AUTO REFKERATOMETER

ACCUREF-K 9001

Maintenance Manual

SHIN-NIPPON

RB-400-C02C

Contents

Note

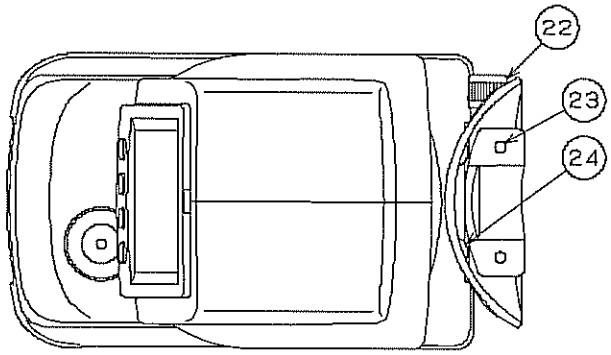
You will find some descriptions stating '**P model**' or '**AH model**' in this manual. These parts describe the differences in each specification of 'P model' and 'AH model'. Each of 'P model' and 'AH model' has a following serial number:

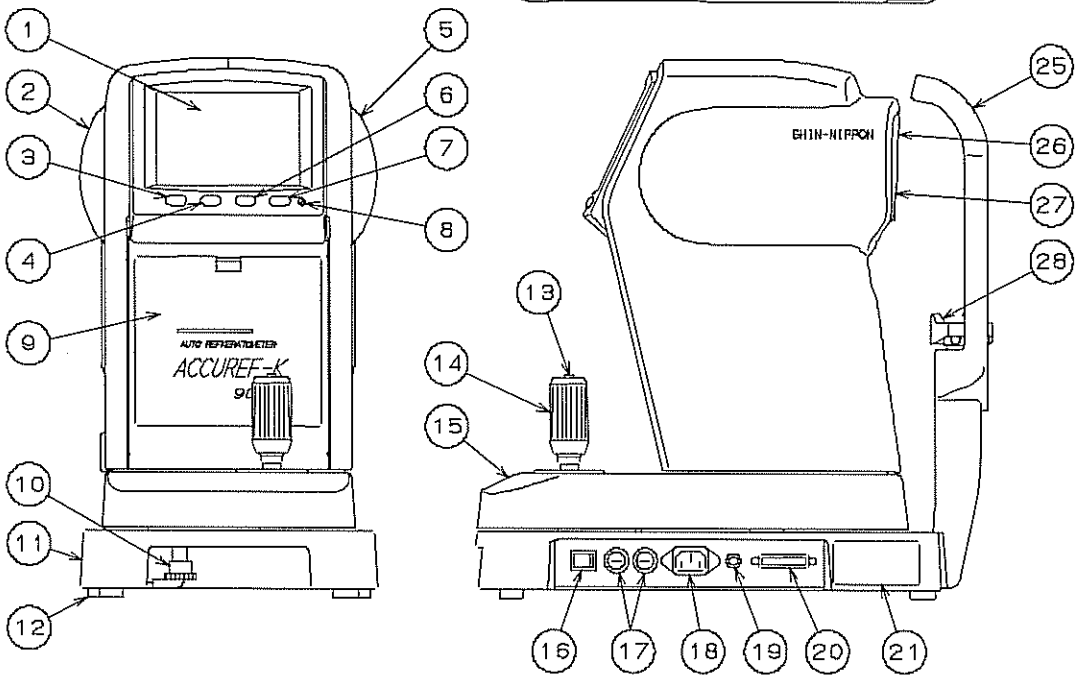
P model: a model with a serial number 'xx**P**xxxx".
AH model: a model with a serial number 'xx**AH**xxxx".

1 External View

No.	Name
1	LCD monitor
2	Main unit cover R
3	IOL switch
4	Measurement mode selection switch
5	Main unit cover L
6	Menu switch
7	Print switch
8	Power indicator
9	Printer cover
10	Main unit sliding lock
11	Base
12	Rubber leg
13	Measurement start switch
14	Joystick
15	Base cover
16	Power switch
17	Fuse holder
18	Power plug connector

No.	Name
19	External monitor terminal
20	External interface connector
21	Rating nameplate
22	Chin rest knob
23	Pins for chin rest liners
24	Head rest rubber
25	Head rest
26	Face panel
27	View window
28	Chin rest

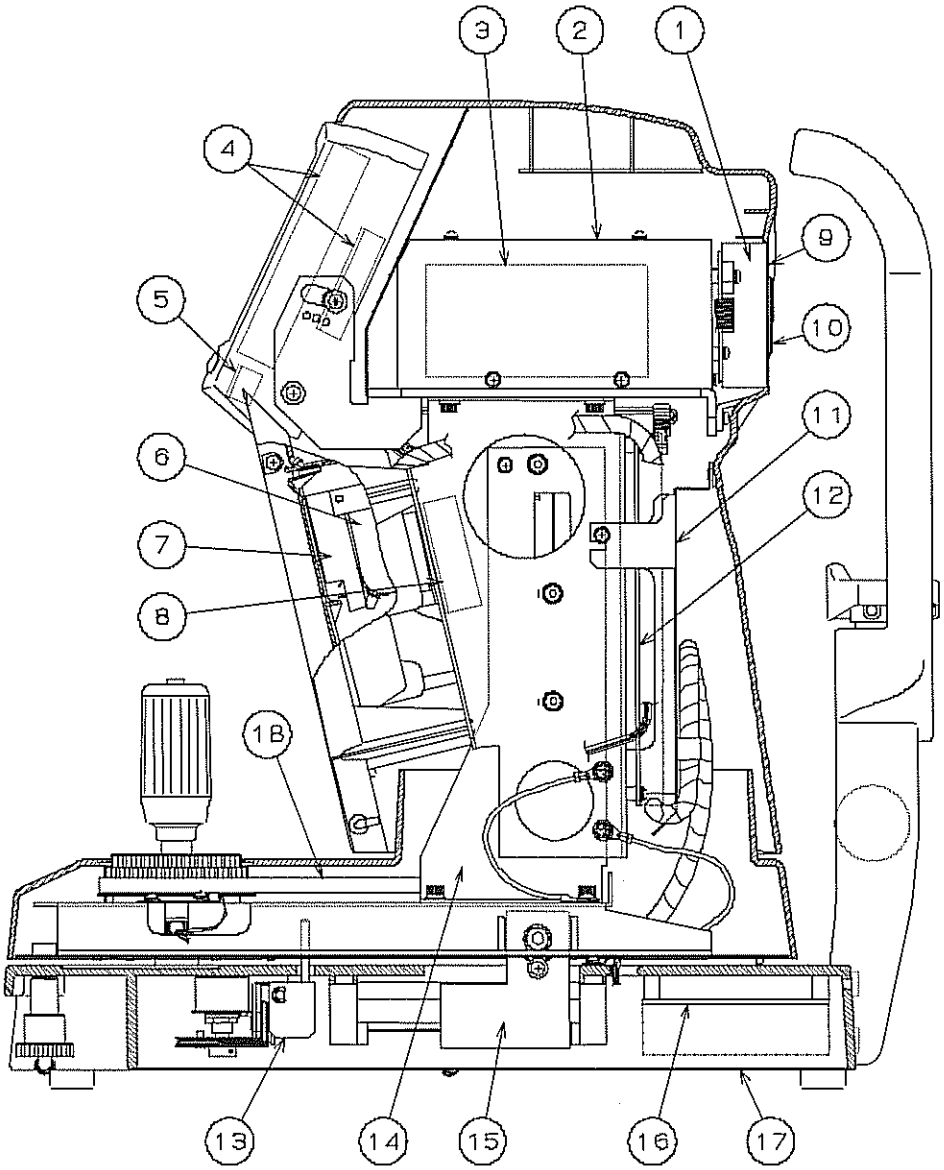




2 Construction Diagram

No.	Name
1	Optical unit ASSY
2	Optical unit ASSY cover
3	Driver board
4	LCD unit
5	Operation SW board ASSY
6	Printer
7	Printer auto cutter
8	Printer I/F board ASSY
9	View window filter
10	View window ring

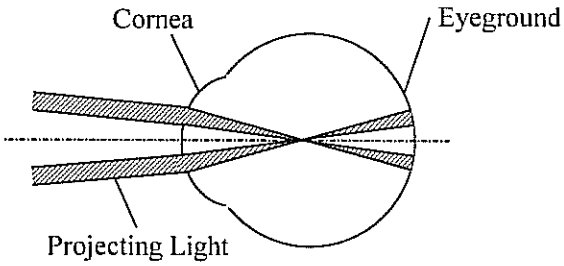
No.	Name
11	Case attachment plate
12	Control board
13	PD ASSY
14	Vertical unit
15	XY unit
16	Switching power supply
17	Base plate
18	Timing belt



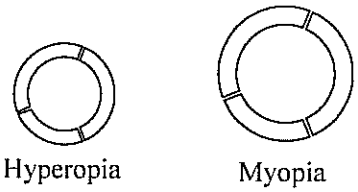
3 Measurement Principle

1) Refractive Measurement

When measurement starts, a measurement pattern for refractive measurement is projected onto the subject's eyeground. The projected pattern changes its size according the eye's refractive power. The reflected light of this eyeground image passes through the measurement system to the sensor. Data detected is stored in the frame memory, and in addition, the pattern is analyzed by image processing to calculate S, C, and A.



Subject's Eye

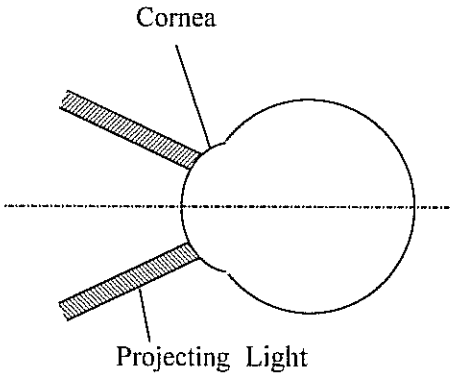


Patterns projected onto the sensor

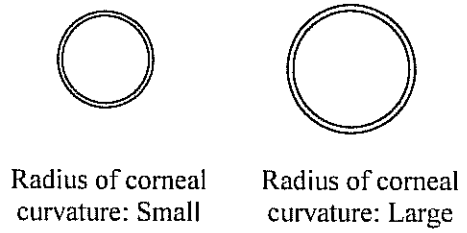
First measurement gives rough refractive power (tentative measurement). According this data, auto fogging and focusing of the eyeground image start functioning. Then, actual measurement starts, and the refractive power is calculated and displayed.

2) Measurement of Radius of Corneal Curvature

A ring-shaped measurement pattern is projected onto a cornea of the subject's eye. The pattern projected onto the cornea changes its size according the radius of corneal curvature. The projected light passes through the measurement system for corneal shape to the sensor. The data detected is stored in the frame memory, and the pattern is analyzed by image processing to calculate R1, R2 and A.

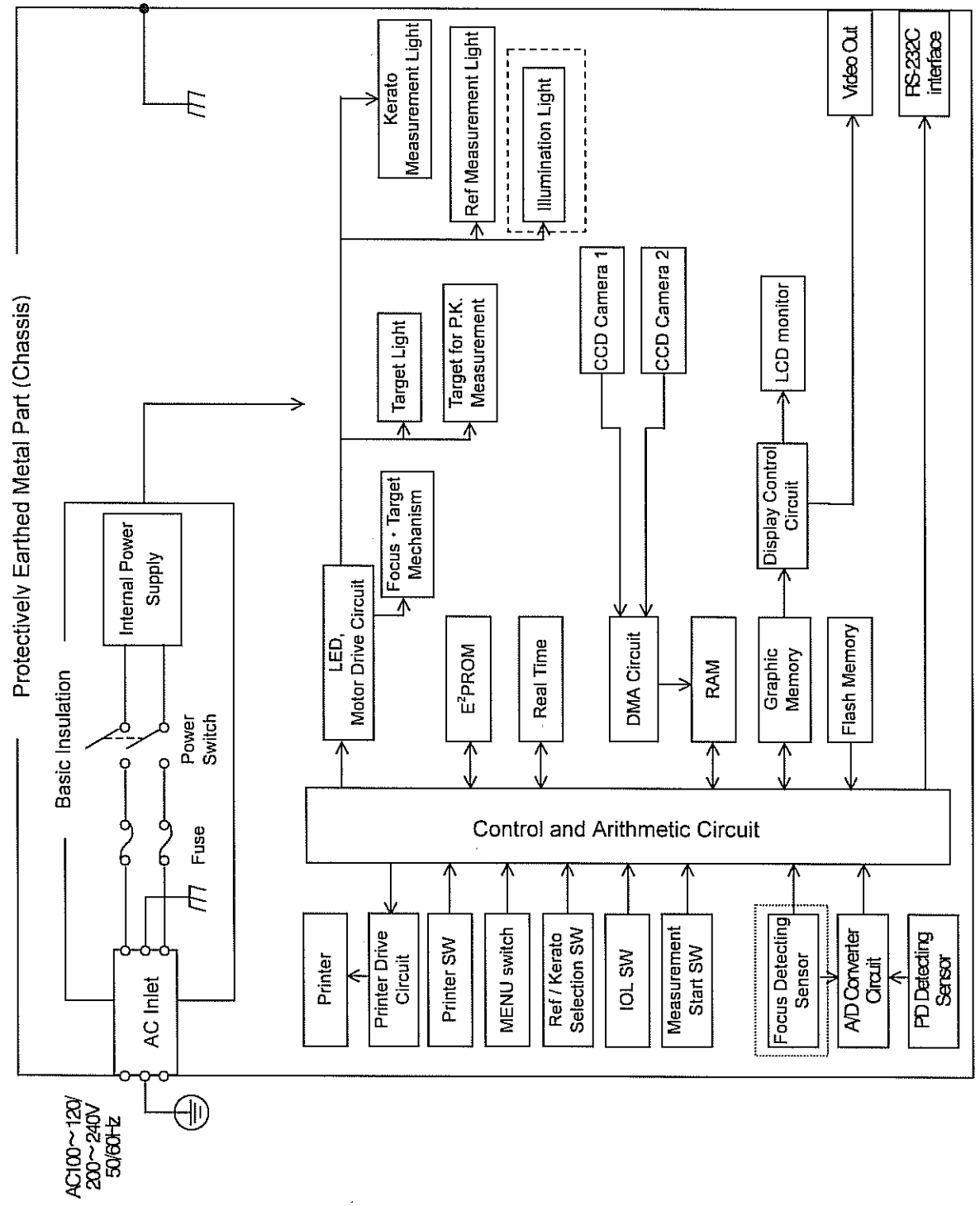


Subject's Eye



Pattern projected onto the sensor

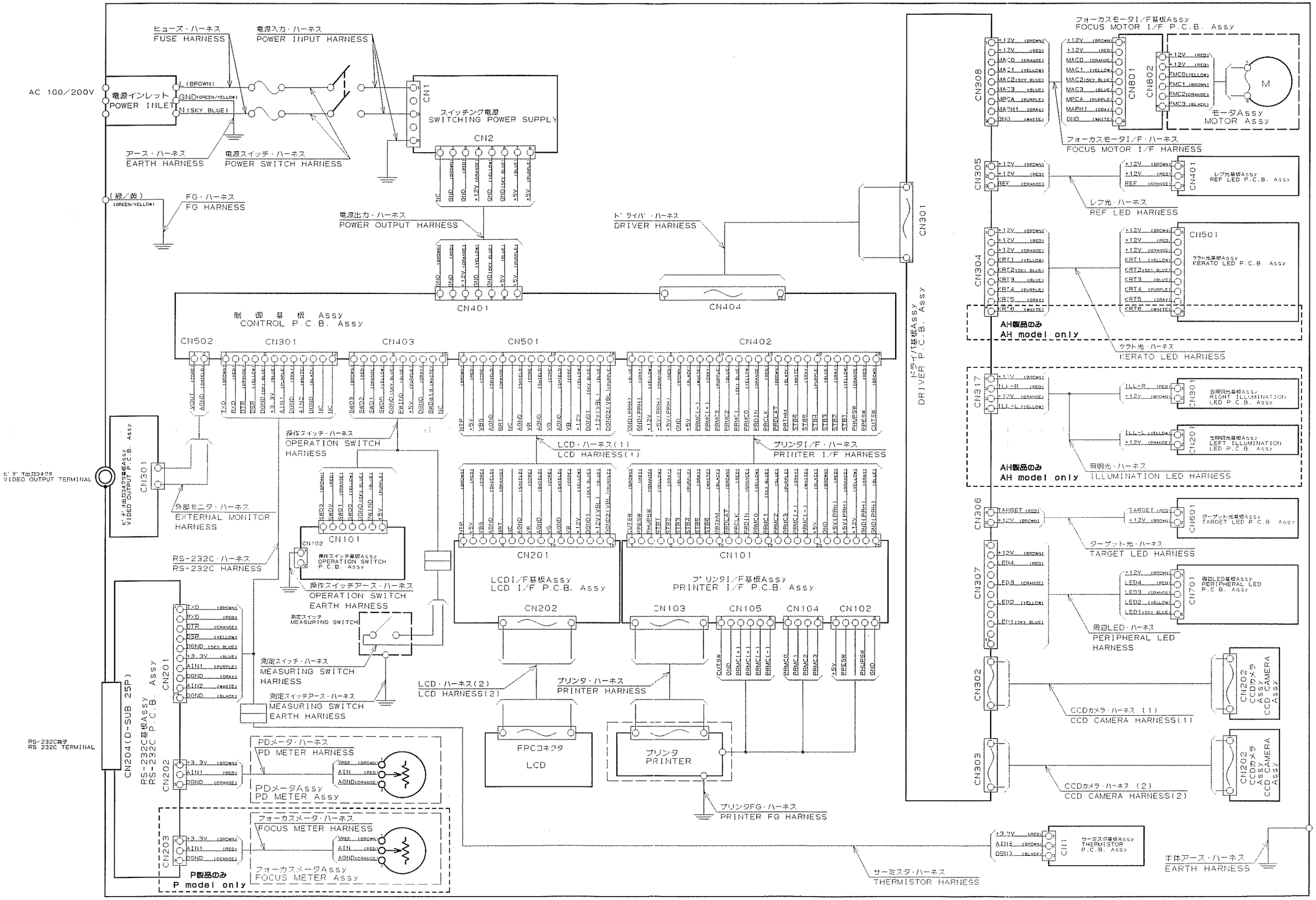
4 Block Diagram



Note: The item enclosed by ┈┈┈ is included in 'P model' only.

