

SERVICE MANUAL

Interpretive Electrocardiograph

FCP-2155

4R2044

 **FUKUDA DENSHI CO., LTD.**

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Denshi Co., Ltd.

Manufactured in Japan

Foreword



We list up here the warning marks used in Fukuda operation and service manuals.

When you service the FCP-2155, read this service manual thoroughly and pay attention especially to instructions bearing the following marks:

Warning Marks

Warning marks used in operation and service manuals and labelled on the equipment have the following meanings:

Read them carefully to understand the meanings and make sure of the significance of each particular.



Danger

This mark is used to indicate the direct hazards which may lead to the death or serious injury of the person, may wholly damage the instrument or may cause fire hazard, unless the instructions written there are observed.



Warning

This mark is used to indicate the indirect potential hazards which may lead to the death or serious injury of the person, may wholly damage the instrument or may cause fire hazard, unless the instructions written there are observed.



Caution

This mark is used to indicate the possible hazards which may lead to a mild or medium injury of the person, may partially damage the instrument or may erase data from the computer.

NOTE

“NOTE” is not warning instructions but offers information to prevent the person from doing erroneous servicing.

Other Marks



Notice to indicate general unspecific prohibited matters.



Notice to indicate general unspecific caution, warning or hazard.

This service manual describes technical information on FCP-2155 to aid the service engineer in troubleshooting.

The manual is intended to be used by service engineers of Fukuda representatives and authorized technical staff concerned with medical electronic equipment. Description includes repairing and assembling methods of each component unit of FCP-2155. For parts lists and diagrams, refer to the Part II of the service manual.

The service manual consists of the following nine chapters:

1. General Description

The outline of FCP-2155, specifications and controls and indicators are described.

2. Circuit Description

Circuit configuration and functions are explained.

3. Troubleshooting

Troubles vs. causes and countermeasures are described.

4. Maintenance

Procedures to replace the power fuse, ROM and battery and to perform self-test are described.

5. Periodical Inspection




Inspection procedures to prevent troubles and ensure safe and complete operation of the instrument are described.

6. Circuit Diagrams


7. Assembly Diagrams

8. Electrical Parts Lists

9. Structural Diagrams

 Caution	
	<ul style="list-style-type: none">• Never remodel Fukuda medical electronic equipment.
	<ul style="list-style-type: none">• The service manual is intended for the service engineers of Fukuda representatives and the technical staff concerned with medical electronic equipment. Servicing, reassembling and adjustment shall be performed by authorized service engineers.• Prepare proper facilities and tools when servicing.• Be sure to follow the instructions of operation manual when operating the equipment. For operating precautions, refer to the operation manual.

Servicing Precautions

-  Listed below are the instructions of prohibit, danger, warning, and caution which are described in this service manual. When taking the procedure bearing the following mark, read the description thoroughly, then start the task.

Caution

(page 3—2)

When checking voltages and signals on circuits for troubleshooting, take sufficient care to avoid short circuit.
Also take care of the AC input side of PCB-6238. Contacting it when the instrument is powered may cause an accidental hazard.

Caution

(page 4—1)

When replacing the power fuse, be sure to turn the power off and disconnect the power cord from the wall outlet in advance.

Caution

When replacing the ROM, be sure to turn the power off in advance. Also take care to mount it in correct direction.

Caution

(page 4—2)

When replacing the battery, be sure to turn the power off and disconnect the power cord from the wall outlet in advance.

Caution

(page 4—8)

Disassembling/Reassembling Precautions

- Be sure to turn the power off and disconnect the power cord from the wall outlet. Then start disassembling the equipment.
- When removing the main PC board, remove the Ni-MH battery in advance.
- Take care not to disconnect and connect the key panel and sensor board from/to the connector too frequently. Too frequent disconnection and connection of these units may cause poor contact.
- Use proper screwdrivers to loosen screws.
- When reassembling, make sure all screws are tightened to original positions and all disconnected connectors are reconnected properly.

PC Board Handling Precautions

- PC boards are equipped with extremely sensitive devices to static electricity.
- PC boards are sensitive electronic assemblies. Take proper measures for removed PC boards, e.g. put them in a conductive bag.
- Handle PC boards carefully. Giving an impact to them may damage devices mounted onto them.
- Never remove a PC board or connect the connector to it when supplied with power.

Caution

(page 5—2)

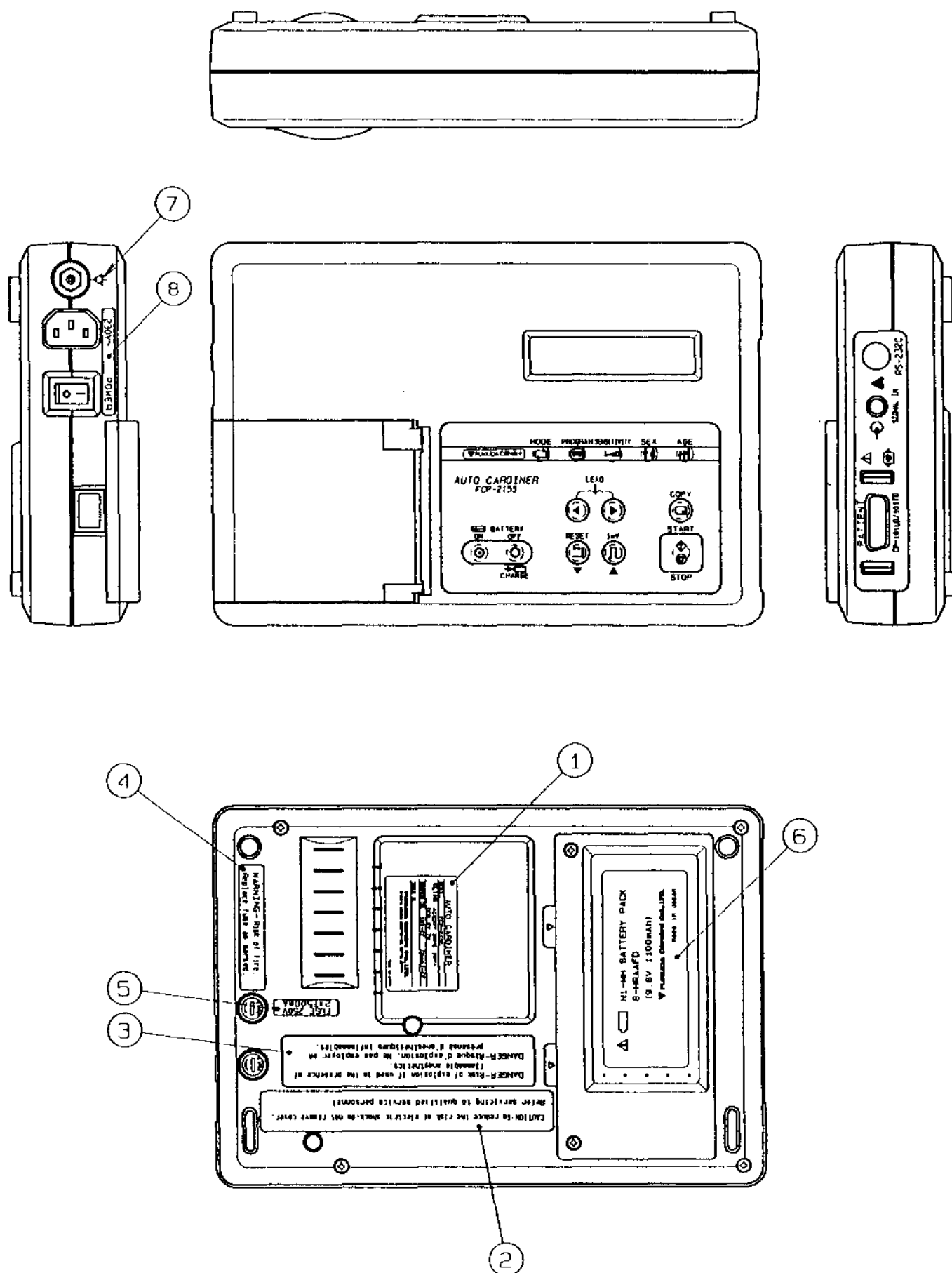
If you find a value which exceeds the allowable level, be sure to let the user avoid using the equipment. If the user operates the equipment as it is, he/she may receive an hazardous accident.

Equipment Classification

The FCP-2155 is classified into the following equipment:

1. Protection against electrical shock
Class I
2. Type against electrical shock
Applied part: Type CF
3. Degree of protection against harmful water invasion
Other equipment
4. Degree of safety in using under air-inflammable anesthetic gases or oxygen/nitrous oxide-anesthetic gases
Equipment used under an environment containing no inflammable anesthetic gases or no inflammable cleaning agent.
5. Running mode
Continuous running mode

External Labels



① RATING Label

AUTO CARDINER	
MODEL	FCP-2155
VOLTAGE	AC230V 50HZ 19VA
	DC9.6V 7W
EQUIPMENT TYPE	INT-CF CassI-CF
SERIAL NO.	
FUKUDA DENSHI CO., LTD.	
3-39-4, HONGO, BUNKYO-KU, TOKYO, JAPAN	
MADE IN JAPAN	

② CAUTION Label

CAUTION-To reduce the risk of electric shock, do not remove cover.
Refer servicing to qualified service personnel.

③ DANGER Label

DANGER-Risk of explosion if used in the presence of flammable anesthetics.
DANGER-Risque d'explosion. Ne pas employer en presense d'anesthésiques inflammables.

④ WARNING Label

WARNING-Risk of fire.
Replace fuse as marked.

⑤ FUSE Label

FUSE 250V
2×T500mA

⑥ BATTERY Label



Ni-MH BATTERY PACK
8-HRAAFD
(9.6V 1100mAh)

▼ FUKUDA DENSHI CO., LTD.

Made in Japan

⑦ Equipotential Ground



⑧ POWER Label

230V~ POWER

General Description

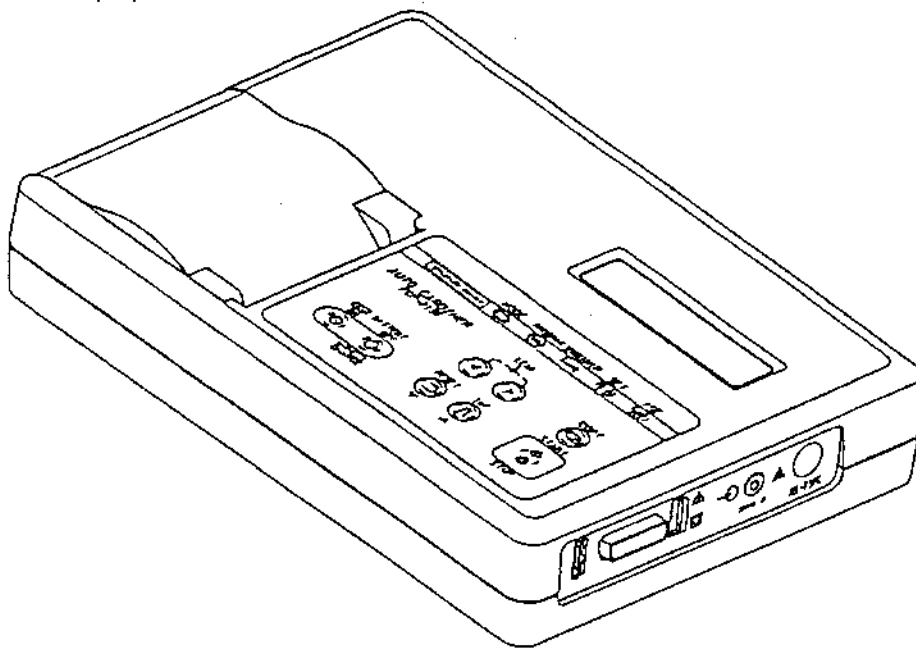
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3. Controls and Indicators	1—3

1. Outline

The FCP-2155 is a multi-channel electrocardiograph. It measures and analyzes standard 12-lead ECG waveforms with high accuracy, then records analysis results and ECG waveforms.

Based on clinically improved diagnostic criteria, the analysis program classifies measured ECG waveforms by Minnesota codes, age group and sex for increased accuracy.

The recorder adopts a high-density thermal print system to output clear ECG waveforms and measurements, together with patient data on a 63mm wide paper.



2. Specifications

Amplifier Section

Input circuit:	Floating above the ground
Leads:	Standard 12 leads, Cabrera leads
Input impedance:	20M Ω min. (10Hz refereed to)
Input circuit current:	5 x 10 ⁻⁸ max.
Input level:	\pm 18mV min.
Calibration voltage:	1mV within \pm 2%
CMR:	100dB or more
Electrode voltage tolerance:	\pm 400mV min.
Time constant:	3.2 seconds. min.
Sensitivities:	1/4, 1/2, 1, and 2 cm/mV; manual/automatic selection
Internal noise:	20 μ V p-p max.
Overload:	1V p-p 50/60Hz for 2 seconds
Frequency response:	0.05 to 150Hz within -3dB
Filters:	AC: -20dB or lower at 50/60Hz EMG: -3dB (-6dB/oct) at 40Hz Drift: -3dB or lower at 0.5Hz

A/D conversion: 13 bits
Sampling speed: 1ms

Amplifier Section

Recording system: Thermal writing with thermal print head
Paper speeds: 25 and 50mm/sec within $\pm 3\%$
Recording density: 8 dots/mm in amplitude direction
1msec in time axis direction
Chart paper: Roll paper 63mm wide x 30m long
Z-fold paper 63mm wide x 20m long,
75mm/fold

Auxiliary Input Section

DC input: 10mm/0.5V, unbalanced, input impedance
100k Ω min.

Display Section

Display: Liquid crystal, 40 characters (20 chars. x 2
lines), character configuration 5 x 7 dots
Types of characters: Alphanumerics and symbols

General

Safety features: Class I and internally-powered equip-
ment, Type CF (IEC 601-1)
Power requirements: 115V AC, 50/60Hz; 19VA
230V AC, 50/60Hz; 19VA
Ni-MH rechargeable battery 9.6V DC, 7W
Continuous operation time: Approx. 70
minutes at 20°C
Charging time: Within 3 hours
Dimensions: 26(W) x 18.2(D) x 6.05(H) cm
Weight: 2.0kg (including the battery)

Operating Environmental Conditions

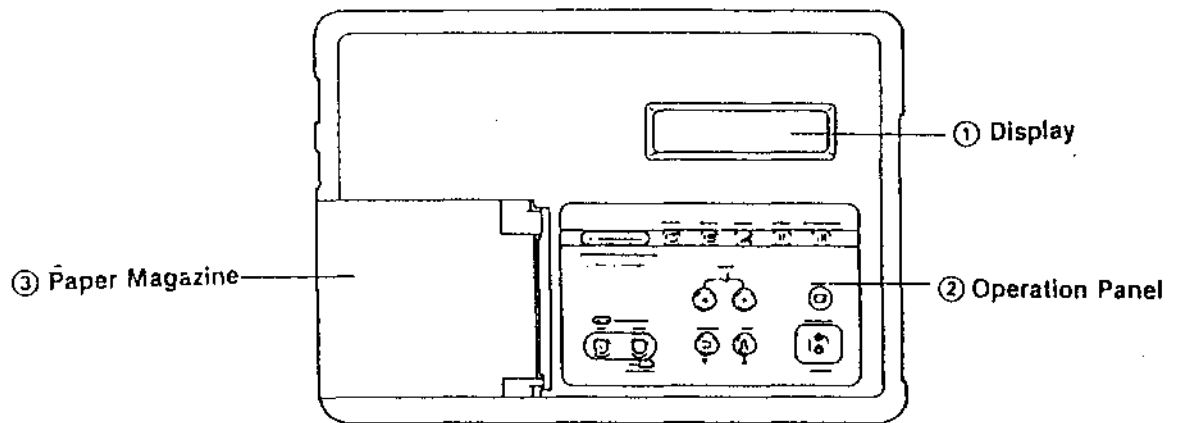
Temperature: 10 to 40°C
Humidity: 30 to 85% R.H. (no dew condensing)
Atmospheric pressure: 70 to 106kPa (700 to 1060mbar)

Transportation/Storage Environmental Conditions

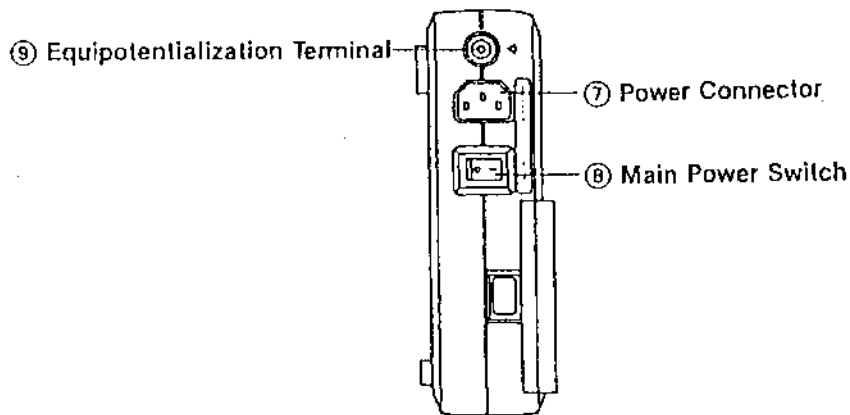
Temperature: -10 to +50°C
Humidity: 10 to 90% R.H. (no dew condensation)
Atmospheric pressure: 70 to 106kPa (700 to 1060mbar)

3. Controls and Indicators

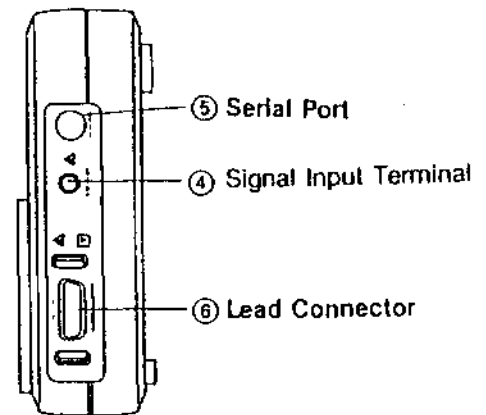
Top Panel



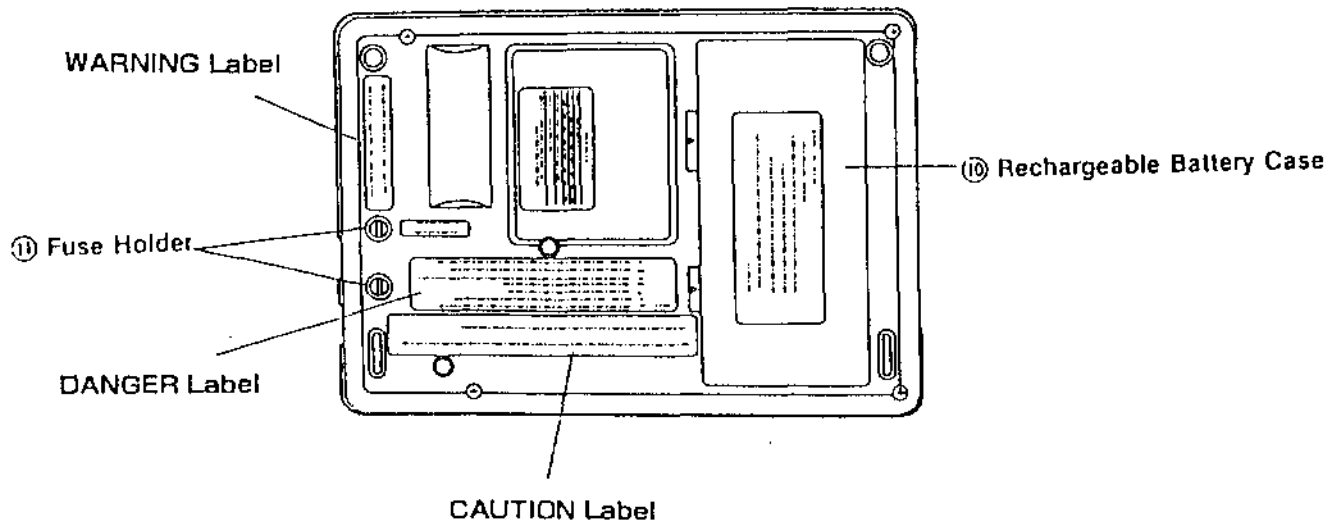
Left Panel



Right Panel



Bottom Panel



Front Panel

- ① **Display:** Displays the prevailing recording mode, lead name, sensitivity and heart rate or program.
- ② **Operation Panel:** See the next page for details.
- ③ **Paper Magazine:** Accommodates the chart paper.

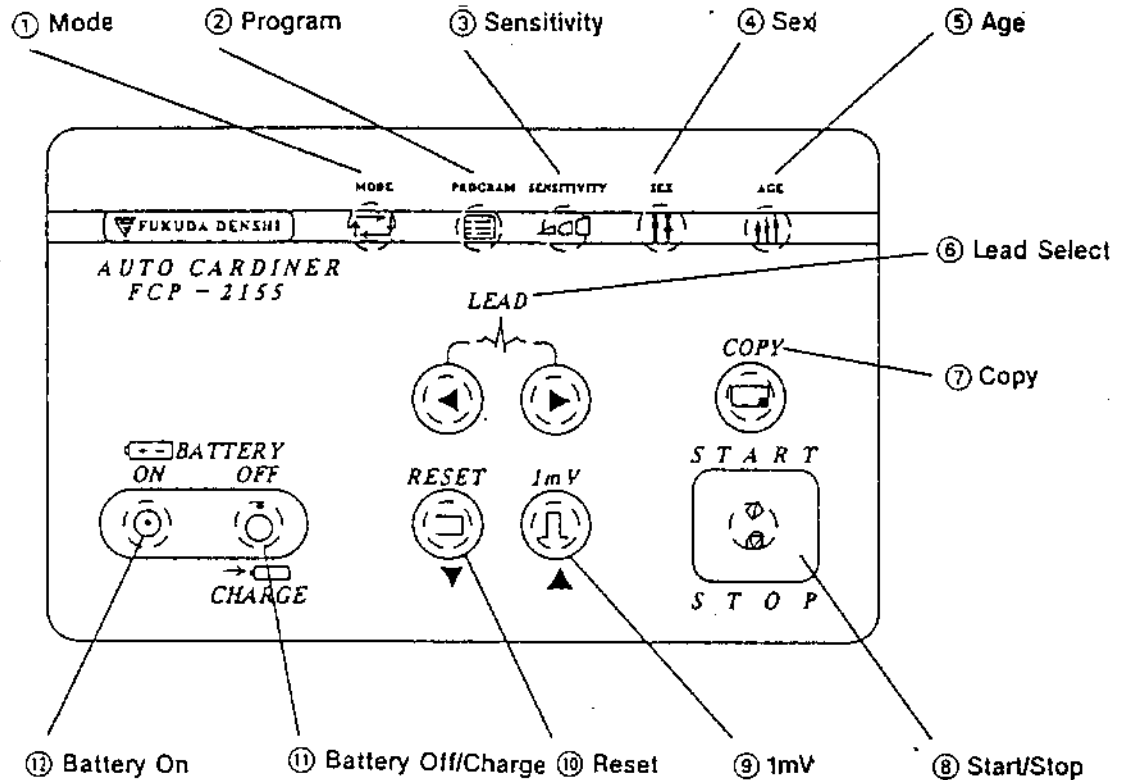
Left and Right Panels

- ④ **Signal Input Terminal:** Inputs external signals. The recording sensitivity is 10mm/0.5V.
- ⑤ **Serial Port:** Inputs and outputs serial data from/to other instruments.
- ⑥ **Lead Connector:** Connects to the lead cable.
- ⑦ **Power Connector:** Connects to the power cord.
- ⑧ **Main Power Switch:** Turns AC power on/off.
- ⑨ **Equipotentialization Terminal:** Connects to the grounding conductor common to another instrument, if connected, via an optional grounding wire.

Rear Panel

- ⑩ **Rechargeable Battery Case:** Accommodates the rechargeable battery.
- ⑪ **Fuse Holder:** Has the power fuse inserted.

Operation Panel



- ① **Mode:** Selects a recording mode from automatic, manual, arrhythmia analysis and autonomic nerve examination.
- ② **Program:** Selects the program mode.
- ③ **Sensitivity:** Selects a recording sensitivity from AUTO, 1, 1/2, 1/4 and 2 cm/mV.
- ④ **Sex:** Selects male or female.
- ⑤ **Age:** Selects an age group from 0-2, 3-11, 12-18, 19-29 and over 30 years old.
- ⑥ **Lead Select:** Select a lead group. Note, however, that this key is not effective for analysis and automatic recording modes in which lead selection is automatically made.
- ⑦ **Copy:** Copies an analysis or autonomic nerve examination record. It is effective only when the data is available in the instrument. Note that starting the next record or changing the recording mode erases the data for copying.
- ⑧ **Start/Stop:** Starts the instrument recording. In the manual or arrhythmia analysis mode, a second press of the key stops the instrument from recording. In other modes, the instrument stops recording automatically.
- ⑨ **1mV:** Applies 1mV calibration waveform in the manual mode.

- ⑩ **Reset:** Keeps resetting the circuit while held down.
- ⑪ **Battery Off/Charge:** Turns the power off in battery operation. In AC operation, a press of the key places the instrument in charge mode.
- ⑫ **Battery On:** Turns the power on in battery operation. A press of the key during battery charge cancels charge mode and calls up the same initial display as upon turning the AC power on.

Circuit Description

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1. Introduction

The FCP-2155 is composed of the following circuits:

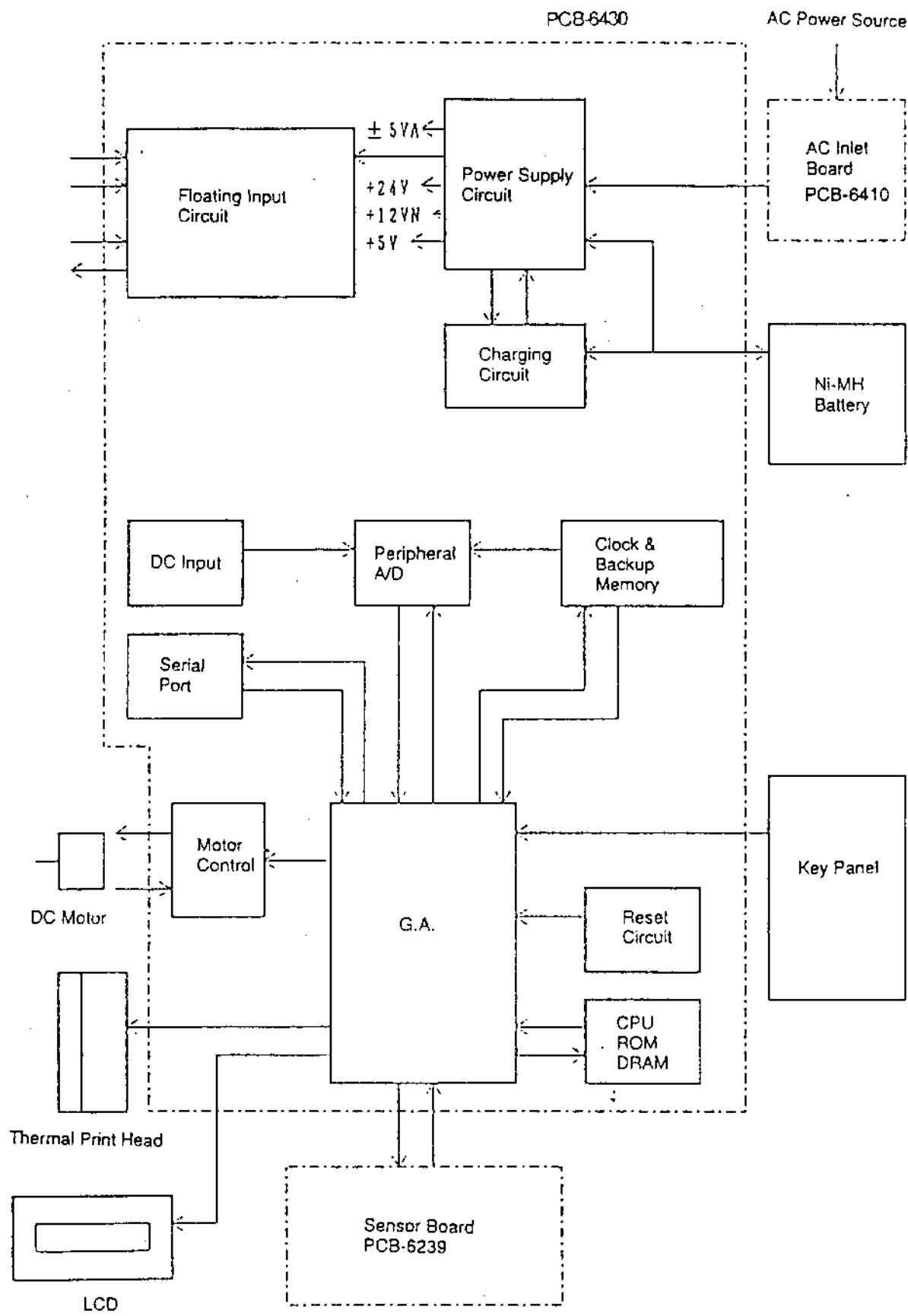
- (1) Main Board PCB-6430
 - Floating input circuit
 - Motor control circuit
 - Sensor circuit
 - Reset circuit
 - CPU circuit
 - LCD control circuit
 - Thermal print head control circuit
 - Memory backup circuit
 - Power supply circuit
 - Charging circuit
- (2) Sensor Board PCB-6239
- (3) AC Inlet Board PCB-6410

ECG signals input from the lead connector are amplified in the floating input circuit. The amplified signals are converted into digital signals. The digital signals are digitally filtered then transferred to the thermal print head control circuit to be recorded on the chart paper.

The LCD screen displays the heart rate detected with a software technic, lead-off status, if any, filter on/off status, etc.

The power supply circuit supplies power to circuits, while the charging circuit charges the Ni-MH battery. The charge status is displayed on the LCD screen.

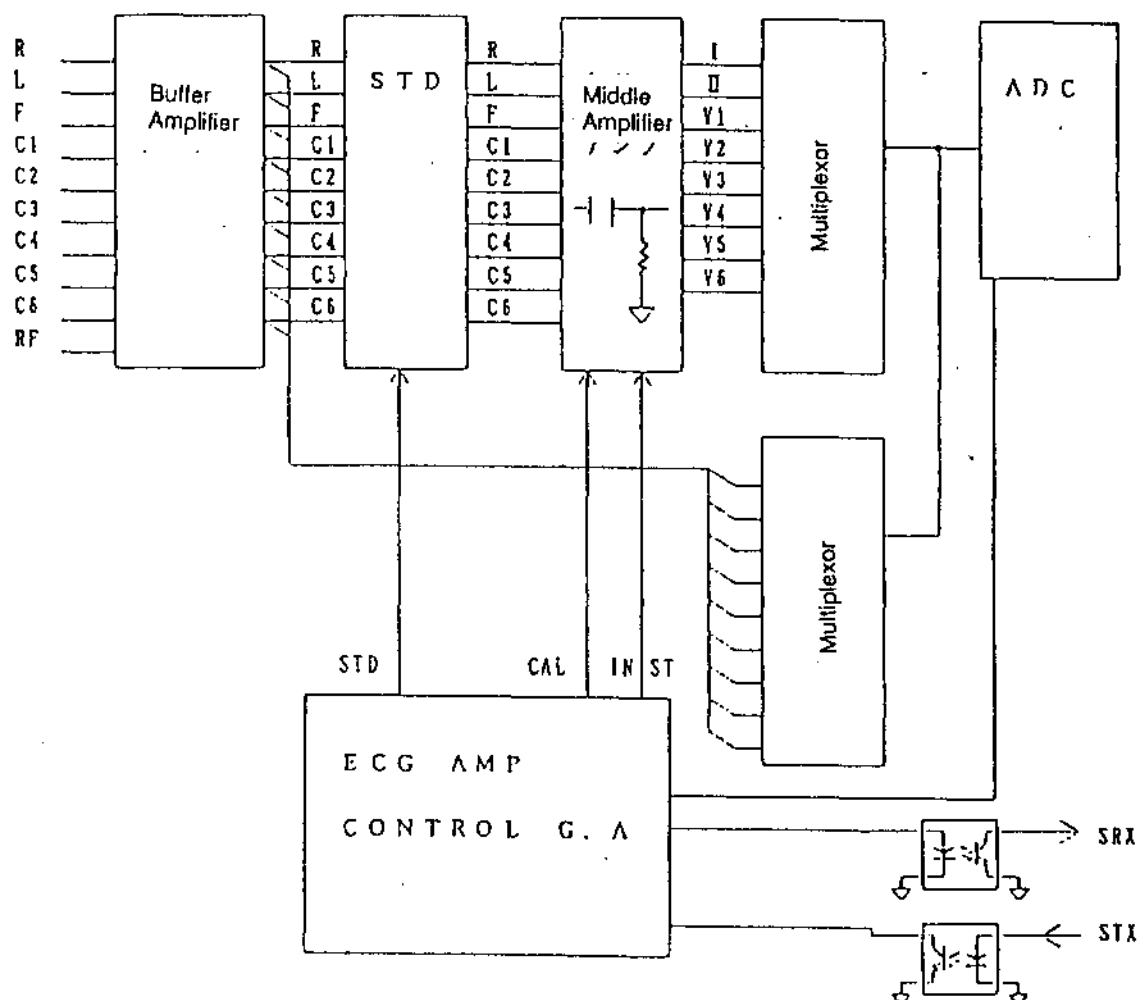
Block Diagram



2. Floating Input Circuit

The floating input circuit is composed of the following:

- (1) Buffer amplifier
- (2) Middle amplifier
- (3) A/D converter
- (4) Amplifier control and CPU interface



Block Diagram of Floating Input Circuit

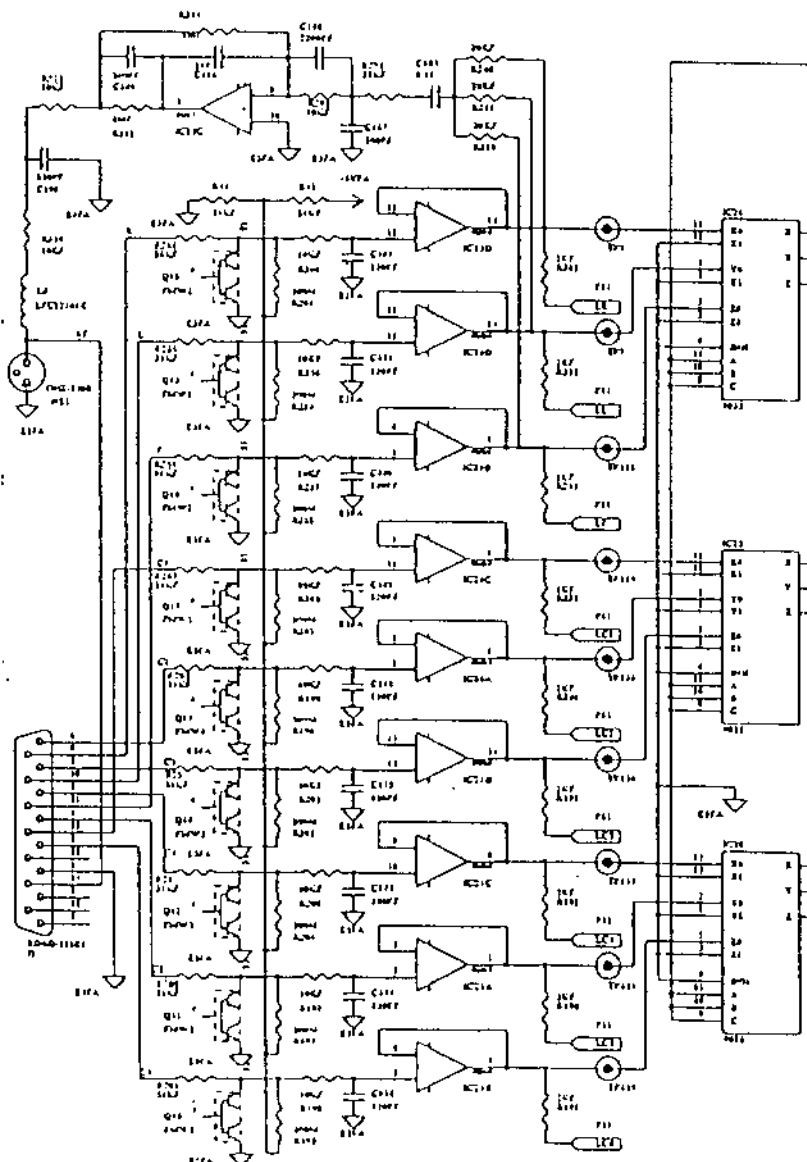
2.1 Buffer Amplifier

The buffer amplifier converts the input signals into high-impedance signals and the output signals into low-impedance signals. Each input has 50k Ω and 10k Ω resistors mounted in series, thereby suppressing a patient measurement current at single fault to less than 50 μ A. Dual transistors Q10 to Q18 are mounted as limiters to protect the circuit against excess input.

The RF drive circuit feeds back the Wilson's center signal to the right foot of patient for improved CMR.

Each input is put in a minus potential by a 50 Ω resistor. The reason is that a lead-off status can be detected by pulling the input potential at the time of electrode disconnection into that minus potential.

The output of each buffer amplifier is connected to the lead-off detection circuit to let it check for any possible disconnection of electrode.



