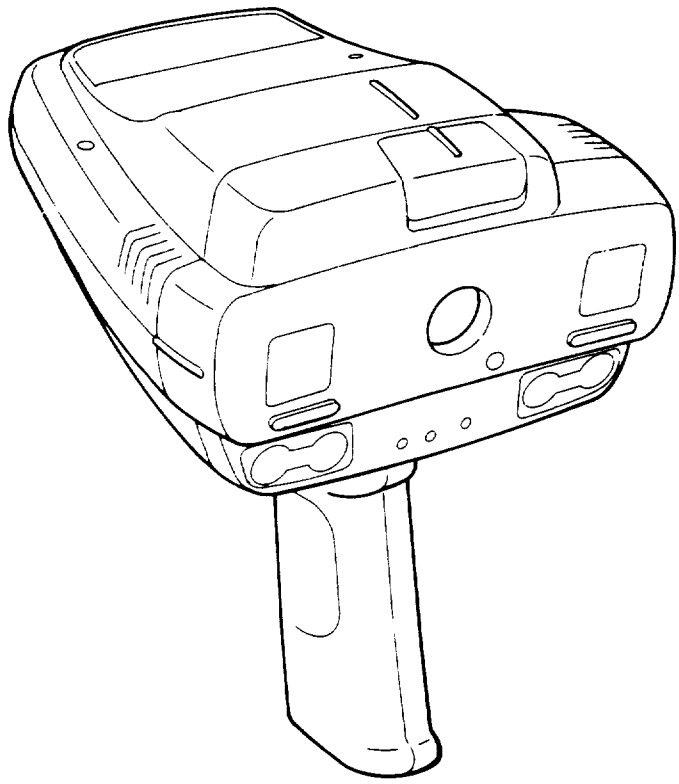
Nikon

Nikon Retinomax

Instructions



NIKON CORPORATION
TOKYO, JAPAN

Nikon Retinomax Operation Manual

Foreword

Thank you for purchasing Nikon Retinomax.

For proper operation ,prior to for quick reference using the Nikon Retinomax, read this operation manual be sure to use this instrument correctly. After reading, keep this manual in a convienitlfly located place to which you can easily access.

For simplicity, throughout this manual, the Retinomax measuring unit (measuring unit), the Retinomax printer, and the Retinomax station are referred to as the measuring unit, the printer, and the station respectively.

Table of Contents

1. Precautions for Operations

You must observe the following instructions. Nikon is not responsible for the impaired safety or reliability of this product due to your failure to follow the correct operating procedure.

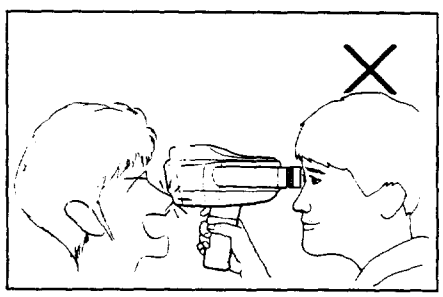
(a) Do not set this instrument up other than as specified in this manual.
(b) Nobody other than Nikon-qualified sales or service personel should adjust or repair this instrument.
(c) Use this instrument only according to the instructions specified in this manual. Do not perform any operations which is not described.

(1) Safety Precautions

1) Never disassemble this instrument (which contains hazardous high-voltage parts which can cause injury).

2) Do not drop the Retinomax. Use the accompanying strap when handling the measuring unit and printer. Do not drop on the Retinomax.

3) Take precaution that the measuring unit does not bump against the patient's face (when moving it toward the patient or in the right or left direction).



(2) Environmental Requirements

1) The best environment for operation is between approximately 10-30° C room temperature, and 70% or less humidity.

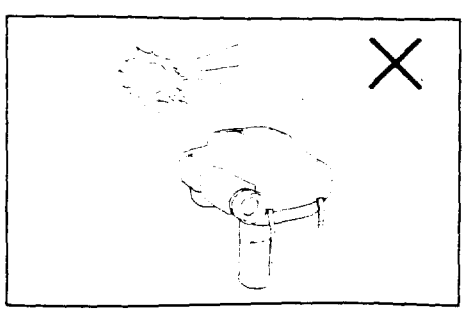
2) The Retinomax is not waterproof and therefore must not be placed in an environment where water (such as rainwater) may come in contact with the unit.

3) When dew forms on the instrument, do not use it until the dew evaporates.

4) The Retinomax is reasonably dustproof, but use it away from dust.

5) Put on the place where air the station and printer. And do not put a thick cloth or paper under the station and printer, because there raditate heat. in the charging case.

6) The best place for operation is in a dimly lit room. The measuring window should not be subject to bright, brightly light, because the measuring accuracy may be reduced.

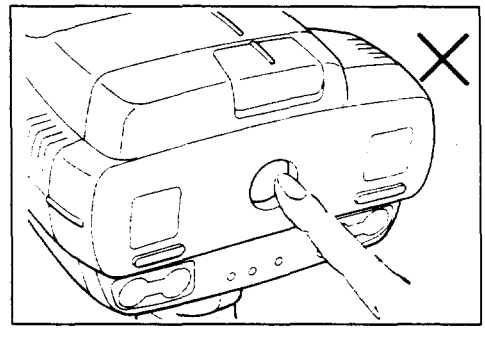


3) Handling Precautions

1) Do not hold any part other than the grips of the measuring unit (such as the view finder or forehead rest).
2) Handle the measuring unit with caution.
3) Do not unnecessarily swing the measuring unit.
4) Do not touch the contact points of the connectors or the charging terminals with your hand or metal. If the contact points are stained, became farrished turn the power switch off and wipe them with dry and a soft cloth.
5) Do not place the measuring unit or the printer near any magnetic object.
6) Hold the plug when disconnecting the power cable or the optional communication cable from the outlet or connector to not break or damage the cable.
7) Use only the Nikon-designated battery pack and optional AC adapter.
8) Never short-circuit the terninals the charging of the charging case. If you short-circuit the terninal will blow the fuses.

4) Maintenance

1) The measuring unit is a precision optical instrument. If the measuring window glass is smudged with grease from the patient's nose, finger prints or dust, accurate measured values will not be obtainable. Keep the measuring window glass clean.
When you clean the glass, be careful not to scratch or break it (see "(4) Cleaning the measuring window" in page 44).



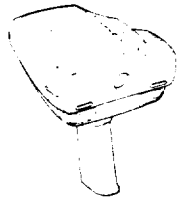
2) After operation, turn the power switch off and cover the instrument with the vinyl cover provided.

(5) Pre Cautions for the Battery Pack

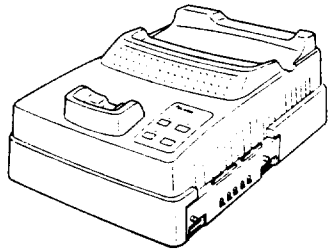
1) Use only the DURACELL nickel-hydrogen battery DR10 (manufactured by Duracell). Nikon will not assure proper operation if you use any other type of battery pack.
2) Never disassemble the battery pack.
3) Never short-circuit the battery pack terminal, because you may get burned by the generated heat. Take recaution so that any metal (such as a coin and clip) does not touch the terminal.
4) Charge the battery pack with the specified printer or station (if the battery pack is installed in the measuring unit).
5) Do not expose the battery pack to any source of excessive heat or flames, because it may explode, leak or cause a fire.
6) Do not leave the battery pack in an excessively hot place (such as inside a car).
7) Not using the measuring unit or printer , remove battery.
8) If the metal terminal of the battery pack is tarnished, wipe it with a dry and soft cloth.
9) Do not jar or drop the battery pack.

2. Package Contents

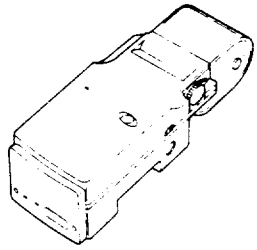
When opening the package, make sure that all the following items are included.



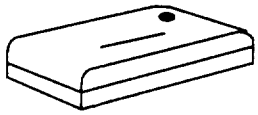
Measuring unit (1)



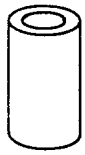
Station (1)



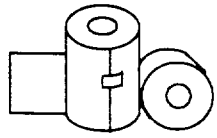
Printer (1)



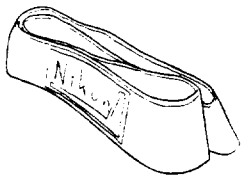
Battery pack (1)



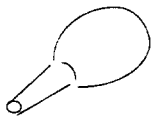
Model eye (1)



Print paper roll (3)



Strap (1)



Blower (1)

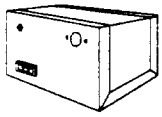
Power cable set (1)

Fuse (2)

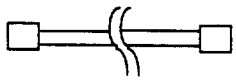
Vinyl cover (1)

Operation manual(1)

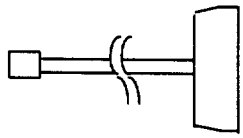
Options



AC adapter (1)



DC cord (1)



Communication cable (1)

Carrying case (1)

3. Nomenclature

Measuring unit (Patient side)

Front

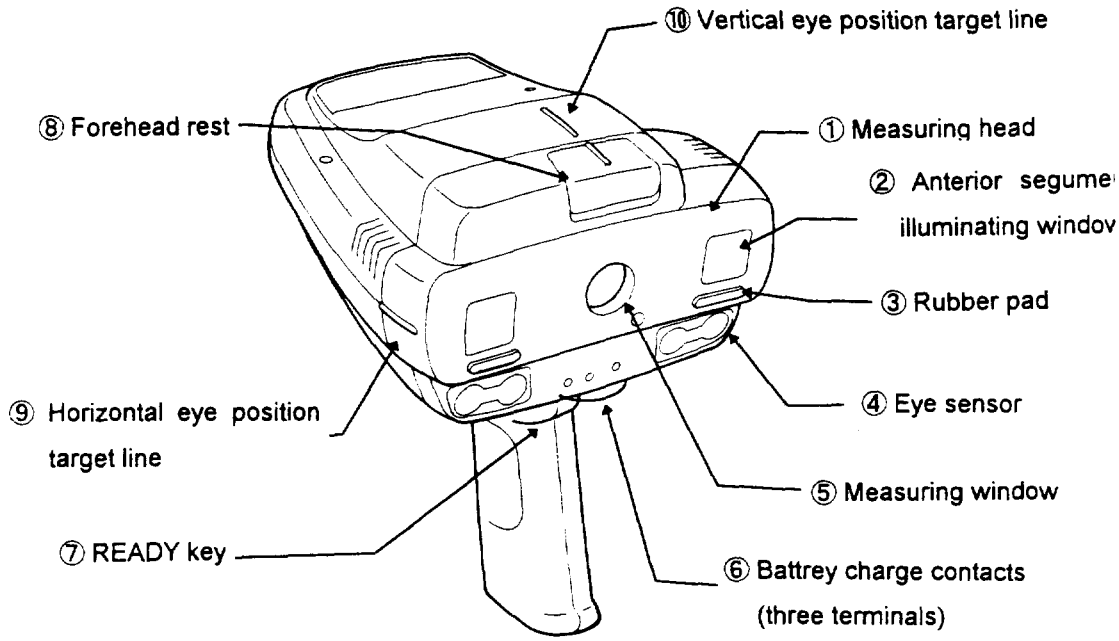


Figure 3-1

① Measuring head ..... Incorporates the measuring mechanism.

