranges must be met: 0.5 Hz: 90 to 105% 20 Hz: 71 to 105%
	2	Transient characteristics	Input a 0.05 Hz step voltage to the Pulse Wave 1 and 2 connectors and measure the amplitude 2 s later.	Deviation after 2 s must be 37% or more.

● Status Check

Item	Inspection Item		Criteria
Status Test	1	ECG electrodes	LOF mark shall be displayed when electrode is detached.
	2	Backup battery	It shall be 2.2V or more
	3	Thermal print-head temperature	It shall be within the room temperature ±10°C
	4	Paper tray status	OPEN/CLOSE status should be properly displayed.
	5	Mark sensor	When a mark is detected on the paper, “Black” should be displayed.

Press the (Menu) key to open the [Top Menu], then touch [Initial Setting/Maintenance] → [Maintenance] → [OK (↵)] → [Status] to open the [Status] window.

● **Others**

Item		Inspection Item	Procedure	Criteria
Others	1	Clock Setting	Press the (Menu) key, and touch [Initial Setting/Maintenance] → [Clock Setting], and check the Clock Setting menu.	Current date/time should be displayed.
	2	Network Setting	Press the (Menu) key, and touch [Initial Setting/Maintenance] → [Network and ID Reader Setting], and check the Network and ID Reader Setting menu.	Correct network should be set.
	3	Power Supply Cable	Perform continuity test using the tester.	Should pass continuity test.
	4	Electric Fan	Verify that electric fan is operating when the power is turned ON.	Electric fan should be properly operating.

5.9.4.2 Safety Inspection

Perform inspections according to the procedure explained in “5.9.5 Safety inspections”.

5.9.4.3 Cleaning and Disinfecting

Clean and disinfect according to the procedure explained in “5.2 Cleaning and Disinfecting”.

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5.9.5 Safety Inspections

Safety-related testing methods and measurement equipment are prescribed in safety test standards. At the actual sites where medical treatment is being given, however, it can be extremely difficult to verify that everything meets the standards. For this reason, when performing inspections, set up and make acceptance determinations using the methods described below.

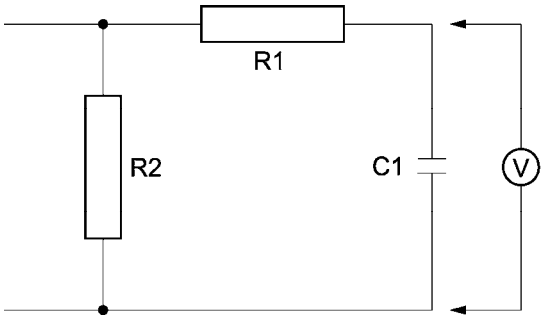
⚠ WARNING
If, during a safety inspection, a value that exceeds the allowable limit is confirmed, immediately stop using the given unit; then replace the defective part or make proper repairs. Failure to repair the unit can lead to a serious accident.

- **Before checking the leakage current**

  There are a number of conditions for measuring leak current. For the measured values, however, use the maximum values that are obtained.
  When checking, it is also important to make comparisons with past measured values to confirm that there are no large differences.
  To measure the leakage current, use leakage current gauges (electronic voltmeters and digital voltmeters), impedance for measurement, power switch box, and similar equipment.

- **Impedance for measurement**

  The impedance will have a structure such as that shown below.



R1:10kΩ±5% (No lead)
R2:1kΩ±1% (No lead)
C1:0.015μF±5% (No lead)
V :Voltmeter

  By measuring the voltage at both ends of the impedance, you can find the leakage current.

- **Voltmeter**

  Because digital voltmeters are required to indicate true effective values for composite waveform from DC to 1 MHz, it is recommended that you use a voltmeter whose performance meets the prescribed standard as closely as possible.
  For use during maintenance and inspection in the field, you can use a commercially available digital voltmeter instead. However, check the frequency band of the voltmeter you plan to use ahead of time. To measure a leakage current that exceeds the measurable frequency band, use it with care paying attention to the indication on the voltmeter.

- **Electric current calculation method**

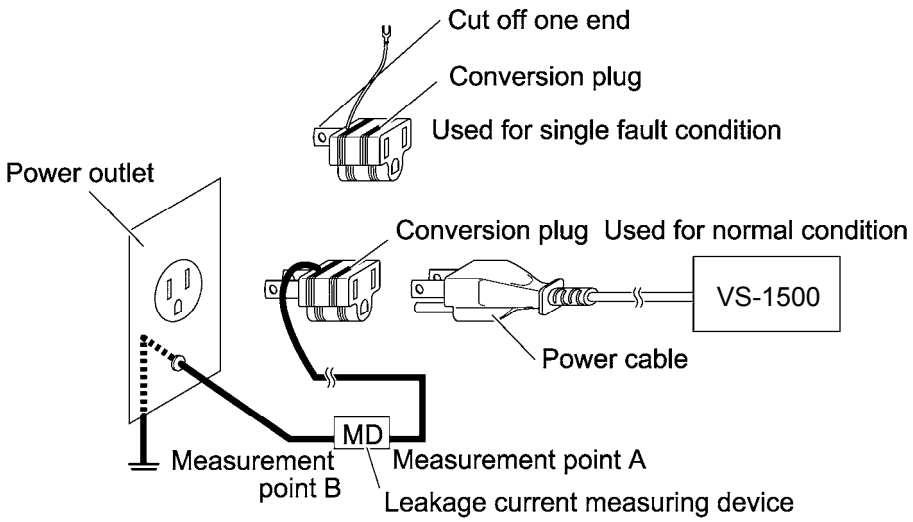
  When checking a leakage current, measure the AC voltage by using a leakage current measuring device (MD).

  Convert the measured voltage to current by employing the formula below.
  If the phase is switched and measurements are made, use the higher voltage to calculate the current.

$$\frac{\text{Measured voltage (V)}}{1000} = \text{Measured current (mA)}$$

5.9.5.1 Checking the earth leakage current (current that flows to protective earth resistance)

(1) Measurement wiring diagram



(2) Earth leakage current measurement points

Measurement point A	Earth wire of power supply cord from unit
Measurement point B	Earth terminal of power outlet

Place the MD in between measurement point A and B.

(3) Earth leakage current measurement conditions

It is necessary to measure the earth leakage current under two conditions: normal condition and single fault condition.

(4) How to reproduce a single fault condition

To reproduce a single fault condition, insert one of the two inserts of the conversion plug by cutting the other insert.

How to change the phase

You can switch the phase by inserting the conversion plug into the power outlet upside down.

(5) Acceptance standards

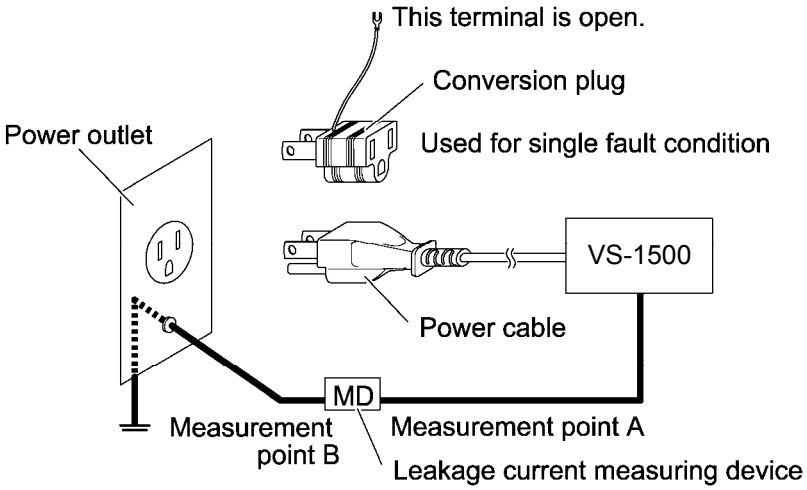
Check that the maximum current value meets the following judgment criteria.

Normal condition	0.5 mA or less
Single fault condition	1.0 mA or less

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5.9.5.2 Checking the enclosure leakage current (current that flows from the enclosure to the earth terminal of the power outlet)

(1) Measurement wiring diagram



(2) Enclosure leakage current measurement points

Measurement point A	Optional location on enclosure; or, if enclosure is insulated, metal foil attached to enclosure
Measurement point B	Earth terminal of power outlet

Place the MD in between measurement point A and B.

(3) Enclosure leakage current measurement conditions

It is necessary to measure the enclosure leakage current under two conditions: normal condition and single fault condition.

(4) How to reproduce a single fault condition

You can reproduce a single fault condition by connecting the conversion plug to the power outlet with the earth wire not connected.

How to change the phase

You can switch the phase by inserting the conversion plug into the power outlet upside down.

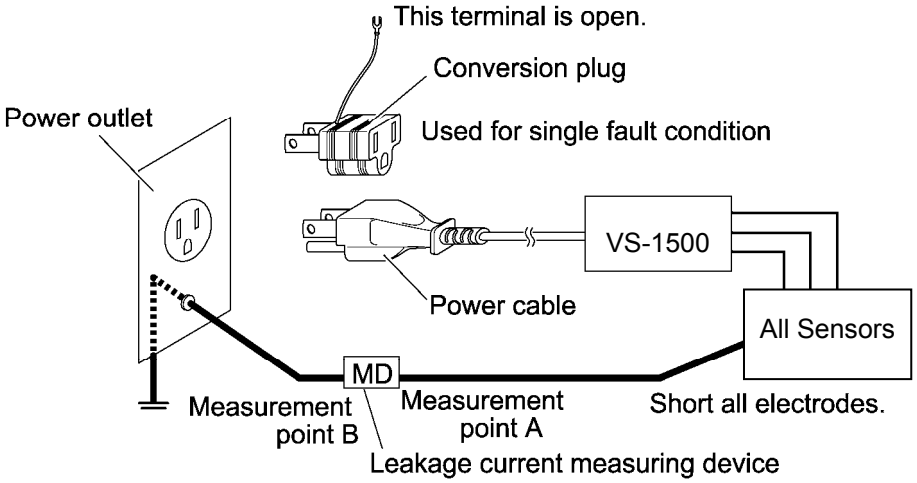
(5) Acceptance standards

Check that the maximum current value meets the following judgment criteria.

Normal condition	0.1 mA or less
Single fault condition	0.5 mA or less

5.9.5.3 Checking the patient leakage current I

(1) Measurement wiring diagram



(2) Patient leakage current I measurement points

Measurement point A	All sensors (Short all electrodes.)
Measurement point B	Earth terminal of power outlet

Place the MD in between measurement point A and B.

(3) Patient leakage current I measurement conditions

It is necessary to measure the patient leakage current under two conditions: normal condition and single fault condition.

(4) How to reproduce a single fault condition

You can reproduce a single fault condition by connecting the conversion plug to the power outlet with the earth wire not connected.

How to change the phase

You can switch the phase by inserting the conversion plug into the power outlet upside down.

(5) Acceptance standards

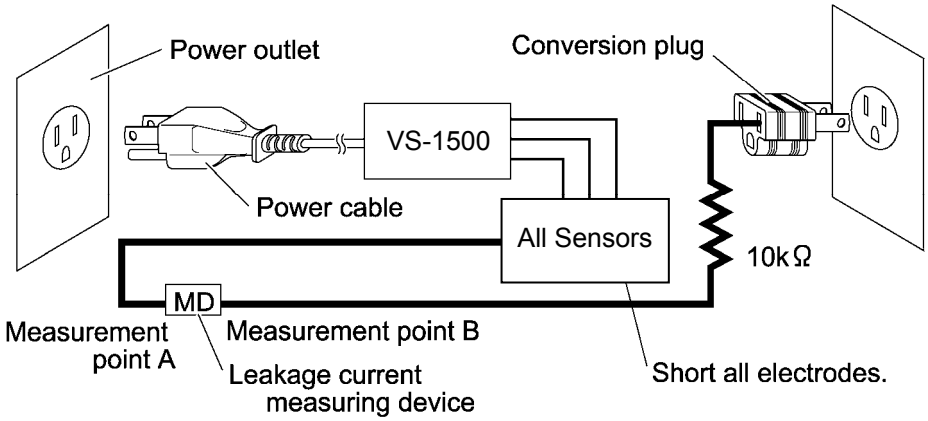
Check that the maximum current value meets the following judgment criteria.

Normal condition	0.1 mA or less
Single fault condition	0.5 mA or less

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5.9.5.4 Checking the patient leakage current III

(1) Measurement wiring diagram



(2) Patient leakage current III measurement points

Measurement Point A	All sensors (Short all electrodes.)
Measurement Point B	Resistance 10 kΩ connected to one insert of the conversion plug (protective resistance)

Place the MD in between measurement point A and B.

(3) Patient leakage current III measurement conditions

To measure the patient leakage current III, it is necessary to change the power phase under the single fault condition. Consequently, total of two measurements should be carried out to measure current in all conditions.

(4) How to change the phase

You can switch the phase by inserting the conversion plug into the power outlet upside down.

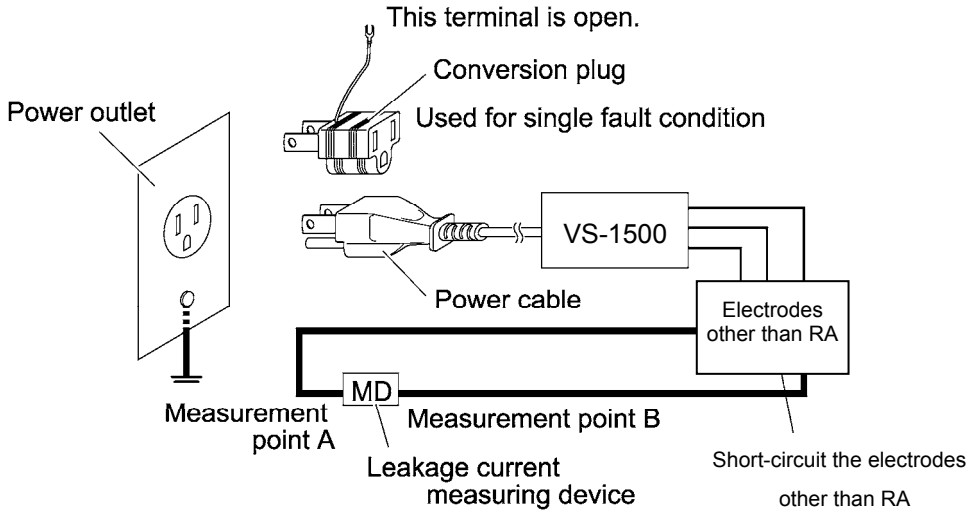
(5) Acceptance standards

Check that the maximum current value meets the following judgment criteria.

Single fault condition	0.05 mA or less

5.9.5.5 Checking the patient auxiliary current

(1) Measurement wiring diagram



(2) Patient auxiliary current measurement points

Measurement point A	RA terminal of patient cable
Measurement point B	All sensors (Short all electrodes except RA terminal.)

Place the MD in between measurement point A and B.

(3) Patient auxiliary current measurement conditions

It is necessary to measure the patient auxiliary current under two conditions: normal condition and single fault condition.

(4) How to reproduce a single fault condition

You can reproduce a single fault condition by connecting the conversion plug to the power outlet with the earth wire not connected.

How to change the phase

You can switch the phase by inserting the conversion plug into the power outlet upside down.

(5) Acceptance standards

Check that the maximum current value meets the following judgment criteria.

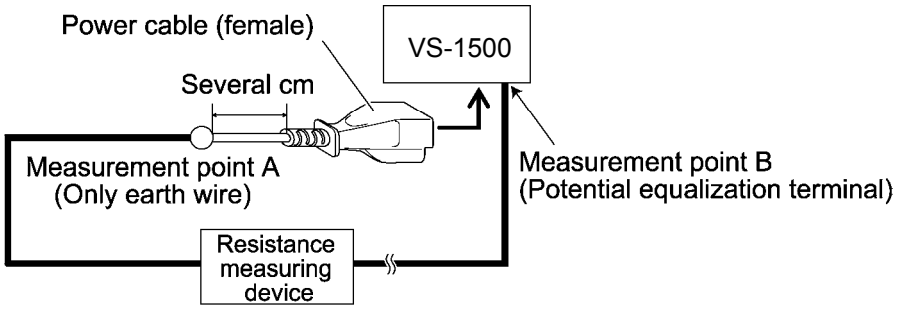
Normal condition	0.01 mA or less
Single fault condition	0.05 mA or less

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5.9.5.6 Checking the protective earth resistance

(1) Measurement wiring diagram

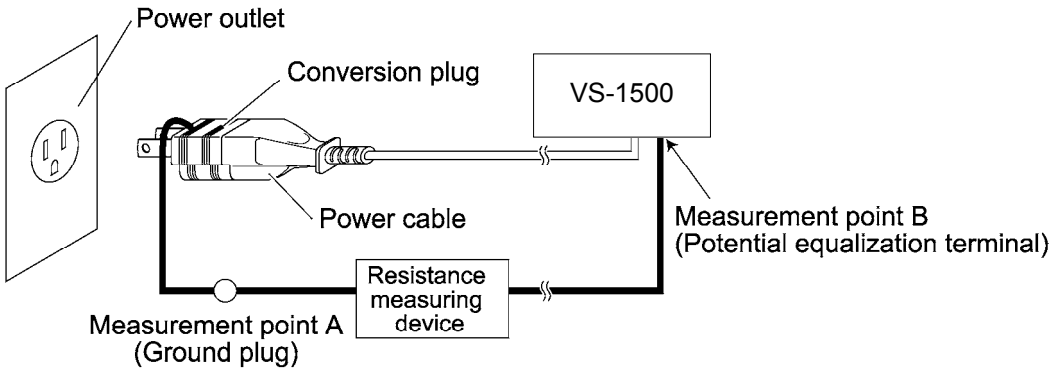
・Without power supply cable



If no jig is equipped for the female power cable like the above, measure it at the protective earth terminal inside the AC inlet of electrocardiography directly.

Protective earth terminal ⇔ Potential equalization terminal

・With power supply cable



Power cable protective earth terminal ⇔ Potential equalization terminal

(2) Protective earth resistance measurement points

	Measurement Conditions	
	Without power supply cord	With power supply cord
Measurement point A	Protective earth terminal	Protective earth terminal for power supply cable
Measurement point B	Potential equalization terminal	Potential equalization terminal

(3) Protective earth resistance measurement conditions

Measure the resistance between the potential equalization terminal (and/or other accessible conductive parts) and the protective earth terminal, or the protective earth terminal (ground plug) while the AC power supply cord is connected.

(4) Acceptance standards

Between protective earth terminal and potential equalization terminal	0.1Ω or less
Between power supply cord protective earth terminal and potential equalization terminal	0.2Ω or less

Daily Check List

Conduct the routine inspection according to “Daily Check List”. Management No. _____

Item		Inspection Item		Requirements	Judgment	Remarks
Visual Check	Main Unit	1	Enclosure	No scratch, crack, deformation or rust	Pass/Fail	
		2	Labels and panels	No peeling or dust	Pass/Fail	
		3	Keys	No damage	Pass/Fail	
	Accessories	1	Power cables	No scratch or damage	Pass/Fail	
		2	Lead cables	No scratch or damage	Pass/Fail	
		3	Clip electrodes	No stain, rust, scratch or damage	Pass/Fail	
		4	Chest electrodes	No stain, rust, scratch or damage	Pass/Fail	
		5	Cuffs	No scratch or damage	Pass/Fail	
		6	Air hoses	No scratch or damage	Pass/Fail	
		7	PCG microphone	No scratch or damage	Pass/Fail	
		8	Amorphous PW sensors	No scratch or damage	Pass/Fail	
		9	Air bag pulse wave Sensor	No scratch or damage	Pass/Fail	
		10	Chart paper	Loaded with no problem	Pass/Fail	
		11	Operation manual	Kept in specified location.	Pass/Fail	
Mechanical Check	Main Unit	1	Keys	Smooth operation	Pass/Fail	
		2	Recorder	Smooth application and removal	Pass/Fail	
	Accessories	1	Power cable	Smooth application and removal	Pass/Fail	
		2	Lead cable	Smooth application and removal	Pass/Fail	
		3	Clip electrodes	Properly connected	Pass/Fail	
		4	Chest electrodes	Properly connected	Pass/Fail	
		5	Cuffs	Smooth application and removal	Pass/Fail	
		6	Air hoses	Smooth application and removal	Pass/Fail	
		7	PCG microphone	Smooth application and removal	Pass/Fail	
		8	Amorphous PW sensors	Smooth application and removal	Pass/Fail	
		9	Air bag pulse wave sensor	Smooth application and removal Sufficient air in air bag	Pass/Fail	
Electrical Check	Performance	1	Power supply	Screen display upon power-on	Pass/Fail	
		2	Display	No abnormality or flickering	Pass/Fail	
		3	Printing	Waveform printing possible	Pass/Fail	
		4	Zero Balance	0 ±1mmHg with no load to air connector	Pass/Fail	
		5	NIBP measurement	Proper measurement of NIBP of brachials and ankles	Pass/Fail	
Maintenance Test		1	REC test	No zigzag running, irregular recording and missed dots; paper speed accuracy 25 and 50mm/s within ±3%	Pass/Fail	
Overall Judgment					Pass/Fail	

Series	VaSera VS-1500	Model	VS-1500	Serial No.	
Installation Place				Date of purchase	
Check Date		Checked by		Approved by	

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Periodic Check List (1)

Conduct the routine inspection according to “Periodic Check List (1)”. Management No.

Item		Inspection Item		Requirements	Judgment	Remarks
Visual	Main Unit	1	Enclosure	No scratch, crack, deformation or rust	Pass/Fail	
		2	Labels and panels	No peeling or dust	Pass/Fail	
		3	Keys	No damage	Pass/Fail	
	Accessories	1	Power cables	No scratch or damage	Pass/Fail	
		2	Lead cables	No scratch or damage	Pass/Fail	
		3	Clip electrodes	No stain, rust, scratch or damage	Pass/Fail	
		4	Chest electrodes	No stain, rust, scratch or damage	Pass/Fail	
		5	Cuffs	No scratch or damage	Pass/Fail	
		6	Air hoses	No scratch or damage	Pass/Fail	
		7	PCG microphone	No scratch or damage	Pass/Fail	
		8	Amorphous PW sensor	No scratch or damage	Pass/Fail	
		9	Air bag pulse wave sensor	No scratch or damage	Pass/Fail	
		10	Chart paper	Loaded with no problem	Pass/Fail	
		11	Instruction manual	Kept in specified location	Pass/Fail	
Mechanical	Main Unit	1	Keys	Smooth operation	Pass/Fail	
		2	Recorder	Smooth operation with no abnormal sound	Pass/Fail	
	Accessories	1	Power cable	Smooth application and removal	Pass/Fail	
		2	Lead cable	Smooth application and removal	Pass/Fail	
		3	Clip electrodes	Properly connected	Pass/Fail	
		4	Chest electrodes	Properly connected	Pass/Fail	
		5	Cuffs	Smooth application and removal	Pass/Fail	
		6	Air hoses	Smooth application and removal	Pass/Fail	
		7	PCG microphone	Smooth application and removal	Pass/Fail	
		8	Amorphous PW sensors	Smooth application and removal	Pass/Fail	
		9	Air bag pulse wave sensor	Smooth application and removal Sufficient air in air bag	Pass/Fail	
Electrical	Performance	1	Power supply	Proper screen display upon power-on	Pass/Fail	
		2	Display	No abnormality and flickering	Pass/Fail	
		3	Printing	Waveform printing possible	Pass/Fail	
		4	Zero Balance	0 ±1mmHg with no load to air connector	Pass/Fail	
		5	NIBP measurement	Proper measurement of NIBP of brachials and ankles	Pass/Fail	
Status Test		1	ECG Electrodes	LOF shall be displayed when electrode is detached.	Pass/Fail	
		2	Backup Battery	It shall be 2.2V or more	Pass/Fail	
		3	Print-head Temperature	It shall be within the room temperature ±10°C	Pass/Fail	
		4	Paper Tray Status	OPEN/CLOSE status should be properly displayed.	Pass/Fail	
		5	Mark Sensor	When mark is detected, “Black” should be displayed.	Pass/Fail	
Maintenance Test		1	Pressure Accuracy	It shall be ±3mmHg at 150/280mmHg	Pass/Fail	
		2	Air Leakage	Pressure drop should be 6mmHg/min or less at 300mmHg.	Pass/Fail	
		3	Built-in Recorder	No zigzag running, irregular recording and missed dots; paper speed accuracy 25 and 50mm/s within ±3%	Pass/Fail	
		4	Display Test	All dots should be displayed in correct colors	Pass/Fail	
		5	Touch Panel Test	The touched point should properly respond.	Pass/Fail	
		6	Fixed Key Test	Symbol corresponding to the pressed key should highlight.	Pass/Fail	
		7	Sound Test	Proper sound or tone should generate.	Pass/Fail	
Others		1	Clock Setting	Current date/time should be displayed.	Pass/Fail	
		2	Network Setting	Correct network should be set.	Pass/Fail	
		3	Power cable	Should pass continuity test.	Pass/Fail	
Overall Judgment					Pass/Fail	

Series	VaSera VS-1500	Model	VS-1500	Serial No.	
Installation Place				Date of purchase	
Check Date		Checked by		Approved by	

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Periodic Check List (2)

Conduct the routine inspection according to “Periodic Check List (2)”. Management No.

Item		Inspection Item		Procedure and Criteria	Judgment	Remarks
Visual Check	Main Unit	1	Enclosure	No scratch, crack, deformation and rust	Pass/Fail	
		2	Labels and panels	No peeling and dust	Pass/Fail	
		3	Keys	No damage	Pass/Fail	
	Accessories	1	Power cable	No stain, rust, scratch and damage	Pass/Fail	
		2	Lead cable	No stain, rust, scratch and damage	Pass/Fail	
		3	Clip electrodes	No stain, rust, scratch and damage	Pass/Fail	
		4	Limb electrodes	No stain, rust, scratch and damage	Pass/Fail	
		5	Cuffs	No stain, rust, scratch and damage	Pass/Fail	
		6	Air hoses	No stain, rust, scratch and damage	Pass/Fail	
		7	PCG microphone	No stain, scratch and damage	Pass/Fail	
		8	Amorphous PW sensor	No stain, scratch and damage	Pass/Fail	
		9	Air bag pulse wave sensor	No stain, scratch and damage	Pass/Fail	
		10	Chart paper	Loaded with no problem	Pass/Fail	
		11	Operation manual	Kept in specified location	Pass/Fail	
Mechanical Check	Mainframe	1	Keys	Smooth operation	Pass/Fail	
		2	Recorder	Smooth operation with no abnormal sound	Pass/Fail	
	Accessories	1	Power cable	Smooth application and removal	Pass/Fail	
		2	Lead cable	Smooth application and removal	Pass/Fail	
		3	Clip electrodes	Properly connected	Pass/Fail	
		4	Chest electrodes	Properly connected	Pass/Fail	
		5	Cuffs	Smooth application and removal No air leakage or breakage of center plate.	Pass/Fail	
		6	Air hoses	Smooth application and removal No air leakage	Pass/Fail	
		7	PCG microphone	Smooth application and removal	Pass/Fail	
		8	Amorphous PW sensor	Smooth application and removal	Pass/Fail	
		9	Air bag pulse wave sensor	Smooth application and removal Sufficient air in air bag.	Pass/Fail	
Electrical Check	Power	1	Power supply	Display turns ON at power ON.	Pass/Fail	
	Display	1	Display Test	No abnormality or flickering should be found.	Pass/Fail	
		2	Display Test	All dots should be displayed in correct colors	Pass/Fail	
	Touch Panel	1	Touch Panel Test	The touched point should properly respond.	Pass/Fail	
	Control Panel	1	Fixed Key Test	Symbol corresponding to the pressed key should highlight.	Pass/Fail	
	Sound	1	Sound Test	Proper sound or tone should generate.	Pass/Fail	
	Built-in Recorder	1	Print	Waveform should be properly printed	Pass/Fail	
		2	Built-in recorder test	No zigzag running, irregular recording and missed dots	Pass/Fail	
				Recording speed should be within 5/10/12.5/25/50mm±3%.	Pass/Fail	
	I/O	1	I/O Test	No error should be found	Pass/Fail	

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Conduct the routine inspection according to “Periodic Check List (2)”. Management No.

Item		Inspection Item			Procedure and Criteria	Judgment				Remarks
						R-B	L-B	R-A	L-A	
Electrical Check	BP	1	Zero point		Within 0±1mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		2	Pressure accuracy	50mmHg	Within ±3mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
				100mmHg	Within ±3mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
				150mmHg	Within ±3mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
				250mmHg	Within ±3mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
				300mmHg	Within ±3mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		3	BP Test		Proper BP value should be displayed.	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		4	Maximum pressure		320±10mmHg	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		5	Inflation time		9 sec or less	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		6	Air leakage		6mmHg/min or less	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		7	Quick exhaust		10 sec or less	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		8	100% open		20 to 60mmHg/sec	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		9	75% open		10mmHg/sec or above	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
		10	Time Limit		130±10sec., 8±1sec. at high speed:	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	
	ECG	1	Sensitivity	(1)	Within 10±0.2mm	Pass/Fail				
				(2)	Within ±5%	Pass/Fail				
		2	Time Constant		Within 3.2 to 3.84 sec.	Pass/Fail				
		3	Frequency Characteristic	0.67Hz	+5, −10%	Pass/Fail				
				40Hz	+5, −10%	Pass/Fail				
				100Hz	+10, −30%	Pass/Fail				
				150Hz	+10, −50%	Pass/Fail				
		4	Common-mode Signal Control		4.0mmp-p or below at sensitivity 2	Pass/Fail				
		5	Withstand Polarization Voltage		±5%	Pass/Fail				
		6	Noise level		0.4mmp-p or below at sensitivity 2	Pass/Fail				
	PCG	1	PCG filter characteristics (PWV)	165Hz	70% or above	Pass/Fail				
				280Hz	70% or above	Pass/Fail				
		2	PCG filter characteristics (L)	30Hz	50% or above	Pass/Fail				
				50Hz	70% or above	Pass/Fail				
				80Hz	90% or above	Pass/Fail				
	PW 1 PW 2	1	Frequency response	0.5Hz	90% to 105%	Pass/Fail				
				20Hz	71% to 105%	Pass/Fail				
		2	Transient characteristics		37% or above	Pass/Fail				

Conduct the routine inspection according to “Periodic Check List (2) .” Management No.

Item		Inspection Item		Procedure and Criteria	Judgment	Remarks
Status Test	1	ECG electrodes		“LOF” should be displayed when electrode is detached.	Pass/Fail	
	2	Backup battery		Should be 2.2V or above	Pass/Fail	
	3	Thermal print-head temperature		Should be within room temperature±10℃	Pass/Fail	
	4	Paper tray status		OPEN/CLOSE status should be properly displayed	Pass/Fail	
	5	Mark sensor		When mark is detected: Black	Pass/Fail	
Others	1	Clock setting		Current date/time should be displayed.	Pass/Fail	
	2	Network setting		Proper network should be set.	Pass/Fail	
	3	Power supply cable		Should maintain continuity.	Pass/Fail	
	4	Electric fan		Should properly operate.	Pass/Fail	
Safety Check	1	Ground leakage current	Normal condition	(0.5mA or below) mA	Pass/Fail	
			Single fault condition	(1.0mA or below) mA	Pass/Fail	
	2	Enclosure leakage current	Normal condition	(0.1m or below) mA	Pass/Fail	
			Single fault condition	(0.5mA or below) mA	Pass/Fail	
	3	Patient leakage current I (AC)	Normal condition	(0.01mA or below) mA	Pass/Fail	
			Single fault condition	(0.05mA or below) mA	Pass/Fail	
	4	Patient leakage current III	Normal condition			
			Single fault condition	(0.05mA or below) mA	Pass/Fail	
	5	Patient auxiliary current (AC)	Normal condition	(0.01mA or below) mA	Pass/Fail	
			Single fault condition	(0.05mA or below) mA	Pass/Fail	
	6	Protective ground resistance	Protective ground terminal / potential equalization terminal	(0.1Ω or below) Ω	Pass/Fail	
			Tip of power cable/ potential equalization terminal	(0.2Ω or below) Ω	Pass/Fail	
Cleaning and Disinfection				Cleaning and disinfection should be properly performed.	Pass/Fail	
Others						
Overall Judgment					Pass/Fail	

Series	VaSera VS-1500	Model	VS-1500	Serial No.	
Installation Place				Date of purchase	
Check Date		Checked by		Approved by	

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Chapter 6 Troubleshooting

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CAUTION

- For repairs requiring disassembly, please contact Fukuda Denshi Technical Services Co., Ltd. Be sure to contact Fukuda Denshi Technical Services Co., Ltd. for cuff PCB and pump unit replacements since they require a weights and measures inspection.

6.1 Power supply

No.	Symptom	Check	Remedy
1	Turning the power switch ON does not start the instrument.	Check power cord connection.	Connect the power cord.
		Check if the power unit cable is connected. (☞8.1.2)	Connect the cable.
		Check if the keyboard cable is connected. (☞8.1.2)	Connect the cable. Replace the cable if broken. (☞11.9.3)
		Check the voltage. (☞10.4.1)	Replace the power supply if no voltage is output. (☞11.9.3)

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6.2 Built-in Thermal Array Recorder

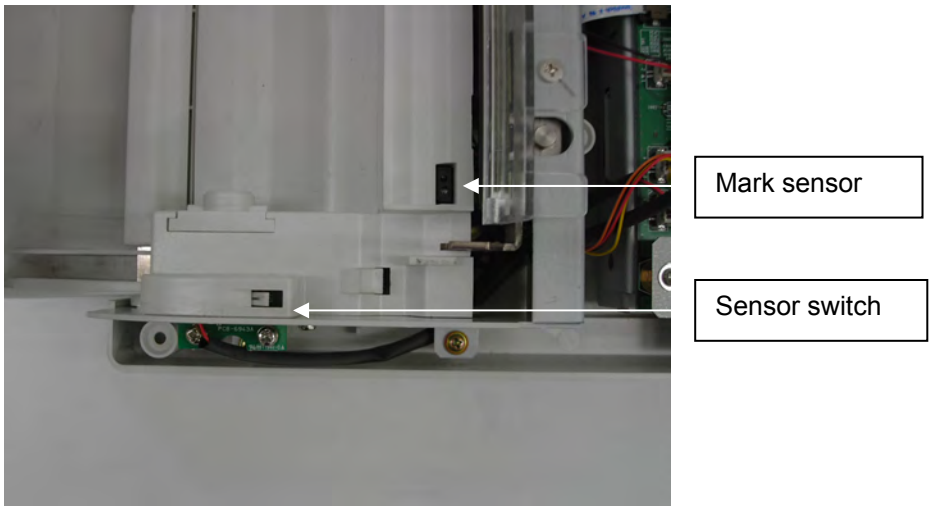
No.	Symptom	Check	Remedy
1	Refuses to print.	Check if the error message "Thermal head heat up" appears. Temperature is indicated as 63°C or more.	Wait to start printing until the message goes off. Use the [Status] window in the maintenance menu to check thermal print head temperature.
		Check whether the cables connecting the thermal print head have come loose.	Connect the cables securely to the CN4 connector. (☞10.1.1.A2)
		Check whether the cables connecting the thermal print head are broken.	Replace the thermal print head.
		Check the +24 VT (pin 5 on CN4 and C20) thermal print head power supply at start of print. (☞10.1.1.A2)	• Only CN4 is not output. → FET (Q37) is defective and should be replaced. (☞10.1.2.A3) • CN4 and C20 are not output. → The power supply unit is defective and should be replaced.
		Check whether printing signal at pin 3 on CN4 fluctuates. (☞10.1.1.A2)	If the output changes between H and L, the thermal print head is defective. Replace the thermal print head.
2	Printout is too light and misses dots.	Check the thermal print head for soiling.	Clean the thermal print head. Use a cotton swab immersed in alcohol for cleaning.
		Use the [Built-in Recorder Test] window in the maintenance menu to make adjustments to the thermal print head.	If the adjustments do not correct the problem, replace the thermal print head.
		Check the service life of the thermal print head. The thermal print head is a consumable and deteriorates with use. (Service life: approx. 50 km of continuous printing)	Replace the thermal print head.
3	Uneven paper speed and unstable printing	Check the thermal print head for soiling.	Clean the thermal print head.
		Check the service life of the paper drive motor. The paper drive motor is a consumable and deteriorates with use. (Service life: approx. 8,000 hours of continuous printing)	Replace the paper drive motor. (☞11.12)
4	The chart paper is not fed.	Check if the error message "Thermal head heat up" appears. Temperature is indicated as 63°C or more.	Wait to start printing until the message goes off. Use the [Status] window in the maintenance menu to check thermal print head temperature.
		Check the paper tray for cracks and bending and whether the gears mesh properly.	Replace the recorder unit.
		Check whether the cables connecting the paper drive motor are broken.	Replace the cables.
		Check whether the thermal motor is supplied with +24 VM (C5, C6) when printing is started. (☞10.1.1.A1)	If +24 V is not output, the power supply unit is defective and should be replaced.

No.	Symptom	Check	Remedy
5	The error message “No paper” appears.	Check whether chart paper has been loaded in the recorder.	Load chart paper.
		Remove all chart paper, then open and close the paper tray in the [Status] window in the maintenance menu to check mark sensor operation. Paper tray open: white Paper tray closed: black	Clean the mark sensor. Take care not to damage the sensor.
			Check cable connections and reconnect cables to the CN1 connector. (☞10.1.1.A1)
		Check the signal output at pin 4 on CN1 when the paper tray is opened and closed. (☞10.1.1.A1)	If the output is constant and does not change, the sensor cable is defective and should be replaced.
6	The error message "Paper magazine up" appears.	Check whether the paper tray is loose.	Close the paper tray again properly so that a click is heard.
		Press the recorder sensor switch (see margin) to check paper tray status. Use the [Status] window in the maintenance menu to check. Press the sensor switch to go from OPEN → CLOSE.	If the change caused by pressing the sensor switch is normal, the paper tray is defective and should be replaced.
			Check cable connections and reconnect cables to the CN1 connector. (☞10.1.1.A1)
		Check the signal output at pin 1 on CN1 when the paper tray is opened and closed. (☞10.1.1.A1)	If the output is constant and does not change, the sensor cable is defective and should be replaced.
7	The error message "Thermal head heat up" appears.	Use the [Status] window in the maintenance menu to check whether thermal print head temperature is high.	Open the paper tray to let it cool sufficiently.
		Check output voltage for thermal print head temperature at pin 1 on CN4. (☞10.1.1.A2)	If the voltage is 1.25 V or lower, the thermal print head is defective and should be replaced.
8	Refuses to print trend graphs.	Check the [Storage Setting] in the top menu.	Set "CF Card Store" to On.
		Check whether past inspection data is stored on the CF card.	Use ID to search past inspection data in [File Mode]. Trend graph printing is not available without past data. s
		Check if patient data can be read after ID input.	If data cannot be read, the data may have become corrupted. Replace the CF card. Consult our head office for information on repair of damaged cards.
9	Z-fold paper does not stop at the perforation.	Check [Other Setup] window in initial setting/maintenance.	Set thermal paper type to [Z-fold paper].
		Adjust the mark position in the [Built-in Thermal Array Recorder Adjustment] window in manufacturer maintenance.	• When the perforation exceeds the cut-off location, adjust toward the – side. • When the perforation does not reach the cut-off location, adjust toward the + side.
		Remove all chart paper, then open and close the paper tray in the [Status] window in the maintenance menu to check mark sensor (see	Clean the mark sensor. Take care not to damage the sensor.

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		margin) operation. Paper tray open: white Paper tray closed: black	Check cable connections and reconnect cables to the CN1 connector. (☞10.1.1.A1)
		Check the signal output at pin 4 on CN1 when the paper tray is opened and closed. (☞10.1.1.A1)	If the output is constant and does not change, the sensor cable is defective and should be replaced.

Open the paper tray to check the sensor switch and mark sensor.



6.3 Blood Pressure

No.	Symptom	Check	Remedy
1	The error message “Press over” appears. (The software safety mechanism was triggered due to an abnormal rise in cuff pressure.)	Check for clogging in cuffs and air hoses.	Remove whatever clogs the cuff or air hose.
		Check air passages inside the case for kinked hoses and sensor pressure detectors for clogging.	Remove any kinks. Remove whatever clogs the cuff or air hose.
2	The error message “Safety” appears. (Hardware safety mechanism operation)	A cuff pressure of over 320 ± 10 mmHg activated the safety mechanism. 1. Check for clogging in cuffs and air hoses. 2. Check air passages inside the case for kinked hoses and sensor pressure detectors for clogging.	1. Remove whatever clogs the air passages. 2. Remove any kinks. Remove whatever clogs the cuff or air hose.
		A cuff pressure of over 10mmHg lasting longer than 130 ±10 seconds activates the safety mechanism. 1. Check if there is any air in the cuffs. 2. Check for damages in cuffs and air hoses that cause air leaks. 3. Disconnect the air hose and check the supplementary pressure (Q) in the [Pump Unit] window of the manufacturer maintenance menu. (☞5.4.2)	1. Disconnect the hose and let air out of the cuff. 2. Replace the cuff and air hose. 3. Replace the cuff PCB if the pressure is 10 mmHg or more.
		Check the cable that connects the cuff unit and the main board.	Make sure that all connections are correct.
3	The error message “Time over” appears. (The software safety mechanism was triggered by an excessively long measurement time.)	Check for clogging in cuffs and air hoses.	Remove whatever clogs the cuff or air hose.
		Check air passages inside the case for kinked hoses and sensor pressure detectors for clogging.	Remove any kinks. Remove whatever clogs the cuff or air hose.
		Disconnect the air hose and check the positive pressure (P) in the [Pump Unit] window of the manufacturer maintenance menu. (☞5.4.2)	Replace the cuff PCB if the pressure is 7 mmHg or more.
		Perform the [Pressure Test] in the maintenance menu and check inflation time and exhaust characteristics at 100% and 75% open.	If the standards are exceeded (numeric values are highlighted), replace the air control unit (pump, flow control valves).
4	The error message “Cuff error” appears. (Excessive inflation time)	Check whether the air connectors are loose.	Reconnect the air connectors.
		Check whether air hose or cuffs (rubber bag) are damaged and leak air.	Replace the cuffs and air hose.
		Check the air passages in the case for leaks and damages.	Replace the air hoses inside the case.
		Perform the [Pressure Test] in the maintenance menu and check the inflation time. (☞5.3.10)	If the standards are exceeded (numeric values are highlighted), replace the air control unit (air pump).