2.2 Middle Amplifier

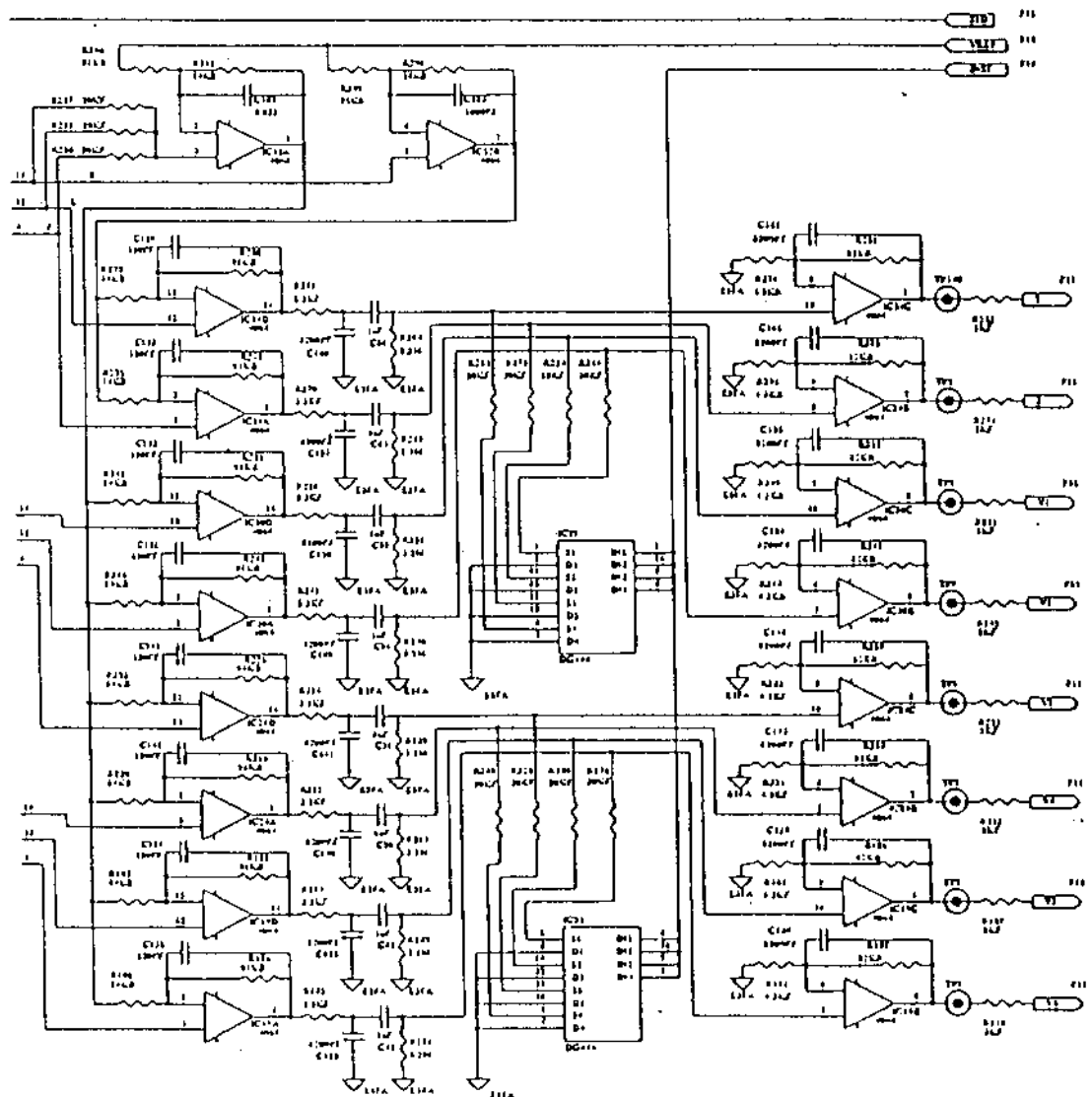
The middle amplifier has eight channels for I, II, V1, V2, V3, V4, V5 and V6.

Differential amplifiers for RA-LA and RA-LF commonly use the amplifier for RA. Differential amplifiers for the midpoint of limb and C1 to C6 commonly use the amplifier for the midpoint of limb.

The differential amplifier section provides a gain of 7.5 times and the non-inversion amplifier section provides a gain of 20 times, thereby offering a total gain of 150 times.

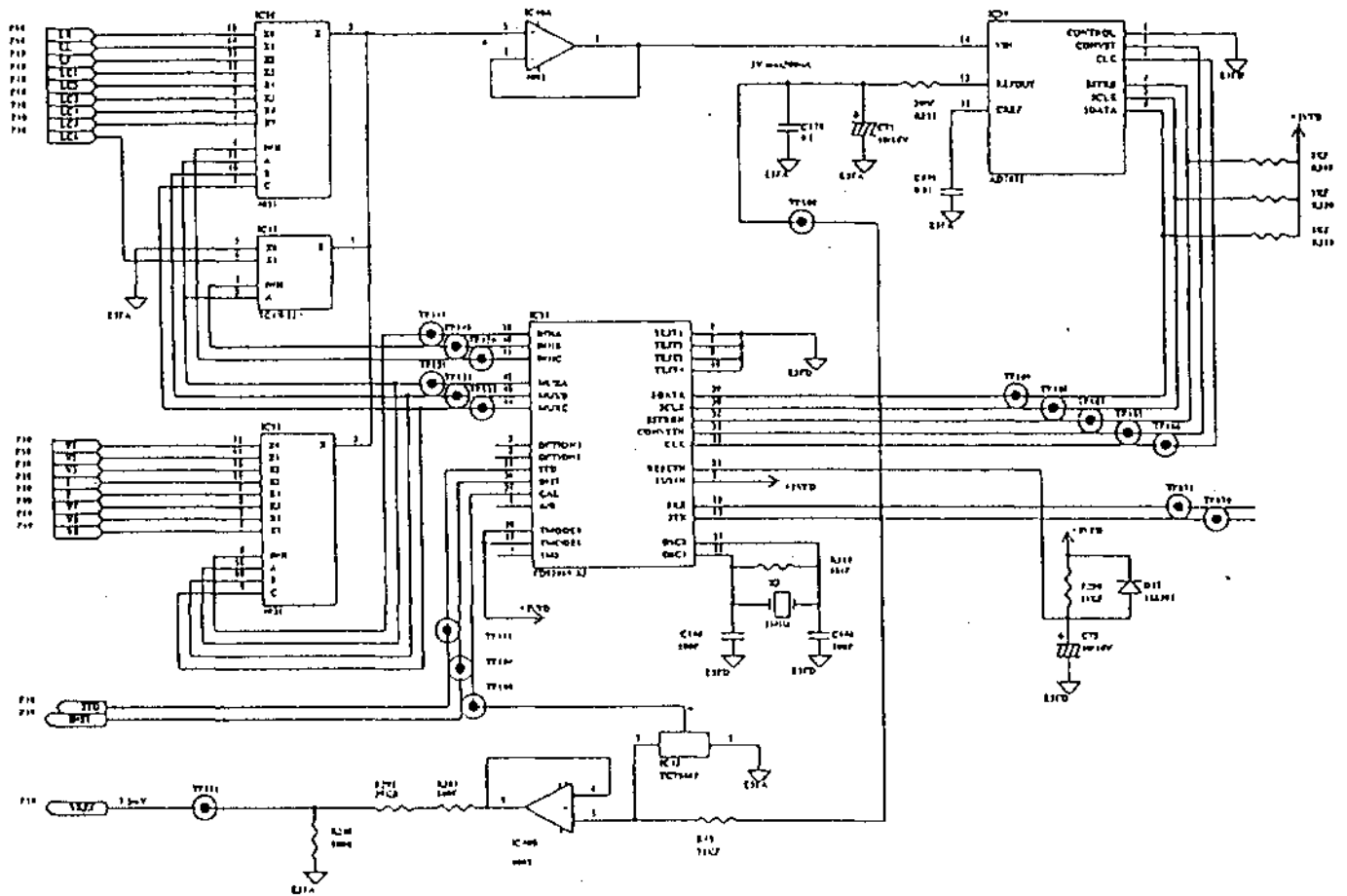
The time constant is set at 3.5 seconds by $1\mu\text{F}$ capacitor and $3.5\text{M}\Omega$ resistor. Under a reset condition, $1\mu\text{F}$ capacitor and $20\text{k}\Omega$ resistor make the time constant 0.02 seconds.

The output of each differential amplifier is connected to the lead-off detection circuit to let it check for disconnection of electrode.



2.3 A/D Converter

The multiplexor (IC35, 36, 41) sequentially selects analog signals of middle amplifier and lead-off detection to let the A/D converter (IC39) convert them to digital signals. It takes 12 μ s to convert signals of one channel.



Signals are input in the A/D converter in the following order.

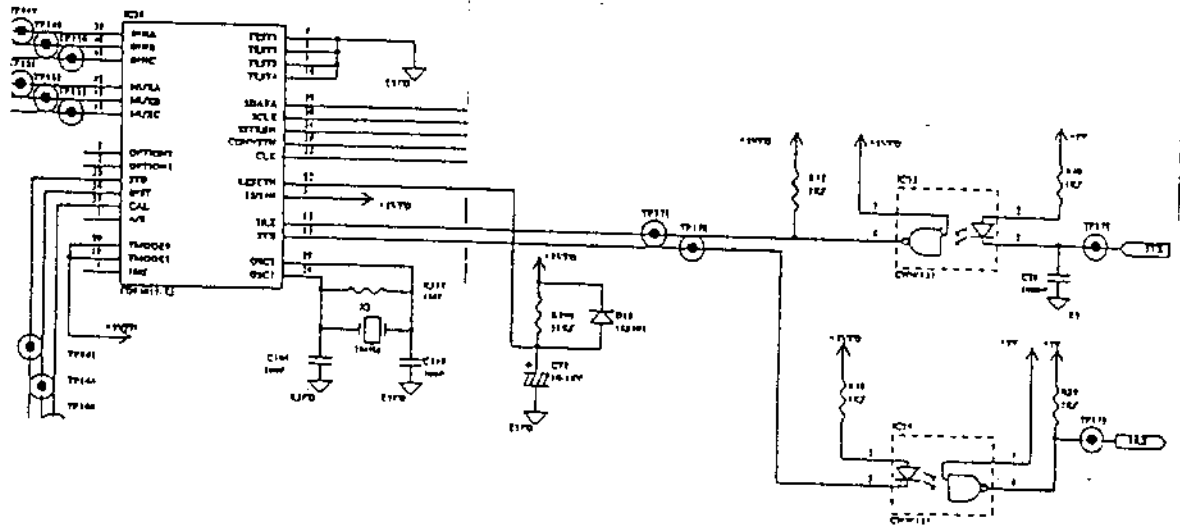
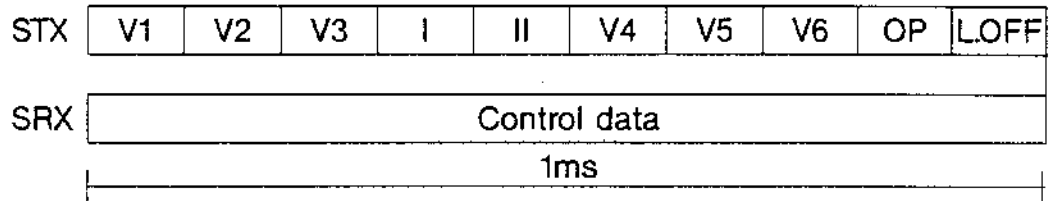
12 μ s									
V1	V2	V3	I	II	V4	V5	V6	O.P.	Leaf Off
RL	LL	LF	C1	C2	C3	C4	C5	C6	

Lead for lead-off detection is switched every 1ms.



2.4 Amplifier Control and Interface

IC38 controls signals such as STD, RESET, and CAL transferred from the CPU. The A/D converter transfers the data to the CPU via IC38 in the following order:



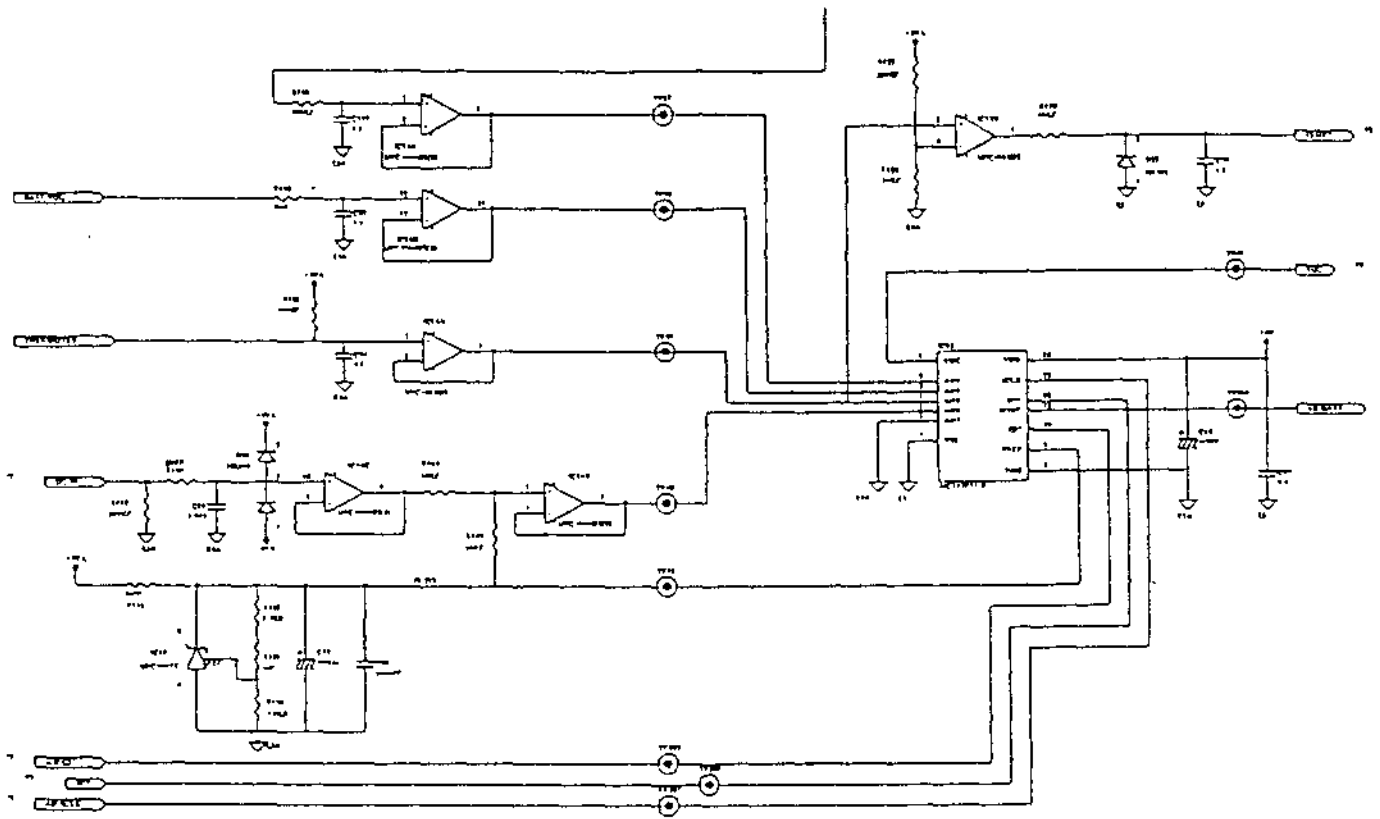
3. Peripheral A/D Converter Circuit

IC13 of peripheral A/D converter circuit converts analog signals around the CPU, such as lithium battery voltage, Ni-MH battery voltage, thermal print head temperature, and DC input, into digital signals with a resolution of 10 bits.

The DC input accepts signals of up to $\pm 3.2V$ ($\pm 6.4cm$).

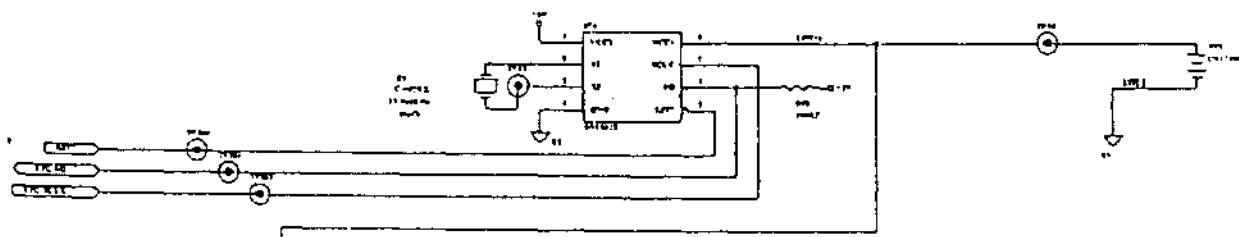
A/D converted data are transferred to the CPU in serial communication.

This peripheral A/D converter circuit also detects abnormal temperature of thermal print head.



4. Clock & Backup Memory

IC4 has a clock, backup memory, and power switching circuit built in. Clock and backup memory data are transferred to the CPU in serial communication.

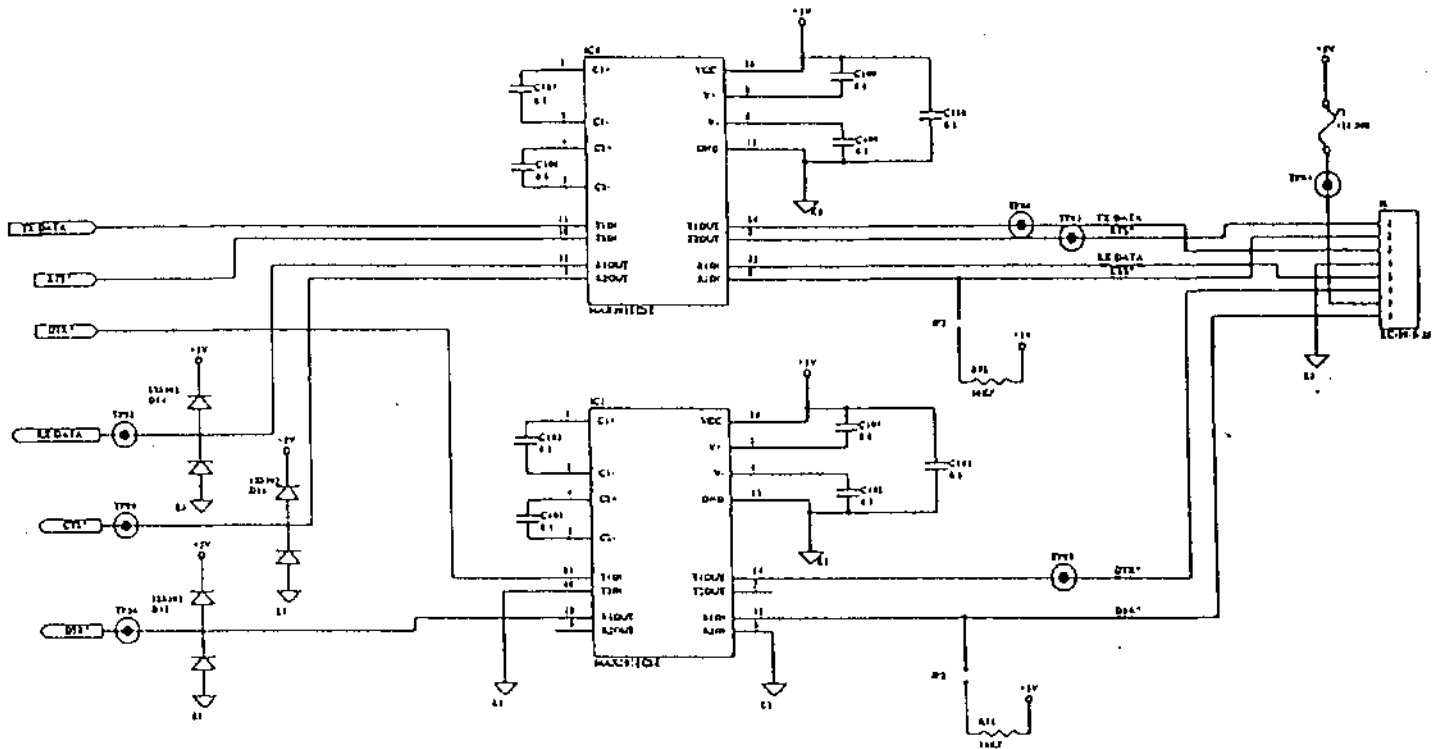


5. Serial Port

The serial controller is in the GA (IC8) and the data from it are made RS232C level by IC5 and IC6.

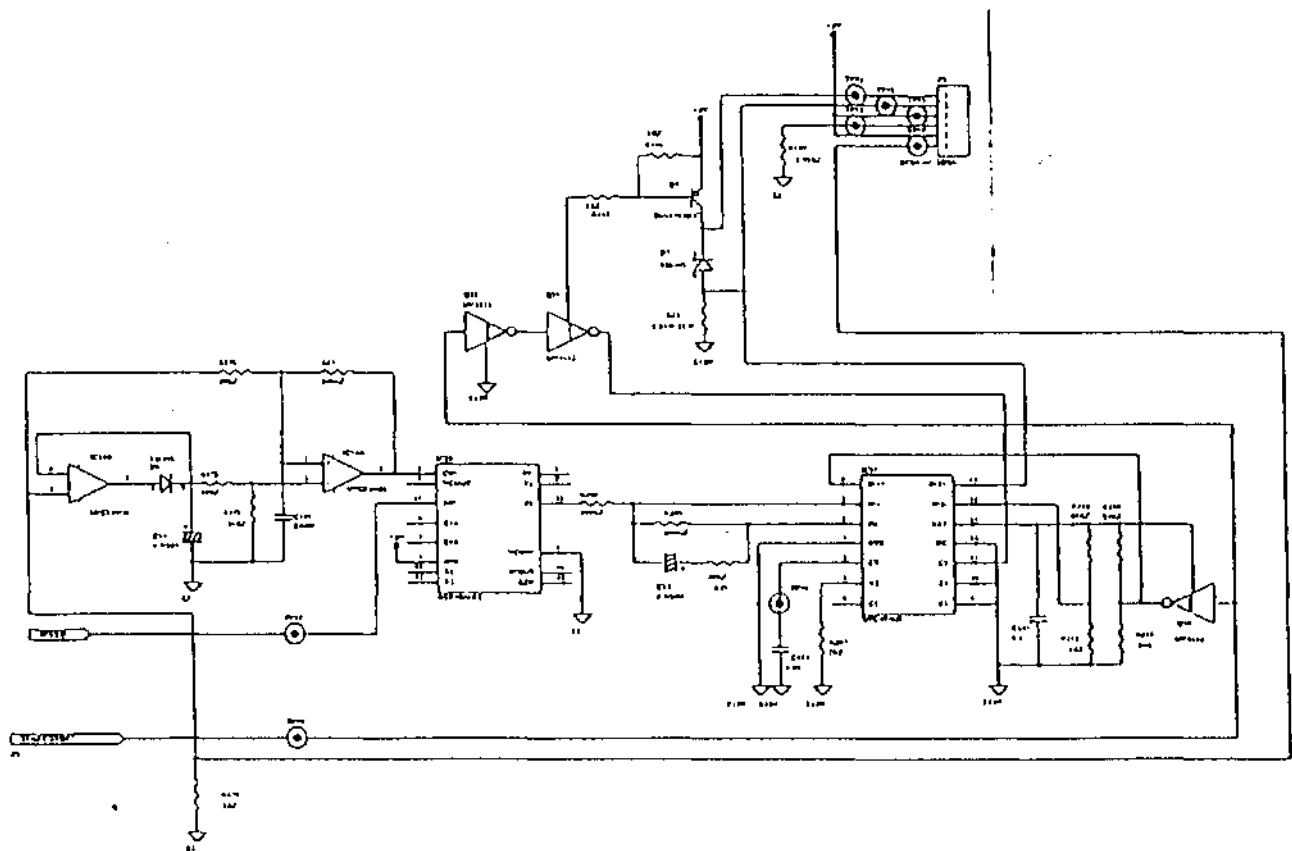
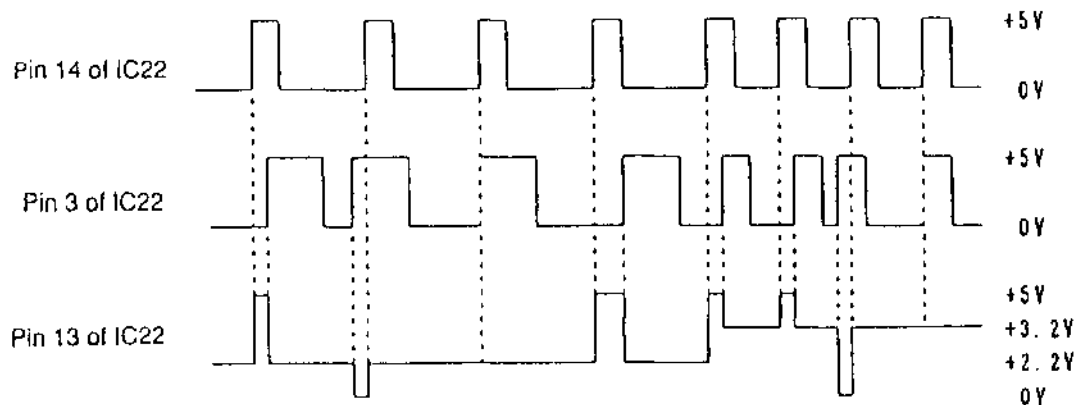
The connector J1 can supply +5V power. But do not take an output of over 500mA from the connector.

Caution: Take care of the serial port. It is not floating.



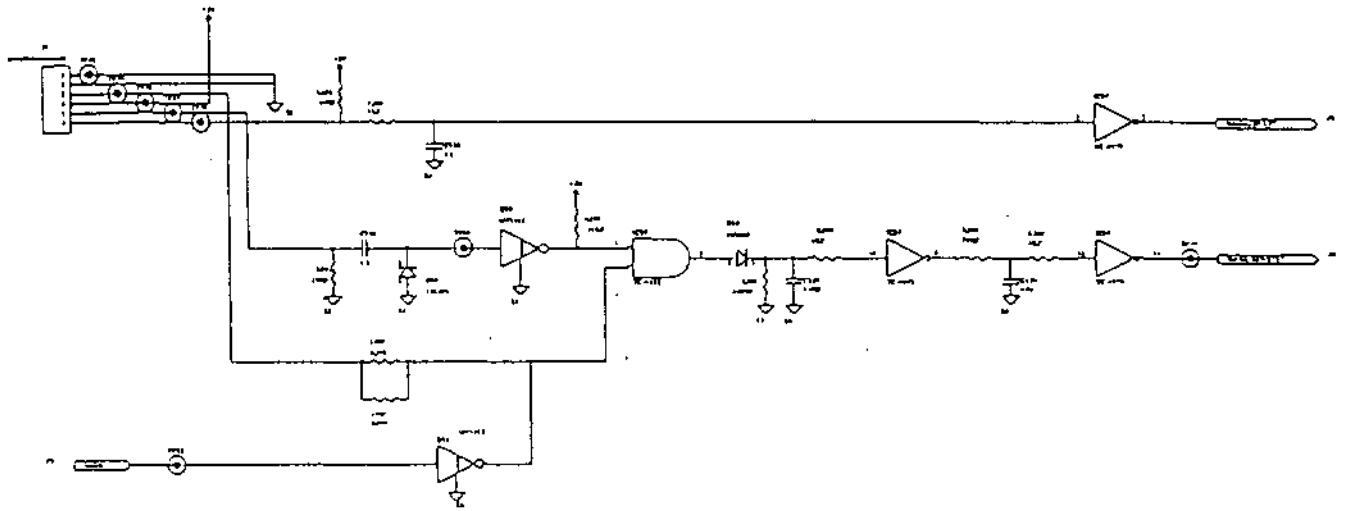
6. Motor Control Circuit

The recorder driving motor is a DC motor equipped with a photo sensor for speed detection. The signal detected by the photo sensor is compared in phase with the reference frequency by the PLL control IC (IC22) to provide a motor control signal at pin 13 of IC22. The motor control signal is transferred to the PWM control circuit of IC27 via the integrator circuit (R27, R209, C25) so that a proper motor drive voltage is supplied.



7. Sensor Circuit

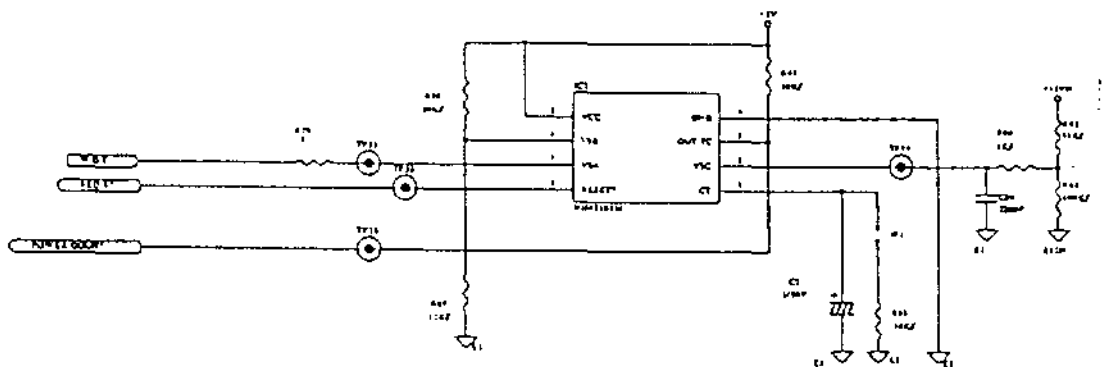
The sensor circuit is provided to detect paper magazine open condition, paper end, and paper mark.



8. CPU-GA Circuit

The CPU-GA circuit is composed of a reset circuit, CPU, ROM, DRAM, and GA.

(1) Reset Circuit



(2) CPU, ROM, DRAM, GA

12.5MHz TMP68HC000 is used for the CPU (IC9), which controls the overall system via GA (IC8). The ROM (IC3) has a capacity of 4 Mbits (512 Kbytes). The DRAM (IC15) has a capacity of 4 Mbits (512 Kbytes). In addition to various kinds of control, the GA inputs key operation signals.

9. LCD Control Circuit

Since the LCD (NDM202A00) has a controller built in, it is interfaced directly with the CPU.

V0 for contrast adjustment is set at a fixed voltage.

10. Thermal Print Head Control Circuit

The thermal print head control circuit is built in the GA (IC8) controls the print head for recording waveforms and alphanumerics, as well as controlling strobe and heating temperatures.

Data transfer

Waveform data are written in the register in the gate array every 1ms then transferred to the thermal print head. Alphanumeric data are transferred to the thermal print head via the gate array.

Strobe control

The thermal print head heating degree is controlled by changing the base temperature or the pulsewidth of strobe according to a chart speed.

Heat control

Previous dot heating information is stored in the heat control memory and based on the information heating temperature is controlled to an optimum printout condition.

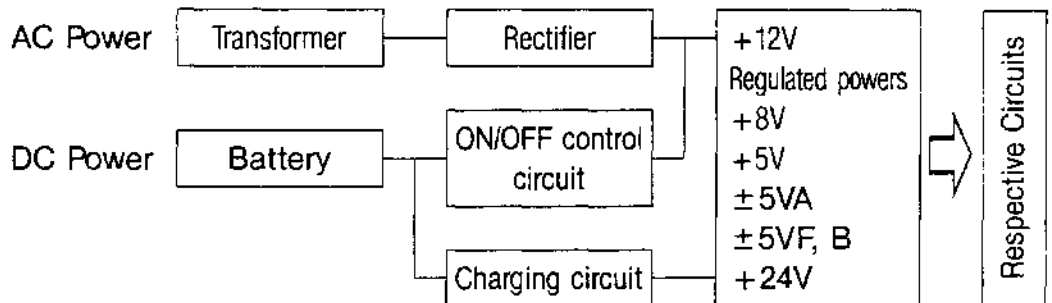
Print head protection

An overheat of thermal print head or magazine open condition forcibly shut off the +24V supply.

11. Power Supply Circuit with Charging Circuit

11.1 Outline of the System

Using the AC power through the transformer or the DC power from the NI-MH battery, the power supply circuit makes and supplies necessary regulated powers. The power supply circuit involves a circuit to charge the Ni-MH battery.



Block Diagram of Power Supply Circuit

11.2 Rectifier/Smoothing and On/Off Control Circuits

11.2.1 AC Operation

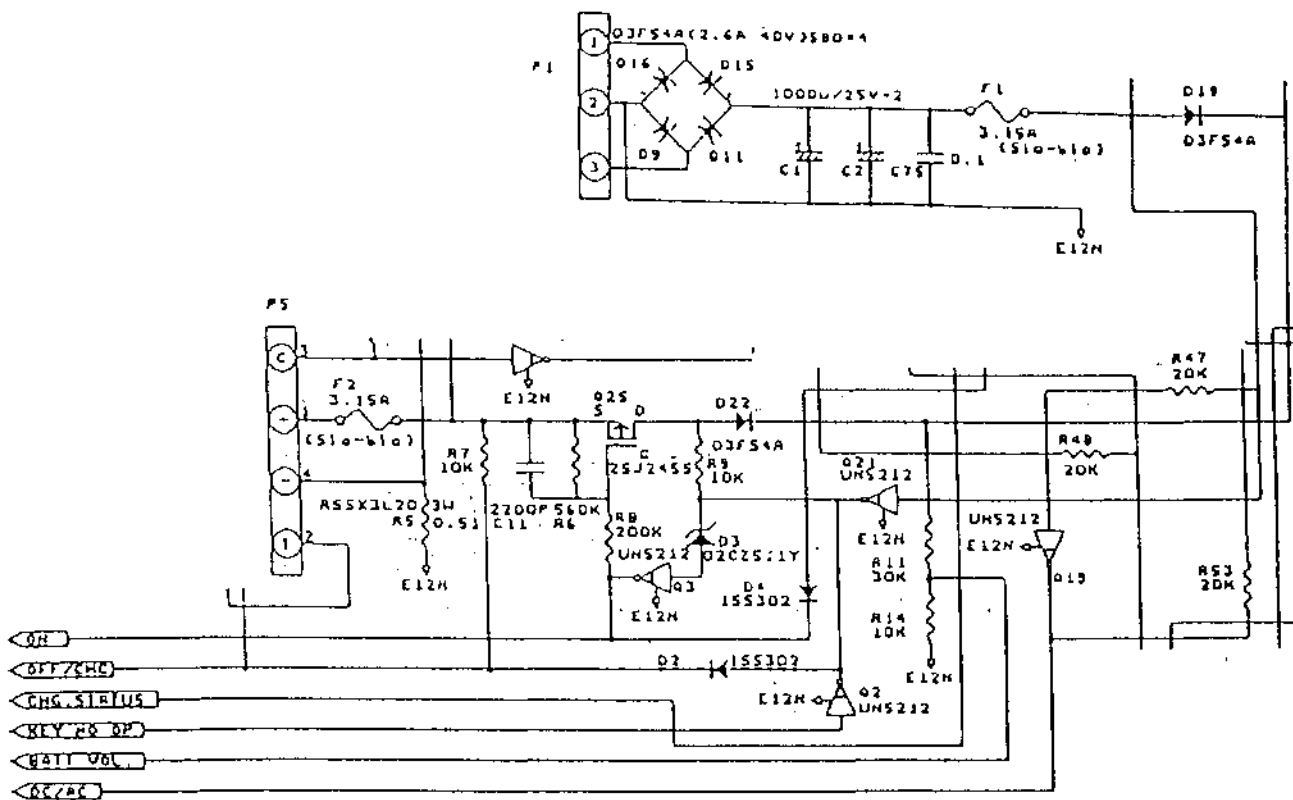
The AC power transformed in voltage by the transformer is rectified through D9, D11, D15, and D16 and smoothed by C1 and C2. These low VF Schottky diodes D9, D11, D15, and D16 form a bridge circuit to reduce lowering of the voltage and features less heat generation.

11.2.2 On/Off Control Circuit

In battery operation, a press of the Battery ON key turns the FET switch Q25 on, thereby letting the current flow to D3 and the base of Q3 be driven. Thus, Q5 is kept on and the power is supplied to the equipment if the Battery On key is detached.

The battery voltage is detected via D22. If it lowers to approximately 7.9V, the gate array generates a power-off signal to turn Q21 on and cancel the bias voltage of Q3, thereby turning Q25 off. Since power supply to the equipment stops at that time, the equipment is turned off.

Similarly, when the Battery Off key is pressed, the bias voltage of Q3 is cancelled, thereby turning the equipment off. In AC operation, Q21 is on and the base of Q3 cannot be driven, thereby making it impossible to keep Q24 in ON status and disabling battery operation.



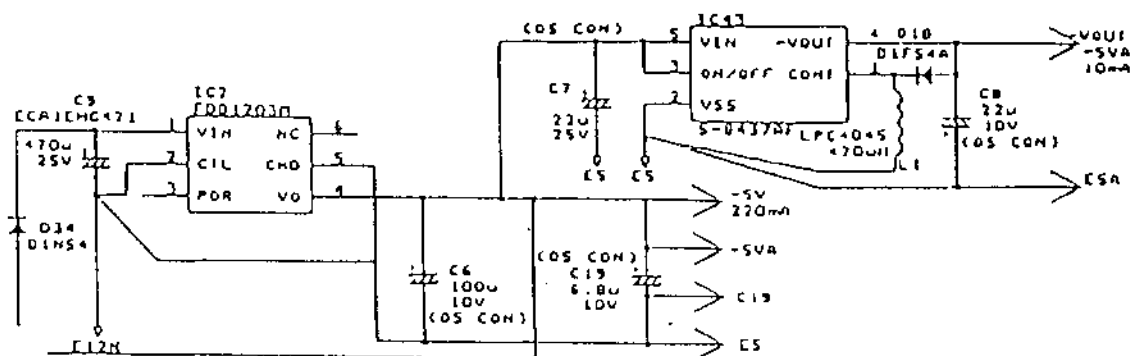
11.2.3 +5V and +5VA Generator

IC7 (FDD1203M) is a DC/DC converter having a capacitor at the input and output to make the regulated +5V from the unregulated 12VN. The output voltage is internally fixed at +5V.

The 5V power supplied from IC7 provides +5V and 5VA for digital and analog systems. The capacitor at the output is an organic semiconductor capacitor which features good low-temperature characteristic, less leakage current and superior high-frequency characteristic.

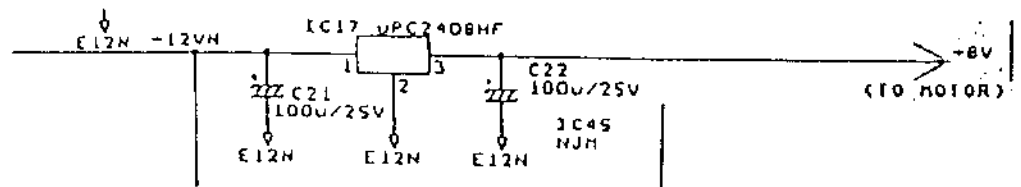
11.2.4 -5VA Generator

IC43 is a CMOS inversion type switching regulator. Its output voltage is internally fixed. It inverts the input +5V to output -5V. The capacitor at the output is an organic semiconductor capacitor.



11.2.5 +8V Generator

IC17 is a dropper type 3-terminal regulator. It makes the regulated +8V from the unregulated 12VN. The regulated +8V power is used as the power source for the motor.



11.2.6 +24V Generator

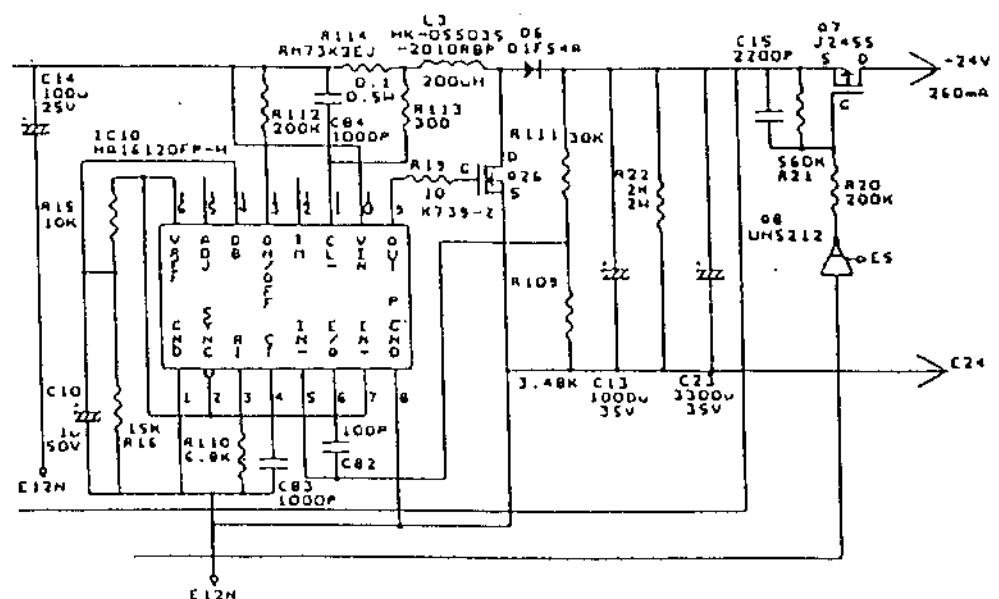
Using 12VN from the AC power supply or the battery, the boosting DC/DC converter makes 24V to drive the thermal print head or charge the battery.