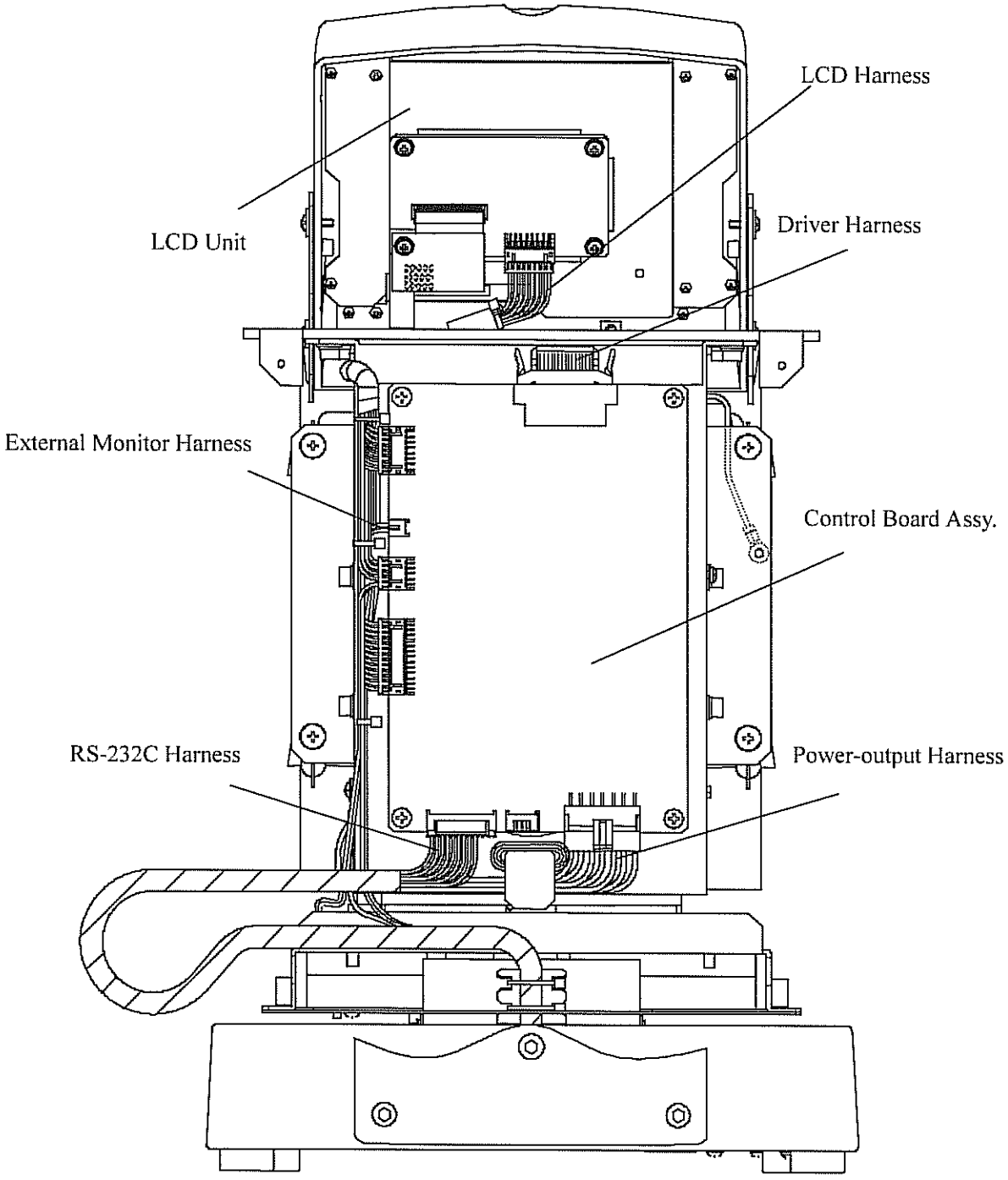
The item enclosed by - - - is included in 'AH model' only.

5 Connection Diagram

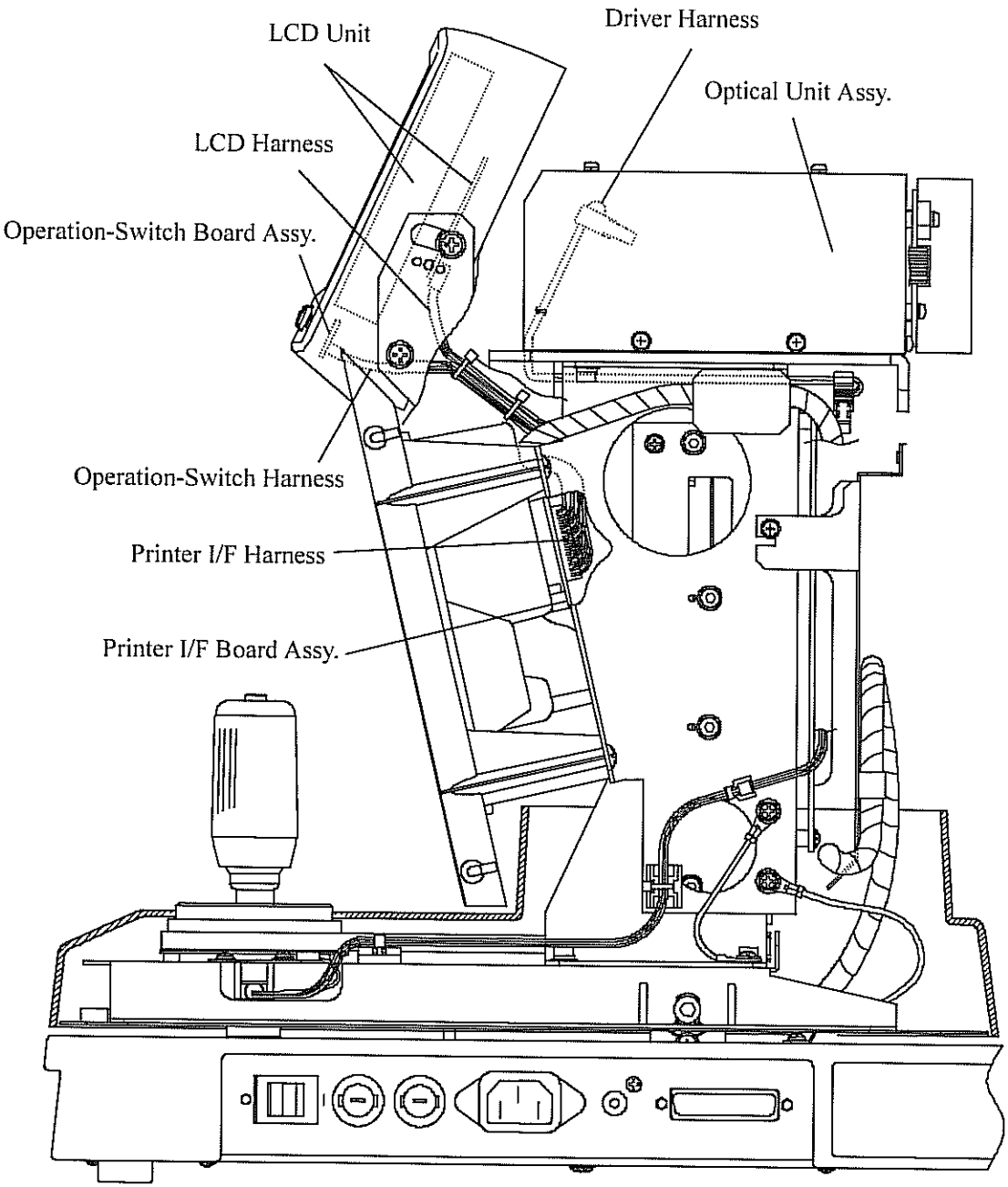


6 Wiring Diagram

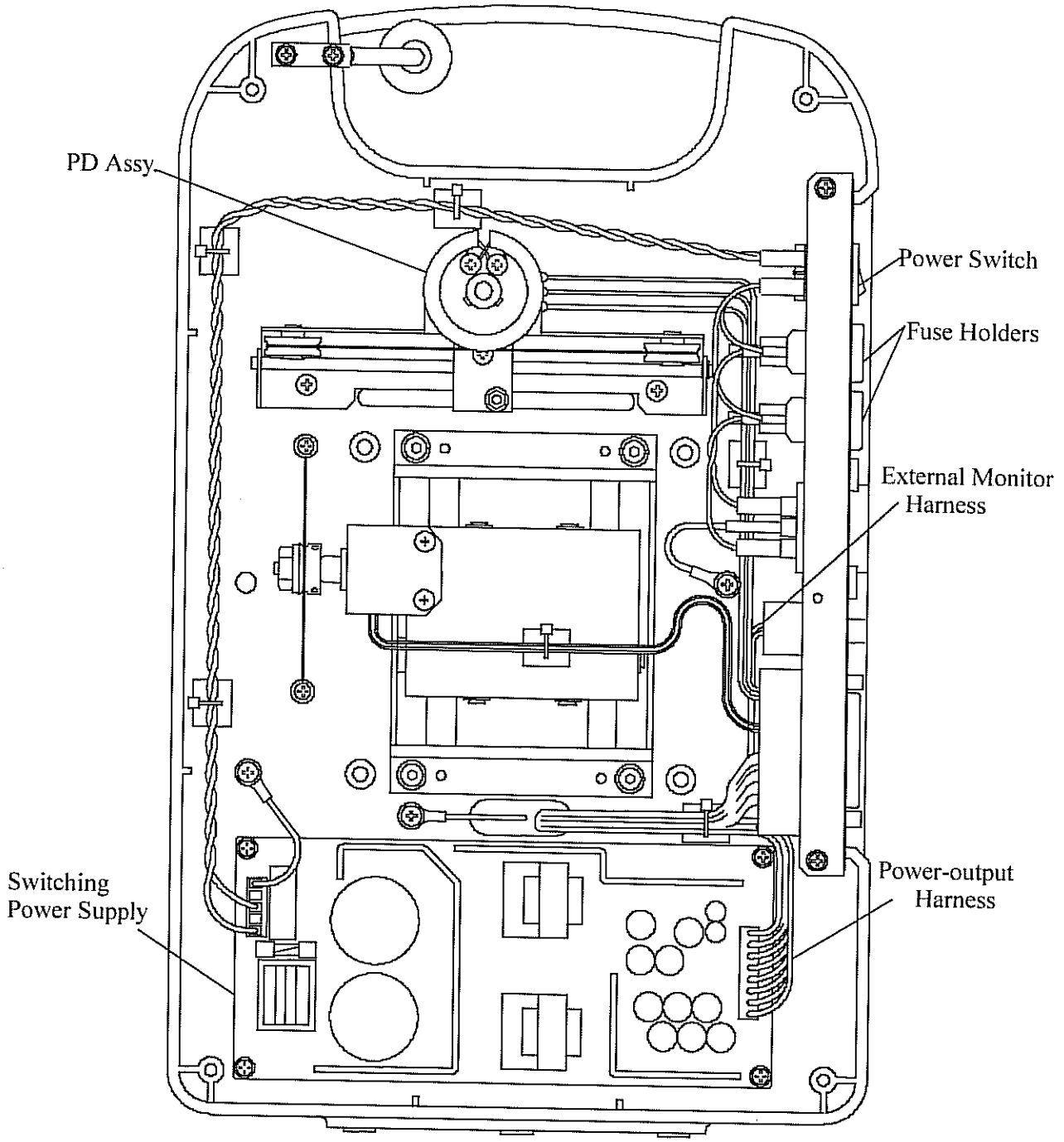
6-1 Rear View



6-2 Side View

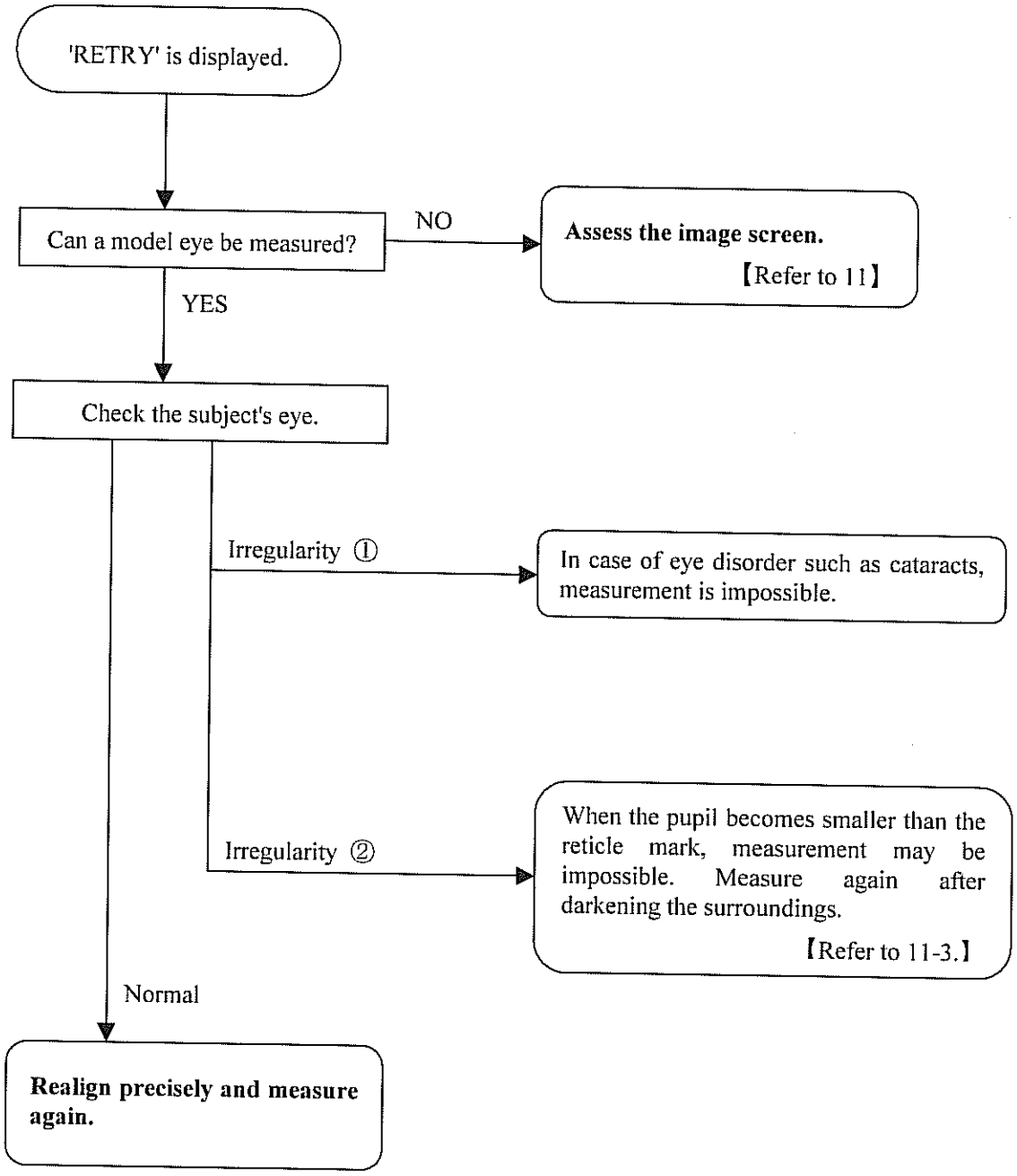

LCD Unit
Driver Harness
Optical Unit Assy.
LCD Harness
Operation-Switch Board Assy.
Operation-Switch Harness
Printer I/F Harness
Printer I/F Board Assy.