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5	The error message “BP error” appears. (BP measurement cannot be made)	Check it cuffs are correctly wound and whether the patient is relaxed.	Make sure the patient is relaxed before remeasurement. A weak pulse, body movement and arrhythmia may prevent measurement.
6	The error message “Offset error” appears. (Pressure at atmospheric pressure is unstable)	Check if there is any air in the cuffs.	Disconnect the hose and let air out of the cuffs.
		Check waveform at atmospheric pressure and check the baseline.	If the baseline wanders, the cuff PCB is defective and should be replaced.
		Disconnect the air hoses and press [Offset] in the [Pump Unit] window of the manufacturer maintenance menu to check the positive pressure (P) and supplementary pressure (Q).	If the difference between positive pressure (P) and supplementary pressure (Q) is 10 mmHg or more, replace the cuff PCB.
		Check the C359 main board for short-circuiting. (☞10.1.2.B3)	Improve insulation.
7	The error message “Valve error” appears. (Deflation or exhausting takes too long)	Check for clogging in cuffs and air hoses.	Remove whatever clogs the cuff or air hose.
		Check air passages or pressure detector in the case for clogging.	Remove any kinks. Remove whatever clogs the cuff or air hose.
		Perform the [Pressure Test] in the maintenance menu and check exhaust characteristics at 100% and 75% open. (☞5.3.10)	The air control unit (flow control valve) is defective and should be replaced.
		Check the C359 main board for short-circuits. (☞10.1.2.B3)	Improve insulation.
8	Blood pressure is too high or too low.	Check if the right cuff size is used.	Use a size in the applicable cuff range.
		Check if pressure accuracy is correct. (☞5.3.12)	If appropriate accuracy cannot be obtained, replace the cuff PCB.
		Perform the [Pressure Test] in the maintenance menu and check the pump unit function.	If anything is defective, replace the pump unit.
9	Measurement site and pressure site do not match.	Check whether the air hose and cuffs are connected.	Reconnect securely.
		Perform [Pressure Upper Limit] Test in the maintenance menu. Place your hand close to the VS-1500 air connectors to check if air is output in the order, right brachial → left brachial → Right ankle → Left ankle. (☞5.3.10)	Should the order be incorrect, check and correct the wiring in the case.

6.4 ECG

No.	Symptom	Check	Remedy
1	Error message “Lead off” appears.	Check if the lead cables are broken or are short-circuited by some other signal.	Replace the lead cable.
2	Lead off could not be detected.	Check if the lead cables are broken or are short-circuited by some other signal.	Replace the lead cable.
		In lead off condition, check the AD converter input to the lead that is not detected. (☞10.1.1.C4)	The input amplifier is defective if –2.5 V cannot be obtained.
3	Recording of a lead is in the baseline state.	Check whether the lead cables are loose.	Connect the lead cable correctly.
		Check if the lead cables are broken or are short-circuited by some other signal.	Replace the lead cable.
		Check the AD converter input to the lead that is not detected. (☞10.1.1.C4)	If the signal does not change with waveform input, the input amplifier is defective.
4	Recording of all leads is in the baseline state.	Check whether the F3 or F5 fuses are blown. (☞10.1.2.B1)	Replace blown fuses.
		Check the power supply of the ECG-AMP. C478: +5V (☞10.1.1.B4)	The ECG-AMP power supply is defective.
5	Noise contamination	Check for hum contamination.	Set the hum filter to the electric frequency of the local area.
		Check if the instrument is grounded.	Ground the instrument securely via the power cord or grounding conductor.
		Check clip electrodes and echopads.	Apply clip electrodes securely and replace echopads.

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6.5 PCG and Pulse Waves

No.	Symptom	Check	Remedy
1	The error message “Check PCG” appears.	Check if the PCG microphone has come loose or if the connector has been incorrectly inserted.	Apply the PCG microphone correctly.
		Check PCG.	If the waveform is too small, adjust the position of the PCG microphone to increase the amplitude.
			If no waveform is available, the PCG microphone is defective and should be replaced.
		Check TP2 and TP3 on the main board. (☞10.1.1.A4)	If no PCG is output, the PCG input amplifier is defective.
2	No pulse wave is induced from the cuff.	Check if the air hose is incorrectly connected.	Connect the air hose correctly.
		Check whether air hose or cuffs (rubber bag) are damaged and leak air.	Replace the cuffs and air hose.
		Check air passages inside the case for kinked hoses and sensor pressure detectors for clogging.	Remove any kinks. Remove whatever clogs the cuff or air hose.
		Check the connection of the BP cable that connects the cuff board and the main board. (☞8.1.3)	Be sure to match up colors and sites when connecting the main board to the cuff board using the BP cable.
		Check cuff pulse wave at pin 5 on CN2 on the cuff board. (☞10.2.1)	If no waveform is output, the board is defective and should be replaced.
3	Carotid and femoral pulse waves do not appear on the LCD screen.	Check the test mode in the [BP/Pulse Test Condition Setting].	Set the test mode to [Aorta PWV].
4	Knee pulse waves do not appear on the screen.	Check the test mode in the [BP/Pulse Test Condition Setting].	Set test mode to [Basic] and measurement item to [kCAVI].
5	Carotid, femoral and knee pulse waves do not appear.	Check if the pulse wave sensors have come loose or if the connector has been incorrectly inserted.	Apply sensors and connectors correctly.
		Check pulse waveform.	If the waveform is too small, adjust the position of the pulse wave sensors to increase the amplitude.
			If no waveform is output, the pulse wave sensor is defective and should be replaced.
		Check PW cable connection to the main board and check the cable for breakage.	Reconnect the connectors. Change any broken cables.
		Check if the F1 fuse is blown. (☞10.1.1.B3)	Replace blown fuses.
		<PULSE WAVE1> Check the pulse wave at TP4 on the main board. (☞10.1.1.B4)	If no pulse wave is output, the pulse wave input amplifier is defective.
		<PULSE WAVE2> Check the pulse wave at TP1 on the main board. (☞10.1.1.A4)	
6	Toe waveforms do not appear on the screen.	Check the test mode in the [BP/Pulse Test Condition Setting].	Set the test mode to [Toe Wave].

6.6 Fixed Keys/Touch Panel

No.	Symptom	Check	Remedy
1	The touch panel does not function.	Check if the touch panel cable of the LCDTP_IF board has come loose from the CN3 connector. (☞10.3.1)	Connect the cable correctly.
		Check if the cable connecting the main board and the LCDTP_IF board has come loose.	Connect the cable correctly.
		Check whether the touch panel works in the [Touch Panel Test] window of the maintenance menu. (☞5.3.17)	If the touch panel does not respond, it is defective and should be replaced.
2	The fixed keys do not function.	Check if the cable connecting the keyboard and the main board has come loose.	Connect the cable correctly.
		Check the key cable for breakage.	Replace the cables.
		Check if the rubber key has deteriorated so badly that proper contact is not possible.	If rubber key contact resistance is 3 KΩ or more, replace the keyboard.

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6.7 Display

No.	Symptom	Check	Remedy
1	The screen goes dark.	Check the backlight setting in the [Energy Save Setup].	Set [Dim backlight when no operation] to [Off].
2	The screen vanishes.	Check the auto power off setting in [Energy Save Setup].	Set [Auto Power Off] to [Off].
3	The screen is dark.	Check if the cable connecting the main board and the LCD_TP_IF board has come loose or is broken.	Connect the cable correctly. Replace the cable if broken.
		Check the service life of the display. The display backlight is a consumable and deteriorates with use. (Life: approx. 54,000 hours)	Replace the display. (☞11.8)
		Check the inverter On/Off signal (pin 3 on CN4) on the LCDTP_IF board. (☞10.3.1)	If the signal is "L", the inverter is defective and should be replaced.
4	LCD is abnormal.	Check if the cable connecting the display and the LCDTP_IF board has come loose or is broken.	Connect the cable correctly. Replace the cable if broken.
		Check if the cable connecting the main board and the LCDTP_IF board has come loose or is broken.	Connect the cable correctly. Replace the cable if broken.
		Check the power supply of the LCDTP_IF board. C12: +3.3V (☞10.3.1)	If the power supply voltage is abnormal, the cable may be broken. Replace the cable. Also check the +3.3 V of the main board.

6.8 CF Cards

No.	Symptom	Check	Remedy
1	The error message "CF card write error" appears.	Check if the ◈ icon appears in the lower right of the screen.	Reinsert the CF card.
		Test the CF card in the maintenance menu. (☞5.3.6)	If the test result is OK, the CF card is defective and should be replaced.
		Check the detection signal (pin 10 and 77 on IC61) input to the CF card connector. CF card detected: "L" CF card not detected: "H" (☞10.1.2.C4)	If the CF card is not detected, it is defective and should be replaced.
		Check the +3.3 V power supply (pin 22 and 43 on IC61) on the CF card. (☞10.1.2.C4)	If the +3.3 V signal is not detected, FET (Q58) is defective and should be replaced.
2	The error message "Data write to the CF card now" appears.	Wait until the write operation completes.	If the error message does not go out, the data may be corrupted. Replace the CF card. Consult our head office for information on repair of damaged cards.
3	The error message "File read error" appears.	Check if the ◈ icon appears in the lower right of the screen.	Reinsert the CF card.
		Patient data cannot be found from the ID. In the file mode, check if there is any past data for that ID.	Use CF cards containing past data.
4	The error message "CF card read error" appears.	Check if the ◈ icon appears in the lower right of the screen.	Reinsert the CF card.
		Test the CF card in the maintenance menu. (☞5.3.6)	If the test result is OK, the CF card is defective and should be replaced.
		Check the detection signal (pin 10 and 77 on IC61) input to the CF card connector. CF card detected: "L" CF card not detected: "H" (☞10.1.2.C4)	If the CF card is not detected, it is defective and should be replaced.
		Check the +3.3 V power supply (pin 22 and 43 on IC61) on the CF card. (☞10.1.2.C4)	If the +3.3 V signal is not detected, FET is defective and should be replaced.
5	The error message "CF card format abnormal end. Check card" appears.	Check if the CF card is one we recommend.	Replace the CF card with one we recommend.
6	The error message "File write error" appears.	Check if the ◈ icon appears in the lower right of the screen.	Reinsert the CF card.
		Test the CF card in the maintenance menu. (☞5.3.6)	If the test result is OK, the CF card is defective and should be replaced.
		Check the detection signal (pin 10 and 77 on IC61) input to the CF card connector. CF card detected: "L" CF card not detected: "H" (☞10.1.2.C4)	If the CF card is not detected, it is defective and should be replaced.
		Check the +3.3 V power supply (pin 22 and 43 on IC61) on the CF card. (☞10.1.2.C4)	If the +3.3 V signal is not detected, FET is defective and should be replaced.

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No.	Symptom	Check	Remedy
7	The CF card is new, but the ◈ icon is still red.	The CF card has not been initialized. Initialize the CF card.	Use [CF Card Initialize] in Initial Setting/Maintenance.

6.9 LAN Communications

No.	Symptom	Check	Remedy
1	The error message "VS-PC host not connect" appears.	Check if the PW icon appears in the lower right of the screen. Check the setting in [Storage Setting].	Set to On to automatically send data to a PC, otherwise set to Off.
2	The error message "ECG-PC host not connect" appears.	Check if the ECG icon appears in the lower right of the screen. Check the setting in [Storage Setting].	Set to On to automatically send data to a PC, otherwise set to Off.
3	The error message "Data cannot send to Order-PC host" appears.	Check if the ORD icon appears in the lower right of the screen. Check [Order Setting] window in initial setting/maintenance.	Set operation to [Online]. Enter the IP address and port number of the order PC.
		Check the network settings for VS-1500 and conduct the [ping Test] in the maintenance menu. 1. An error occurs immediately. 2. The error occurs again.	1. Correctly enter the IP address of the order PC. 2. Do not connect the VS-1500 directly to the hospital LAN or other network. If Ethernet hubs will be used, use only hubs that we recommend.
		Check if the LAN cable is loose or broken.	Connect the cable correctly. Replace the LAN cable if broken.
		Check if D14 on the main board lights. (☞10.1.1.C3)	The hub has not been turned on. Turn it on.
			The LAN cable is not properly connected. Connect the cable correctly.
		Check if D15 and D16 lights during PC connection. (☞10.1.1.C3)	Check the network settings for VS-1500 and conduct the [ping test] in the maintenance menu.
4	The error message "Data cannot send to VS-PC host" appears. The error message "Data cannot send to ECG-PC host" appears.	Check the network settings for VS-1500 and conduct the [ping Test] in the maintenance menu. 1. An error occurs immediately. 2. The error occurs again.	1. Correctly enter the IP address and port number of the order PC. 2. Do not connect the VS-1500 directly to the hospital LAN or other network. If Ethernet hubs will be used, use only hubs that we recommend.
		Check if the LAN cable is loose or broken.	Connect the cable correctly. Replace the LAN cable if broken.
		Check if D14 on the main board lights. (☞10.1.1.C3)	Check the power supply of the hub and turn on the power.
			The LAN cable is not properly connected. Connect the cable correctly.
		Check if D15 and D16 lights during PC connection. (☞10.1.1.C3)	Check the network settings for VS-1500 and conduct the [ping test] in the maintenance menu.
5	The error message "File send error" appears.	Check if the LAN cable is loose or broken.	Connect the cable correctly. Replace the LAN cable if broken.
6	The error message "A communication error is occurred" appears.	Check [Network and Master ID Setting] window in initial setting/maintenance.	Set Master ID request to [Host].

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6.10 Color Printer

No.	Symptom	Check	Remedy
1	The error message "Couldn't receive printer information" appears.	Check if you are using a printer recommended by Fukuda Denshi.	Use only printers recommended by Fukuda Denshi.
2	Printing is not possible.	Check if the printer icon lights.	Turn the printer on.
		Check if the printer has run out of ink in the [Color Printer Maintenance] window.	Replace the ink. (☞5.7.3)
		Check if the printer has run out of paper.	Load chart paper.
		Check if a paper jam has occurred.	Open the rear door, clear the paper jam and press the Resume Print button.
		Restore the printer from a paperless state.	Press the Resume Print button on the printer.
		Check if the printer cover is open.	Make sure the printer cover is completely closed. Printing will not start if the cover is even slightly open.
		Check if the printer cable is loose or broken. If the device is connected via a print server, check the connection with the print server, the power supply and the connecting cables.	Connect the cable correctly. Replace the cable if broken.
		Check the power supply during communications. Pin 1 on CN15: +5 V (☞10.1.1.C2)	The IC34 is defective and should be replaced. (☞10.1.1.C2)
3	Prints white sheets.	The ink may have clogged up. Perform nozzle cleaning. (☞5.7.2)	Perform nozzle cleaning in the [Color Printer Maintenance] window. Note that frequent nozzle cleaning will deplete the ink. Do not perform nozzle cleaning unless absolutely necessary.
		The tape has not been removed from the ink cartridges.	Take the print cartridges out and remove the tape.
4	Print quality is poor.	The ink may have clogged up. Perform nozzle cleaning. (☞5.7.2)	Perform nozzle cleaning in the [Color Printer Maintenance] window. Note that frequent nozzle cleaning will deplete the ink. Do not perform nozzle cleaning unless absolutely necessary.
		The color ink and black ink nozzles may be misaligned.	Perform head adjustment in the [Color Printer Maintenance] window.
5	The paper jams.	The feed rollers slip and the paper does not advance fully.	Open the rear door and clean the feed rollers with a cotton swab, etc.

No.	Symptom	Check	Remedy
6	Print position is misaligned.	The paper in the input tray is not straight.	Reload the paper in the input tray, making sure it is inserted as far as it will go. Adjust the side and rear guides according to the size of the paper to keep the paper straight.
		The paper in the input tray is not straight.	Reload the paper in the input tray, making sure it is inserted as far as it will go. Adjust the side and rear guides according to the size of the paper to keep the paper straight.
7	Two sheets of paper feed through the printer at one time.	Check the sheets in the input tray.	Remove all the paper from the input tray and fan it before loading it in the tray.
8	The printer cannot be turned off.	The printer will automatically turn off when the instrument is powered down.	Turn the instrument off with the printer cable plugged in. If the problem persists, replace the print cartridges with new cartridges.

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6.11 Serial Communications

No.	Symptom	Check	Remedy
1	The ID card reader does not function.	Check ID card reader connections.	Connect the card reader correctly.
		Check VS-1500 settings.	Set serial select in the [Other Setup] window in initial setting/maintenance to [ID Card Reader].
			Set sequence to [ACK] and data type to [STX-ETX BCC] in the [ID Card Reader Setting] window in initial setting/maintenance.
		Check whether the F2 or F4 fuses are blown. (☞10.1.2.C3)	Replace blown fuses.
2	The bar code reader does not function.	Check bar code reader connections.	Connect the card reader correctly.
		Check VS-1500 settings.	Set serial select in the [Other Setup] window in initial setting/maintenance to [ID Card Reader].
			Set sequence to [Non-procedure] and data type to [CR, LF] in the [ID Card Reader Setup] window in initial setting/maintenance.
		Check whether the F2 or F4 fuses are blown. (☞10.1.2.C3)	Replace blown fuses.
3	The master's apparatus does not function.	Check bar master's apparatus connections.	Connect the apparatus correctly. Use a CJ-325 cable for connecting the master's apparatus.
		Check VS-1500 settings.	Set serial select in the [Other Setup] window in initial setting/maintenance to [OM-110].
		Check whether the F2 or F4 fuses are blown. (☞10.1.2.C3)	Replace blown fuses.

6.12 Other Functions

No.	Symptom	Check	Remedy
1	Date/time is not indicated correctly.	Set the time.	Set the time in the [Clock Setting] window in initial setting/maintenance.
		Check the voltage of the backup battery in the [Status] window of the maintenance menu.	If the battery is lower than 2.2V, replace it.
2	The buzzer and key sound cannot be heard.	Check [BP/Pulse Test Condition Setting] and [ECG Setup] → [ECG Common Setup].	Set sound to [On] and voice guidance to [ON].
		Check if the speaker cable is loose or broken.	Connect the cable correctly. Replace the speaker cable if broken.
		Check signal output during sound output. (Pin 1 on CN3)(☞10.1.1.A1)	If the output fluctuates, the speaker is defective and should be replaced.
3	The backlight does not go off even when the display is closed.	Check [Energy Save Setup] in the maintenance menu.	Set [Backlight Off When Display Closed] to [On].
		Check if the LCD_SW cable is loose or broken. (☞8.1.6)	Connect the cable correctly. Replace the LCD_SW cable if broken.
		Check the signal from pin 5 on CN8 when the screen is closed. (☞10.1.1.A1)	If the signal is "L", the LCD_SW is defective and should be replaced.

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7

Chapter 7 Messages

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7.1 Messages and Countermeasures

This chapter lists onscreen messages and provides information on the measures that should be taken when they appear.

MEMO **If the error message re-appears despite taking countermeasures, stop any inspections and contact your Fukuda Denshi service representative.**

7.1.1 Instrument and Measurement-related Messages

Message	Cause	Countermeasure
AIR leak error	When the pulse wave was acquired, the Cuff pressure was 5mmHg or less.	Inspect the cuff and air hose for damages or breakage.
	The time to reach target-inflating pressure was longer than specified.	・If the cuffs start leaking air, press the ◇ (Start) key again to measure. ・Inspect the cuff and air hose for damages or breakage.
	Loose “air” connector causes air leakage.	Connect the air connectors correctly.
BP error	Blood pressure measurement is not possible.	Check whether cuffs are properly set, have the patient relax and re-measure.
BP low error	Because SYS is less than 30mmHg and DIA is less than 20mmHg, the blood pressure value cannot be measured.	Confirmed that the cuff is appropriately installed. If the cuff is correctly attached, then double check the pressure of the patient with another system to confirm low blood pressure.
BP re-inflation has been turned off.	The re-inflation is turned off, and could not inflate again when re-inflation was necessary.	Set the setting of re-inflation to ON or raise the pressure value.
Repress off error		
Check PCG	The PCG microphone is not connected.	Connect the PCG microphone.
Check PCGII sound.	The second heart sound cannot be detected.	・Check whether the ECG can be correctly captured. ・Adjust the PCG microphone location.
Cuff error	Damaged cuff (rubber pouch) causes air leakage.	Replace the cuff.
Cuff type error	When the inflation is intended for an ankle cuff but a toe cuff is connected or vice versa.	・Connect a suitable cuff for the measurement mode.
Illegal cartridge used.	A different type of cartridge is used.	Make sure to use the same type of cartridge as used before.

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Message	Cause	Countermeasure
Input age (birthday) and/or sex. No vascular age will be present in the report without entering patient age.	The patient's age and sex have not been entered.	Enter the patient's age and sex. (Entry is not necessary if it is the CAVI value and not the vascular age that is of interest.)
Input Aorta-Femoral (AF) distance.	No AF value has been entered.	・Enter an AF value. ・To use patient height to enter this value, select [Height] as the Distance Input Method in the BP/Pulse Test Condition Setting (2/3).
Input height	The height has not been entered.	Enter the height.
Input L as vascular length.	Enter L as vascular length.	・Enter L as vascular length. ・To use patient height to enter this value, select [Height] as the Distance Input Method in the Pulse Test Condition Setting (2/3).
Lead off	Loose electrodes.	Apply the electrodes correctly.
Loose electrodes. Check electrodes.	Loose electrodes.	Check the electrodes.
Low osc error	The pulse wave was too small; the blood pressure could not be measured.	Confirmed that the Cuff is appropriately installed. If the cuff is correctly attached, then double check the pressure of the patient with another system to confirm low blood pressure.
No paper.	No paper has been loaded in the built-in recorder.	Load chart paper.
Offset error	The pressure sensor unit is out of range.	・Check whether there is air in the cuff or not. ・Turn the power OFF and turn it back ON.
Paper tray open	The paper tray of the built-in recorder is open.	Close the paper tray.
Press over	Cuff pressure increased over the limit during measurement, thereby activating the safety device.	Inspect the cuff and air hose for damages or breakage.
Replace backup battery.	The battery service life has expired.	Replace the battery.
Stop for Safety	Cuff pressure increased over the limit during measurement or the measurement timed out and activated the safety device.	Inspect the cuff and air hose for damages or breakage.
Thermal head is too hot!!	Thermal head temperature exceeds 63ºC.	Stop recording until the message disappears.
The R wave could not be detected. Check electrode(s).	The R wave could not be detected after 7 s or longer.	Check whether the ECG electrodes are correctly applied.

Message	Cause	Countermeasure
The settings have been reset to factory default. (***) (***) can be either FLASH or SRAM.	For FLASH: Faulty memory can be expected. For SRAM: Low voltage in the "back-up" battery for settings and clock.	For FLASH: Please contact our service department. For SRAM: Please replace the back-up battery.
Time over	The measurement timed out and activated the safety device.	Inspect the cuff and air hose for damages or breakage.
Valve error	Cuff deflation took too long.	Inspect the cuff and air hose for damages or breakage.

7.1.2 CF Card-related Messages

Message	Cause	Countermeasure
Failed to write on the CF card.	No CF card has been inserted or data cannot be properly written to the card.	Reinsert the CF card. If the problem persists, replace the card.
Format CF card is needed.	The inserted CF has not been formatted.	Format the card on the VS-1500.
Retrieving patient data from CF card failed.	The ID entered in the patient information could not be found on the CF card.	Either there is no patient data on the CF card with that ID or the data file is corrupted.
Failed to read from the CF card.	Either the CF card has not been inserted or the data cannot be read from the card.	Reinsert the CF card. If the problem persists, replace the card.
CF card format error. Check the card.	Check CF card for damages.	Reinsert the CF card. If the problem persists, replace the card.
File is not selected.	The file to perform data detail, delete or PC transfer has not been selected.	Select the file to be processed.
Write file error.	Data was not written correctly to the CF card.	・Reinsert the CF card. ・Check that the CF card has been formatted. If the message re-appears, replace the CF card.
Send file error.	Files cannot be properly sent to the PC.	・Check whether the LAN cable is correctly connected. ・Check whether the PC software is running. ・Check network settings.
The CF card is write-protected.	The CF card is set to write-protected.	Set writable on the CF card.
Read file error.	Instrument settings and doctors and other data cannot be read from the CF card.	The file could be corrupted.

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7.1.3 Color Printer related Messages

Message	Cause	Countermeasure
Front cover open.	The color printer cover is open.	Close the front cover.
Error (Nozzle), please check.	The color printer nozzle is clogged.	Perform nozzle cleaning. If the problem persists, change the ink cartridge.
No cartridge installed.	There is no cartridge in the color printer.	Install a ink cartridge.
Couldn't receive printer information.	The online printer is not operating normally.	Turn the printer OFF and back ON again. Check under color printer maintenance for status.

7.1.4 Personal Computer-related Messages

Message	Cause	Countermeasure
VS-PC host not connected	Connections cannot be made with the PC when [PC Sending After Test] is set to [On] in Pulse Wave Automatic Storing.	・Check whether the LAN cable is correctly connected. ・Check whether the PC software is running. ・Check network settings. ・Set [PC Sending After Test] to [Off] when a connection to a PC is not required.
Data cannot sent to VS-PC host.	Measurement results cannot be transferred to the PC.	・Check whether the LAN cable is correctly connected. ・Check whether the PC software is running. ・Check network settings.
Communication error has occurred.	The ID entered in the patient information could not be found on the PC.	Either there is no patient data on the PC with that ID or the data file is corrupted.

8

Chapter 8 Disassembly and Assembly

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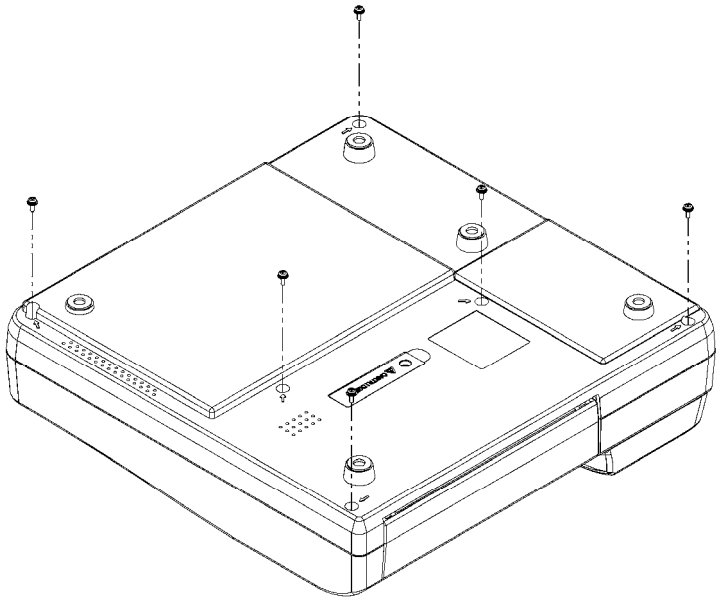
CAUTION

- For repairs requiring disassembly, please contact Fukuda Denshi Technical Services Co., Ltd. Be sure to contact Fukuda Denshi Technical Services Co., Ltd. for cuff PCB and pump unit replacements since they require a weights and measures inspection.

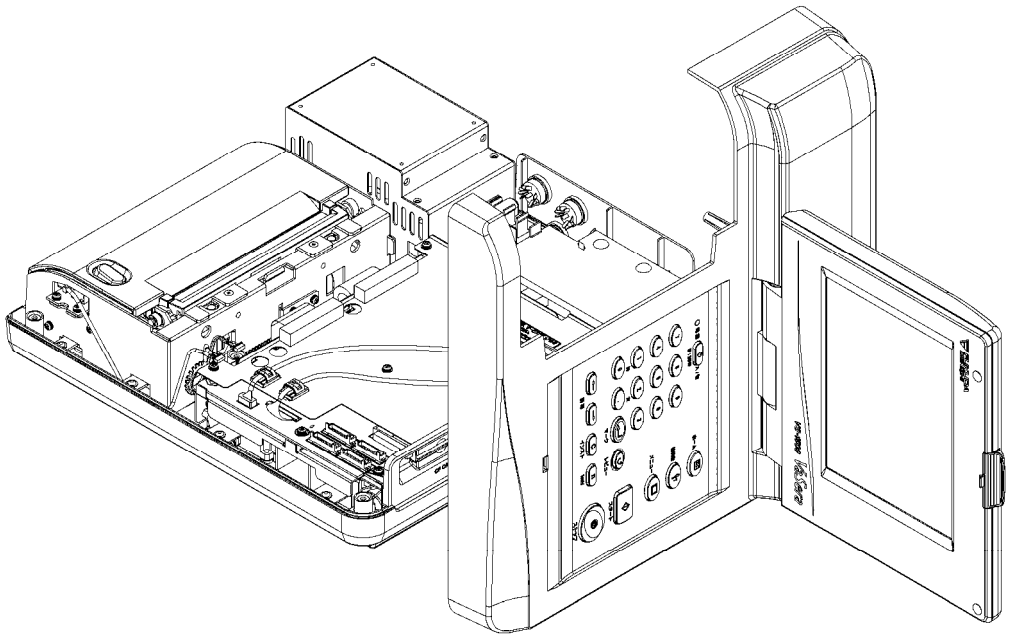
8.1 Instrument Disassembly

8.1.1 Removing the Upper and Lower Cases

(1) Remove the screws (6 W SEMS (L) M3 × 8) from the bottom of the instrument.



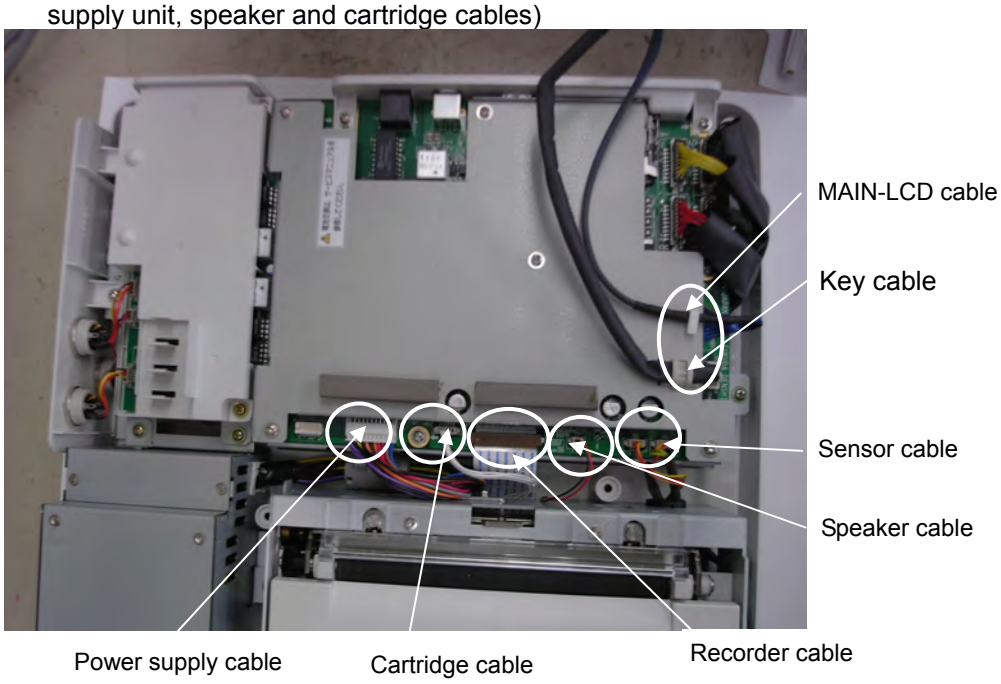
(2) Remove the upper case, open the display assembly as shown below and place it on the right side of the lower case.



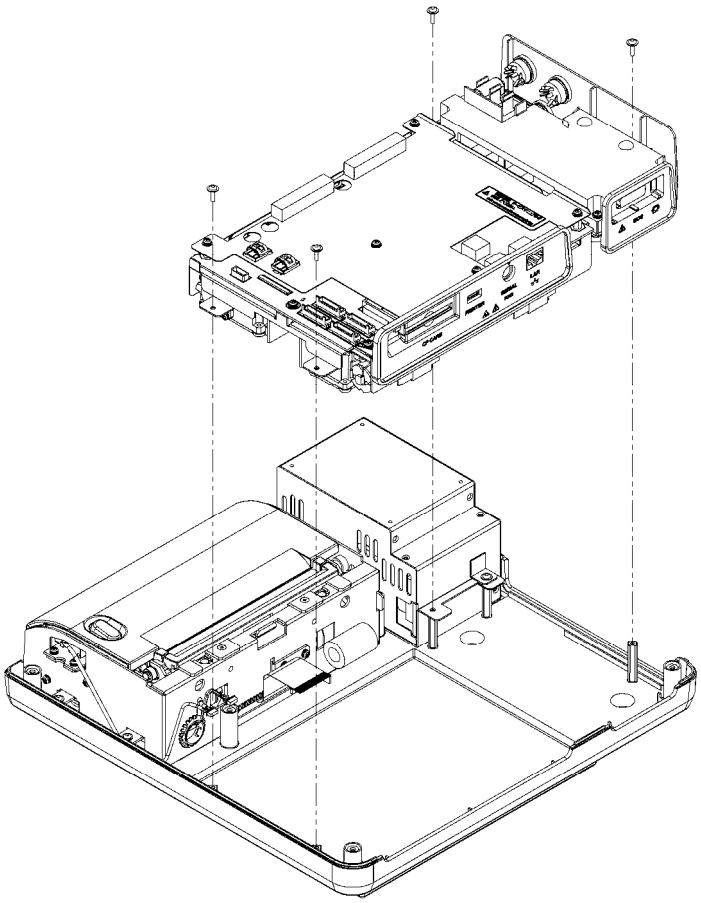
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8.1.2 Removing the Main Board

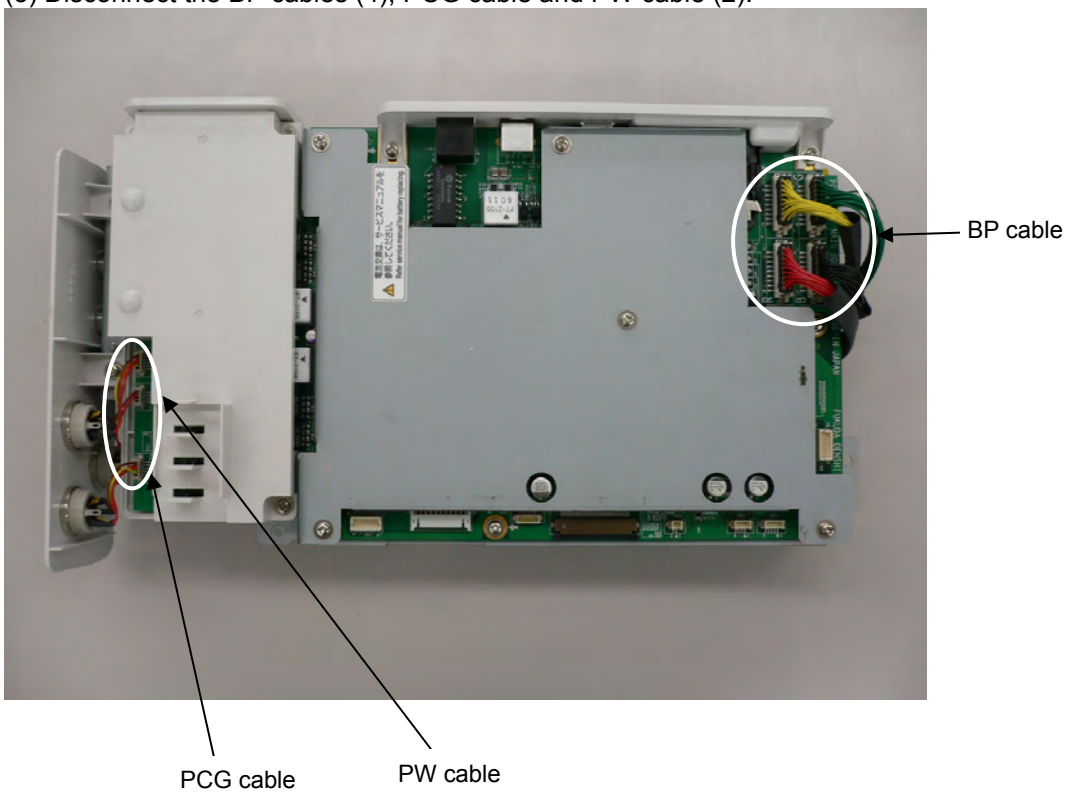
(1) Disconnect the cables connected to the main block. (Main-LCD, key, recorder, sensor, power supply unit, speaker and cartridge cables)



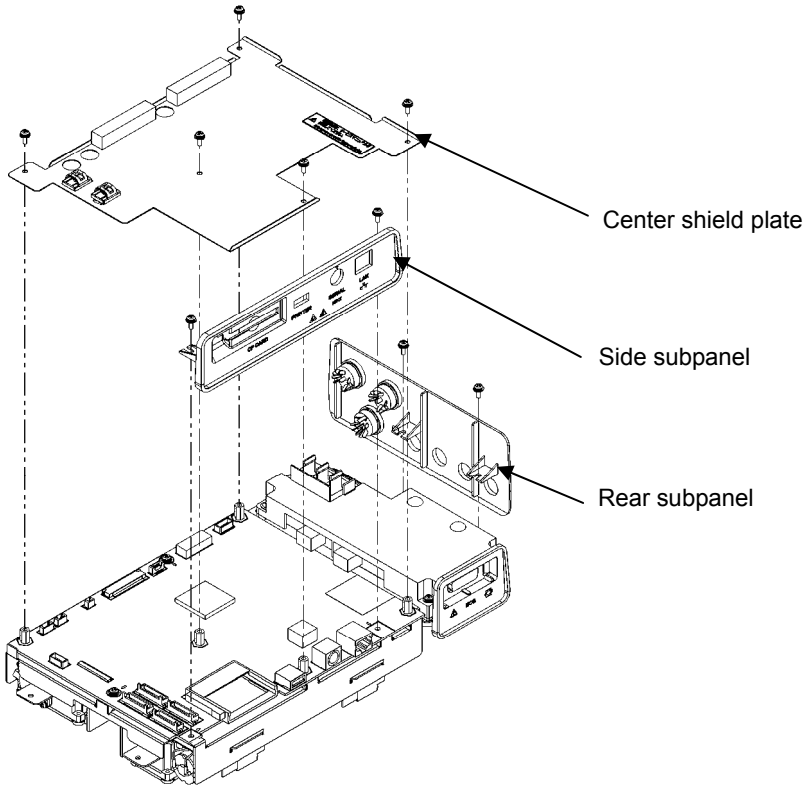
(2) Remove the screws (4 P tight pan head WH 3 × 12) and take out the main block.



(3) Disconnect the BP cables (4), PCG cable and PW cable (2).

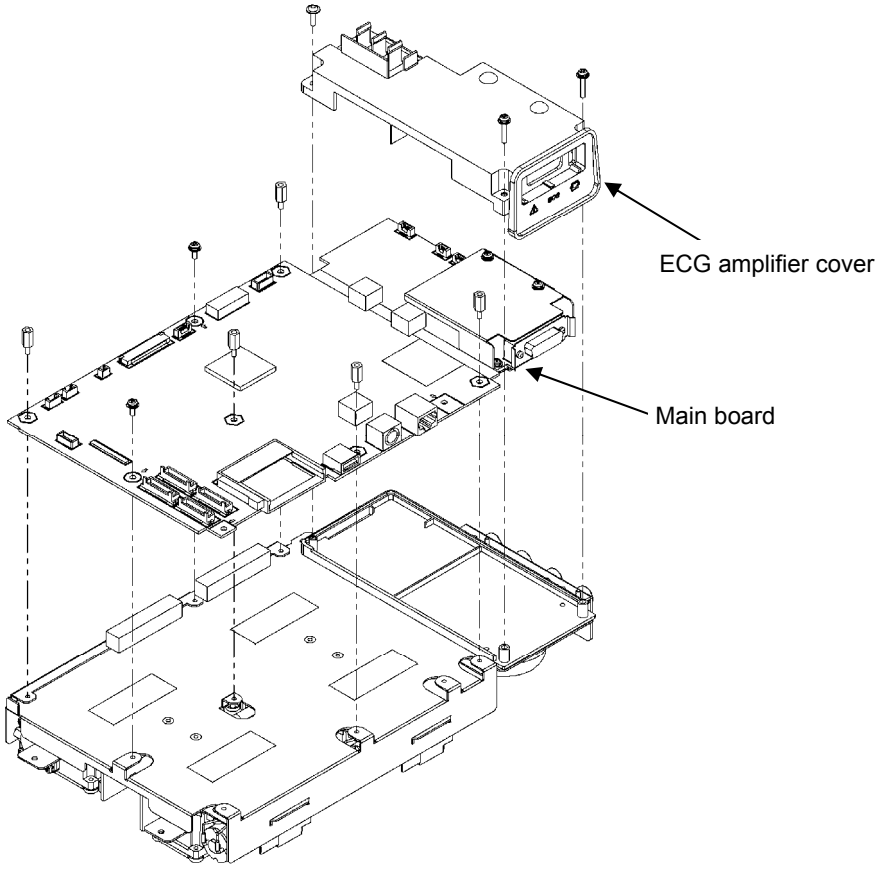


(4) Remove the screws (5 W SEMS (L) 3 × 8) and remove the center shield plate.
Remove the screws (2 W SEMS (L) 3 × 8) and remove the side subpanel.
Remove the screws (2 W SEMS (L) 3 × 8) and remove the rear subpanel.