IC10 is a switching regulator for PWM control. The oscillation frequency is determined by R110 and C83. PWM control is done at a frequency of approximately 170kHz to drive Q26 at a high speed.

When Q26 is on, the current flows to L3 to let it store the energy. When Q26 is turned off, the energy stored in L3 becomes a counter-electromotive force and flows into C13 and C23 via D6 to be stored there. Repeating this series of operations makes it possible to obtain an output voltage higher than the input voltage. The output voltage is set by R111 and R109.

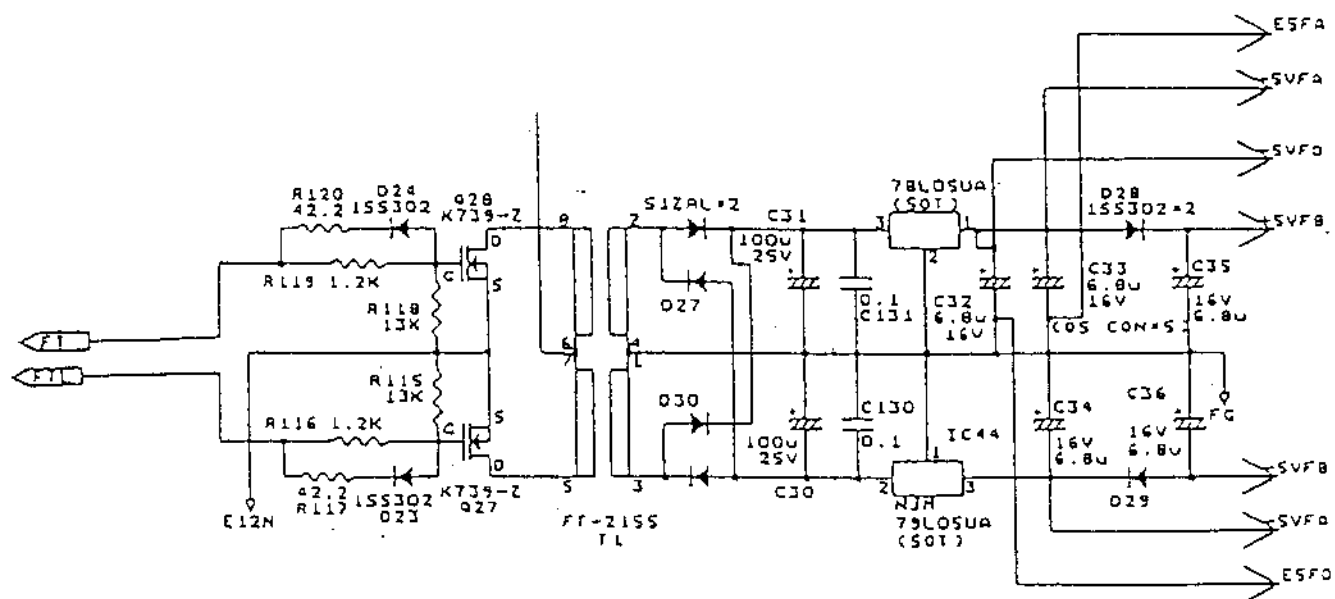
R114 detects an overcurrent and when a load current increases to over 0.4A or so, the output voltage gradually lowers.

The +24V power thus boosted is supplied under the control of FET switch Q7 to drive the thermal print head. At the time of printing, a signal from the gate array drives the base of Q8 to turn Q7 to supply the power to the thermal print head. When printing is not done, Q7 and Q8 are turned off and the power is not supplied to the thermal print head.



11.2.7 Isolated Power Circuit

The power is supplied to the isolated side by pushing and pulling FETs Q28 and Q27. At the isolated side, the power is rectified and smoothed and the 3-terminal regulator makes $\pm 5V$. The power is separated at the output side to powers for the digital and analog patient input circuits.



11.2.8 Charging Circuit

The charging circuit uses a quick charging IC1 (bq2003). It performs constant current control by frequency modulation to regulate the charging current, while monitoring the battery temperature, charging voltage, and charging time to ensure proper charging.

The circuit also detects the presence or absence of battery and makes it possible to charge only when the battery is loaded.

In AC operation, supplemental charging is always made even if the equipment is not placed in the charge mode.

(1) Starting the Charging Circuit

A press of the Battery Off key in AC operation turns Q5 on to let it supply the IC operation power of +5V. When Q5 is turned on, the base of Q6 is driven, thereby keeping Q5 turning on.

When +5V is supplied to IC1, the charging circuit starts up automatically.

(2) Monitoring/Controlling Charging Temperature and Voltage

Charging is controlled so that it is made in proper ranges of battery temperatures and voltages.

To monitor battery temperature, the thermistor (negative temperature coefficient) connected to the inside of battery pack sends a voltage signal to pin 6 (TS) of IC1 and charging is available when the input voltage is within set limits. The sensitivity for a battery temperature rise ratio (dI/dt) is adjusted by resistances of the thermistor and resistors R54 and R2 of the charging circuit.

The battery voltage is divided to a voltage per cell by R77 and R4 which are connected between battery terminals. The divided voltage is input to pin 7 (BAT) of IC1 and charging is available when the voltage is within set limits.

Battery temperature limits and cell voltage limits are set as follows:

- Battery temperature limits

Low temperature LTF to prohibit charging: Approx. -5°C
(voltage level 2.0V)

High temperature HTF to prohibit charging: Approx. 60°C
(voltage level 1.13V)

High temperature TCO to stop charging: Approx. 65°C
(voltage level 1.01V)

- Battery cell voltage limits

Low cell voltage to stop charging: Approx. 1.0V

High cell voltage to stop charging: Approx. 1.78V

As indicated above, the charging circuit which is turned on charges the battery if the battery satisfies the conditions of ($-5^{\circ}\text{C} < \text{temperature} < 60^{\circ}\text{C}$ and $1.0\text{V} < \text{cell voltage} < 1.78\text{V}$) and it does not charge the battery if any of the conditions is not satisfied. The charging circuit stands by until all conditions are satisfied. Also note that if the battery shows a cell voltage exceeding the maximum of 1.78V before the start of charge, the battery is regarded as abnormal and is not charged.

Charging once started is terminated in the charge complete method described later.

(3) Controlling Charging Current

The charging power is supplied from the 24V power supply. The charging current flowing to the battery is detected by the current detection resistor R5 and input to pin 9 (SNS) of IC1. Depending on the voltage level at R5, the output of pin 14 (MOD) of IC1 changes, thereby switching Q4 to ensure the constant current characteristic.

The charging current is set at 0.45C (480mA).

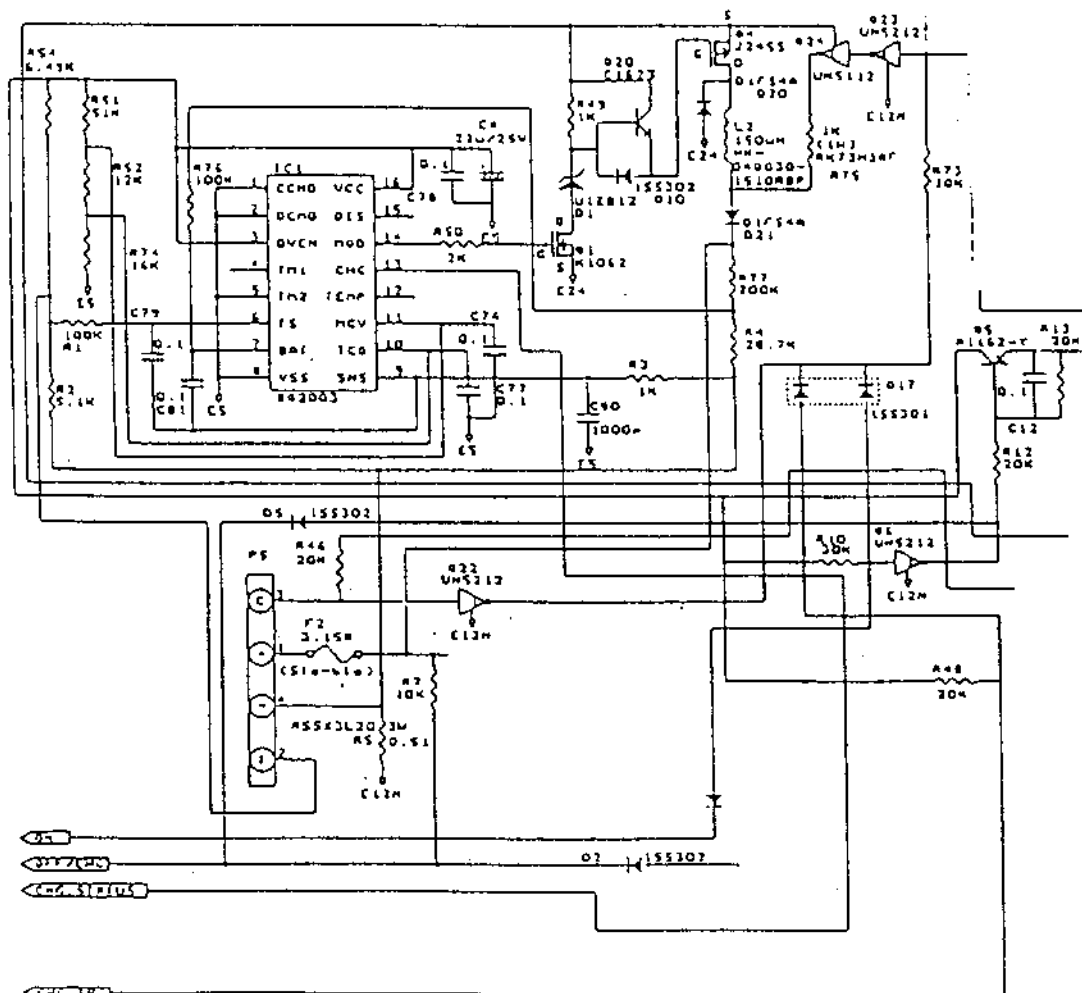
Q1, D1, and Q20 forms a MOS FET driver and level shifter circuit to increase the switching frequency.

(4) Charge Complete Method

When the battery temperature and cell voltage are within set limits, the charging circuit continues to charge the battery until one of the following five is satisfied.

- $-\delta V$ detection method
- $-\delta T/\delta t$ (temperature rise ratio) method
- High temperature to stop charging (TCO 65°C)
- Maximum charging time (3 hours)
- Maximum cell voltage (MCV 1.78V)

Usually, charging is completed by the $-\delta V$ method. However, if charging is started at a high ambient temperature, the high temperature TCO stops the circuit from charging the battery. Also, to ensure the safety in the case where no $-\delta V$ is found, a maximum charging time is set by the timer. The timer setting is determined by pins 4 (TM1) and 5 (TM2) of IC18.

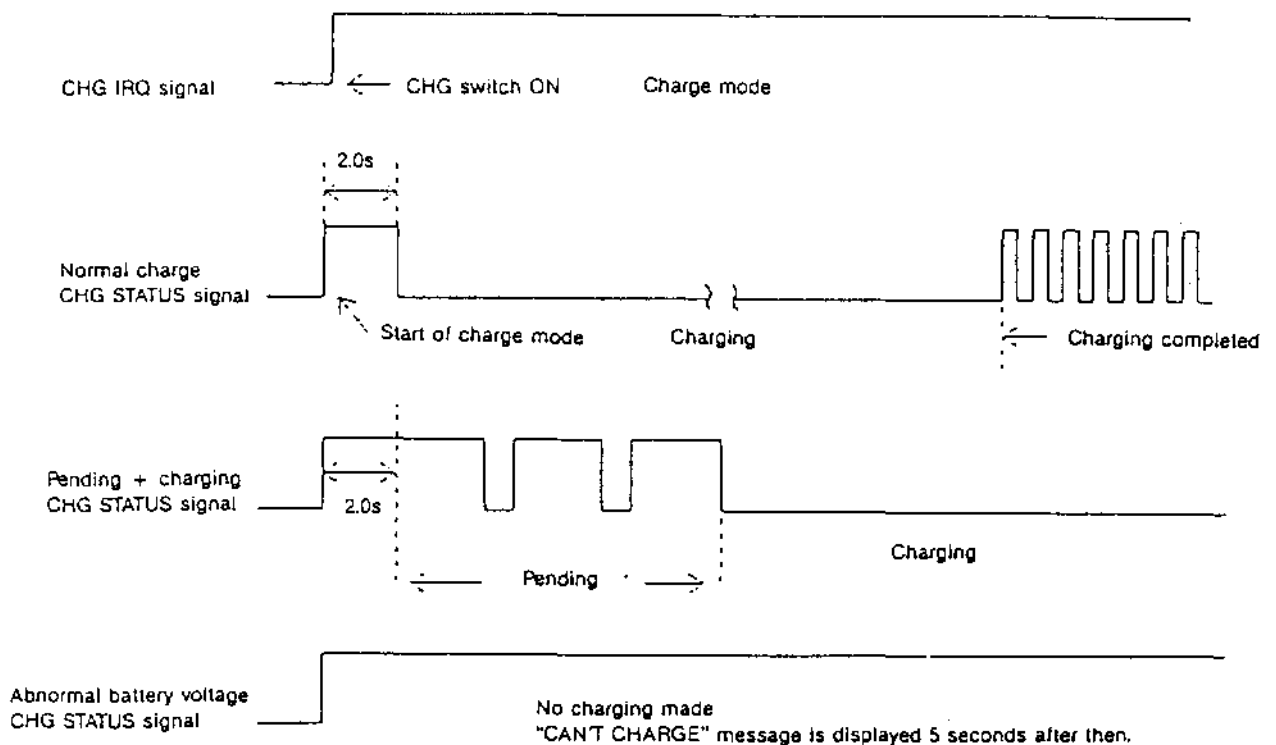


(5) Other Supplemental Functions

In AC operation, Q23 is turned on to drive the base of Q24, thereby supplying R75 with 24V power. Supplemental charging is made through R75. The current of which the level depends on a voltage difference at R75 flows for supplemental charging. However, if the battery is not connected, Q22 is turned on to keep Q23 turned off. Thus, supplemental charging is prohibited and the bias voltage of Q6 is cancelled. So the 5V power is not retained and charging is made invalid.

Also, the charging section outputs CHG IRQ and CHG STATUS signals. When 5V is supplied, the CHG IRQ becomes high to indicate that the charging circuit is placed in the charge mode. The CHARGE STATUS signal is output to indicate the present charging status as follows:

	CHARGE STATUS signal output	
	H	L
Abnormal battery voltage	Continuous	—
Start of charging	Continuous (rise)	—
Pending	$1.375s \pm 0.225s$	$125ms \pm 20ms$
Charging in progress	—	Continuous
Charging completed	$125ms \pm 20ms$	$125ms \pm 20ms$



Troubleshooting

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1. Internal Power Supplies

The FCP-2155 has the following internal power supplies:

+12VN

It is a rectified power output from the secondary side of transformer. Since it is not regulated, the voltage fluctuates depending on the operating condition of the instrument and AC input voltage.

The power is supplied to the following blocks:

+5V

It is the power source for the digital system.

A switching regulator produces the regulated power from +12VN.

-5VA

It is the power source for DC input circuit.

It is produced by inverting +5V power source above.

+24V

It is to drive the thermal print head and charge the Ni-MH battery.

A step-up circuit produces it by boosting +12VN.

+8V

It is the power source for the motor.

A 3-terminal regulator produces it from +12VN.

Floating Blocks

+5VFD

It is the floating +5V power source for the digital patient input circuit.

An isolation transformer isolates +12VN from the ground then a 3-terminal regulator produces the +5V power.

+5VFA

It is the floating +5V power source for the analog patient input circuit.

Its output line has a capacitor inserted to provide the power source for the analog circuit.

+5VFB

Similar to +5VFA, it is the power source for the analog patient input circuit. A diode and capacitor separate the output line of +5VFA to produce this +5VFB which is not affected by a load of +5VFA.

-5VFA

It is the floating -5V power source for the analog patient input circuit.

An isolation transformer isolates +12VN from the ground then a 3-terminal regulator produces the +5V power source.

-5VFB

Similar to -5VFA, it is the power source for the analog patient input circuit. A diode and capacitor separate the output line of -5VFA to produce this -5VFB which is not affected by a load of -5VFA.

2. Faulty Power Supplies vs. Effects

2.1 If no 12VN is output

All internal power supplies such as 5V and 24V are not produced and the equipment does not operate at all.

2.2 If only 8V is not output

The CPU does not receive any adverse influence but the motor is not supplied with power, thereby making it impossible to drive the chart paper.

2.3 If only +5V is not output

Since the CPU is not supplied with power, the equipment does not operate apparently despite that other power supplies are available.

2.4 If only +24V is not output

The LCD and keys operate normally but the equipment does not record any waveform and alphanumeric data.

2.5 If the floating +5VFD is not output

The equipment does not start up. (A system error is generated.)

2.6 If floating $\pm 5VFA$ and $\pm 5VFB$ are not output

The equipment does not start up. (A system error is generated.)

 Caution
When checking voltages and signals on circuits for troubleshooting, take sufficient care to avoid short circuit. Also take care of the AC input side of PCB-6410. Contacting it may cause an accidental hazard when the equipment is powered.

3. Troubles and Countermeasures

3.1 No specified power supplies are available in AC operation

Countermeasures

- (1) Check that the equipment is securely connected to the wall outlet with the specified power cord.
- (2) Check that the AC inlet has two specified power fuses inserted and they are not blown out.
- (3) Disconnect the output jack of power transformer from the P1 connector. Apply the probe between pins 1 and 3 of output jack to measure the AC voltage of the secondary side of power transformer. It should be in a range of:
 - 9.0 to 12.5V for 100V model
 - 9.0 to 12.5V for 115V model
 - 8.5V to 12.5V for 230V model
- (4) On the PCB-6430, measure the voltage between the anode side of D16 or D9 and the cathode side of D15 or D11. It should be in a range of 10 to 16V DC.
- (5) On the PCB-6430, measure the voltage between the cathode side of D19 and E12N. It should be in a range of 10 to 16V DC.

NOTE: If the transformer output is normal but DC voltage output on PCB-6430 is not in a specified range, contact of the P1 connector may be poor or diodes D1 to D4 may be damaged.
If the voltage between the cathode side of D19 and E12N is not in a specified range, the fuse F1 on the PC board may be blown out or diode D19 may be damaged.

3.2 No specified power supplies are available in DC operation

Countermeasures

- (1) Open the battery cover at the rear of equipment. Check that the battery is loaded and connected to the main unit securely with the connector.
- (2) On PCB-6430, check that the battery voltage is available between pins 1 and 4 of P5 and between the plus side (TP) and GND side (TP).
If not, the contact of P5 may be inferior or the fuse F2 may be blown out.
- (3) Press ON key and check that the battery voltage is available between the drain of Q25 (anode side of D22) and GND on PCB-6430.
If not, the holding circuit around Q25, D3 and Q3 may be faulty or the connection of key panel may be poor.
- (4) On PCB-6430, check that the battery voltage is available between the cathode side (TP) of D22 and GND.
If not, D22 may be faulty.

3.3 +24V is not output

Countermeasures

- (1) Check that 12VN (8V to 16V) is output and the voltage is supplied to pins 10 and 13 of IC10.
- (2) Using an oscilloscope, verify that pin 4 of IC10 outputs an approximately 170kHz triangular wave.
If not, IC10 may be faulty.
- (3) Using an oscilloscope, verify that the gate of Q26 outputs an approximately 170kHz rectangular wave.
If not, IC10 may be faulty.
- (4) Using an oscilloscope, verify that the waveform at the drain of Q26 is switched at approximately 170kHz.
If not, Q26 and D5 may be faulty.

If the +24V power is not supplied to the thermal print head only, take the following step:

- (5) Press the RECORD/STOP key to place the equipment in the recording condition. Then check that the +24V is output at the drain of Q7 and pins 13, 14 and 15 of connector P4.
If not, Q7 and Q8 may be faulty. Also, check whether or not the signal is sent from the gate array (pin 68).

Signal level at the base input of Q8: "H" 24V ON

"L" 24V OFF

If +24V is output at the drain of Q7 and pins 13, 14 and 15 of connector P4 but is not supplied to the thermal print head, check the thermal print head cable.

3.4 +8V is not output

Countermeasures

- (1) Check that the 12VN voltage is input to pin 1 of IC17. The +12VN input should be +8V or over to output +8V.
If the +12VN is input but +8V output is not available, IC22 may be faulty.

3.5 +5V is not output

Countermeasures

- (1) Check that the +12V power is input to pin 1 of IC7.
If the +12V is input but +5V output is not available, IC7 may be faulty.

3.6 Floating +5VFD is not output

Countermeasures

- (1) Check that the 10VN (8V to 16V) is input to pin 3 of IC45.
If not, check that the voltage is output at D27 and D30.
- (2) Check that the +5VFD is output at pin 1 of IC45.
If not, IC45 may be faulty.

3.7 Floating $\pm 5VFA$ are not output

Countermeasures

- (1) Check that the +12VN (8V to 16V) is supplied to pins 6 and 7 of T1.
If not, check that +12VN is output.
- (2) Check that a 100kHz rectangular wave is output at G terminals of Q27 and Q28 as FT and FTL. FT and FTL are signals having opposite phases each other.
If not, the GA oscillation output (IC8) may be faulty.
- (3) Check that a 100kHz rectangular wave is transferred to pins 2 and 3 of T1 at the floating side.
If not, T1 may be faulty.
- (4) Check that rectified and smoothed plus and minus voltages are input to pin 2 of IC44 and pin 3 of IC45.
If not, check whether or not D27 and D30 are faulty. If these are normal, IC44 and IC45 may be faulty.

3.8 Floating $\pm 5VFB$ are not output

Countermeasures

- (1) Check that $\pm 5VFA$ are supplied to D28 and D29.
If not, check the polarity of D28 and D29. If the polarity is normal but $\pm 5VFB$ are not output, D28 and D29 may be faulty.

3.9 Troubles in charging operation

3.9.1 The equipment is not placed in charge mode or charging does not start

Countermeasures

- (1) Check that the battery is loaded and connected to the main unit securely with the connector and that the cable is not broken down.
- (2) Press the OFF key in AC operation and check that +5V is output from pin 16 of IC1. At the same time, check that +5V is output from pin 65 of gate array IC8.
If not, check the operation of +5V supply.
 - If it outputs +5V only when the OFF key is pressed, Q6 may be faulty.
 - If it does not output +5V when the OFF key is pressed, Q5, Q6 and D5 may be faulty.
 - If it does not output only +5V for CHG IRQ, check whether or not the collector of Q22 is at the low level. If it is at a low level, Q22 may be faulty.
- (3) Check that voltages between pins 6 (TS) and 9 (SNS) of IC1 and between pins 7 (BAT) and 9 (SNS) are in the following specified ranges:

Pin 6 (TP42)	$1.01V < V_{ts} < 2.0V$
Pin 7 (TP2)	$1.0V < V_{bat} < 1.78V$

If the Vbat is beyond the abovementioned range, check the terminal voltage of battery. Charging is not started unless the battery voltage is approximately 8.0V or over. Supplemental charging in AC operation is intended to keep the battery voltage 8.0V or over. Check that +24V is output at the collector of Q24 in AC operation.

If Vts is beyond the abovementioned range, remove the battery and check the thermistor in the battery. Measure the resistance between pins 2 (blue) and 4 (black) of connector. The resistance should be in a range of 3k Ω to 30k Ω . Also, the ambient temperature should be proper.

NOTE: If the equipment is not placed in the charge mode, the cause may be that the CHG IRQ (+5V) is not available at pin 9 of IC1 or +5V is not supplied to overall charging circuit.

If charging is not started at all, the battery cell voltage or temperature may be beyond the limits though +5V is supplied to the charging circuit and the CHG IRQ output. However, if +5V is not output normally and has a large error, the specified limits shift. So you need to check +5V taking the abovementioned steps (1) to (3).

3.9.2 Virtually no charging is made despite ‘CHARGE COMPLETE’ message on display

(1) Check that +24V is supplied to the source side of Q4.

If not, check the +24V supply referring to 3.3.

(2) Check that an approximately 140kHz rectangular wave is output at pin 14 (MOD) of IC1 and at the drain of Q4. Also check that an approximately 140kHz triangular wave is output at pin 9 (SNS) of IC1.

If not,

- Check R5 and R3.
- Check Q4, Q1, Q20, D1 and other parts around IC18.
- If all the above parts are normal, IC1 may be faulty.

Note that the charging current is detected as a voltage of R5 by pin 9 (SNS) and switches pin 14 (MOD) output.

(3) Check the number of charge/discharge times. Also check whether the operation time per charge is shortened or the battery is discharged quickly.

Usually, an allowable number of charge/discharge times is 200 but is lowered due to adverse operating environment.

Also, the higher the number of charge/discharge times, the shorter the operation time per charge become.

If the charging circuit has no problem, this trouble may be caused by the battery expiring the service life.

3.10 LCD does not operate normally

Countermeasures

- (1) Check that the connector P2 on the main board is securely connected to the connector of LCD unit.
Check for any poor soldering of connector terminal.
- (2) Check power supplies to the following pins of connector P2:
 - V_{SS} Pin 1 GND level
 - V_{DD} Pin 2 +5V
 - V_{EE} Pin 3 +0.238V
- (3) Press the PROGRAM or any other key which affects the LCD screen and verify that the following control signals are not fixed at a high or low level:
 - Signal lines
 - R_s signal
 - R/W signal
 - E signal
 - DB0 to DB7 signals

NOTE: The LCD module has a control driver built in and can be directly accessed by the CPU (with MEMORY READY put in between).

3.11 No key operation is available

Countermeasures

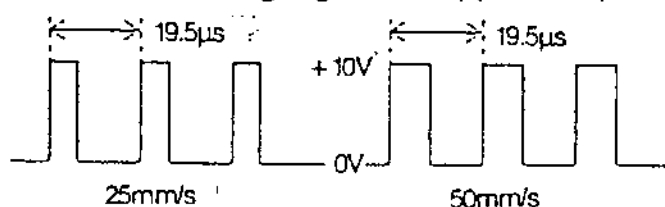
- (1) Check that the J5 on the main board is securely connected to the flexible cable of key panel.
Check for any inferior soldering of P7.
Check whether or not the flexible cable of key panel is broken or the carbon part is worn.
- (2) Press each key other than ON and OFF/CHARGE and check that the corresponding key signal becomes low level.

NOTE: If only a specific key is not effective, the cause may lie in poor contact of the key switch.

3.12 Chart paper is not driven or driven abnormally

Countermeasures

- (1) Check that the P3 on the main board is securely connected to the motor cable.
Check for any poor soldering of P3.
Check for any possible disconnection of motor cable.
- (2) Check that +5V is supplied to pins 3 and 5 of P3.
- (3) Check that the following signal is supplied to pin 1 of P3:



Check the frequency of SPEED signal at pin 14 of IC22. It should be as follows.

256Hz at a paper speed of 25mm/sec

512Hz at a paper speed of 50mm/sec

Check that the START/STOP signal is high level when recording.

3.13 Mark on Z-fold paper is not detected

Countermeasures

- (1) Check that "RECORDING MODE" in the program is set to "MARK."
- (2) Check that no dirt is clogged on the mark sensor and the sensor is securely mounted.
- (3) Check that the flexible cable of sensor is securely connected to the J4 on the main board.

NOTE: The mark sensor is the only part in the equipment which is adjusted by variable resistor. Check for any possible peeling of lock paint and dislocation of the variable resistor.

3.14 Paper end is not detected or “PAPER END” alarm is always on display

Countermeasures

- (1) Check that no dirt is clogged on the mark sensor and the sensor is securely mounted.
Check that the magazine sensor switch is mounted with no dislocation and it is pressed when the magazine is closed.
- (2) Check that the flexible cable of sensor is securely connected to the J4 on the main board.
Check for any poor soldering of J4.
Check for any possible disconnection of the flexible cable.

NOTE: The mark sensor is the only part in the equipment which is adjusted by variable resistor. Check for any possible peeling of lock paint and dislocation of the variable resistor.

3.15 Programmed settings change (clock goes wrong)

Countermeasures

- (1) Check that the lithium battery provides +2.0V.
Check for any poor soldering of lithium battery.
- (2) Check that pin 3 of IC4 outputs an approximately 32kHz sine wave.

NOTE: Backup RAM and clock circuit are in IC4.

3.16 Buzzer does not sound

Countermeasures

- (1) Check that a 1kHz rectangular wave is output from pin 78 of gate array (or R81) under the condition where the buzzer is to sound.
If QRS synchronization sound is not available, check that “QRS BEEP” in the program is set to ON.
If the 1kHz rectangular wave is available at pin 78 of gate array, the cause of this trouble may lie in faulty R81, poor soldering of buzzer or faulty buzzer.

3.17 No waveform and alphanumeric data are recorded

Countermeasures

- (1) Check that the thermal print head cable is securely connected to P4 on the main board.
Check that the thermal print head cable is securely connected to the thermal print head.
Check for any poor soldering of P4.
- (2) Check that +24V is supplied to pins 13 to 15 of P4 under the condition where the waveform is to be recorded.
Check that +5V is supplied to pin 9 of P4.

- (3) Check that the THEN signal at pin 68 of IC8 or the base of Q8 is high under the condition where recording is to be made.
Check that LATCH (pin 2 of P4), CLOCK (pin 3 of P4), STROBE (pins 5 to 7 of P4) and DATA IN (pin 1 of P4) are not fixed at high or low level under the condition where recording is to be made.

NOTE: If electrical signals are normal, recording may be impossible due to a mechanical failure. So check mechanical parts such as spring around the thermal print head.

3.18 No DC input waveform is recorded

Countermeasures

- (1) Check that "DC RECORDING" in the program is set to ON.
- (2) Check for any poor soldering of J2 on the main board.
- (3) Check that normal power voltages are supplied to DC input as follows:
 - +5V between plus and minus side of C19
 - 5V between minus and plus sides of C8
- (4) Check that the reference voltage of 3.2V is available at K of IC14.
- (5) Check that AD DATA, DIN, AD SCLK, and EOC signals above A/D CS* are not fixed at high or low level.

3.19 All 12-lead waveforms are recorded as baselines

Countermeasures

- (1) Check isolated power supplies (+5VFD, ± 5 VFA and ± 5 VFB) referring to paragraphs related with power supplies.
Check that the power is supplied to power pins of ICs* such as operation amplifier and multiplexor.
*IC19, 20, 21, 23, 24, 25, 26, 29, 30, 31, 32, 34, 36, 38, 39, 40, 41
- (2) Check that pin 35 of IC38 is not fixed at a high level.

3.20 Some lead waveform is recorded as baseline

Countermeasures

- (1) Check the lead cable for any possible disconnection or inferior connection.
- (2) Check whether or not the buffer IC for the lead which becomes a baseline and the excess input protection limiter of dual transistors Q10 to Q18 are short-circuited.

3.21 Lead-off detection is not available for all leads

Countermeasures

- (1) Check that the voltage at the connection of R44 and R43 is 1.4V or so.

3.22 Lead-off detection is not available for some specific lead

Countermeasures

- (1) Initiate a condition to cause lead-off (for example, by disconnecting the lead cable) and check whether or not the buffer IC for that specific lead outputs a voltage of over -0.4V .
- (2) Select the dual transistor for that specific lead from Q10 to Q18 (excess input protection limiter) and remove it. Then check the operation of the dual transistor under the condition to cause lead-off.

NOTE: Since a high-impedance circuit is applied to the ECG input, it is difficult to measure parts before the buffer IC with a measuring instrument. So the servicing time can be effectively saved by judging a faulty part while replacing the device.

3.23 System error (code 24) is generated at power-up

Countermeasures

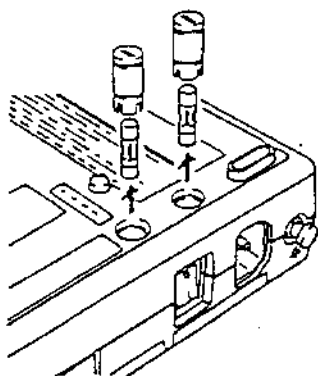
- (1) Check floating power voltages of ECG amplifier referring to paragraphs 3.4 to 3.8.
- (2) Check control and data signals. Pin 6 of IC33 and pin 6 (SRX) of IC28 should not be kept at a high or low level.
- (3) Check the reference voltage of 3V at pin 13 of IC39.
- (4) Check the operation of A/D converter. Pins 1 to 6 of IC39 should not be kept at a high or low level.
- (5) Check the oscillation of ceramic oscillator. Pin 27 of IC38 should output a 2MHz sine wave.

CHAPTER 4

Maintenance

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7. Disassembling/Reassembling the Equipment	4—8

1. Replacing Power Fuse

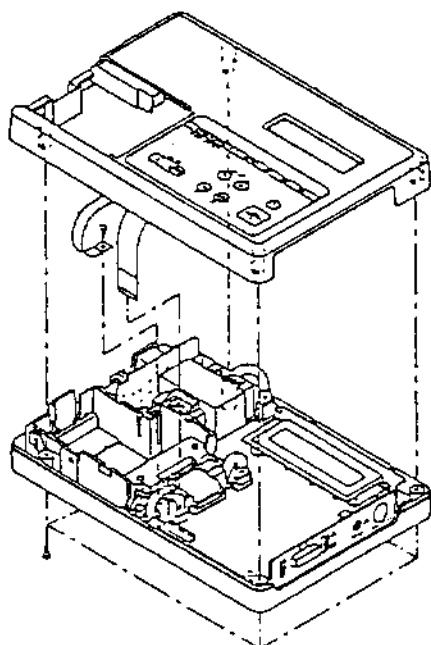


Caution

When replacing the power fuse, be sure to turn the power off and disconnect the power cord from the wall outlet in advance.

The power fuse is hardly blown out. But if it is blown out due to some reason, pull out the fuse holders at the bottom of equipment, then replace the blown fuse with a spare.

2. Replacing ROM

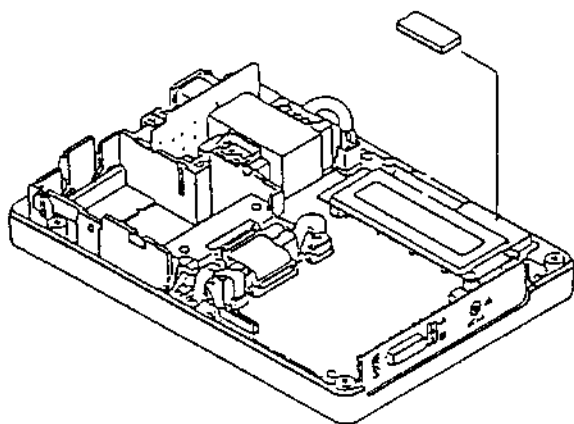


Caution

When replacing the ROM, be sure to turn the power off in advance.

Also take care to mount it in correct direction.

- (1) Remove the upper casing referring to "7. Disassembling/Reassembling the equipment."
- (2) Then you can see the ROM on the main PC board. Remove the ROM (IC3) from the PC board.
- (3) Mount the replacement ROM taking care of the direction.
- (4) Make sure the ROM is not contacted with the feet of R5, etc.
- (5) If the ROM is mounted with no problem, put the upper casing and fix it with screws.
- (6) Turn the equipment on and make sure the version number of control program on the standby display is the same as labelled on the ROM.

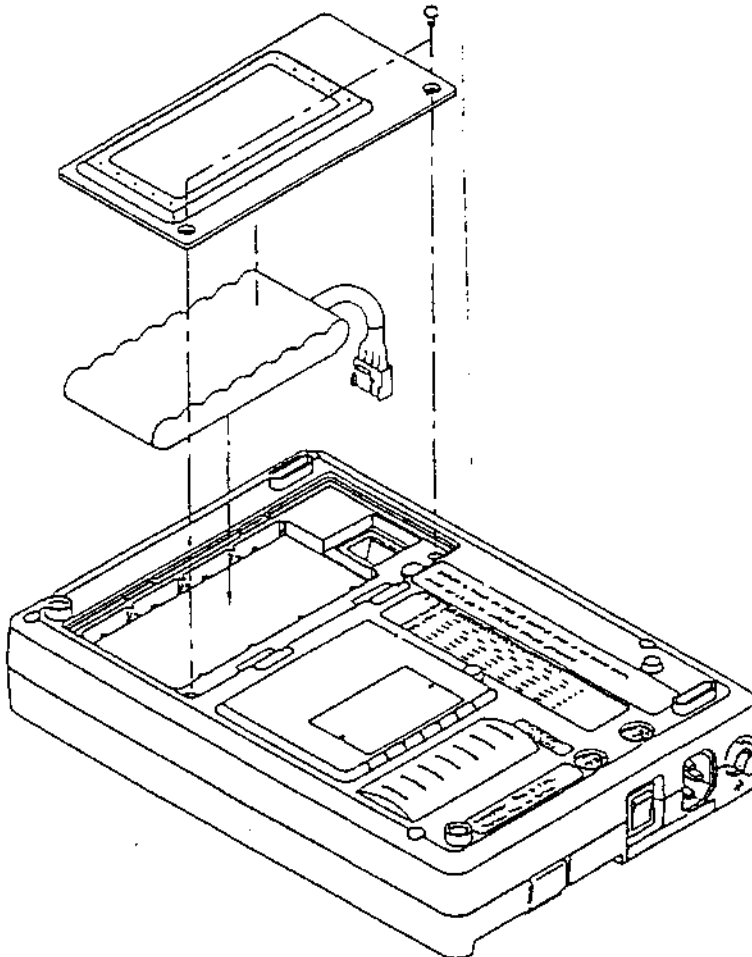


3. Replacing Battery

Caution

When replacing the battery, be sure to turn the power off and disconnect the power cord from the wall outlet in advance.

- (1) Turn the power off and disconnect the power cord from the wall outlet.
- (2) Put the equipment upside down. Loosen two screws on the battery cover and remove the battery cover.
- (3) Insert the connector of replacement battery into the end of mating connector and put it squarely in the battery room.
- (4) Put the battery cover and tighten it with screws. If the cover is not put in the original position, neatly arrange the battery cable.
- (5) Press the ON key and make sure the equipment starts up.
- (6) The replacement battery may have been stored for a long period of time and the capacity may be lowered due to self-discharge. Charge it first after replacing.



NOTE: Charge spare batteries in stock every six months. Also, to make full use of the battery loaded in the equipment, the user should follow the instructions described in the operation manual.