6-3 Base

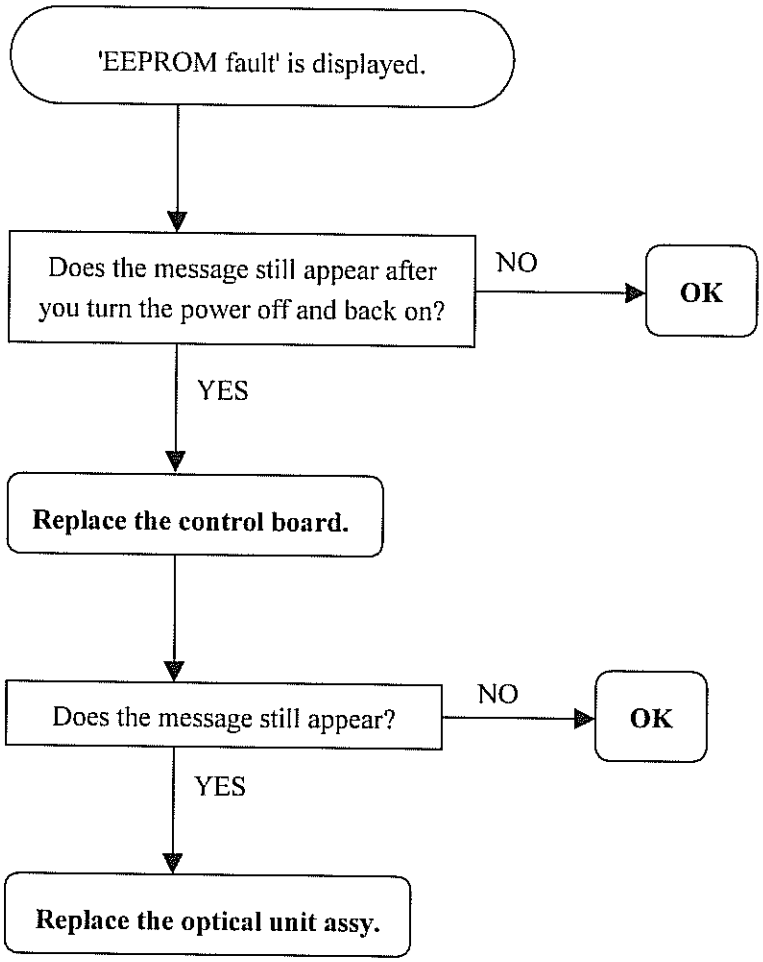

PD Assy
Power Switch
Fuse Holders
External Monitor Harness
Switching Power Supply
Power-output Harness

7 Troubleshooting

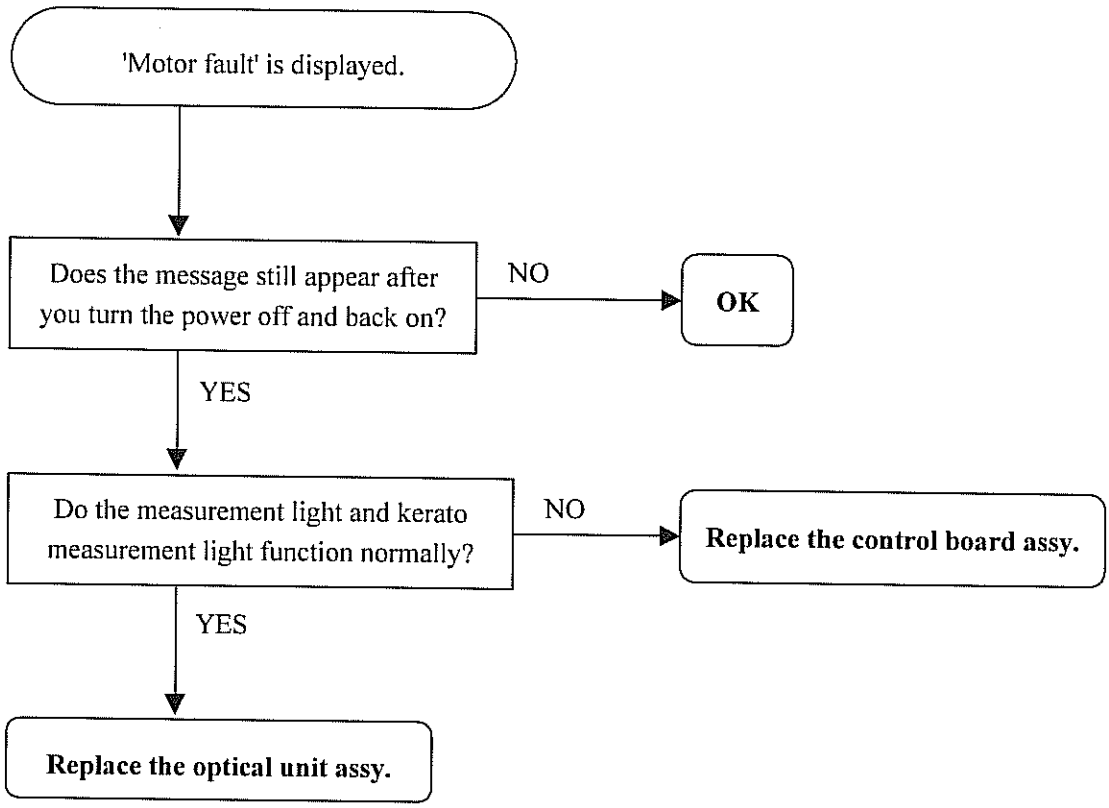
7-1 Error message 'RETRY' appears.



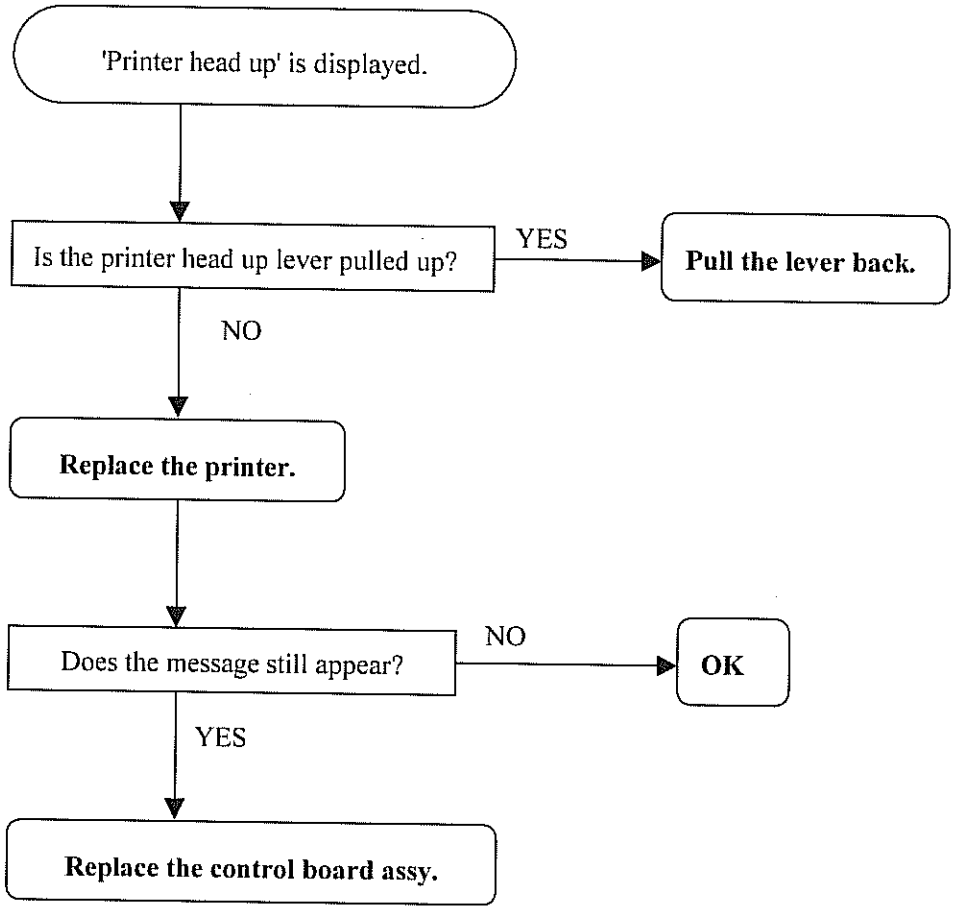
7-2 Error message 'EEPROM fault' appears.



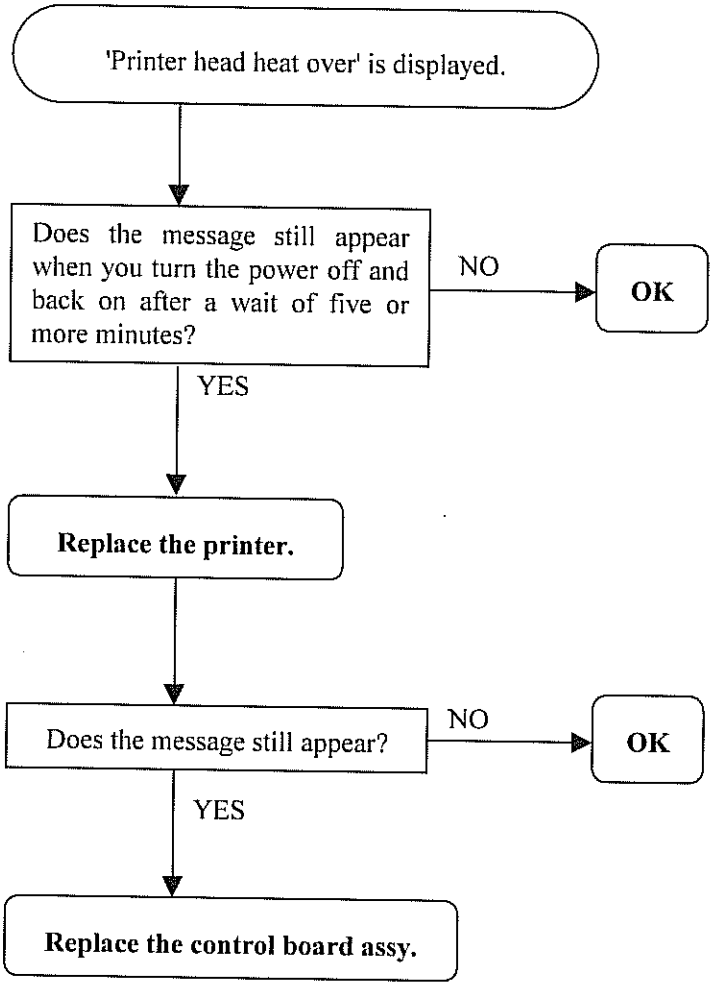
7-3 Error message 'Motor fault' appears.



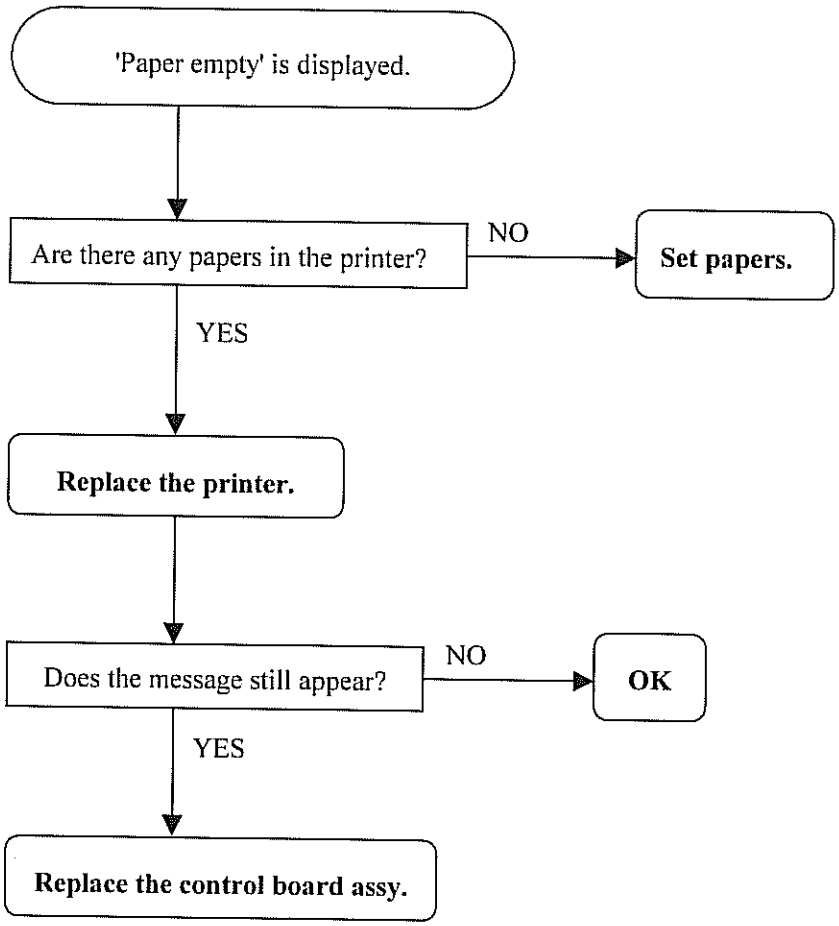
7-4 Error message 'Printer head up' appears.



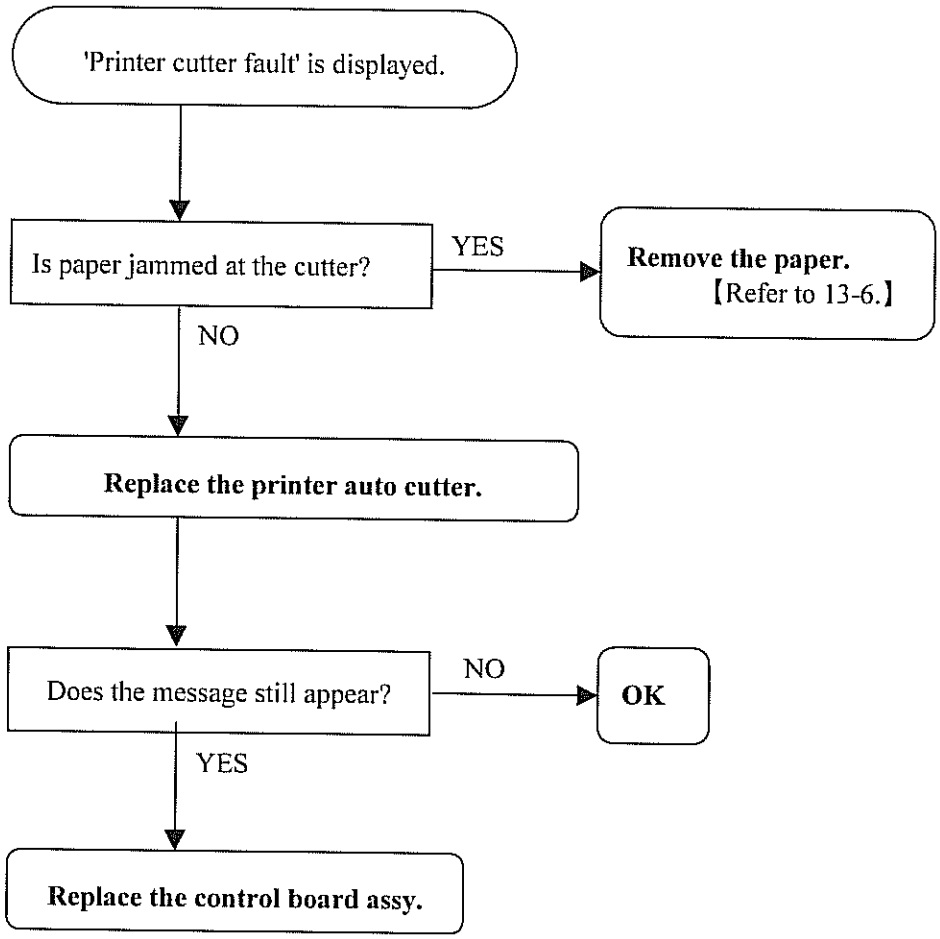
7-5 Error message 'Printer head heat over' appears.



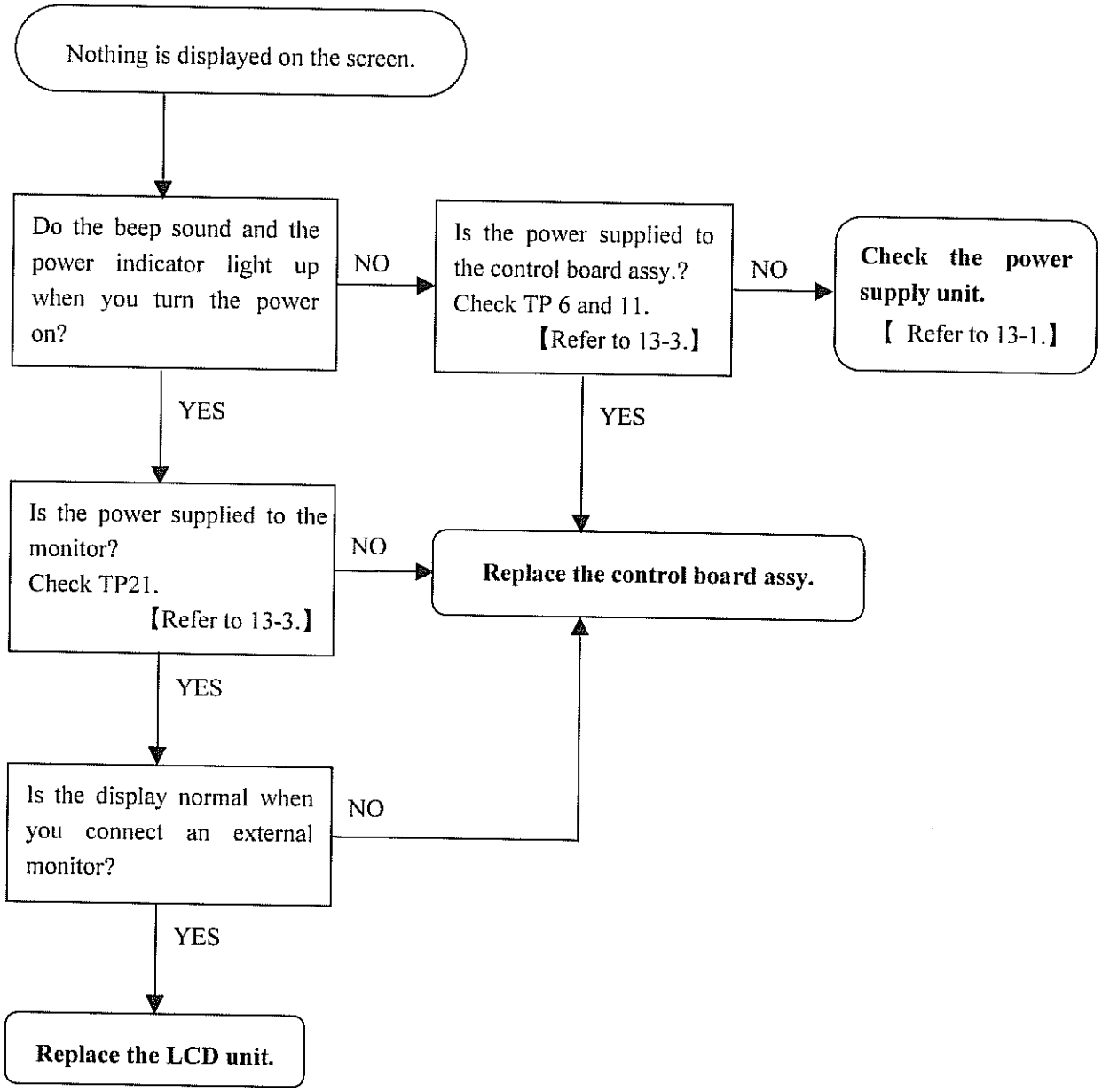
7-6 Error message 'Paper empty' appears.