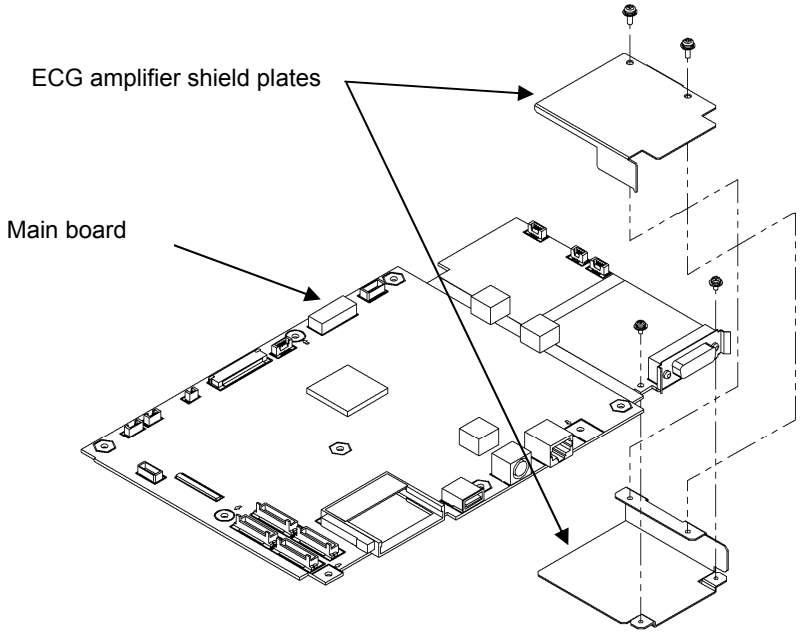


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(5) Remove the screws (1 tight pan head WH 3 × 10, 2 W SEMS (L) M3 × 16) and the upper ECG amplifier cover.
Remove the spacers (5 BSB-310), the screws (2 W SEMS (L) M3 × 8) and the main board.



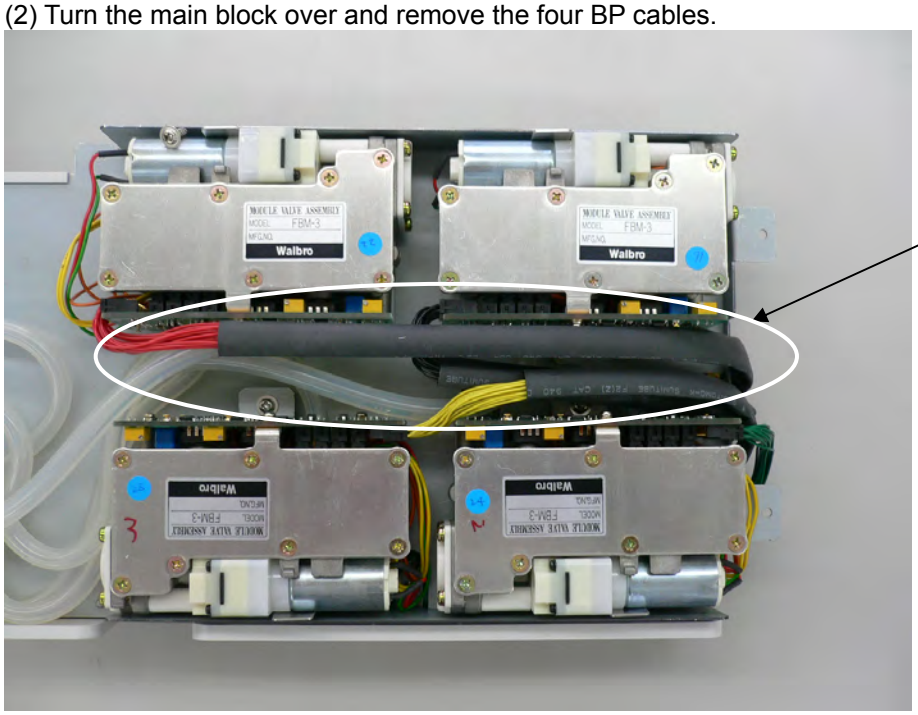
(6) Remove the screws (2 W SEMS (L) M2.6 × 8, 2 W SEMS (L) M3 × 8) and the ECG amplifier shield plates.



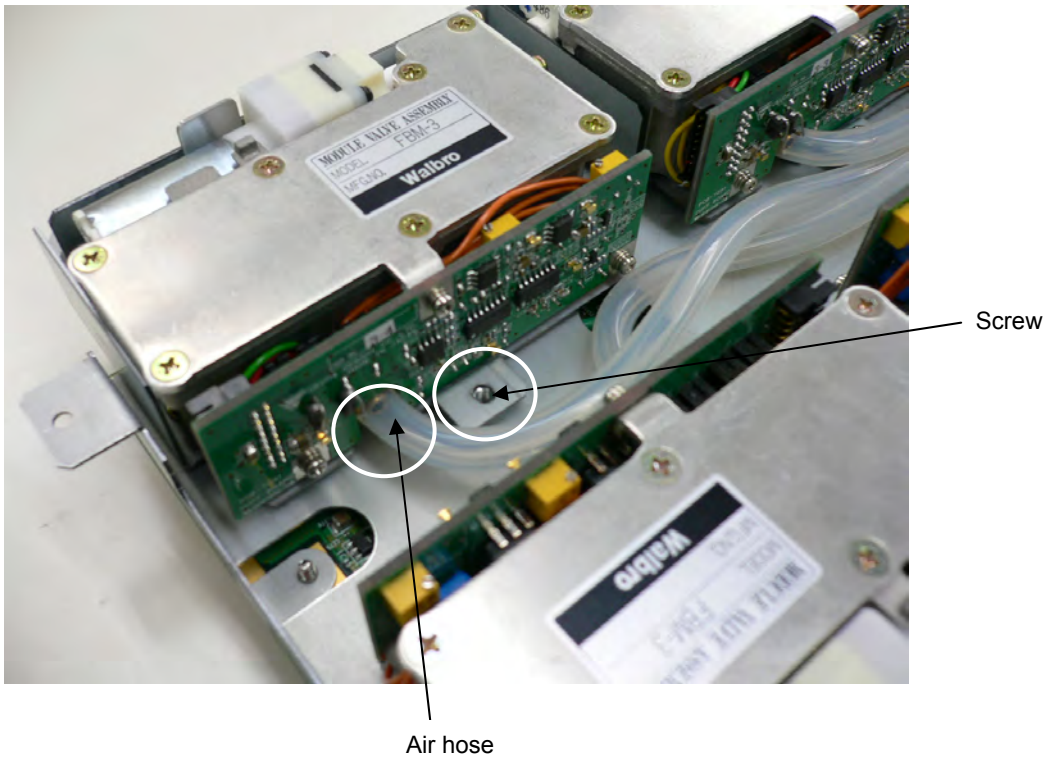
8.1.3 Removing the Pump Block

(1) Disassemble the instrument until the main block can be taken out. (☞8.1.2(2))

(2) Turn the main block over and remove the four BP cables.



(3) Remove the screw (1 W SEMS (L) M3 × 8), air hose and pump block. Air hose removal requires some physical strength so proceed with care.

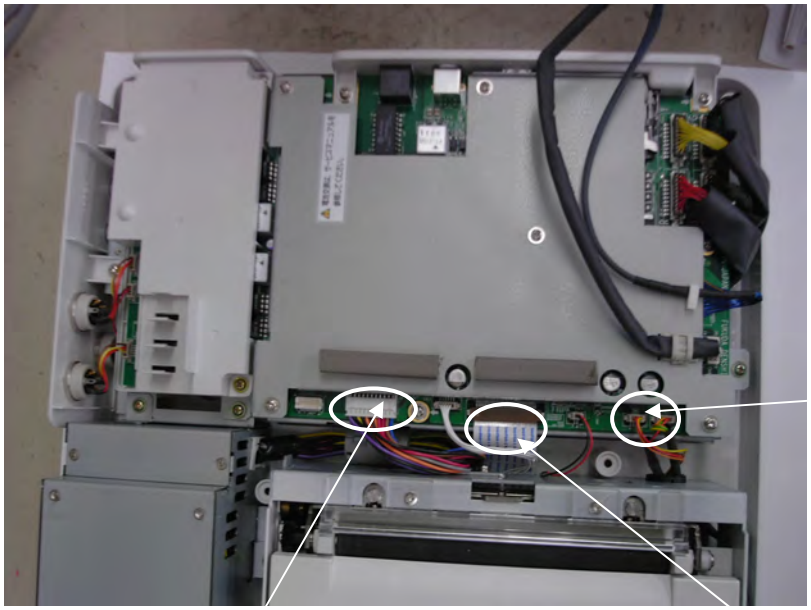


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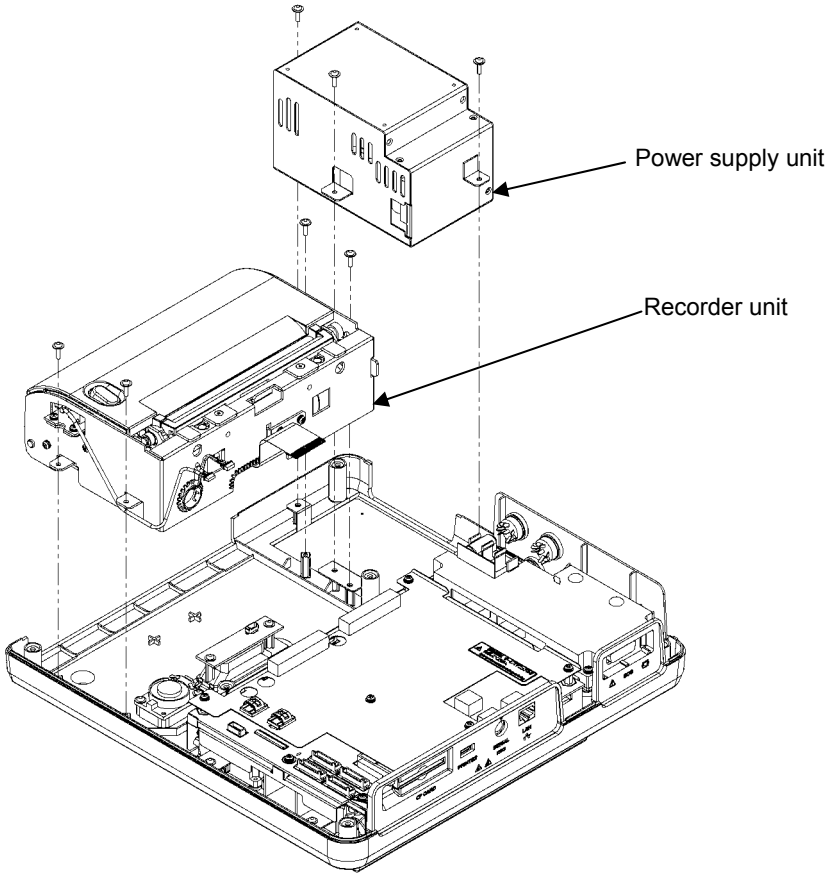
8.1.4 Removing Recorder and Power Supply Unit

(1) Remove the upper case. There is no need to disconnect the MAIN-LCD cable and the key cable.

(2) Disconnect the record cable, sensor cable and power supply cable.

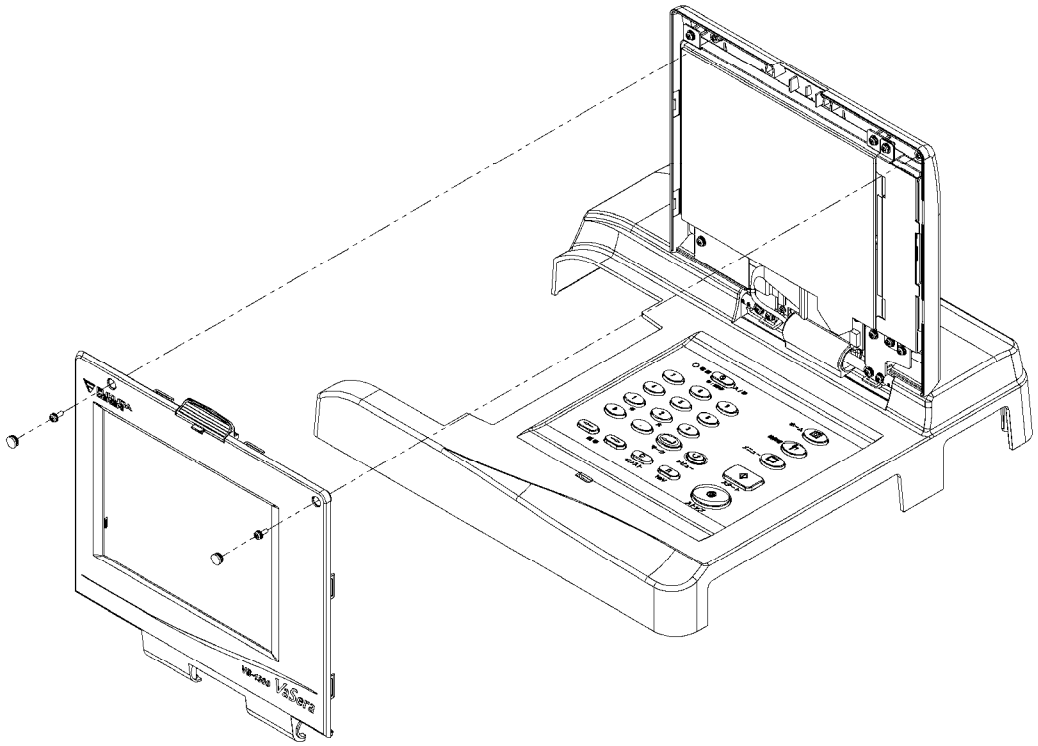


(3) Remove the screws (4 P tight pan head WH 3 × 10) and take out the recorder unit.
Remove the screws (3 P tight pan head WH3 × 12) and the power supply unit.

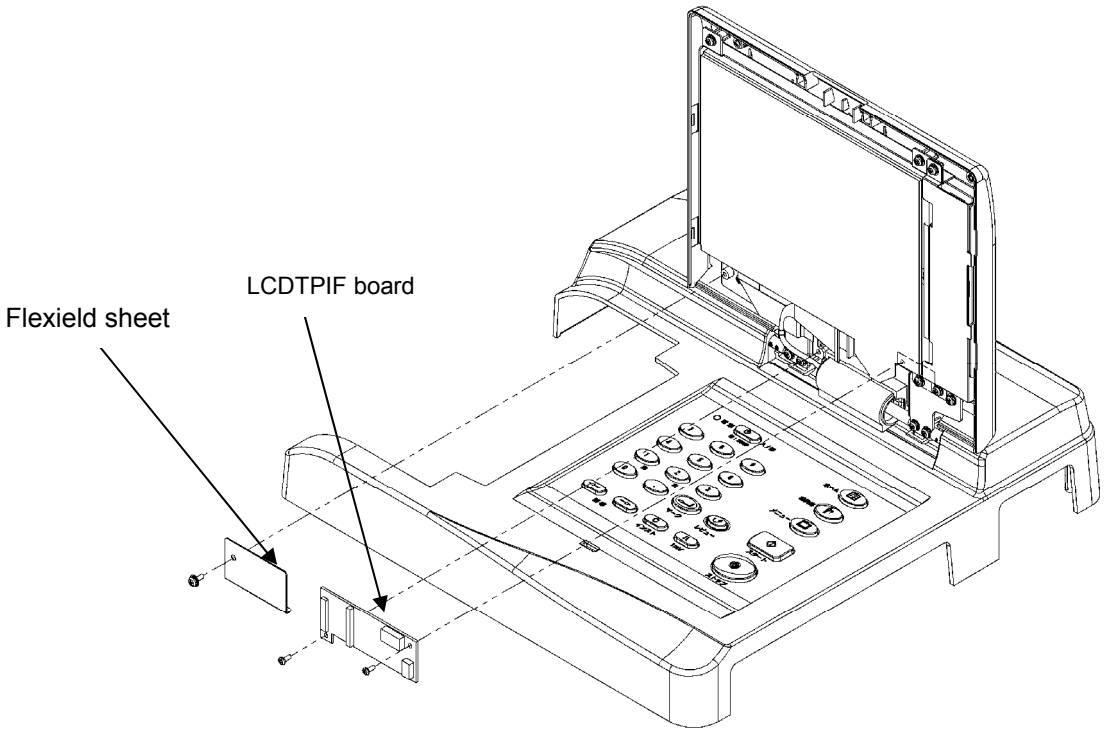


8.1.5 Removing the LCD

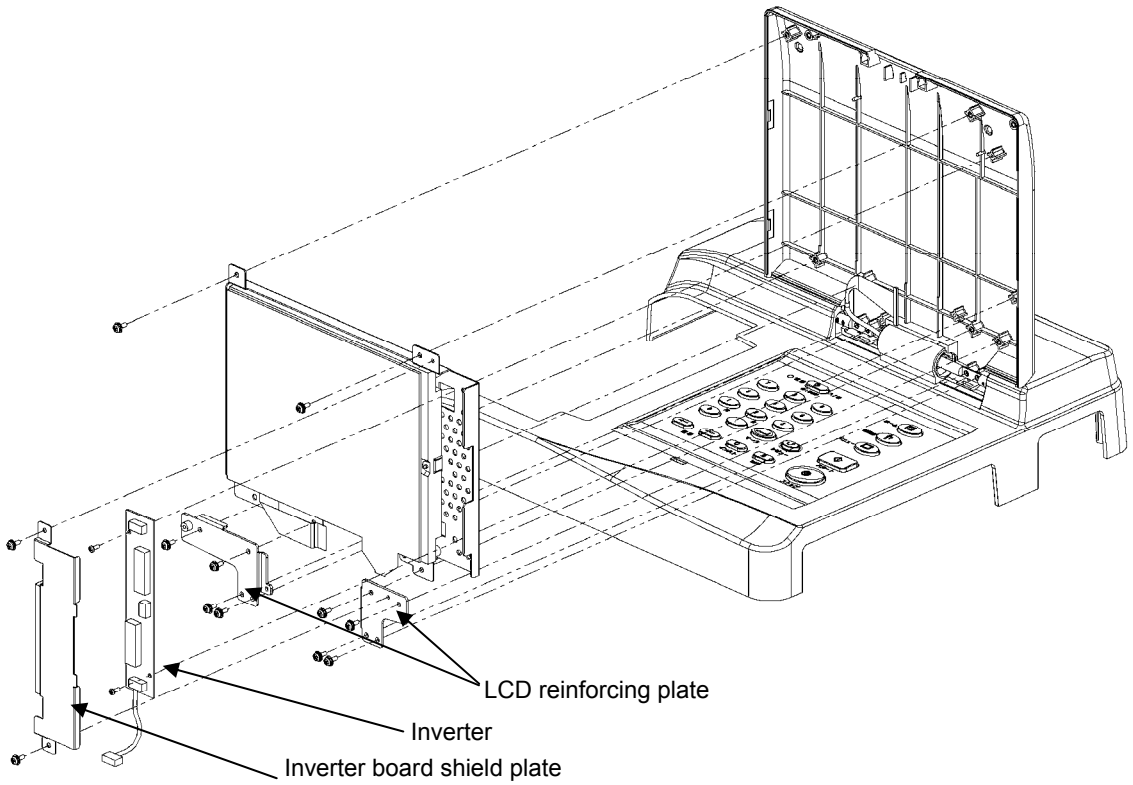
(1) Remove the two rubber caps, screws (2 W SEMS (S) M3 × 8).
Remove the front LCD cover. Remove the cover starting from the upper left corner.



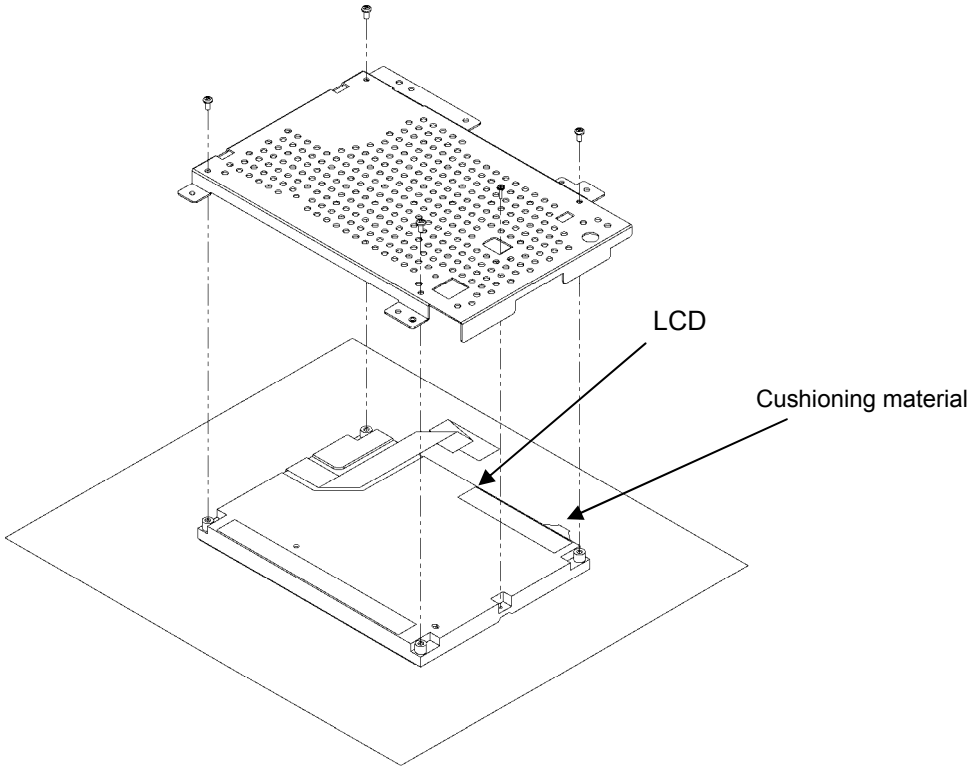
(2) Remove the screw (1 W SEMS (L) M3 × 8) and remove the Flexield sheet.
Remove the screws (2 Plax pan head 2.6 × 8), four cables (LCD cable, MAIN-LCD cable, touch panel cable, inverter cable) and the LCDTPIF board.



(3) Remove the screws (2 W SEMS (L) M3 × 8) and the inverter board shield plate.
Remove the screws (2 Plax pan head 2.6 × 8), disconnect the two cables that connect the inverter to the LCD and remove the inverter.
Remove the screws (8 W SEMS (L) M3 × 8) and the right (R) and left (L) LCD reinforcing plates.
Finally, remove the screws (2 W SEMS (S) M3 × 8) on top of the LCD and remove the LCD.



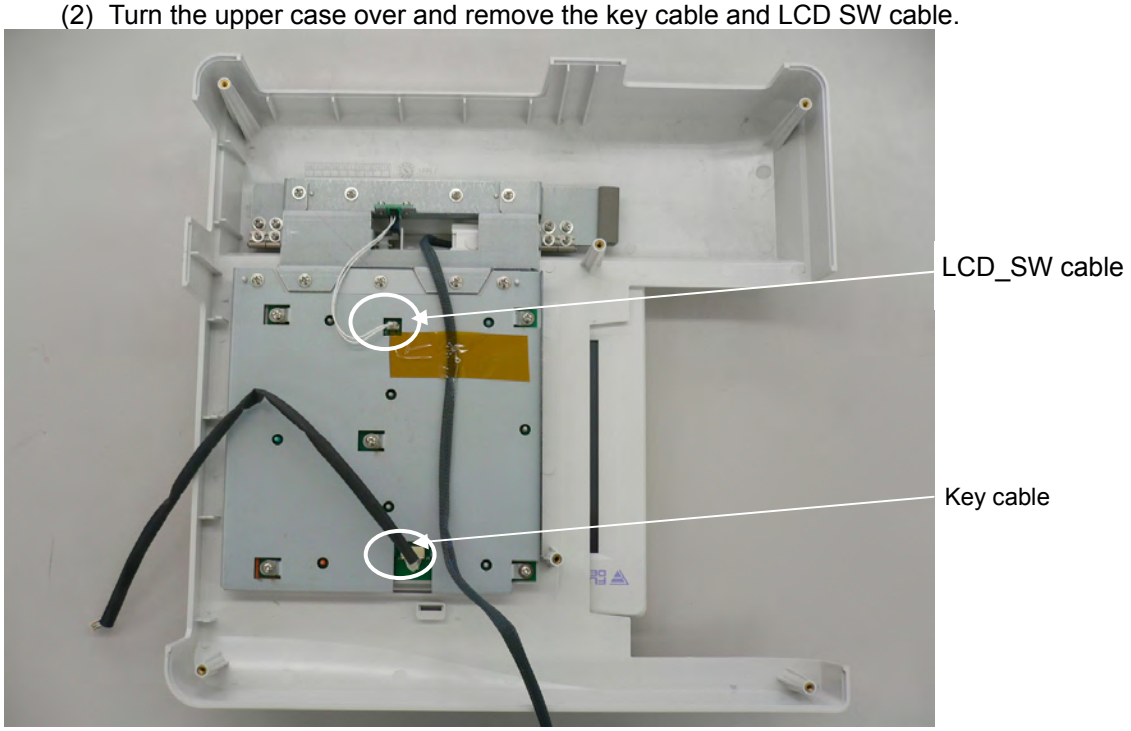
(4) Remove the screws (4 Plax pan head 3 × 6, 1 W SEMS (S) M2 × 8), the LCD cable and the LCD. Place cushioning material on the touch panel to prevent damage.



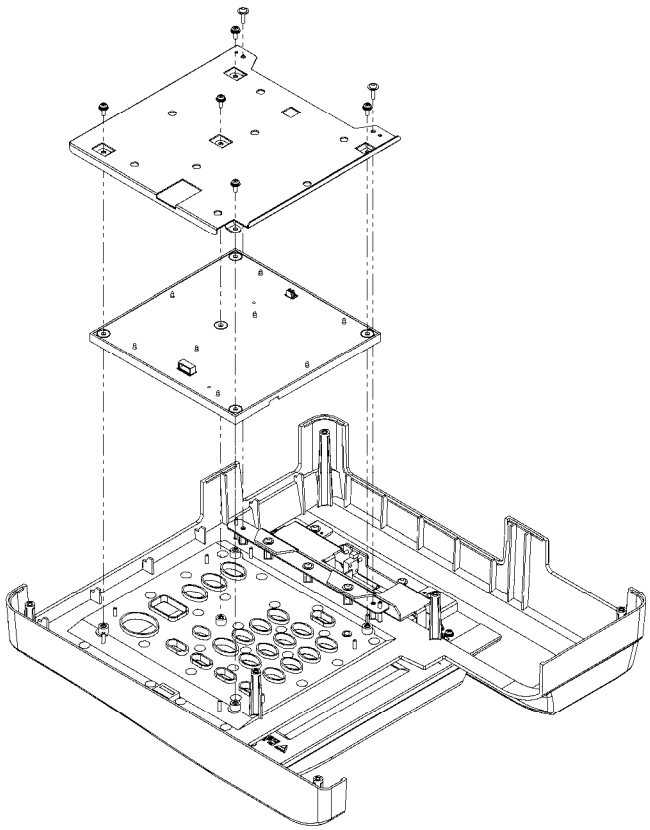
8.1.6 Removing the Keyboard

(1) Remove the upper case.

(2) Turn the upper case over and remove the key cable and LCD SW cable.



(3) Remove the screws (2 P tight pan head WH3 × 12, 5 W SEMS (L) 3 × 8) and the keyboard.

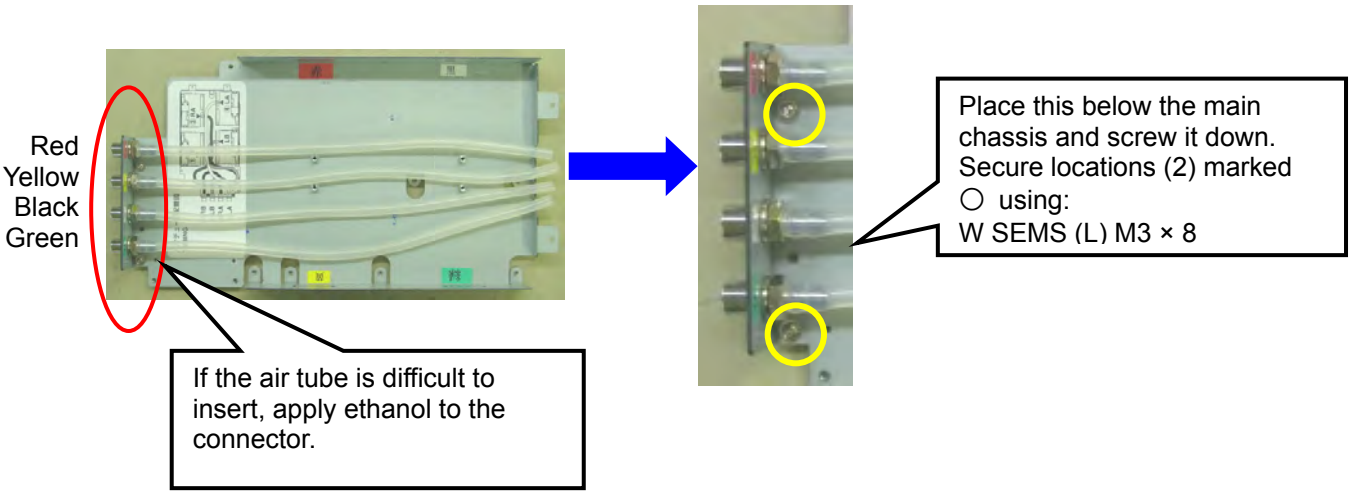


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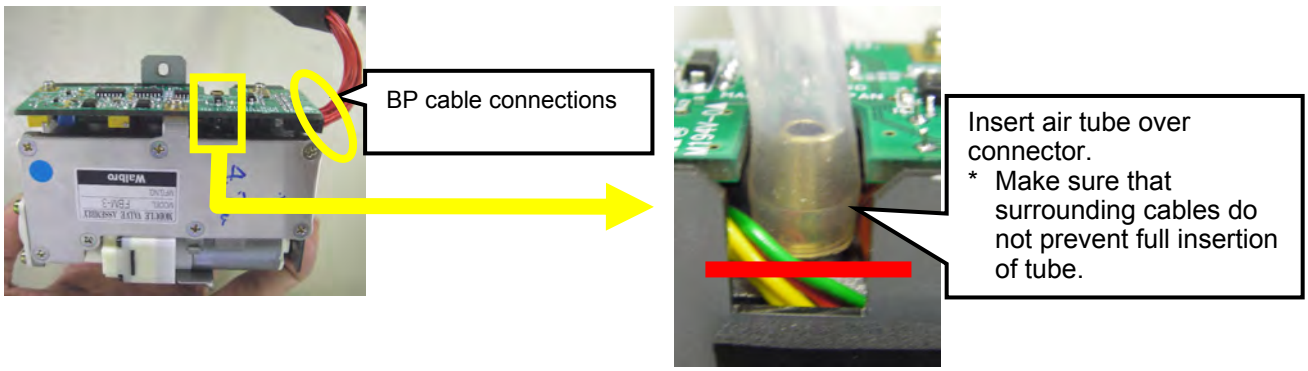
8.2 Instrument Assembly

8.2.1 Main Block Assembly

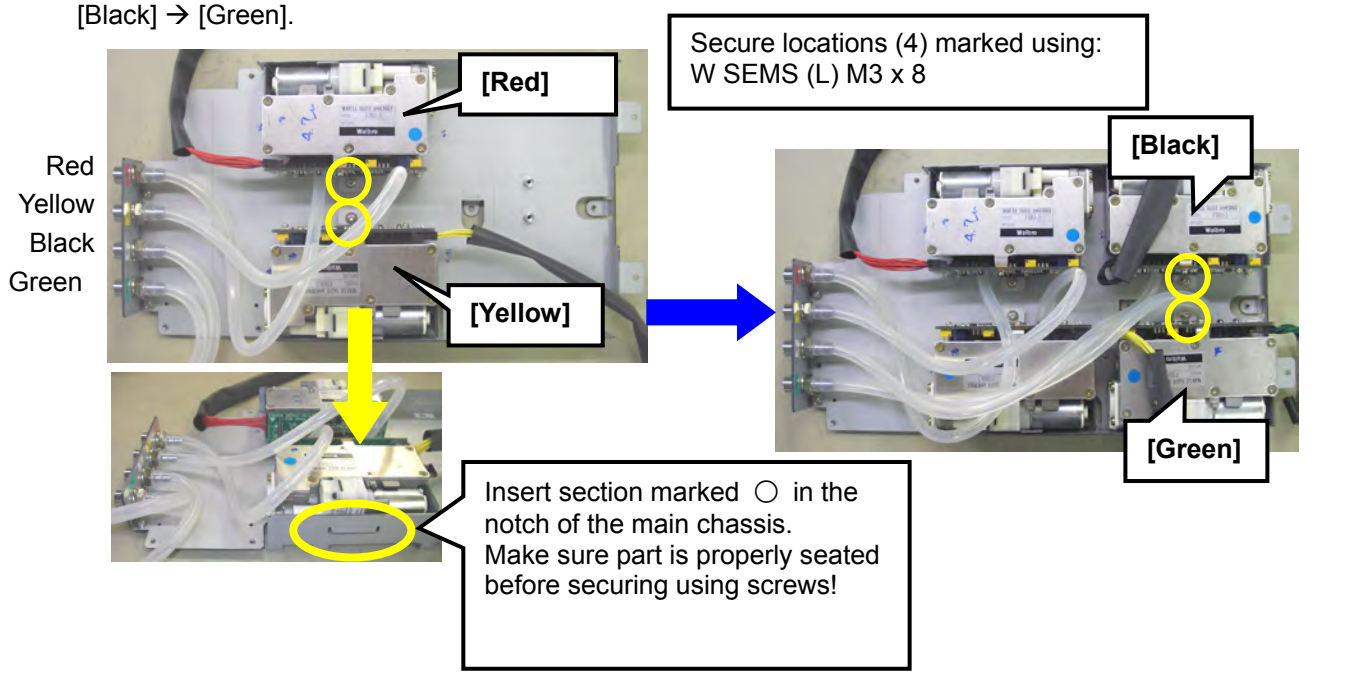
(1) Insert the air tube in the connector to assemble the main chassis SU.



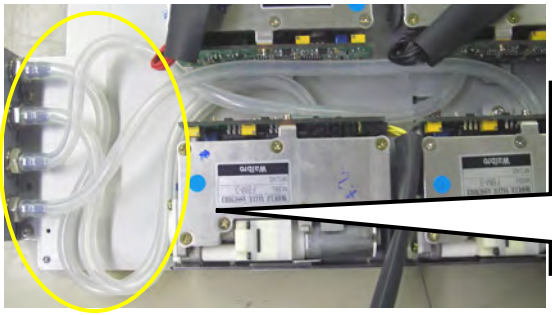
(2) Connect the BP cable and air tube to the pump block assembly.



(3) Mount the pump block assembly parts on the main chassis SU in the following order: [Red] → [Yellow] → [Black] → [Green].

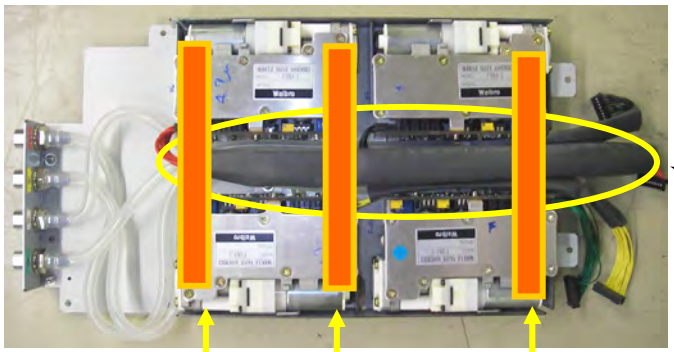


(4) Route the air tubes and the BP cable.



Route air tubes so that excess tubing is contained in area marked ○.

*The tube must not be bent.



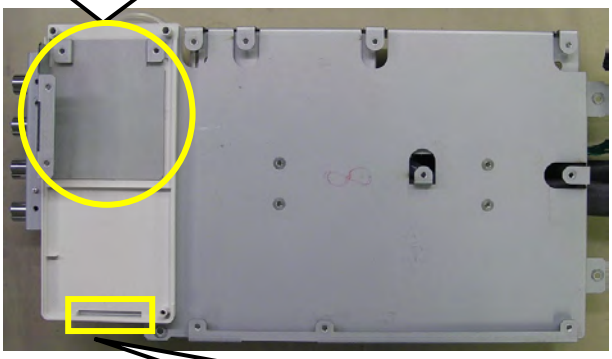
The BP cable must be contained inside the pump unit.

Use acetate tape (L=120) to secure cables and tubes in place.
* Make sure that cables and tubes do not obstruct pump unit labels.

Important!!
1) Tubes must be oriented away from the pump unit.
2) Tubes must not be bent (kinked.)

(5) Turn the main block upside down, to install the lower ECG amplifier cover and the ECG amplifier shield plate (lower).

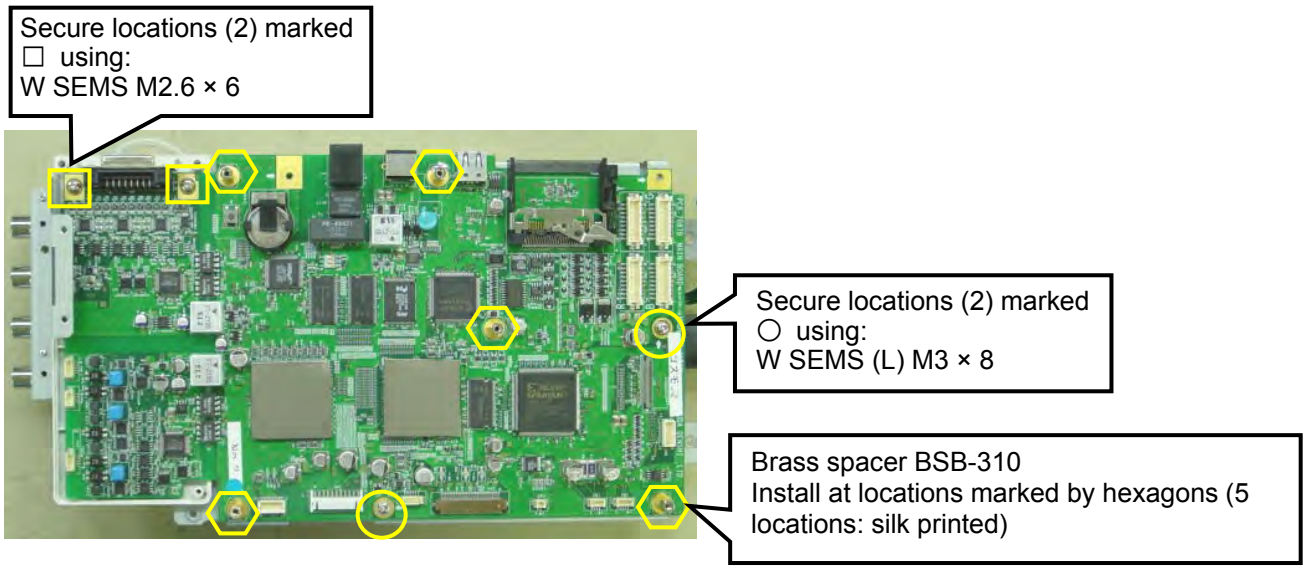
Place the ECG amplifier shield plate (lower) here.



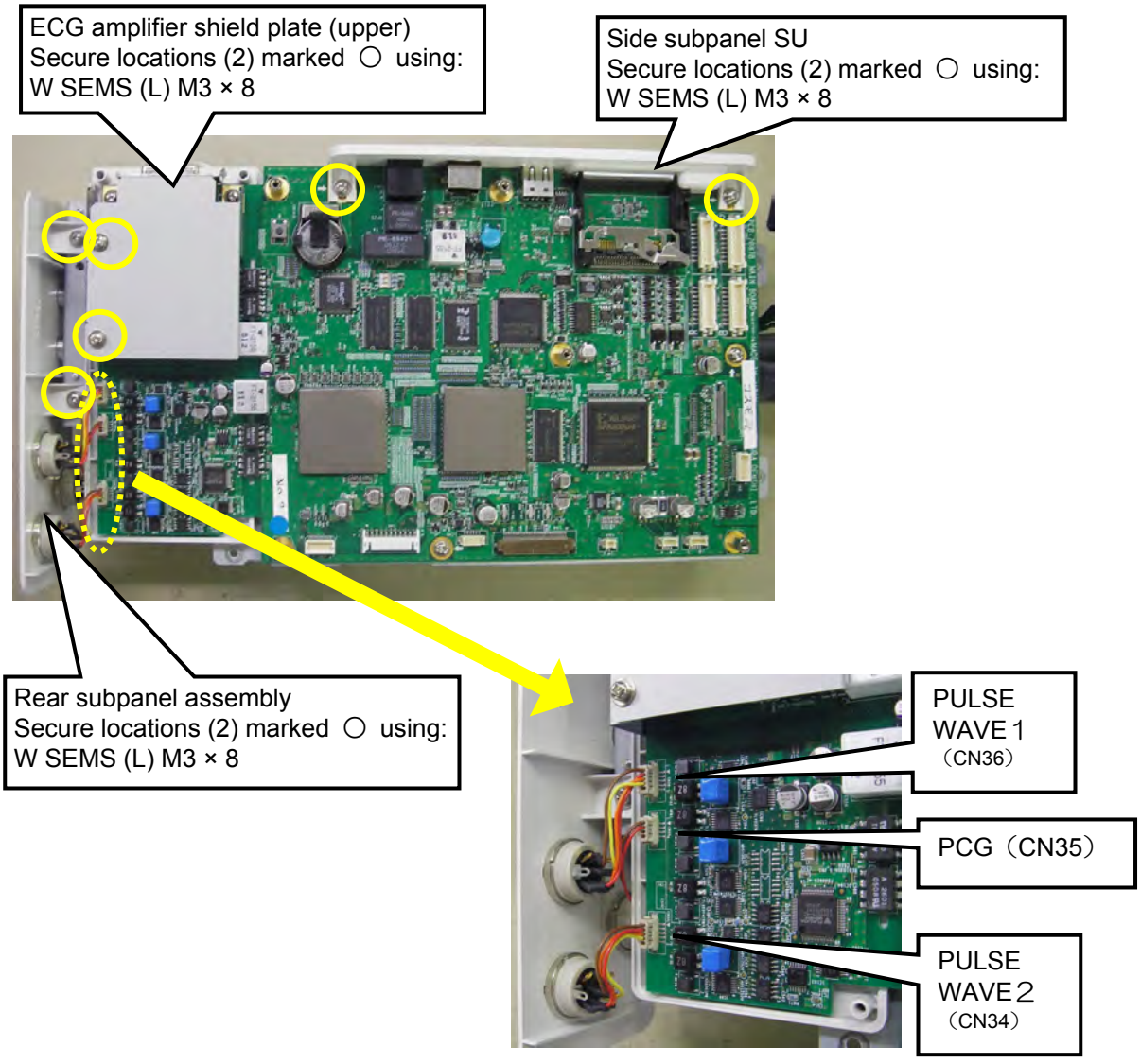
Fit the claw in the lower ECG amplifier cover.