4. Clock Setting

If there are errors in the date and time, correct them with the following procedure:

1. AC FILTER (ON)

35. MAINTENANCE
PUSH [START] KEY

3. DATE/TIME SETTING
PUSH [START] KEY

DATE / TIME
'94 / 1 / 1 23 : 59

3. DATE/TIME SETTING
PUSH [START] KEY

(1) Press the PROGRAM key to call up the setting display.

(2) Press the ▲ or ▼ key until the "35. MAINTENANCE" is selected.

Press the START/STOP key. The maintenance menu will be called up.

(3) Press the ▲ or ▼ key until "3. DATE/TIME SETTING" is selected.

Press the START/STOP key. The date/time setting display will be called up.

(4) Using the ◀ or ▶ key, move the cursor to a desired setting item.

Then using the ▼ or ▼ key, revise the numerical value.

Setting ranges are:

Day: 1 to 31

Month: 1 to 12

Year: 0 to 99

Hour: 0 to 23

Minute: 00 to 59

(5) Press the MODE key to enter the revised values.

(6) Press the PROGRAM key. The display before switching to the program mode will return.

5. Checking the Operation of Equipment

To check the operation of instrument, conduct the total test of self-test program. The total test allows you to check the following:

- Time constant of ECG amplifier
- Paper speed
- Possibility of unevenness in recording
- Possibility of missed dots on print head

1. AC FILTER

[ON]

35. MAINTENANCE

PUSH [START] KEY

5. SELF TEST

PUSH [START] KEY

1. TOTAL TEST

PUSH [START] KEY

(1) Press the PROGRAM key to call up the setting display.

(2) Press the ▲ or ▼ key until "35. MAINTENANCE" is selected.

Then press the START/STOP key. The maintenance menu will be called up.

(3) Press the ▲ or ▼ key until "5. SELF TEST" is selected.

(4) Press the START/STOP key to call up "1. TOTAL TEST."

(5) Press the START/STOP key once more to execute "TOTAL TEST."

As the total test advances, the key operation guide changes accordingly. When the total test is complete, the initial key operation guide returns.

(6) After completing the total test, press the PROGRAM key. The initial display at power-on will return.

The self-test program involves the following tests:

1. Total test
2. Time constant test
3. Recorder test
4. Printout test
5. Key test
6. LCD test (display test)
7. Status 1 test
8. Status 2 test
9. Memory test
10. Serial I/O test
11. Auto power-off test

To perform a test other than the TOTAL TEST

(1) Take the abovementioned steps (1) to (4) to call up "1. TOTAL TEST" on display.

(2) Press the ▲ or ▼ key until a desired test is selected from those listed at the left.

Then press the START/STOP key. The test will be executed.

(3) When completing the test, press the PROGRAM key. The initial display will return.

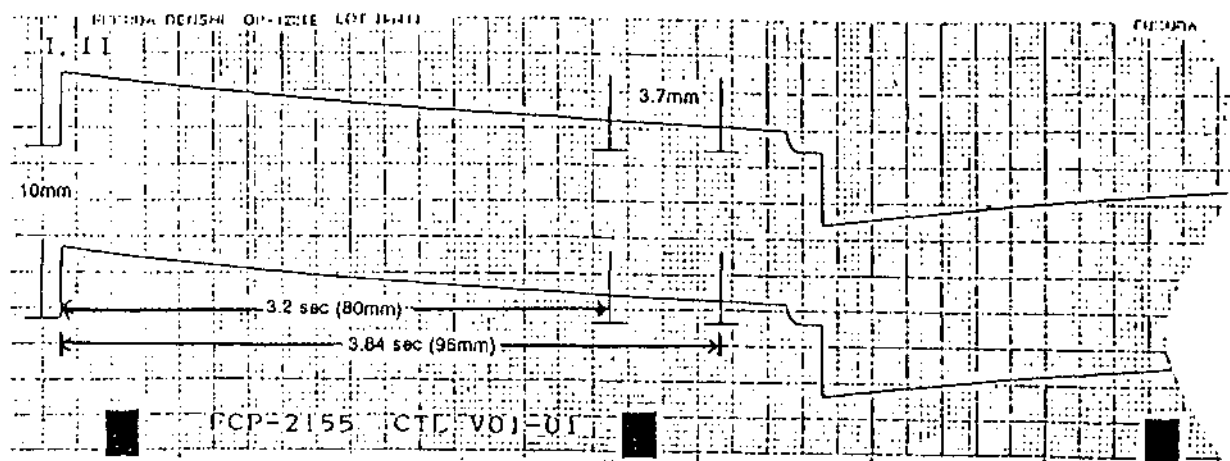
Details of Self-test

1. Total Test

Time constant test, recorder test and printout test are executed successively.

2. Time Constant Test

The time constant curve of ECG amplifier is output onto the chart paper.

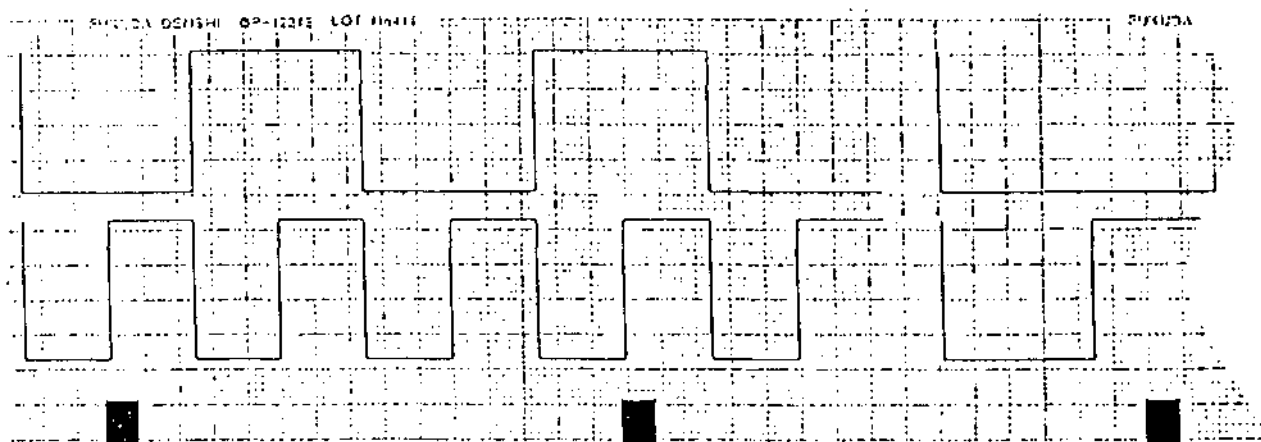


3. Recorder Test

A pulse waveform is recorded to allow you to check paper speeds, unevenness in recording and missed dots on the thermal print head.

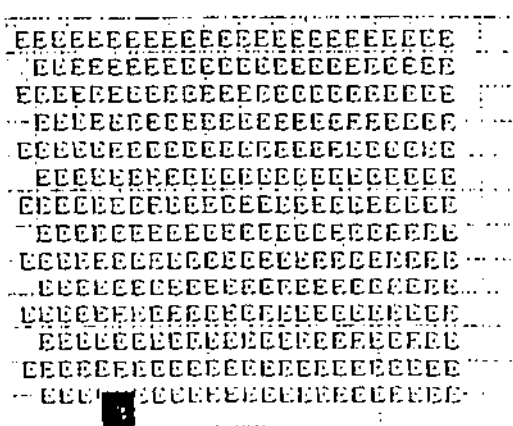
25mm/sec (± 1.5 mm)

50mm/sec (± 3 mm)



4. Printout Test

All alphanumerics and symbols available for recording are output onto the chart paper.



5. Key Test

The name of a pressed key is displayed on the LCD screen.

SELF TEST [KEY]

[MODE]

← Name of pressed key

6. LCD Test

Characters available on the display are called up successively.

SELF TEST [LCD]

[! " # \$ % & ' () * + , - / 0 1]

Displayed on the second line.

7. Status 1 Test

Lead-off, lithium battery voltage, print head temperature, magazine status, etc. are displayed.

① L: ② T: ③
B: ④ SW: ⑤ M: ⑥ S: ⑦

- ① Lead-off status checked for
- ② Lithium battery voltage (by 0.1V unit)
- ③ Print head temperature
- ④ Ni-MH battery voltage
- ⑤ Dip switch setting condition
- ⑥ « Magazine status (○: Closed, X: Open)
- ⑦ Mark sensor status (0: White, 1: Black)

8. Status 2 Test

A/D converted ECG data are displayed.

① ② ③ ④
⑤ ⑥ ⑦ ⑧

- ① A/D converted I lead value
- ② A/D converted II lead value
- ③ A/D converted V1 lead value
- ④ A/D converted V2 lead value
- ⑤ A/D converted V3 lead value
- ⑥ A/D converted V4 lead value
- ⑦ A/D converted V5 lead value
- ⑧ A/D converted V6 lead value

9. Memory Test

Internal memory is checked.

SELF TEST [MEMORY]

PC: ①

E.C: ②

- ① Pass count of memory
- ② Error count of memory

10. Serial I/O Test

Serial interface is checked.

SELF TEST [SERIAL]

①

- ① Transmission/reception data (15 characters)

An asterisk (*) is displayed for communication error.

Note that the serial I/O test requires an exclusive cable.

11. Auto Power-off Test

Auto power-off function in DC operation is checked.

11. AUTO POWER OFF

PUSH [START] KEY

Press the START key in DC operation mode.
The equipment will be turned off.

6. System Error Messages

When the equipment gets out of order, it displays an error code on the LCD screen.

SYSTEM ERROR CODE= # #	←Error code
---------------------------	-------------

Error codes vs. their causes are as follows:

Error Codes	Causes
21	Pass error
22	Address error
23	Instruction error (illegal command)
24	Zero subtraction
25	Spurious instruction
27	Privilege violation
28	Unused interrupt error (all points which are not prepared as error code in vector region)
2A	Operation code error (unused command '1010')
2B	Operation code error (unused command '1111')
31	Memory error
41	Overheat of thermal print head (over 60°C)

7. Disassembling/Reassembling the Equipment

You need to disassemble the instrument for servicing, inspection and replacement of devices such as ROM. Here, we describe the disassembling procedure. When reassembling, take the reverse steps to the disassembling procedure.

When disassembling or reassembling the FCP-2155, take the following caution:

Caution

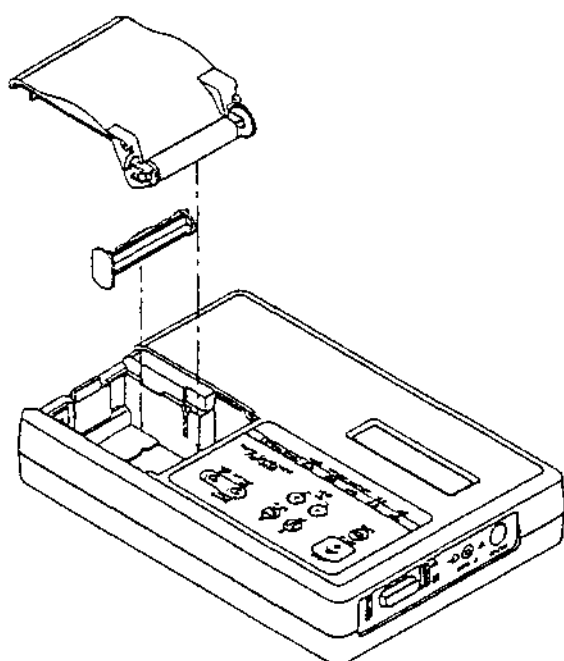
Disassembling/Reassembling Precautions

- Be sure to turn the power off and disconnect the power cord from the wall outlet. Then start disassembling the equipment.
- When removing the main PC board, remove the Ni-MH battery in advance.
- Take care not to disconnect and connect the key panel and sensor board from/to the connector too frequently. Too frequent disconnection and connection of these units may cause poor contact.
- Use proper screwdrivers to loosen screws.
- When reassembling, make sure all screws are tightened to original positions and all disconnected connectors are reconnected properly.

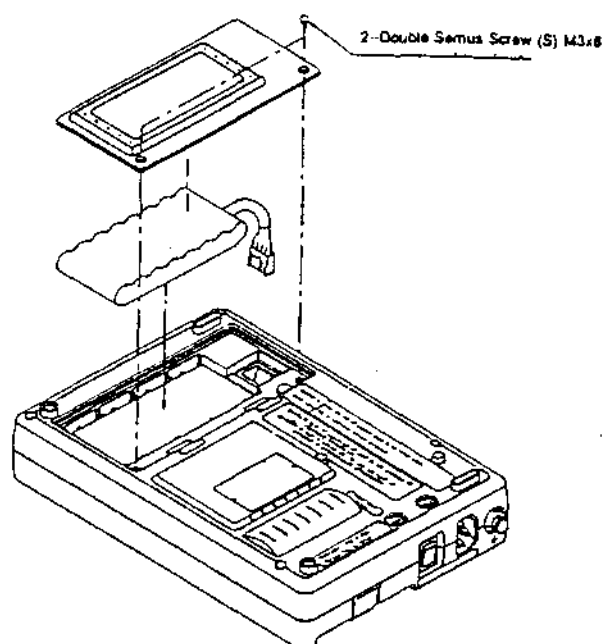
PC Board Handling Precautions

- PC boards are equipped with extremely sensitive devices to static electricity.
- PC boards are sensitive electronic assemblies. Take proper measures for removed PC boards, e.g. put them in a conductive bag.
- Handle PC boards carefully. Giving an impact to them may damage devices mounted onto them.
- Never remove a PC board or connect the connector to it when supplied with power.

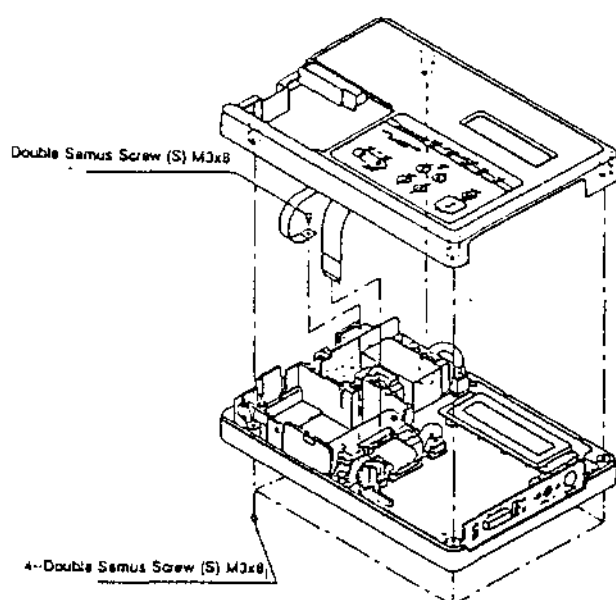
7.1 Disassembling Procedure



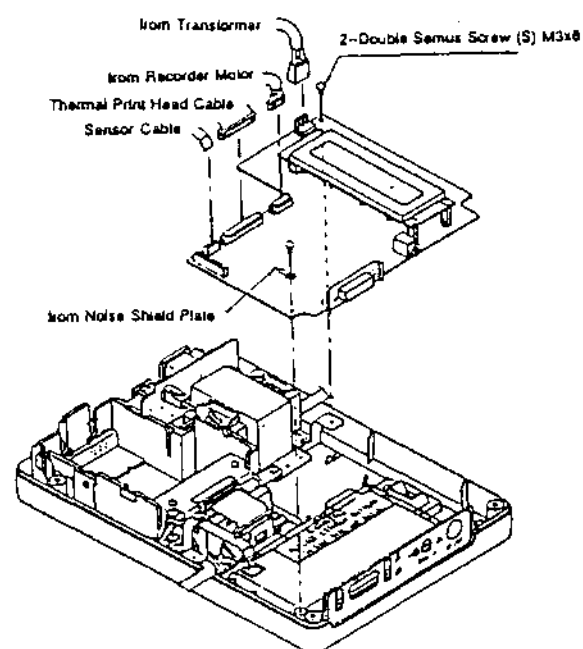
1. Remove the paper magazine and paper shaft from the main unit.



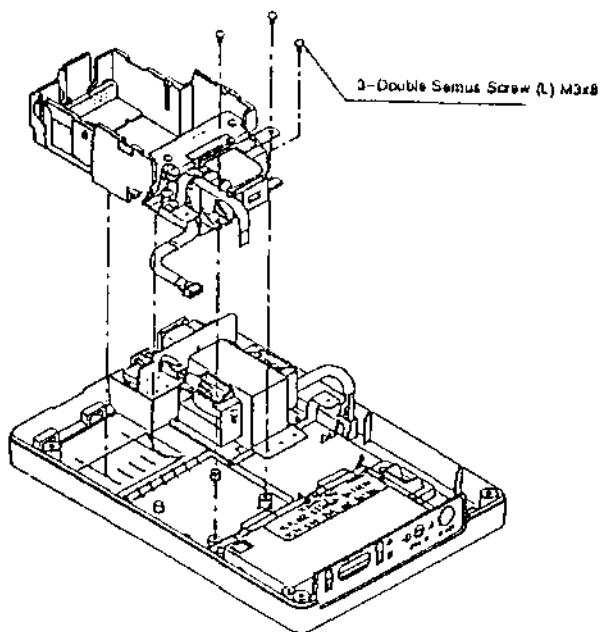
2. Remove the battery cover at the bottom of equipment and put out the battery.



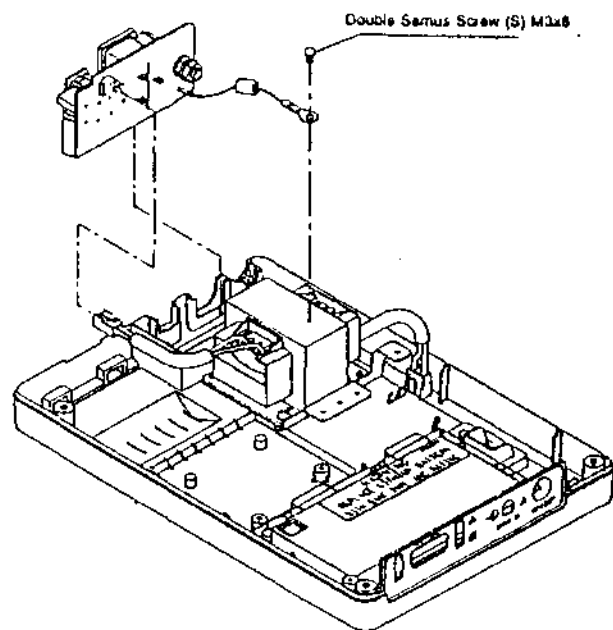
3. Loosen four screws on the bottom panel and remove the upper casing panel.



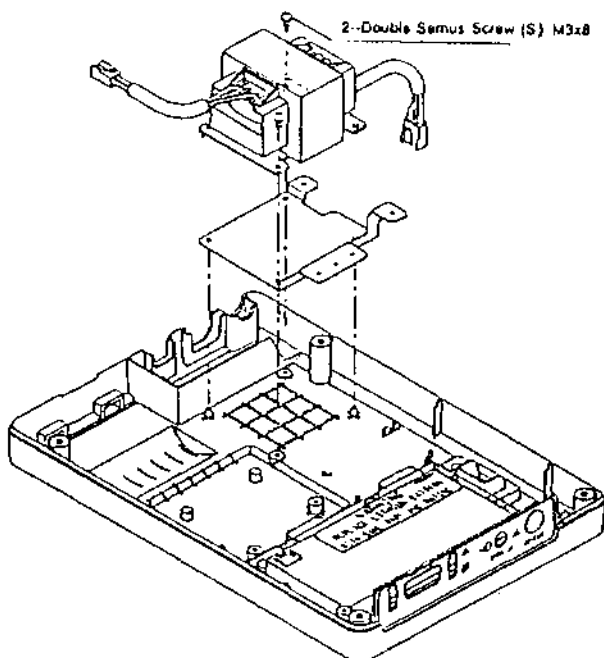
4. Disconnect connectors from the main PC board. Loosen two screws on the PC board. Then you can remove the PC board.



5. Loosen three screws on the recorder block and remove it.



6. Loosen the screw which fixes both power board PCB-6410 and the transformer. Disconnect connectors of the transformer then remove the PC board.



7. Finally, loosen the screw on the transformer and remove the transformer and the metal fitting for grounding.

Periodical Inspection

1. Periodical Inspection	5—1
1.1 Checking lead cable and power cord	5—1
1.2 Visual inspection	5—1
1.3 Cleaning the equipment	5—1
1.4 Self-test and total function check	5—1
1.5 Battery check.....	5—2
2. Safety Inspection	5—2
2.1 Measuring leakage current	5—2
2.2 Measuring protective grounding resistance.....	5—5
2.3 Remarks	5—6

1. Periodical Inspection

In this chapter, we describe the inspection to prevent troubles and let the instrument keep the sufficient safety and complete operating condition.

Perform the following at least once a year:

- Check the lead cable, power cord, and grounding wire for any possible damage.
- Conduct visual inspection.
- Clean the instrument.
- Perform the self-test and total function check.
- Check the battery.
- Check the leakage current.
- Measure the protective grounding resistance.

As with simple inspection, recommend the user to make it every day or week. But let the user refer a complete function check and troubleshooting to the service engineer authorized by Fukuda Denshi.

1.1 Checking lead cable and power cord

Visually check the lead cable and power cord for any possible damage. Check also the connectors for any possible looseness. If a damage is found, replace as required. Merely applying a tape may not repair the cable sufficiently.

Also measure the resistance of each electrode to check for internal cable disconnection and damage.

1.2 Visual inspection

- Check that mechanical parts such as screws are securely fitted.
- Check that connectors inside the equipment are securely connected.
- Check that there is no trace of damage.
- If a loose part is found, tighten it securely.

1.3 Cleaning the equipment

The recommended number of cleaning times depends on the operating frequency and environment.

For cleaning, wipe the casing with a properly wetted soft cloth. You can use the cleanser for tableware by weakening it with water. However, take care that the cleaning solution or water may not enter the inside through openings. Finally, wipe off wetty substance with a dry cloth.

1.4 Self-test and total function check

Perform the self-test described in “4. Maintenance” and check the total function of the equipment to ensure that the equipment operates safely and completely.

1.5 Battery check

Measure the voltage between plus and minus sides of battery to check the capacity. If it is below 9V, charge the battery. Also, if the battery has not been charged for six months, charge it. If the battery will not be used for a long period of time, remove it from the equipment and store in a cool place.

If the battery is below 6V, it may be difficult or impossible to charge. In such a case, replacement is required.

2. Safety Inspection

To ensure the safety of equipment, it is recommended to perform safety inspection. The test methods and measuring instruments are stipulated in the standard for safety test. It is considered extremely difficult to fully follow the standard for the safety test at the health care site. In checking for maintenance and inspection, therefore, measure each specified value as a rough rule of thumb.

We describe here examples of simplified measurement of leakage current and protective grounding resistance.

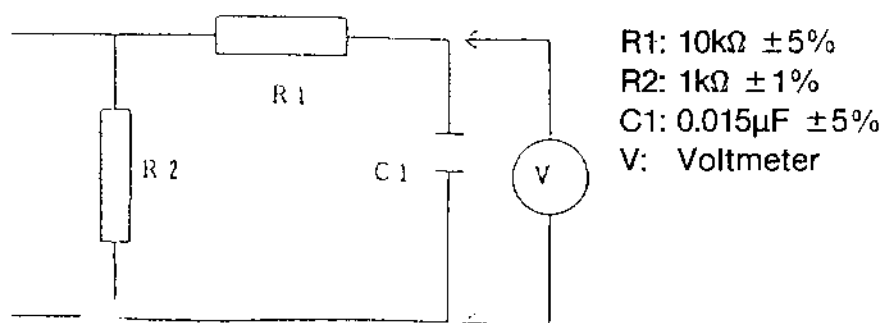
Caution

If you find a value which exceeds the allowable level, be sure to let the user avoid using the equipment. If the user operates the equipment as it is, he/she may receive an hazardous accident.

2.1 Measuring leakage current

Prepare an instrument to measure the leakage current (electronic or digital voltmeter), impedance device and power switch box.

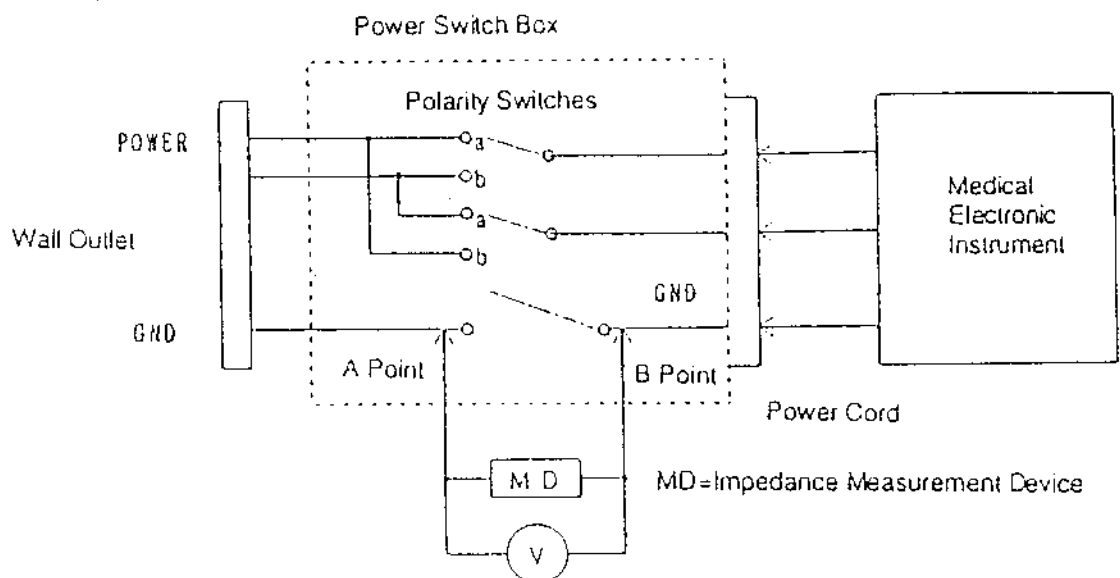
The impedance device has the following configuration:



You can obtain a leakage current by measuring voltages at both ends of the impedance device.

The digital voltmeter shall indicate a true root mean square value to a composite waveform of a frequency band from DC to 1MHz. If such a voltmeter is not available in hand, you may use a commercially available digital voltmeter for the purpose of simple maintenance and inspection. However, make sure of the frequency band of the voltmeter and note that the voltmeter will not indicate a leakage current at a frequency exceeding the capacity.

(1) Example of checking ground leakage current (current flowing in protective grounding conductor)



See the figure above. A grounding terminal and the power switch box which allows you to switch the polarity facilitate measurement of ground leakage current.

The procedure to measure ground leakage current using the power switch box is as follows:

- Measurement of ground leakage current is made by measuring voltages at B point (grounding conductor of power cord) and A point (wall grounding terminal)... under normal condition and single fault condition.

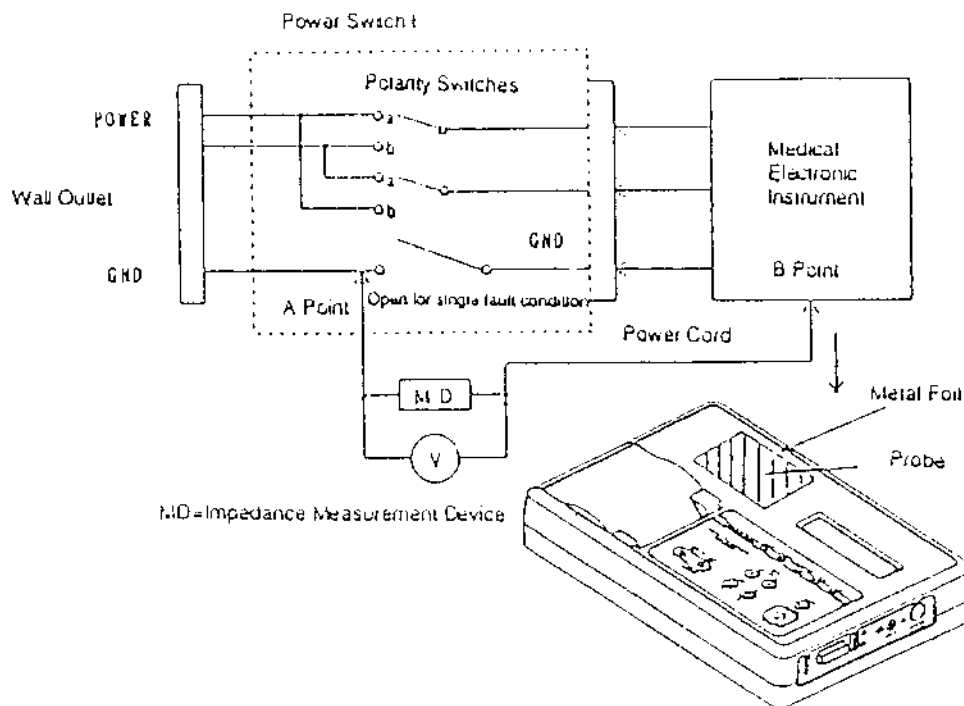
Normal condition

- Measurement of ground leakage current under normal condition is made by switching the polarity switches to "a" positions then to "b" positions. Thus, measurement is made in two ways.

Single fault condition

- Measurement of ground leakage current under single fault condition is made with a power fuse removed by switching the polarity switches as above. Since the same measurement is made with another fuse removed, measurement for single fault condition is made in four ways.

(2) Example of measuring enclosure leakage current (current flowing from enclosure to the ground)



Apply a metal foil of 20 x 10 cm to the isolated enclosure. Put the probe to the metal foil for measurement.

- Measurement of enclosure leakage current is made by measuring voltages at A point (wall grounding terminal) and B point (desired part of enclosure).
If the enclosure is isolated, stick a metal foil (e.g. aluminium foil) onto the enclosure with a conductive tape and apply the probe to that metal foil.
- Measurement of enclosure leakage current under normal condition is made by switching the polarity switches to “a” positions then to “b” positions. A value measured under normal condition will be a very small value near zero.
- Measurement of enclosure leakage current under single fault condition is made with the wall grounding terminal and the grounding conductor of power cord removed and by switching the polarity of power source.

In leakage current measurement, take a maximum value as the measurement result.

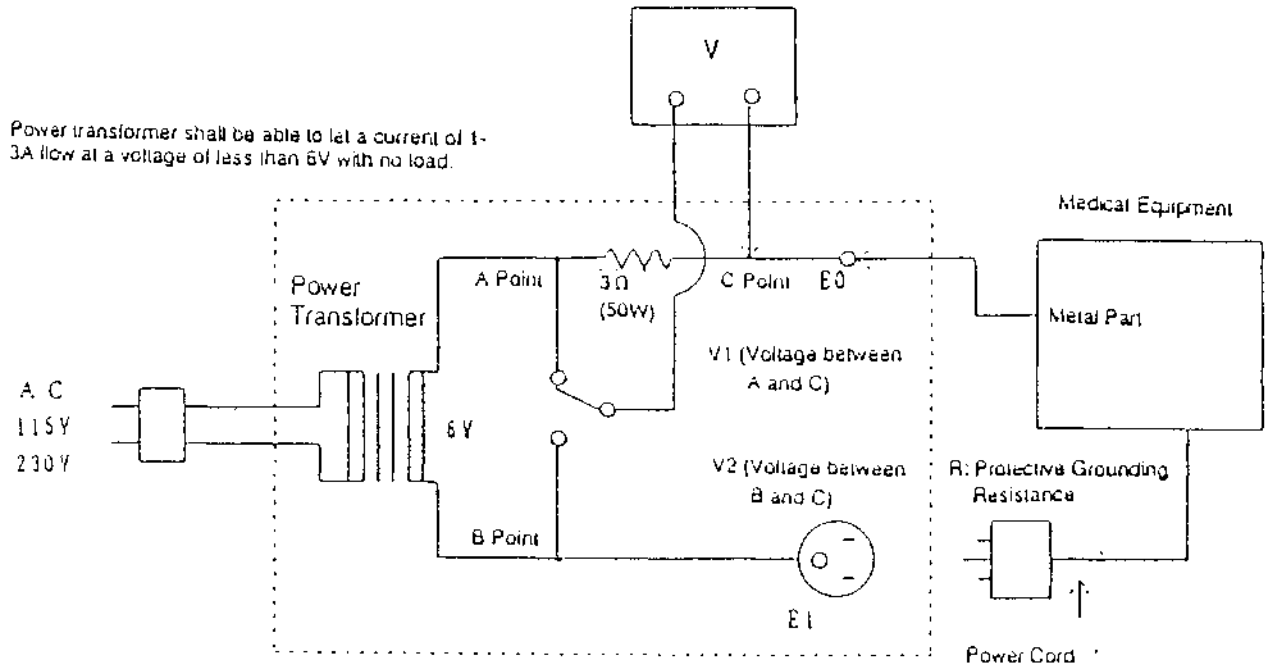
The following are maximum allowable ground leakage current and enclosure leakage current: In inspection, it is important to compare measurement values with past ones to check for any outstanding difference.

Maximum allowable leakage currents (117/253V AC)

	Normal condition	Single fault condition
Ground leakage current	0.5mA	1.0mA
Enclosure leakage current	0.1mA	0.5mA

2.2 Measuring protective grounding resistance

According to the standard, protective grounding resistance shall be measured by letting the testing transformer flow an AC current of 10-20A from a power source of which the voltage with no load does not exceed 6V. Practically, however, it is not easy to prepare such a testing device. We show therefore a simplified method as follows:



Simplified Measurement of Protective Grounding Resistance

The testing circuit above allows you to measure the protective grounding resistance of equipment using an AC current of 2A or so. Connect the power cord of equipment to E1 and the metal part (such as equipotentialization terminal) to E0. Make the conductor to E0 shortest possible to suppress the contact resistance. Flow a current of 2A or so to the equipment and measure voltage V1 between A and C points and V2 between B and C points.

Since the flowing current is the same, the subject protective grounding resistance can be obtained through the relations between the voltage ratio and resistance ratio as follows:

$$R/3 = V2/V1 \quad \therefore R (\text{protective grounding resistance}) = 3 \cdot V2/V1 (\Omega)$$

Measurement current may be 1A or so.

With the standard, the resistance between an accessible conductive part and the protective grounding terminal shall be 0.1Ω maximum. In measurement at the grounding conductor of power cord with the power cord connected, the grounding resistance including that of the protective grounding conductor of power cord shall be 0.2Ω maximum.

Protective grounding resistance

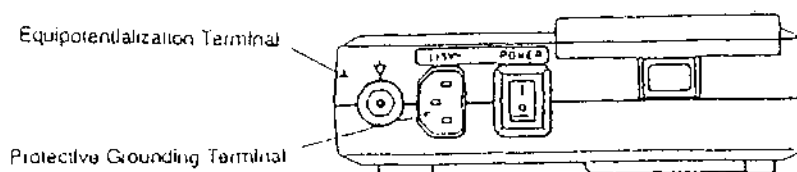
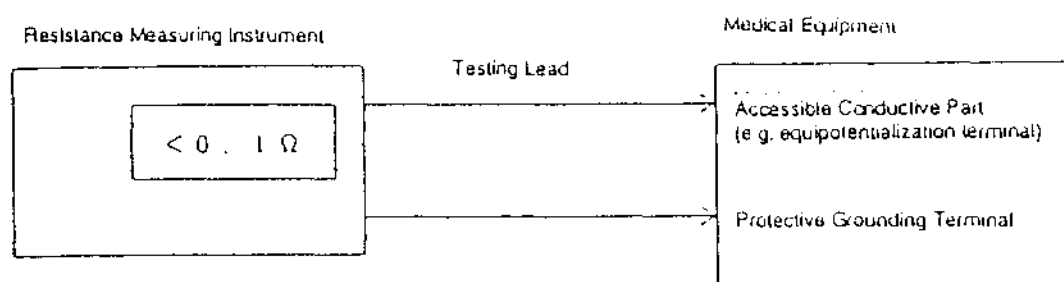
Resistance between protective grounding terminal and equipotentialization terminal	0.1Ω maximum
Protective grounding conductor of power cord and equipotentialization terminal	0.2Ω maximum

2.3 Remarks

Abovementioned measurement of protective grounding resistance requires the power transformer which can flow an AC current of several amperes and a testing fixture. If you cannot prepare such a testing power transformer, you may measure it with the following method to obtain a rough rule of thumb:

Measure the resistance between an accessible conductive part and the protective grounding terminal to verify that it is lower than 0.1Ω . If you measure the protective grounding resistance with the grounding conductor of power cord as the protective grounding terminal, the resistance shall be lower than 0.2Ω including that of the protective grounding conductor.

You need also to adjust the resistance of the testing lead or probe used for measurement.



Simplified Method of Resistance Measurement

This method considerably differs from that of the standard. Consider the result as a rough rule of thumb.