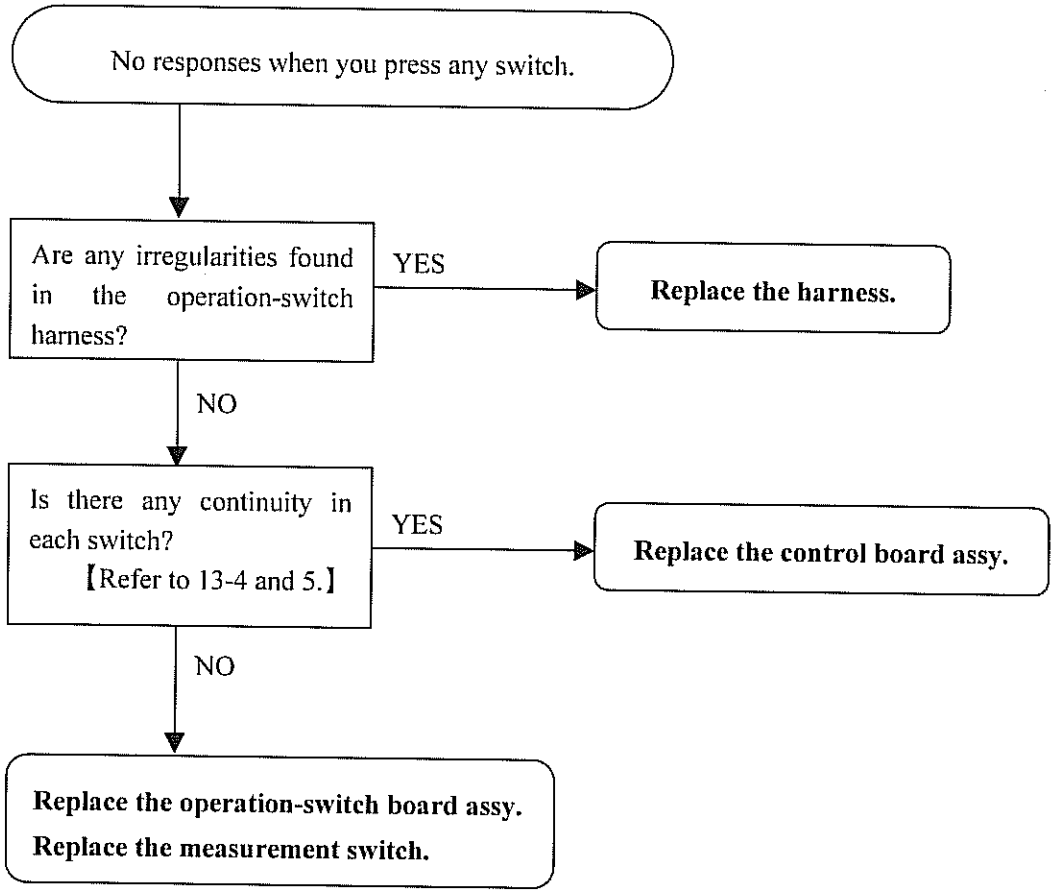
7-7 Error message 'Printer cutter fault' appears.



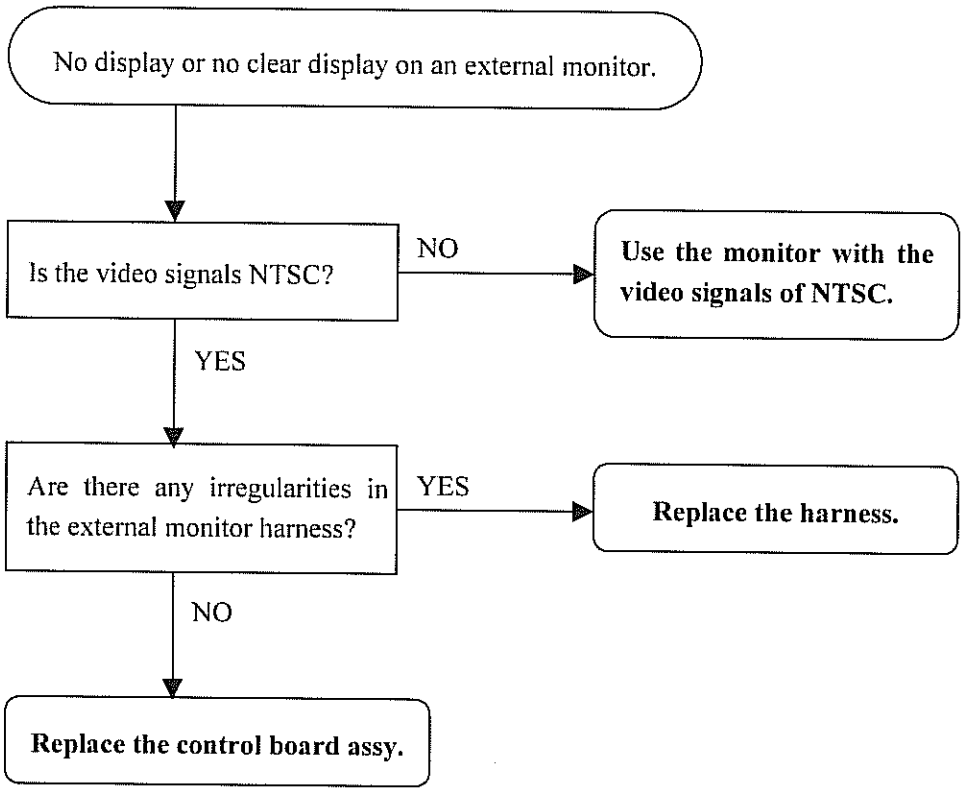
7-8 Nothing is displayed on the screen when you turn the power on.



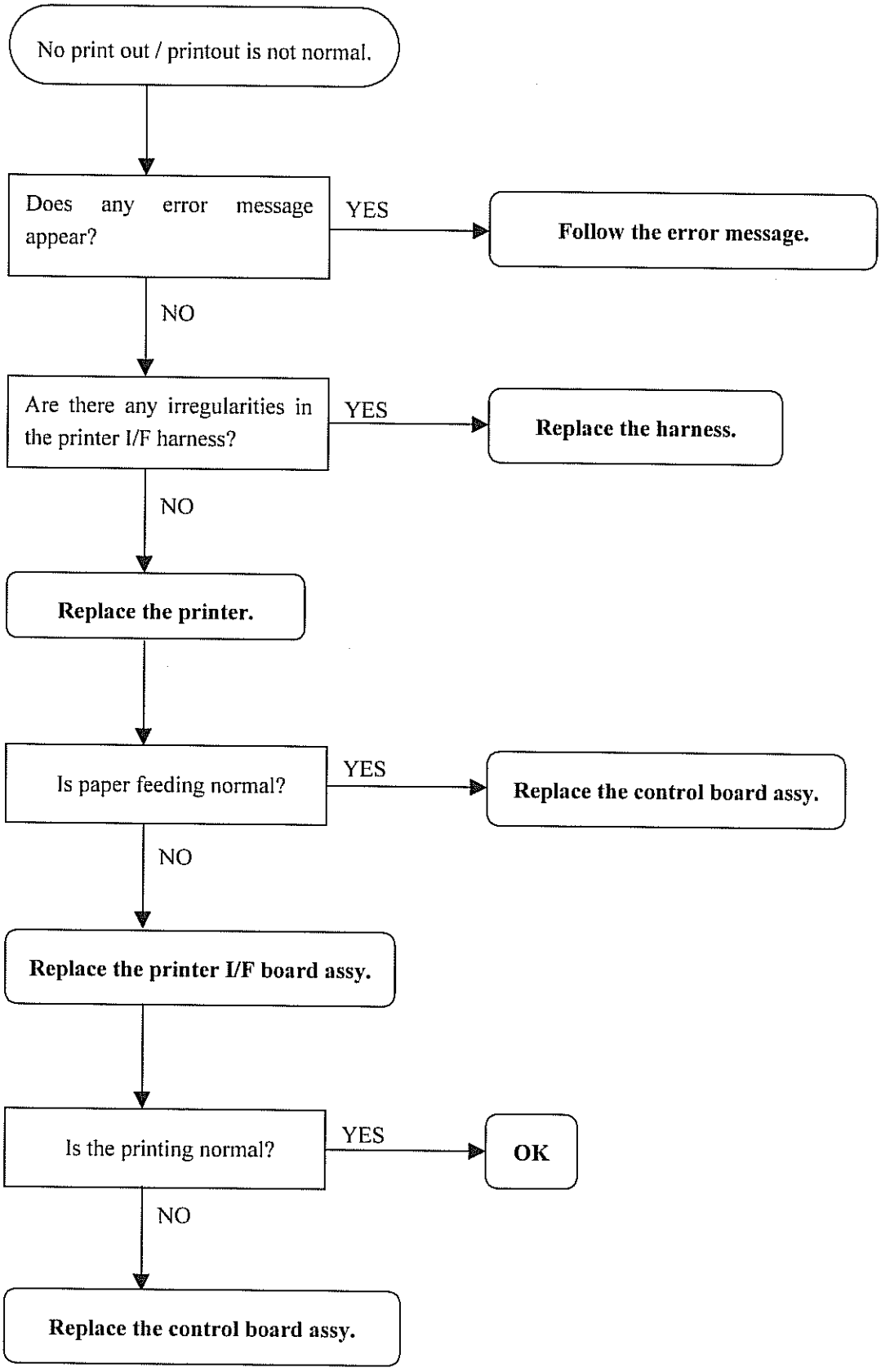
7-9 No responses when you press each switch.



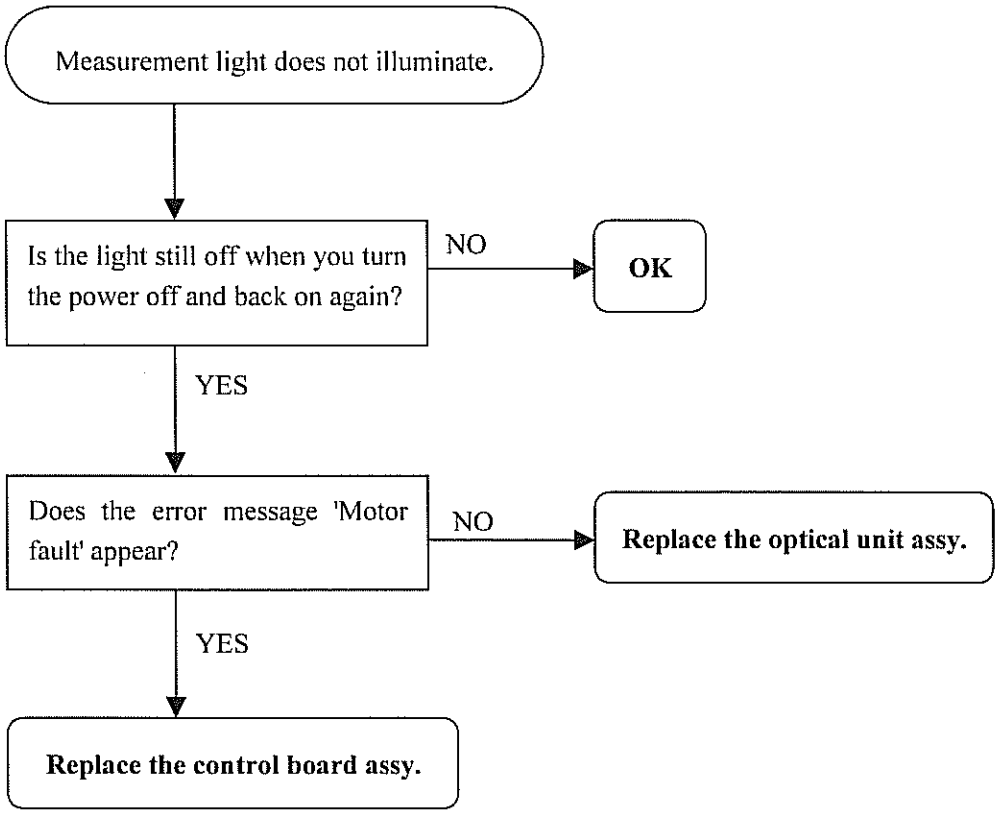
7-10 No display or no clear display on an external monitor.



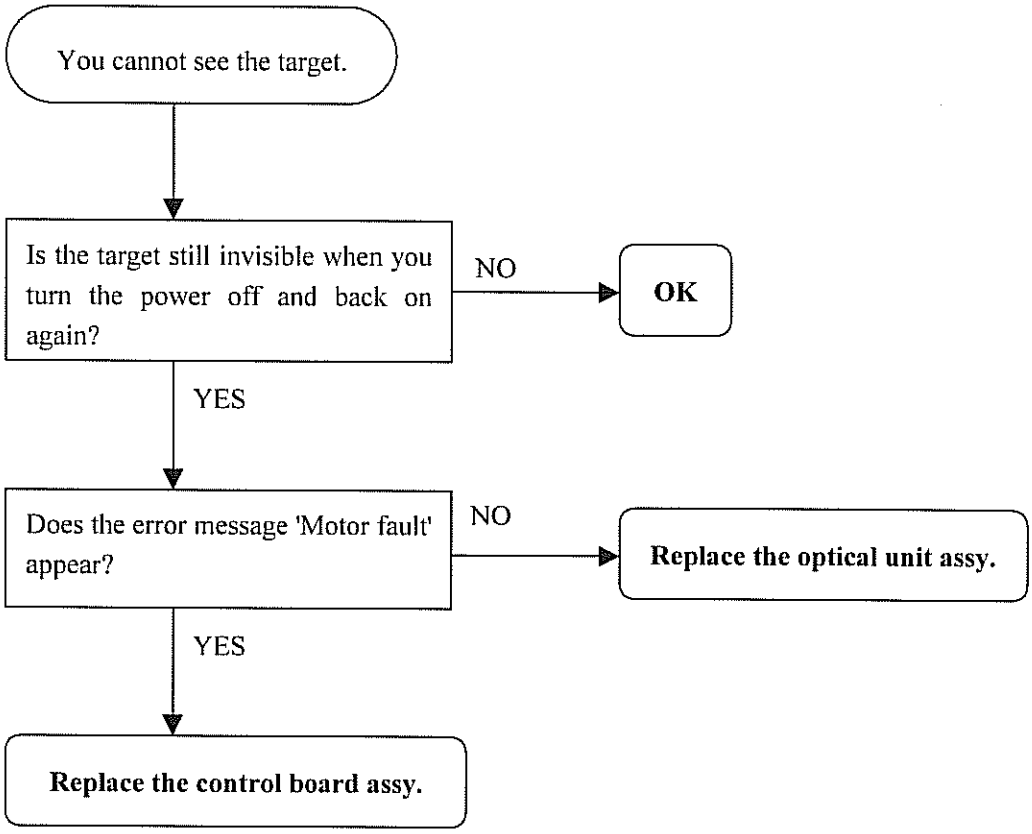
7-11 Result is not printed out / printout is not normal.



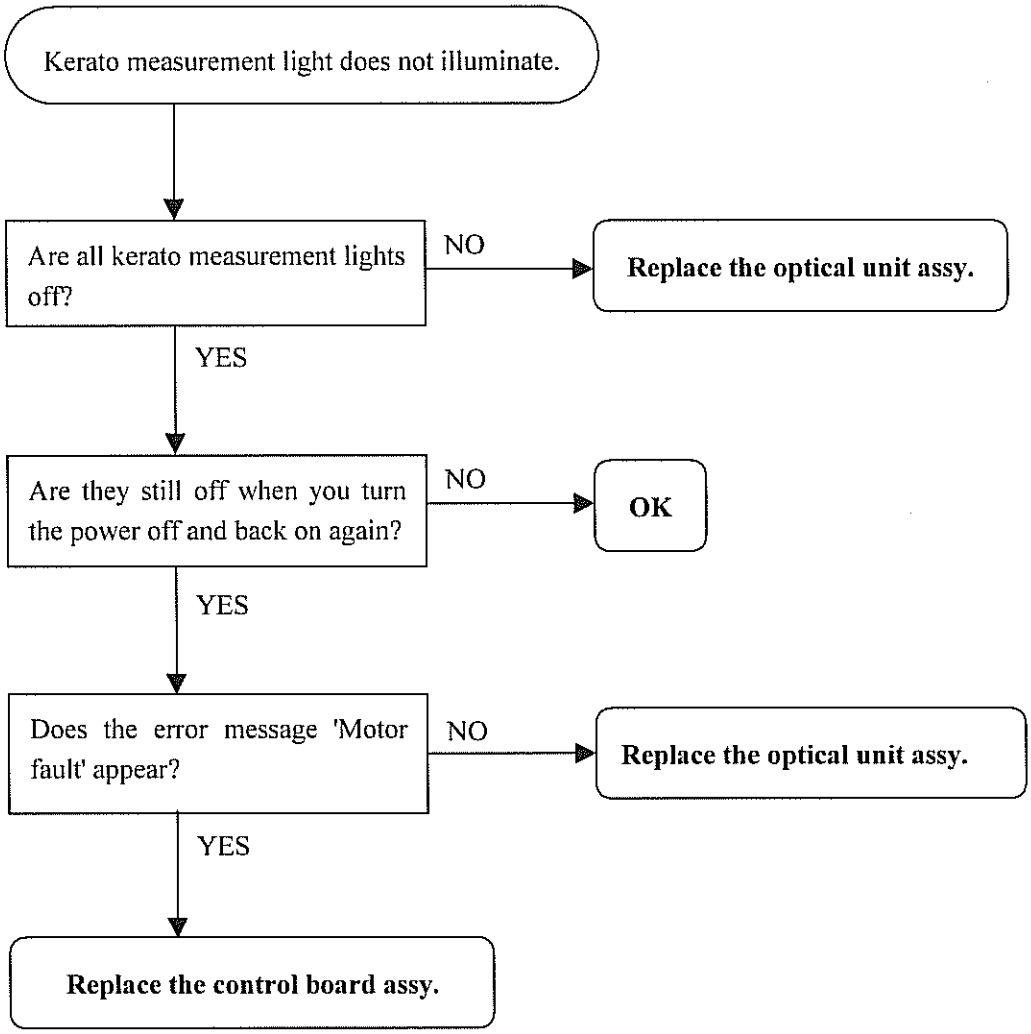
7-12 Measurement light does not illuminate.