② Anterior segment illuminating window ..... Lights the anterior segment.

③ Rubber pad ..... Shock absorbing rubber, this cushion is used when placing the measuring unit on the station.

④ Eye sensor ..... Automatically identifies the patient's right and left eyes by using ultrasonic waves.

⑤ Measuring window ... The patient looks at the target (see Figure 6-4 in page 23) through this window.

⑥ Battery charge contacts (three terminals) ..... Connected with the charging contact of the station (see page 10) to charge the battery pack (see page 16).

⑦ READY key ..... Starts and ends measurement (see page 23).

⑧ Forehead rest ..... Pressed against the patient's forehead to stabilize the measuring unit (see page 29).

⑨ Vertical eye position target line ..... Align with the patient's eye to determine the correct height (see page 24).

⑩ Horizontal eye position target line ..... Align with the patient's eye to determine the correct horizontal position (see page 24).

Measuring unit (Operator side)

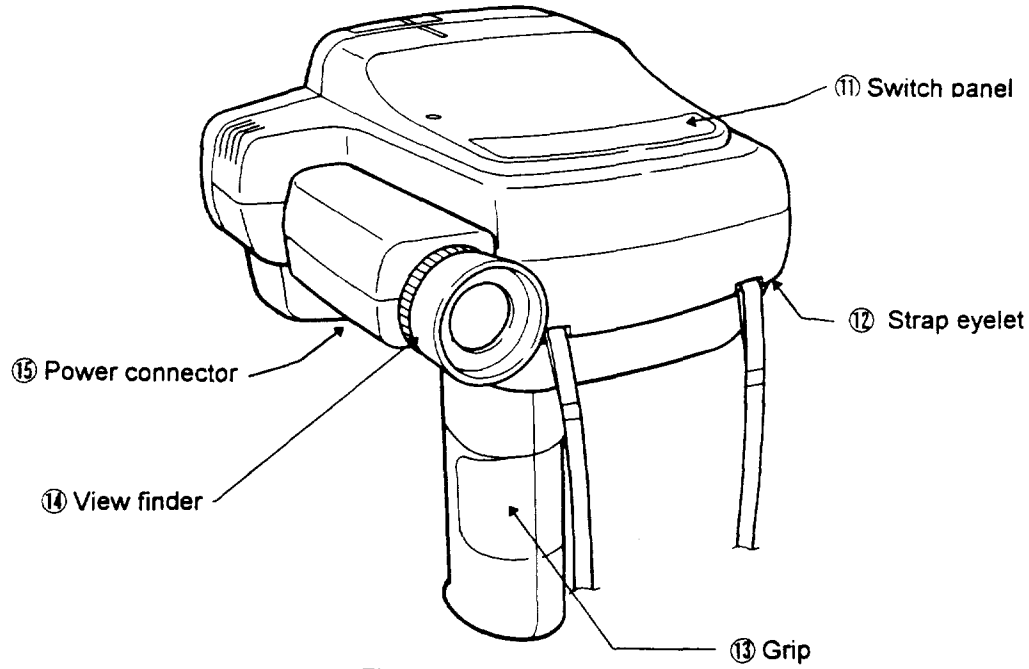


Figure 3-2

⑪ Switch panel ..... See "Measuring unit Switch Panel" in page 9 and "Measurement Method" in page 22.

⑫ Strap eyelet ..... Attach the strap through this eyelet (see page 13).

⑬ Grip ..... Hold this grip with your hand to handle when using the measuring unit.

⑭ View finder ..... Look at the patient's eye through this view finder for measurement alignment.

⑮ Power connector.... Connect an optional AC adapter with this connector to supply power to the measuring unit from an outlet.

Measuring Unit Switch Panel

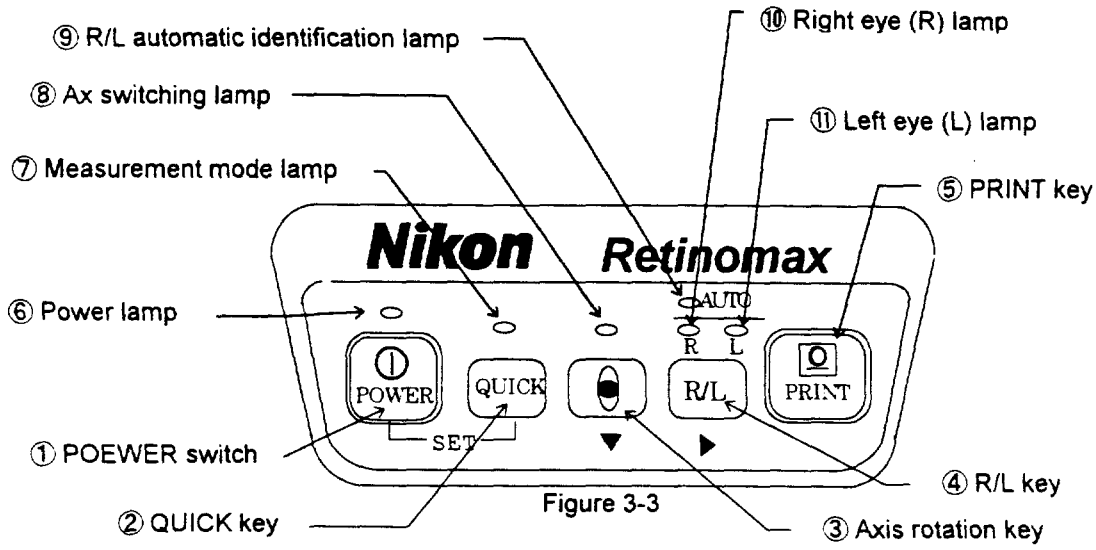


Figure 3-3

① POWER switch ..... Sets the power ON and OFF of the measuring unit.

② QUICK key ..... Allows you to enter Quick mode (see page 28).

③ Axis rotation key..... Turns the measuring unit by 45˚ , 90˚ or 135˚ . Automatically compensates for the Ax (cylindrical axis) by 45˚ , 90˚ or 135˚ (see page 28).

④ R/L key.....Sets the right and left eyes identification between automatic and manual mode. In the manual mode, you selects the patient's right and left eyes manually (see page 27).

⑤ PRINT key..... Sends data to the printer (see page 31).

⑥ Power lamp..... Indicates the units power status.
ON : Lit OFF : Dark

⑦ Measurement mode lamp ..... Indicates the measurement mode.
In quick mode : Lit, In normal mode : Dark

⑧ Ax switching lamp....Indicates the Ax compensation mode.
In Ax compensation : Lit, In no compensation : Dark.

⑨ R/L automatic identification lamp ... Indicates R/L automatic identification mode.
In Automatic mode : Lit, In manual mode : Dark.

⑩ Right eye (R) lamp ..Indicates the Right eye measurement..
In Right eye measurement mode : Lit, In Left eye measurement mode : Dark

⑪ Left eye (L) lamp .... Indicates the Left eye measurement.
In Left eye measurement mode : Lit, In Right eye measurement mode : Dark