Protective grounding resistance

Resistance between protective grounding terminal and equipotentialization terminal	0.1Ω maximum
Protective grounding conductor of power cord and equipotentialization terminal	0.2Ω maximum

CHECK SHEET FOR PERIODICAL INSPECTION

Inspection Date:

Inspected by:

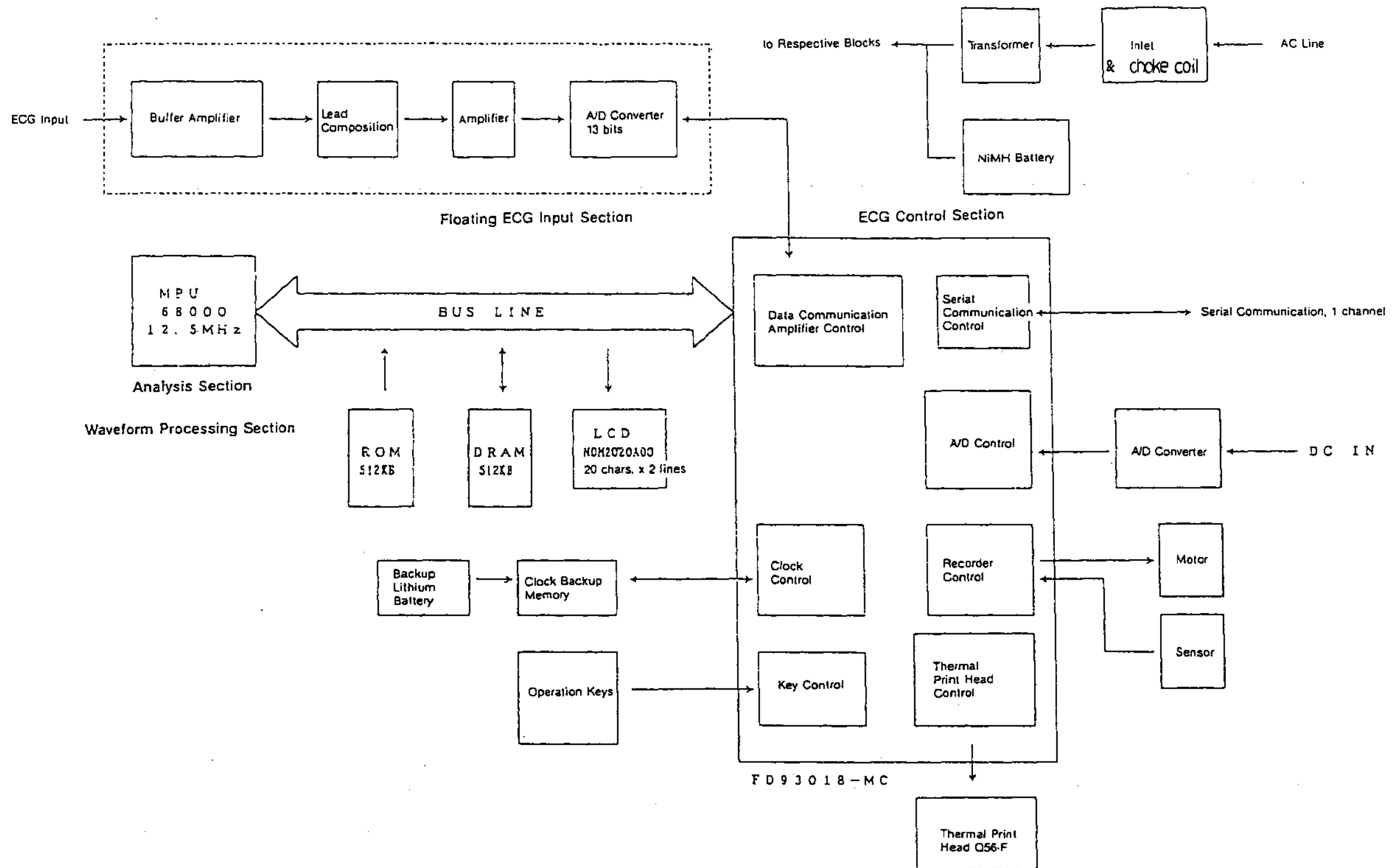
Model Number	Installation Site
Serial Number	Years of Use

Check Items	Judgment/Measurement	Remarks (Repair Required)
VISUAL INSPECTION		
1. Cords and Cables		
• Power cord and lead cable for damage	Pass/Fail	
• Connections of power cord and lead cable	Pass/Fail	
2. Casing and Accessories		
• Casing for damage such as crack	Pass/Fail	
• Casing for dirt	Pass/Fail	
• Labels for fading letters	Pass/Fail	
• Screws for looseness and dropout	Pass/Fail	
• Electrodes for dirt and rust	Pass/Fail	
• Expendables and operation manual	Pass/Fail	
3. Connectors		
• Power and lead connectors for damage and looseness	Pass/Fail	
4. Others		
• Power fuses for breakdown	Pass/Fail	
• Protective grounding terminal for damage	Pass/Fail	
• Switch panel for damage and dirt	Pass/Fail	
• Thermal print head for damage and dirt	Pass/Fail	
• Paper magazine for damage and dirt	Pass/Fail	
• LCD module for damage and dirt	Pass/Fail	
ELECTRICAL INSPECTION		
• AC operation and battery operation	Pass/Fail	
• Time constant test	Pass/Fail	
• Recorder test (paper speed & sensitivity)	Pass/Fail	
• Printout test (for missed dots)	Pass/Fail	
• Key test	Pass/Fail	
• LCD test	Pass/Fail	
• Auto power-off test	Pass/Fail	
• Battery charge	(V) Pass/Fail	Charge OK/NG
SAFETY		
• Ground leakage current (normal condition)	_____ μA Pass/Fail	
(single fault condition)	_____ μA Pass/Fail	
• Enclosure leakage current (normal condition)	_____ μA Pass/Fail	
(single fault condition)	_____ μA Pass/Fail	
• Protective grounding resistance	_____ Ω Pass/Fail	
OTHERS		

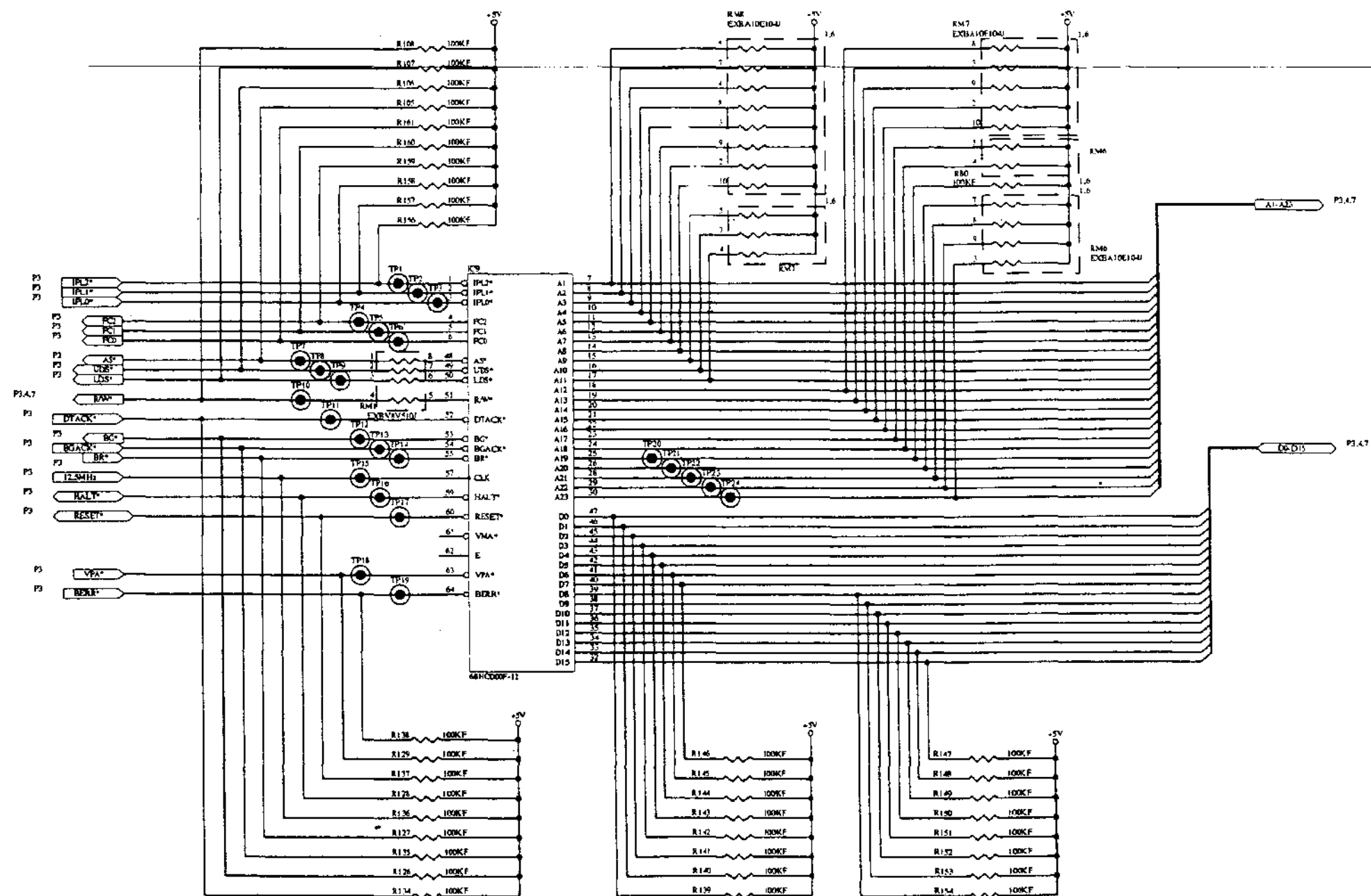
CHAPTER 6

Circuit Diagrams

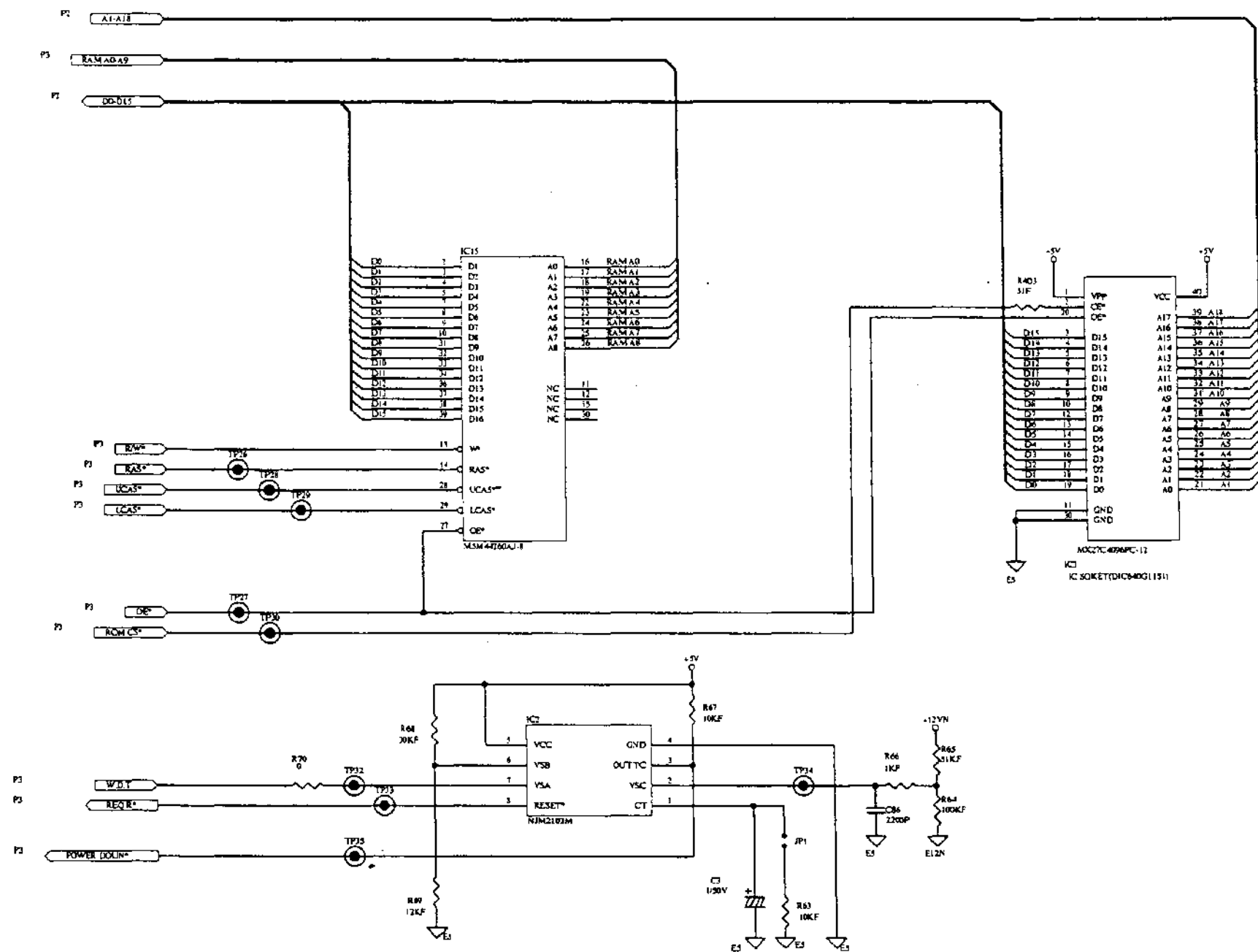
Overall Block Diagram	433-4979	6—1
Main Board, PCB-6430.....	523-2048	6—3
Inlet Poard, PCB-6410.....	524-2049	6—27
Sensor Board, PCB-6239	524-1959	6—28
Motor Module	524-1960	6—28
Dry Cell Battery	524-1962	6—30
Overall Connection Diagram.....	433-4980	6—31
Motor Connection Diagram.....	434-4896	6—33
LCD Connection Diagram	434-4895	6—34
Inlet Board Component Layout Diagram	434-4981	6—35



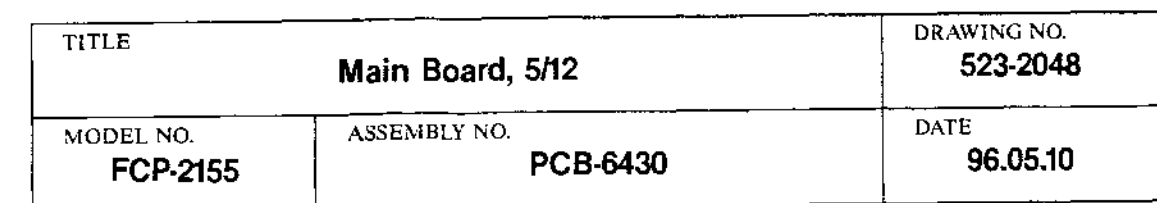
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MODEL NO. FCP-2155	ASSEMBLY NO.	DATE 96.05.10

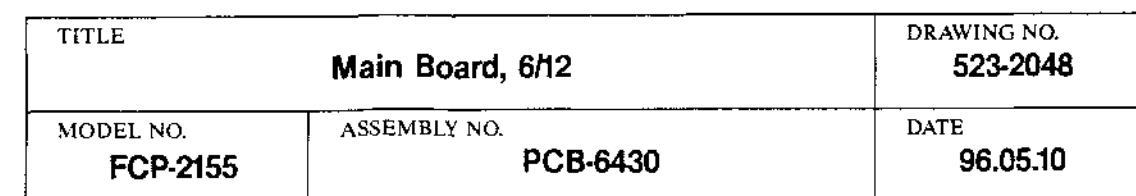


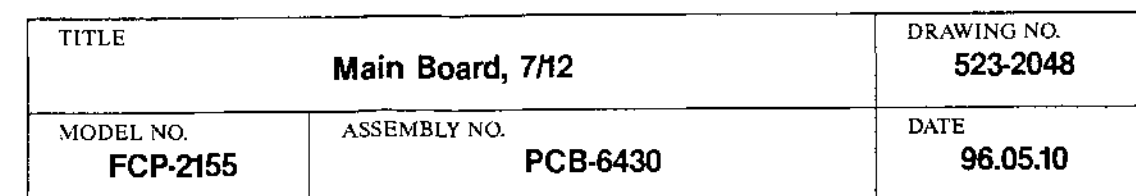
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Main Board, 2112		523-2048
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	PCB-6430	96.05.10

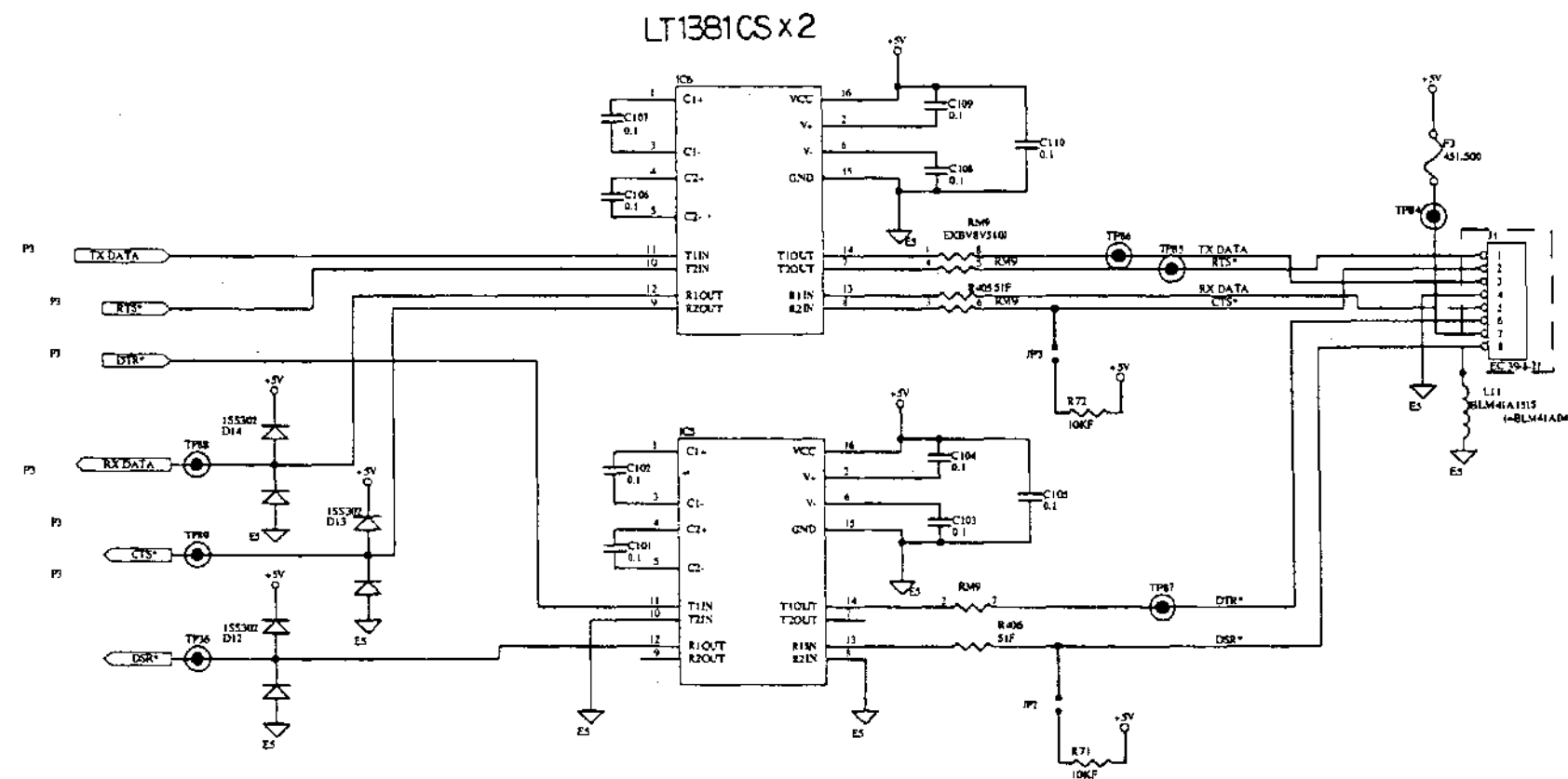


TITLE		DRAWING NO.
Main Board, 4/12		523-2048
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	PCB-6430	96.05.10

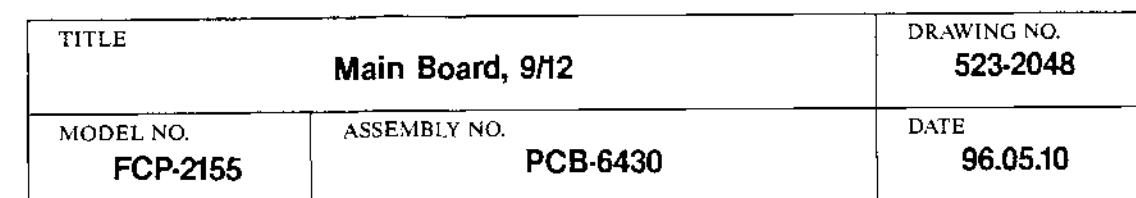


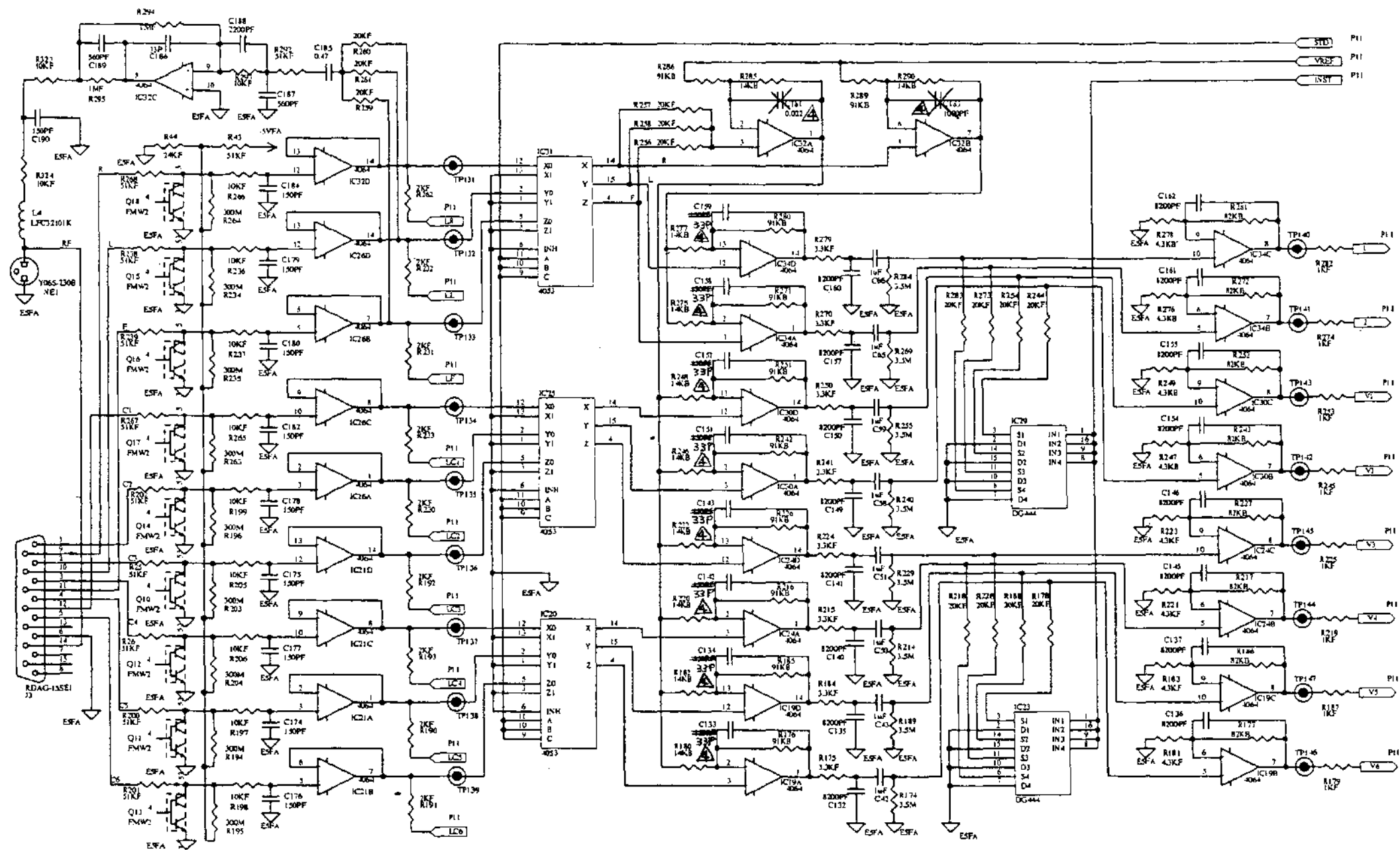




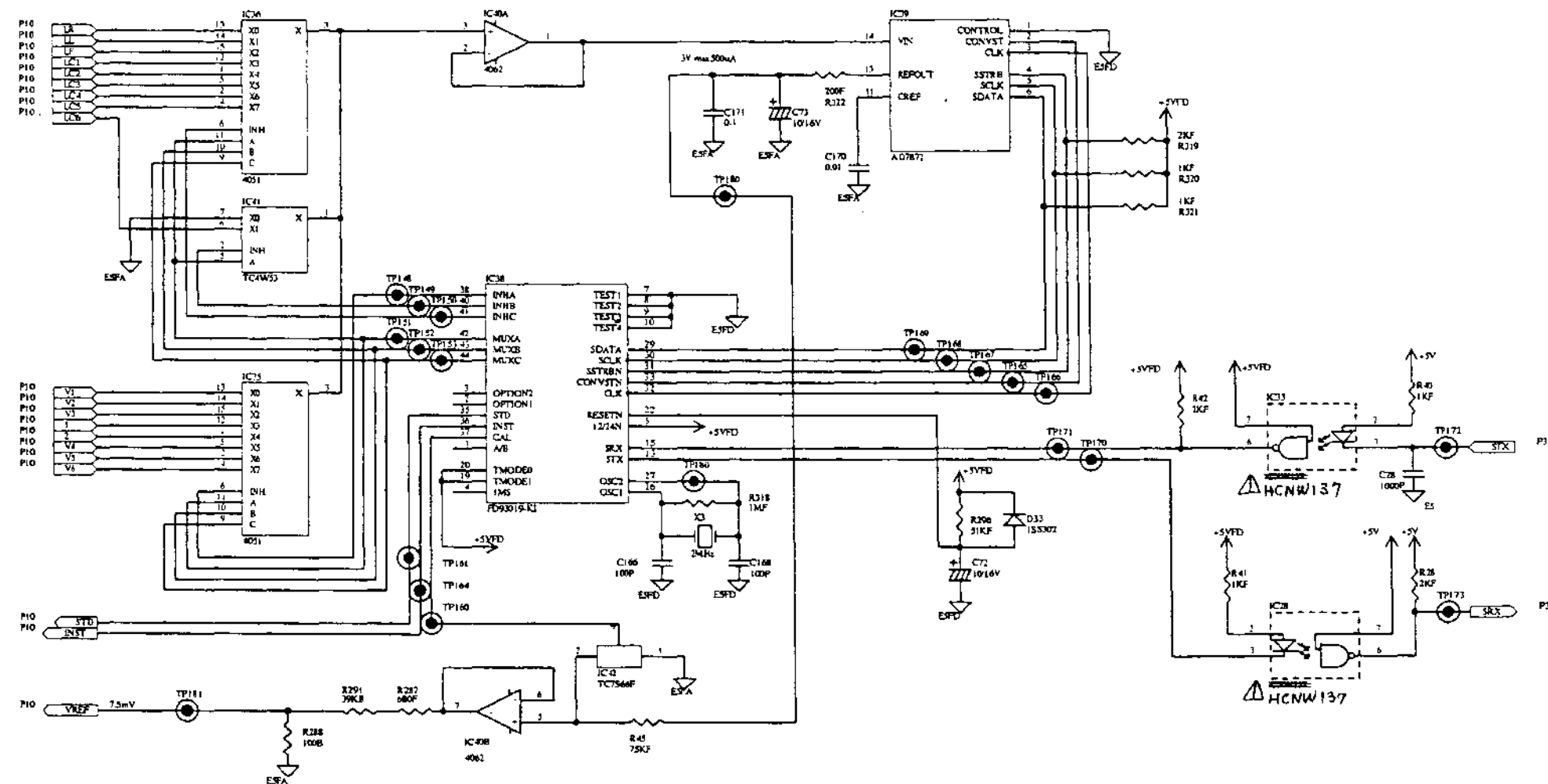


TITLE		DRAWING NO.
Main Board, 8/12		523-2048
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	PCB-6430	96.05.10

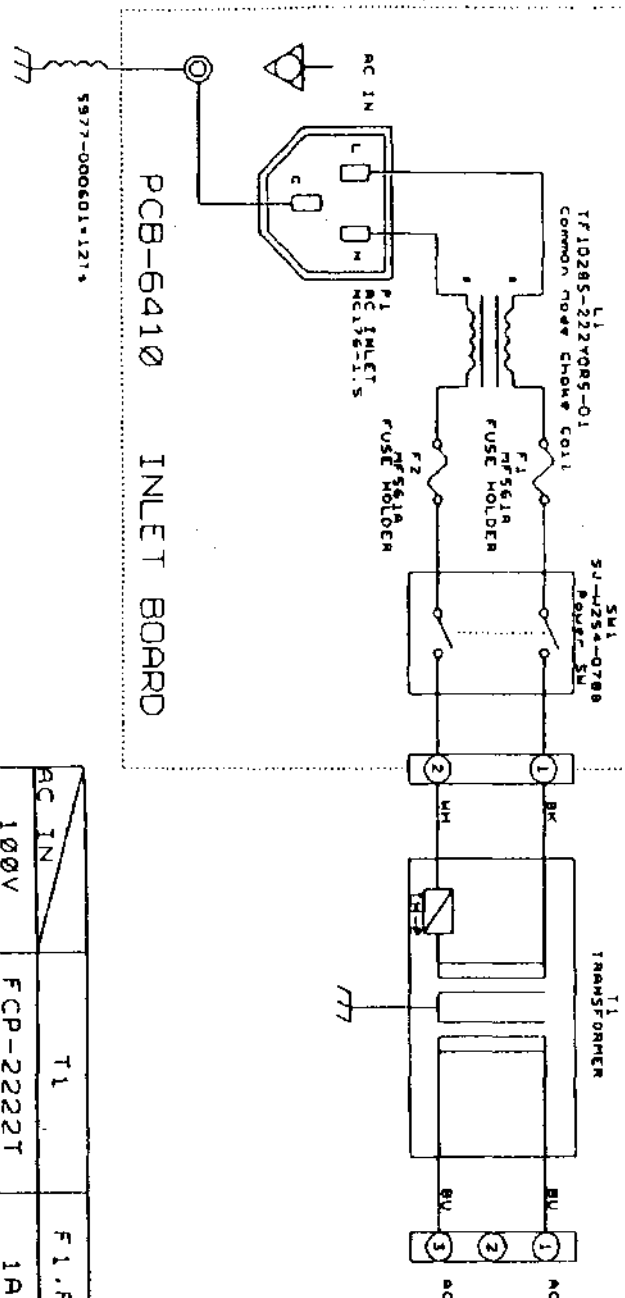




TITLE		DRAWING NO.
Main Board, 10/12		523-2048
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	PCB-6430	96.05.10

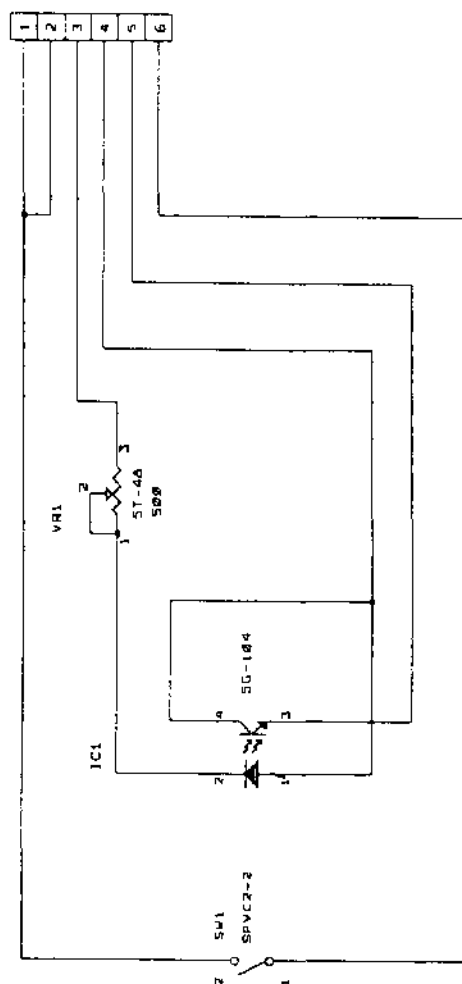


TITLE		DRAWING NO.
Main Board, 11/12		523-2048
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	PCB-6430	96.05.10

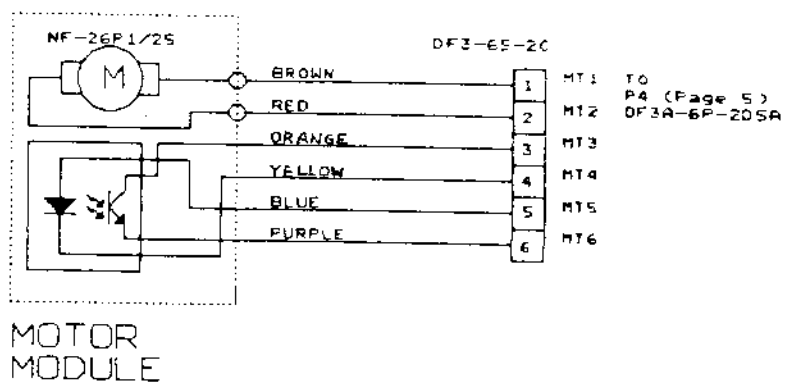


AC IN	T1	F1, F2
100V	FCP-2222T	1A
115V	FCP-2222AT	1A
230V	FCP-2222UT	0.5A

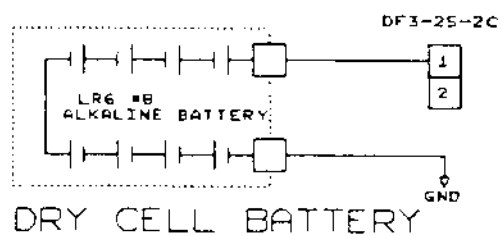
TITLE Inlet Board		DRAWING NO. 524-2049
MODEL NO. FCP-2155	ASSEMBLY NO. PCB-6410	DATE 96.05.10



TITLE Sensor Board		DRAWING NO. 524-1959
MODEL NO. FCP-2155	ASSEMBLY NO. PCB-6239	DATE 94.07.14

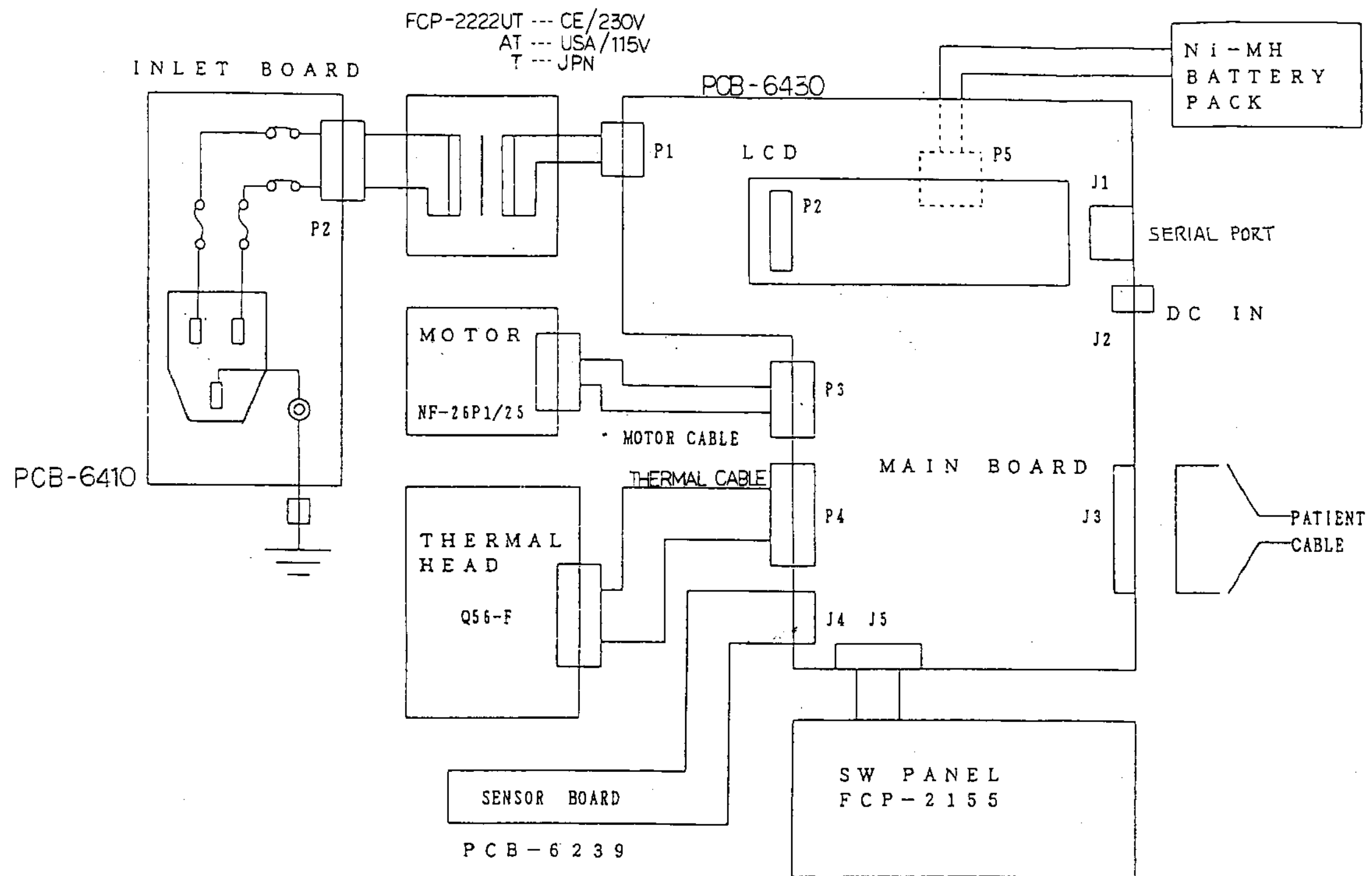


TITLE		DRAWING NO.
Motor Module		524-1960
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155		94.07.14