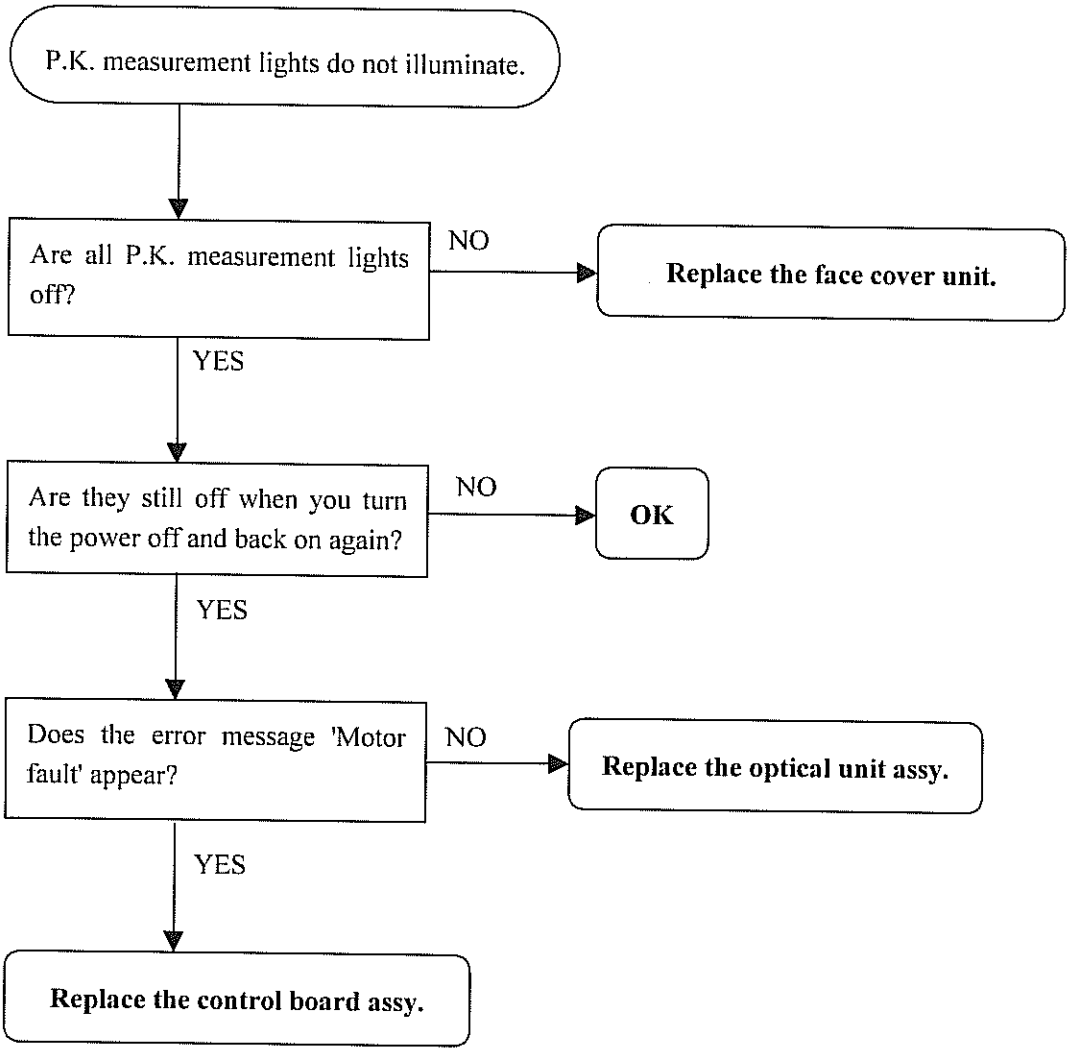
7-13 You cannot see the target.



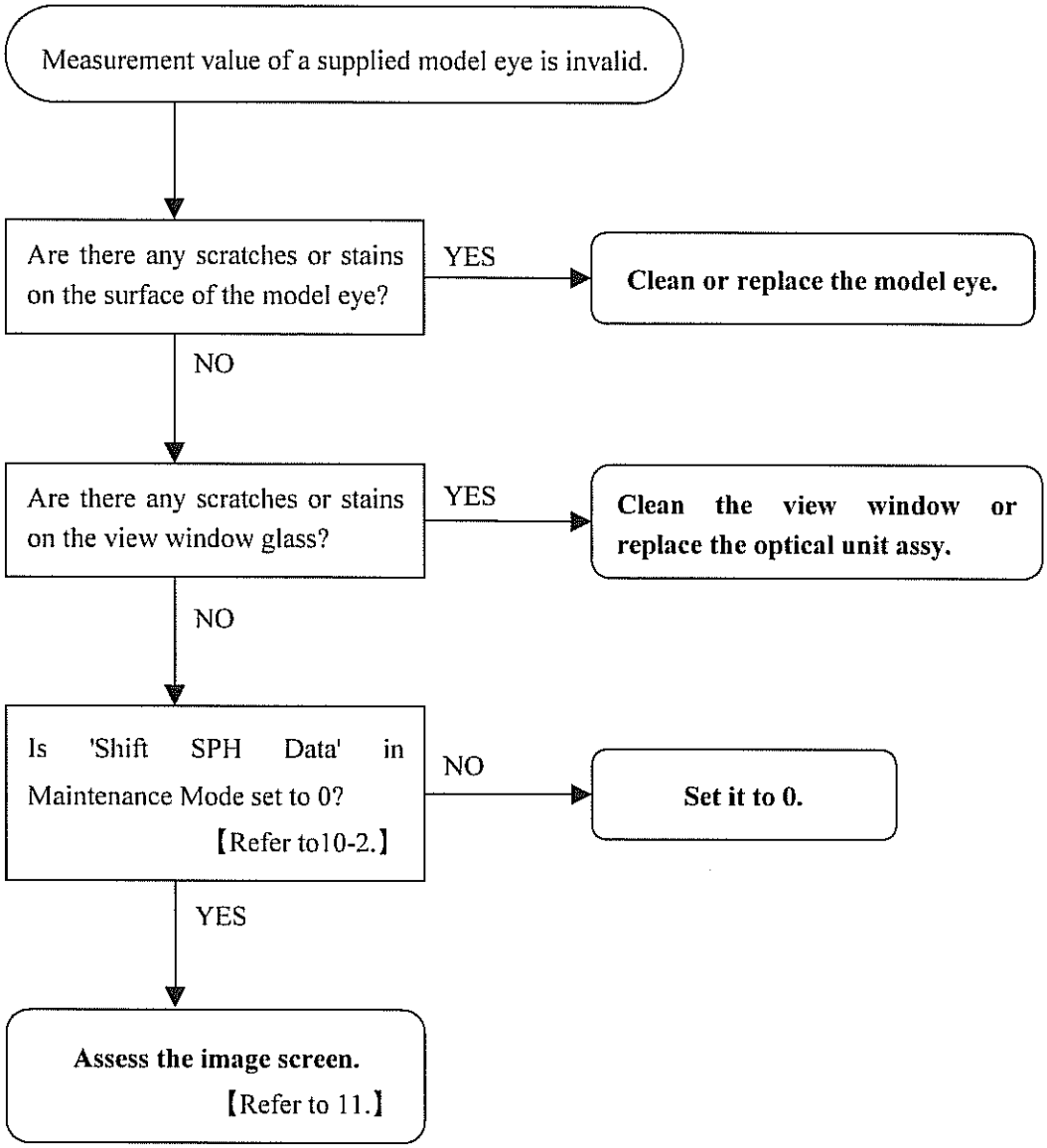
7-14 Kerato measurement light does not illuminate.



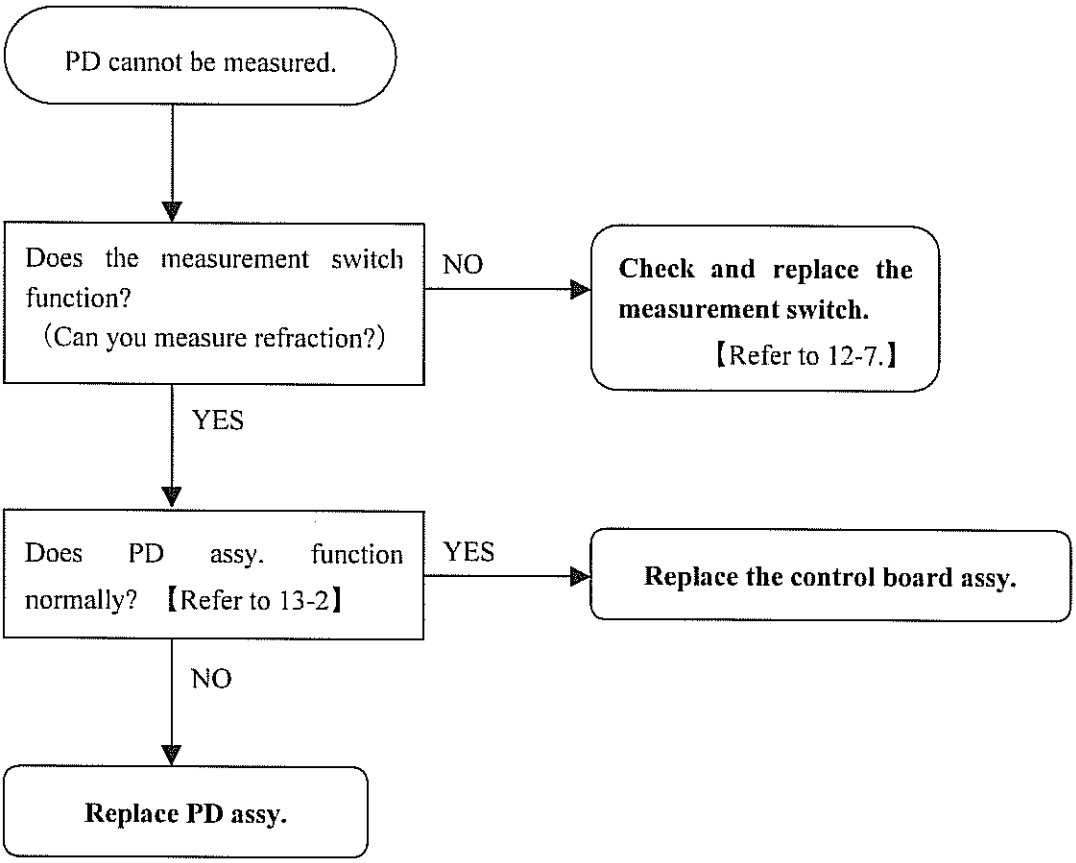
7-15 P.K. measurement lights do not illuminate.



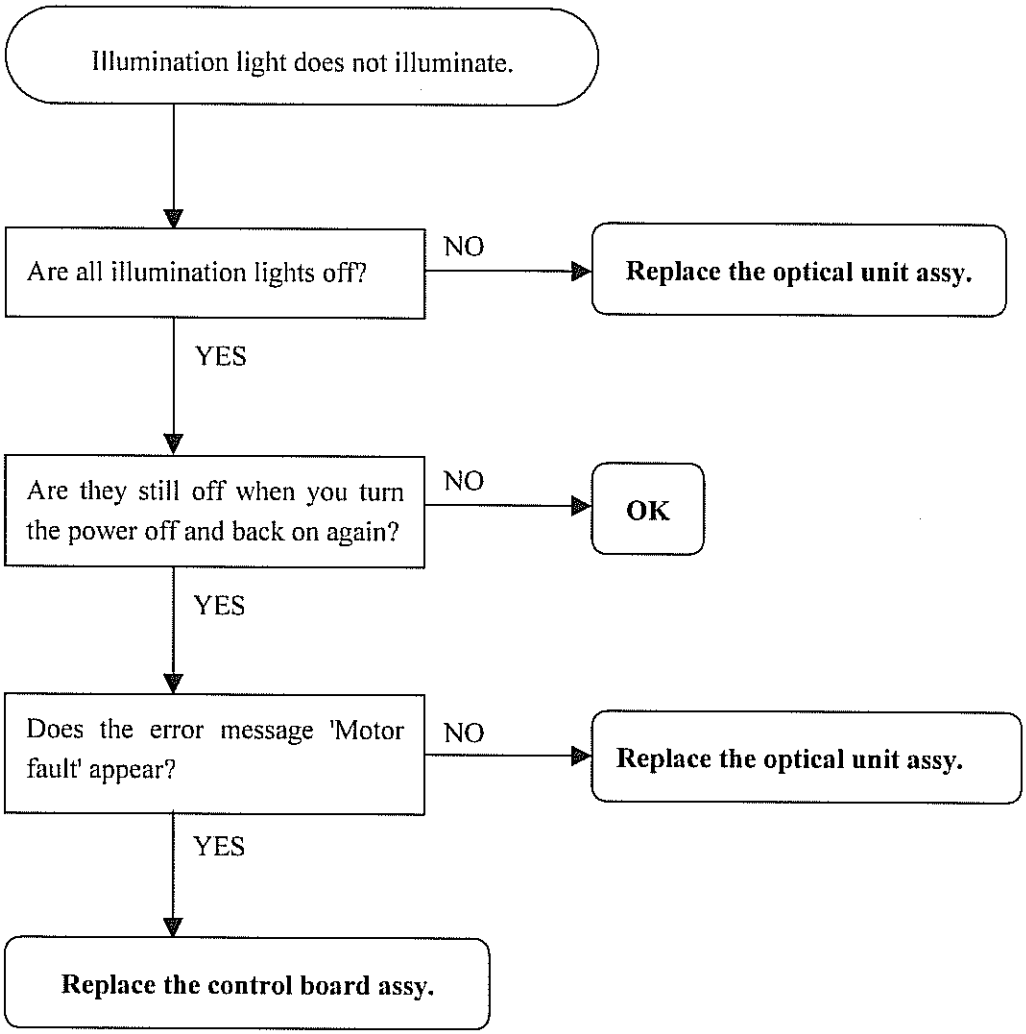
7-16 Measurement value of a supplied model eye is invalid.



7-17 PD cannot be measured (cannot be measured precisely).



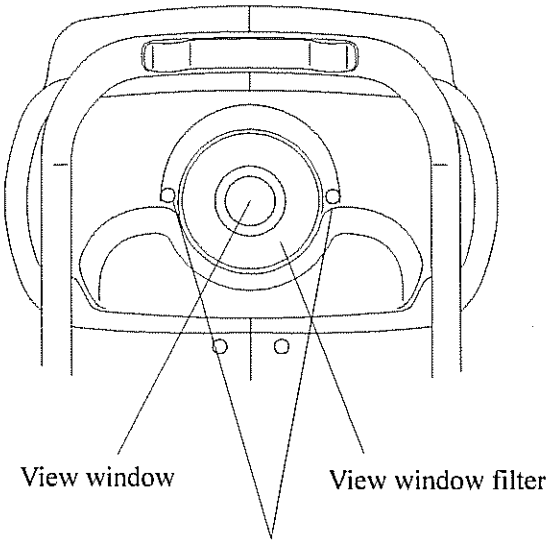
7-18 Illumination light does not illuminate. (AH model only)



8 Cleaning of View Window

When a view widow glass is dirty from fingerprints, dust and the like, the measurement accuracy will be adversely affected. Please clean it according the procedure below.

1) Apply a small amount of lens cleaner (absolute alcohol) to soft cloth.
2) Wipe the view window glass in circle from its center. Repeat until it becomes clean.
3) When the view window filter and P.K. measurement widows are dirty, apply a neutral cleanser into the soft cloth to wipe it lightly. Avoid using an organic solvent.



Windows for illumination light (AH model only)

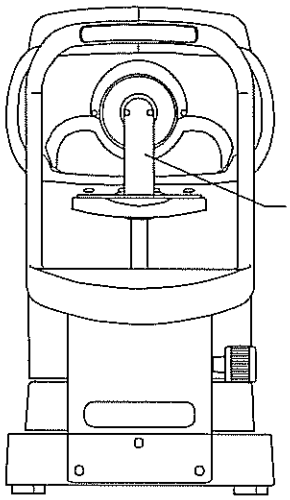
9 Function Check

Measurement Accuracy Check for Refraction

It is very important to check the accuracy of the apparatus using a supplied model eye in order to assess validity of the measurement results.

Check the accuracy with a supplied model eye periodically.