Station

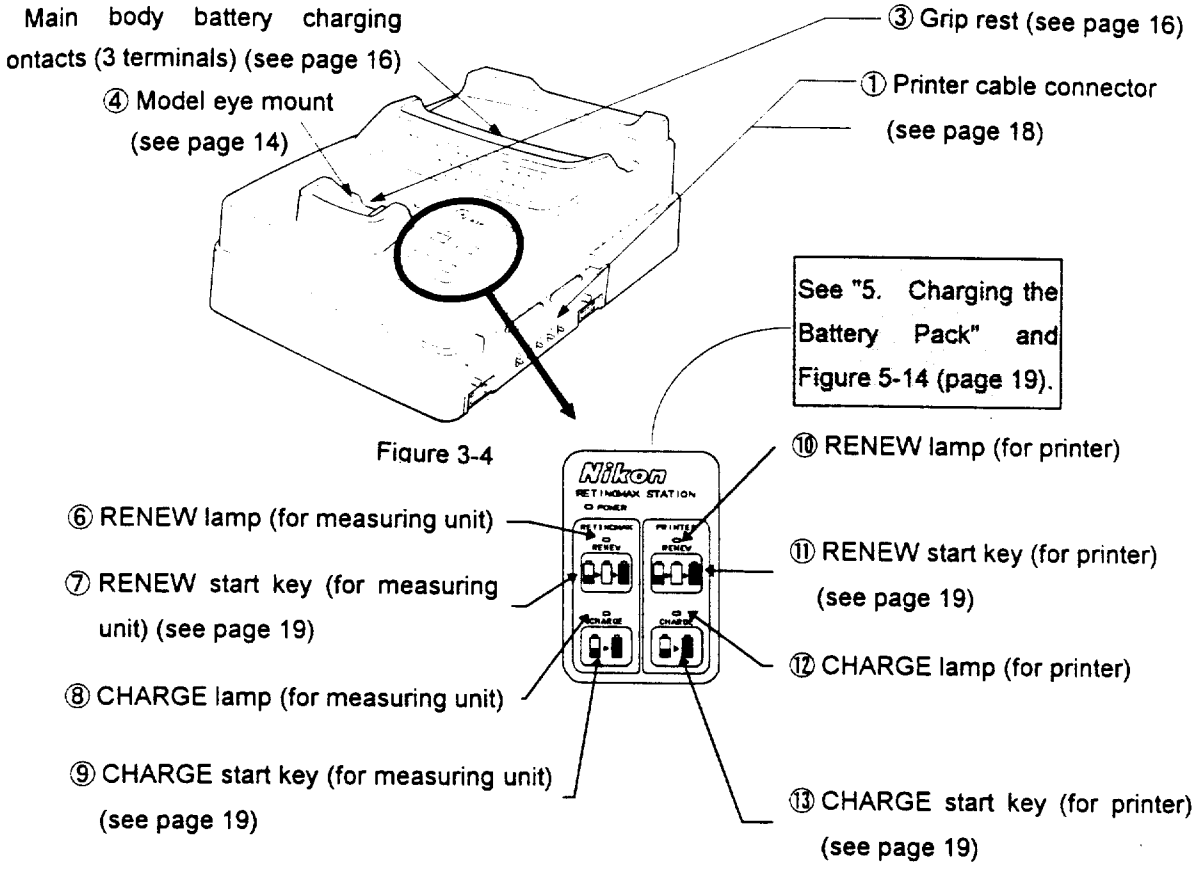


Figure 3-4

Station rear view

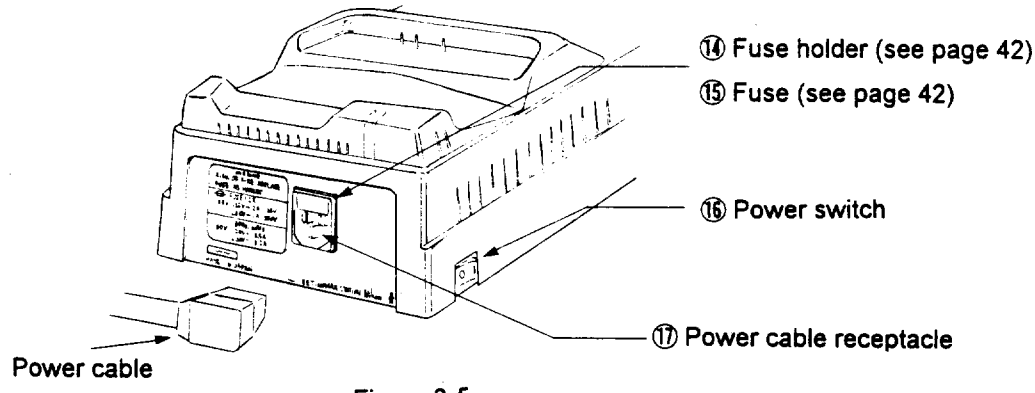


Figure 3-5

Printer

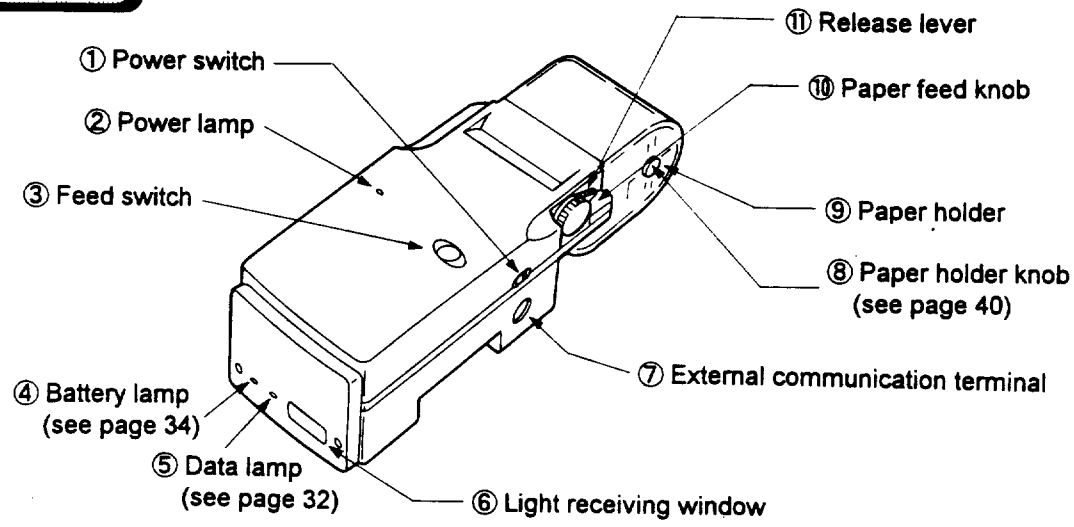


Figure 3-6

Printer bottom view

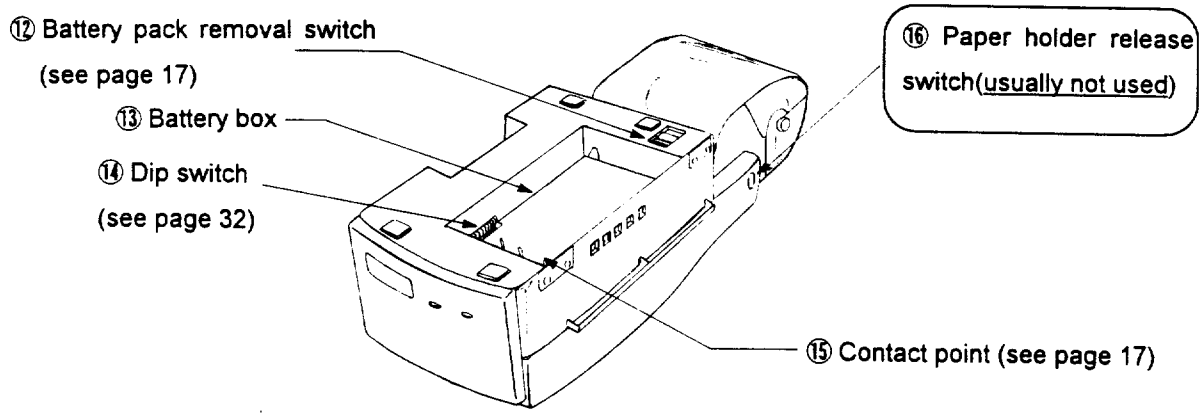


Figure 3-7

Retinomax System Configuration

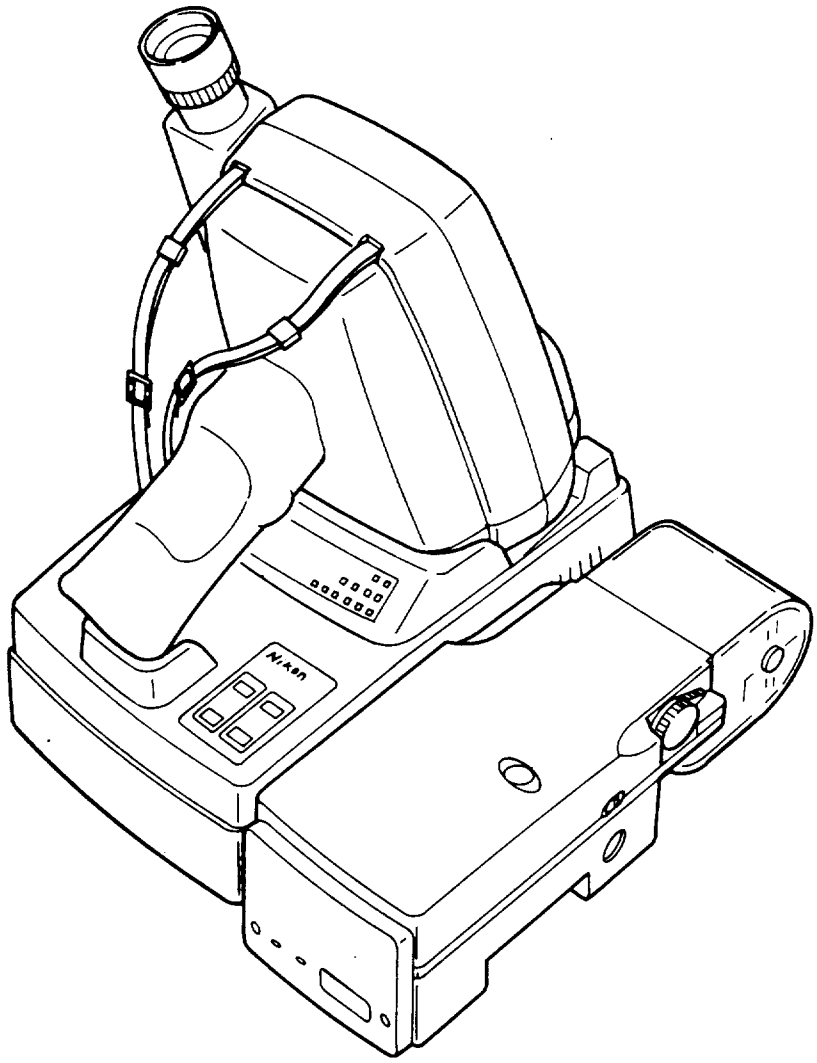


Figure 3-8

4. Preparation

(1) Attach the strap to the measuring unit.
(see Figure 4-1)

(2) Connect the power cable to the power cable receptacle located on the station.

(3) Make sure that the station power switch is set to OFF, and plug the power cable into a wall outlet (AC100 V).

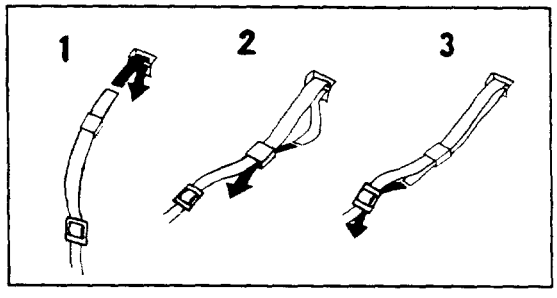


Figure 4-1

(4) Turn the stations power switch on.
The power lamp will illuminate.

(5) Install the battery pack in the measuring unit.
→ See "5. Charging the Battery Pack"
(Figures 5-1, 5-2 and 5-3 in page 15).

(6) Charge the battery about 90 minutes by placing the measuring unit on the station.
→ See "5. Charging the Battery Pack"
(page 16).
* A new battery pack is fully discharged and must be charged about 90 minutes before initial use.
** When a new battery pack is installed or after the unit has not been for a long time, it will require the battery to charged/discharged a few times in order to permit the battery to hold a proper charge for use.

When you charge your battery for the first time you may get an indication of charging complete after just 10 to 15 minutes. This is normal and can happen with all rechargeable batteries when first charged.

↓

Push the CHARGE key. If the CHARGE lamp is not illuminate, repeat the pushing the CHARGE key.

(7) Install the print on paper roll.
→ See "8. Maintenance" (page 41).

(8) Connect the printer with the station.
(see Figure 5-10 in page 18)

(9) Turn the printer power switch on.
* When the printer is connected with the station, it cannot be used unless the station is ON.

(10) Remove the measuring unit from the station, and turn the measuring unit on.

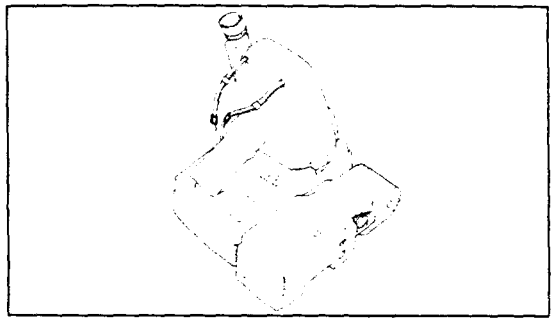


Figure 4-2

(11) Complete various settings.
→ See "7. Initial Settings (SETUP)" (page 36).

(12) Measure the modelege which was provided with the unit. Make sure that the model eye and measuring window are clean. If they are tarnished, carefully, clean them referring to sections "(4) Cleaning the measuring window" and "(5) Model eye" (page 44) in "8. Maintenance".

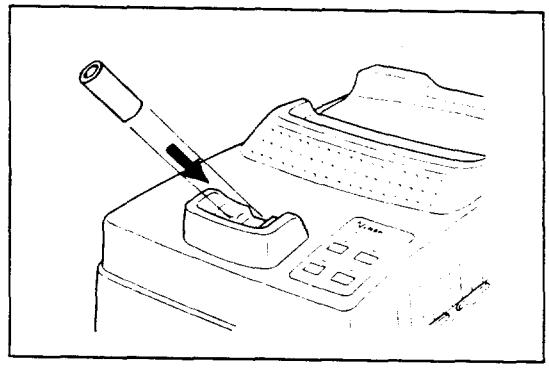


Figure 4-3

① Place the model eye on the model eye mount on the station (see Figure 4-3).