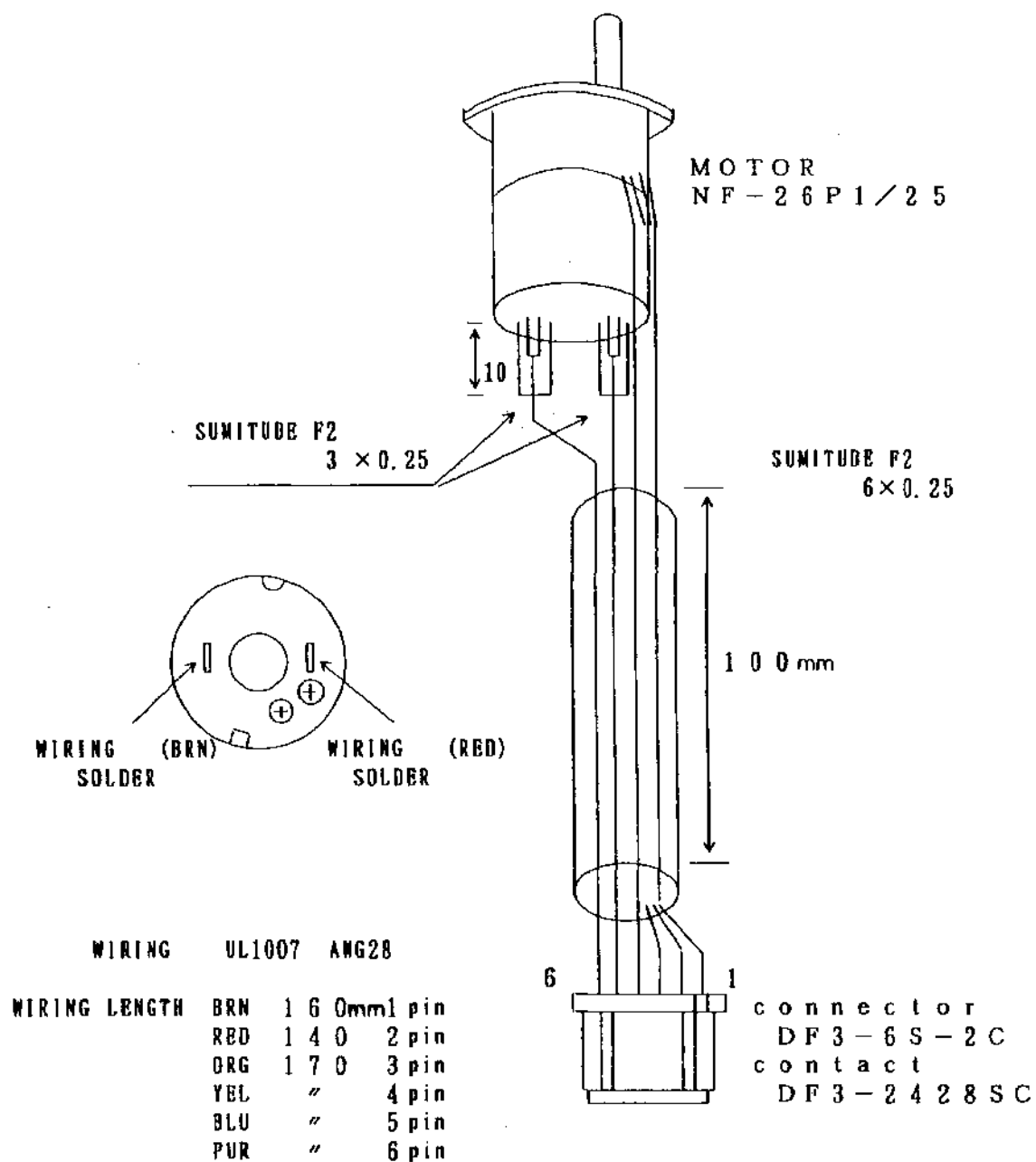


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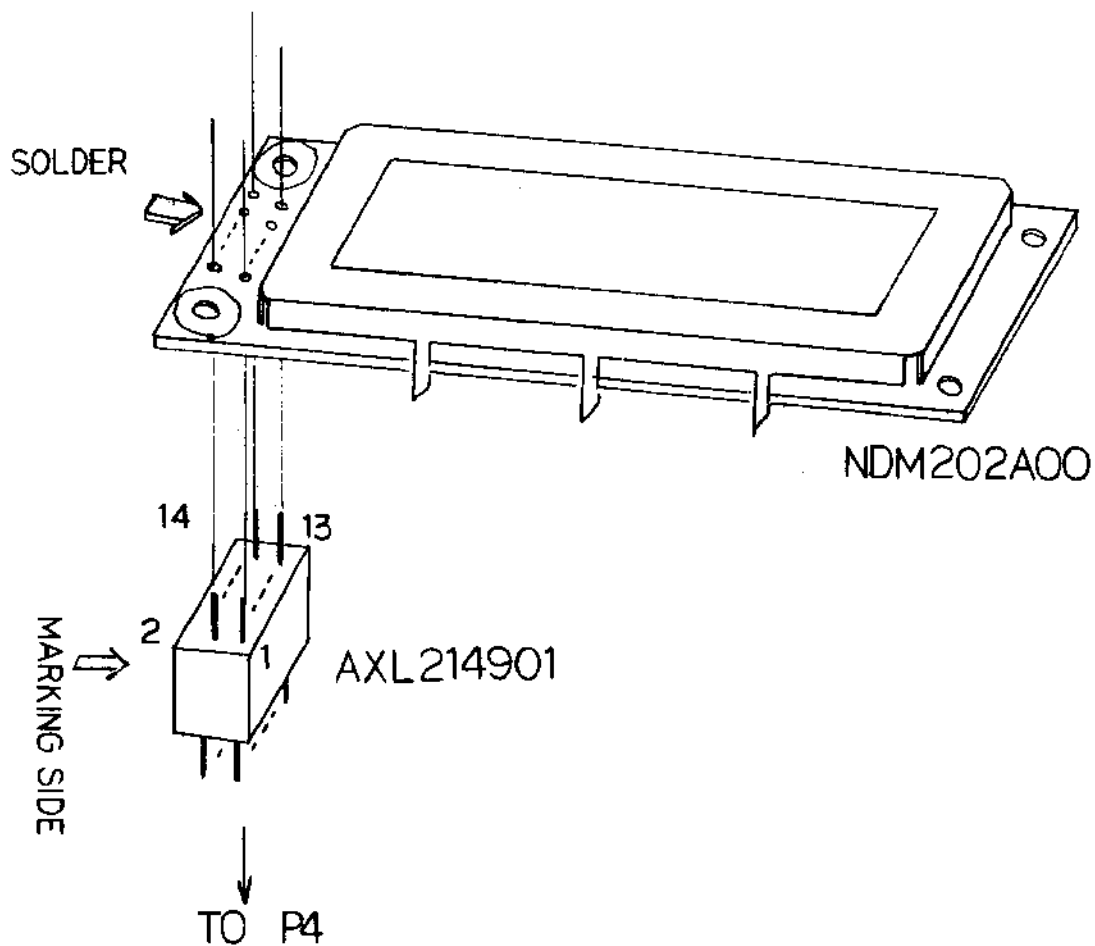
TITLE		DRAWING NO.
Dry Cell Battery		524-1962
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155		94.07.14



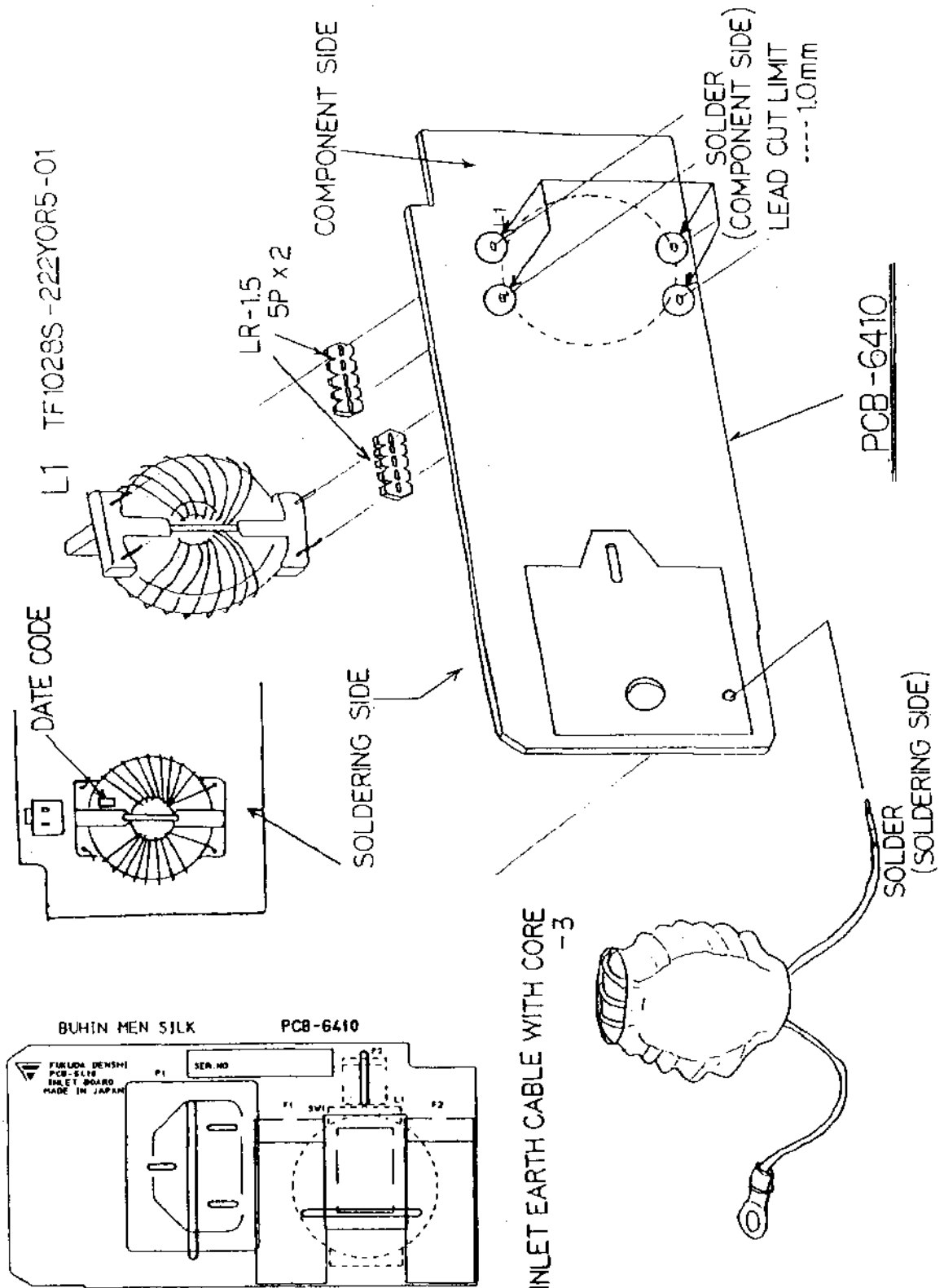
TITLE Overall Connection Diagram		DRAWING NO. 433-4980
MODEL NO. FCP-2155	ASSEMBLY NO.	DATE 96.05.10



TITLE Motor Connection Diagram		DRAWING NO. 434-4896
MODEL NO. FCP-2155	ASSEMBLY NO.	DATE 96.01.08



TITLE LCD Connection Diagram		DRAWING NO. 434-4895
MODEL NO. FCP-2155	ASSEMBLY NO.	DATE 96.01.08

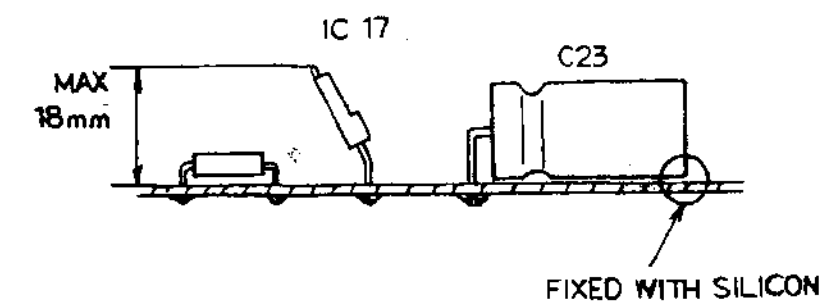
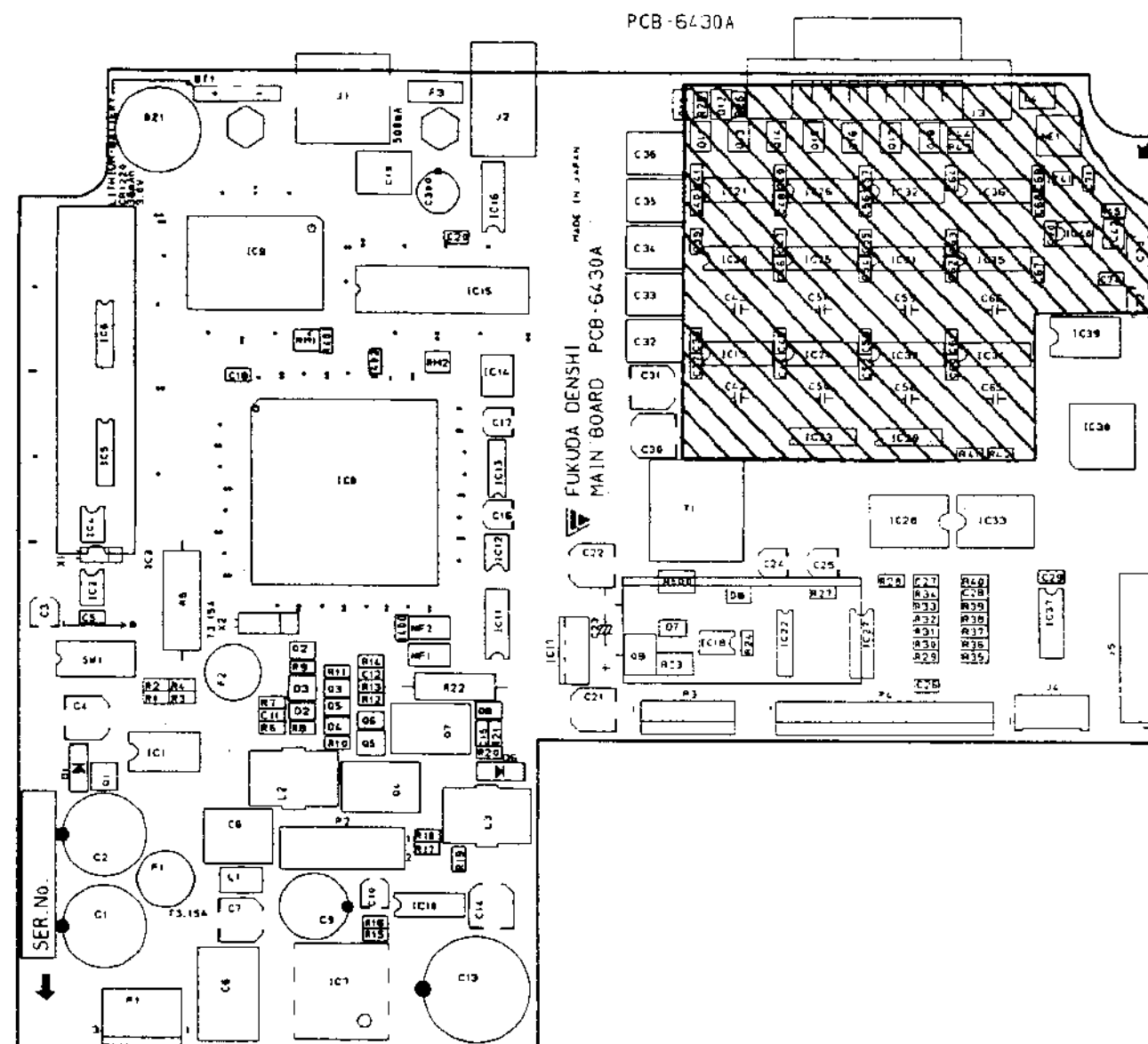


TITLE Inlet Board Component Layout Diagram		DRAWING NO. 434-4981
MODEL NO. FCP-2155	ASSEMBLY NO. PCB-6410	DATE 96.05.10

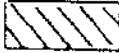
CHAPTER 7

Assembly Diagrams

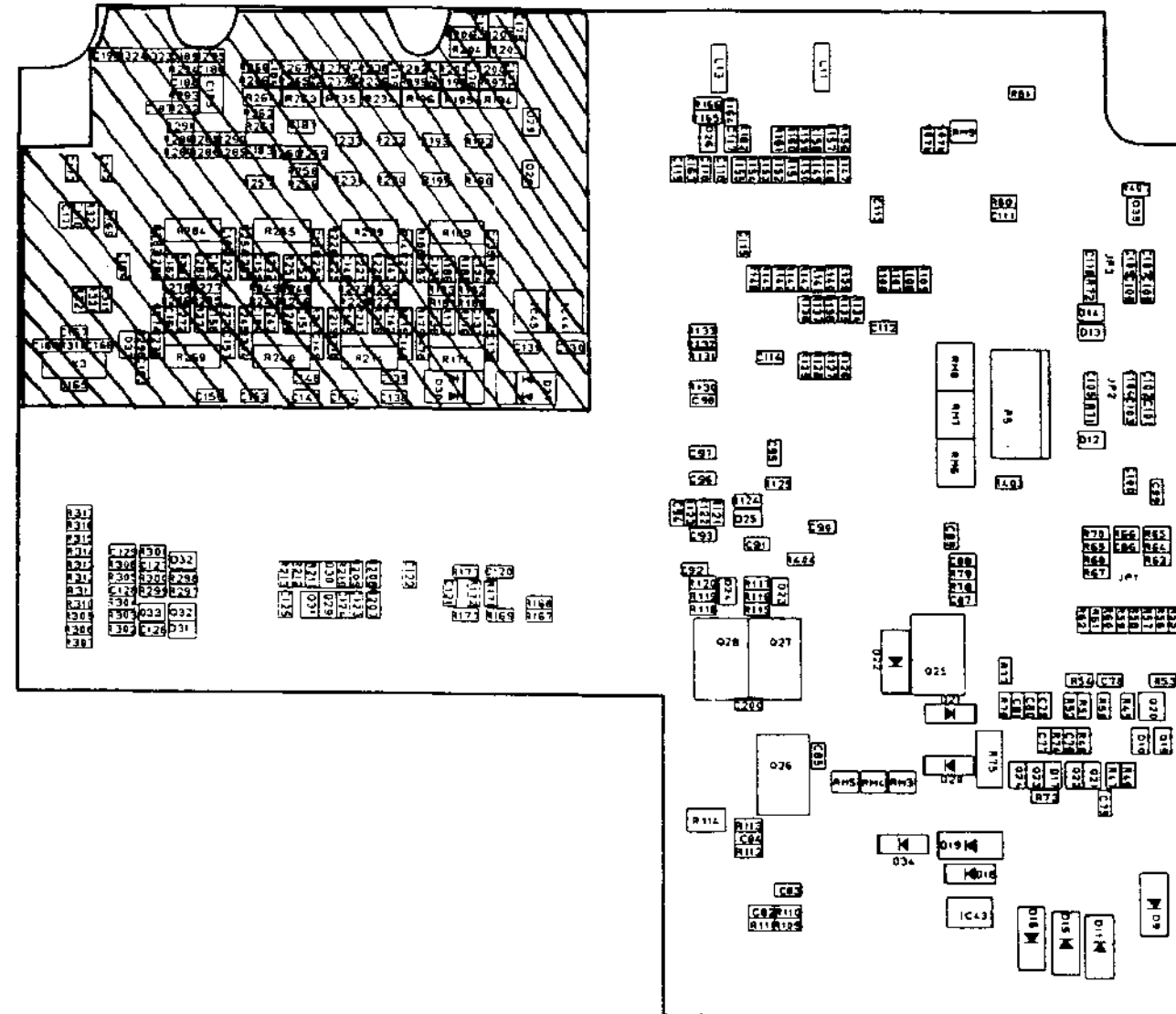
Main Board, 1/2 (Parts Side), PCB-6430A	433-4982	7—1
Main Board, 2/2 (Soldering Side), PCB-6430A	433-4982	7—3




NOTES)

1.  IS A FLUX AREA.
2. LEADS CUT LIMIT(soldering side) : MAX1.5mm.

TITLE Main Board, 1/2 (Parts Side)		DRAWING NO. 433-4982
MODEL NO. FCP-2155	ASSEMBLY NO. PCB-6430A	DATE 96.09.26



NOTES)
 1.  IS A FLUX AREA.

TITLE Main Board, 2/2 (Soldering Side)		DRAWING NO. 433-4982
MODEL NO. FCP-2155	ASSEMBLY NO. PCB-6430A	DATE 96.09.26

Electrical Parts Lists

1. Electrical Parts Common to All Export Versions of FCP-2155		
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1.2 Main Board, PCB-6430 THD	674-11648	8—10
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1. Electrical Parts Common to All Export Versions of FCP-2155

1.1 Main Board, PCB-6430 SMD

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
Square Chip Resistors					
1A7522A	R1, 55 ~ 62, 64, 76, 80, 105 ~ 108, 123, 125 ~ 129, 134 ~ 154, 156 ~ 161, 166, 208, 209	RK73H2AF 100k Ω		52	
1A7545A	R2, 307 ~ 317	RK73H2AF 5.1k Ω		12	
1A9655A	R3, 18, 40, 41, 49, 66, 167, 168, 170, 179, 187, 212, 219, 225, 245, 253, 274, 282, 300, 304, 306, 320, 321, 407	RK73H2AF 1k Ω		24	
1A9303A	R4	RK73H2AF 28.7k Ω		1	
1A7641A	R6, 21, 24	RK73H2AF 560k Ω		3	
1A7510A	R7, 9, 14, 15, 63, 67, 71 ~ 73, 124, 163, 165, 171, 197 ~ 199, 205, 206, 236, 237, 265, 266, 293, 303, 323, 324	RK73H2AF 10k Ω		26	
1A9666A	R8, 20, 77, 112, 122, 162	RK73H2AF 200k Ω		6	
1A9662A	R10, 11, 68, 111	RK73H2AF 30k Ω		4	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1A7503A	R12, 13, 17, 27, 46~48, 53, 164, 178, 188, 218, 228, 244, 254, 256~261, 273, 283	RK73H2AF 20k Ω		23	
1A7512A	R16	RK73H2AF 15k Ω		1	
1A9631A	R19, 131	RK73K2AF 10 Ω		2	
1A9270	R23	RM73H2EF 0.51 Ω		1	
1A7519A	R25, 26, 29~39, 43, 51, 65, 173, 200~ 202, 238, 239, 267, 268, 292, 296, 299	RK73H2AF 51k Ω		27	
1A9656A	R28, 42, 50, 81, 190~ 193, 207, 230~233, 262, 319	RK73H2AF 2k Ω		15	
1A7540A	R44, 210, 213	RK73H2AF 24k Ω		3	
1A7504A	R45, 305	RK73H2AF 75k Ω		2	
1A7685A	R52, 69	RK73H2AF 12k Ω		2	
1A7615A	R54	RK73H2AF 6.49k Ω		1	
1A9001	R70	ERJ-6GE 0R00		1	
1A7547A	R74, 121, 172	RK73H2AF 16k Ω		3	
1A9271	R75	RK73H3AF 1k Ω /1W		1	
1A9653A	R78	RK73H2AF 100 Ω		1	
1A7586A	R79, 155, 294, 295, 318	RK73H2AF 1M Ω		5	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1A7534A	R109	RK73H2AF 3.48k Ω		1	
1A7502A	R110	RK73H2AF 6.8k Ω		1	
1A7571A	R113	RK73H2AF 300 Ω		1	
1A9263	R114	SR73K2EJ 0.1 Ω		1	
1A7652A	R115, 118, 302	RK73H2AF 13k Ω		3	
1A7674A	R116, 119	RK73H2AF 430 Ω		2	
1A7558A	R117, 120	RK73KAF 42.2 Ω		2	
1A9388	R130, 181, 183, 221, 223, 247, 249, 276, 278	RN73F2ATD-B, Metal Film 4.3k Ω		9	
1A9400	R132	RN73F2ATD-B, Metal Film 1.2k Ω		1	
1A7676A	R133	RK73H2AF 560 Ω		1	
1A7604A	R169	RK73H2AF 1.43k Ω		1	
1A7202	R174, 189, 214, 229, 240, 255, 269, 284	TRN60LG 3.5M Ω		8	
1A9658A	R175, 184, 215, 224, 241, 250, 270, 279	RK73H2AF 3.3k Ω		8	
1A9375	R176, 185, 216, 226, 242, 251, 271, 380, 286, 289	RN73F2ATD-B 91KB, Metal Film		10	
1A9385	R177, 186, 217, 227, 243, 252, 272, 281	RN3F2ATD-B, Metal Film 82k Ω		8	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1A9375	R180, 182, 220, 222, - 246, 248, 275, 277, 285, 290	RN73F2ATD-B 14KB, Metal Film		10	
1A9024	R194 ~ 196, 203, 204, 234, 235, 263, 264	TSR8GTM-307V 300M Ω		9	
1A7554A	R211	RK73H2AF 36k Ω		1	
1A7575A	R287	RK73H2AF 680 Ω		1	
1A9399	R288	RN73F2ATD-B, Metal Film 100 Ω		1	
1A9396	R291	RN73F2ATD-B 39k Ω		1	
1A7578A	R297, 298	RK73H2AF 150 Ω		2	
1A7657A	R301	RK73H2AF 240k Ω		1	
1A9667A	R322	RK73H2AF 200 Ω		1	
1A7343A	R400 ~ 406	RK73K2AF 51 Ω		7	
1A9368	R500	SR73H2E 3 Ω		1	
Resistor Arrays					
1R5602	RM1 ~ 5, 9	EXBV8V510J 51 Ω		6	
1R5653	RM6 ~ 8	EXB-A10E104J 100k Ω		3	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
		Capacitors			
1B5408A	C3, 10, 16A	EEV-HB1HV010, Chemical	1μ	3	
1B5021A	C5, 12, 18, 20, 26, 27, 29, 37 ~ 41, 44 ~ 49, 52 ~ 57, 60 ~ 64, 67 ~ 71, 74 ~ 79, 81, 85, 89 ~ 97, 99 ~ 116, 118, 119, 121, 122, 124 ~ 126, 128, 130, 131, 138, 139, 144, 147, 148, 153, 156, 163 ~ 165, 167, 169, 171 ~ 173	GRM40F104Z, Ceramic	0.1μF	94	
1B5413A	C4, 7	EEV-HB1EV, Chemical	220	2	
1B0703	C6	10SM100M, OS	100μF/10V	1	
1B0208	C8	10SM22M, OS	22μF/10V	1	
1B5055A	C11, 15, 86, 120, 188	GRM40B222K, Ceramic	2200pF	5	
1B0702	C15, 21, 22, 30, 31	25CV100GX, Electrolytic	100μF/25V	5	
1B5401A	C17, 72, 73	EEV-HB1CV, Chemical	100	3	
1B0209	C19, 32 ~ 36	16SM6R8M, OS	6.8μF/16V	6	
1B5402A	C24, 25	EEV-HB1EV 4R7, Chemical		2	
1B5073A	C28, 80, 83, 84, 98	GRM40CH102J50, Ceramic	1000pF	5	
1B5019A	C82, 166, 168	GRM40CH101J, Ceramic	100pF	3	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1B6103A	C87	GRM40CH050C50, Ceramic	5pF	1	
1B5095A	C88	GRM40CH150J, Ceramic	15pF	1	
1B5062	C117, 127	MCH215C223K, Ceramic	0.022μF	2	
1B5022A	R123, 129, 170	GRM40B103K, Ceramic	0.01μF	3	
1B5107A	C132, 135 ~ 137, 140, 141, 145, 146, 149, 150, 154, 155, 157, 160 ~ 162	GRM40B822K, Ceramic	8200pF	16	
1B5020A	C133, 134, 142, 143, 151, 152, 158, 159	GRM40CH330J, Ceramic	33pF	9	
1B5003A	C174 ~ 180, 182, 184, 190	GRM40CH151P, Ceramic	150pF	10	
1B5014	C185	MCH325F474Z, Ceramic	0.47μF	1	
1B5027	C187, 189	MCH215A561J, Ceramic	560pF	2	
1B5074A	C200	GRM40CH331J, Ceramic	330pF	1	
Diodes					
1D4552	D1	U1ZB12, Zener		1	
1D3886	D2, 4, 5, 7, 8, 10, 12 ~ 14, 23 ~ 26, 28, 29, 31 ~ 33	1SS302		18	
1D4200	D3	02CZ-5.1Y, Zener		1	
1D3928	D6, 18, 20, 21, 34	D1FS4A		5	
1D3929	D9, 11, 15, 16, 19, 22	D3FS4A		6	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1D3885	D17	1SS301		1	
1D3899	D27, 30	S1ZAS4, Schottky Barrier		2	
		Transistors			
1D2392	Q1	2SK-1062		1	
1D1735	Q2, 3, 6, 8, 19, 21 ~ 23, 31 ~ 33	UN5212, Digital		11	
1D2394	Q4, 7, 25	2SJ245S, FET		3	
1D0117	Q5	2SA-1162Y		1	
1D0153	Q9	2SA-1463(1K)		1	
1D1713	Q10 ~ 18	FMW2		9	
1D0968	Q20	2SC-1623(L5/L6)		1	
1D1734	Q24, 29, 30	UN5112, Digital		3	
1D2385	Q26	2SK-739-Z, FET		1	
1D2342	Q27, 28	2SK1920-FA, FET		2	
1D3885	D17	1SS301		1	
1D3899	D27, 30	S1ZAS4, Schottky Barrier		2	
		Transistors			
1D2392	Q1	2SK-1062		1	
1D1735	Q2, 3, 6, 8, 19, 21 ~ 23, 31 ~ 33	Digital UN5212		11	
1D2394	Q4, 7, 25	FET 2SJ245S		3	
1D0117	Q5	2SA-1162Y		1	
1D0153	Q9	2SA-1463(1K)		1	
1D1713	Q10 ~ 18	FMW2		9	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1D0968	Q20	2SC-1623(L5/L6)	684-2185	1	
1D1734	Q24, 29, 30	UN5112, Digital		3	
Integrated Circuits					
1E6167	IC1	bq2003S, Quick Charging IC		1	
1E2769	IC2	NJM2103M, Reset IC		1	
1E0628	IC4	DS1302S, Real-time Clock		1	
1E0743	IC5, 6	LT1381CS, Serial Communication Driver		2	
1E6246	IC7	FDD1203M-TL, DC-DC Converter		1	
1E9214	IC8	FD93018-MC (TC160G70AF), Gate Array		1	
1E1906	IC9	TMP68HC000F-12, CPU		1	
1E6168	IC10	HA16120FP, Switching Regulator IC		1	
1E5583	IC11	TC-74C04F, CMOS Logic		1	
1E0263	IC12, 40	μPC4062G2, Operational Amp		2	
1E1122	IC13	MC145053-D, A/D Converter		1	
1E6171	IC14	μPC1093T, Shunt Regulator		1	
1E4739	IC15	M5M44260CJ-7, DRAM		1	
1E0264	IC16, 19, 21, 24, 26, 30, 32, 34	μPC4064G2(2), Operational Amp		8	
1E0266	IC18	μPC358G2, Comparator		1	
1E4169	IC20, 25, 31	TC-4053BF, CMOS Logic		3	
1E2613A	IC22	HEF4046BT, PLL		1	
1E0550	IC23, 29	DG-444DY, Analog Switch		2	
1E0715	IC27	μPC494GS, Switching Regulator Control IC		1	
1E8962A	IC28, 33	HCNW137 #300, Photo Coupler		2	
1E4170	IC35, 36	TC-4051BF, CMOS Logic		2	

1.1 Main Board, PCB-6430 SMD, continued

674-11647

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks		
1E4425	IC37	TC-4572BF, CMOS Logic	684-2185	1			
1E9213	IC38	FD93019-K1 (TC140G04AU), Gate Array		1			
1E1121	IC39	AD7872KR, A/D Converter		1			
1E5570	IC41	TC4W53FU, L-MOS Logic		1			
1E5510	IC42	TC7S66F, L-MOS Logic		1			
1E7205	IC43	S-8437AF, Switching Regulator		1			
1E7221	IC44	NJM79L05UA, 3-terminal Regulator		1			
1E6235	IC45	NJM78L05UA, 3-terminal Regulator		1			
Coils							
1T6047	L1	LPC4045TE-471K470μH	323-3991	1			
1L6246	L4	LFC32 101K		1			
Others							
1D7626	X3	CSAC2.00MGCM, Ceramic Oscillator		1			
1L4086	F3	451.500, Fuse		1			
1G2628	SW1	CHS-08TB, Dip Switch		1			
1H6237A		Printed Circuit Board PCB-6430A		1			
1L4547	NF1, 2	NFM41R00C471, Noise Filter		2			

1.2 Main Board. PCB-6430 THD

674-11648

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
Plugs					
1F0215	P1	B3P-VH		1	
1F1068	P2	AXB114001 BB Socket		1	
1F0562	P3	DF3-6P-2DSA		1	
1F9376	P4	DF3-15P-2DSA		1	
1F0365	P8	B4P-VH		1	
Connectors					
1F3714	J1	EC-39-8-21		1	
1F3208	J2	SG8036, Phone Jack		1	
1F1104	J3	RDAG-15SE1(F), ECG Input		1	
1F0548	J4	008370061000800		1	
1F1131	J5	008370151000800		1	
Resistors					
1A7040	R5	RSSX3L20, Metal Film	0.51 Ω /3W	1	
1A6925	R22	ERG-25J, Metal Film	2k Ω /2W	1	
Capacitors					
1B0832	C1, 2	25MV1000GX, Chemical		2	
1B8756	C9	ECA 1EHG471, Chemical	470 μ F/25V	1	
1B0719	C13	URS1V102MHZ, Chemical	1000 μ F/35V	1	
1B0838	C23	UVR1V332MHA, Chemical	3300 μ F/35V	1	
1B4733	C42, 43, 50, 51, 58, 59, 65, 66	MMT50J1050117, Film	1 μ F	8	
1B8496	C300	16SA33M, OS	33 μ F/16V	1	

1.2 Main Board, PCB-6430 THD continued

674-11648

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
		Ferrite Fuse			
1T6067	L10	BL02RN2-R62		1	
		Coils			
1T6243	L2	HK-04D030-1510 RBP		1	
1T6242	L3	HK-05S035-2010 RBP		1	
		Isolation Transformer			
1T6016A	L1	FT-2155	684-2154	1	
		Crystal Oscillators			
1D76528	X1	C-002RX (32.768kHz)	684-2187	1	
1D7627	X2	CA-301 (25MHz 10pH)	684-2186	1	
		Arrestor			
1L4807A	NE1	Y06SZ-230B		1	
		Fuses			
1L4057	F1, 2	TR-5K19374 3.15A Slow-blow		2	
		Lithium Battery			
1U0225	BT1	CR1220FE	684-2189	1	
		Heat-shrink Tube			
6G0308		Sumi-tube F2 9x0.25, 15mm		1	
		Buzzer			
1S3200	BZ1	PKM13EPP-4002		1	
		Integrated Circuit			
1E6404A	IC17	μPC2408HF, 3-terminal Regulator		1	
1E9199		DIC640G11S1, IC Socket		1	

1.3 ROM on PCB-6430

674-11649

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1E8643		Programmed ROM		1	
1E5060		ROM MX27C4096DC-12		1	
		Program V01-03			

1.4 Parts Mounted at Wiring/Assembling Process

674-11652

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
Motor Related Parts					
1M0385		Motor Assembly	434-4725	1	
1Y0815A		Motor, NF-26P-8B 1/25	684-2152	1	
1F0560		Connector, DF3-6S-2C		1	
1F9383		Press-fit Terminal, DF3-2428SC		6	
6G0263		Heat-shrink Tube, Sumi-tube F2 6x0.25x10cm		1	
		Wire, AWG 28 (Red), 17cm		2	
Inlet Board Related Parts					
1M0466		Inlet Board with Coare and Grounding Cable 3			
1M0482		Grounding Cable 3	684-2415	1	
1L4581		Ferrite Core, 5977-000601		1	
6G0234		Heat-shrink Tube, Sumi-tube F2 25x0.4x3cm		1	
1K0031		Press-fit Terminal, TMEV1.25-3		1	

1.5 LCD Assembly

674-11342

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1L1709		LCD, NDM202A00		1	
1F1085		Connector, AXL214901		1	
6B8308		Spacer, SP-15		2	
6B9216		Grounding Plate (D)		1	
6B9217		Shielding Finger (A)		1	
6B9218		Shielding Finger (B)		1	

2. Electrical Parts Specific to 115V Version of FCP-2155

2.1 Parts Mounted at Wiring/Assembling Process

674-12315

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1W3006		Thermal Print Head, Q56-F	684-2092	1	
1M0381A		Harness, Thermal Print Head Cable (UL1684)	684-2093	1	
9F3289		Sensor Board, PCB-6239 SMD	674-10490	1	
1U1001		Battery, S-HRAAFD	684-2122	1	
1T1558		Transformer, FCP-2222AT	684-2166	1	
1G9343A		Key Panel	684-2148	1	
9H3456A		Noise Shielding Plate (Middle), SU		1	
6B9504A		Noise Shielding Plate (Middle)		1	
1M0436		Shield Plate Cable		1	

2.1 PCB-6410 Related Parts

674-12292

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1L4095		Fuse Holder, MF-561A	314-3471	2	
1G3508		Locker Switch, SJ-W254A-07BB		1	
1F0288		AC Power Inlet, NC176-1.5		1	
1K1151A		GND Terminal (A)		1	
1H6410		Printed Circuit Board, PCB-6410		1	
1F0159		Connector, B2P-VH		1	
1T6208		Coil, TF1028S-222Y0R5-01		1	
1Z4311		Spacer, LR-1.5		1/2	
1L4476		Fuse, 239001		2	

3. Electrical Parts Specific to 230V Version of FCP-2155 (CE)

3.1 Parts Mounted at Wiring/Assembling Process

674-12651

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1W3006		Thermal Print Head, Q56-F	684-2092	1	
1M0381A		Harness, Thermal Print Head Cable (UL1684)	684-2093	1	
1T1559		Transformer, FCP-2222UT	684-2157	1	
1G9343A		Key Panel	684-2148	1	
9F3289		Sensor Board, PCB-6239 SMD	674-10490	1	
1U1001		Battery, S-HRAAFD	684-2122	1	
9H3456A		Noise Shielding Plate (Middle) SU	314-2122	1	
6B9504A		Noise Shielding Plate (Middle)	314-3781	1	
1M0436		Shield Plate Cable		1	

3.2 PCB-6410 Related Parts

674-11650

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
1L4091		Fuse, No. 19195, 500mA		2	
1L4905		Fuse Holder, MF-561A		2	
1G3508		Locker Switch, SJ-W254A-07BB		1	
1F0288		AC Power Inlet, NC176-1.5		1	
1K1151A		GND Terminal (A)		1	
1H6410		Printed Circuit Board, PCB-6410	323-2961	1	
1F0159		Connector, B2P-VH		1	
1T6208		Choke Coil, TF1028S-222Y0R5-01	684-2633	1	
1Z4311		Spacer, LR-1.5		1/2	

4. Spare Parts

4.1 List of Blocks

674-10850

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
9E3187		PCB-6410	674-12350	1	
9E3188		PCB-6430	674-12351	1	
9E2954		Paper Magazine (common to FX-2111)	674-10548	1	
9E2955		Recorder (common to FX-2111)	674-10549	1	
9E3000		Upper Case	564-10853	1	
9E3001		Lower Case	674-10854	1	
9E2960		Set of Screws (common to FX-2111)	674-10552	1	

4.2 PCB-6410

674-12350

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
9E3157		PCB-6410(1) Assembly for 115V Version	314-3471	1	
9E3189		PCB-6410(2) Assembly for 230V Version		1	
9E3481		PCB-6410 Assembly for 230V Version		1	
5T3111		Nut, Type 3, M6		2	
5T2009		Spring Washer, Nominal Diameter 6		1	
1M0468		Grounding Wire 3 with Core		1	
1K1151A		GND Terminal (A)		1	
1L4476		Fuse, 239001 for 115V Version		2	
1L4475		Fuse, 239501 for 230V Version		2	

4.3 PCB-6430

674-12351

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
9E3155		PCB-6430(1) Assembly	684-2189	1	
9E3190		PCB-6430(3) Assembly		1	
9F3478		PCB-6430 with ROM		1	
5R1604		Double Semus Screw, M3x8		2	
1E8643		Programmed ROM		1	
1L4057		Fuse, TR-5 K19374 3.15A		2	
1U0225		Lithium Battery, CR1220FE		1	
1L4086		Fuse, 451.500		1	
9F3421		LCD Assembly		1	
6B8308		Spacer, SP-15		2	

4.4 Upper Case

674-10853

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
9F3355		Upper Case Assembly		1	
1G9343A		Key Panel	684-2148	1	
5H9128		Power Label (B) for 115V Version	154-4573	1	
5H9130		Power Label (C) for 230V Version	154-4575	1	

4.5 Lower Case

674-10854

Parts No.	Symbol	Description	Drawing No.	Q'ty	Remarks
9E3403		Lower Case Assembly (3)		1	
9H3212A		Grounding Plate (A) SU	313-3459	1	
1T1558		Transformer, FCP-2222AT for 115V Version	684-2156	1	
1T1559		Transformer, FCP-2222UT for 230V Version	684-2157	1	
6B8326		Battery Cover	112-6624	1	
5H9146		Instruction Label (E)	154-4592	1	
9H9147		Instruction Label (F) for 230V Version	154-4593	1	
5H9129		Fuse label (B) for 115V Version	154-4574	1	
5H9131		Fuse Label (C) for 230V Version	154-4576	1	
5H5639		Lithium Battery Label	154-3574	1	
6B6796		TM-166 No. 12		1	