(1) After checking that no flows and dirt are found on the surface of the model eye, set the model eye unit as below for accuracy check.

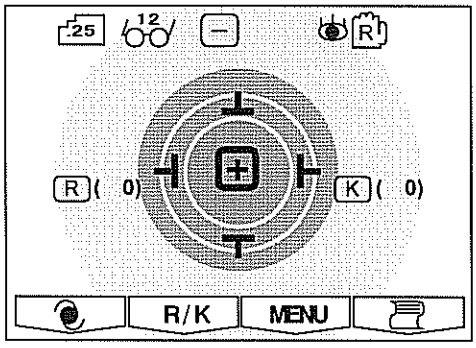


(2) To avoid inclining the model eye, raise the chin rest to the top and secure the model eye at the chin rest pins.

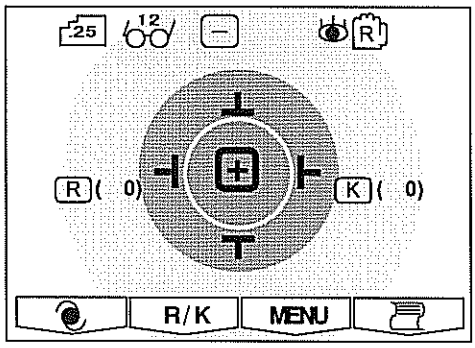
(3) Carry out alignment precisely so that the alignment mark is at the center of the reticle mark and the focus indicators disappear. Then, proceed measurement.

Proper alignment is required for accurate measurement.

Display with Precise Alignment



<P model>



<AH model>

When the requirements above are met, start measurement.

(4) When the measurement result is within the tolerance below, the measurement accuracy is considered valid.

The precise value of the model eye is indicated on the model eye unit. It is a spherical value (SPH) with VD = 12. Since CYL is 0.00, it is not indicated as well as AXIS.

Tolerance			
S	C	(R1 + R2)/2	R1 - R2
±0.25D	±0.25D	±0.05mm	±0.05mm

When the measurement result exceeds the tolerance above, the apparatus need to be checked. Refer to Troubleshooting 7-16.

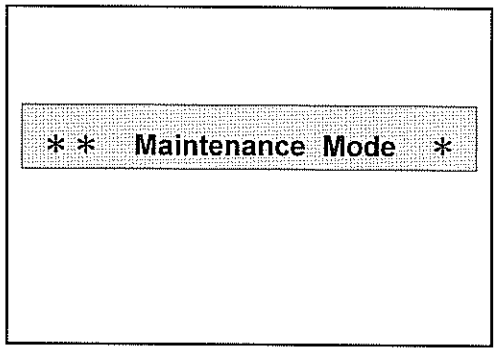
10 Maintenance Mode

Maintenance mode has various functions required for maintenance, including assessment of measurement image, adjustment data and hardware, shifting SPH data, and calibration and printout of the optical adjustment data.

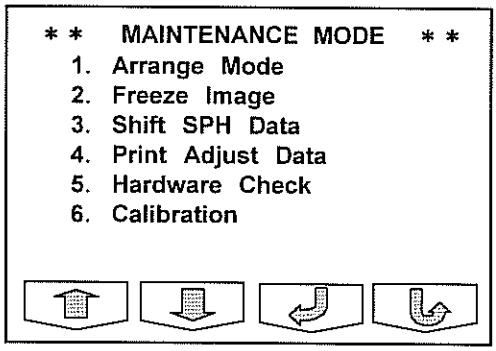
10-1 Start-up

1) Turn on the power of the apparatus, pressing the measurement switch.

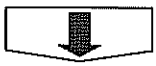
2) Keep pressing the measurement switch about 10 seconds. Beep sounds twice and the display as on the right will appear.

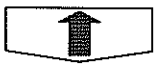


3) Release the measurement switch when you see the word "Maintenance Mode" on the screen. You will see the menu screen as on the right.



4) Switch functions on the panel will change and correspond to the functions displayed on the screen.


Menu Selection: use when you move the cursor downward.


Menu Selection: use when you move the cursor upward.


Confirmation of the menu selection.


Return switch to the previous menu and the measurement screen.

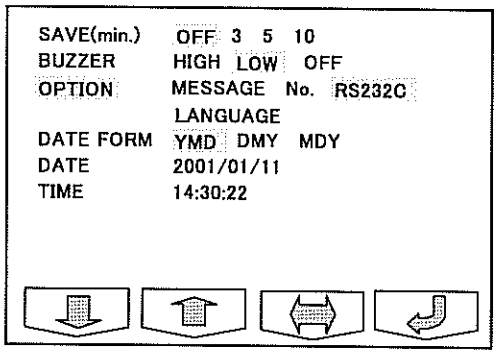
5) When you finish setting of maintenance mode, cut the power once. Turn the power on again to confirm the normal mode is engaged.

10-2 Each Menu Function

1) Arrange Mode

When you select this menu, the normal menu screen will appear. Refer to Operations Manual for description and setting of each menu. Press [↵], and then you can return to the menu screen.

'OPTION' of the arrange mode includes items for communication setting to Remote Refractor by Nikon and for language selection of English and Chinese.

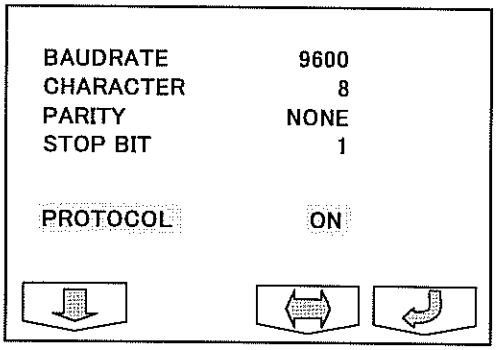


① PROTOCOL

With this item, you can select to communicate with Remote Refractor by Nikon.

To do so, select 'RS232C' from 'OPTION' in the menu screen. Press [↵], and you will see the display on the right.

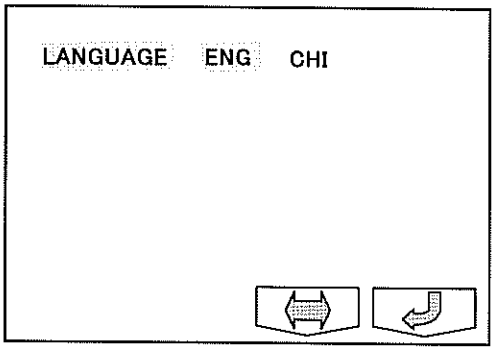
Select 'PROTOCOL', and using [↔] select ON or OFF (to communicate or not to communicate). Return to the measurement screen when you finish selecting. Then, cut the power and turn it on again.



② LANGUAGE

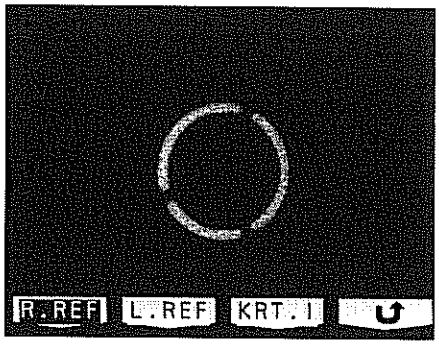
With this item, you can select the language of characters used on the screen: English or Chinese.

Select 'LANGUAGE' from 'OPTION' in the menu screen and press [↵]. You will see the display on the right. Using [↔], select 'ENG' or 'CHI' (English or Chinese). Return to the measurement screen when you finish selecting. Cut the power and turn it on again.



2) Freeze Image

When selecting this menu after measurement, you will see the measurement image assessment screen (Image Screen) on the right. Displayed is the image of the last measurement. The display will be changed as following when you press each switch.



R. REF	Image of refractive measurement for a right eye.
L. REF	Image of refractive measurement for a left eye.
KRT. I	Image of kerato measurement.
ALI. I	Anterior segment image.

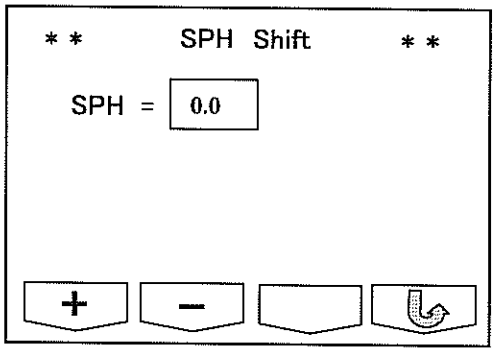
With  , you can return to the menu screen.

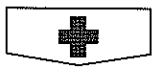
Use this function to assess and evaluate the measurement image when error occurs frequently or any failure in the measurement accuracy is found.

For assessment of measurement image, refer to '11 Assessment of Image Screen'.

3) Shift SPH Data

When selecting this menu after measurement, you will see the screen on the right. This menu allows you to shift the indicated value of SPH to any given number in the range of +1.0 ~ -1.0D (0.1 step)





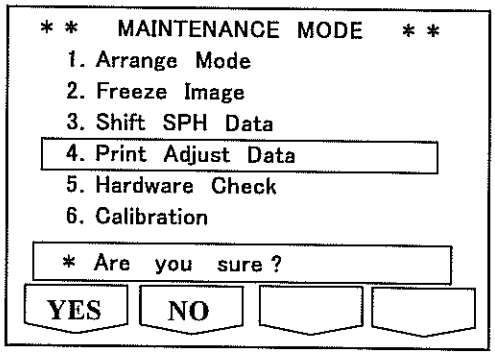
You can add 0.1 to the indicated value when you press the switch.

You can subtract 0.1 from the indicated value when you press switch.

You can return to the menu screen.

4) Print Adjust Data

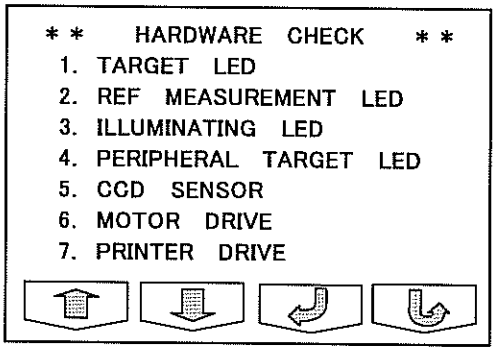
When you select this menu, you will see the screen on the right, and the switch functions will change as below.



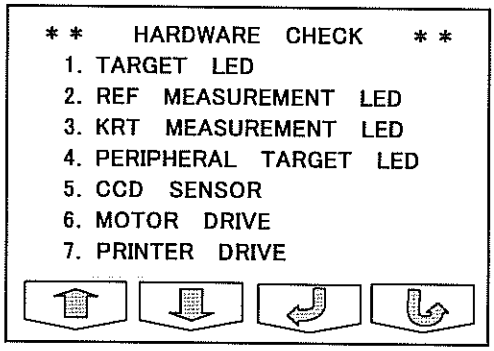
For printout, press [YES] so that the adjustment data is printed out to check for any irregularities.
When you do not wish to print out, press [NO].
You can return to the original screen.

5) Hardware Check

When you select this menu, the display on the right will appear. With this, you can check operation of light sources, motor, camera and so on.
When you press [↵], each operation starts and you will hear the beep when it is finished.
Operation of each item is as follows.



<P model>



<AH model>

1. TARGET LED

   Looking through the view window, you can check illumination of the target. The target will blink three times.

2. REF MEASUREMENT LED

   You can check illumination of REF measurement light on the monitor screen.
   Set the supplied model eye, carry out alignment, and then, press [↵].
   REF measurement light will blink three times.

3. ILLUMINATING LED

   You can check illumination of KERATO measurement light on the monitor screen.
   Set the supplied model eye, carry out alignment, and then, press [↵].
   KERATO measurement light will blink three times.

4. PERIPHERAL TARGET LED

Looking through the view window, you can check the illumination of peripheral target. The target illuminates three times in a clockwise direction.

5. CCD SENSOR

You can check on the monitor screen that CCD sensor projects the image properly.
Set the supplied model eye, carry out alignment, and then, press  .
REF image and KERATO image will be alternately indicated three times according CCD sensor being switched.

6. MOTOR DRIVE

You can check that the motor moves the moving unit back and forth within the stroke range (three times). Set the supplied model eye, carry out alignment, and then, press  .
The motor function normally when you can see REF image on the screen, changing its focus, and when the focus of the target changes in case that you look it through the view window. In addition, you can check the motor movement when you remove the main unit cover and the optical unit cover.

7. PRINTER DRIVE

You can check the printer operation by printing the test pattern.

6) Calibration

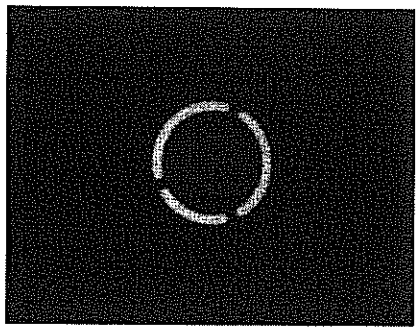
This menu is to readjust the apparatus using the model eye for calibration, one of the maintenance tools.

When you use this menu, you always need the model eye unit for calibration. Detail on setting is attached on the model eye.

11 Freeze Image Assessment

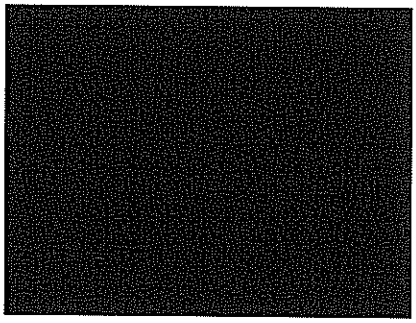
11-1 Normal Image

When the apparatus operates properly and alignment is made precisely, you will find the image on the screen as shown on the right.



11-2 No Measurement Image on the Screen

If you do not see any measurement image when you check the image screen after measurement, you will receive no results. In such a case, the measurement light may fail to be projected properly.



Please check that the measurement light is properly projected in the following manner.

Return to the menu screen of 'MAINTENANCE MODE'. Enter 'REF MEASUREMENT LED' and select '5. Hardware Check.'

The measurement light is properly projected when you can see the flash of the measurement light. (Remember to check with proper alignment.)

When you can see the measurement light flashing on the screen but no image on the freeze image screen, there is malfunction in the control board. Please replace it.

When you cannot see the measurement light flashing, there is malfunction in the drive circuit of the measurement light. Check it according Troubleshooting 7-12.

11-3 Measurement Image exits

In some cases, you may see the measurement image on the freeze image screen but cannot measure. Such examples are:

a) Undesired corneal reflection exists,

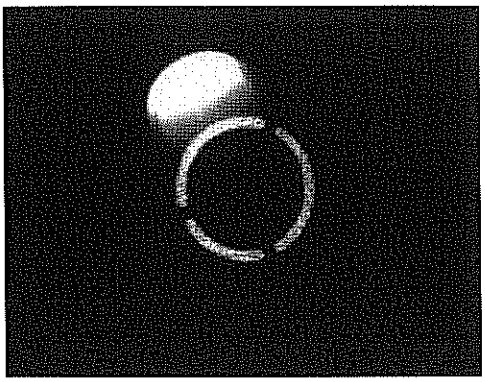
b) The image is chipped,

c) The measurement image is not focused.

Following are the detail description of each example.

a) Undesired corneal reflection exists.

Measurement fails when too much undesired reflection exists near or on the measurement image as shown on the right. This may happen in the following cases.

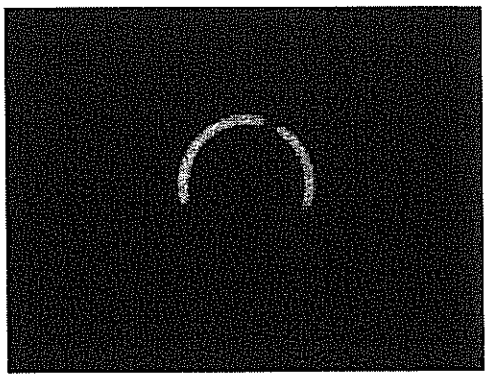


① The distance between the subject's eye and the measurement unit (working distance) is inappropriate.
→ Make proper alignment and measure again.

② An optical axis is misaligned inside the optical unit.
→ Replacement of the optical unit is necessary.

b) The image is chipped.

When the image on the freeze image screen is chipped as shown on the right, you cannot measure. This may happen in the following cases.



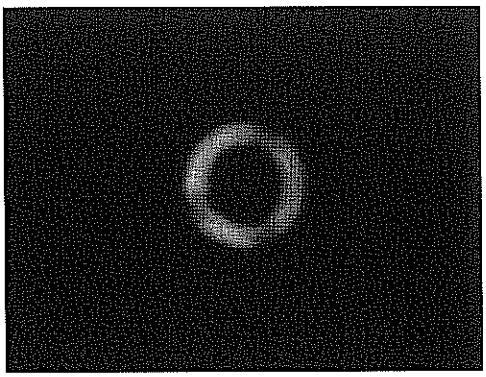
① Measurement started when the subject blinked.
→ Ask the subject not to blink.

② The pupil of the subject's eye is too small.
→ Take some measure to enlarge the pupil.
(such as darkening the room.)

In both cases, make proper alignment and measure again.

c) The measurement image is not focused.