② Refer "6. Measurement Method" (page 22) for measuring the model eye .

③ The measured values must be within the following range:

SPH +4D - +5.5D (CYL is 0)

(CYL. Power should be set to 0 dioptors. Otherwise, the measurment will vary from -0.25 ~ +0.25 dioptors. This is a normal variance.)

If the measured value is out of the range, make sure that the measurement was correct performed correctly and do the measurement again (see "6. Measurement Method" (page 22).

When measuring the model eye, keep it in a stable position (for example, place your elbow on the table) to accurately use the measuring unit.

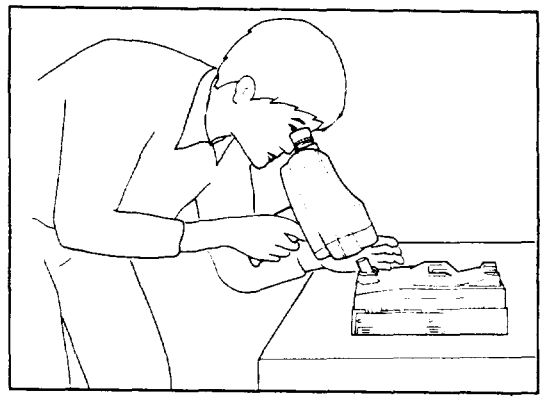


Figure 4-4

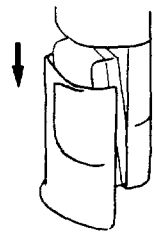
(13) Clean the forehead rest by using ethyl alcohol or other cleaning liquid.

5. Charging the Battery Pack

(1) Automatic charging of the measuring units battery pack

1) Replacing the battery pack

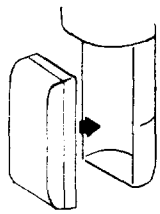
1



Open battery pack cover located near the grip.

Figure 5-1

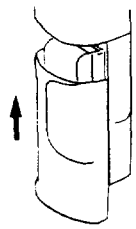
2



Replace the battery pack with a new one.

Figure 5-2

3



Fit the battery pack cover as shown in the figure 5-3.

Figure 5-3

Note: When installing a charged battery, align the green seal on the battery pack with the figure in the measuring units handle, as shown in the figure 5-4.

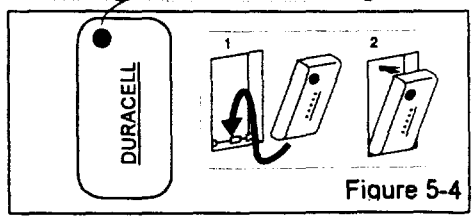
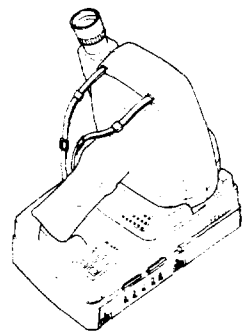


Figure 5-4

2) Automatic charging

1 Turn the station power switch on.

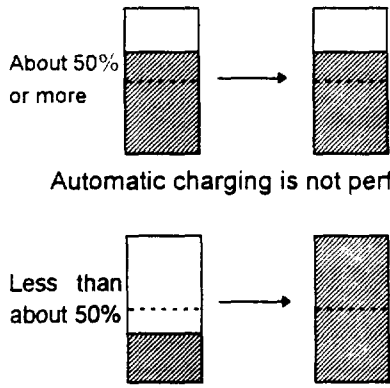
2 Place the measuring unit on the station.



Becuse of the battery charge contacts of the measuring unit and the station to each other don't touch, the measuring unit just fit on the station.

Figure 5-5

3 The station checks the voltage of the battery and starts charging automatically.



When the charging is started, the CHARGE lamp for the measuring unit is illuminated.

However, when the battery capacity is 50% or more , it will not be charged and the CHARGE lamp remains off to ensure a long life of the battery pack. When the battery capacity is less than 50%, it will be charged to the maximum capacity (charging requires about 90 minutes).

Figure 5-6

4 When charging is complete, the CHARGE lamp for the measuring unit goes off.

The charger will turn on automatically when the battery has less than half a charge. If the battery is at more than 50% of its charge and you would like to charge it futher, you must press the charge, button again.

* This value will change when the battery life has decreased its capacity according to the number of charge/discharge cycles.

Note: The battery is not always full charge. To make it full charge, use the CHARGE or RENEW key.

See "(3) Renewing the battery pack" in page 19 and "(4) Forced charging" in page 20.

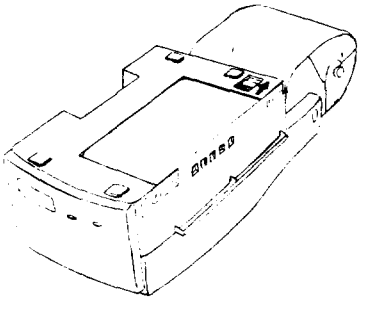
(2) Automatic charging of the printer battery pack

The printer can be operated with an optional battery pack (of the same type is used for th measuring unit). It is located and installed in the printer battery box. The battery charge i performed in the printers battery box.

Remark: No battery pack is provided for the printer. You must purchase an additiona battery pack for battery operation. The printers battery pack is the same type use for the measuring unit.

1) Replacing the battery pack

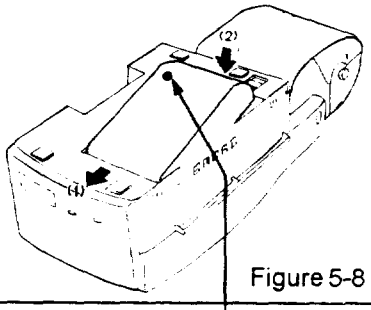
1



Place the printing unit on its side. Then slide the battery release button upward to pop the battery outward for removal.

Figure 5-7

2



Remove the battery pack and install the new one as shown in the figure 5-8. Ensuring the correct orientation of the battery pack, first slide the side of the battery pack (1) into the battery box and then push down the side (2) until it clicks shot.

Figure 5-8

When installing a battery pack, you must align the green seal on the battery pack with the green seal on the charging unit.

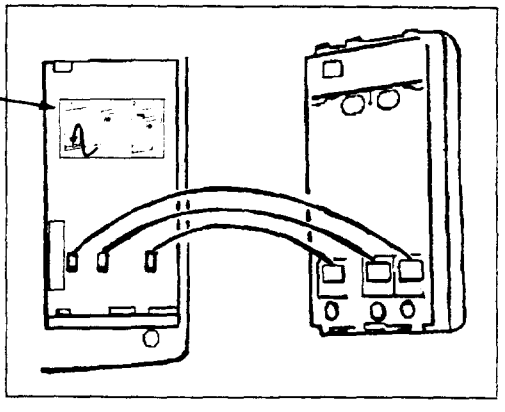


Figure 5-9

Note: Install the battery pack with, the contact point positioned as shown in the figure 5-9.

2) **Automatic charging**

1 Turn the printer power switch on.

2 Connect the printer with the station as shown in the figure 5-10.

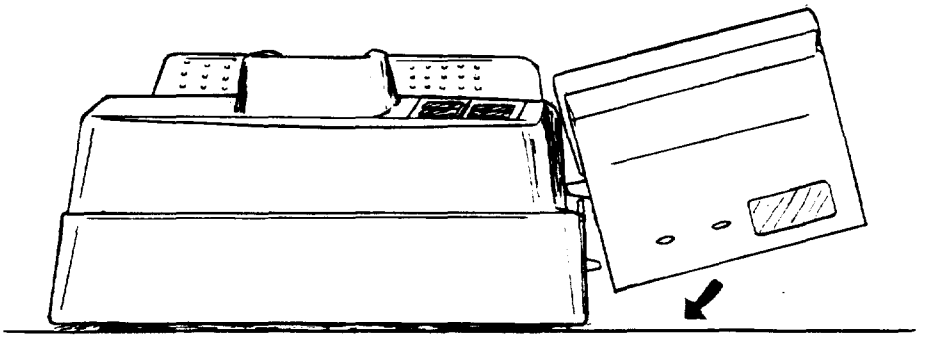
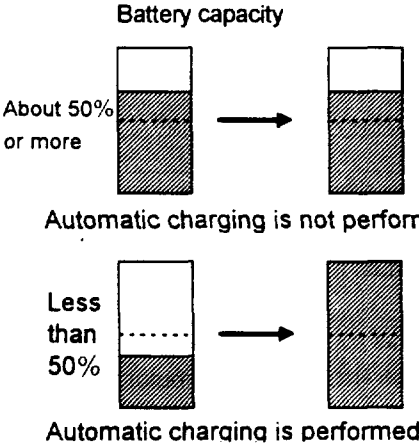


Figure 5-10

3 The station starts to charge the battery pack in the printer automatically.



When charging is started, the CHARGE lamp for the printer will be illuminated.

However, when the battery capacity is 50% or more, it will not be charged and the CHARGE lamp will remains off to ensure a long life of the battery pack.

When the battery capacity is less than 50% , it will be charged to its maximum capacity (charging requires about 90 minutes maximum).

Figure 5-11

4 When charging is complete, the CHARGE lamp for the printer goes off.

The charger will turn on automatically when the battery has less than half a charge. If the battery is at more than 50% of its charge and you would like to charge it futher, you must press the charge, button again.

* This value will change when the battery life has decreased its capacity according to the number of charge/discharge cycles.

Note: The battery is not always full charge. To make it full charge, use the CHARGE or RENEW key.

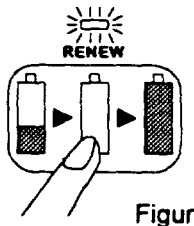
See "(3) Renewing the battery pack" in page 19 and "(4) Forced charging" in page 20.

(3) Renewing the battery pack

The batteries performance will be slightly affected from frequent charge / discharge cycles. (Which is called □memory-effect□.)
A long life of the battery pack is ensured by fully discharging and recharging it. This type of charging is called Renewing.

To renew the battery pack, use perform the following procedure:

1



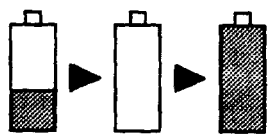
Press the RENEW key for a second or more.

The RENEW lamp is will illuminate.

Figure 5-12

To renew the battery pack for the measuring unit, press the RENEW key for the measuring unit. For the printer, press the RENEW key for the printer.

2 The battery pack starts full-discharge cycle and then recharges fully.



Discharging Charging

Renewing a battery pack requires about four and one-half hours maximum time, which may vary depending on the batteries capacity.