Structural Diagrams

FCP-2155 (CE)

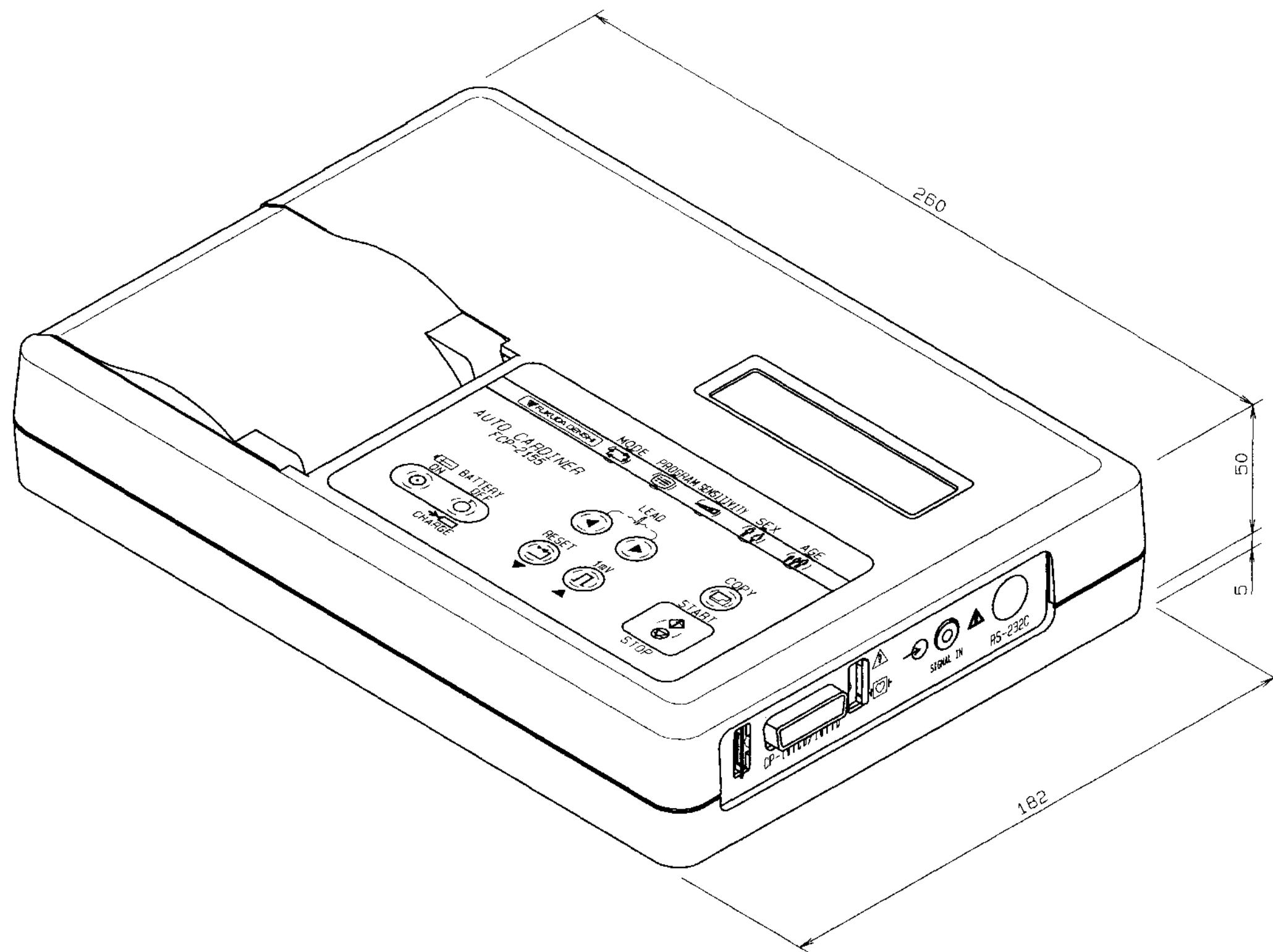
External Appearance (1)	413-0880	9—1
External Appearance (2)	413-0978	9—3
PCB-6410 Assembly	424-3584	9—5
Main PC Board Assembly	423-3585	9—7
Upper Case Assembly	423-3586	9—9
Lower Case Assembly (1)	423-3587	9—11
Lower Case Assembly (2)	422-3588	9—13
Upper Case Assembly (3)	422-3389	9—15
Overall Assembly	412-0879	9—17

115V General Export Version

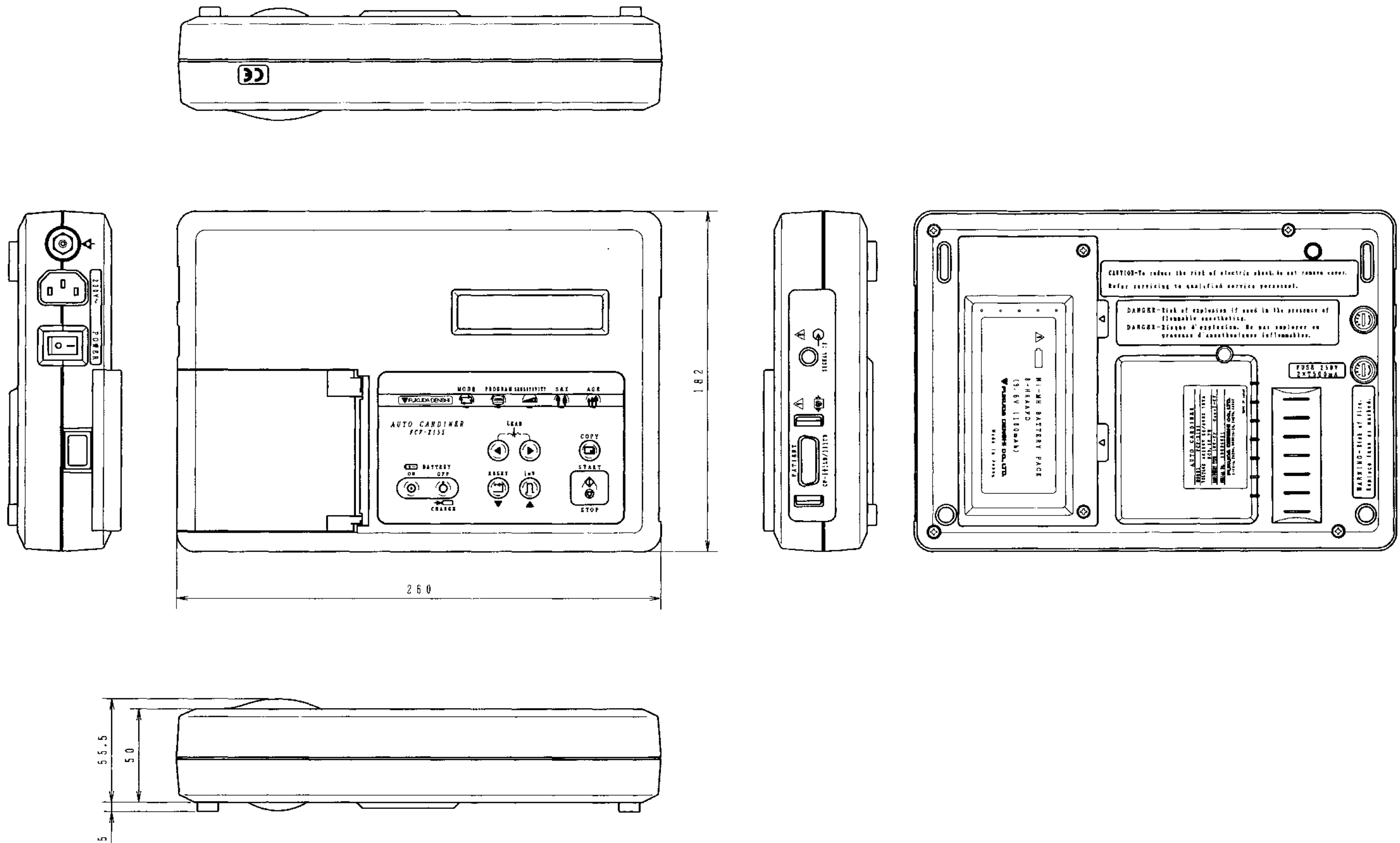
External Appearance (1)	413-0876	9—19
External Appearance (2)	413-0877	9—21
Upper Case Assembly	423-3322	9—23
Lower Case Assembly (1)	423-3323	9—25
Lower Case Assembly (2)	422-3324	9—27
Lower Case Assembly (3)	422-3325	9—29
Overall Assembly	412-0878	9—31

230V General Export Version

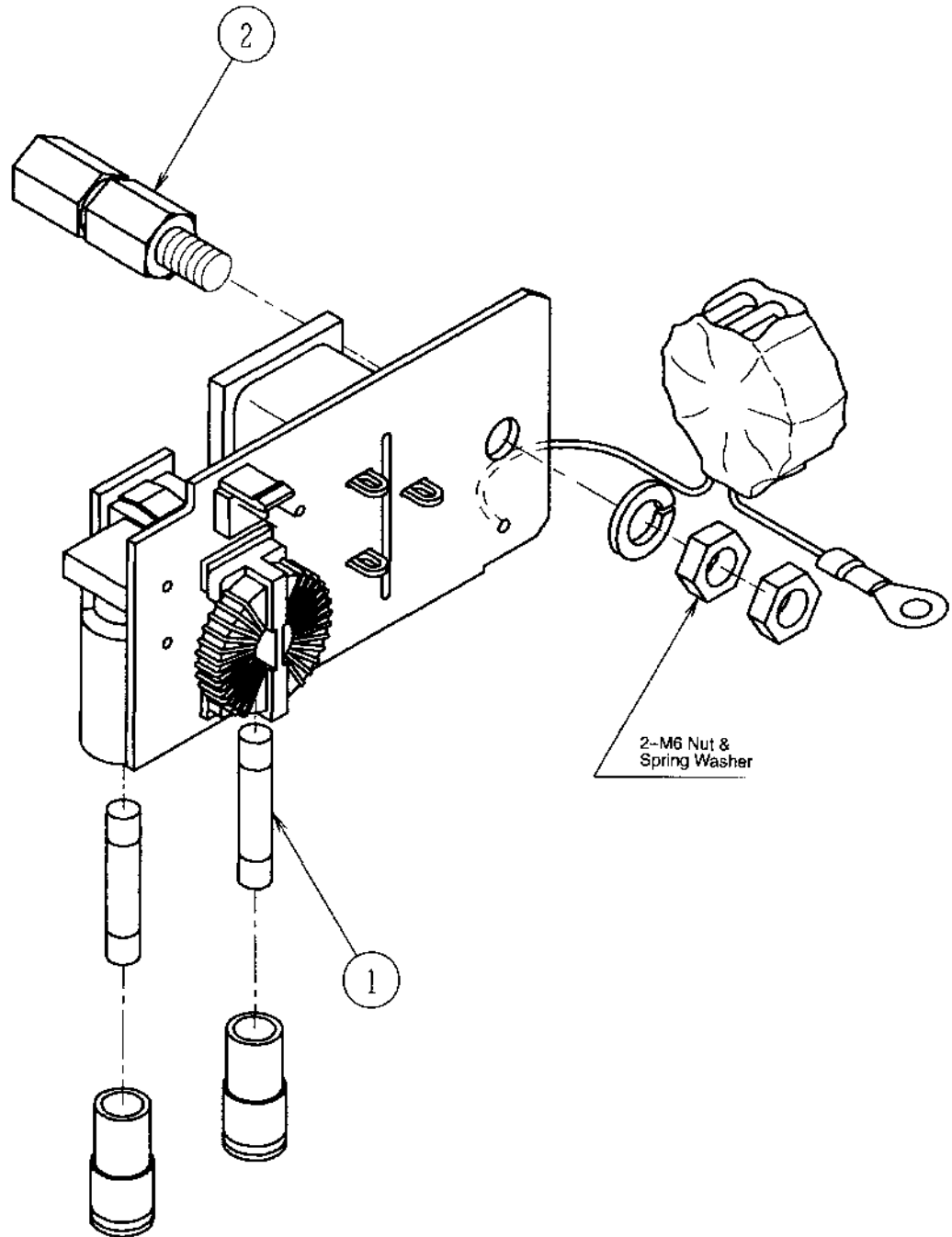
External Appearance (2)	413-0879	9—33
Upper Case Assembly	423-3328	9—35
Lower Case Assembly (1)	423-3329	9—37



TITLE		DRAWING NO.
External Appearance (1)		413-0880
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155 (CE)	(230V Version for Europe)	95.03.09

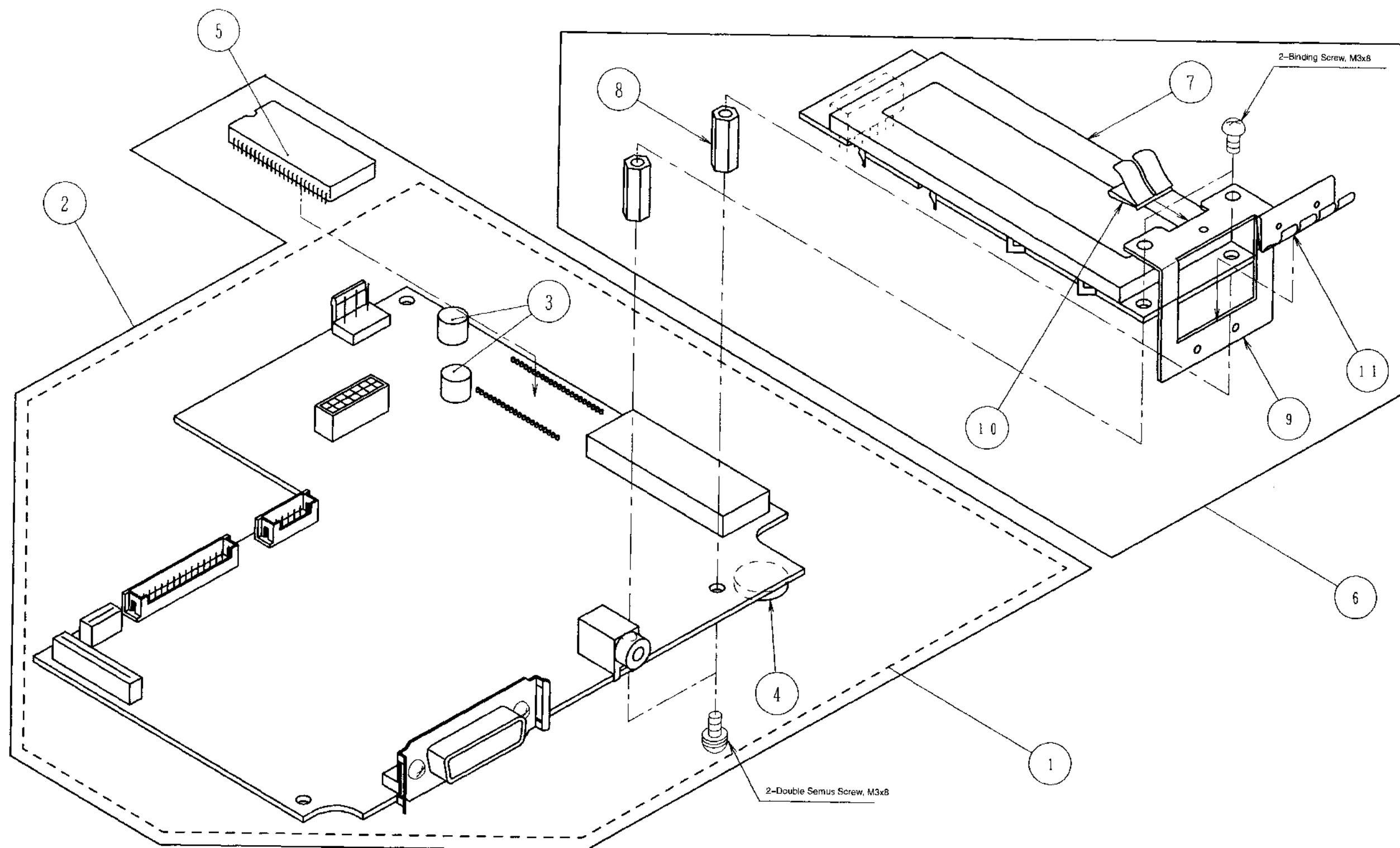


TITLE		DRAWING NO.
External Appearance (2)		413-0978
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155 (CE)		96.07.30



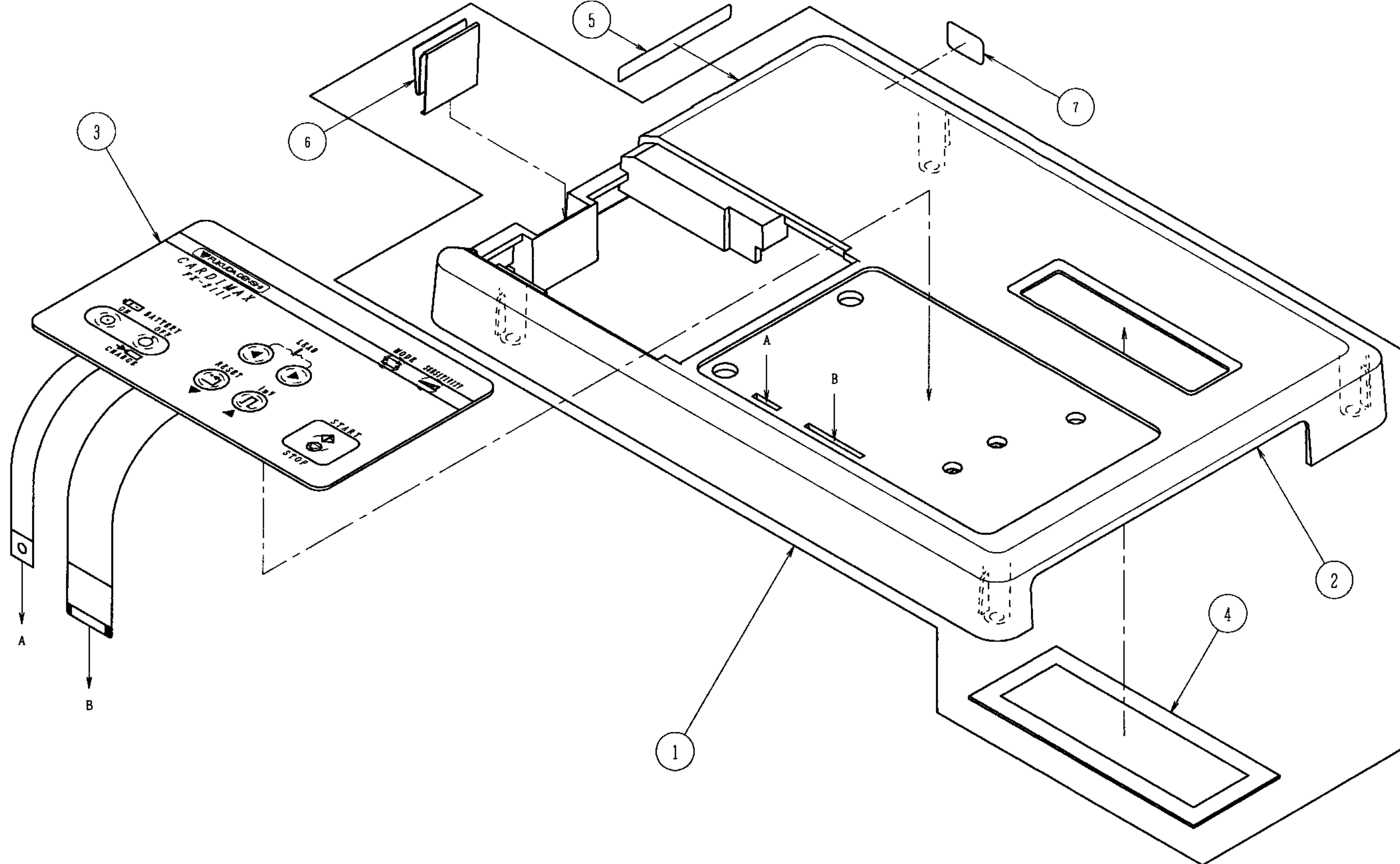
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	1L4475	114-3471	Fuse, 239500	1	
2	1K1151A		GND Terminal (A)	1	

TITLE PCB-6410 Assembly		DRAWING NO. 424-3584
MODEL NO. FCP-2155 (CE)	ASSEMBLY NO.	DATE 96.07.30



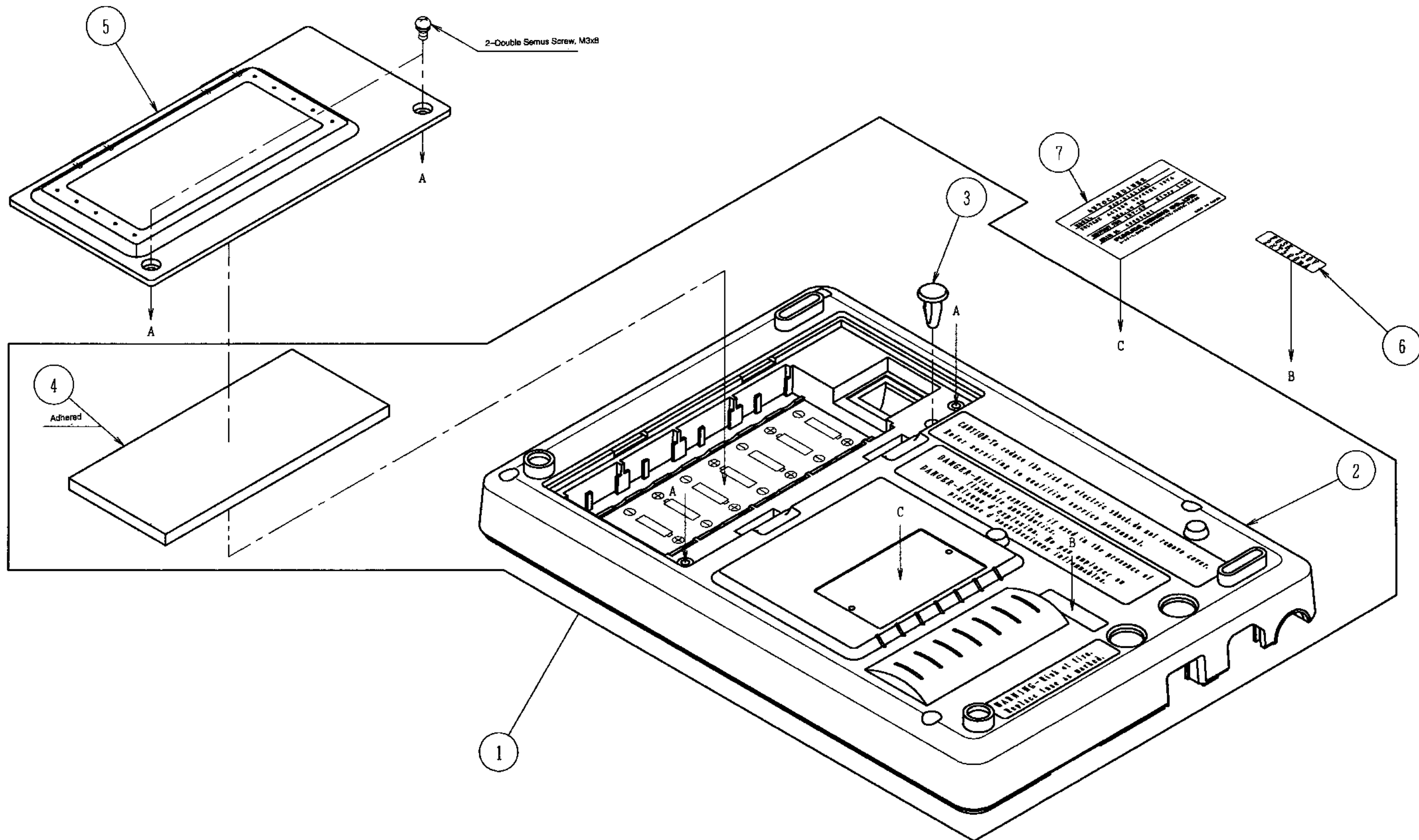
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F		PCB-6430 SAS	1	
2	9F		PCB-6430 with ROM	1	
3	1L4057		Fuse, TR-5 K1937, 3.15A	2	
4	1U0231	684-2428	Lithium Battery, CR-1/2N-FT-2-1	1	
5	1E8631		Programmed ROM, FX-2111 (36-202)	1	
6	9F3421		LCD Assembly	1	
7	1L1709		LCD, NDM202A00	1	
8	6B8308		Spacer, SP-15	2	
9	6B9216	314-3602	Grounding Plate (D)	1	
10	6B9217	314-3603	Shielding Finger (A)	1	
11	6B9218	314-3604	Shielding Finger (B)	1	

TITLE		DRAWING NO.
Main PC Board Assembly		423-3585
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155 (CE)	PCB-6430	96.07.30



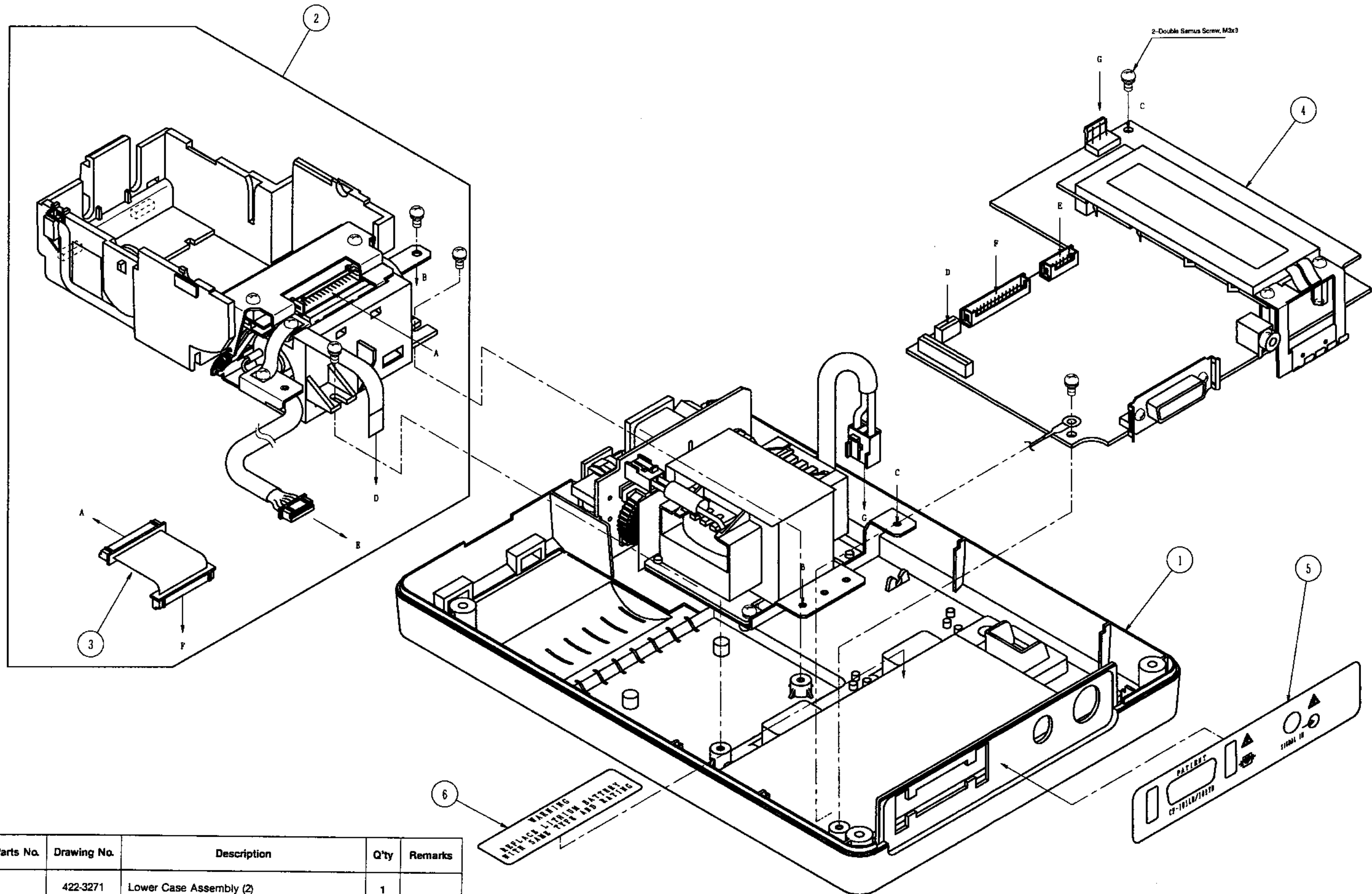
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F3355		Upper Case Assembly	1	
2	9H3211C	111-6621	Upper Case Assembly SU	1	
3	1G9340	684-2146	Key Panel	1	
4	6B8305	114-6625	LCD Filter	1	
5	5H9130	154-4575	Power Label (C)	1	
6	6B9171	114-6811	Lock Spring	1	
7	5H9428	154-1694	CE Mark Label	1	

TITLE Upper Case Assembly		DRAWING NO. 423-3586
MODEL NO. FCP-2155 (CE)	ASSEMBLY NO.	DATE 96.07.30



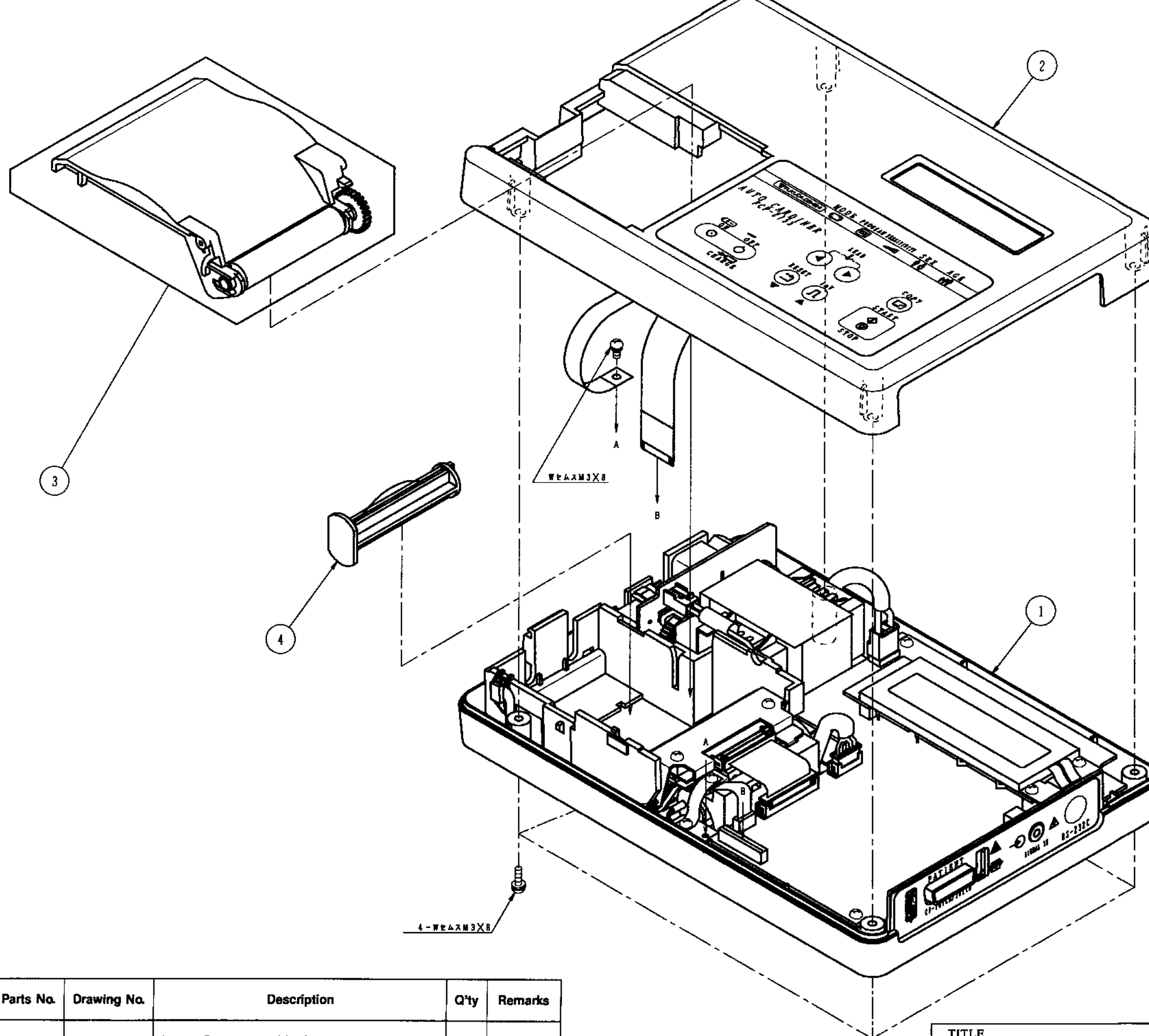
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F3356		Lower Case Assembly (1)	1	
2	9H3112D	111-6622	Lower Case Assembly SU	1	
3	6B8328		Canoe Clip, TL-180-3	1	
4	6B8327	214-3466	Battery Presser Sponge	1	
5	6B8325	112-6624	Battery Cover	1	
6	5H9131	154-4576	Fuse Label (C)	1	
7	9B7293		Rating Label	1	

TITLE		DRAWING NO.
Lower Case Assembly (1)		423-3587
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155 (CE)		96.07.30



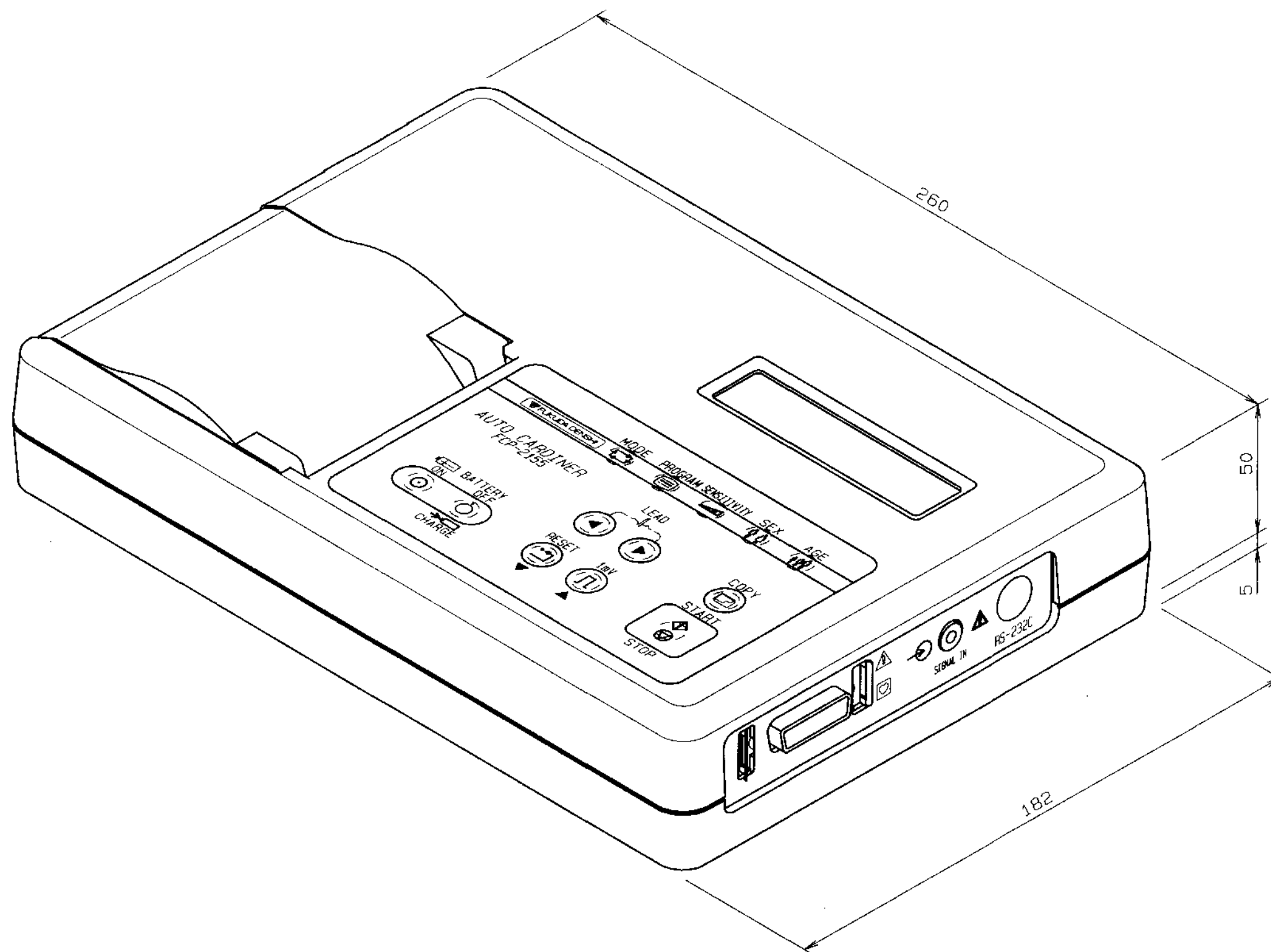
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1		422-3271	Lower Case Assembly (2)	1	
2	9F3354		Recorder Assembly	1	
3	1M0381	684-2093	Thermal Print Head Cable	1	
4		423-3444	PCB-6409 Assembly	1	
5	5H9138	154-4577	Lead Label (C)	1	
6	5H5639	154-3574	Lithium Battery Label	1	

TITLE		DRAWING NO.
Lower Case Assembly (3)		422-3389
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155 (CE)		95.12.05