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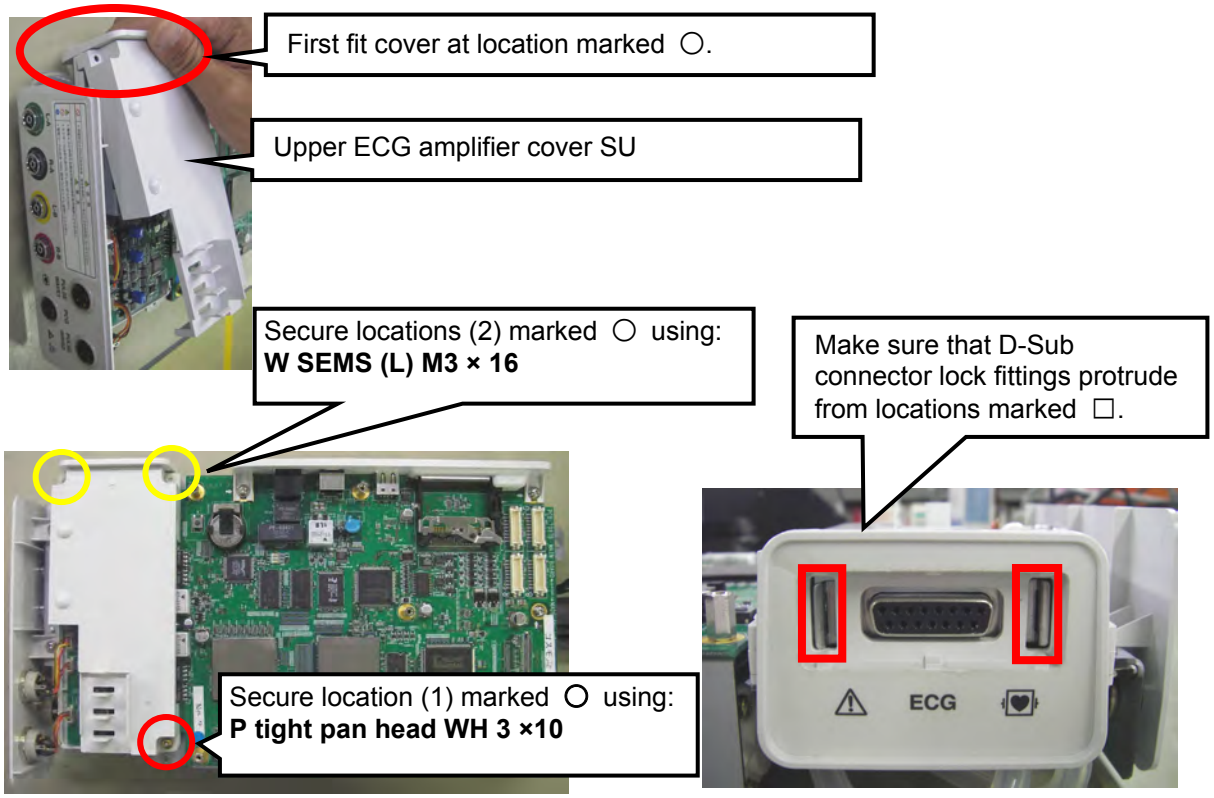
(6) Screw down the main board.



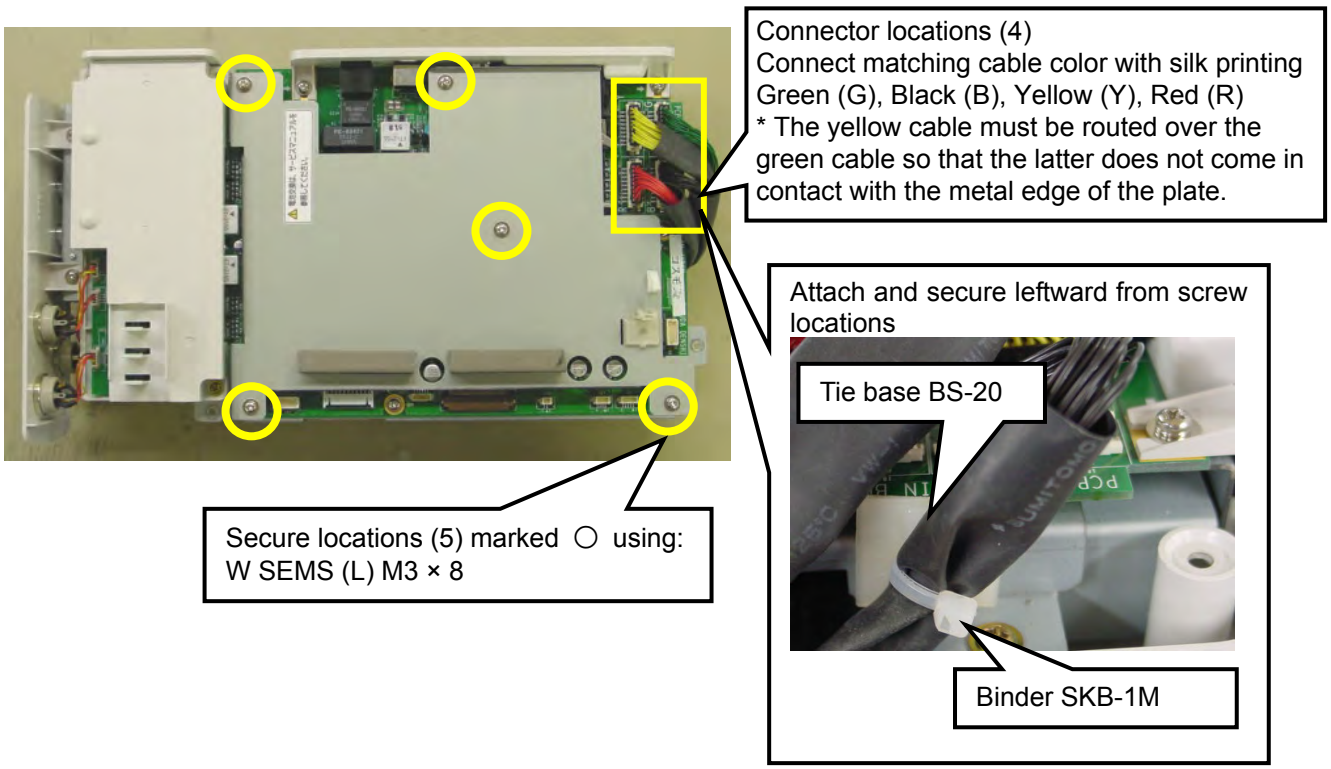
(7) Attach the ECG amplifier shield plate (upper), side subpanel SU and rear subpanel.
Connect the cables from the rear panel to the connector.



(8) Screw down the upper ECG amplifier cover SU.



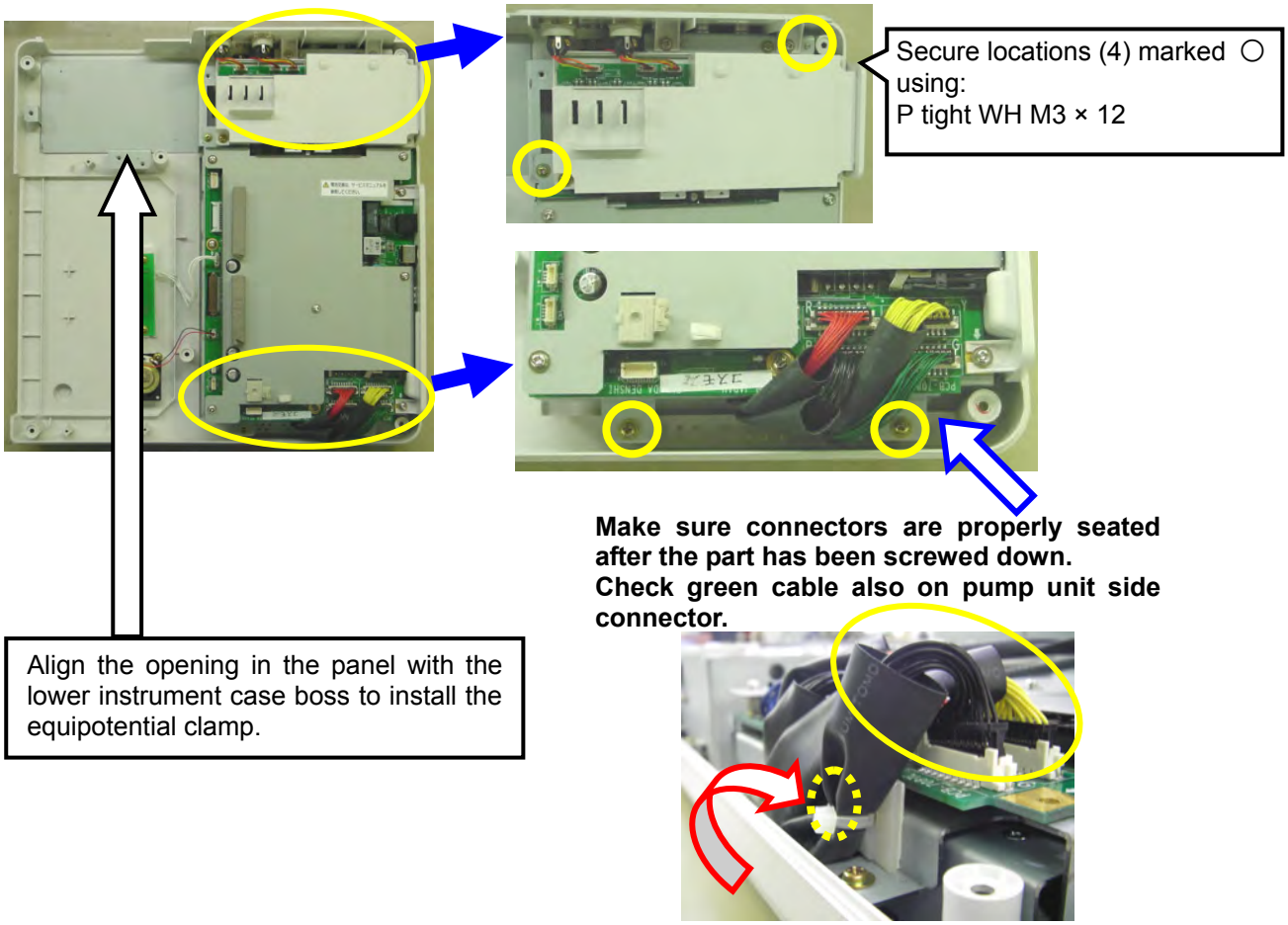
(9) Attach the center shield plate and connect the BP cable.



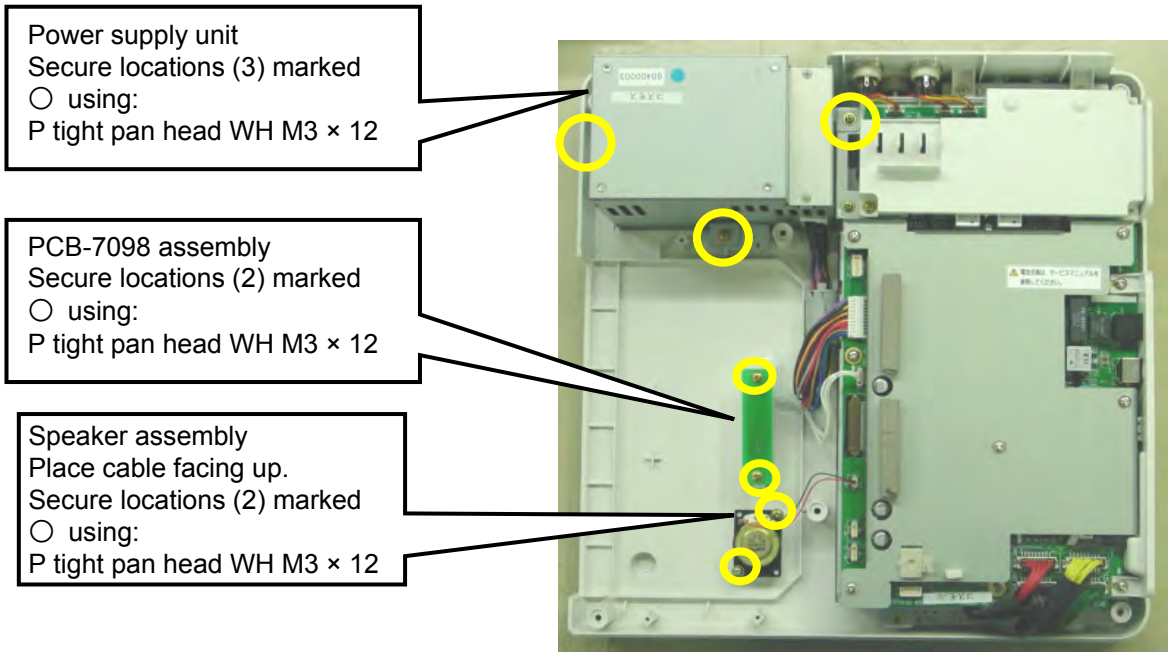
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8.2.2 Lower Case Assembly Drawing

(1) Place the equipotential clamp in the lower instrument case and secure the main block using screws.

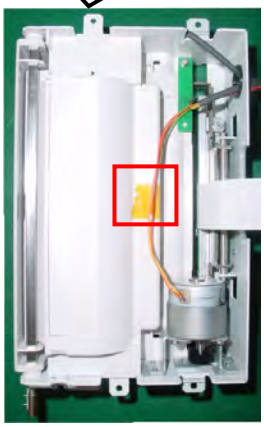


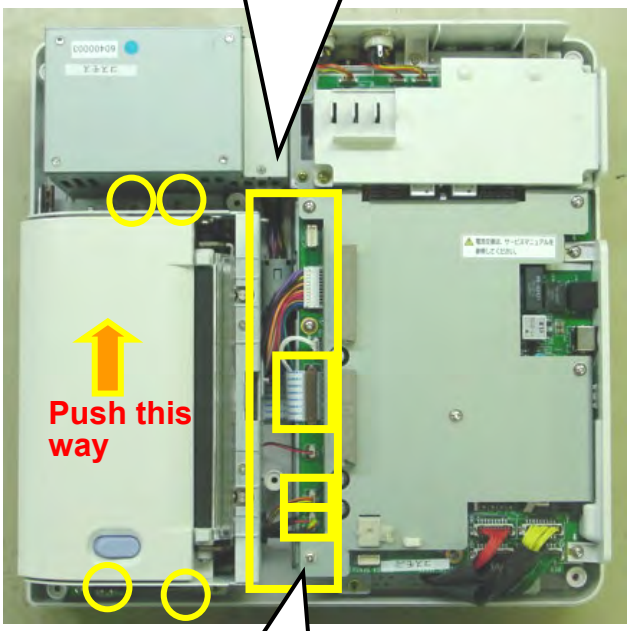
(2) Secure the power supply unit, PCB-7098 assembly and speaker assembly using screws and connect the connectors.



(3) Screw down the recorder unit.

145mm recorder assembly
Secure locations (4) marked ○ using:
P tight pan head WH M3 × 12
* Be sure to secure the motor cable on the rear using adhesive tape.





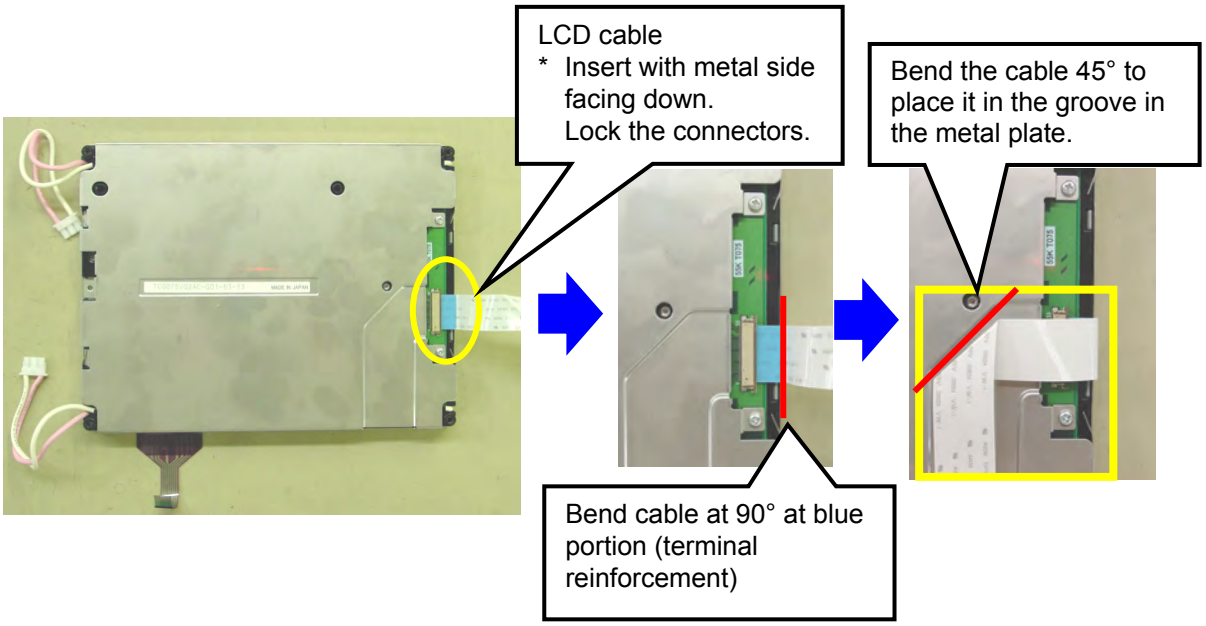
* Be sure not to pinch cables in this area when mounting the recorder assembly.

*Connector connections (3)
・Thermal head cable
・Motor cable
・Mark sensor cable
* Be sure to securely lock the thermal head cable in the connector.

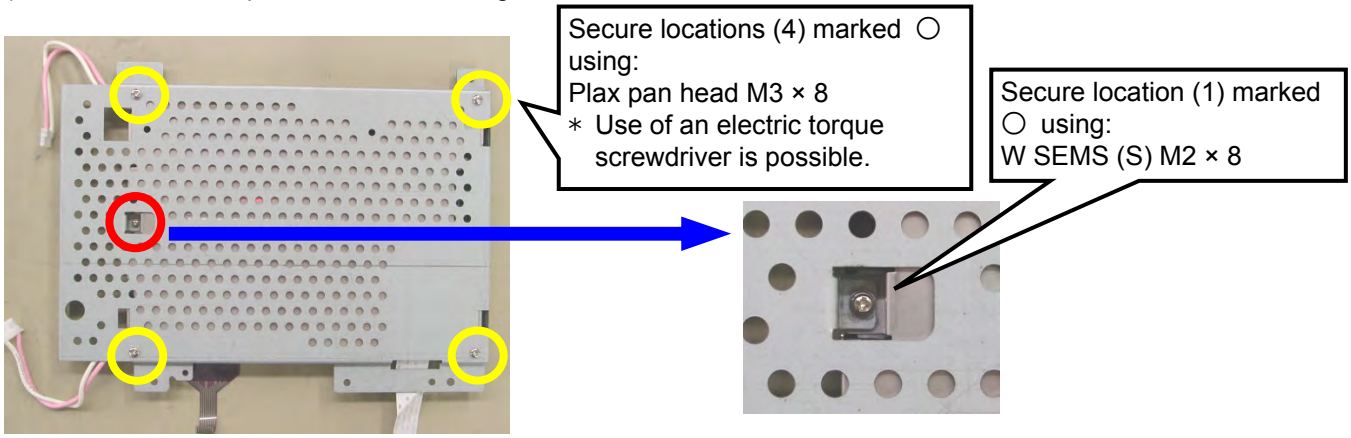
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8.2.3 LCD Unit (Rear) Assembly Drawing

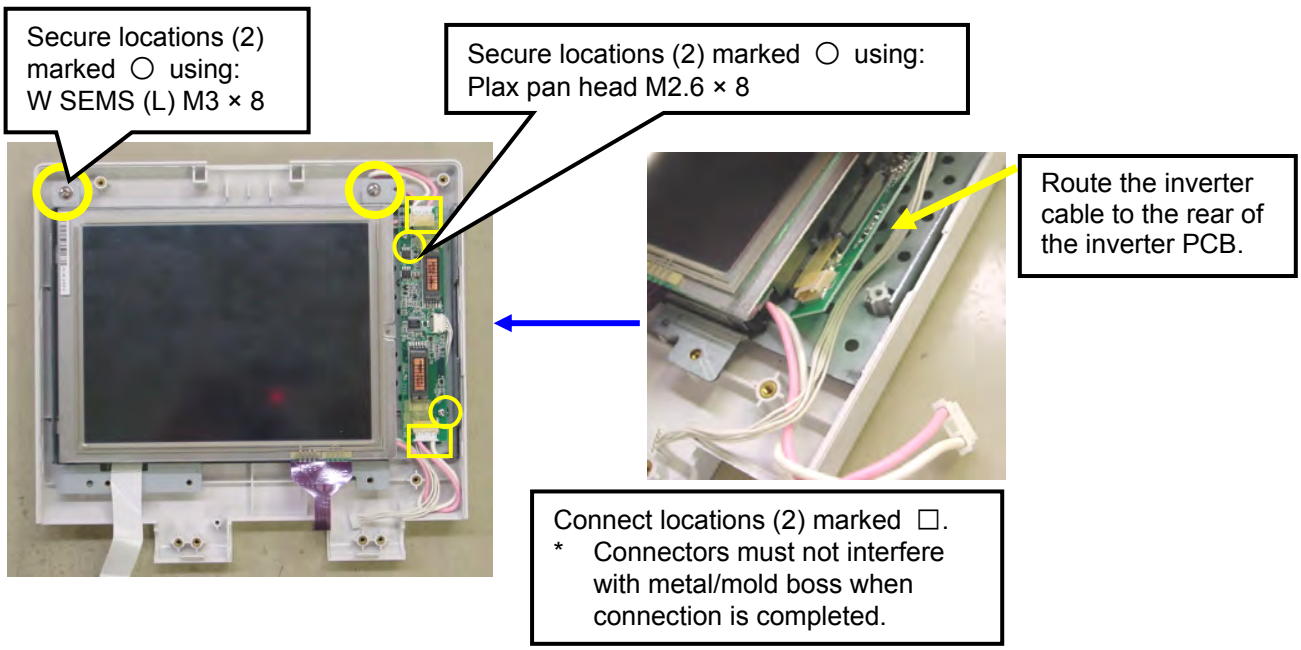
(1) Connect the LCD cable to the LCD unit.



(2) Secure the shield plate to the LCD using screws.

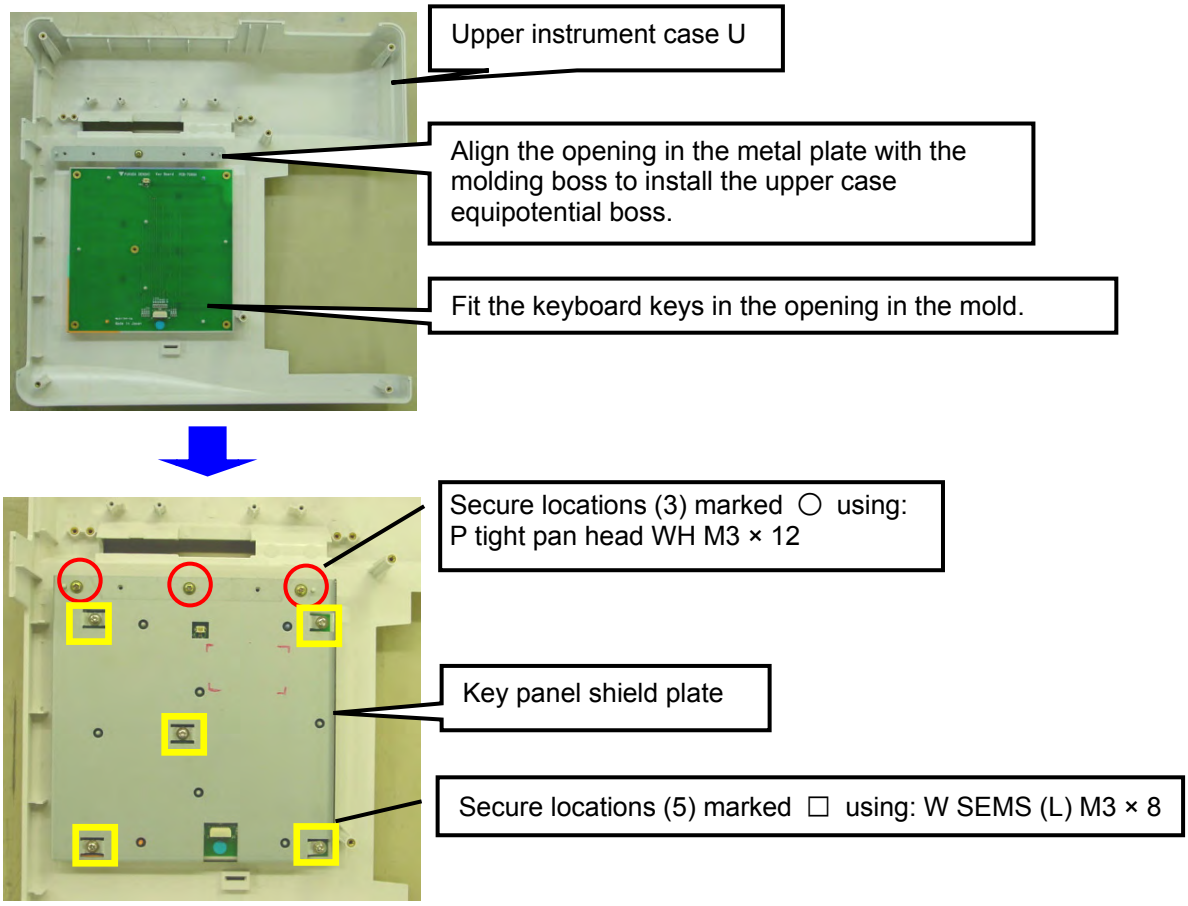


(3) Secure the LCD unit to the rear LCD cover U and the inverter using screws and connect the cables.

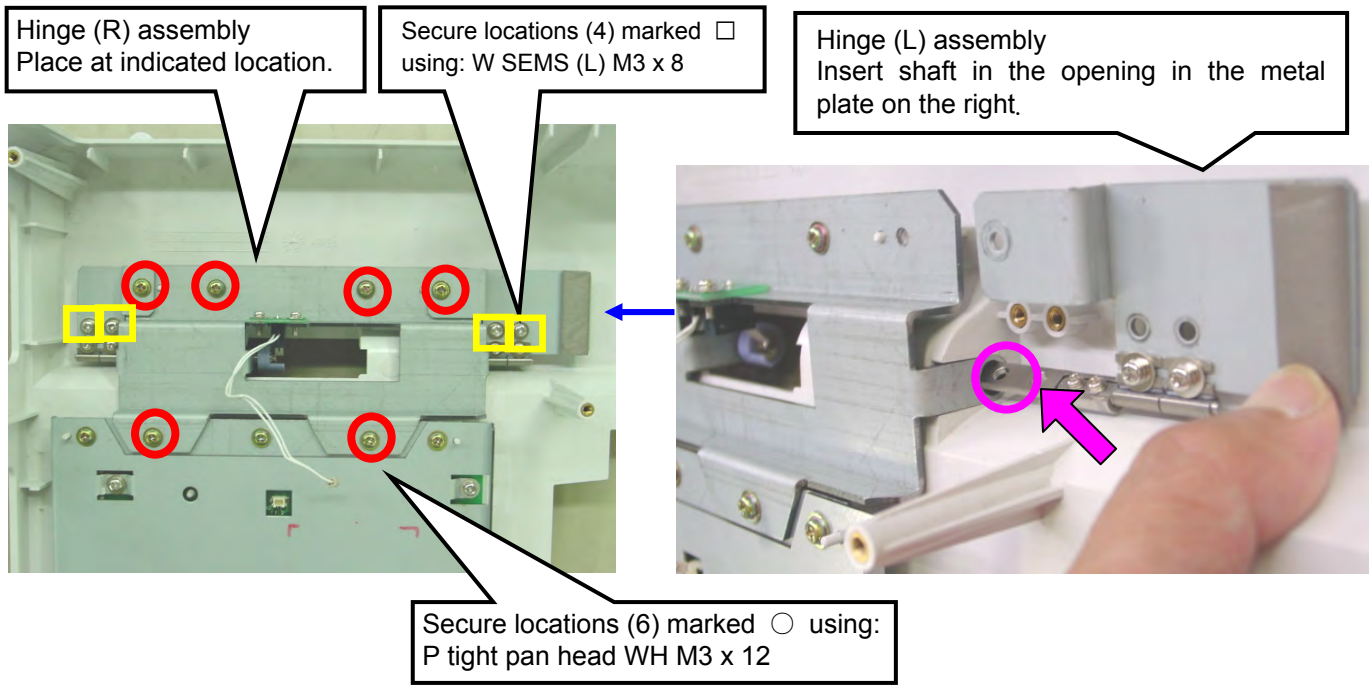


8.2.4 Upper Case Assembly Drawing

(1) Secure the keyboard and key panel shield plate to the upper instrument case using screws.

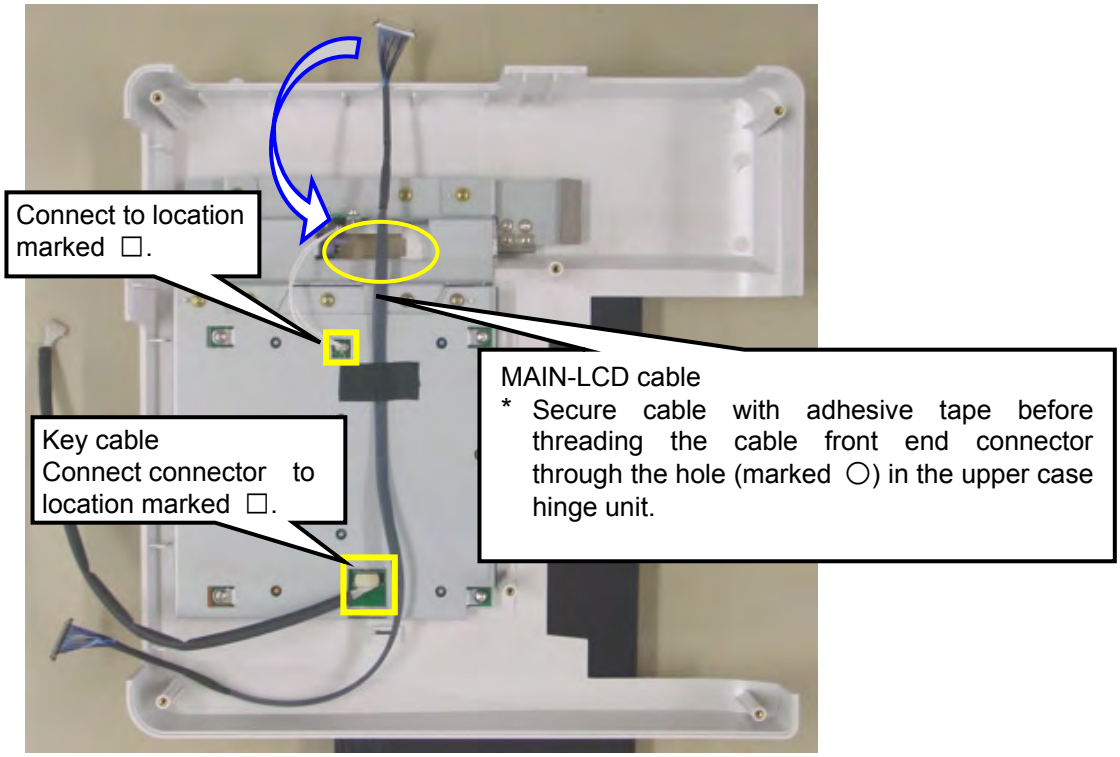


(2) Install hinges (L) and (R) and secure them using screws.

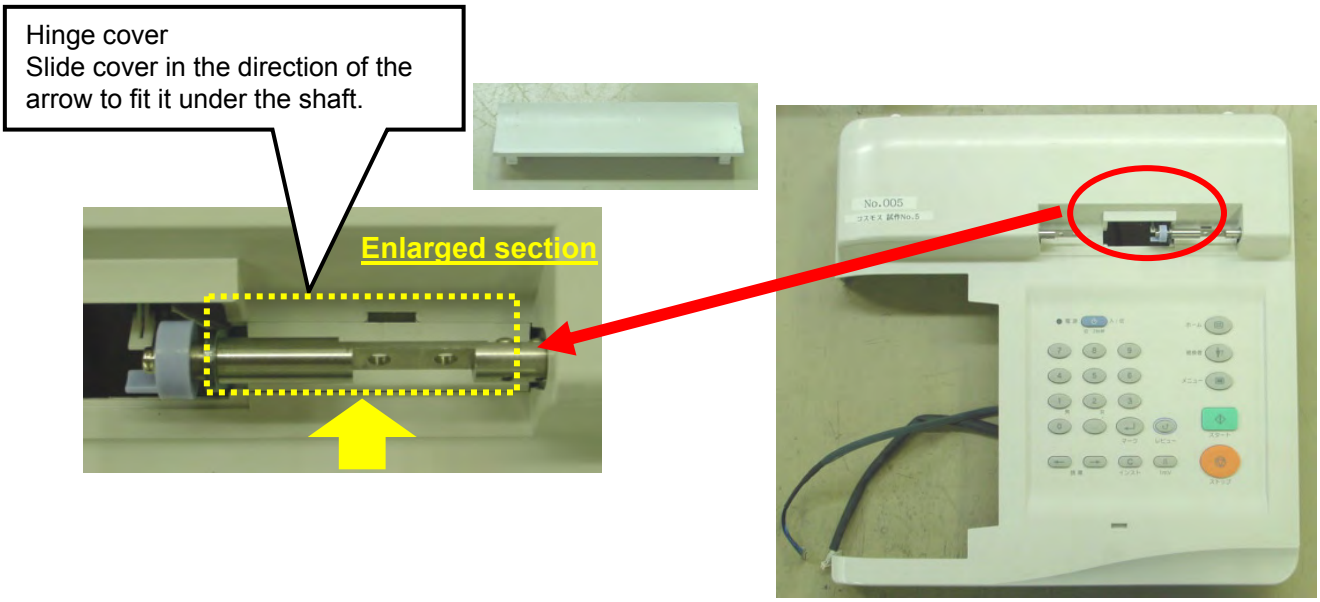


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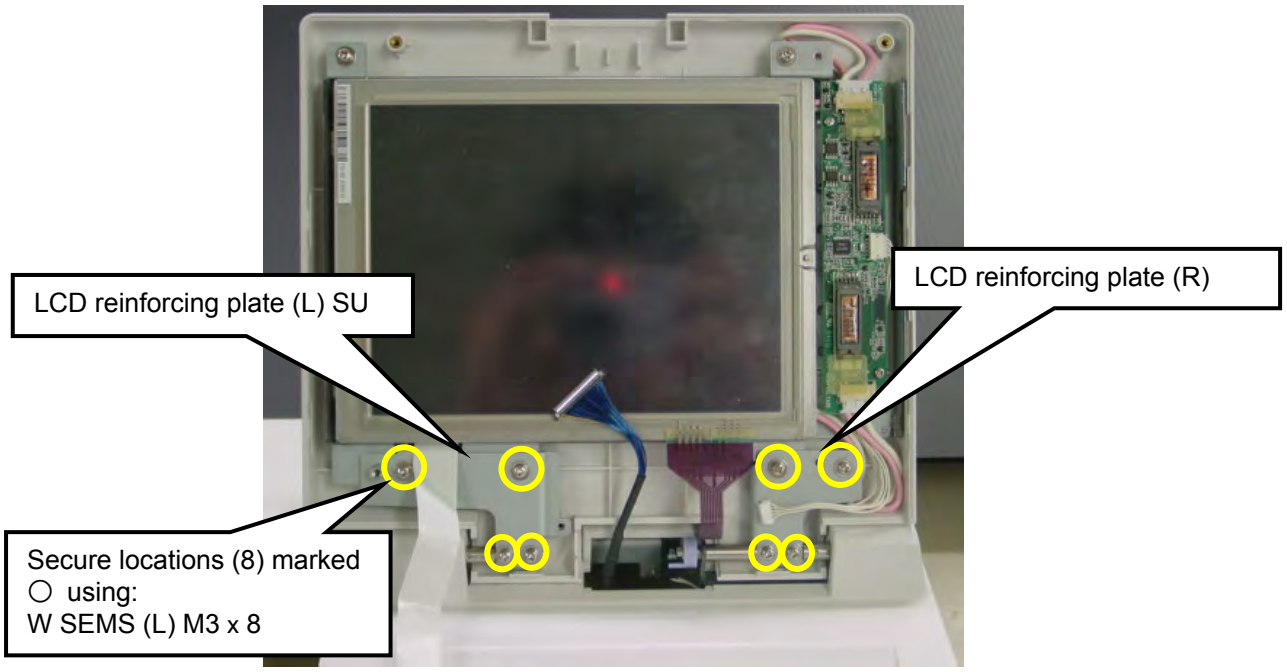
(3) Install the MAIN-LCD cable, key cable and LCD_SW cable.



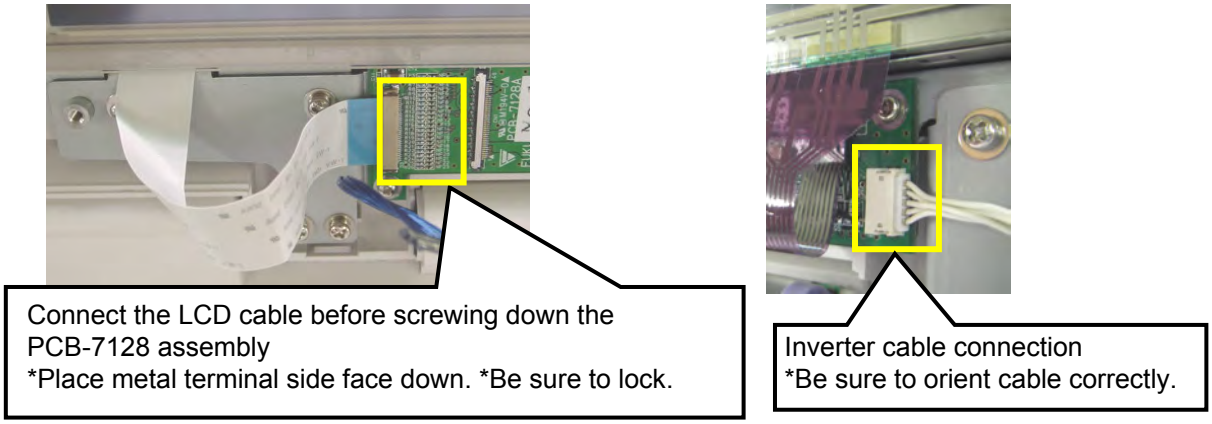
(4) Install the hinge cover.



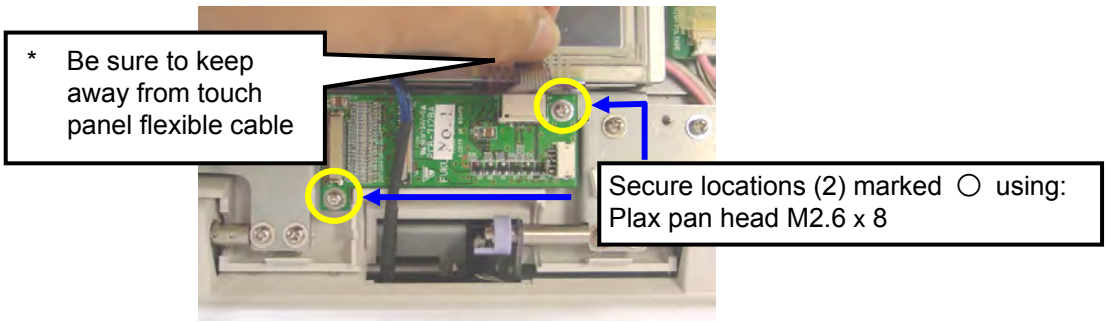
(5) Install the CD block in the upper case and attach the LCD reinforcing plates (L) and (R) using screws.



(6) Connect the LCD and inverter cables before screwing down the LCDTPIF Board (PCB-7128 assembly).

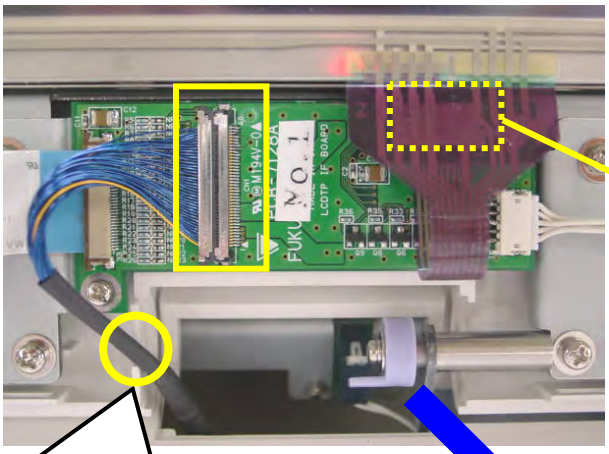


(7) Screw down the LCDTPIF Board (PCB-7128 assembly).