Figure 5-13

3 When the charging is complete, the RENEW lamp will go off.

If you press the CHARGE key during renewing, the battery is forcedly charged.
If you do not want to charge the unit after placing it on the station, you must press and hold the RENEW key for more than one second. Or you must remove the retinomax and/or printer from the station entirely.
If a battery will not recovered by renewing, it is has run down and will no longer hold a charge. Purchase a new battery pack from your local Nikon Retinomax distributor.

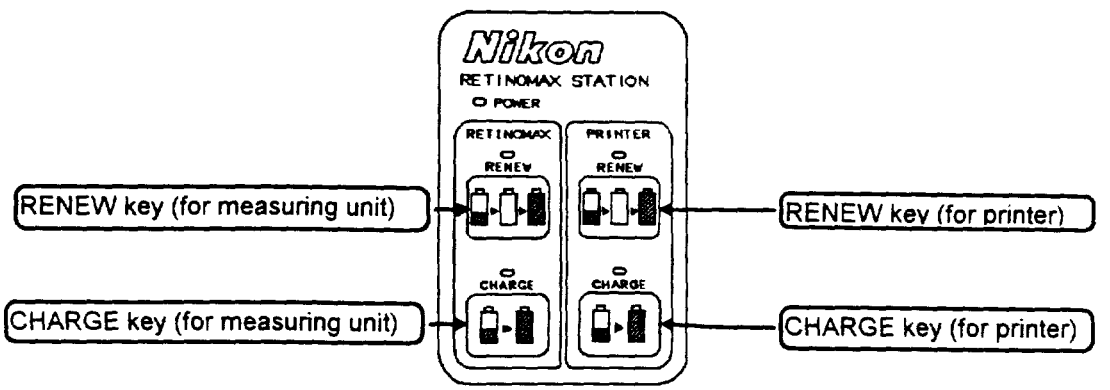
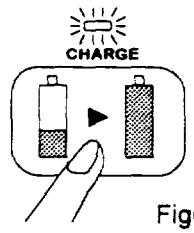


Figure 5-14

(4) Forced charging

When charging the battery pack forcedly regardless of the current capacity perform the following procedure:

1

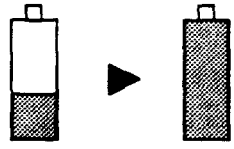


Press the CHARGE key.
The CHARGE lamp is illuminated and the battery pack starts charging.

Figure 5-15

To charge the battery pack for the measuring unit, press the CHARGE key for the measuring unit. For the printer, press the CHARGE key for the printer.

2 The battery pack is forcedly charged.



Charging Figure 5-16

3 When charging is complete, the CHARGE lamp goes off.

If a battery pack is repeatedly charged, not only will its life be shortened but also the battery pack's memory feature reduces the capacity. We recommend that you renew the battery at one week intervals.

Battery life will shorten due to the memory effect. The battery life will last longer if frequently renewed after use.

The charger automatically stops when the retinomax or printer is removed from the station.

(5) Charging the optional spare battery pack

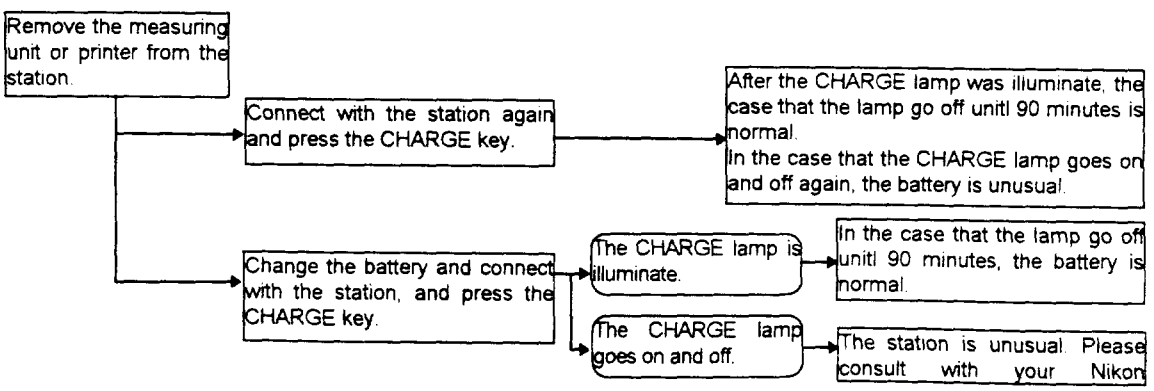
1) Install the spare battery pack in the printer battery box by following the procedure described in "(2) Automatic charging of the printer battery pack", "1) Replacing the battery pack".
2) Charge the spare battery pack in the same way as charging the printer battery pack.
3) After the charging is complete, remove the spare battery pack.

Important : Before using the battery pack, read the operation manual thoroughly which was provided with the unit.

Note : Use only the DURACELL DR10 battery.

(6) Advise and confirmation

1) If is normal for the battery to become warm after use or charging.
2) When the charging is started, the measuring unit and printer were used for 30 minutes or were charged before 3 hours.
3) After renewing or charging, in the case that the measuring unit or printer has catched the station for 2 hours and press the RENEW or CHARGE key, these key is not able to set in once. This case is not unusual, becuase of the avoiding the over charging.
4) The case that for charging or renewing, the CHAGE or RENEW lamp goes on and off, there may unusual. Do the next way.



5) The measuring and printer can use remove the station before completing the charging.

6. Measurement Method

(1) Measurement

Complete the steps (2) through (10), as well as (11) through (13) if necessary, that are described in "4. Preparation" in page 13.

When you turn the Retinomax on, the opening screen appears (Figure 6-1). After a few seconds, the standby screen will appears (Figure 6-2) indicating that the Retinomax has entered the standby mode.

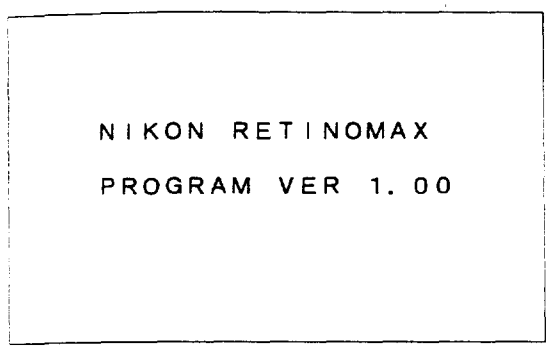


Figure 6-1 Sample Standby Screen

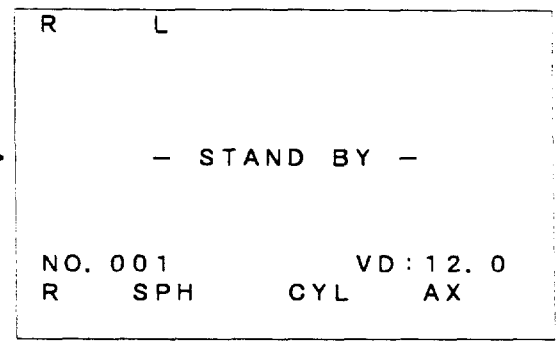


Figure 6-2 Sample Standby Screen

Measurement Screen

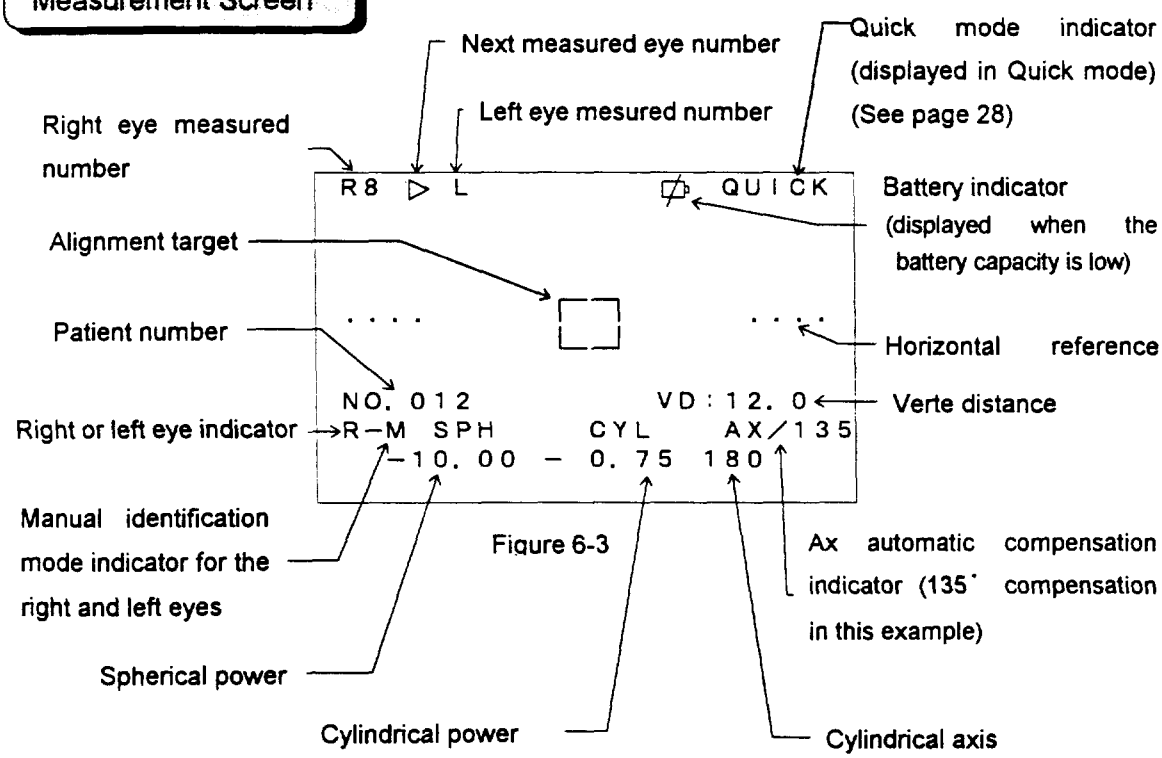


Figure 6-3

1) **Before measurement**

① Most patients will be a little nervous, so try to relax them by explaining the measurement process in detail.

② Briefly explain the units operation and purpose to the patient:

- "This machine gives the doctor starting point for the correct spectacle lense power for your eyes."
- "You will see a green field with a Christmas tree in the center. Please look at the tree with your eye in a relaxed manner."
- Try to keep your eye open as long as possible."

Figure 6-4 Target Seen by the Patient

Note: In a measurement with 90˚ rotation or from the patient's vertex, the patient will see the picture rotated by 90˚ or 180˚ respectively. In a measurement with 45˚ or 135˚ rotation, the patient see the picture inclined.

2) **Measurement procedure**

① Show the patient where to sit. Ask the patient to rest both the hands on their lap to relax him or her.

② Press the Ready key on the measuring unit to enter the measurement mode (see Figure 6-5).

In the measurement mode, when the alignment has been completed, the Retinomax will automatically start measurement. Measurement cycles are taken in the measurement mode continuously.

Pressing the Ready key halts the temporarily measurement mode, and however pressing the Ready key again returns to the measurement mode for continued operation.