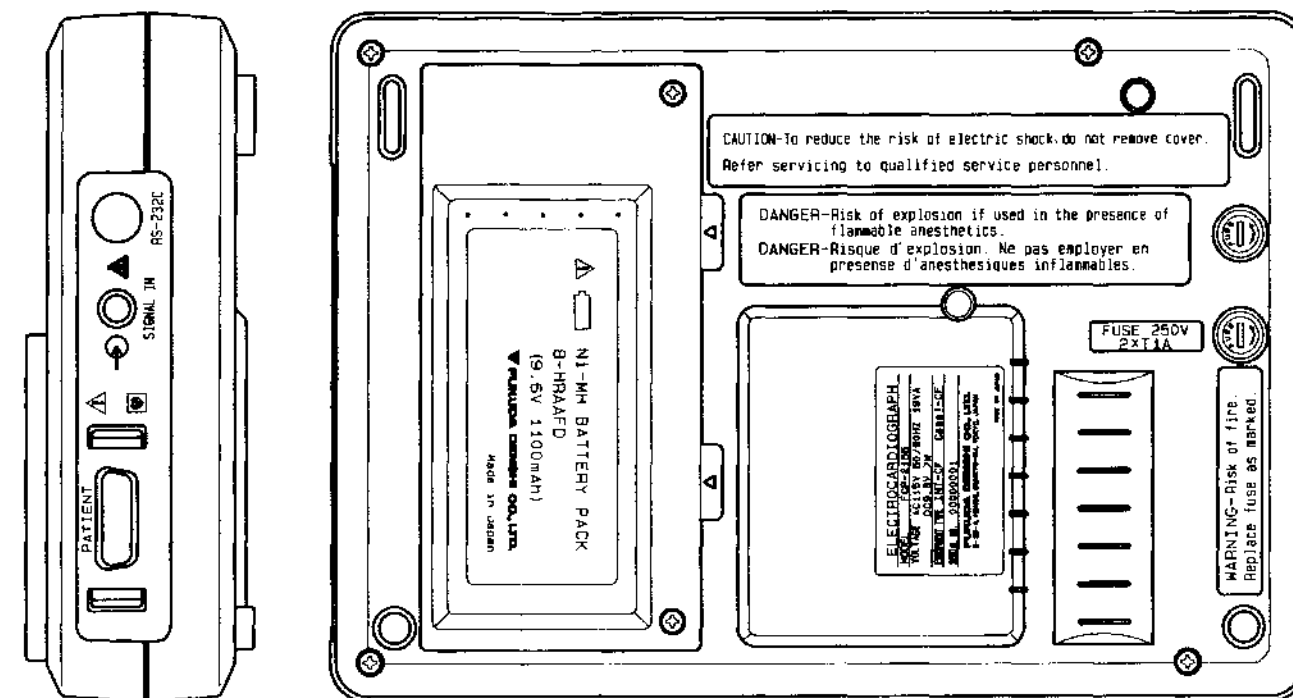
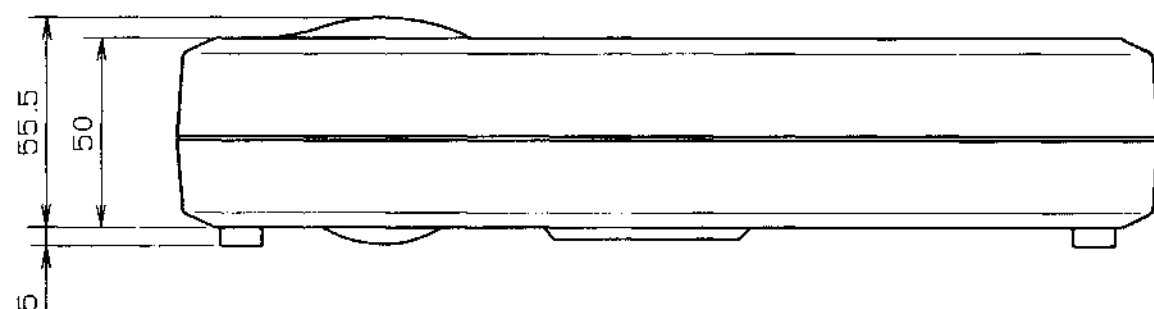
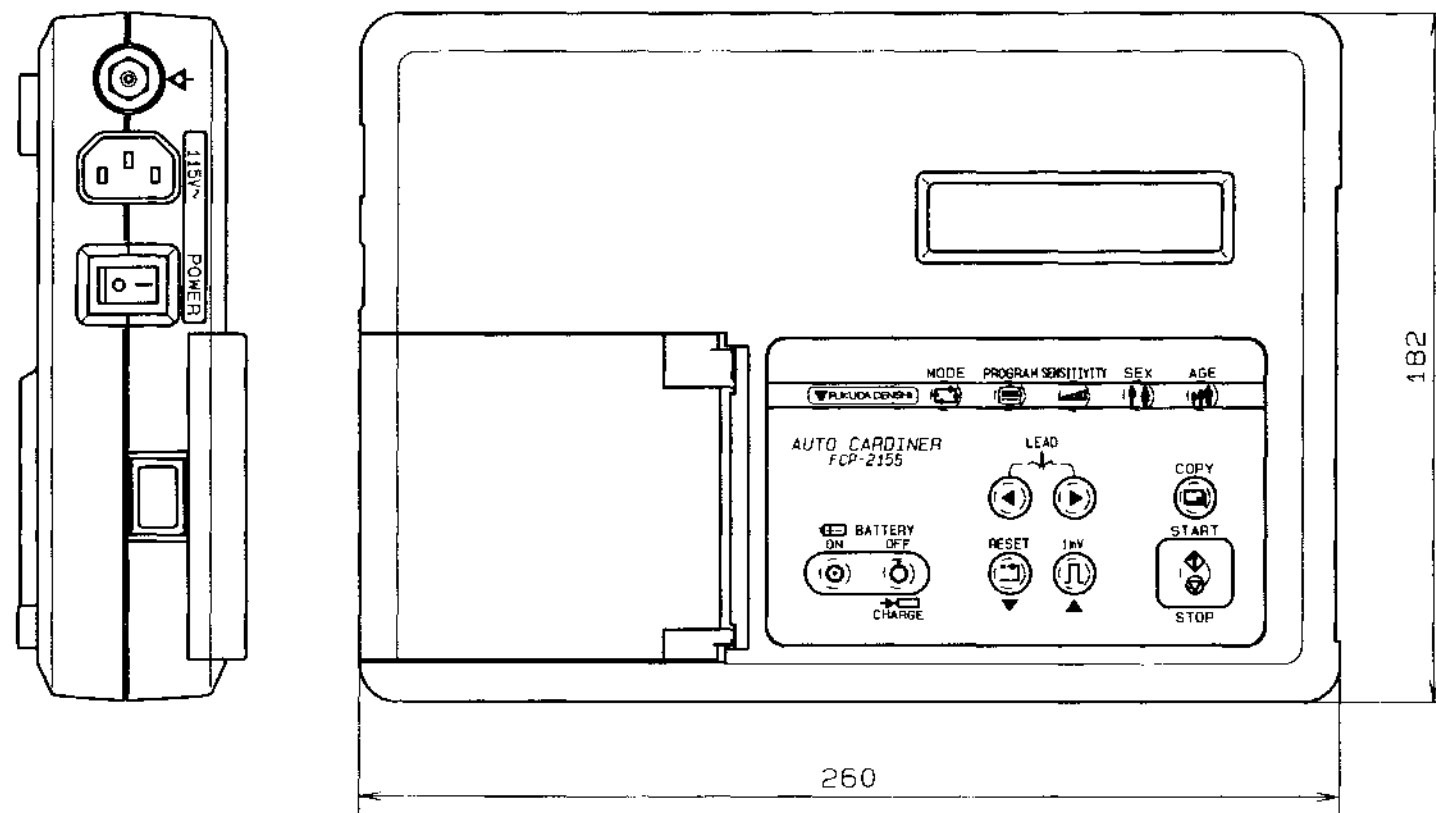


Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1			Lower Case Assembly (3)	1	
2			Upper Case Assembly	1	
3	9F2648		Paper Magazine Assembly	1	
4	9H3522	224-0891	Paper Shaft SU	1	

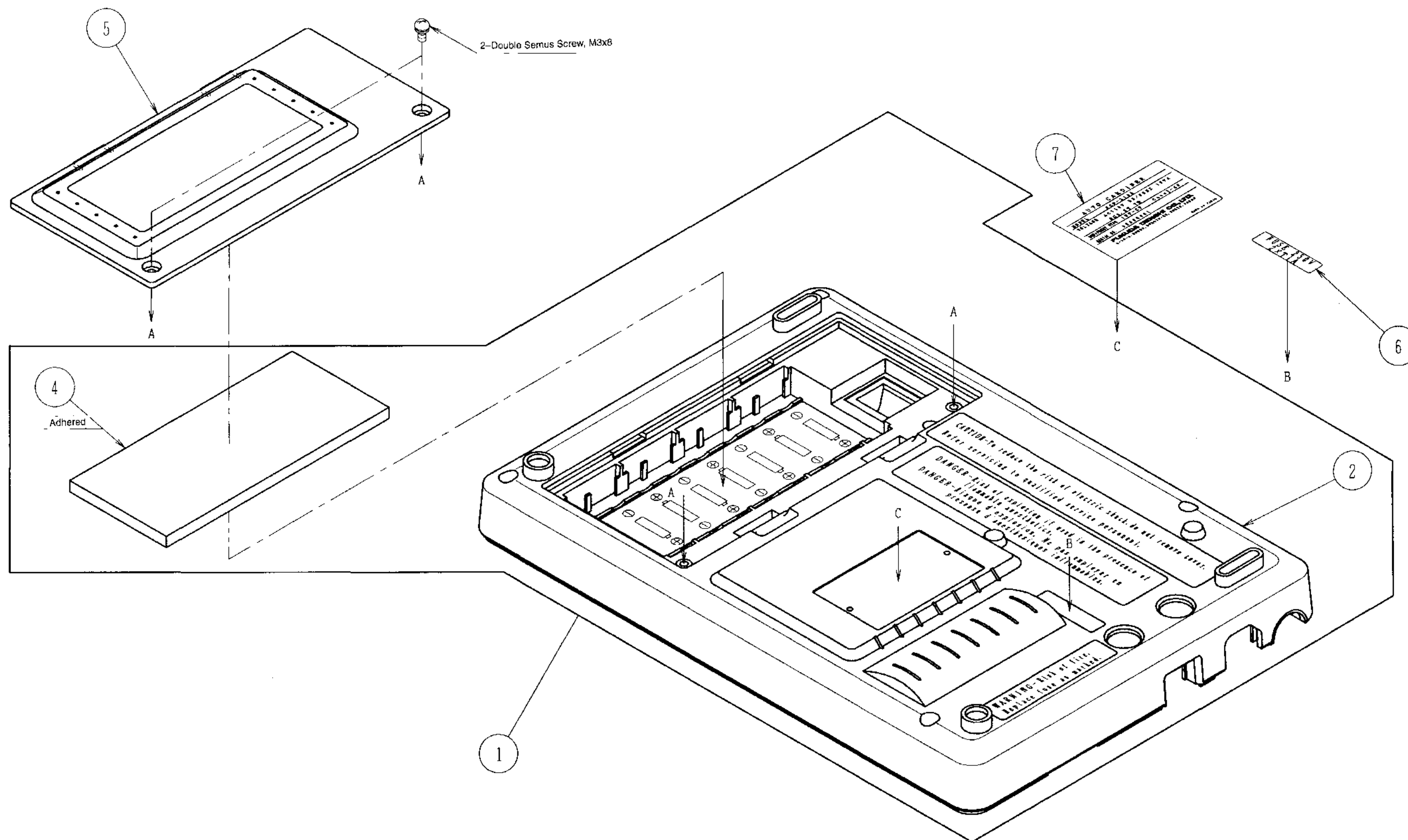
TITLE		DRAWING NO.
Overall Assembly		412-0879
MODEL NO.	ASSEMBLY NO.	DATE
	96.12.03	FCP-2155 (CE)



TITLE External Appearance (1)		DRAWING NO. 413-0876
MODEL NO. FCP-2155	ASSEMBLY NO. (115V General Export Version)	DATE 95.03.07

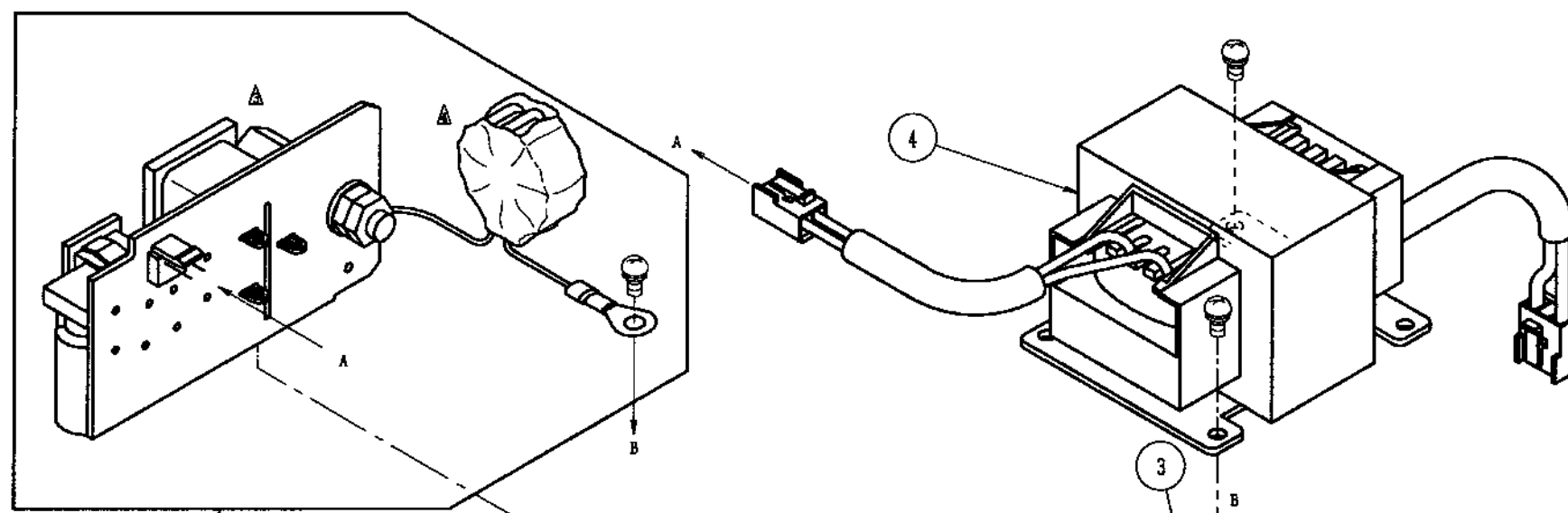


TITLE		DRAWING NO.
External Appearance (2)		413-0877
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	(115V General Export Version)	95.03.07

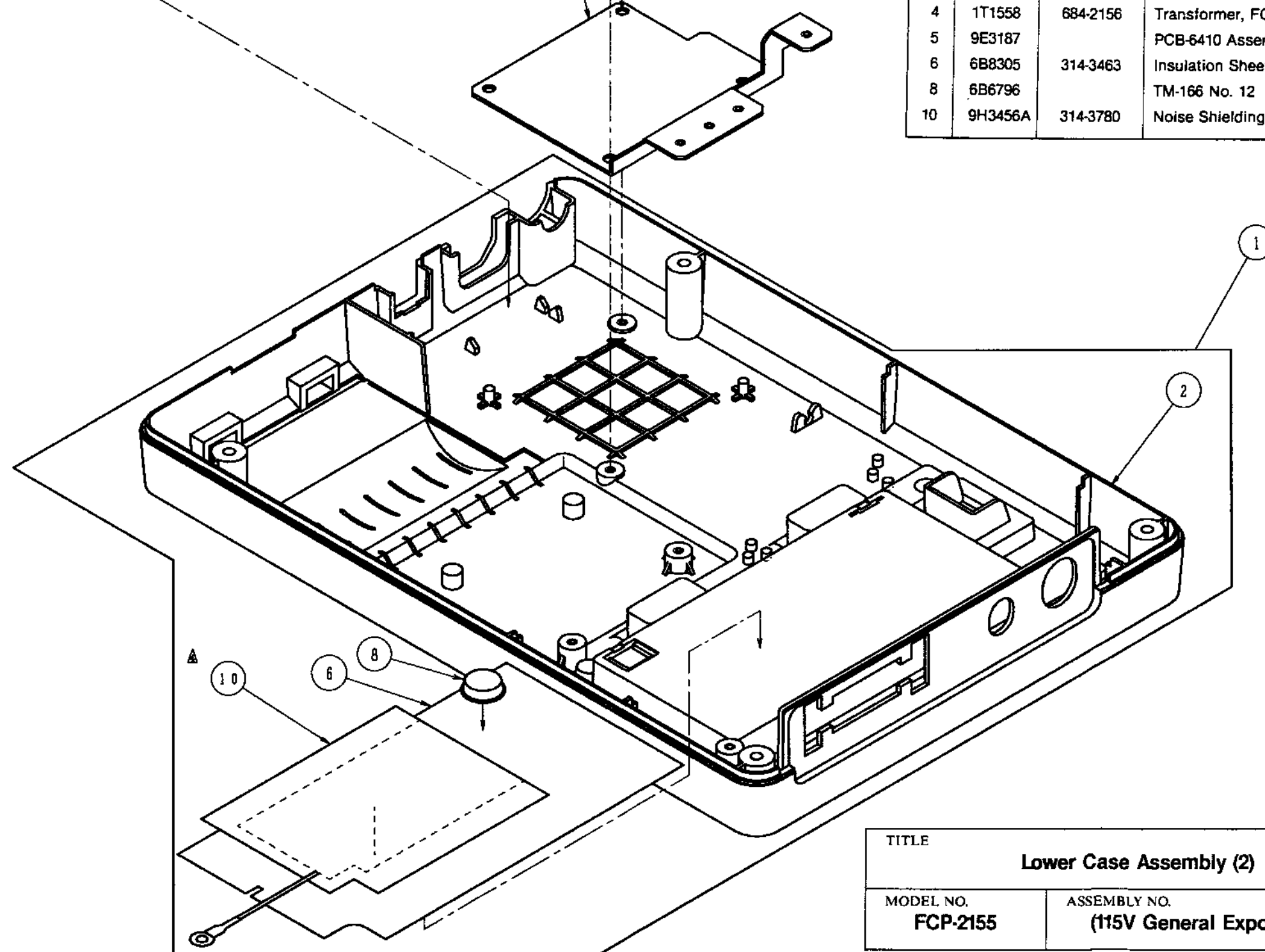


Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F3403		Lower Case Assembly (3)	1	
2	9H3212D	111-6622	Lower Case Assembly SU	1	
4	6B8327	314-3466	Battery Presser Sponge	1	
5	6B8326A	112-6624	Battery Cover	1	
6	5H9129	154-4574	Fuse Label (B)	1	
7	9E7180		Rating Label	1	

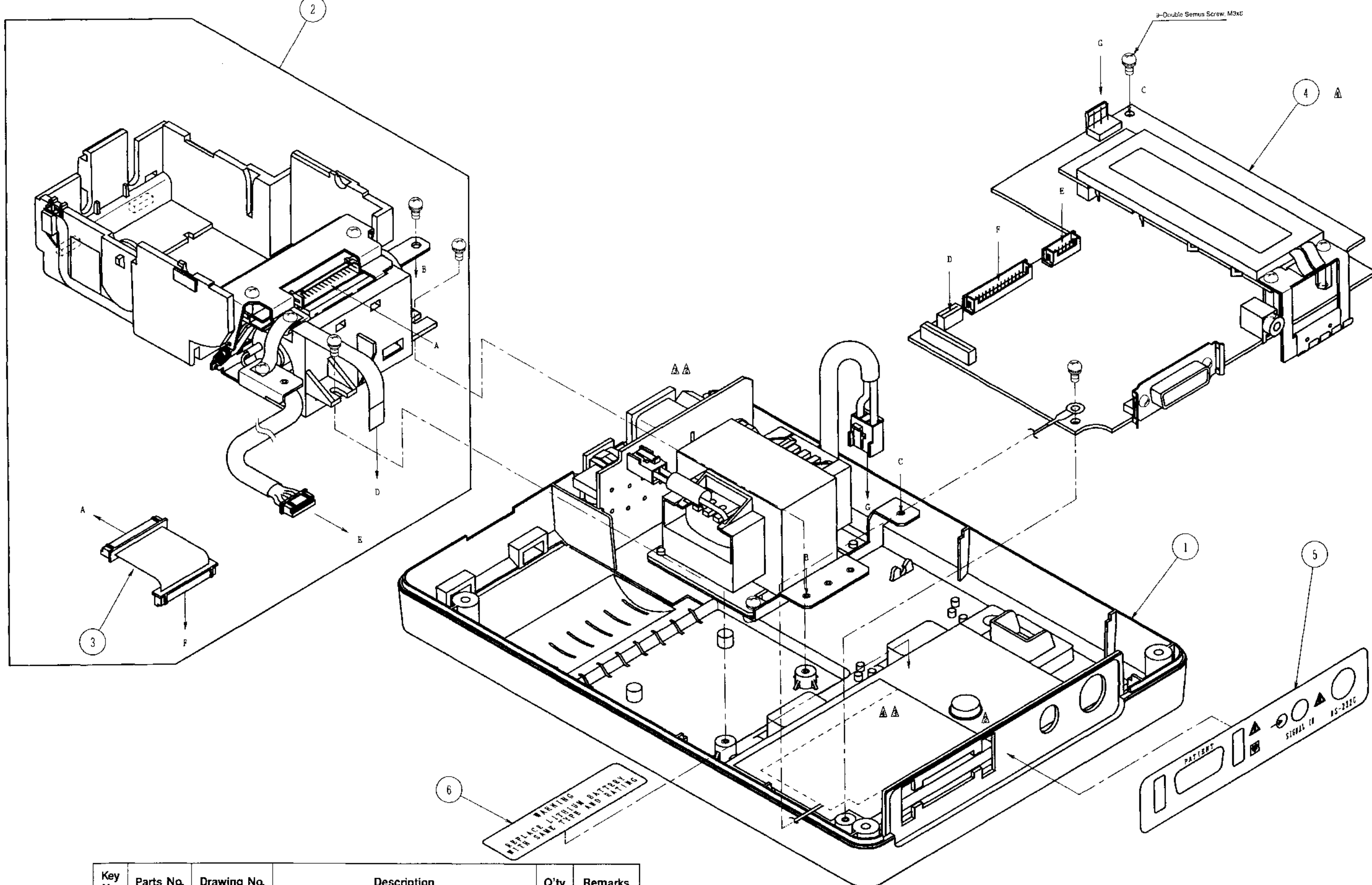
TITLE Lower Case Assembly (1)		DRAWING NO. 423-3323
MODEL NO. FCP-2155	ASSEMBLY NO. (115V General Export Version)	DATE 95.12.01



Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F3403		Lower Case Assembly (3)	1	
2			Lower Case Assembly (1)	1	
3	9H3213A	313-3459	Grounding Plate (A) SU	1	
4	1T1558	684-2156	Transformer, FCP-2222AT	1	
5	9E3187		PCB-6410 Assembly	1	
6	6B8305	314-3463	Insulation Sheet	1	
8	6B6796		TM-166 No. 12	1	
10	9H3456A	314-3780	Noise Shielding Plate (Middle) SU	1	

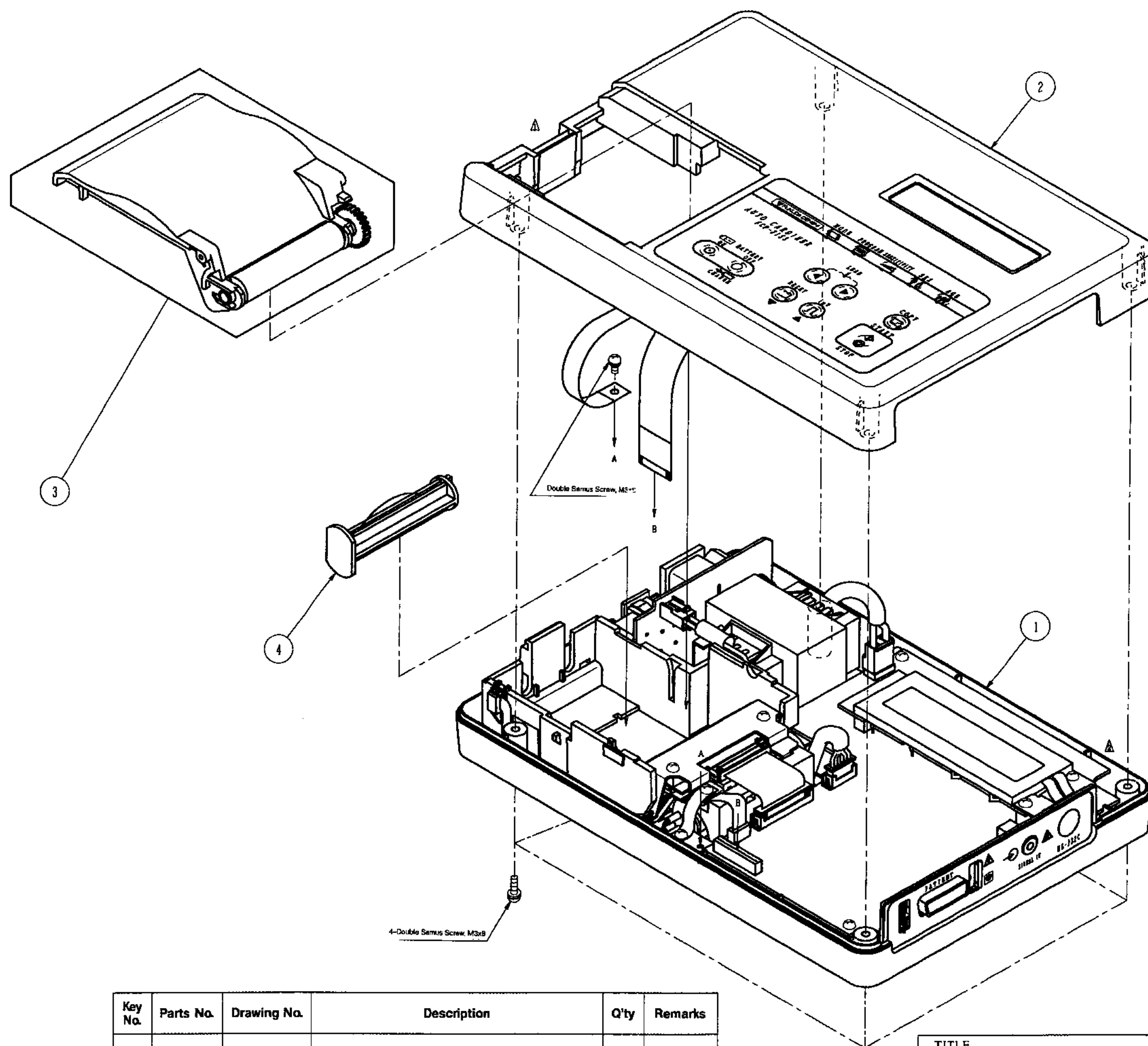


TITLE Lower Case Assembly (2)		DRAWING NO. 422-3324
MODEL NO. FCP-2155	ASSEMBLY NO. (115V General Export Version)	DATE 95.12.01



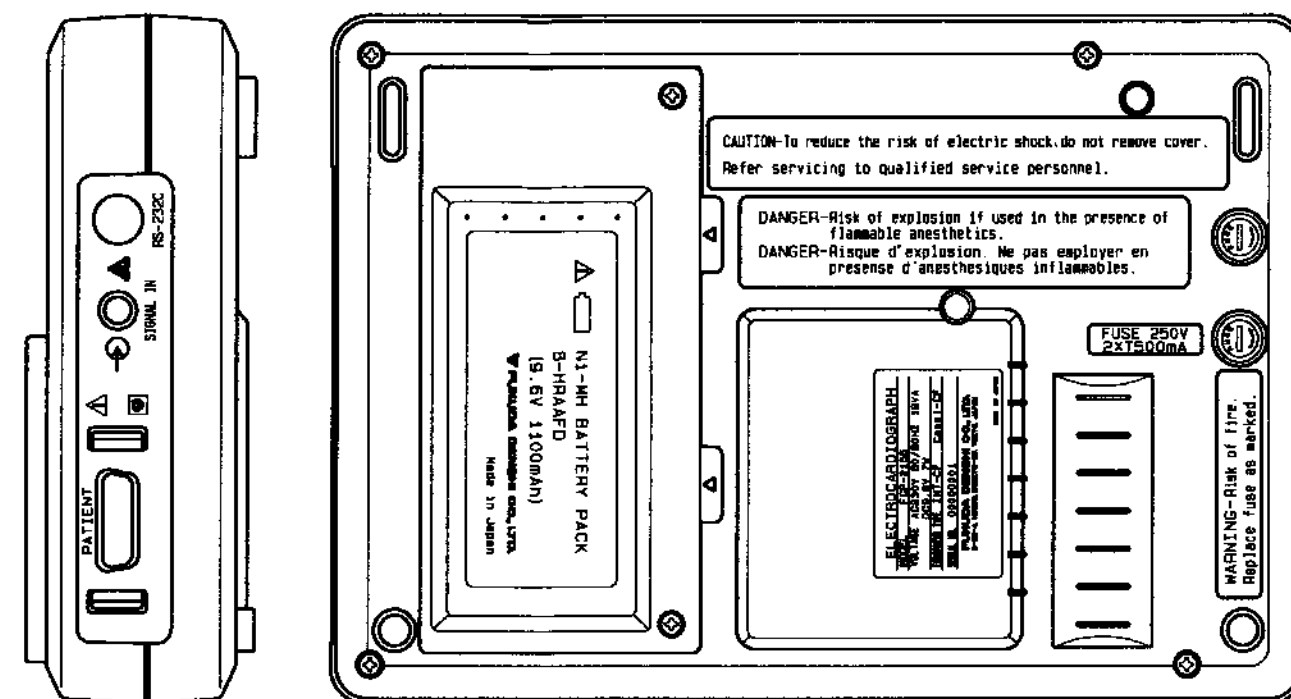
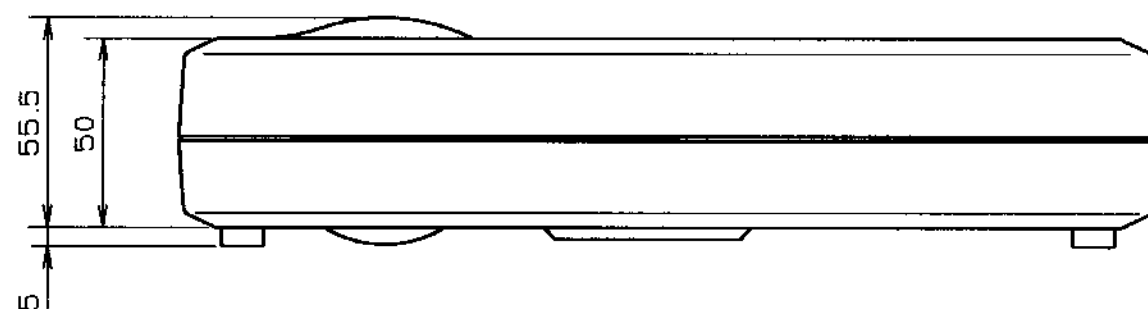
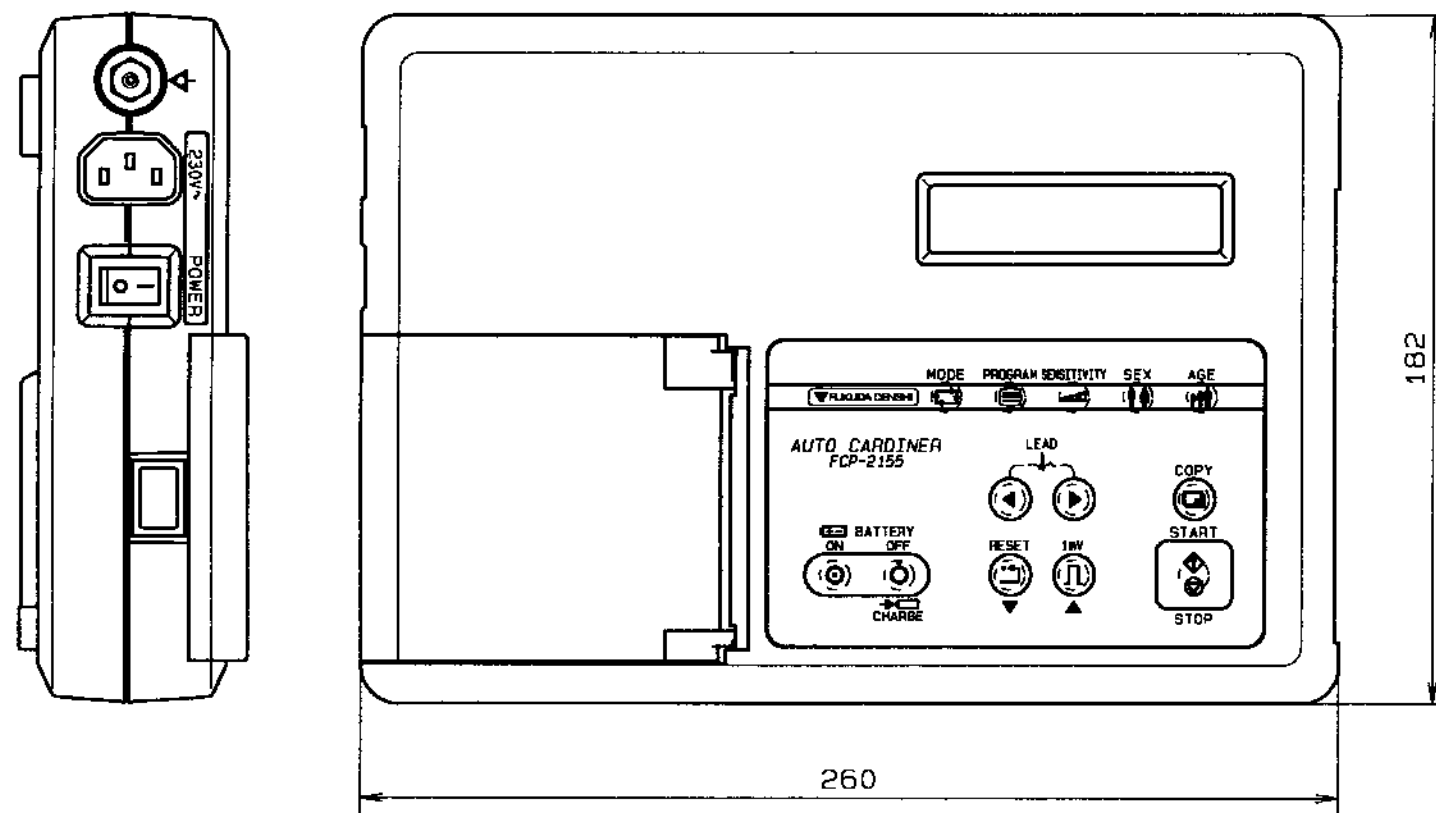
Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1		423-3324	Lower Case Assembly (2)	1	
2	9F3354		Recorder Assembly	1	
3	1M0381	684-2093	Thermal Print Head Cable	1	
4			PCB-6430 Assembly	1	
5	5H9146	154-4592	Lead Label (E)	1	
6	5H3639	154-3574	Lithium Battery Label	1	

TITLE Lower Case Assembly (3)		DRAWING NO. 422-3325
MODEL NO. FCP-2155	ASSEMBLY NO. (115V General Export Version)	DATE 95.12.01

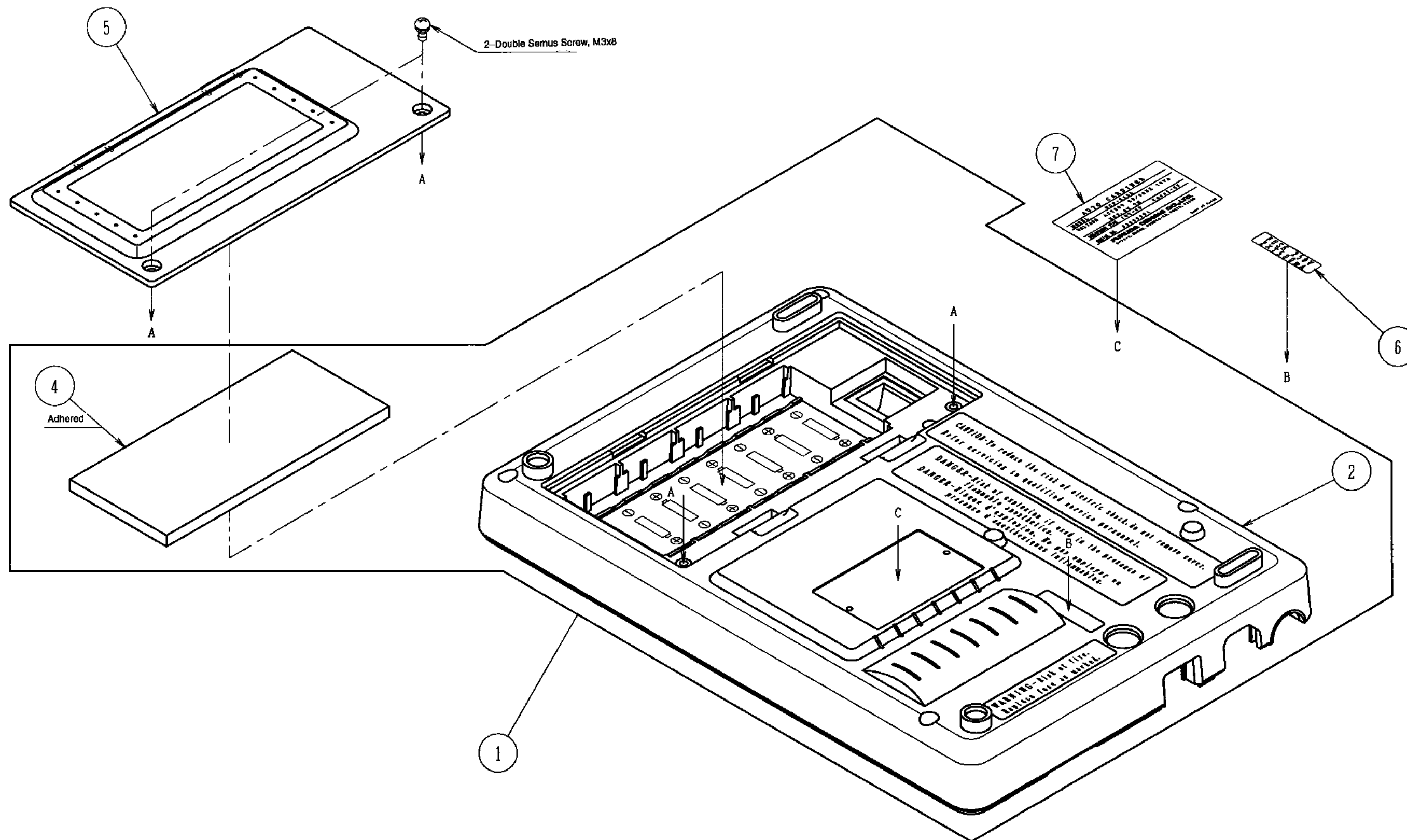


Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1			Lower Case Assembly (3)	1	
2			Upper Case Assembly	1	
3	9F2648		Paper Magazine Assembly	1	
4	9H3522	224-0891	Paper Shaft SU	1	

TITLE		DRAWING NO.
Overall Assembly		412-0878
MODEL NO.	ASSEMBLY NO.	DATE



TITLE External Appearance (2)		DRAWING NO. 413-0879
MODEL NO. FCP-2155	ASSEMBLY NO. (230V General Export Version)	DATE 95.03.07



Key No.	Parts No.	Drawing No.	Description	Q'ty	Remarks
1	9F3403		Lower Case Assembly (3)	1	
2	9H3212D	111-6622	Lower Case Assembly SU	1	
4	6B8327	314-3466	Battery Presser Sponge	1	
5	6B8326A	112-6624	Battery Cover	1	
6	5H9131	154-4576	Fuse Label (C)	1	
7	9E7181		Rating Label	1	

TITLE		DRAWING NO.
Lower Case Assembly (1)		423-3329
MODEL NO.	ASSEMBLY NO.	DATE
FCP-2155	(230V General Export Version)	95.12.01



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