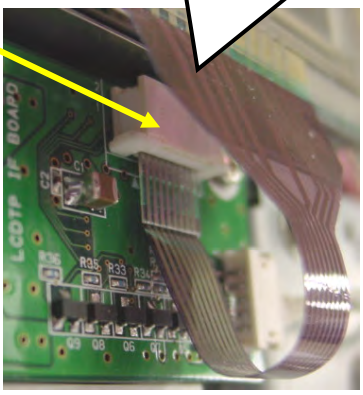


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(8) Install the MAIN_LCD cable, touch panel flexible cable and cable cover.

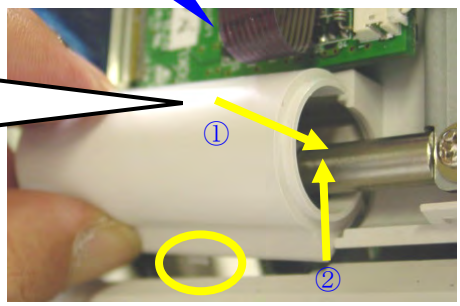


Connect touch panel cable connector.
***Be sure to lock.**

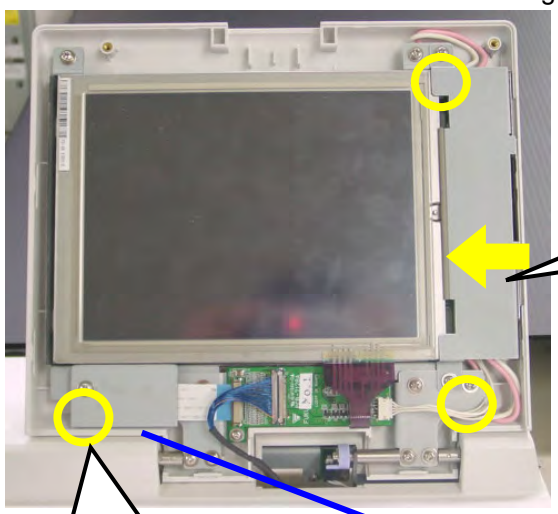


Connect MAIN-LCD cable connector.
Connect so that pin 1 is located at the bottom (gold cable)
* **Route the cable in the groove of the molding (marked ○).**

1. Insert the cable cover in the direction of the arrow.
2. Raise the cable cover to engage it with the claw marked ○.



(9) Secure the inverter board and Flexield sheet using screws.



Push in the direction of the arrow to place it inside the LCD shield plate.

Secure locations (2) marked ○ using:
W SEMS (L) M3 x 8

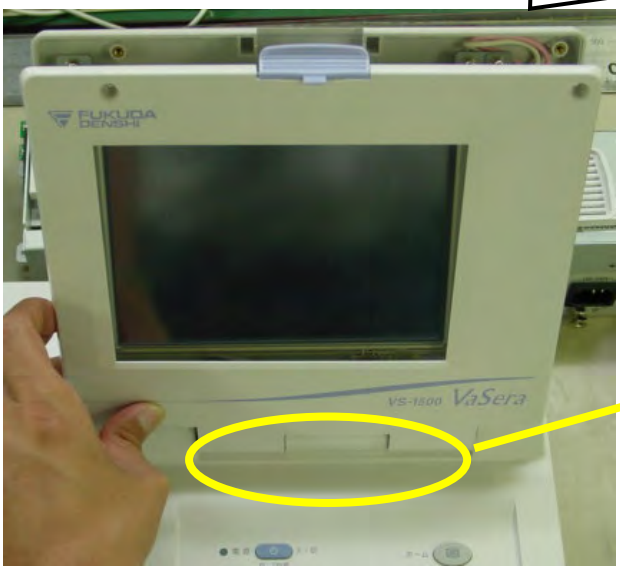
Secure location (1) marked ○ using:
W SEMS (L) M3 x 8



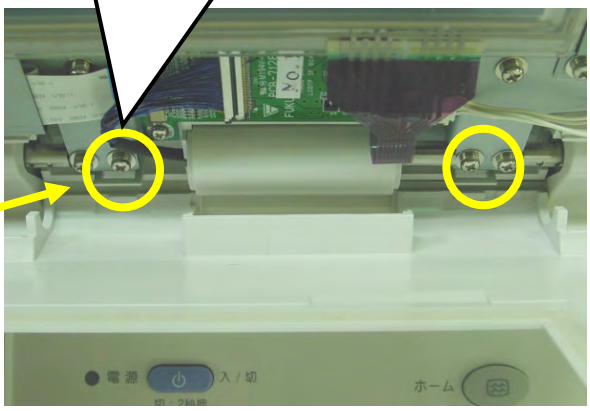
Flexield sheet
* **Fit the L-shaped portion of the plate starting at the bottom to cover the flexible**

(10) Install the front LCD cover, secure it using screws and install the rubber caps.

Front LCD cover assembly
* Engage the claws at the lower end before raising and inserting the top end.



Align the claws (2) marked ○ before fitting the parts together.



Secure locations (2) marked ○ using:
W SEMS (S) M3 x 8 rubber caps

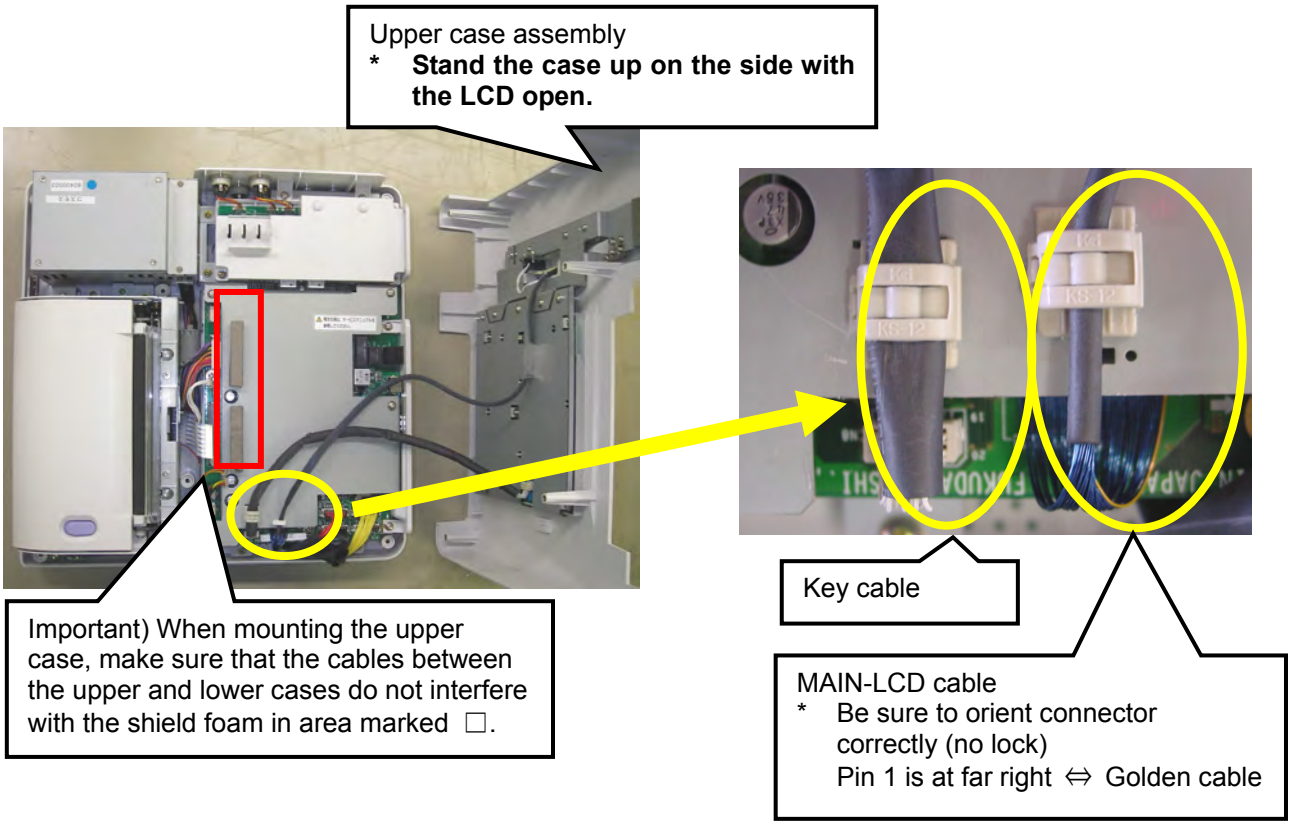


Make sure there is no level difference between locations (2) marked ○.

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8.2.5 General Assembly Drawing

(1) Connect the MAIN_LCD cable and key cable.



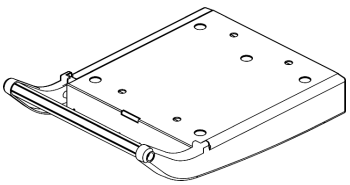
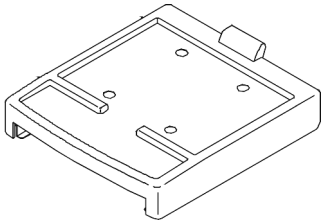
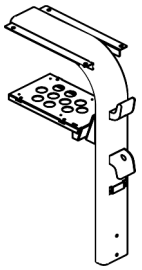
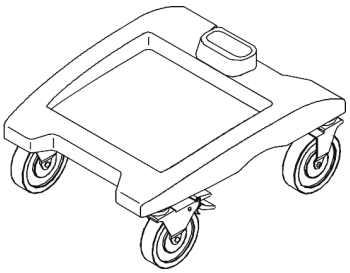
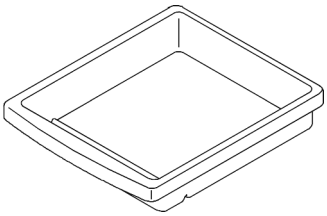
(2) Fit the upper and lower cases together and screw together the cases from the lower case side.



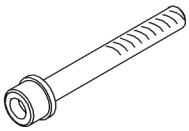
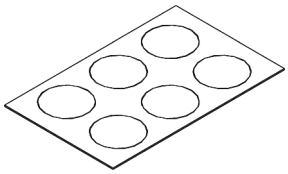
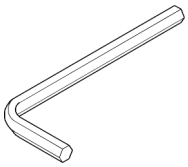
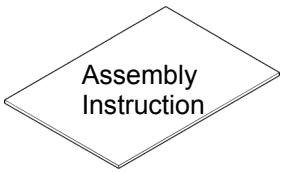
8.3 Assembly of the Trolley OTV-01

The OTV-01 is a trolley to place the VS-1500.

8.3.1 Parts List

(1) Top Plate: 1	(2) Shelf: 1	(3) Column: 1
		
(4) Base: 1	(5) Drawer: 1	
		

【Accessories】

(1) Screw (long): 2	(2) Screw (short): 4	(3) Machine Screw: 4
		
(4) Seal: 1	(5) Hexagon Wrench: 1	(6) Assembly Instruction
		

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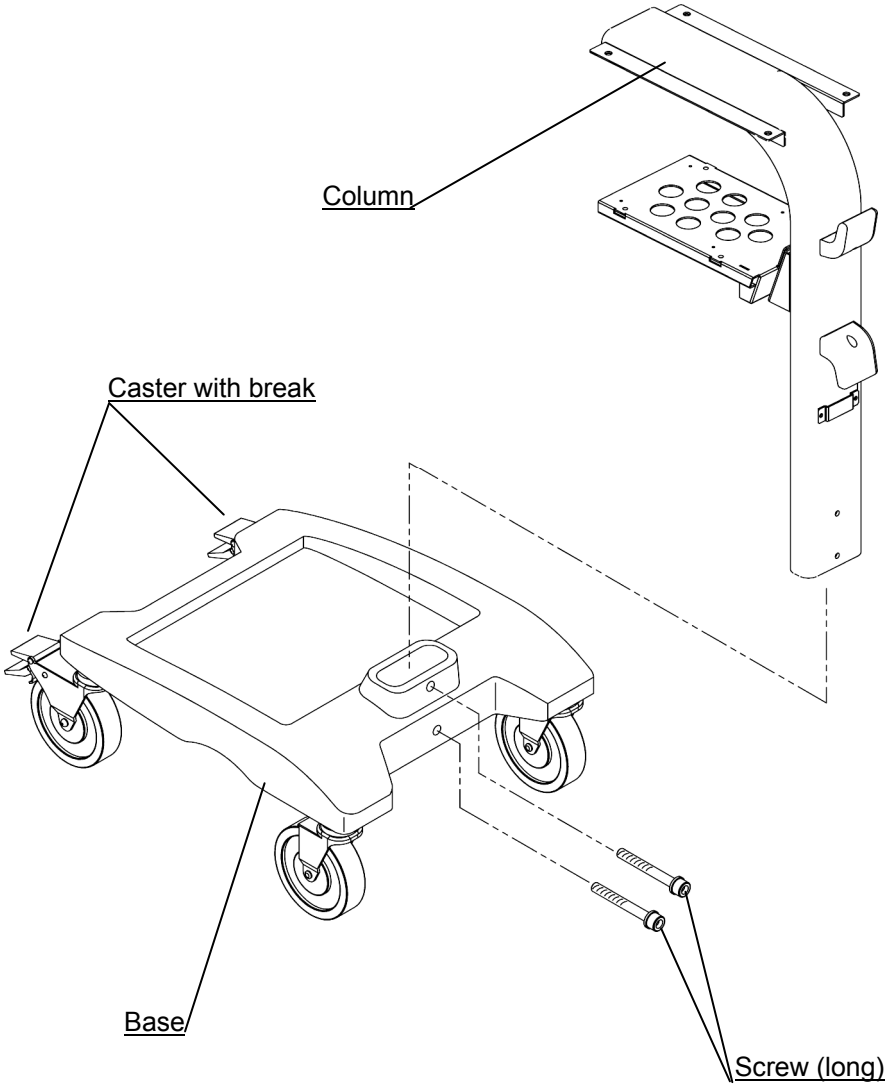
8.3.2 Assembly Procedure

*Prepare a Phillips screwdriver (M3).

⚠ CAUTION
Assemble the trolley on a horizontal surface

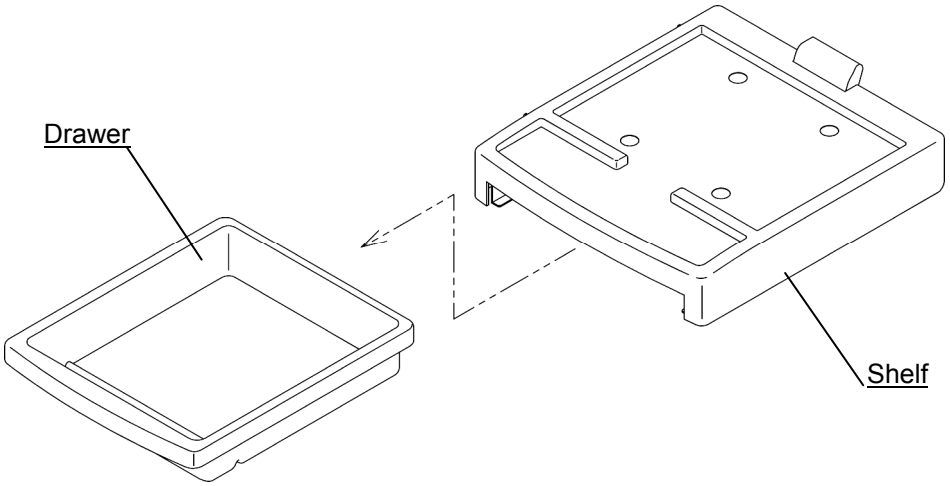
(1) Mount the column to the base.

Insert the column into the base, ensuring proper orientation.
Then fasten the column securely with the 2 screws for assembly (long) using a hexagonal wrench.

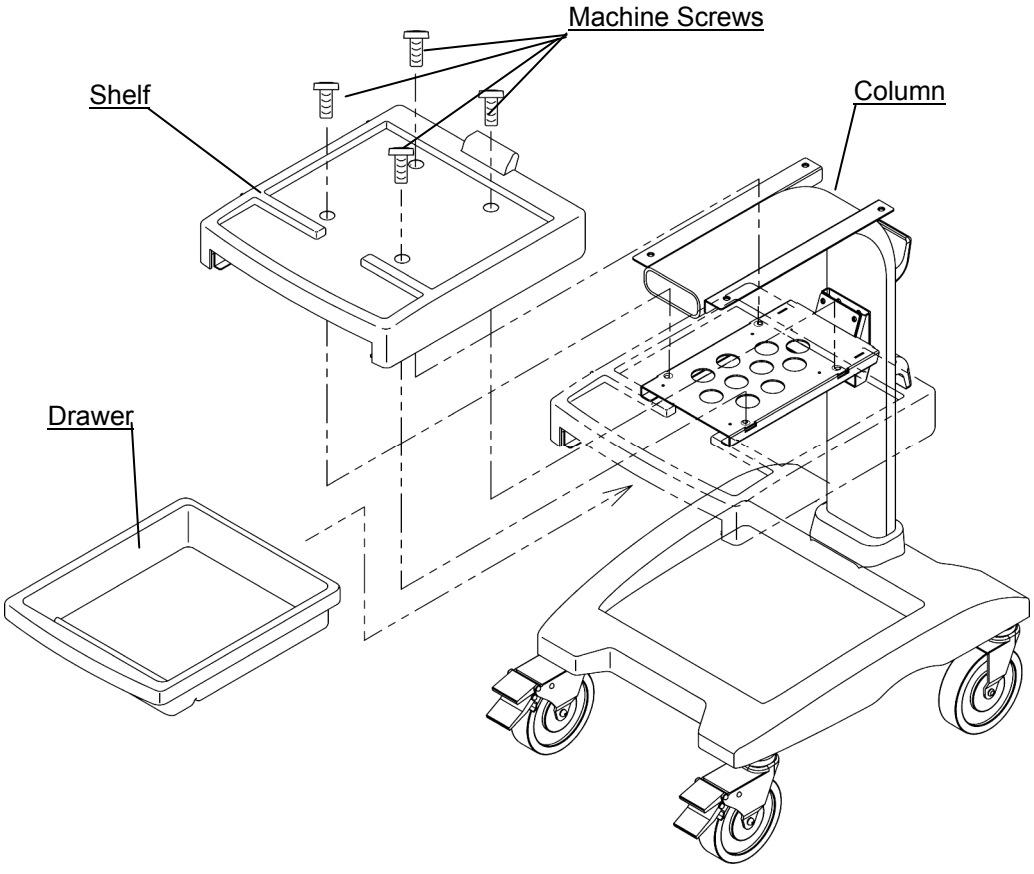


(2) Mount the shelf.

1. Remove the “drawer” stored in the shelf by lifting it up.



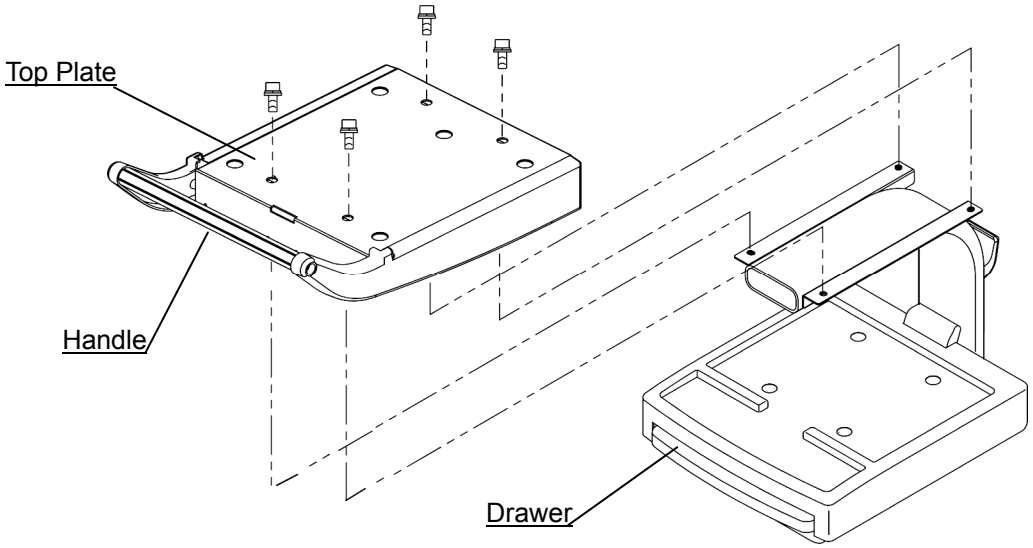
2. Place the shelf on the rack provided in the middle of the column, and fasten it with 4 machine screws. Then attach the “drawer” in position again.



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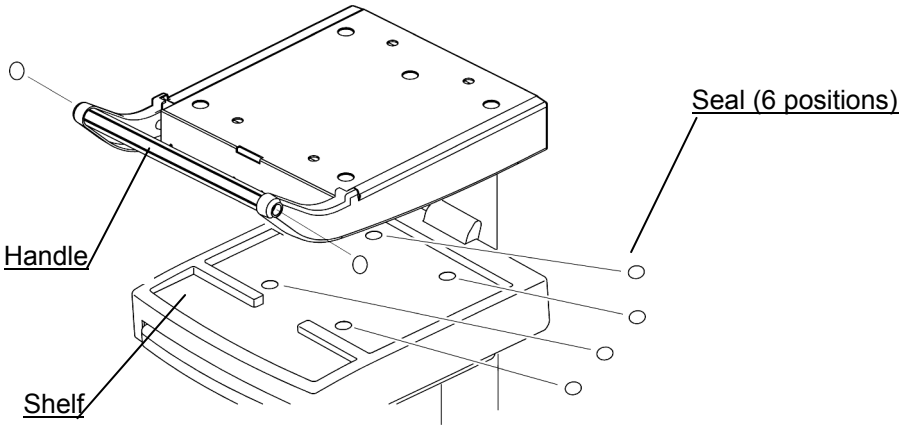
(3) Mount the Top Plate

Place the top plate on the column, aligning the side of the handle with that of the drawer, and fasten it securely with 4 screws (short) using the hexagonal wrench.



(4) Attach the seals.

Check that all the screws are securely fastened, and then cover the screws of the handle and the shelf with the seals.



The assembly is completed.
Check carefully that no parts are missing or redundant.

⚠ CAUTION

- Make sure that the screws are securely tightened after assembly and at periodic inspections.
- Keep the supplied hexagonal wrench.

8.4 Installation of the Cuff Holder OAV-01A

By attaching the OAV-01A to the top plate of the trolley (OTV-01), the cuffs for the VS-1500 can be stored.

8.4.1 Parts List

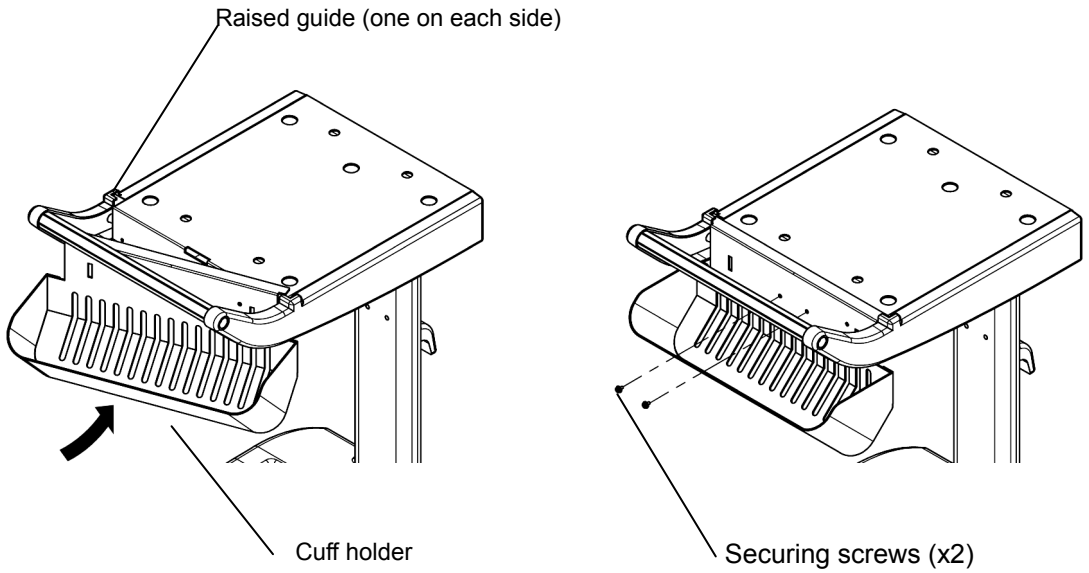
Name	Q'ty	Function
Cuff Holder	1	Stores the cuffs used with the Vasera Series
Securing Screws	2	Screws for securing the holder to the trolley top.

8.4.2 Installation Procedure

*The following procedure requires a Phillips screwdriver (M3).

(1) As shown in the figure below, hold the cuff holder at an oblique angle relative to the lower front end (the side with the raised guides) of the trolley plate. Engage one end of the holder with the raised guide on one side then engage the guide on the other side.

(2) Use the screws to firmly secure the center portion of the cuff holder.



⚠ CAUTION

- Do not use this holder for items other than BP cuffs.
- Do not lean against the cuff holder or place heavy objects on it. The holder could become deformed or damaged.
- Do not attach the holder in a location other than specified.

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8.5 Installation of the Printer Shelf OAV-03A

The OAV02A is a printer shelf to install the printer on the OTV-01 trolley.

8.5.1 Parts List

Name	Q'ty	Function
Printer Shelf	1	
Cable Guide Pin	10	To secure cables and wires
Securing Screws	4	To attach the shelf to the trolley

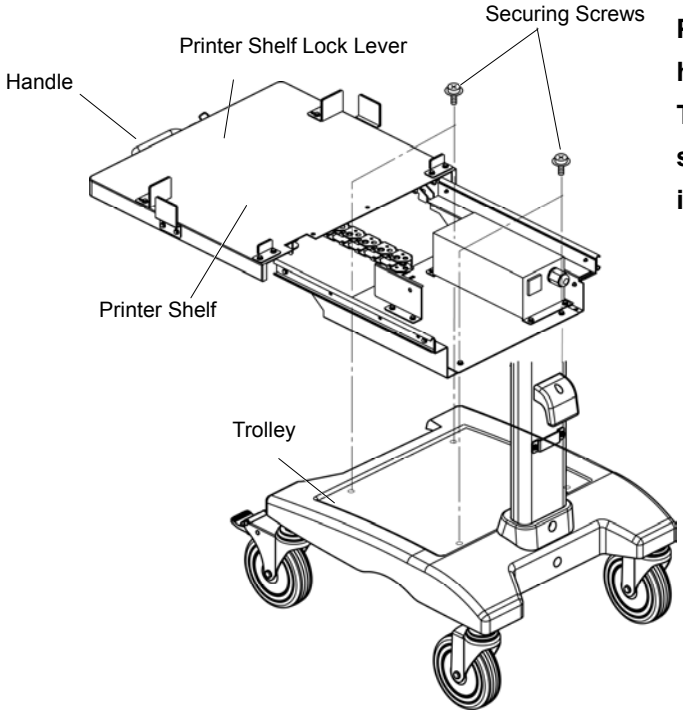
8.5.2 Installation Procedure

*The following procedure requires a Phillips screwdriver (M4, M5).

⚠ CAUTION

- **Place the trolley on a level surface and make sure to lock both casters.**

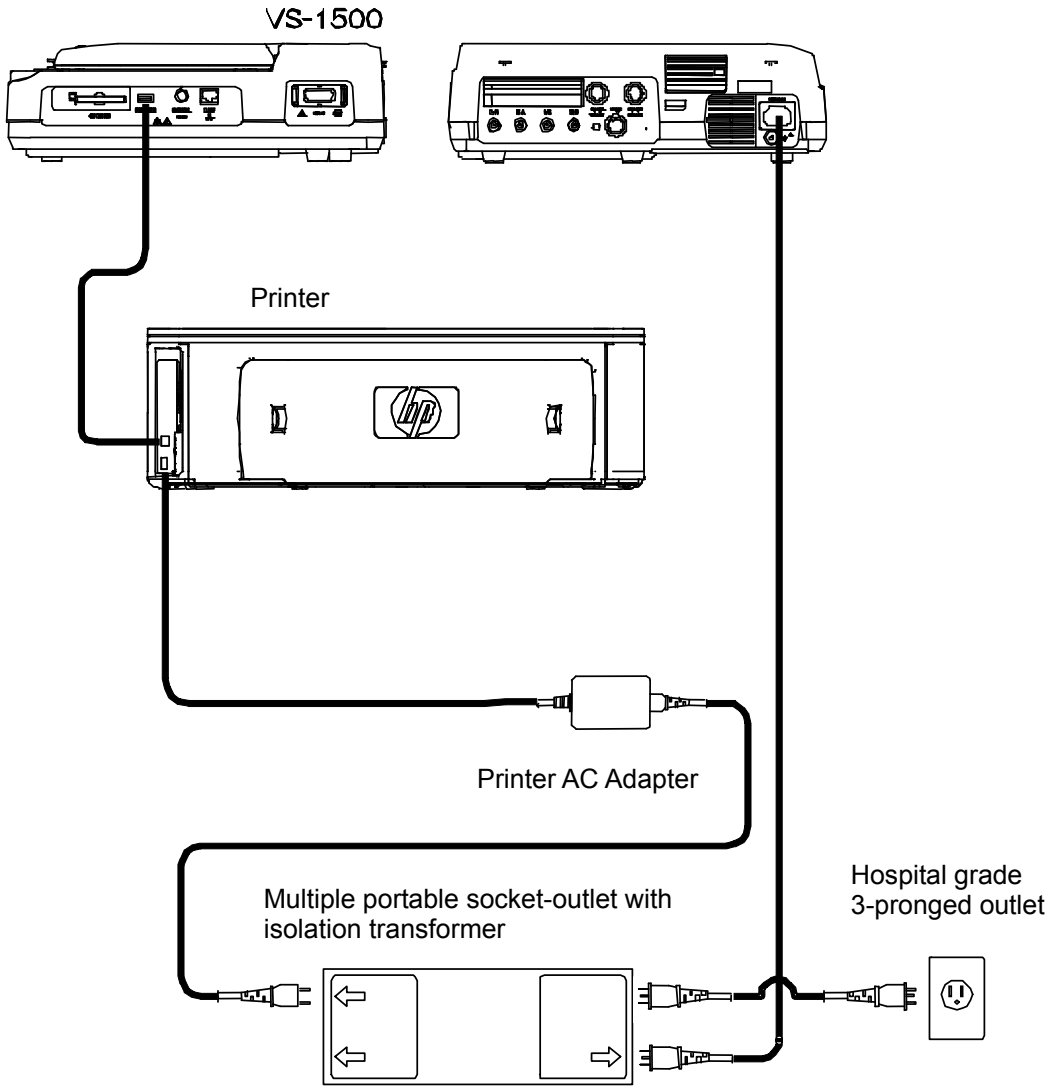
(1) Installing the Printer Shelf



Press the lock lever located beside the handle and pull out the printer shelf. Then secure the shelf with the four screws on the trolley while supporting it. (See diagram for position.)

(2) Wiring Diagram

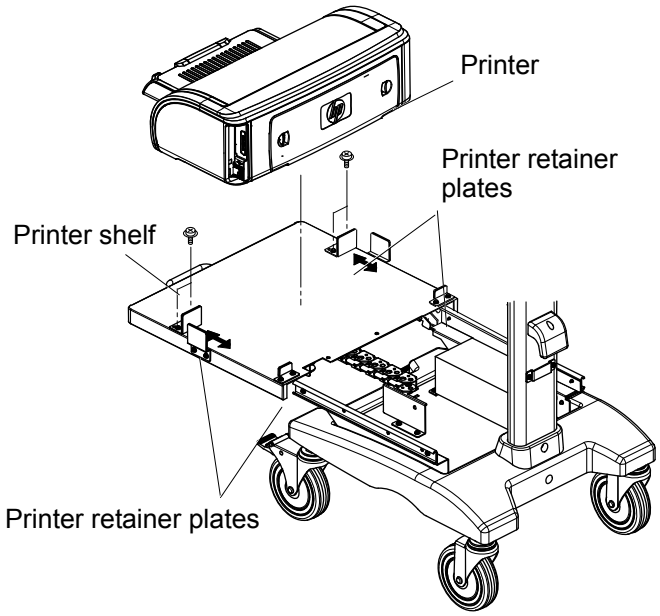
Refer to the following wiring diagram to connect the equipments.



⚠ WARNING	
	● Do not connect unspecified medical equipment. ● Do not connect unspecified printer. ● Do not use unspecified cables.
	● Use the accompanying 3-pronged power cable to connect to the medical equipment.

(3) Installing the Printer

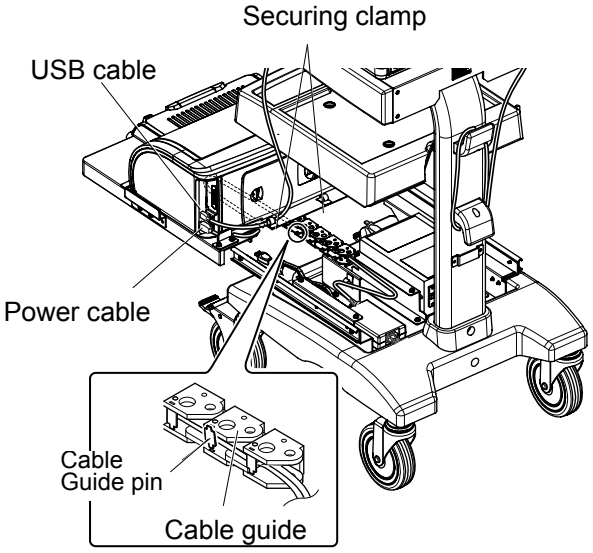
1. Place the printer.



Place the printer in its assigned location on the printer shelf.

[Note] Place the printer between the four printer retainer plates on the printer shelf. Loosen the screws in the retainer plates to adjust them so that the printer is firmly held in place.

2. Connect the cables to the printer and route them as necessary.

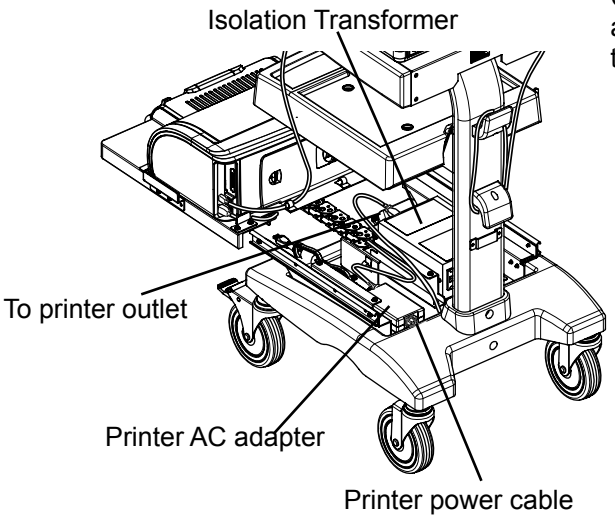


Connect the power cable and the USB cable to the printer.

Place the printer AC adapter in its assigned location on the printer shelf. Route the power cable and the USB cable through the securing clamps and the cable guide below the printer shelf. Then secure them using the cable guide pins.

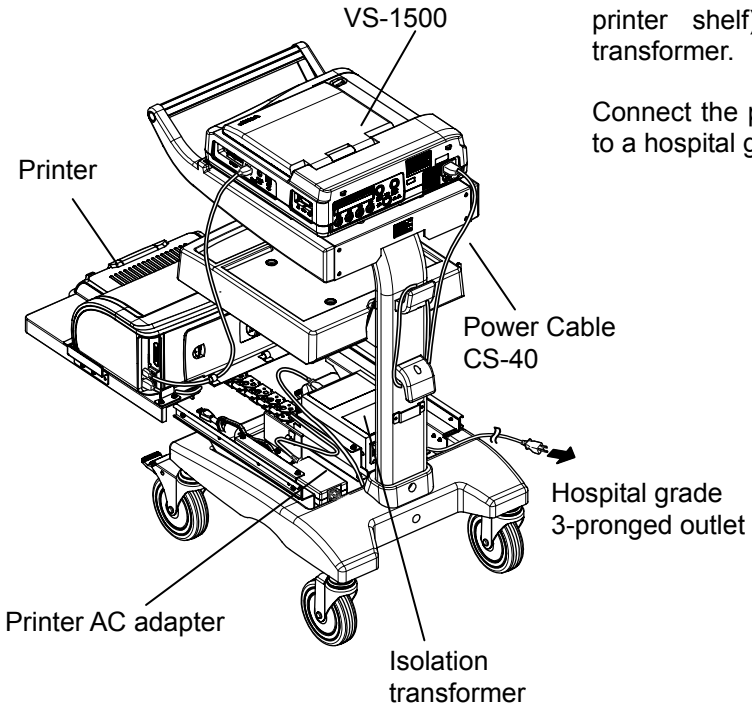
[Note] Route the power cable and the USB cable from the printer so that they are not pinched or exposed to unnecessary stress.

3. Connect the power cable (printer).



Connect the power cable from the printer AC adapter to the printer outlet on the isolation transformer.

4. Connect the cables (VS-1500, printer). For details refer to “Wiring Diagram”.



Connect the power cable (CS-40, accessory from the printer shelf) from the VS-1500 to the isolation transformer.

Connect the power cable from the isolation transformer to a hospital grade 3-pronged outlet.

5. Check the installation, wiring and connections of all devices again.
   - The printer shelf should slide smoothly.
   - No cables should be exposed to stress.
   - The printer power cable and the USB cable must be properly routed through the cable guides to enable it to move with the sliding of the printer shelf.
   - You should be able to lock the printer shelf both in its retracted and extended position.

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8.6 Installation of the Cable Hanger OA-300A

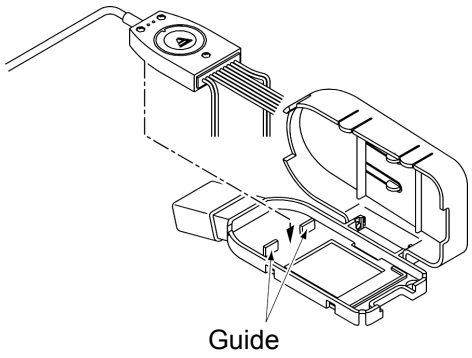
The OA-300A is a cable hanger to attach the lead cables.

8.6.1 Parts List

Name	Q'ty	Function
Mounting bracket	1	For attaching to the trolley, bed, etc.
Mounting bracket backing plate (C)	1	For attaching to the round pole of the trolley, bed, etc.
Mounting bracket backing plate (D)	1	For attaching to the square pole of the trolly, bed, etc.
Collar (Small)	1	For preventing the cable hanger from detaching.
Collar (Large)	1	For preventing the cable hanger from detaching.
Butterfly bolt M5×12	1	For preventing the cable hanger from detaching.
Butterfly bolt M5×45	1	For preventing the cable hanger from detaching.
Bracket spacer	1	For preventing the cable from getting caught.
Screw M6×30	4	For securing the mounting bracket.
Screw M6×15	4	For securing the mounting bracket.
Nut M6	4	For securing the mounting plate and its backing plate.
SW M6	4	For securing the mounting plate and its backing plate.

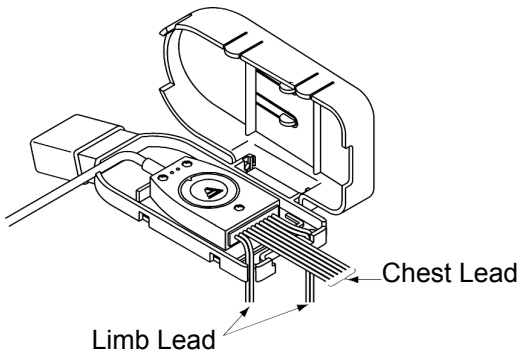
8.6.2 Installation Procedure

(1)



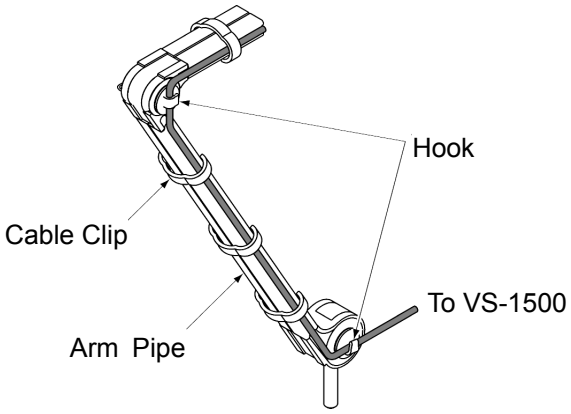
- Place the relay unit of the patient cable on the holder, aligning it with the depressed area of the holder.

(2)



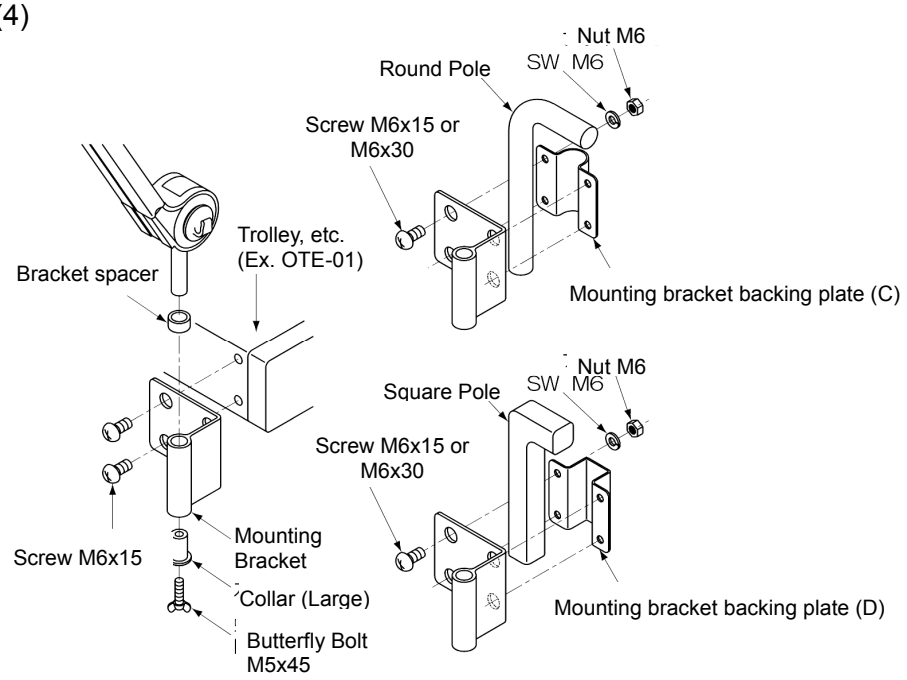
- Place the 6 chest leads together at the center, and let the limb leads go through the round holes on both sides by two.
- While pressing down the relay unit of the patient cable lightly, close the cover carefully not to have the cable get caught in between.