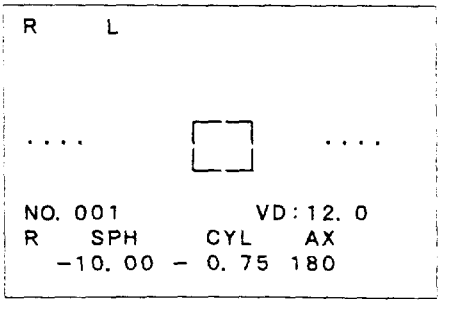


Figure 6-5 Sample Screen During Measurement

Note: Do not hold down the Ready key.

③ Rough alignment of the patient's eye (see Figure 6-6).

- Vertical: Align the patient's eye parrallel with the target line located on the side of the measuring unit.
- Horizontal: Align the patient's eye parrallel with the target line located on the top of the measuring unit.
- working distance: Position the patient's eye about 40 mm away from Maxs in body.

Placing your other hand as shown in figure 6-7 on the units main body will stabilize the measurement procedure.

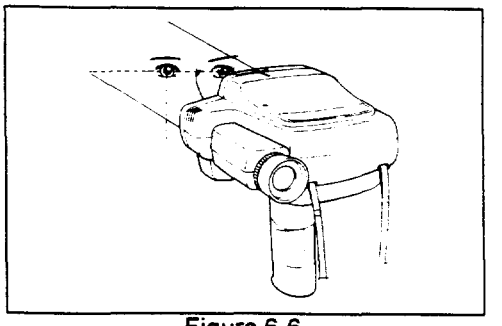


Figure 6-6

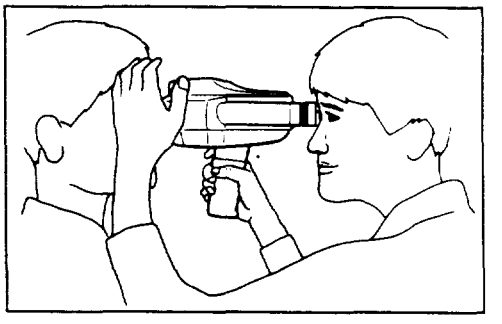


Figure 6-7

④ In the measurement mode, with the patient's eye roughly aligned, look through the view finder.

When you see the patient's eye on the screen, position the pupil image towards the center (see Figure 6-8).

Fine focus the dot by moving the measuring unit back and forth until the light spot becomes as small as possible.

When bringing the measuring unit close to the patient's eye, it will automatically identify the right and left eyes.

The eye being measured whether right or left will be indicated in the screen as shown in the figure on the right.

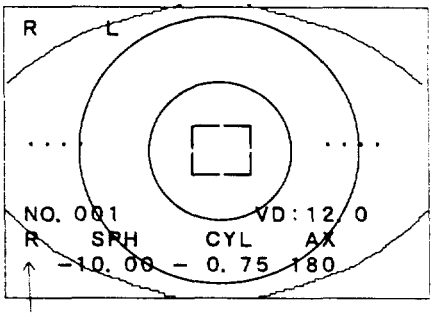


Figure 6-8

⑤ When the alignment process is complete, the measurement is automatically started. Every time a measurement cycle is done, a beep sounds. During measurement to reduce accommodate, the automatic fogging function slightly blurs the target (see page 26). If you would like to disable the automatic fogging function, simply press the QUICK key to enter the Quick mode (see page 28).

⑥ Measured values are displayed directly on the screen (see Figure 6-9).

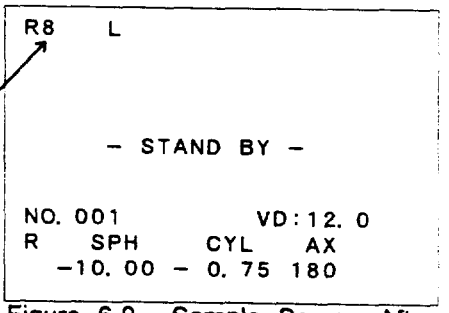


Figure 6-9 Sample Screen After Measurement

⑦ Take at least five measurements for each eye. If the eye movement of patient is unstable or the measurement values vary, take additional measurements.

The measurement values of the last eight measurement cycles for each eye will be used to calculate the measurement.

⑧ After measuring one of the patient's eyes, measure the other in the same way.

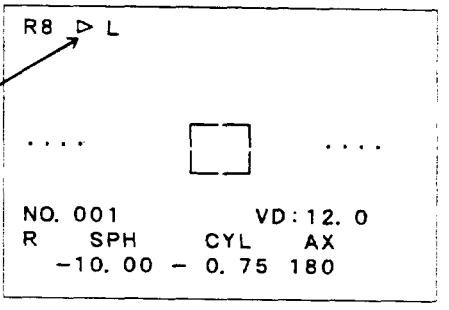


Figure 6-10 Sample Next Measured Eye Indicator

The indicator "▷" appears in the view finder showing which eye should be measured next (see Figure 6-10).

Remark: When a specified number of measurement cycles are complete, the Next measured eye indicator in the figure 6-10 will be displayed.

(Figure 6-10 illustrates the screen when the number of measurement cycles has been set to ON For details, see page 36.)

⑨ Aim the front of the measuring unit toward the printer and press the PRINT key (see page 31).

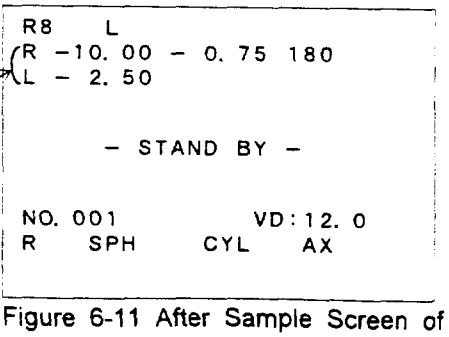


Figure 6-11 After Sample Screen of Printout

After the data is transmitted to the printer, The representative values are displayed in the view finder as shown in figure 6-11.

Note: Pressing the PRINT key increments the patient number.

To continue the measurement process, repeat the procedures as described above.

To end the measurement process, go to the following steps.

⑩ Turn the measuring unit off.

⑪ Return the measuring unit to its original position on the station.

Automatic Fogging System

The purpose of the automatic fogging System the patient eye correctly and then minimize the patients eye accommodation. When the patient's eye is aligned with the Retinomax, the fogging is then automatically made .

The target will slightly blurs.

↓

When the alignment for the measurement is complete, the target will blur further (enters the fogging state).

↓

The instrument will beep while it performs the measurement process.
When stop beeping, one measurement cycle has been completed.

↓

The patient will now see a dim target.

↓

The next measurement cycle starts.

Measurement is repeated while remaining in the fogging state.

You may also disable the automatic fogging mechanism by switching the unit to the quick mode.
(See page 28.)

Power Saving

When any key is not pressed for 3 minutes or more, the measuring unit is automatically turned OFF. To restart measurement, press the POWER key.

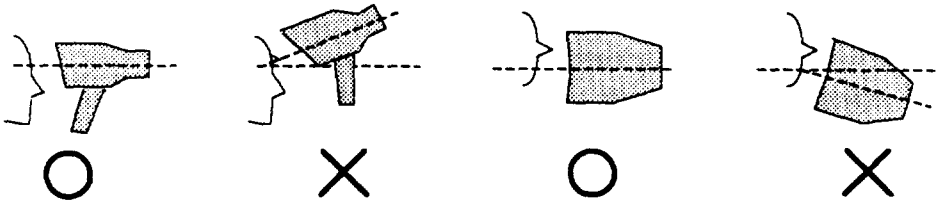
The IOL eyes measurement

The Retinomax will automatically measure IOL eyes (intraocular lens-contained eyes) in the same process as normal eyes without any special switch setting. IOL eyes should be measured as many times as possible (at least 8 cycles), because the measured values may vary in a wider range when compared with normal eyes.

(2) Helpful hints for successful measurement

When the right and left eyes are not correctly identified

- You must observe the following items to operate the automatic eye identification function properly
  - Do not touch the eye identification sensor not to move it when you insert your hand in between a testee' s forehead and the sensor.
  - Set the sensor in front of a testee' s face as follows to take measurement. If you take measurement from the upper, right, or left angle, an incorrect decision may occur.
    When you set the sensor properly, you can obtain stable measurement resuls because eye parts such as eyelashes.



- If you cannot operate the automatic eye identification function properly (e.g. if the eye indication remains R when the measurement window is turned to the left eye) even by observing the above items, switch the eye identification mode to Manual Identification. In particular, the automatic eye identification function may not work properly in the following cases:
  - When a testee wears a mask on his mouse.
  - When a testee (especially a woman) has much hair over the cheek.
  - When a testee is achild whose face is very small.

  * When you measure the patients eyes from the vertex or temple, you must switch to the right and left eyes identification mode to manual.

- To switch the right and left eyes identification mode from automatic to manual:

  Press the R/L key on the measuring units switch panel.

  →The right eye measurement mode is entered and the right eye lamp (R) will illuminate.

  →Pressing the R/L key a second time switches the instrument to the left eye measurement mode and the left eye lamp (L) will illuminate. Subsequently, whenever you press the R/L key, the measurement mode will alternates between right and left.

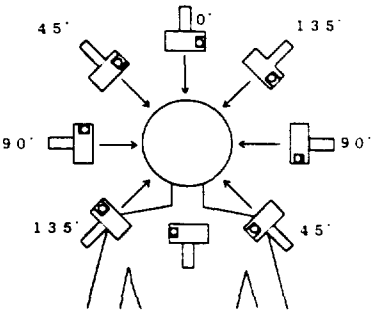
To return to the automatic right and left eyes identification mode, press the PRINT key.

Note: After transmitting the measurement data into the printing station, and restarting the measurement cycle (by the READY key), the previous patient data will be crased.

To switch to the manual right and left eyes identification mode after pressing the PRINT key (measurement data will be printed out), press the R/L key again.

Measurement with bed-ridden patients (45°, 90° or 135°)

When measuring bed-ridden patients from the 45°, 90° or 135° direction, An Ax shifting is required. Select the AXIS compensation offset according to the measuring direction as shown to the right.



The Ax (cylindrical axis) shifting is performed by pressing the Ax switching key on the measuring units switch panel; the first time the switch is pressed the unit performs an automatic 45° compensation, the second time the switch is pressed the unit performs an automatic 90° compensation, the third time the switch is pressed the unit performs automatic an 135° compensation, and the fourth time the switch is pressed the unit cancels the automatic compensation.

On automatic Ax compensation mode, the Ax switching lamp will illuminate and the R/L reading mode automatically switches from automatic to manual. When the automatic Ax compensation is canceled, the R/L reading mode is also restored.

Pressing the PRINT key prints out the measurement data and then cancels the automatic compensation. An automatic Ax compensation mark will be shown on the printout (see page 33).

When the measurement is not successfully done due to instability or quick movement of eyes (QUICK mode)

- When the measurement can not successfully be done due to eye instability or quick movement of a child's eyes, the Quick mode is useful.

Press the QUICK key on the measuring unit switch panel.