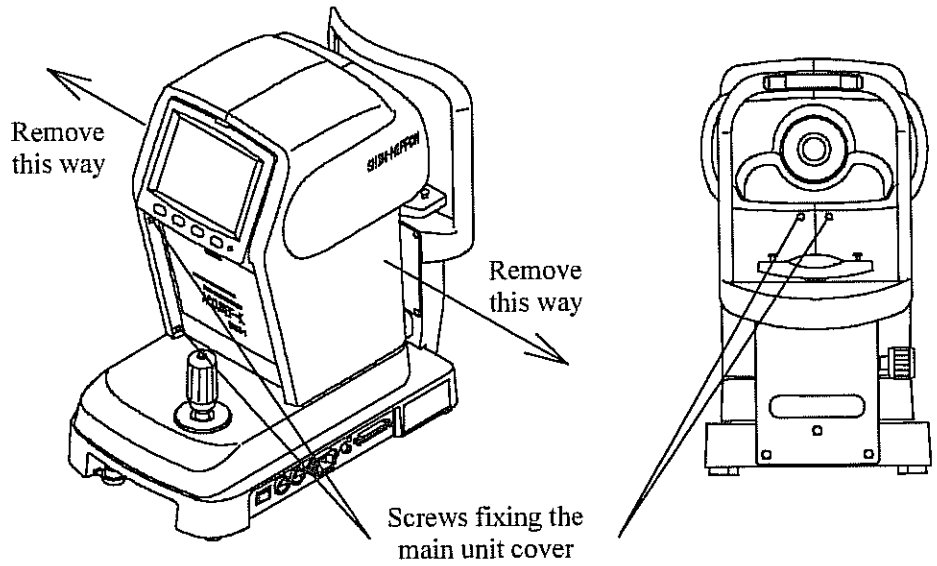
You cannot measure when the measurement image on the freeze image screen is not focused as shown on the right. This may be caused by malfunction of the drive unit in the optical unit. Check it according Troubleshooting 7-3.



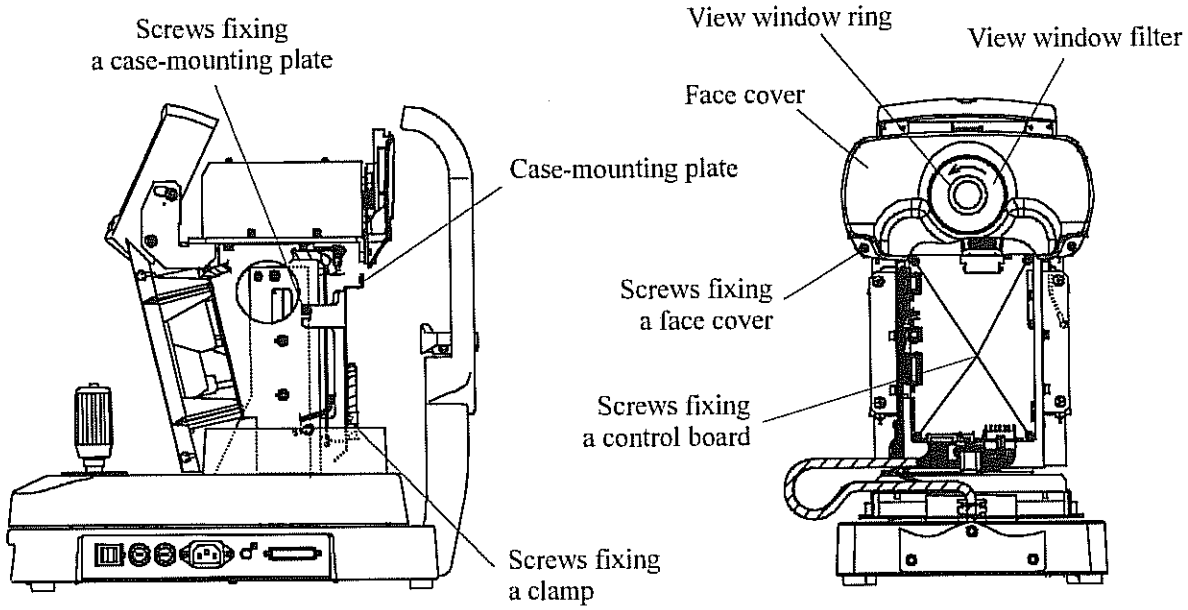
12 Individual Replacement

12-1 Control Board

1) Unscrew six screws fixing a main unit cover R and a main unit cover L. There are two on the side facing the chin rest and four in the front.
2) Main unit cover R and main unit cover L are fit together with a tab inside. To remove, unhook the tab and slide the covers in the directions of arrows.

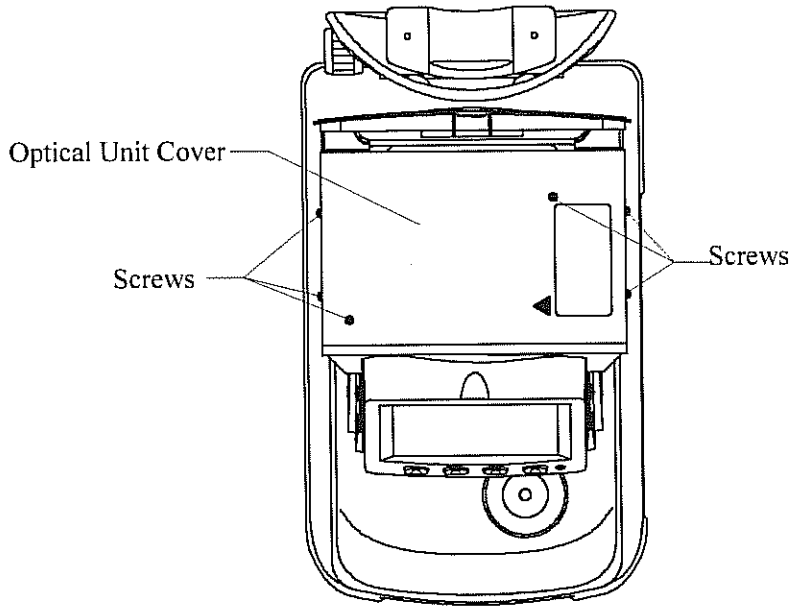


3) Rotate a view window ring in the direction indicated by an arrow to remove it with a view window filter. Unscrew two screws fixing a face cover to remove the face cover.
4) Unscrew four screws fixing a case-mounting plate and clamp to remove the case mounting plate.
5) Disconnect all harness connecting to the control board. Unscrew four screws and remove the control board.

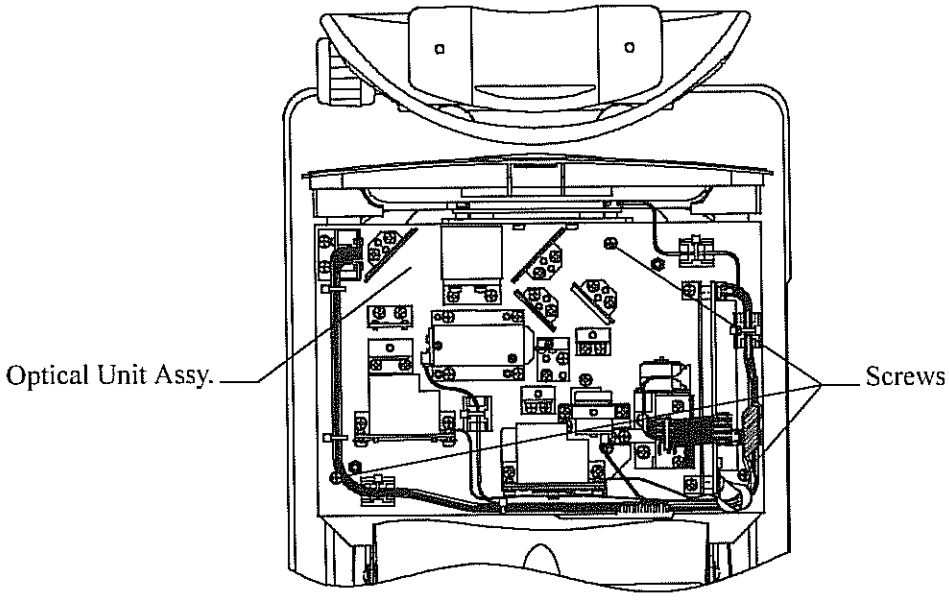


12-2 Optical Unit Assy.

1) Remove a main unit cover R and L, a view window ring and a view window filter. See 12-1.
2) Remove an optical unit cover, which is secured by six screws.



3) Disconnect a harness connecting to the optical unit assy.
4) Unscrew three screws fixing the optical unit assy to remove the assy. Avoid touching the optical parts inside the assy. You may cause out of adjustment which adversely affect the measurement accuracy.

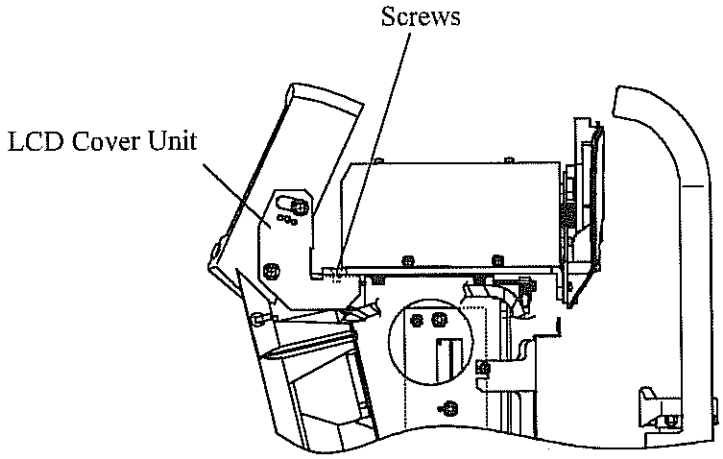


5) After replacing, measure the model eye to check the accuracy.

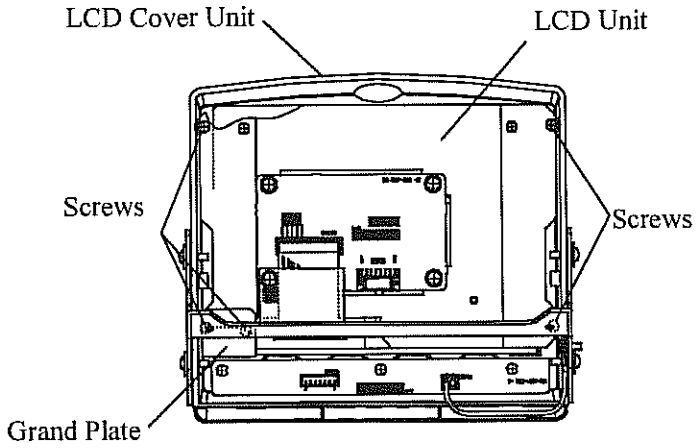
12-3 LCD Assy., Operation-Switch Board Assy. and LCD Cover Unit

1) Remove the main unit cover R and L. See 12-1.

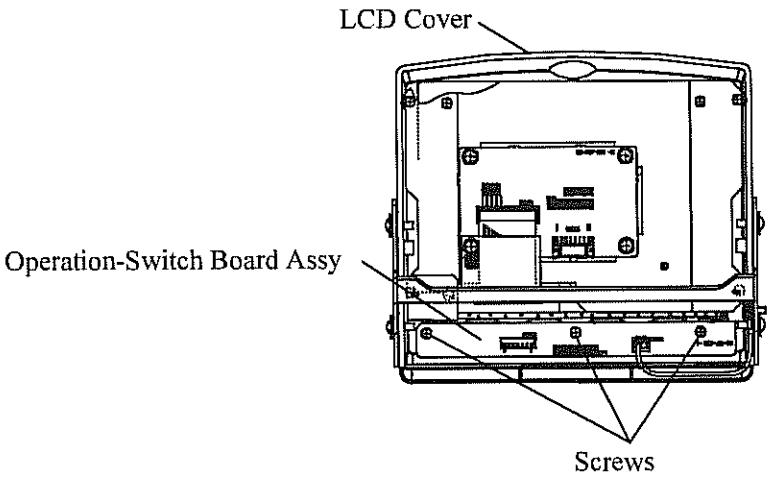
2) Unscrew two screws fixing LCD cover unit and disconnect the harness connected.



3) Unscrew five screws to replace the LCD unit.



4) For replacing the operation-switch board assy, unscrew three screws and disconnect the harness connected.

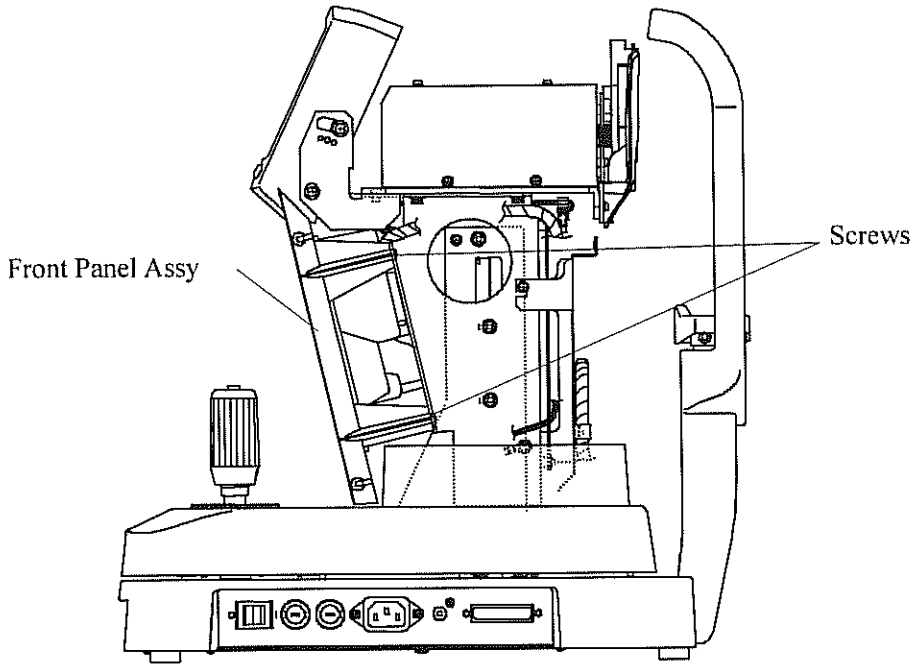


5) To replace the LCD cover unit, remove the LCD unit and the operation-switch board assy first following the procedure 3) and 4) above.

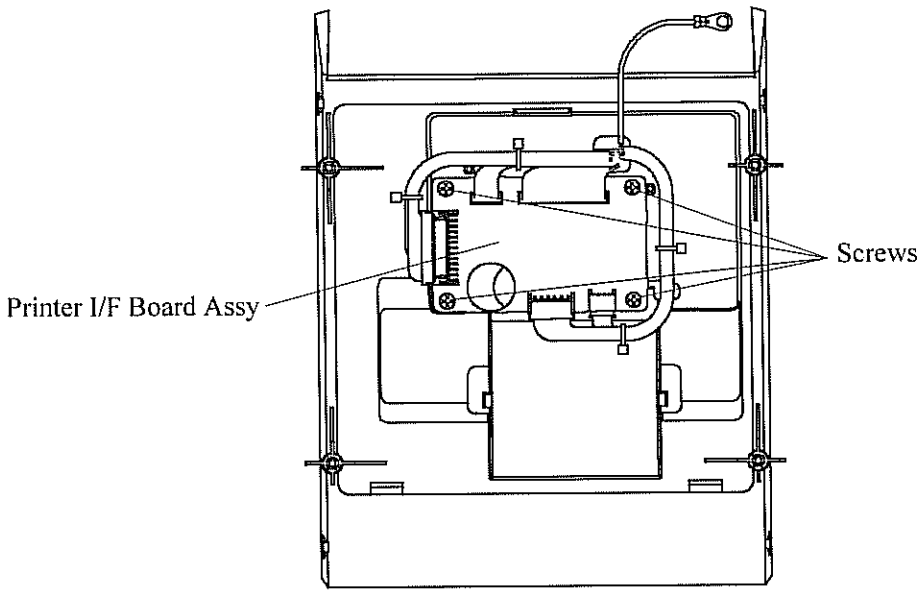
12-4 Printer I/F Board Assy and Printer

1) Remove the main unit cover R and L. See 12-1.

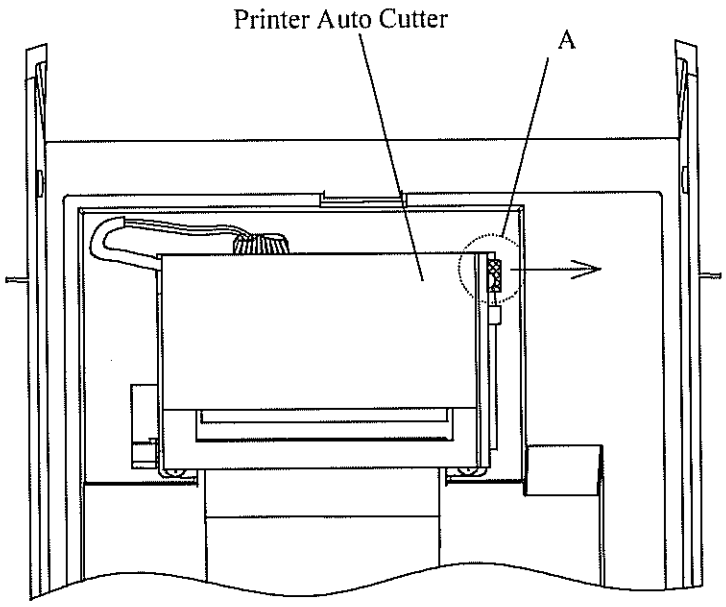
2) Unscrew four screws for the front panel assy and disconnect the harness.