(3)



・ Lay the cable to be connected to the VS-1500 along the groove on the side of the arm pipe, and fasten it with cable clips. Let the cable go through the hook at the joint.

(4)



・ To attach the arm to the trolley, use the brackets and screws as shown in the illustration above.
・ Prepare screwdriver and other necessary tools.

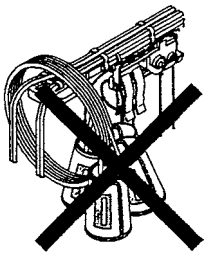
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8.7 Installation of the Hose Hanger Kit OA-130

This product kit can be used as a hose hanger for the Vasera Series by attaching to the OA-300A Cable Hanger (separately sold). Note that the kit cannot be used with any other cable hanger.

⚠ CAUTION

- **Do not install this hose hanger on a trolley other than the one specified for the Vasera Series. The trolley could tip over causing unforeseen injuries.**
- **Do not place the cuffs on or suspend them from the hose hanger. The trolley could tip over causing unforeseen injuries.**



8.7.1 Parts List

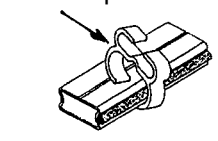
Name	Q'ty	Function
Sensor holder (1)	1	For holding the PCG microphone and pulse wave sensors.
Sensor holder (2)	1	Same as above.
Hose clips	6	For holding lead cables and air hoses in place.
Front end hose clip	1	For holding the air hose on the OA-300A.
Sensor cable clip	4	For holding the PCG microphone and pulse wave sensor cables.
Spiral tube (large)	6	For bundling the sensor cables (max. 3).
Spiral tube (small)	6	Smaller size of above.

8.7.2 Installation Procedure

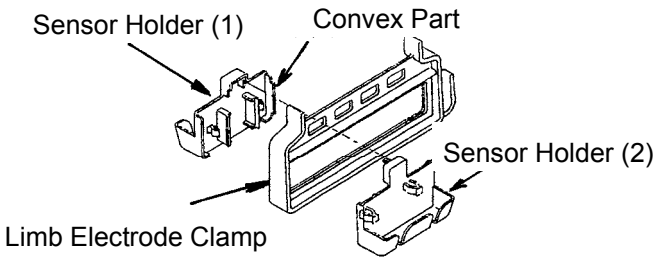
1. First, set the lead cable relay part by following the procedure explained on OA-300A Cable Hanger Operation Manual.

2. Next, insert the hose clips at appropriate locations on the arm to support the lead cables. placing the lead cable first will facilitate later attachment. To remove them, start from the side without the lead cable. [Refer to Figure 1.]

3. Insert the sensor holder (1) inside the limb electrode clamp and position it where desired. Then clip in the sensor holder (2) until it clicks into place. [Refer to Figure 2.]



[Figure 1]



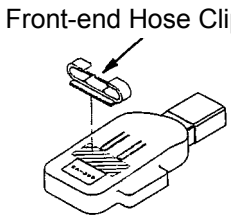
[Figure 2 Sensor Holder Attachment]

4. Attach the front-end hose clip to the OA-300A holder cover. * Firmly press the side with the adhesive. [Refer to Figure 3.]

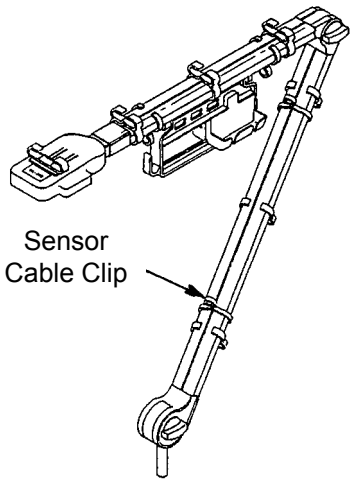
5. Attach the sensor cable clip so that the hook is positioned under the arm (inside). [Refer to Figure 4.]

6. When two or more sensor cables are used, use spiral tubes at sections where cable overlap, to prevent cable entanglement.

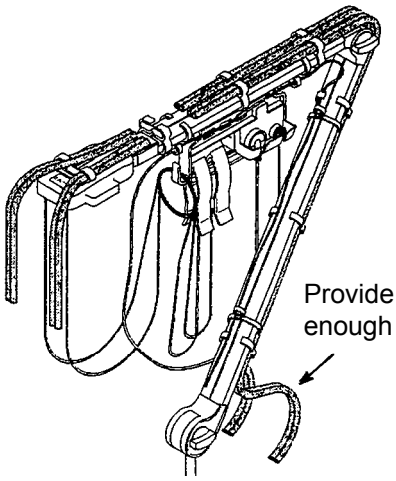
7. To ensure that the sensor cables and air hoses are not pinched when the hose hanger is turned, provide enough slack in hoses and cables at joints. [Refer to Figure 5.]



[Figure 3]



[Figure 4 Completed Assembly]



[Figure 5 Example of Hose Hanger Usage]

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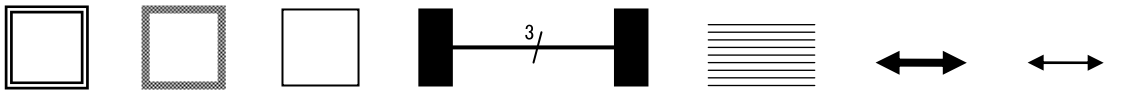
9

Chapter 9 Wiring Diagrams, Block Diagrams With Descriptions and Connector Pin Locations

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9.1 Definitions of Symbols Used in this Document

This document uses the following symbols in wiring and block diagrams. Items (1) to (25) in the diagram are described in detail in the product packing list.

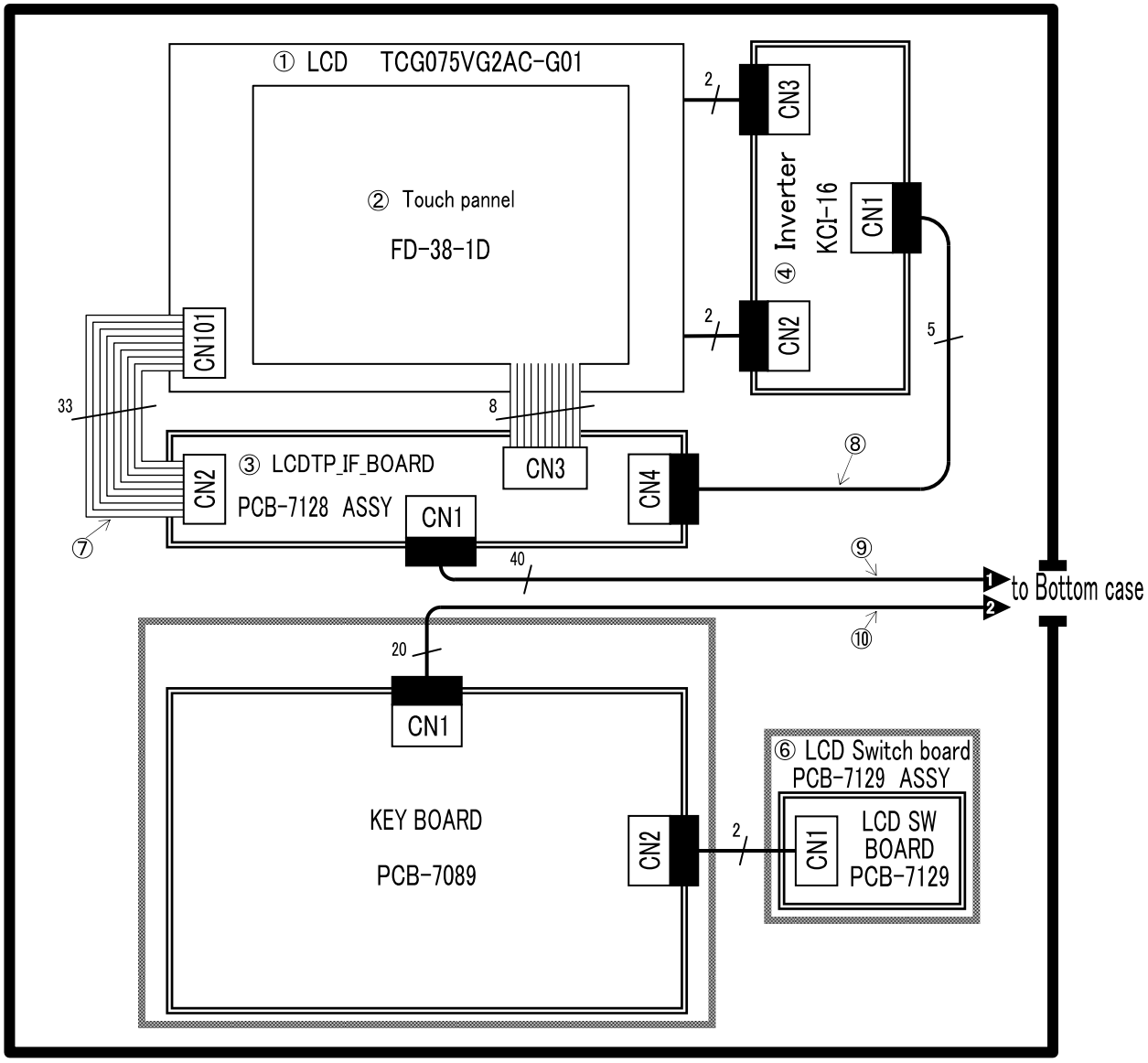


PCB | Unit | Part/block | Cable (the number indicates number of wires) | FFC/FPC | Data/address | Signal

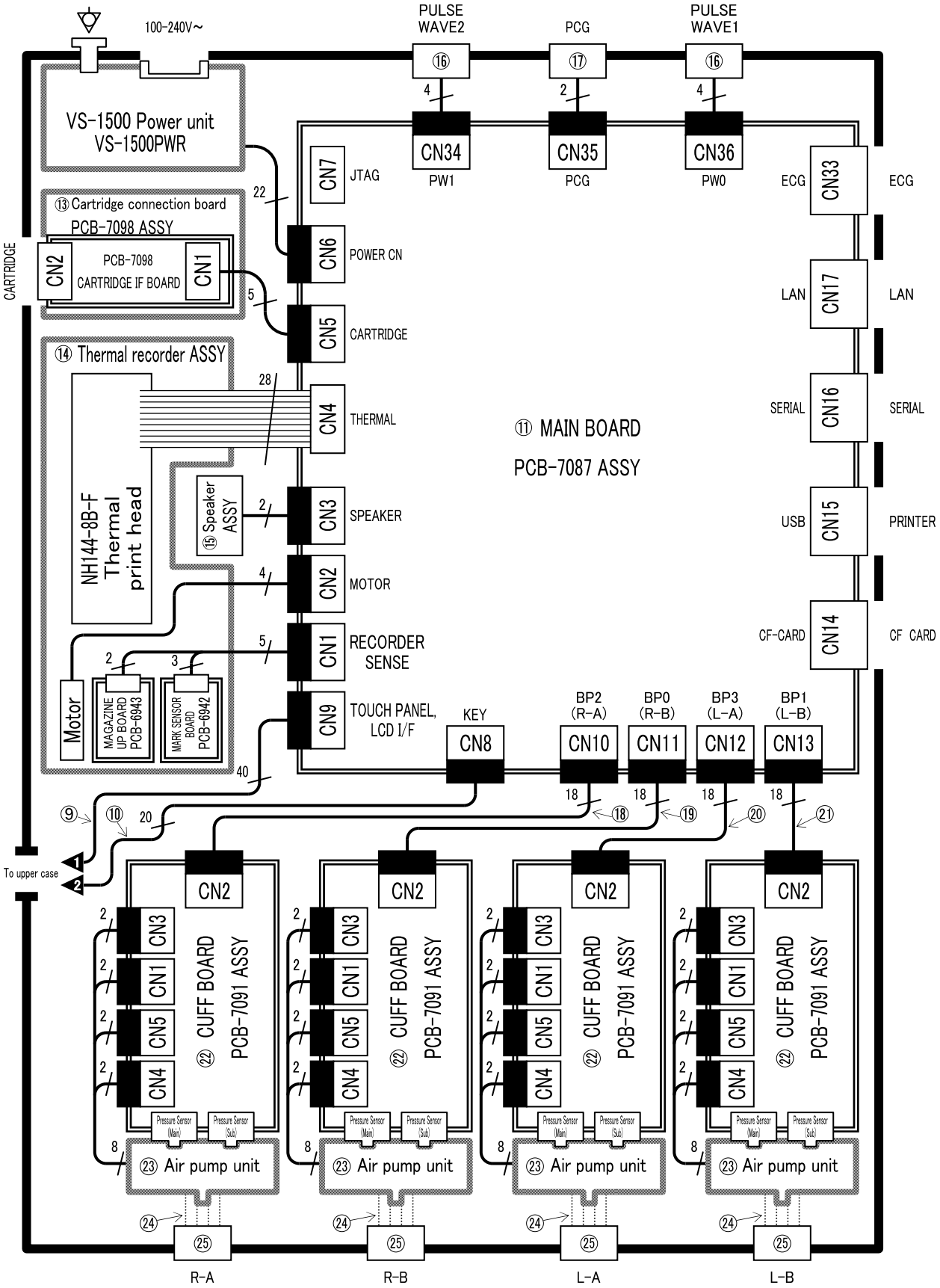
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9.2 Connecting Diagram

9.2.1 Upper Case



9.2.2 Lower Case

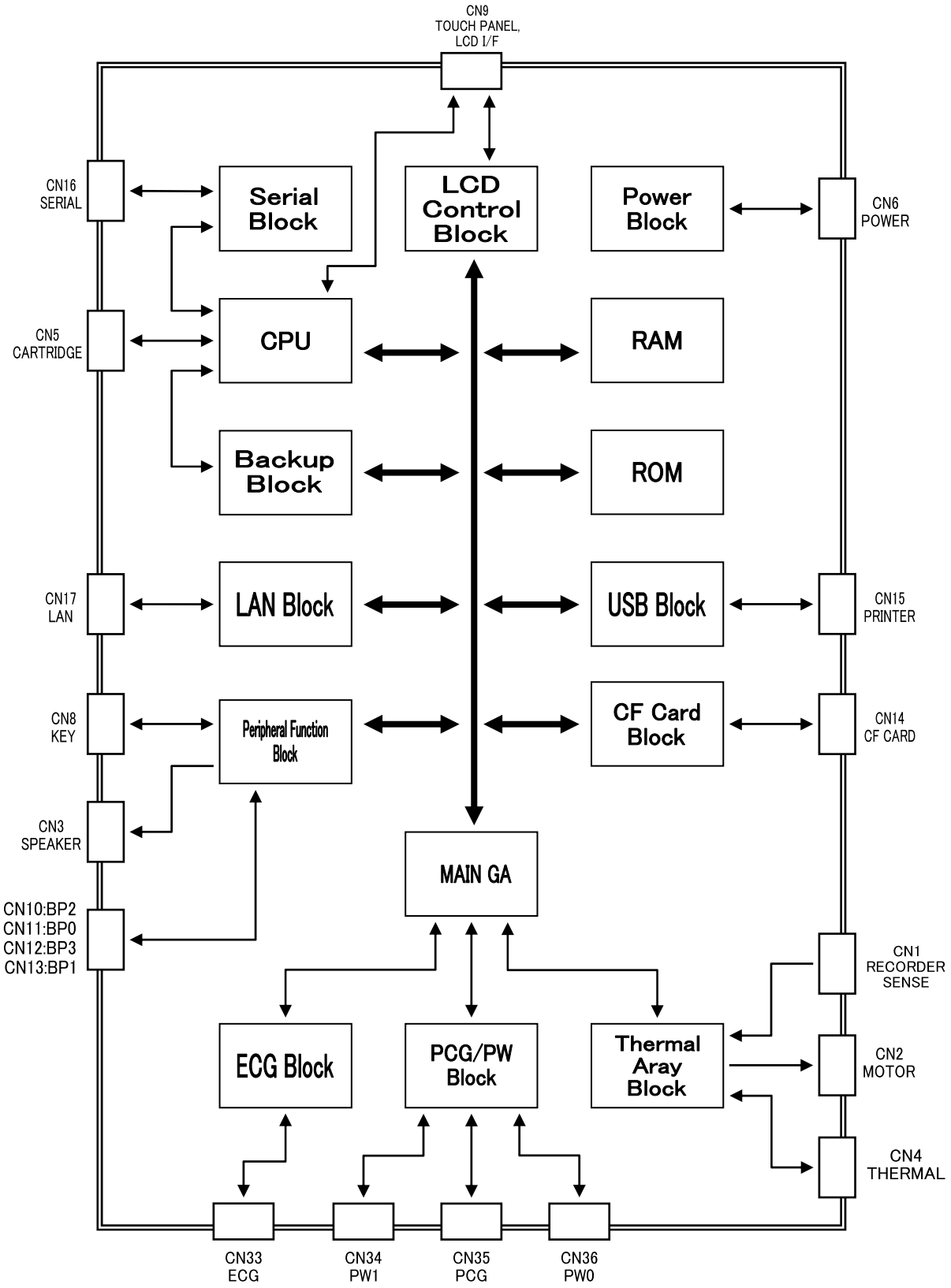


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9.3 Block Diagram and Description

9.3.1 MAIN BOARD

9.3.1.1 Block Diagram



9.3.1.2 Description

■ CPU

The CPU receives ECG, PCG/pulse wave, cuff pressure and cuff pulse wave data. It also handles filtering and processes LCD data, thermal recording, filing, communications, key operations, voice operations and other operations.

■ RAM

SDRAM stores programs, the waveform work area and LCD/thermal graphic data.

■ ROM

FLASH ROM stores the boot program, application programs and font data. It is also used to store miscellaneous function data and waveform data.

■ Backup Block

A lithium battery at all times backs up the SRAM that stores daily report data, log data and other data and the real-time clock IC.

■ Peripheral Function Block

FPGA is used to control NIBP, keys, sound and voice functions.

(1) NIBP
NIBP controls the pump, quick exhaust valves and flow control valves and measures cuff pulse waves and cuff pressure. The flow control valves uses DAC to vary flow rates

(2) KEY
This function uses FPGA to detect use of fixed keyboard keys.

(3) Sound/Voice
This function uses FPGA for sound control. The sound function can output chords. The use of a record and playback LSI makes voice playback possible. A volume control IC provides control of speaker output.

(4) ADC
The ADC converts NIBP data, thermal print head temperature, remaining lithium battery capacity and other analog data to digital data for transfer to FPGA.

■ LCD Control Block

This block is equipped with an LCD controller that controls the LCD.

■ LAN Block

The LAN block uses a LAN port that complies with the IEEE802.3 10BASE-T Ethernet standard to enable high-speed communications between the VS-1500 and a PC allowing exchanges of ECG data and patient data. Three on-board LEDs indicate LAN status (D14: link test status, D15: data reception, D16: data transmission) to enable operation checks. The MAC address is programmed in Flash ROM and is loaded into the controller at power up.

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■ USB Block

The USB port enables direct connection to a printer via USB 2.0 without the need for a computer for printing of test result reports in color. The DMAC in the CPU transfers data between the USB controller and SDRAM.

■ CF CARD

The CF card controller, which operates under CPU control, makes it possible to store pulse wave test and ECG test results including waveform and measurement values on CFA standard compliant CF cards.

■ Serial Block

The instrument comprises a 1-ch RS-232-C standard serial port to connect master apparatus, ID readers, bar code readers and other devices. Communications are asynchronous. It also provides an isolated +5 V output to power external ID card readers and other devices.

■ MAIN GA

This function conducts serial communications with the AMP Control GA of the ECG block and PCG/PW block to control the thermal print head and record motor.

■ ECG Block

ECG signals input from the ECG connector are amplified by an op-amp using the F differential and directly input to the ADC. Each input is provided with an ADC that sends AD converted data to the Main GA via the AMP Control GA. The RF driver circuit inverts the F (left foot) input signal and connects it to the patient's right foot to reduce noise and improve CMRR.

■ PCG/PW Block

This block amplifies signals input from the PCG and PW connectors, filters them and inputs them to the AD converter. The data is serially converted by the AD converter and input to AMP GA. The PCG/PW block is isolated from other blocks to increase protection against electrical shock. Using filters with different characteristics, the amplifier processes PCG signals to produce L characteristic and PWV characteristic PCG. The PW input is a 2 ch input each equipped with a reset function.

■ Thermal Recorder Block

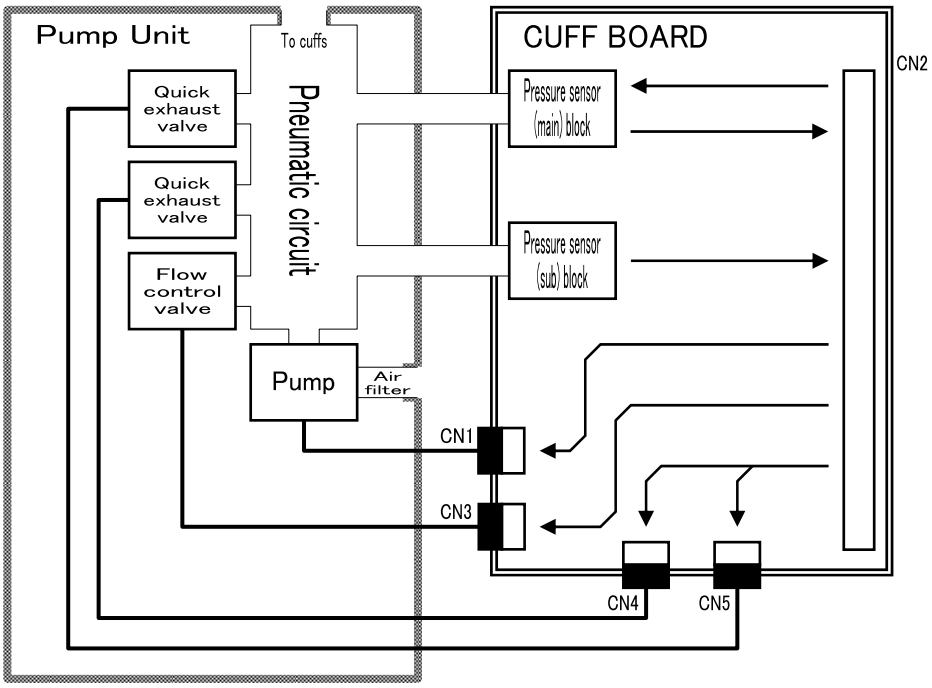
This block transfers waveform data written to graphic data and waveform data registers in SDRAM to the thermal print head to control the paper drive motor and print data via the motor driver. It also monitors chart paper status using the signals from the mark sensor board and magazine up board in the thermal array recorder.

■ Power Supply Block

The power supply unit supplies a primary supply of +3.3 V, +5 V, +12 V and +24 V as well as a secondary power supply of +1.2 V, +1.5 V, +2.5 V, +5 VA and +8 VA, which are supplied to each block.

9.3.2 Cuff Board /Pump Unit

9.3.2.1 Block Diagram



9.3.2.2 Description

- Pressure Sensor (Main) Block

The input to the pressure sensor (main) is output to the Main Board as positive pressure P. Positive pressure P goes through filters and an amplifier to produce pulse waves for CAVI measurement (PW values) and pulse waves for BP measurement (OSC values). Main Board control enables resetting of pulse waves.

- Pressure Sensor (Supplementary) Block

The input to the pressure sensor (supplementary) is output to the Main Board as supplementary pressure Q. The output from supplementary Q comparator is used in the BP safety circuit.

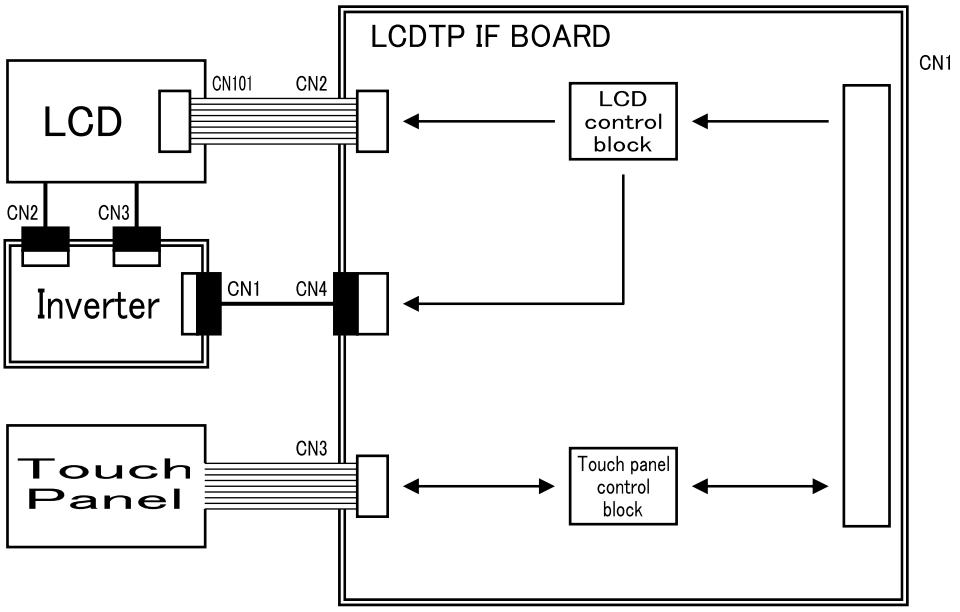
- Pump Unit

This unit uses a motor-driven pump to move air through the air filter to the pneumatic circuit to raise air pressure. The flow rate valve and quick exhaust valves control the reduction of pressure in the pneumatic circuit.

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9.3.3 LCDTP IF Board

9.3.3.1 Block Diagram



9.3.3.2 Description

- LCD Control Block

This block decodes the signal from the LVDS driver IC on the Main Board in the LVDS receiver IC and sends it to the LCD. It also controls inverter On/Off and backlight brightness.

- Touch Panel Control Block

This block inputs touch panel coordinate data to the control IC. The data is converted to serial data and sent to the CPU.

9.3.4 Other Functions

9.3.4.1 Description

- Key Board

The contacts and rubber sheet in the key board make up the fixed keys. They are controlled by FPGA.

- LCD SW Board

This board monitors the opening and closing of the LCD panel.

- Program Cartridge

The program cartridge contains a 2-wire serial interface EEPROM and is connected to the Main Board via the cartridge relay board.

- Power Supply Unit

This unit converts 100 - 240 V AC input to supply the Main Board with +3.3 V, +5 V, +12 V and +24 V DC voltage. The power is turned on and off through Key Board and CPU control.

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9.4 Connector Pin Arrangement

9.4.1 MAIN BOARD

(1) CN1 RECORDER SENSE

Connector Type: DF13-5P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	SW_ON	4	MARK_E
2	SW_COM	5	MARK_A
3	MARK_COM		

(2) CN2 MOTOR

Connector Type: DF13-4P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	OUT1	3	OUT3
2	OUT2	4	OUT4

(3) CN3 SPEAKER

Connector Type: DF13-2P-1.25V(50) (HRS)

No.	Signal Name
1	SP
2	SP G

(4) CN4 THERMAL

Connector Type: 00 6224 028 001 800 (KYOCERA-ELCO)

No.	Signal Name	No.	Signal Name
1	TM	15	VH
2	TM	16	DATA OUT2
3	DATA IN2	17	DATA IN1
4	VH	18	STROBE2 L
5	VH	19	CLOCK
6	VH	20	GND
7	STROBE3_L	21	GND
8	GND	22	GND
9	GND	23	GND
10	GND	24	STROBE1_L
11	GND	25	VH
12	LATCH_L	26	VH
13	VDD	27	VH
14	VH	28	DATA OUT1

(5) CN5 CARTRIDGE

Connector Type: DF13-6P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	＋3.3V		
2	SDA	4	WP
3	SCL	5	GND

(6) CN6 POWER CN

Connector Type: S22B-PHDSS-B (JST)

No.	Signal Name	No.	Signal Name
1	＋3.3V	12	GND
2	＋3.3V	13	＋12VLCD
3	GND	14	GND
4	GND	15	＋24VT
5	＋5V	16	GND
6	＋5V	17	＋24VM
7	GND	18	GND
8	GND	19	POWER_ON_OFF_L
9	＋12V	20	SHUTDOWN_L
10	＋12V	21	AC_FAIL_L
11	GND	22	AC_STB5V

(7) CN7 JTAG

Connector Type: DF20G-20DP-1V (HRS)

No.	Signal Name	No.	Signal Name
1	MTCK	11	
2	MTRST L	12	
3	MTDO	13	
4	MTMS	14	GND
5	MTDI	15	GTCK
6	MASEBRKAKT_L	16	GTRST
7		17	GTDO
8		18	GTMS
9		19	GTDI
10		20	RESET_L

(8) CN8 KEY

Connector Type: DF20G-20DP-1V (HRS)

No.	Signal Name	No.	Signal Name
1	GND	11	KL0
2	POW_ON5V	12	GND
3	AC_STB5V	13	KS5
4	POWER_ON_OFF_L	14	KS4
5	LCD_SW_L	15	KS3
6	KL5	16	KS2
7	KL4	17	KS1
8	KL3	18	KS0
9	KL2	19	GND
10	KL1	20	GND

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(9) CN9 TOUCH PANEL, LCD I/F

Connector Type: SSL00-40L3 (KEL)

No.	Signal Name	No.	Signal Name
1	GND	21	＋3.3V
2	TCP_TXD	22	＋3.3V
3	TCP_RXD	23	＋3.3V
4	TCP_RESET	24	＋3.3V
5	INVBLON_L	25	＋3.3V
6	INVBLHIGH_L	26	＋3.3V
7	GND	27	＋3.3V
8	＋5	28	GND
9	GND	29	TXCLK＋
10	＋12V	30	TXCLK－
11	＋12V	31	GND
12	＋12V	32	TX2＋
13	＋12V	33	TX2－
14	＋12V	34	GND
15	GND	35	TX1＋
16	GND	36	TX1－
17	GND	37	GND
18	＋3.3V	38	TX0＋
19	＋3.3V	39	TX0－
20	＋3.3V	40	GND

(10) CN10 BP2 (R-A)

Connector Type: DF11G-18DP-2V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	＋8V	10	GND
2	GND	11	VLVX＋
3	－8V	12	VLVX－
4	OSC	13	PUMP＋
5	PW	14	PUMP－
6	P	15	VLVF＋
7	Q	16	VLVF－
8	＋12V	17	HICUFF
9	INST	18	LOWCUFF

(11) CN11 BP0 (R-B)

Connector Type: DF11G-18DP-2V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	＋8V	10	GND
2	GND	11	VLVX＋
3	－8V	12	VLVX－
4	OSC	13	PUMP＋
5	PW	14	PUMP－
6	P	15	VLVF＋
7	Q	16	VLVF－
8	＋12V	17	HICUFF
9	INST	18	LOWCUFF

(12) CN12 BP3 (L-A)

Connector Type: DF11G-18DP-2V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	＋8V	10	GND
2	GND	11	VLVX＋
3	－8V	12	VLVX－
4	OSC	13	PUMP＋
5	PW	14	PUMP－
6	P	15	VLVF＋
7	Q	16	VLVF－
8	＋12V	17	HICUFF
9	INST	18	LOWCUFF

(13) CN13 BP1 (L-B)

Connector Type: DF11G-18DP-2V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	＋8V	10	GND
2	GND	11	VLVX＋
3	－8V	12	VLVX－
4	OSC	13	PUMP＋
5	PW	14	PUMP－
6	P	15	VLVF＋
7	Q	16	VLVF－
8	＋12V	17	HICUFF
9	INST	18	LOWCUFF

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(14) CN14 CF-CARD

Connector Type: MI21A-50PD-SF-EJL(91) (HRS)

No.	Signal Name	No.	Signal Name
1	GND	26	CD1_L
2	D3	27	D11
3	D4	28	D12
4	D5	29	D13
5	D6	30	D14
6	D7	31	D15
7	CE1_L	32	CE2_L
8	A10	33	VS1_L
9	OE_L	34	IORD_L
10	A9	35	IOWR_L
11	A8	36	WE/PRG_L
12	A7	37	RDY/IREQ_L
13	VCC	38	VCC
14	A6	39	CSEL_L
15	A5	40	VS2_L
16	A4	41	RESET
17	A3	42	WAIT_L
18	A2	43	INPACK_L
19	A1	44	REG_L
20	A0	45	BVD2/SPKR_L
21	D0	46	BVD1/STSCHG_L
22	D1	47	D8
23	D2	48	D9
24	WP/IOIS16_L	49	D10
25	CD2_L	50	GND

(15) CN15 USB

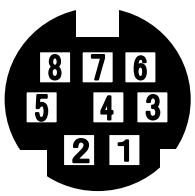
Connector Type: UBA-4R-D14T-1 (JST)

No.	Signal Name	No.	Signal Name
1	VBUS	3	D＋
2	D－	4	GND

(16) CN16 SERIAL

Connector Type: MD-S8100-10 (JST)

No.	Signal Name	No.	Signal Name
1	RTS	5	RXD
2	CTS	6	
3	TXD	7	＋5V
4	SG	8	



Front view

(17) CN17 LAN

Connector Type: SS-640810-A-NF-A111 (STEWART CONNECTOR)

No.	Signal Name	No.	Signal Name
1	TXD＋	5	NC
2	TXD－	6	RXD－
3	RXD＋	7	NC
4	NC	8	NC

(18) CN18 BATTERY

Connector Type: BH-32

No.	Signal Name	Description
1	－	Battery negative terminal
2	＋	Battery positive terminal
3	＋	Battery positive terminal

(19) CN33 ECG

Connector Type: RDAG1-15SE1(F) (HRS)

No.	Signal Name	No.	Signal Name
1	C2	9	R
2	C3	10	L
3	C4	11	F
4	C5	12	C1
5	C6	13	
6		14	RF
7		15	
8			

(20) CN34 PW1

Connector Type: DF13-5P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	－PW	4	+5V
2	GND	5	
3	＋PW		

(21) CN35 PCG

Connector Type: DF13-4P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	PCG	2	GND

(22) CN36 PW0

Connector Type: DF13-5P-1.25V(50) (HRS)

No.	Signal Name	No.	Signal Name
1	－PW	4	+5V
2	GND	5	
3	＋PW		

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9.4.2 CUFF BOARD

(1) CN1 PUMP

Connector Type: DF3A-4P-2DSA (HRS)

No.	Signal Name	No.	Signal Name
1	PUMP＋	3	PUMP－
2		4	

(2) CN2 TO MAIN BOARD

Connector Type: DF11-18DP-2DS(52) (HRS)

No.	Signal Name	No.	Signal Name
1	＋8V	10	GND
2	GND	11	VLVX＋
3	－8V	12	VLVX－
4	OSC	13	PUMP＋
5	PW	14	PUMP－
6	P	15	VLVF＋
7	Q	16	VLVF－
8	＋12V	17	HICUFF
9	INST	18	LOWCUFF

(3) CN3 Flow Control Valve

Connector Type: DF3A-3P-2DSA (HRS)

No.	Signal Name
1	VLVF＋
2	
3	VLVF－

(4) CN4, CN5 Quick Exhaust Valve

Connector Type: DF3A-2P-2DSA (HRS)

No.	Signal Name
1	VLVX＋
2	VLVX－

9.4.3 LCDTP IF BOARD

(1) CN1 TO MAIN BOARD

Connector Type: SSL00-40L3 (KEL)

No.	Signal Name	No.	Signal Name
1	GND	21	＋3.3V
2	TCP_TXD	22	＋3.3V
3	TCP_RXD	23	＋3.3V
4	TCP_RESET	24	＋3.3V
5	INVBLON	25	＋3.3V
6	INVBLHIGH_L	26	＋3.3V
7	GND	27	＋3.3V
8	＋5V	28	GND
9	GND	29	TXCLK＋
10	＋12V	30	TXCLK－
11	＋12V	31	GND
12	＋12V	32	TX2＋
13	＋12V	33	TX2－
14	＋12V	34	GND
15	GND	35	TX1＋
16	GND	36	TX1－
17	GND	37	GND
18	＋3.3V	38	TX0＋
19	＋3.3V	39	TX0－
20	＋3.3V	40	GND

(2) CN2 TO LCD

Connector Type: 08 6210 033 340 800+ (KYOCERA-ELCO)

No.	Signal Name	No.	Signal Name
1	GND	18	G3
2	NC	19	G2
3	U/D	20	G1
4	R/L	21	G0
5	VDD	22	GND
6	VDD	23	R5
7	ENAB	24	R4
8	GND	25	R3
9	B5	26	R2
10	B4	27	R1
11	B3	28	R0
12	B2	29	GND
13	B1	30	VSYNC
14	B0	31	HSYNC
15	GND	32	CK
16	G5	33	GND
17	G4		

(3) CN3 TO TOUCH PANEL

Connector Type: 52043-0810 (MOLEX)

No.	Signal Name	No.	Signal Name
1	YL	5	XR
2	YLREF	6	XL
3	YUREF	7	XLREF
4	YU	8	XRREF

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(4) CN4 TO INVERTER

Connector Type: S5B-ZR-SM3A-TF (JST)

No.	Signal Name	No.	Signal Name
1	＋12V	4	VR_GND
2	＋12VGND	5	VR_5K
3	BL CONT		

9.4.4 CARTRIDGE IF BOARD

(1) CN1 TO MAIN BOARD

Connector Type: DF4-5P-2C (HRS)

No.	Signal Name	No.	Signal Name
1	＋3.3V	4	WP
2	SDA	5	GND
3	SCL		

(2) CN2 TO CARTRIDGE

Connector Type: 20 5082 301 006 100 (KYOCERA-ELCO)

No.	Signal Name	No.	Signal Name
1	＋3.3V	4	WP
2	SDA	5	NC
3	SCL	6	DG

9.4.5 KEY BOARD

(1) CN1 TO MAIN BOARD

Connector Type: DF20F-20DP-1H (HRS)

		No.	Signal Name
1	GND	11	KL0
2	POW_ON5V	12	GND
3	AC_STB5V	13	KS5
4	POWER_ON_OFF_L	14	KS4
5	LCD_SW_L	15	KS3
6	KL5	16	KS2
7	KL4	17	KS1
8	KL3	18	KS0
9	KL2	19	GND
10	KL1	20	GND

(2) CN2 TO LCD SW BOARD

Connector Type: DF13-2P-1.25V(20) (HRS)

No.	Signal Name
1	LCD_SW_L
2	GND

9.4.6 LCD SW BOARD

(1) CN1 TO KEY BOARD

Connector Type: DF4-2P-2C (HRS)

No.	Signal Name
1	LCD_SW_L
2	GND

9.4.7 Inverter

(1) CN1 TO LCDTP IF BOARD

Connector Type: S5B-ZR-SM3A-TF (JST)

No.	Signal Name	No.	Signal Name
1	Vin	4	VR (GND)
2	GND	5	VR (5kΩ)
3	CONT		

(2) CN2、CN3 TO LCD

Connector Type: SM02(8.0)B-BHS-1-TB (JST)

No.	Signal Name	No.	Signal Name
1	VO	3	RET
2			

9.4.8 LCD Module

(1) CN101 TO LCDTP IF BOARD

Connector Type: 08 6210 033 340 800+ (KYOCERA-ELCO)

No.	Signal Name	No.	Signal Name
1	GND	18	G5
2	CK	19	GND
3	HSYNC	20	B0
4	VSYNC	21	B1
5	GND	22	B2
6	R0	23	B3
7	R1	24	B4
8	R2	25	B5
9	R3	26	GND
10	R4	27	ENAB
11	R5	28	VDD
12	GND	29	VDD
13	G0	30	R/L
14	G1	31	U/D
15	G2	32	NC
16	G3	33	GND
17	G4		

(2) CN2, CN3 TO INVERTER

Connector Type: BHR-03VS-1 (JST)

No.	Signal Name
1	HOT
2	
3	COLD

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9.4.9 External Connector

(1) PCG

Connector Type: MAB-8100S-G (HIRSCHMANN)

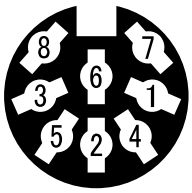
No.	Signal Name	No.	Signal Name
1	GND	5	
2		6	PCG
3		7	
4		8	

(2) PULSE WAVE1 / PULSE WAVE2

Connector Type: MAB-8100S-G (HIRSCHMANN)