The instrument enters the Quick mode and the measurement mode lamp will illuminate.

- The Quick mode increases the speed of measurement due to the automatic fogging being disabled, but may lose measurement values may generate measured values that have low accuracy or vary over a wide range. You should not use the Quick mode for during normal eye measurement.
- Printouts in the Quick mode contain the character "Q" indicating the unit was in the Quick mode. (see a sample printout in page 33)

Pressing the QUICK key a second time cancels the Quick mode. The Quick mode will also be canceled when the PRINT key is pressed.

Using the Forehead Rest

When the patient□s eyes are liable to move, or when you cannot hold the measuring unit steady, using the forehead rest makes measurement easier.

① Push the middle of the forehead rest in the direction as shown by the arrow in the figure 6-11 to set the forehead rest.

② Gently place the forehead rest onto the patient's forehead and then adjust the measurement distance by slowly pushing on the measuring unit.

③ If the forehead rest is not needed, return it to its original position.

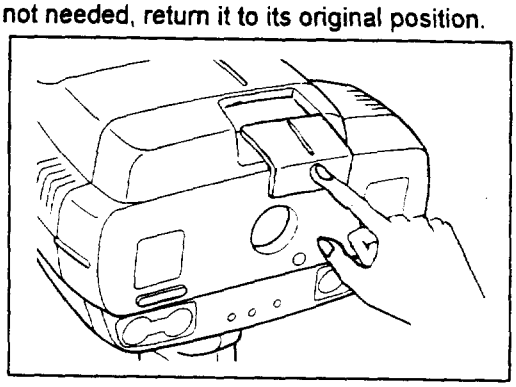
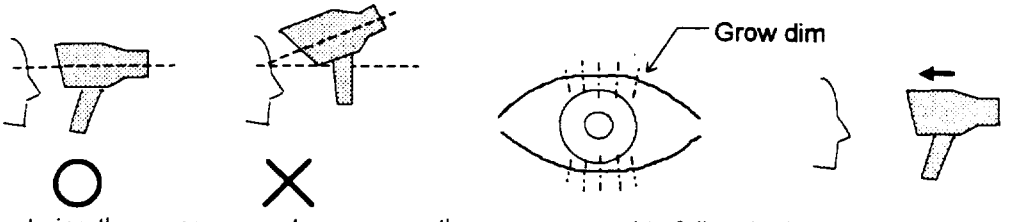


Figure 6-12

When correct measured values are not obtained

- If a patient has drooping eyelashes, ask the patient to please open his or her eyes wider. If necessary, have the patient or an assistant gently lift the eyelid with their fingertip.

- When you approach the patient to be focusing the patient' s eye, you pay attention to look which a patient has drooping eyelashes.



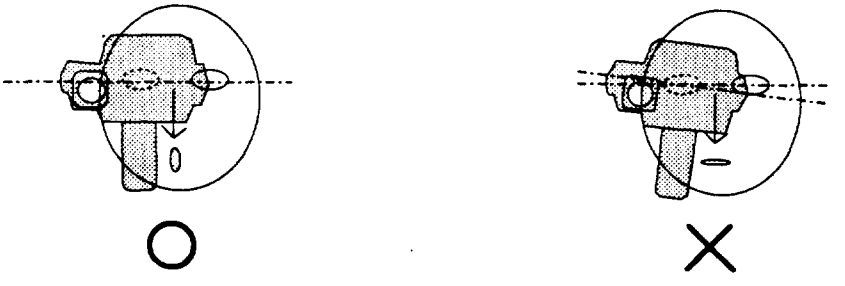
- Blinking during the measurement may cause the measurement to fail on be inaccurate.

- The measurement may not be made if the patient is suffering from an eye disease such as a cataract, retinal detachment, opaque condition of the cornea, crystalline lens, vitreous body or other.

- When the pupil is smaller than 2.9 mm, the measurement will fail, or correct values will not be obtained even if the measurement process is successfully made.

- When <S+C> is stronger than -18D~+22D, or when <C> is stronger than -8D~+8D, measurement cannot be made because these values are beyond the measurement range.

- Set the axis of the mesuring unit and the mesurement eye, or the cylindrical axis of the mesurement result do not equal with the acutiality value.



- When you bring the mesuring unit, set your armpit with your body.

Other

- Measurement with a contact lens on:
  Measurement is possible. However, if the contact lens is not properly fitted, the correct values may not be obtained. Any contamination or damage to the contact lens surface may result in a measurement failure.

- Measurement with eye glasses on:
  Measurement will be possible if the lens is at a slight incline. Howecer, if the lens is at a large incline, the correct values will not be obtained. If light is reflected from the lens surface into the measuring window, or if the glasses have a colored lens with a low light transmission, the measurement may fail.

(3) Printout

To print measured values, use the printer provided with Retinomax.

1) Install the print paper roll by using the procedure described in page 41.
2) After measurement, aim the front of the measuring unit (see page 7) toward the light receivin window of the printer and press the PRINT key.

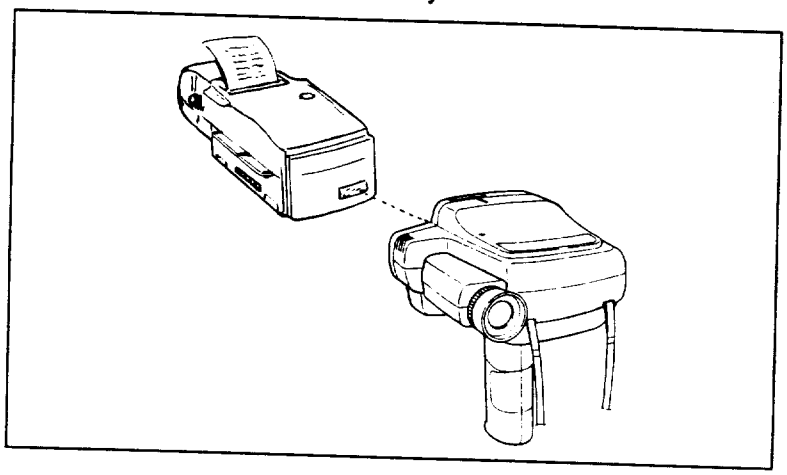


Figure 6-13

Pressing the PRINT key sends data to the printer via infrared rays and printout.
The Printer rings buzzer and is lit DATA lamp when it is received the data.
After the printer has received the measuring data, a beep sounds. Then the data light will illuminate for about one second.
After finishing a print out, a beep sounds. Then the data light will again illuminate for about one second.

The PRINT key functions as specified on the OUTPUT screen (see page 40).

PRINT
- PRINT ONLY ···· Prints out but does not send data.
- PRINT/SEND ·· Sends data after printing out.
- SEND ONLY ···· Sends but does not print out data.
- OFF ····· Neither prints out nor sends data.

The Pre-setting is "PRINT ONLY".

- Only the measured values of the last 8 measurement cycles for each eye will be printed out.
- If the number of measurement cycles exceeds 8, the representative values are selected from the measured values of the last 8 measurement cycles taken.

3) The printer outputs the paper, which the measured values are printed on. Refrieve the printout by pulling it downward.

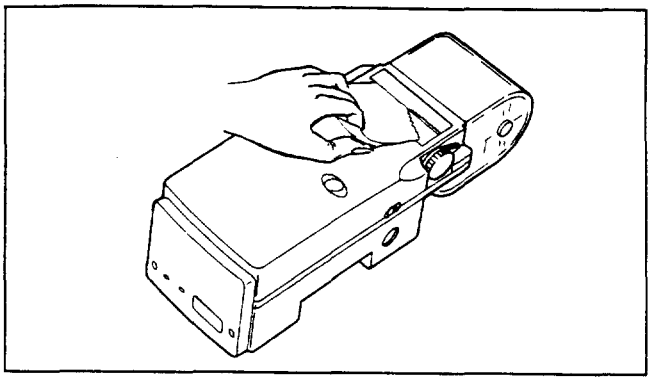


Figure 6-14

Note: On a printout, the measured values for the right eye always precede those for the left eye regardless if the left eye was measured first.

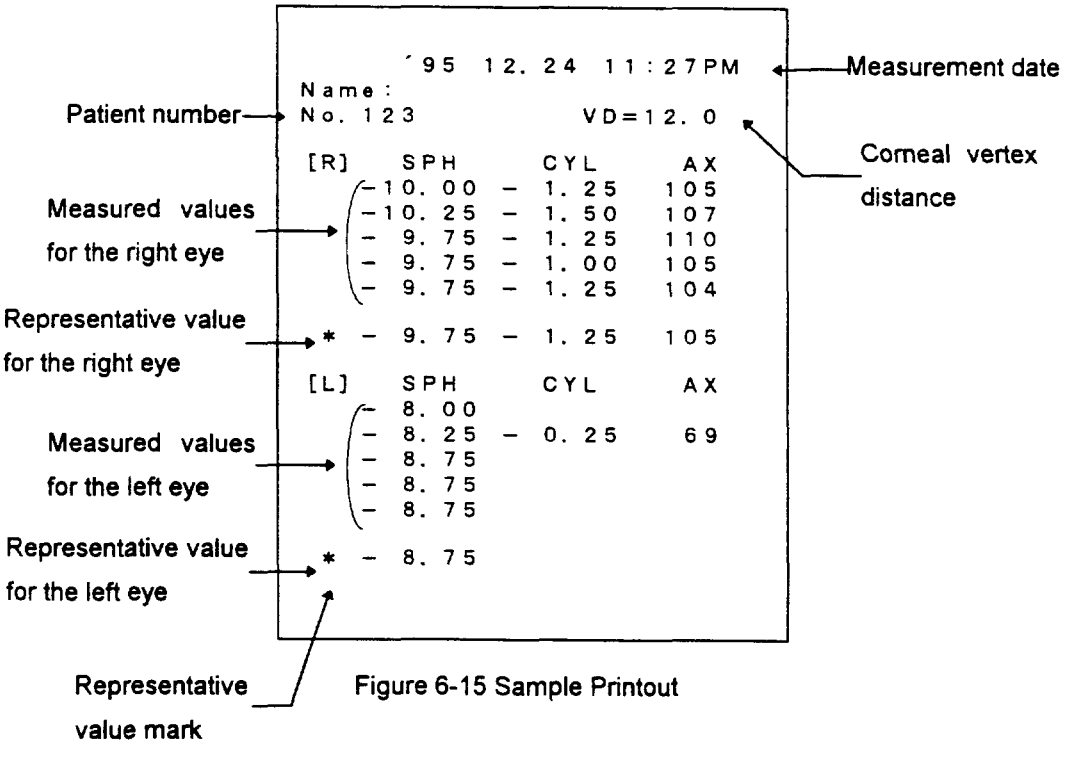
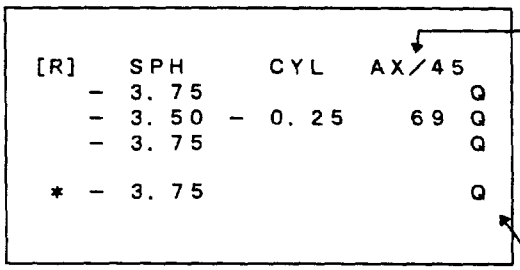


Figure 6-15 Sample Printout



Ax automatic compensation mark

AX/45 : Printed for 45° compensation

AX/90 : Printed for 90° compensation

AX/135 : Printed for 135° compensation

AX : No compensation

(This example shows the measured values with Ax 45° compensation.)