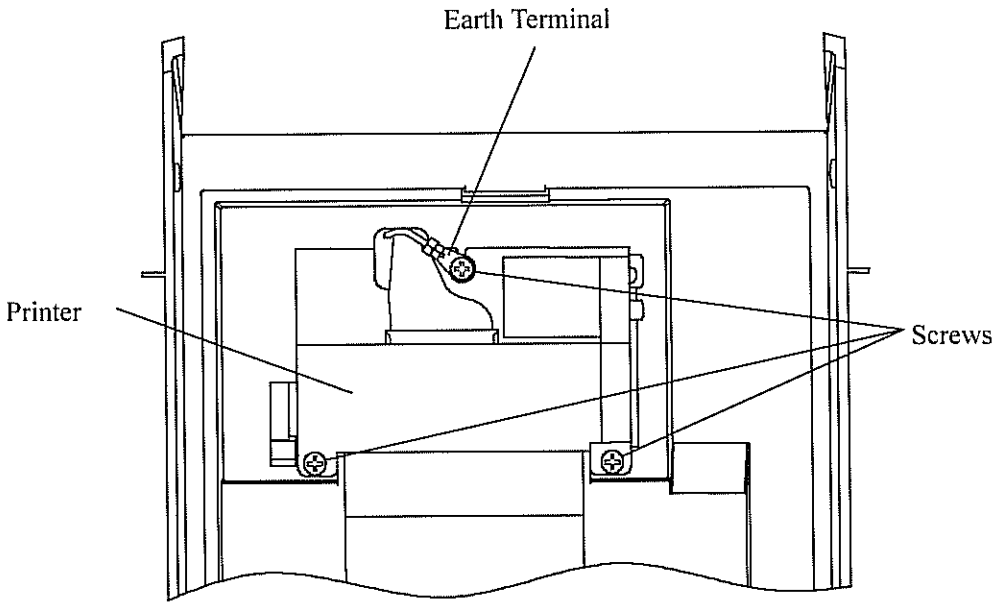
3) For replacement of the printer I/F board assy., unscrew four screws and disconnect the harness.



4) When replacing the printer, you need to remove the printer auto cutter first. Push out the metal sheet indicted by A so that you can unlock the lock. Raise the cutter to remove the printer.

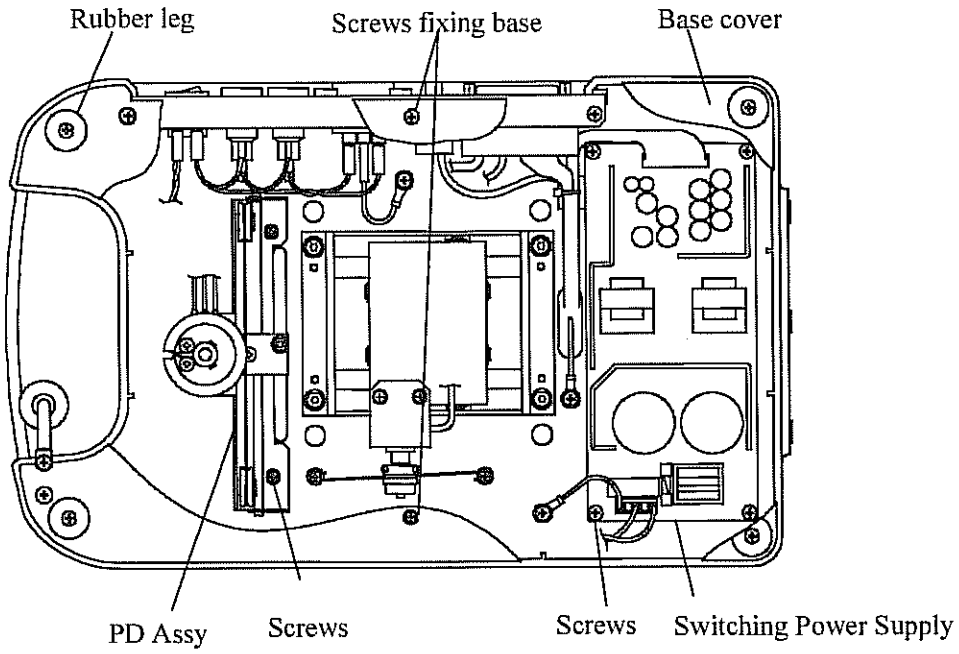


5) For printer, unscrew three screws indicated below and disconnect the harness connected. One of the screw is screwed with the earth terminal.



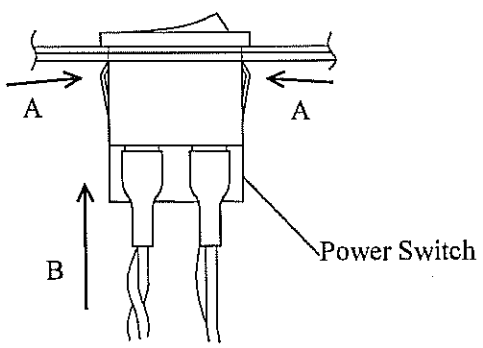
12-5 PD Assy and Switching Power Supply

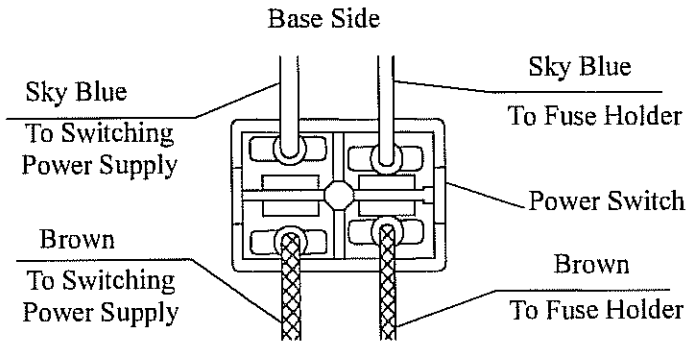
1) To remove the parts inside the base, you need to lock the anti-sliding lock and place the apparatus on its side. Gently put the apparatus into a sideways position on the cushion like a sponge so that you can see the base.
2) Next, remove the base. Unscrew four screws securing the rubber legs and two screws in the middle indicate below.
3) Unscrew the screws fixing the parts to be replaced (PD assy or a switching power supply) and disconnect the harness. Then, you can replace the parts.



12-6 Power Switch

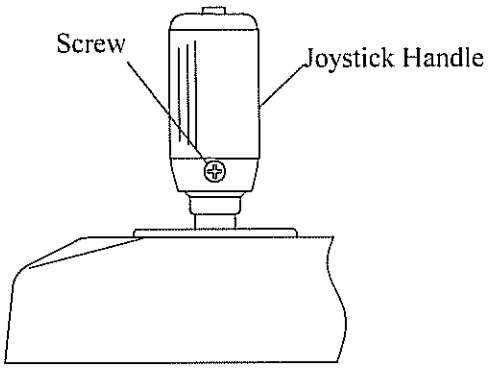
1) Remove the base cover. See 1) and 2) in 12-5.
2) Pinch the parts of a power switch indicated by A with a pair of long-nose pliers or the like, and then, push it out in the direction indicated by B.
3) Disconnect the harness connected to the power switch.
4) Insert the new power switch. Pay attention to the direction to insert the switch. After insertion, connect the harness you disconnected in 3).



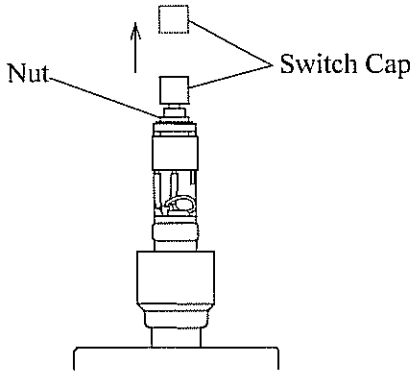


12-7 Measurement Switch

1) Unscrew a screw of a joystick indicated below. Pull the handle up to remove.



2) Pull a cap of the measurement switch to remove.
3) Remove the nut fixing the measurement switch to remove the switch.
4) Disconnect the harness connecting to the terminal of the switch. (Remember to remove a heat-shrinkable tube and the soldering.)



5) Install a new measurement switch and connect the harness disconnected in 4). (The harness is to be connected to the NO terminal and C terminal of the switch. Attach the heat-shrinkable tube.)
6) Reassemble the joystick handle to complete the replacement.

13 Individual Unit Check

13-1 Power Supply Unit

1. Fuse

* Unplug the power plug from the outlet.

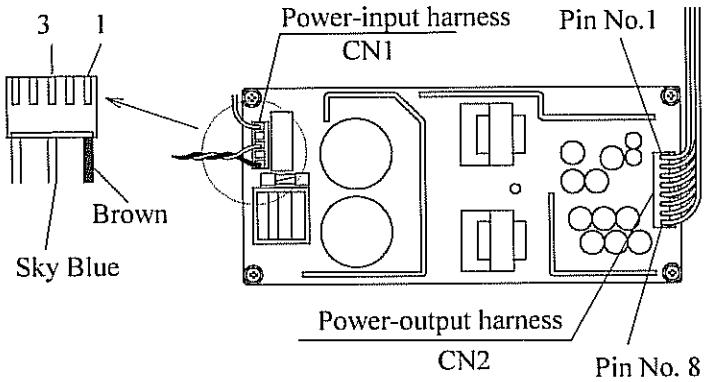
Pull out the fuse from the fuse holder to check the continuity.

Replace it to the specified fuse in case of no continuity.

2. Power Switch

* Unplug the power plug from the outlet.

1) Disconnect the power-input harness (CN1).
2) Short-circuit pin No. 1 to 3 of the power-input harness.
3) Connect the power cord to the power plug connector of the apparatus to check the continuity between both terminals. Switching the power switch on and off, check that there is continuity when the switch is on and no continuity when off.
4) Replace the power switch when you find any irregularity. (See 12-6.)



Switching Power Supply

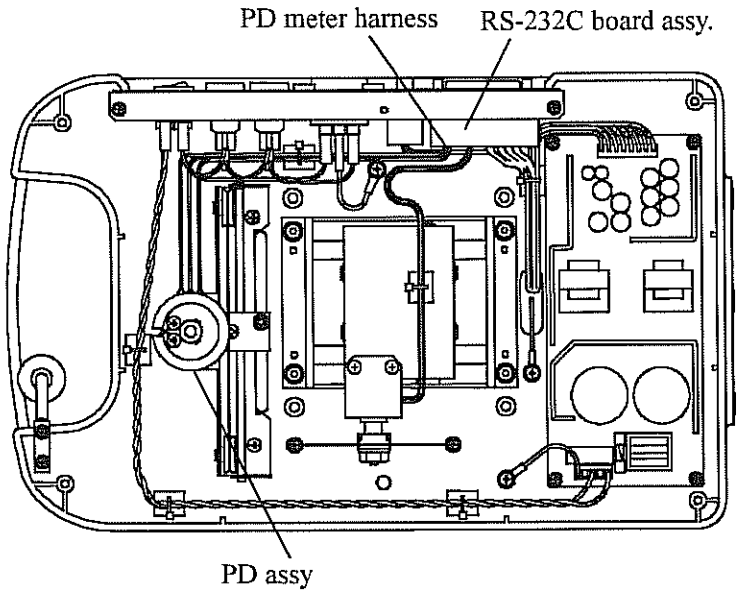
3. Power Supply Unit

1) Disconnect the power-output harness (CN2) from the switching power supply. Connect the power cord and turn the power on. (In case that the fuse is blown at this moment, the switching power supply is broken and need to be replaced.)
2) Check the output voltage of the switching power supply. When the output voltage does not meet the following, replacement is required.

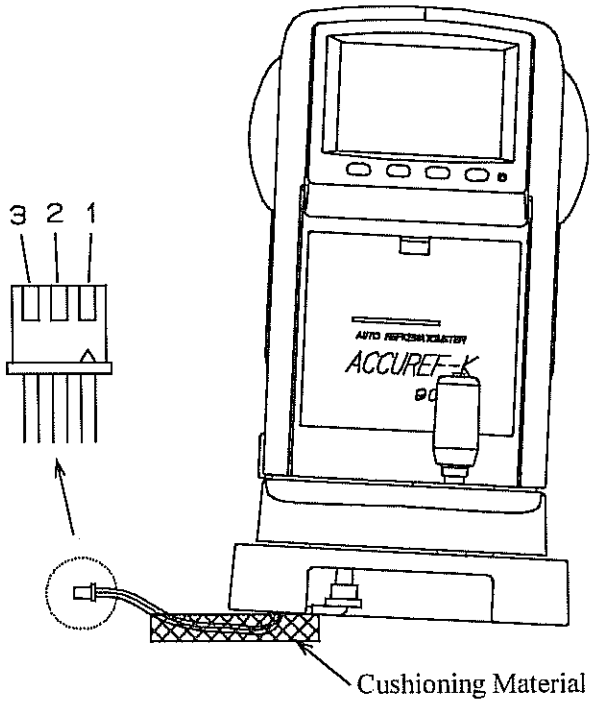
Pin No.		1	2	3	4	5	6	7	8
Voltage (V)	UL spec.	-12	0 (GND)	0 (GND)	+12	0 (GND)	0 (GND)	+5	+5
	Others	0							

13-2 PD Assy

1) Remove the base following 12-5.

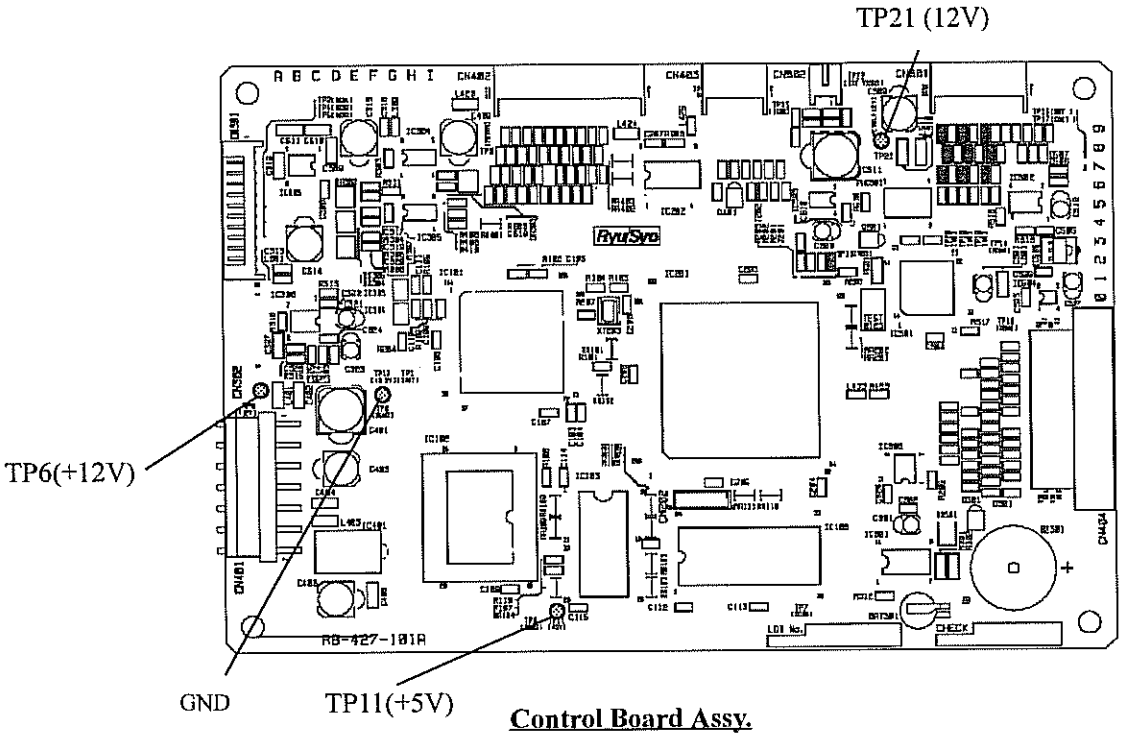


2) Disconnect the connector of PD meter harness from RS-232C Board Assy and pull it to the side as shown below.
3) Measure resistance between pins with a tester. When you measure the resistance between pin No. 1 and 3, it is acceptable if the result is 10 KΩ.
4) Next, measure the resistance between pin No. 1 and 2. Unlock the ant-sliding screw lock and shift the main unit from the right end of the operator to the left end. It is acceptable if the resistance varies gradually from 0 to 10KΩ.
   When you find any irregularity, replacement is required.



13-3 Control Board

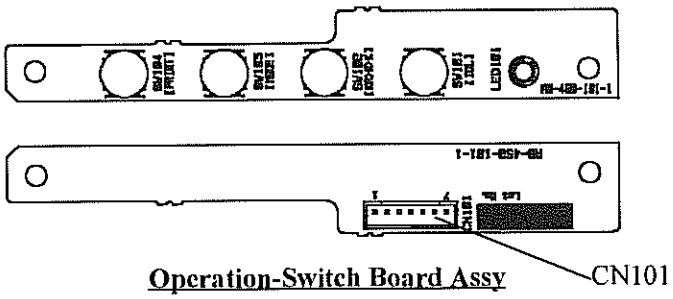
Indicated below are the positions and voltages of test points on the control board explained in Troubleshooting.



Control Board Assy.

13-4 Continuity of Operation Switches

Check the continuity of each operation switch at CN101. Confirm that there is continuity when the operation switch is turn on and no continuity when off. Replace it when you find any irregularities.



Operation-Switch Board Assy

Switch No.	Pin No. to be check (CN101)
SW101	4 - 5
SW102	3 - 5
SW103	2 - 5
SW104	1 - 5

13-5 Continuity of Measurement Switch

Check the continuity between measurement switch harnesses. Confirm that there is continuity when the operation switch is turned on and no continuity when off. Replace it when you find any irregularities.

13-6 Printer Auto Cutter

Check for a paper jam at an printer auto cutter. When you find the paper jam, remove the paper by hand. When you cannot remove the paper because the paper is jammed at the cutter part, remove the cutter from the main unit (see 12-4). Insert a Phillips screwdriver from a hole indicated by B below. Rotate a drive gear of the cutter part to remove the paper. (You can turn the gear in the either right or left direction.)