No.	Signal Name	No.	Signal Name
1	＋PW	5	
2		6	+5V
3	－PW	7	GND
4		8	

Front view



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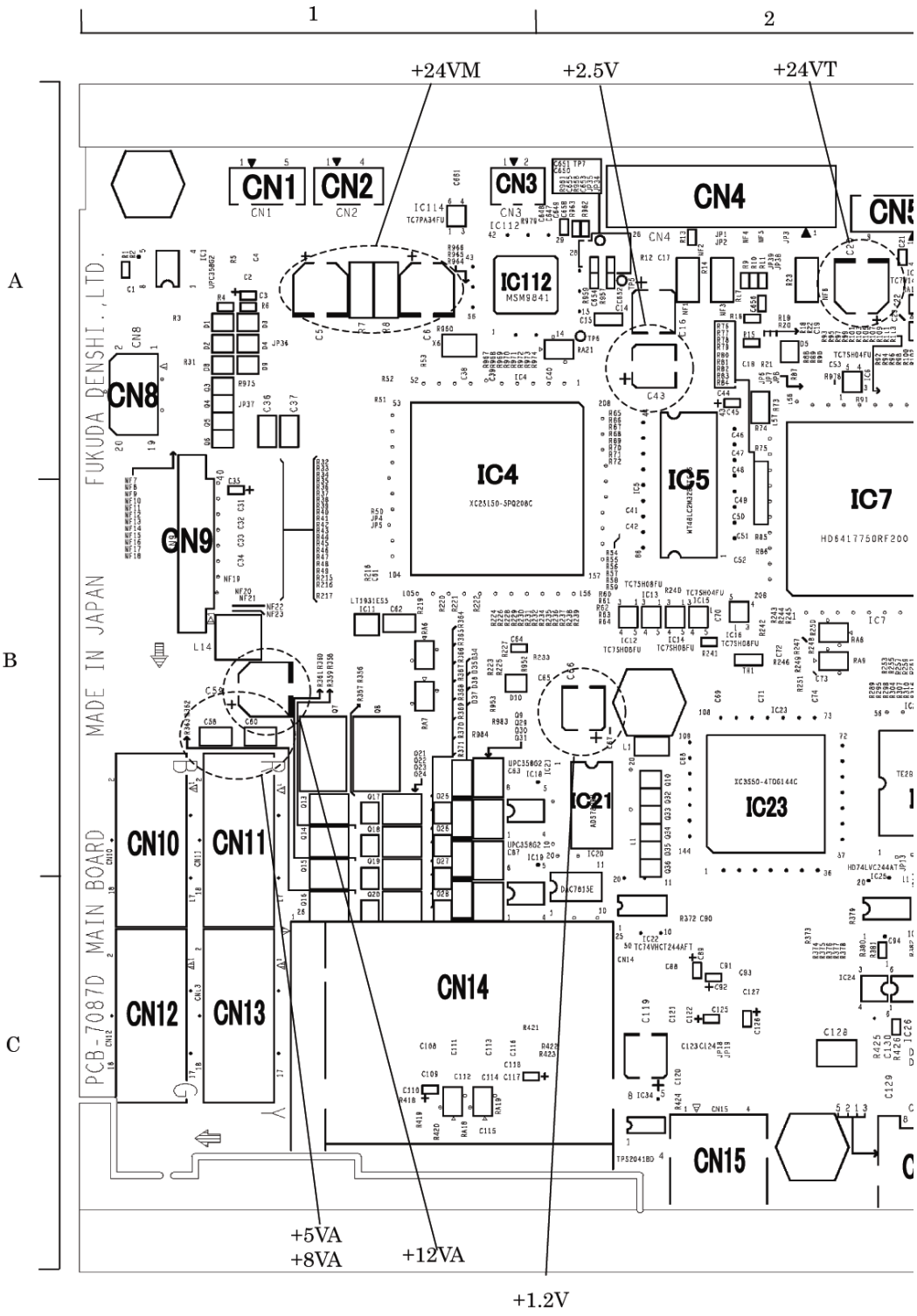
10

Chapter 10 Part Location Diagram and Checkpoints

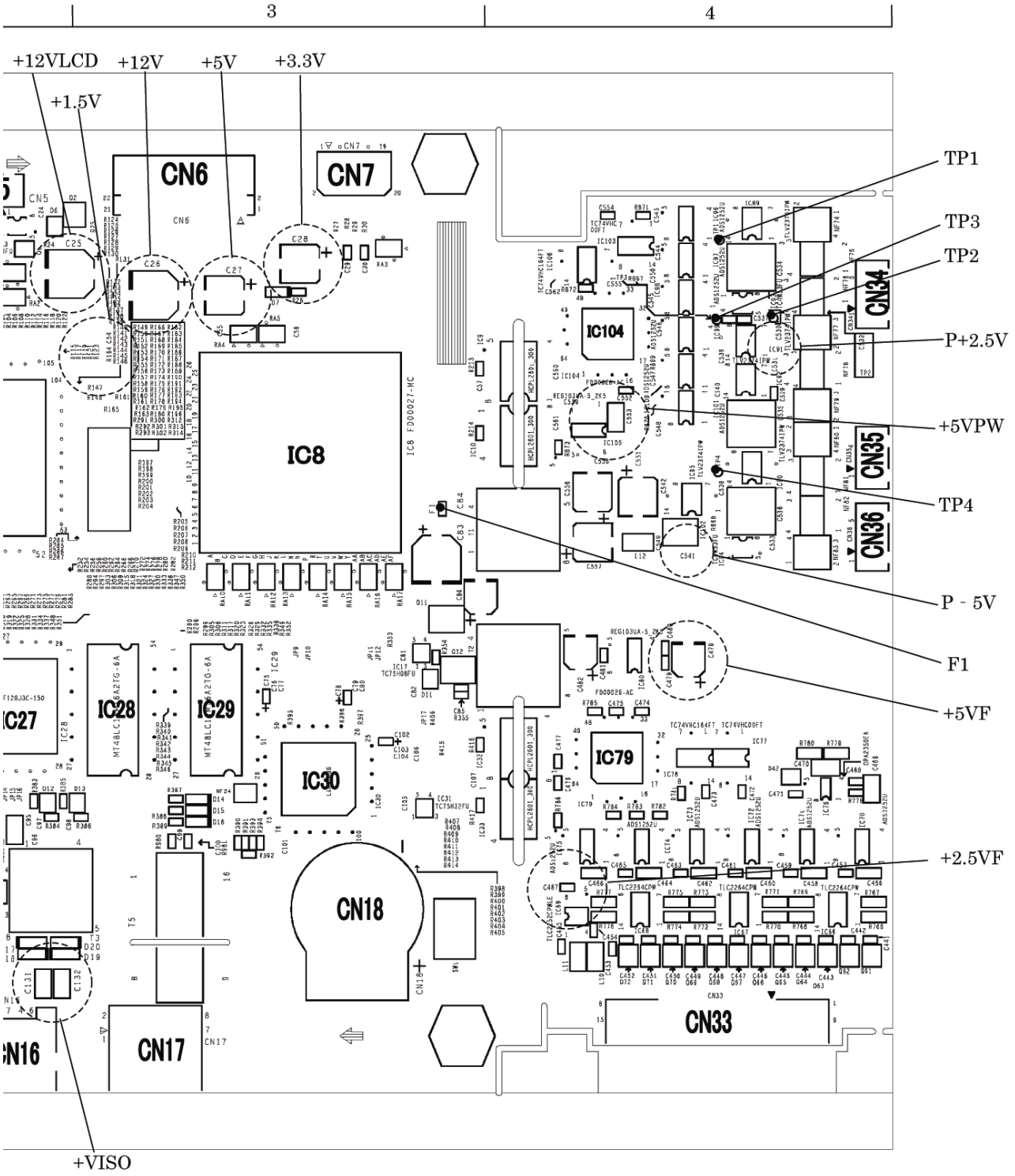
10.1 MAIN BOARD 10-2
10.1.1 MAIN BOARD Part Location Diagram (Component Side) 10-2
10.1.2 MAIN BOARD Part Location Diagram (Soldering Side) 10-4
10.1.3 Main Board Checkpoints 10-6
10.2 CUFF BOARD 10-12
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10.3.2 Power Supply and Signal Checks 10-14
10.4 Power Supply Unit 10-15
10.4.1 Output Voltage Check 10-15

10.1 MAIN BOARD

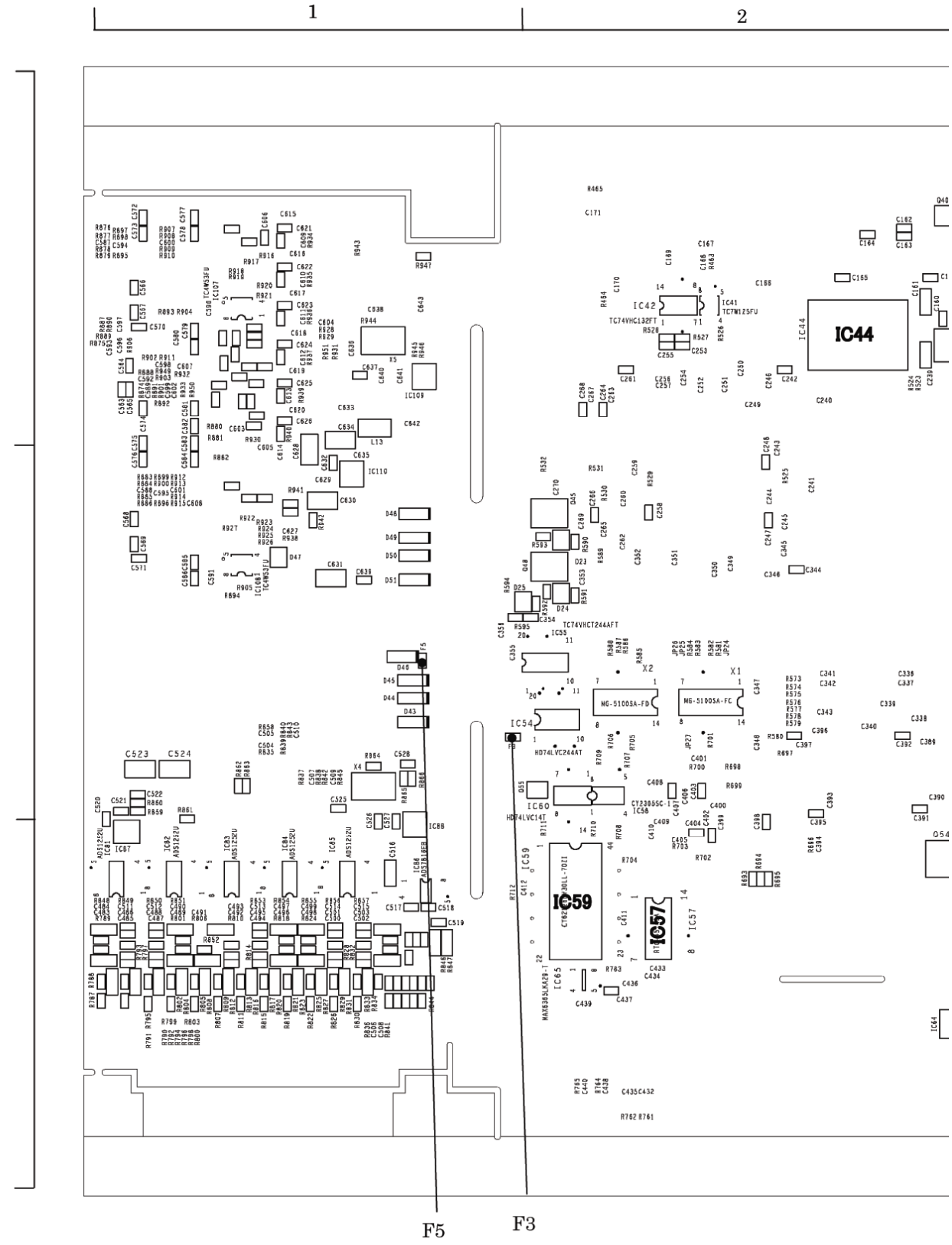
10.1.1 MAIN BOARD Part Location Diagram (Component Side)



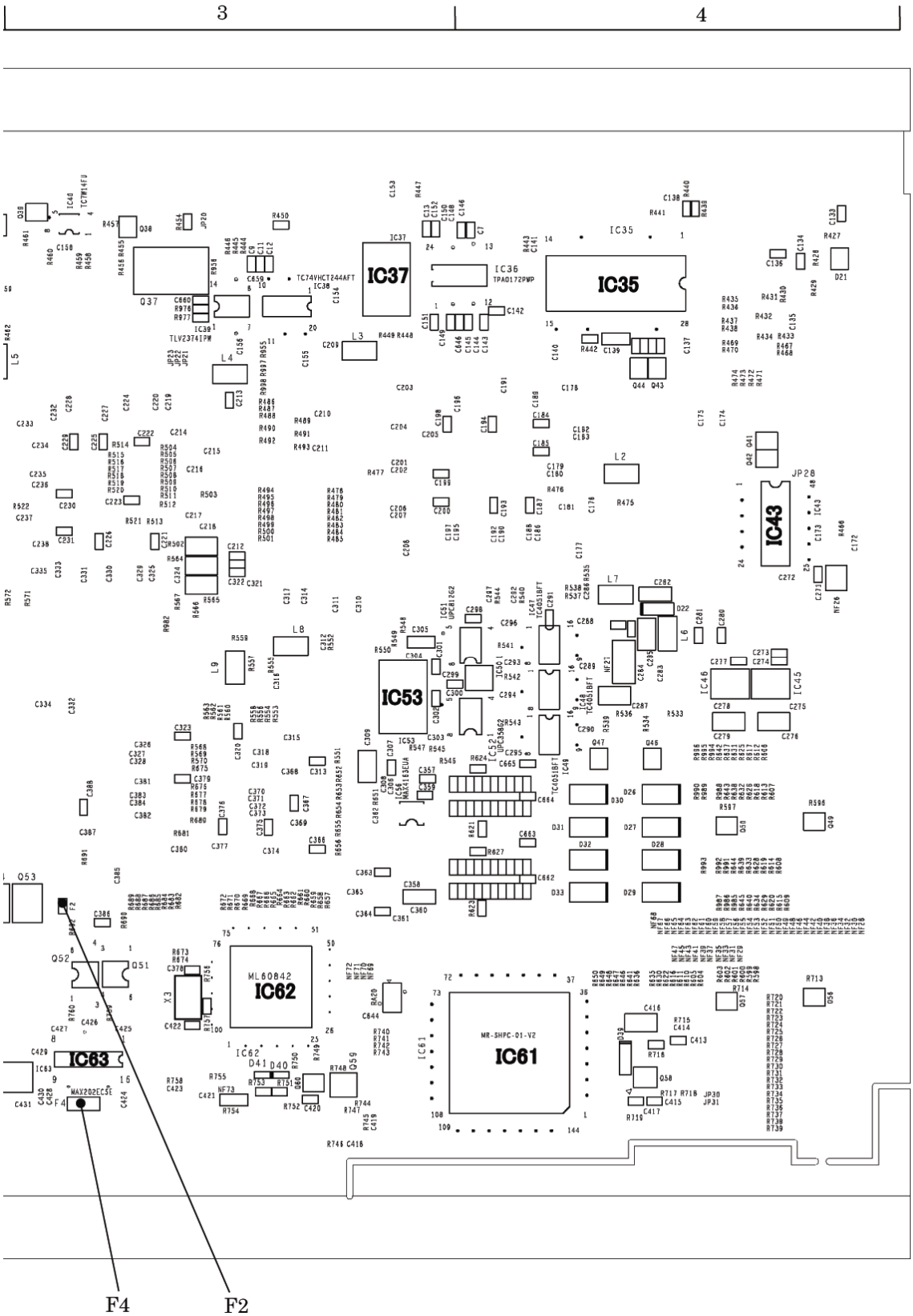
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3
4
+12VLCD
+12V
+5V
+3.3V
+1.5V
CN6
CN7
CN5
IC8
IC104
IC30
IC28
IC29
IC27
IC79
CN18
CN17
CN16
CN33
CN34
CN35
CN36
TP1
TP3
TP2
P+2.5V
+5VPW
TP4
P - 5V
F1
+5VF
+2.5VF
+VISO

10.1.2 MAIN BOARD Part Location Diagram (Soldering Side)



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3
4
IC37
IC35
IC36
TPA0172PWP
IC43
IC53
IC62
ML60842
IC63
IC61
MR-SHPC-01-V2
F4
F2

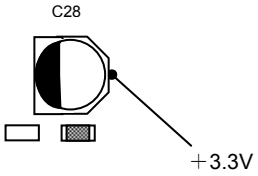
10.1.3 Main Board Checkpoints

10.1.3.1 Power Supply and Signal Checks

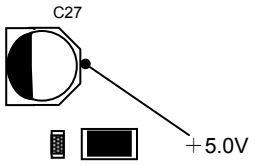
Refer to the part location diagram for a rough location of parts on the board.

(1) Power supply

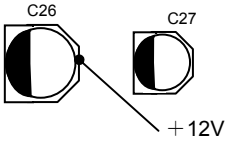
1. +3.3V
   Allowable voltage is +3.3 ±0.165 V.
   Check voltage at the + side of C28.
   (☞10.1.1.A3)



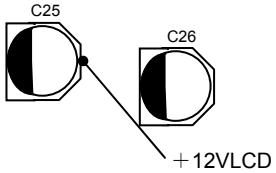
2. +5.0V
   Allowable voltage is +5.0 ±0.25V.
   Check voltage at the + side of C27.
   (☞10.1.1.A3)



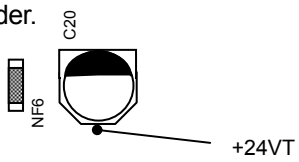
3. +12V
   Powers the air unit drive.
   Allowable voltage is +12 ±0.6V.
   Check voltage at the + side of C26.
   (☞10.1.1.A3)



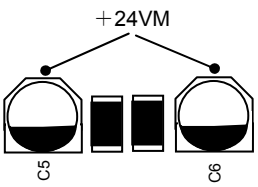
4. +12VLCD
   Powers the display backlight and analog power supply.
   Allowable voltage is +12 ±0.6V.
   Check voltage at the + side of C25.
   (☞10.1.1.A2)



5. +24VT
   Powers the thermal print head in the built-in thermal array recorder.
   Allowable voltage is +24 ±1.2V.
   Check voltage at the + side of C20.
   (☞10.1.1.A2)

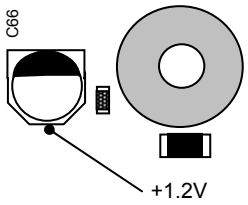


6. +24VM
   Powers the motor in the built-in thermal array recorder.
   Allowable voltage is +24 ±1.2V.
   Check voltage at the + side of C5 or C6.
   (☞10.1.1.A1)

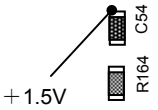


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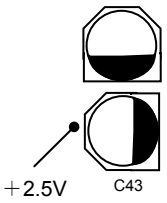
7. +1.2V
   Powers the FPGA (IC23).
   Allowable voltage is +1.2 ±0.06V.
   Check voltage at the + side of C66.
   （☞10.1.1.B2）



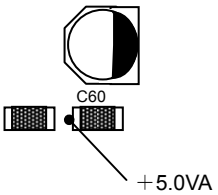
8. +1.5V
   Powers the CPU (IC7).
   Allowable voltage is +1.5 ±0.075V.
   Check voltage at C54.
   （☞10.1.1.A3）



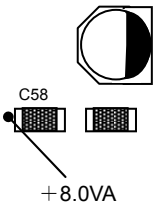
9. ＋2.5V
   Powers the FPGA (IC4).
   Allowable voltage is +2.5 ±0.125V.
   Check voltage at the + side of C43.
   （☞10.1.1.A2）



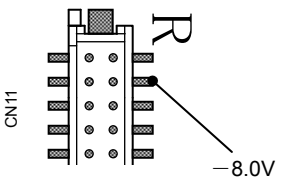
10. +5VA
    Powers the analog circuits.
    Allowable voltage is +5.0 ±0.25V.
    Check voltage at C60.
    （☞10.1.1.B1）



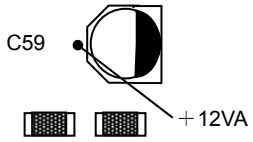
11. +8VA
    Powers the analog circuits.
    Allowable voltage is +8.0 ±0.4V.
    Check voltage at C58.
    （☞10.1.1.B1）



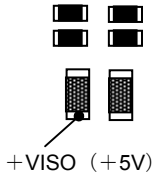
12. –8VA
    Powers the analog circuits.
    Allowable voltage is -8.0 ±0.4V.
    Check at pin 3 on CN11.
    （☞10.1.1.B1）



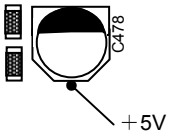
13. +12VA
    Powers the analog circuits.
    Allowable voltage is +12 ±0.6V.
    Check voltage at the + side of C59.
    （☞10.1.1.B1）



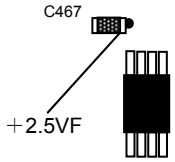
14. +VISO（＋5V）
    Powers the serial isolation unit.
    Allowable voltage is +5.0 ±0.25V.
    Check voltage at C131.
    （☞10.1.1.C2）



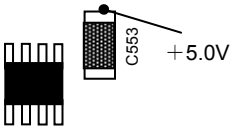
15. +5VF
    Powers the ECG isolation unit.
    Allowable voltage is +5.0 ±0.25V.
    Check voltage at the + side of C478.
    （☞10.1.1.B4）



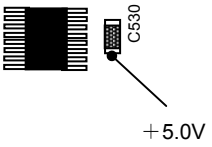
16. +2.5VF
    Powers the ECG isolation unit.
    Allowable voltage is +2.5 ±0.125V.
    Check voltage at C467.
    （☞10.1.1.C4）



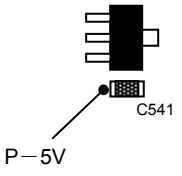
17. +5VPW
    Powers the PCG/pulse wave isolation unit.
    Allowable voltage is +5.0 ±0.25V.
    Check voltage at C553.
    （☞10.1.1.A4）



18. P+2.5V
    Powers the PCG/pulse wave isolation unit.
    Allowable voltage is +2.5 ±0.125V.
    Check voltage at C530.
    （☞10.1.1.A4）



19. P－5V
    Powers the PCG/pulse wave isolation unit.
    Allowable voltage is -5.0 ±0.25V.
    Check voltage at C541.
    （☞10.1.1.B4）



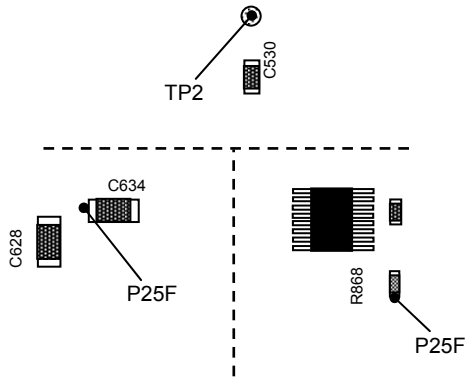
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(2) Body signals

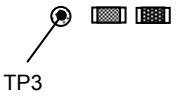
1. ECG
   Check the difference in input between each electrode and F (right leg) on each AD converter.

Input Signals	Check site
R - F	IC81, Pin 1
L - F	IC71, Pin 1
F	IC86, Pin 2
C1 - F	IC73, Pin 1
C2 - F	IC70, Pin 1
C3 - F	IC82, Pin 1
C4 - F	IC72, Pin 1
C5 - F	IC83, Pin 1
C6 - F	IC84, Pin 1

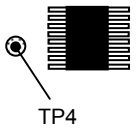
2. PCG PWV characteristics (PCG_PWV)
   Check voltage at TP2.
   Use C634 or R868 as virtual ground.
   (☞10.1.1.A4)



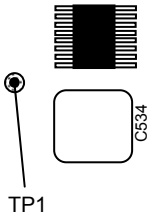
3. PCG L characteristics (PCG_L)
   Check voltage at TP3.
   Use C634 or R868 as virtual ground.
   (☞10.1.1.A4)



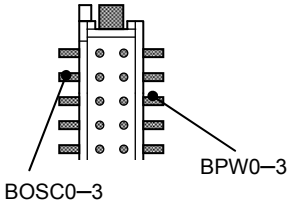
4. Pulse wave 1 (PW0)
   Check voltage at TP4.
   Use C634 or R868 as virtual ground.
   (☞10.1.1.B4)



5. Pulse wave 2 (PW1)
   Check voltage at TP1.
   Use C634 or R868 as virtual ground.
   (☞10.1.1.A4)



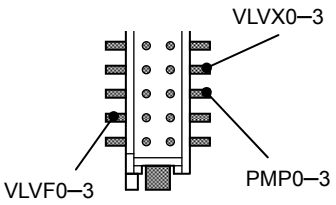
6. Pressure pulse wave (BOSC0–3)
   Check the pressure pulse wave for the right brachial,
   left brachial, right ankle and left ankle at pin 4 on CN11, CN13,
   CN10 and CN12, respectively.
   （☞10.1.1.B1.C1）



7. Cuff pulse wave (BPW0–3)
   Check the cuff pulse wave for the right brachial,
   left brachial, right ankle and left ankle at pin 5 on CN11, CN13,
   CN10 and CN12, respectively.
   （☞10.1.1.B1.C1）

(3) Pump unit control signal

1. VLVX0–3
   This is the quick-exhaust valve control signal.
   Check the signal for the right brachial,
   left brachial, right ankle and left ankle at pin 11 on CN11, CN13,
   CN10 and CN12, respectively.
   （☞10.1.1.C1）



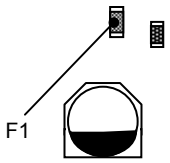
2. PMP0–3
   This is the air pump control signal.
   Check the signal for the right brachial,
   left brachial, right ankle and left ankle at pin 13 on CN11, CN13,
   CN10 and CN12, respectively.
   （☞10.1.1.C1）

3. VLVF0–3
   This is the flow control valve signal.
   Check the signal for the right brachial,
   left brachial, right ankle and left ankle at pin 16 on CN11, CN13,
   CN10 and CN12, respectively.
   （☞10.1.1.C1）

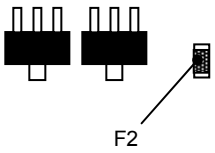
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10.1.3.2 Fuse Check

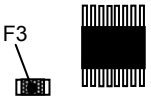
1. F1
   This fuse protects the +12 V power supply providing power to the PCG/PW isolation unit.
   (☞10.1.1.B3)



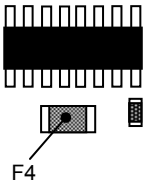
2. F2
   This fuse protects the +5 V power supply providing power to the serial isolation unit.
   (☞10.1.2.C3)



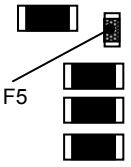
3. F3
   This fuse protects the +5V power supply providing power to the ECG isolation unit.
   (☞10.1.2.B2)



4. F4
   This fuse protects the +5V power supply providing power to externally connected serial devices.
   (☞10.1.2.C3)



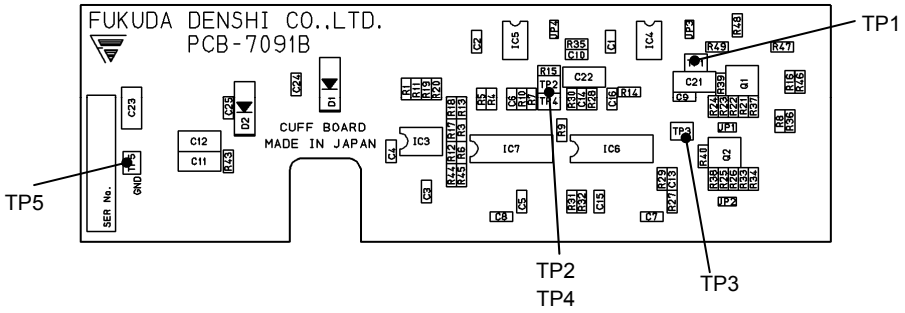
5. F5
   This fuse protects the ECG isolation unit power supply.
   (☞10.1.2.B1)



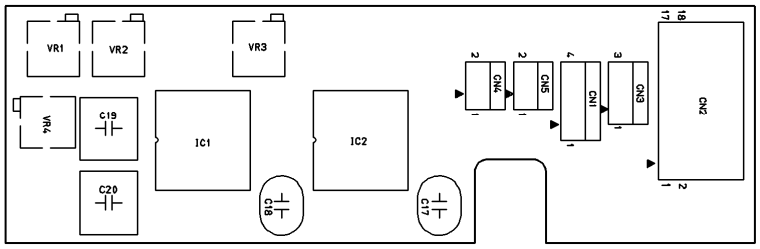
10.2 CUFF BOARD

10.2.1 Part Location Diagram

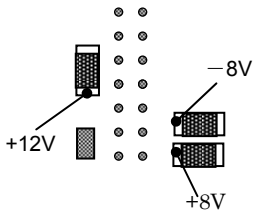
Component side, part location diagram



Solder side, part location diagram



10.2.2 Power Supply and Test Pin Checks



1. +8V
   Allowable voltage is +8.0 ±0.4V.
   Check voltage at C11.

2. −8V
   Allowable voltage is -8.0 ±0.4V.
   Check voltage at C12.

3. +12V
   Allowable voltage is +12 ±0.6V.
   Check voltage at C23.

4. TP1
   Measures the power supply voltage of the positive pressure sensor.
   Use this voltage for adjusting the accuracy of positive pressure P.

5. TP2
   Measures the power supply voltage of the supplementary pressure sensor.
   Use this voltage for adjusting the accuracy of supplementary pressure Q.

6. TP3
   Measures the voltage of positive pressure P.
   Use this voltage for adjusting the accuracy of positive pressure P.

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7. TP4
   Measures the voltage of supplementary pressure Q.
   Use this voltage for adjusting the accuracy of supplementary pressure Q.

8. TP5
   GND terminal.

9. Pressure pulse wave (OSC)
   Check at pin 4 on CN2.

10. Cuff pulse wave (PW)
    Check at pin 5 on CN2.

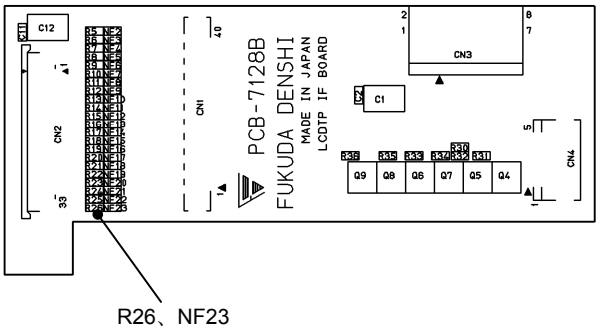
11. Pressure safety circuit 1 (LOWCUFF)
    A 10 mmHg or higher pressure is output as "H".
    Check at pin 18 on CN2.

12. Pressure safety circuit 2 (HICUFF)
    A 320 mmHg or higher pressure is output as "H".
    Check at pin 17 on CN2.

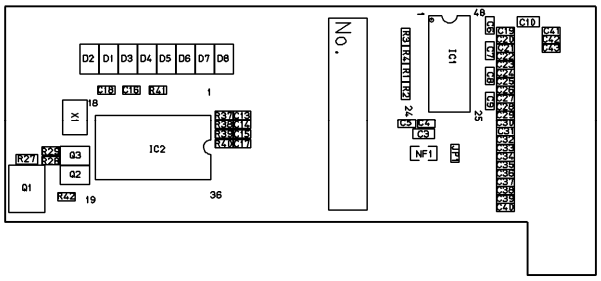
10.3 LCDTP IF BOARD

10.3.1 Part Location Diagram

Component side, part location diagram

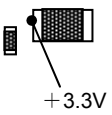


Solder side, part location diagram

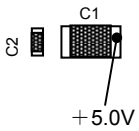


10.3.2 Power Supply and Signal Checks

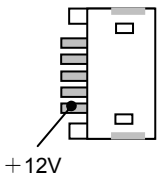
1. ＋3.3V
   Allowable voltage is +3.3 ±0.165V.
   Check voltage at C12.



2. +5V
   Allowable voltage is +5.0 ±0.25V.
   Check voltage at C1.



3. +12V
   Allowable voltage is +12 ±0.6V.
   Check at pin 1 on CN4.



4. Clock
   This is the LCD panel clock signal (25.175 MHz).
   Check at R26 or NF23.

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10.4 Power Supply Unit

10.4.1 Output Voltage Check

To check the output of the power supply only, temporarily set pin 19 to "L" (short it by connecting it to GND) to run the power supply unit.
The output from each pin is as follows.

Pin No.	Output voltage	Allowable voltage	Cable color
Pin 1	+3.3V	+3.3±0.165V	Purple
Pin 2	+3.3V	+3.3±0.165V	Purple
Pin 5	+5V	+5.0±0.25V	Yellow
Pin 6	+5V	+5.0±0.25V	Yellow
Pin 9	+12V	+12.0±0.6V	Orange
Pin 10	+12V	+12.0±0.6V	Orange
Pin 13	+12V	+12.0±0.6V	Orange
Pin 15	+24V	+24.0±1.2V	Red
Pin 17	+24V	+24.0±1.2V	Red
Pin 22	+5V	+5.0±0.25V	Green

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11

Chapter 11 Spare Parts List

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11.2 Main Unit....11-3
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11.11 Optional Accessories....11-14
11.12 Consumables....11-15

11.1 Replacement of the accessories

The following parts and accessories require periodical inspection and replacement. The standard replacement time is as follows:

- **Limb cuffs・・・・・30,000 times**

- **Toe cuffs・・・・・ 6 months after opening**
  Worn cuffs cannot measure blood pressure accurately.

- **TR-13M pulse wave sensor with air bag・・・・・ 3,000 times**

- **Thermal head ・・・・・approx. 50 km (of continuous printing)**
  A worn thermal print head lowers the overall printout density and causes missed dots.

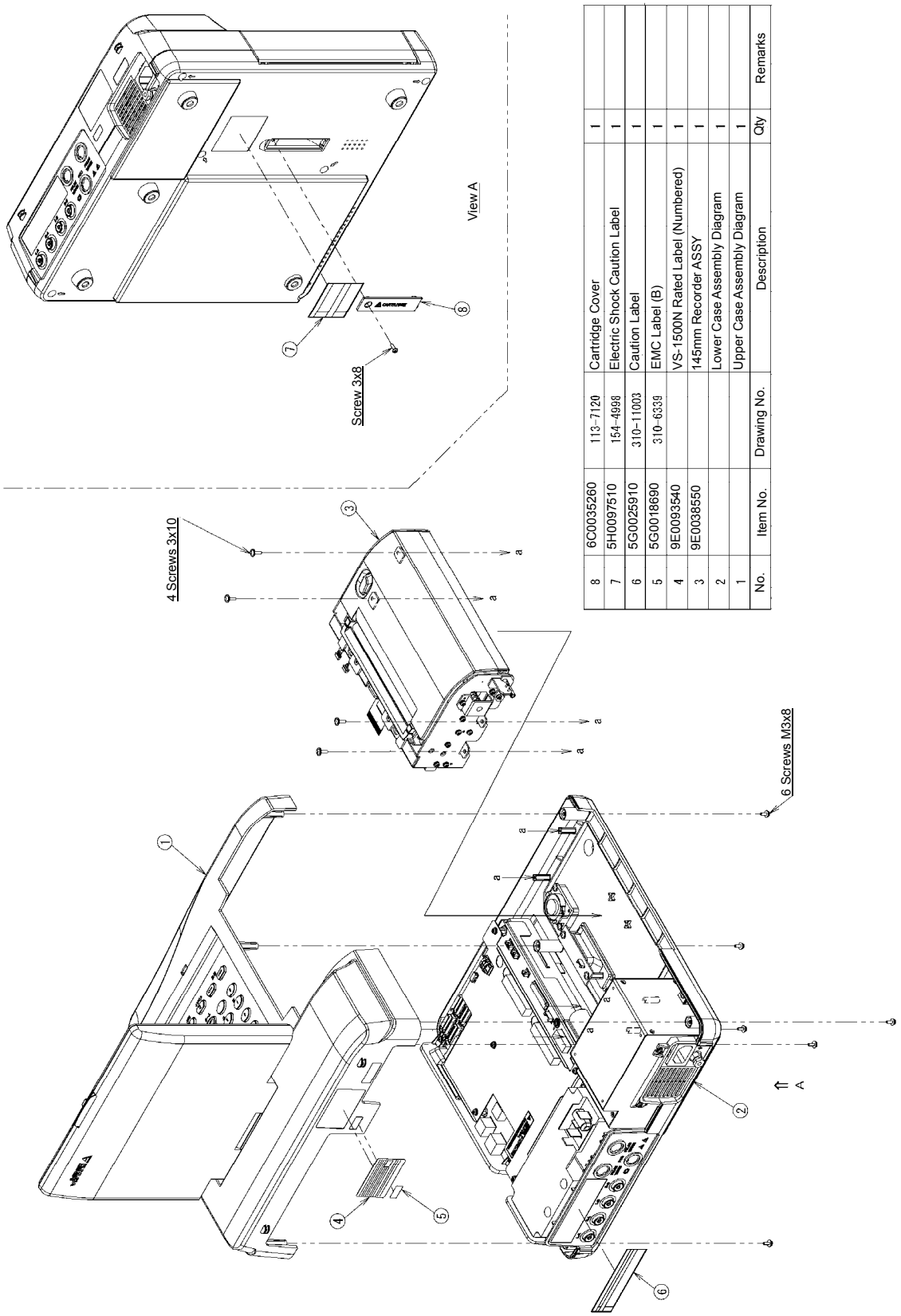
- **Paper driver motor ・・・・・approx 8,000 hours of use (of continuous printing)**
  A worn paper drive motor results in unstable printing due to irregular paper feed and fluctuating paper speed.

- **Display backlight ・・・・・54,000 hours**
  A worn LCD backlight lowers the LCD brightness and may prevent the LCD from illuminating.

- **Clock battery・・・・・ 6 years**
  The clock battery powers the internal clock and preserves made settings. When the battery is depleted, the date and time are no longer correctly displayed and all made settings revert to their factory defaults. Replace the depleted battery with a new one.

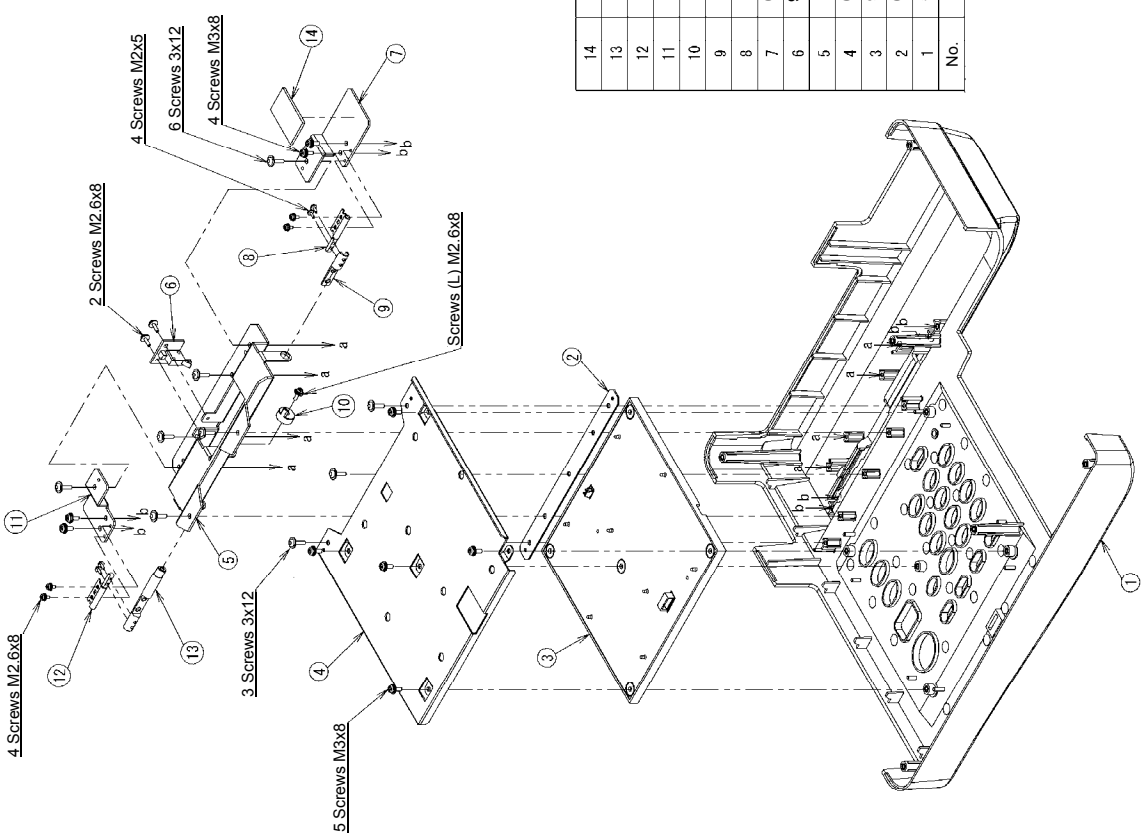
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11.2 Main Unit



No.	Item No.	Drawing No.	Description	Qty	Remarks
8	6C0035260	113-7120	Cartridge Cover	1	
7	5H0097510	154-4998	Electric Shock Caution Label	1	
6	5G0025910	310-11003	Caution Label	1	
5	5G0018690	310-6339	EMC Label (B)	1	
4	9E0093540		VS-1500N Rated Label (Numbered)	1	
3	9E0038550		145mm Recorder ASSY	1	
2			Lower Case Assembly Diagram	1	
1			Upper Case Assembly Diagram	1	

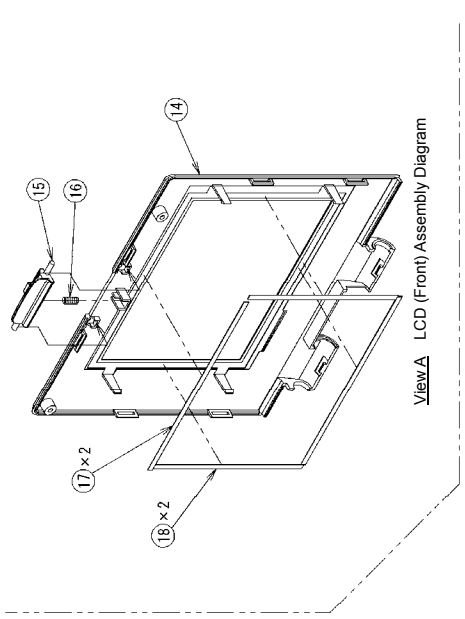
11.3 Upper Case Block



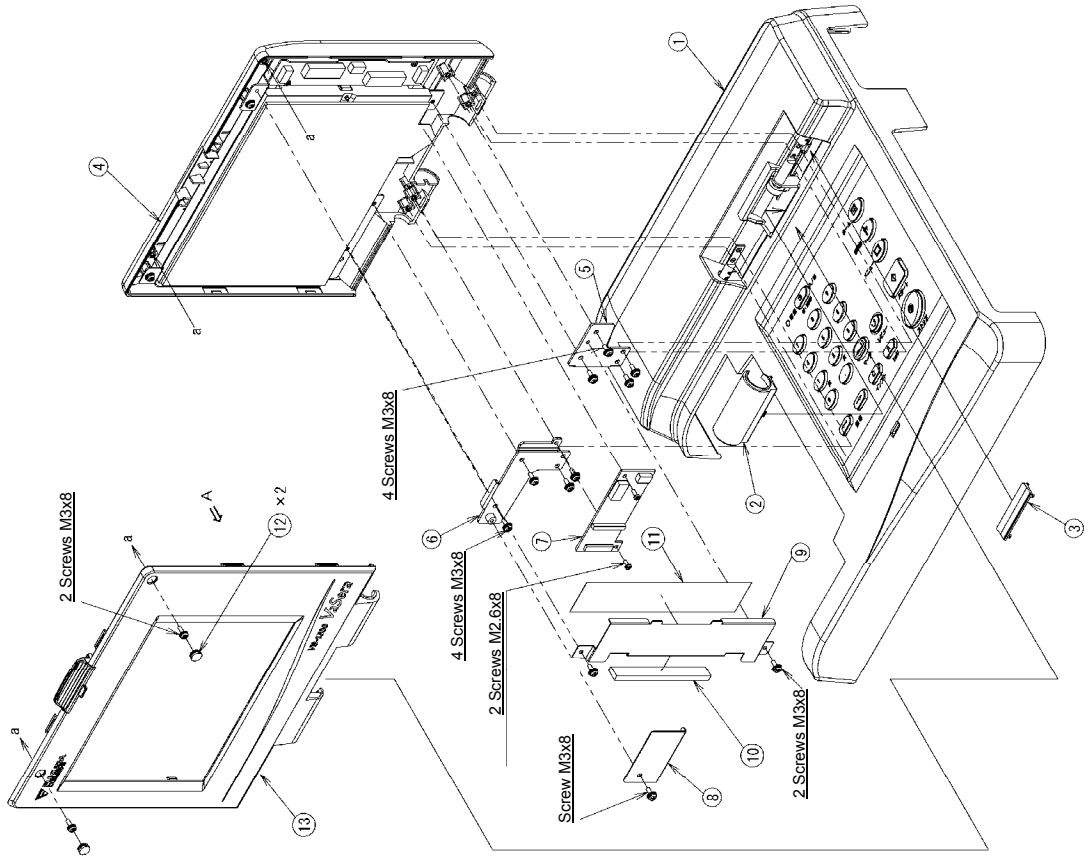
No.	Parts No.	Description	Qty	Remarks
14	1Z0028050	Gasket Width 10 Thickness 4	1	
13	6C0073520	310-11000 Hinge (R)	1	
12	6C0073700	S T 0 6 0 A 0	1	
11	6C0073450	310-10998 Hinge Holding Plate (R)	1	
10	6C0073120	310-10993 Switch Cam	1	
9	6C0073510	310-10999 Hinge (L)	1	
8	6C0073710	S T 0 6 0 A 1	1	
7	6C0073440	310-10997 Hinge Holding Plate (L)	1	
6	9F0055310	LCD Switch Board	1	
5	6C0073430	310-10996 Hinge Chassis	1	
4	6C0073390	310-10995 Key Panel Shield Plate	1	
3	9D0058240	680-5018 Keyboard	1	
2	6C0073420	310-10994 Upper Case Equipotential Metal Plate	1	
1	5G0025810	310-10989 Main Unit Upper Case	1	

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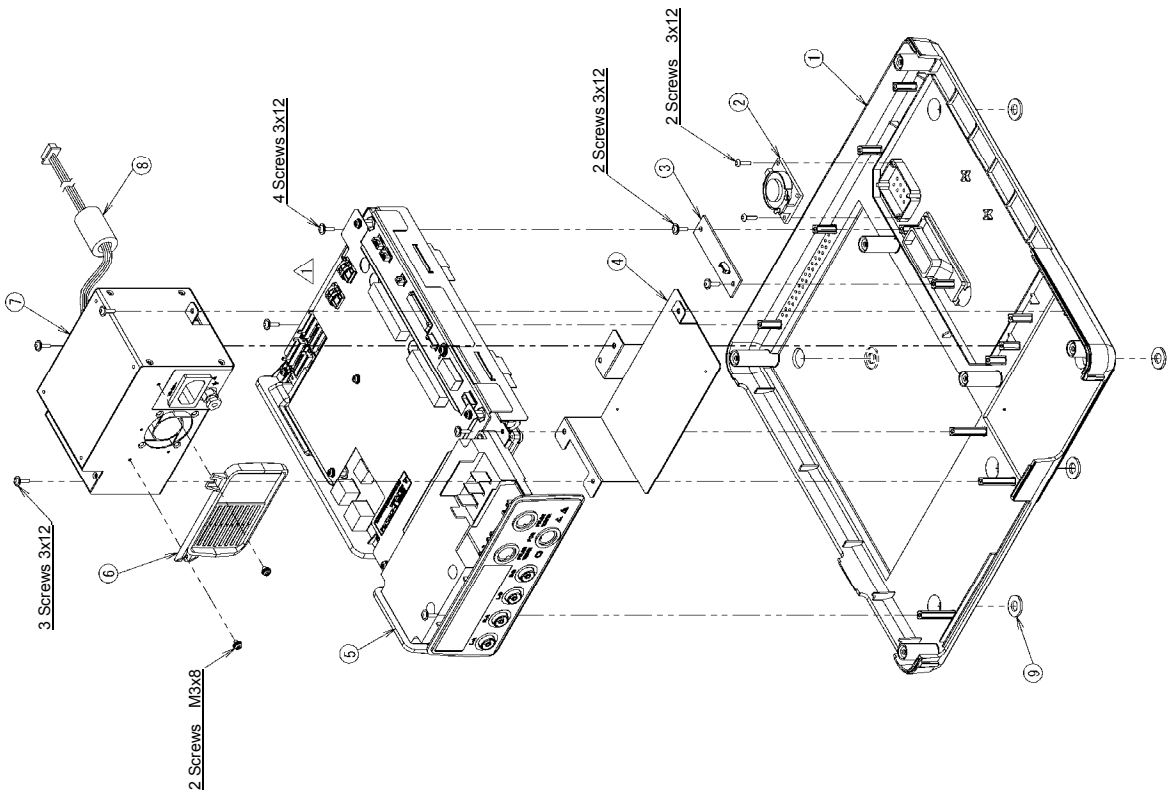
11.4 LCD Block



No.	Parts No.	Drawing No.	Description	Qty	Remarks
18	6C0073680	310-10985	LCD Packing (B)	2	
17	6C0073670	310-10984	LCD Packing (A)	2	
16	6C0073690		Compression Spring	1	
15	6C0073130	310-10975	LCD Lever	1	
14	5G0025820	310-10971	LCD Front Cover SU	1	
13			LCD (Front) Assembly Diagram	1	
12	6C0073140	310-10976	Rubber Cap (Small)	2	
11	6C0073540	310-10983	Inverter Board Insulation Sheet	1	
10	1Z0028050		Gasket	1	
9	6C0073490	310-10981	Inverter Board Insulation Sheet	1	
8	6C0073500	310-10982	Flexield	1	
7	9F0055290		LCD TP-IF Board	1	
6	9H0070650	310-10978	LCD Reinforcing Plate (L) SU	1	
5	6C0073480	310-10980	LCD Reinforcing Plate (R)	1	
4			LCD (Rear) Assembly Diagram	1	
3	6C0073100	310-10992	Hinge Cover	1	
2	6C0073090	310-10991	Cable Cover	1	
1			Upper Case Assembly Diagram (1)	1	



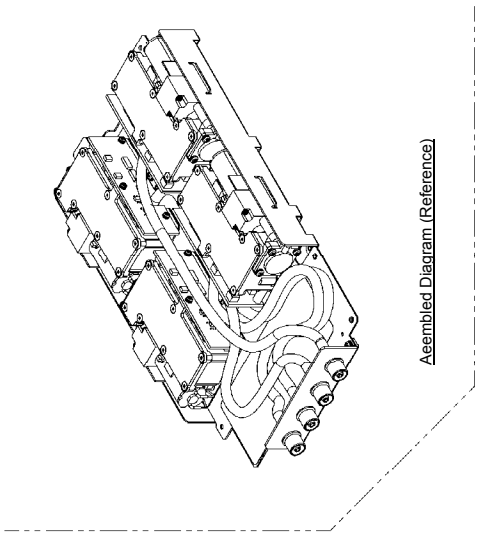
11.5 Lower Case Block



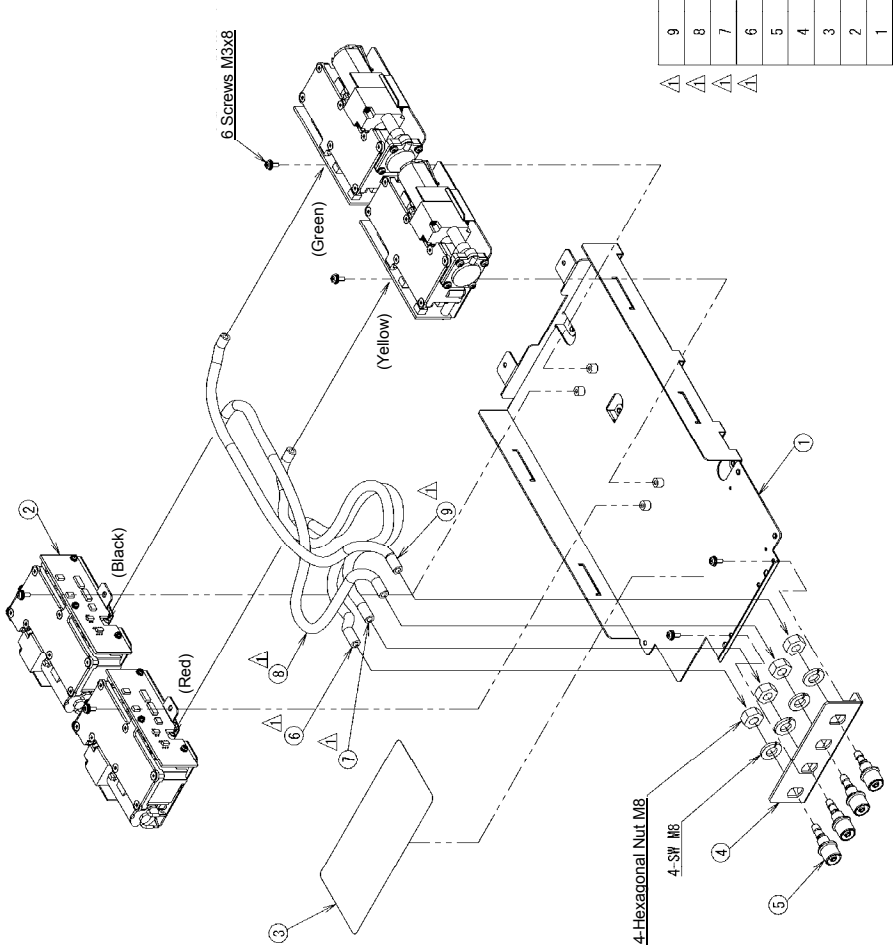
No.	Parts No.	Drawing No.	Description	Qty	Remarks
9	6C0035190	314-5062	Rubber Support	5	
8	1L0046970		Ferrite Core ZCAT2132-1130	1	
7	1T0059880	680-5018	Power Supply Unit	1	
6	6C0073110	310-10987	Fan Cover	1	
5			Main Block Diagram (2)	1	
4	6C0073360	310-10988	Equipotential Metal Plate	1	
3	9F0055340		P Cartridge Relay Board ASSY	1	
2	9E0025150	430-6327	Speaker ASSY	1	
1	6C0073030	310-10986	Main Unit Lower Case	1	

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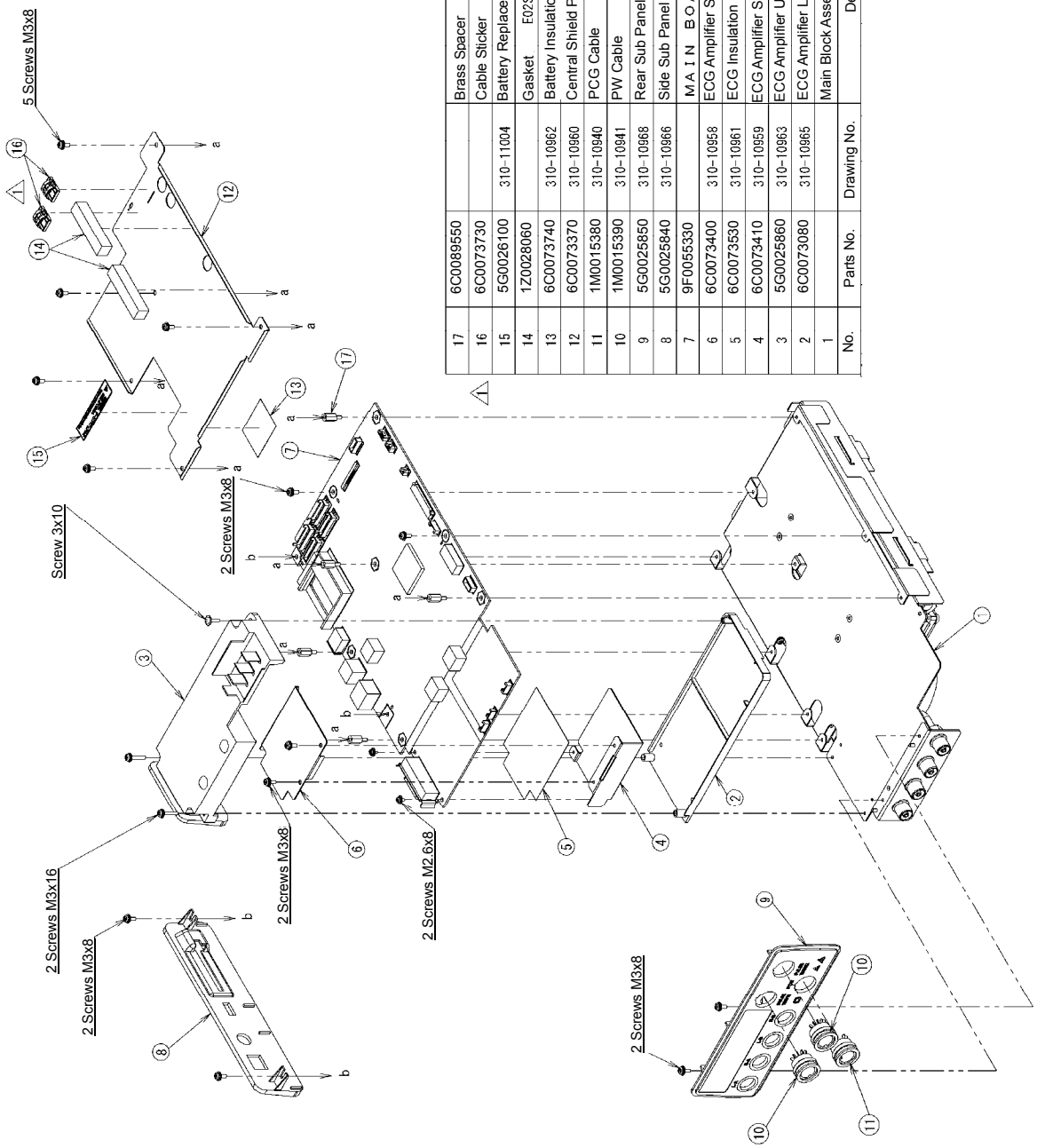
11.6 Pump Block



No.	Parts No.	Drawing No.	Description	Qty	Remarks
9	6G0100100	310-11863	Air Tube 320 (Green)	1	
8	6G0100090	310-11862	Air Tube 320 (Black)	1	
7	6G0100080	310-11861	Air Tube 320 (Yellow)	1	
6	6G0100070	310-11860	Air Tube 320 (Red)	1	
5	6C0083090	680-3935	BP Chassis Plug	4	
4	6C0073350	310-10957	Air Hose Connector L Metal	1	
3	5G0026110	310-11005	Air Tube Location Label	1	
2		410-3268	Pump Block Assembly Diagram	4	
1	9H0070640	310-10954	Main Chassis SU	1	



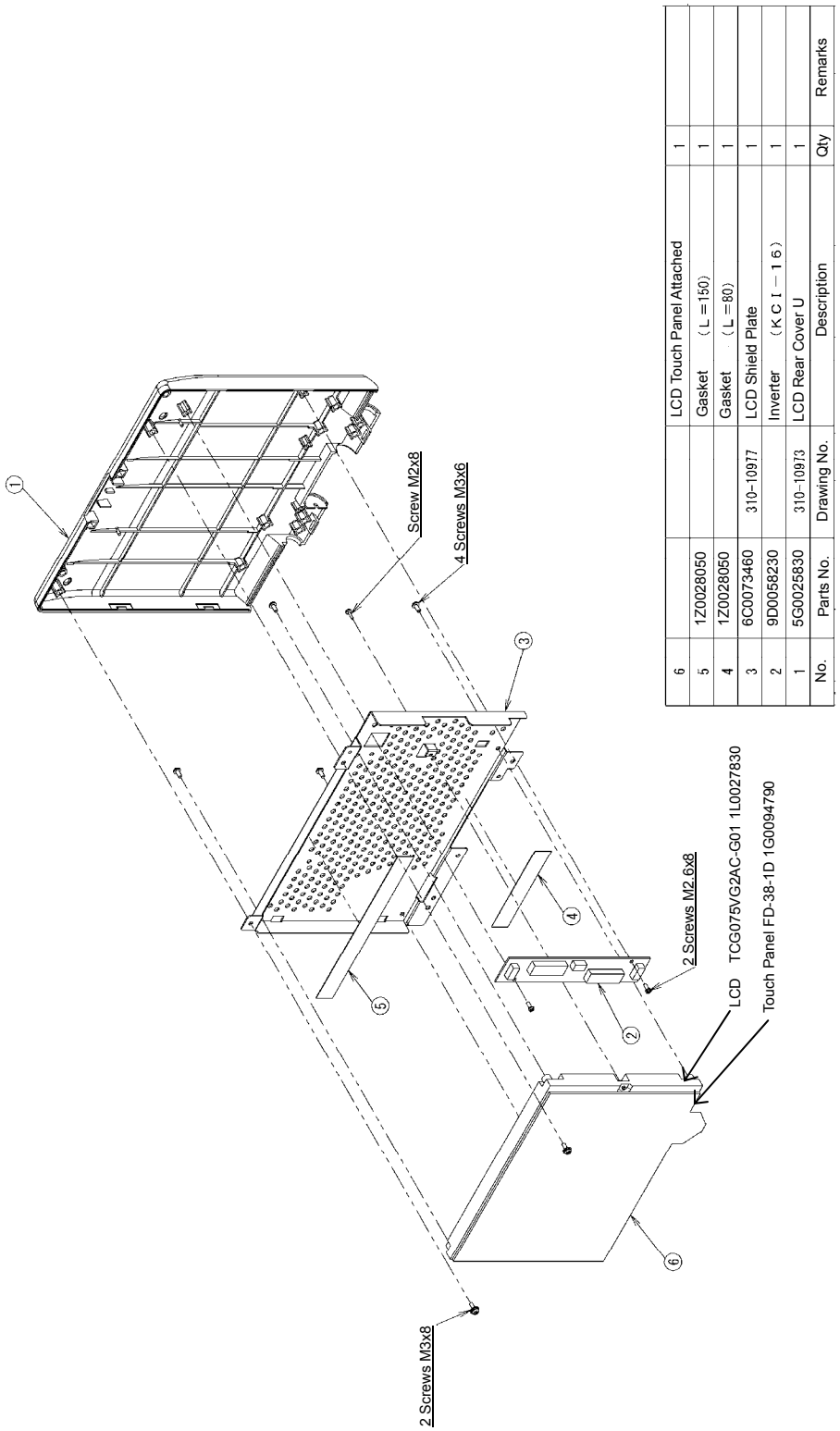
11.7 Main Block



No.	Parts No.	Drawing No.	Description	Qty	Remarks
17	6C0089550		Brass Spacer BSB-310	5	
16	6C0073730		Cable Sticker KS-12	2	
15	5G0026100	310-11004	Battery Replacement Caution Label	1	
14	1Z0028060		Gasket E02S100100JST	2	
13	6C0073740	310-10962	Battery Insulation Sheet	1	
12	6C0073370	310-10960	Central Shield Plate	1	
11	1M0015380	310-10940	PCG Cable	1	
10	1M0015390	310-10941	PW Cable	2	
9	5G0025850	310-10968	Rear Sub Panel SU	1	
8	5G0025840	310-10966	Side Sub Panel SU	1	
7	9F0055330		MAIN BOARD	1	
6	6C0073400	310-10958	ECG Amplifier Shield Plate (Upper)	1	
5	6C0073530	310-10961	ECG Insulation Sheet	1	
4	6C0073410	310-10959	ECG Amplifier Shield Plate (Lower)	1	
3	5G0025860	310-10963	ECG Amplifier Upper Cover SU	1	
2	6C0073080	310-10965	ECG Amplifier Lower Cover	1	
1			Main Block Assembly Diagram (1)	1	

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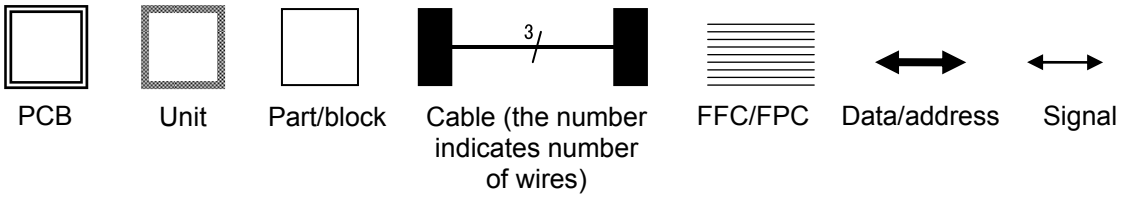
11.8 LCD Unit

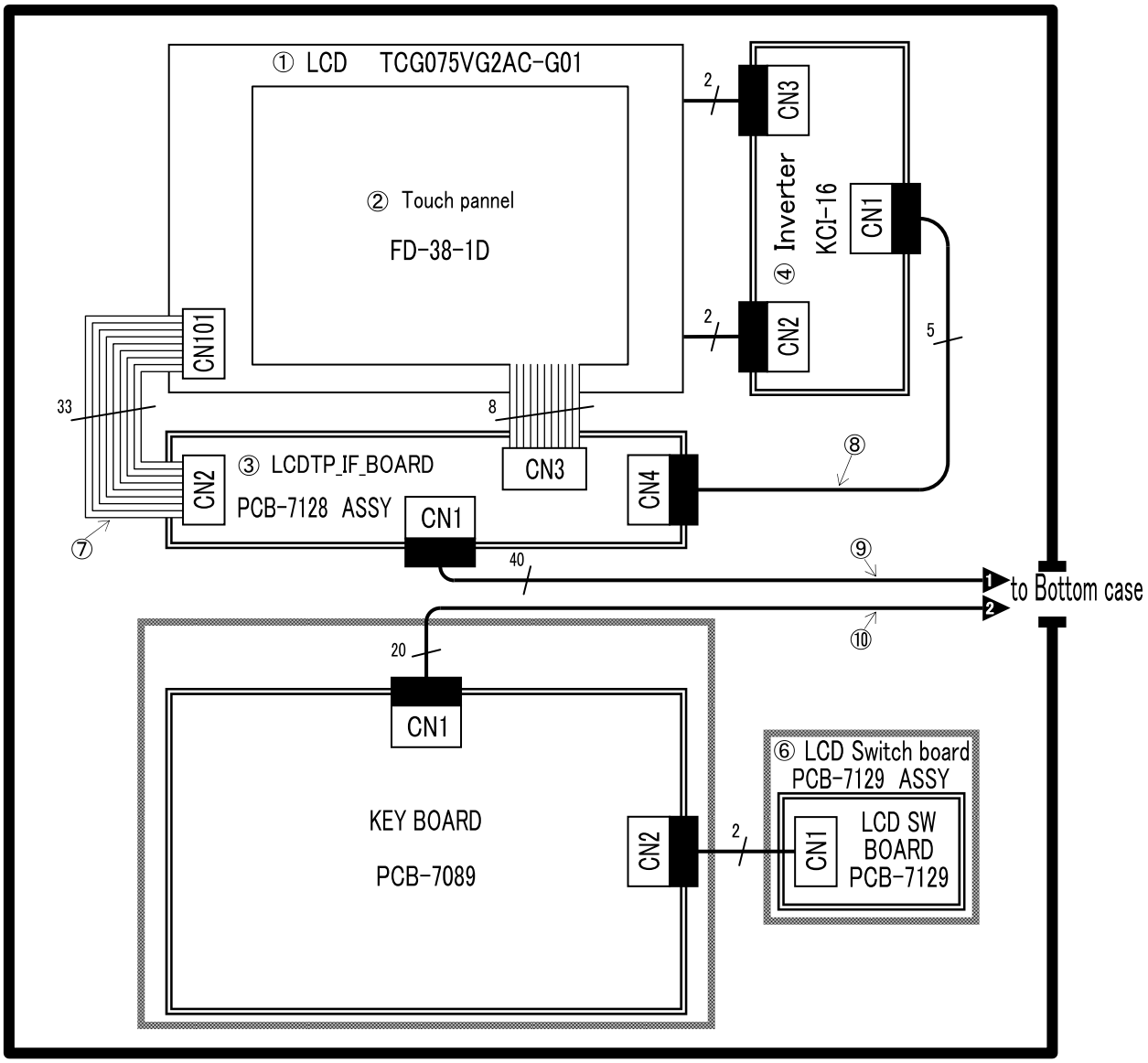


No.	Parts No.	Drawing No.	Description	Qty	Remarks
6			LCD Touch Panel Attached	1	
5	1Z0028050		Gasket （L＝150）	1	
4	1Z0028050		Gasket （L＝80）	1	
3	6C0073460	310-10977	LCD Shield Plate	1	
2	9D0058230		Inverter （KCI－16）	1	
1	5G0025830	310-10973	LCD Rear Cover U	1	

11.9 Part Block Diagram

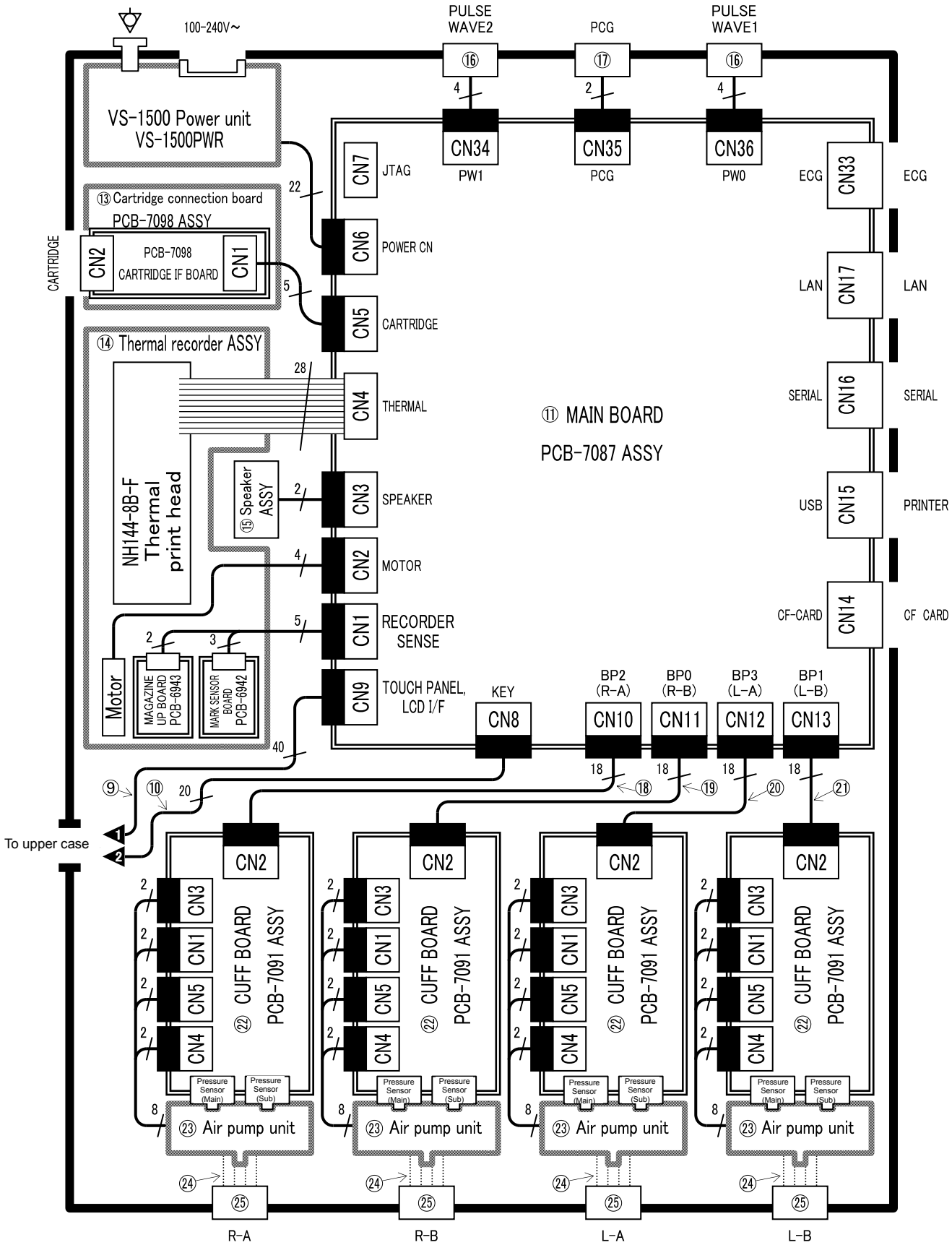
11.9.1 Upper Case Block





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Lower Case Block



Parts List

The parts number listed below corresponds to that indicated on the wire diagram.

No.	Part No.	Model
1	1L0017830	LCD TCG075VG2AC-G01
2	1G0094790	Touch panel FD-38-1D
3	9F0055290	LCDTP_IF_BOARD PCB-7128 ASSY
4	9D0058230	Inverter KCI-16
5	9D0058240	Key board
6	9F0055310	LCD Switch board PCB-7129 ASSY
7	1M0015310	LCD cable
8	1M0015300	Inverter cable
9	1M0015290	MAIN-LCD cable KHSL26-1345-00
10	1M0015320	Key cable
11	9F0055330	Main board PCB-7087 ASSY
12	1T0059880	Power unit VS-1500PWR
13	9F0055340	Cartridge connect board ASSY PCB-7098 ASSY
14	9E0038550	Thermal recorder unit
15	9E0025150	Speaker ASSY
16	1M0015390	PW cable
17	1M0015380	PCG cable
18	1M0015360	BP cable R-A
19	1M0015370	BP cable R-B
20	1M0015340	BP cable L-A
21	1M0015350	BP cable L-B
22	9F0055320	CUFF BOARD
23	6C0083110	Air pump unit FBM-3
24	6G0012320	Air tube
25	6C0083090	NIBP plug

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11.10 Accessories

(1) VS-1500N

No.	Accessory	Model	Parts No.	Quantity	Remarks
1	Power cable (3 m)	CS-18, CS-24	4A0060730	1	
2	NIBP cuffs (Right Brachial)	CUF-129MR	9D005810C	1	
	(Left Brachial)	CUF-129ML	9D005811C	1	
	(Right Ankle)	CUF-138MR	9D0059110	1	
	(Left Ankle)	CUF-138ML	9D0059120	1	
3	Air hose (2.5 m) (Lower limbs)	OA-500A	9D004890A	1	
	(Upper limbs)	OA-500B	9D004886A	1	
4	ECG cable	CPV-01AKP	9D0069480	1	
5	Limb electrode	TE-45	9D0044630	1 set (2)	Wrist
6	PCG Microphone	MA-300HDS(V)	9D004564A	1	
7	Keratin cream	OJ-02	4E001002C	1	
8	Chart paper (145 mm x 30 m, roll paper)	OP-358TE	4G008027A	1	
9	Instrument cover		4K0012020	1	
10	Compact flash card (128 MB)	FCF-128	1Z007333B	1	
11	Limb cushion	OA-461	9D0051000	1	
12	Operation manual			1	

11.11 Optional Accessories

No.		Accessory	Model Remarks
1	Potential equalization cable	CE-12	5m
2	Amorphous pulse wave sensor	TY-501A	
	Amorphous cap	OA-256	Amorphous caps 20 pieces per pack
3	Keratin cream	OJ-01	
4	Trolley	OTV-01	
5	Cable hanger	OA-300A	
6	Hose hanger kit	OA-130	(Purchase the hose hanger kit with the cable hanger.)
7	Roll paper	OP-358TE	
8	Z-fold paper	OP-383TE	
9	Dual-side adhesive tape	DA-30	For PCG microphone, 150 pieces/pack
10	Cuff cover (for upper limb)	OA-1129M	
	Cuff cover (for lower limb)	OA-1130M	
11	Toe blood pressure kit	ASV-2	Toe cuffs, air hoses and extension hoses
	Toe cover (M)	OA-459M	50 pieces per box
	Toe cuffs	CUF-139M2	color: Blue, size: M
	Toe cuffs	CUF-139S2	color: Brown, size: S
	Air hose (2.5 m)	OA-400C	1
	Extension hose	OA-400D	1 set
12	Pulse wave sensor with air bag	TY-101	
13	Air bag for pulse wave sensor	TR-13M	
14	Belt for pulse wave sensor	OB-33	
15	NIBP cuffs		
	(for right brachial, S)	CUF-129SR	17 - 22cm (6.7” – 8.7”)
	(for left brachial, S)	CUF-129SL	
	(for right brachial, L)	CUF-129LR	30 - 39cm (11.8” – 15.4”)
	(for left brachial, L)	CUF-129LL	
	(for right ankle, L)	CUF-138LR	30 – 42cm (11.8” – 16.5”)
	(for left ankle, L)	CUF-138LL	
16	Cuff holder	OAV-01A	
17	Limb cushion cover	OA-463	
18	Pulse wave test data Management software	VSS-10	
19	Printer shelf	OAV-03A	

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11.12 Consumables

No.	Accessory	Model	Parts No.	Quantity
1	NIBP cuffs			
	(Right Brachial M size)	CUF-129MR	9D005810C	1
	(Left Brachial M size)	CUF-129ML	9D005811C	1
	(Right Ankle M size)	CUF-138MR	9D0059110	1
	(Left Ankle M size)	CUF-138ML	9D0059120	1
	(Right Brachial S size)	CUF-129SR	9D005814B	1
	(Left Brachial S size)	CUF-129SL	9D005815B	1
	(Right Brachial L size)	CUF-129LR	9D005816B	1
	(Left Brachial L size)	CUF-129LL	9D005817B	1
	(Right Ankle L size)	CUF-138LR	9D0059130	1
	(Left Ankle L size)	CUF-138LL	9D0059140	1
2	roll paper	OP-358TE	4G008027A	
3	Z-fold paper	OP-383TE	4G006218A	
4	Compact flash card	FCF-128	1Z007333B	128MB
5	Keratin cream	OJ-01	4E001000B	
6	Keratin cream	OJ-02	4E001002C	
7	Amorphous Cap	OA-256	9D004894A	20 pieces /pack
8	Dual-side adhesive tape	DA-30	9D004934B	150 pieces /pack
9	Toe cover	OA-459M	6C0050570	50 pieces /pack
10	NIBP cuff for Toe M size	CUF-139M2	9D0102320	
	NIBP cuff for Toe S size	CUF-139S2	9D0102330	
11	Air Bag for Pulse Wave Sensor	TR-13M	9D0055670	

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Chapter 12 Information of the electromagnetic compatibility (EMC)

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12.1 Guidance to Electromagnetic Compatibility

The VS-1500 complies with the Safety Standard IEC 60601-1-2 (2001). However, if a portable transmitter, telemetry LAN unit or the like is used right by the instrument, it may receive an electromagnetic wave far exceeding the value stipulated in the Standard, adding noise to the waveforms or causing other erratic behavior.
Therefore be sure to use the instrument in the range specified by each individual healthcare institution. If unexpected waveform noise occurs or there is interference from surrounding equipment, stop using the instrument and consult an expert for advice.

Information concerning the electromagnetic compatibility (EMC) of the VS-1500 is provided below.
(Make sure that the VS-1500 is used in the environment described in this instruction manual.)

● Electromagnetic Emission Compatibility

The VS-1500 is designed for use in the electromagnetic environment described below.

Emission Test	Compatibility	Electromagnetic Environment/Guidance
RF emission CISPR 11	Group 1	The VS-1500 uses RF energy for internal functions only. Accordingly, RF emission is extremely low and the possibility of causing interference to nearby electronic equipment is negligible.
RF emission CISPR 11	Class B	The VS-1500 is designated suitable for direct connection to the public low-voltage power supply laid in virtually all structures including general households and used for domestic appliances.

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● Compatibility with Electromagnetic Immunity (1)

The VS-1500 is intended for use in the electromagnetic environments described below. It is recommended to verify that the VS-1500 is used in such an environment.

Immunity Test	IEC 60601-1-2 Test Level	Compatible Level	Electromagnetic Environment/Guidance
Electrostatic discharge (ESD): IEC 61000-4-2	±2, 4, 6 kV, contact ±2, 4, 8 kV, air	±2, 4, 6 kV, contact ±2, 4, 8 kV, air	Floors should be made of wood, concrete or ceramic tiles. In a room with a floor covered with synthetic material, the relative humidity should be at least 30%.
Electrically fast transient/burst: IEC 61000-4-4	±2 kV supply line ±1 kV I/O line	±2 kV supply line ±1 kV I/O line	The power supply should be of the same quality as a commercial or hospital line.
Surge: IEC 61000-4-5	±0.5, 1 kV, differential mode ±0.5, 1, 2 kV, common mode	±0.5, 1 kV, differential mode ±0.5, 1, 2 kV, common mode	The power supply should be of the same quality as a commercial or hospital line.
Voltage drops, dips or fluctuation of input supply line: IEC 61000-4-11	<5% U_T for 0.5 cycles (>95% U_T drop) <40% U_T for 5 cycles (60% U_T drop) 70% U_T for 25 cycles (>30% U_T drop) <5% U_T for 5 seconds (95% U_T drop)	<5% U_T for 0.5 cycles (>95% U_T drop) <40% U_T for 5 cycles (60% U_T drop) 70% U_T for 25 cycles (>30% U_T drop) <5% U_T for 5 seconds (95% U_T drop)	The power supply should be of the same quality as a commercial or hospital line. If continuous operation is required at all times regardless of power outages, connect the VS-1500 to an uninterruptible power supply (UPS) device.
Power frequency magnetic fields (50/60 Hz): IEC 61000-4-8	3 A/m	3 A/m	The power frequency magnetic field of the power supply should be the same level as a standard commercial or hospital line.

● Note: U_T is the AC line voltage prior to application of the test level.

● Compatibility with Electromagnetic Immunity (2)

The VS-1500 is intended for use in the electromagnetic environments described below. It is recommended to verify that the VS-1500 is used in such an environment.

Immunity Test	IEC 60601-1-2 Test Level	Compatible Level	Electromagnetic Environment/Guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz - 80 MHz	3 V/rms	Portable and mobile RF communication equipment including the cable must not be used at a distance that is less than the recommended separation distance calculated using the equation for the concerned transmitter frequency. Recommended separation distance: $d=1.2\sqrt{P}$ $d=1.2\sqrt{P}$ 80 - 800 MHz $d=2.3\sqrt{P}$ 800 MHz - 2.5 GHz Where, P is the rated maximum output power of the transmitter in watts (W) (according to manufacturer specifications) and d is the recommended separation distance in meters (m). The electric field strength of the fixed RF transmitter determined by the electromagnetic field survey*1 must be lower than the applicable level in each frequency range*2. Interference may occur in the vicinity of equipment having the following symbol label: 
Radiated RF IEC 61000-4-3	3 V/m 80 MHz - 2.5 GHz	3 V/m	

- Note 1: The higher frequency range should be applied for 80MHz and 800MHz.
- Note 2: The above guideline is not applicable to every situation. Electromagnetic diffusion depends on reflection from buildings, objects and human beings and how much they absorb.

*1 The electric field strength of fixed transmission stations such as cellular and cordless telephone base stations, regional portable radios, amateur radios, AM/FM broadcasting and TV broadcasting stations cannot be forecast accurately and theoretically.
To correctly assess the electromagnetic environment of fixed RF transmission stations, an electromagnetic survey must be conducted at the site.
If the electric field strength measured at the site where the VS-1500 is used exceeds the applicable level stated above, inspect whether or not the VS-1500 operates normally. If any abnormal operation is found, additional countermeasures may be required to make the VS-1500 operable.

*2 Beyond the frequency range of 150 kHz to 80 MHz, the electric field strength should be 3V/m or less.

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● Recommended Separation Distance between Portable or Mobile RF Communication Equipment and the VS-1500

The VS-1500 is intended for use in electromagnetic environments where radiated RF interference is controlled. Electromagnetic interference can be suppressed by maintaining a minimum allowable distance between portable or mobile RF communication equipment (transmitter) and the VS-1500. The recommended minimum allowable distance depends on the maximum output power of the transmitter as shown below:

Rated Maximum Output Power of Transmitter (W)	Separation Distance (m) based on Transmitter Frequency		
	26 to 80MHz $d = 1.2\sqrt{P}$	80 to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

Use the same equation to determine the recommended separation distance d in meters (m) for the rated maximum output power of transmitters not listed above. P in this equation is the rated maximum output power in watts (W) of the transmitter provided by the manufacturer.

- Note 1: The separation distance for the higher frequency range should be applied for 80MHz and 800MHz.
- Note 2: The above guideline is not applicable to every situation.
- Electromagnetic diffusion depends on reflection from buildings, objects and human beings and how much they absorb.

● Interference generated by electrical scalpels

When used with an electrical scalpel having the specifications described below, this instrument is protected against any malfunctions that the resulting interference could produce.

Immunity Test	IEC 60601 test level	Compatible Level	Electromagnetic Environment/Guidance
Cutting mode	Output power 300 W	Output power 300 W	When an electrical scalpel generates high-frequency energy the waveform noise level that is indicated and recorded by the instrument increases. However, it returns to normal levels less in 10 seconds or less after the high frequency energy ends. Usable analysis results may not be obtainable for analyses made of waveforms during periods when high-frequency energy is generated.
Coagulation mode	Output power 100 W	Output power 100 W	

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