Quick mode mark

Indicates the unit was in the Quick mode during measurement in Quick

Figure 6-16 Sample Printout for Measurement of Model Eye in Quick Mode and Automatic Ax Compensation Mode

4) When the printer cannot operate normally for reasons such as the passing of a person between the measuring unit and the printer while data is being sent, the printer Data lamp will illuminate yellow in color and a beep sounds. The printer may not operate at all if infrared rays do not reach it. In these cases, get closer to t he printer and press the PRINT key again.
Data can be printed any number of times until the next measurement is performed. When you start the next measurement after pressing the PRINT key, the patient number is incremented by one.

Setting the Printer DIP Switch

When using two or more printers in a room, the DIP switch (see Figure 6-16) of each printer should be set as shown in the following figure to prevent radio interference.
The printer addresses will correspond to the measuring unit addresses (see Figure 6-17).

Address	Setting of DIP switch
1 (initial setting)	ON 12345678 initial setting
2	ON 12345678
3	ON 12345678
4	ON 12345678

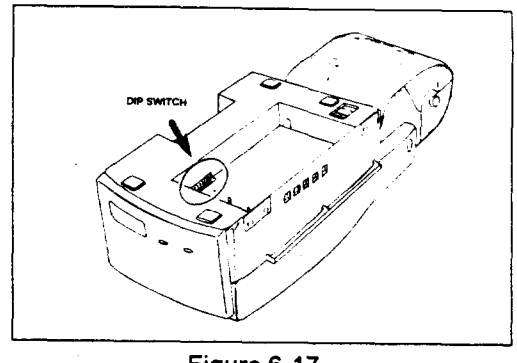


Figure 6-17

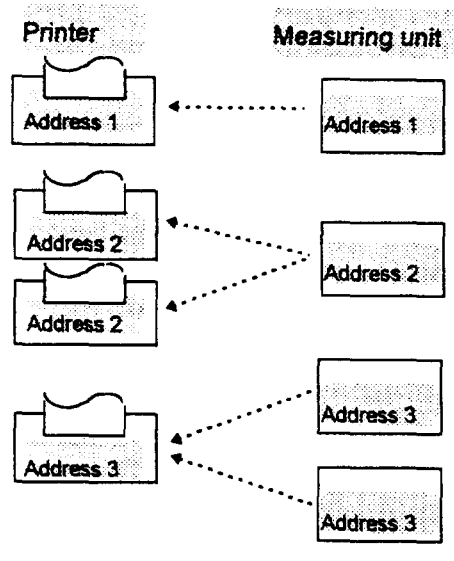


Figure 6-18 Sending of Data from Measuring unit to Printer

Representative Values

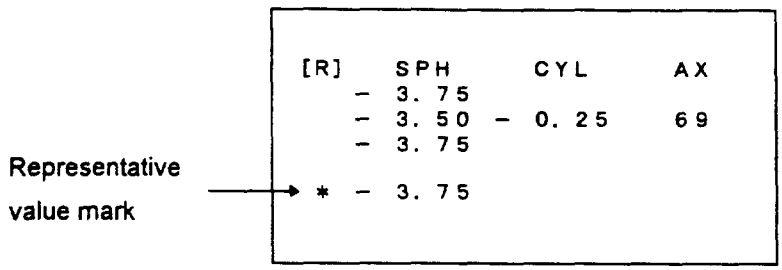


Figure 6-19

An asterisk (*) indicates the representative values on a printout.

Representative Value: A guide to help you choose which one of the several measured values for one eye to use after at least once measurement cycles are done.

When selecting one of the measured refraction values that vary widely, consider the following:

- Substantial variance of SPH values:
  The patient's eye may be accommodating. It is also advisable to remeasure the eye carefully several times.

- Substantial variance of CYL and AX values:
  The AX values may tend to somewhat vary when the eye is weak astigmaticly (CYL value of less than 0.5D).
  Other causes may include:
  - Eyelashes are occluding the pupil.
  - The pupil diameter is less than 2.7 mm.
  - An opaque eye or an irregular astigmatic eye.
    When any of these three situations occurs, normally the accuracy of the measured values will be low. If the eyelashes or pupil diameter affect the measurement (see page 29), you should re-measure the eye paying close attention to these factors.

Battery operation of the Printer

When the printer operate with the battery pack, separate the printer from the station (complete the reversal of the steps shown in Figure 5-8 in page 18) and install the battery pack in the printer.

When you install the battery pack in the printer, the printer BATTERY lamp lights up.

The color of the lamp indicates the batteries charge level as shown in the following table:

Color of BATTERY lamp	Charge level
Green	Charge level is enough.
Alternate light-up of green and yellow	The battery pack is almost empty.
Yellow	The battery pack is empty and needs to be charged.

7. Initial Settings

In Retinomax, the following initial settings are possible.

(1) Initial Setting (SETUP) Screen

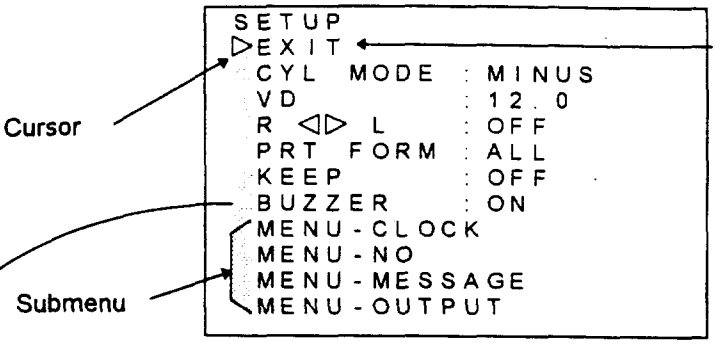


Figure 7-1

This initial setting (SETUP) screen is displayed by turning ON the instrument while pressing the QUICK key.

On this screen, you can move the cursor (▷) down (by pressing the ▼ key) and up (by pressing the QUICK key) to select an item, and press the R/L key to change the value or change the submenu.

The cursor (▷) moves along this shaded bar.

Move the cursor to one of the following items and press the R/L key to display each value of that item in sequence. The selected value becomes effective when you exit from this screen.

Item	Function	Value
EXIT	Switches to the measurement mode.	----------
CYL MODE	Changes the astigmatism mode.	MINUS→PLUS→MIX
VD	Sets the base VD for glasses.	12.0→13.5→13.75→15.0→0.0
R ◁▷ L	Masurement of 8 times taken until the other eye is indicated.	OFF→ON
PRT FORM	Selects the print mode. (REP:Representative value only, MSG:Message)	ALL → ALL/MSG → REP → REP/MSG
KEEP	The Fix Quick, Ax manual compensation and R and L eyes manual identification mode	OFF→ON
BUZZER	Selects the ON/OFF of the message printing.	ON→OFF

Submenu	Function	Menu Opened
MENU-CLOCK	Sets the clock	CLOCK setting screen
MENU-NO	Sets the patient number	Patient number setting screen
MENU-MESSAGE	Specifies the printout message	MESSAGE input screen
MENU-OUTPUT	Sets the output device	OUTPUT setting screen

(2) CLOCK Screen

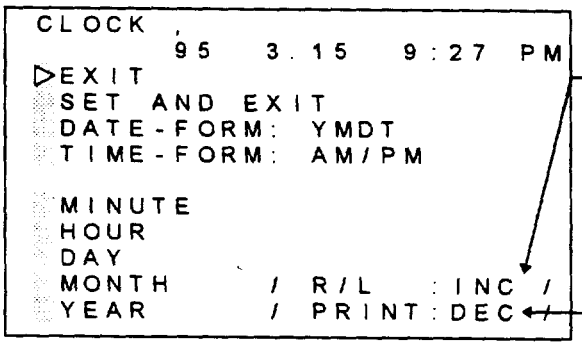


Figure 7-2

This screen allows you to set the internal clock and specify the format of the date on printout. The following table lists the items and functions.

Item	Function	Format
EXIT	Returns to the SETUP screen.	------
SET AND EXIT	Saves the revised and returns to the SETUP screen.	------
DATE-FORM	Specifies the date format.	YMDT→MDYT→DMYT
TIME-FORM	Specifies the time format (24-hour or 12-hour format).	24H→AM/PM

On this screen, the R/L and PRINT keys have the special functions that are shown in the following table.

Item	R/L key	PRINT key
MINUTE	Incremented by a minute.	Decremented by a minute.
HOUR	Incremented by a hour.	Decremented by a hour.
DAY	Incremented by a day.	Decremented by a day.
MONTH	Incremented by a month.	Decremented by a month.
YEAR	Incremented by a year.	Decremented by a year.

When you select a date or time format, the date displayed at the top of this screen changes accordingly.

DATE−FORM	TIME−FORM	Exampl
YMDT (year, month, day, hour)	24H	95 3.15 21:27
YMDT (year, month, day, hour)	AM/PM	95 3.15 9:27 PM
MDYT (month, day, year, hour)	24H	3.15 95 21:27
MDYT (month, day, year, hour)	AM/PM	3.15 95 9:27 PM
DMYT (day, month, year, hour)	24H	15. 3 95 21:27
DMYT (day, month, year, hour)	AM/PM	15. 3 95 9:27 PM

Figure 7-3 Date and Time Formats

(3) Patient number setting screen

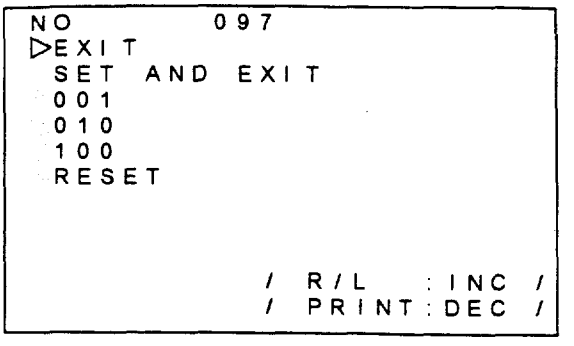


Figure 7-4

This screen allows you to set the patient number.

The range of the patient number is between 001 and 999.

Item	Function	Example
EXIT	Returns to the SETUP screen.	-----
SET AND EXIT	Saves the revises data and returns to the SETUP screen.	-----
001	R/L key : Increments the number by 1. PRINT key: Decrements the number by 1.	097→098 097→096
010	R/L key : Increments the number by 10. PRINT key: Decrements the number by 10.	097→007 097→087
100	R/L key : Increments the number by 100. PRINT key: Decrements the number by 100.	097→197 097→997
RESET	R/L key : Resets the number to 001.	097→001

(4) MESSAGE Input Screen

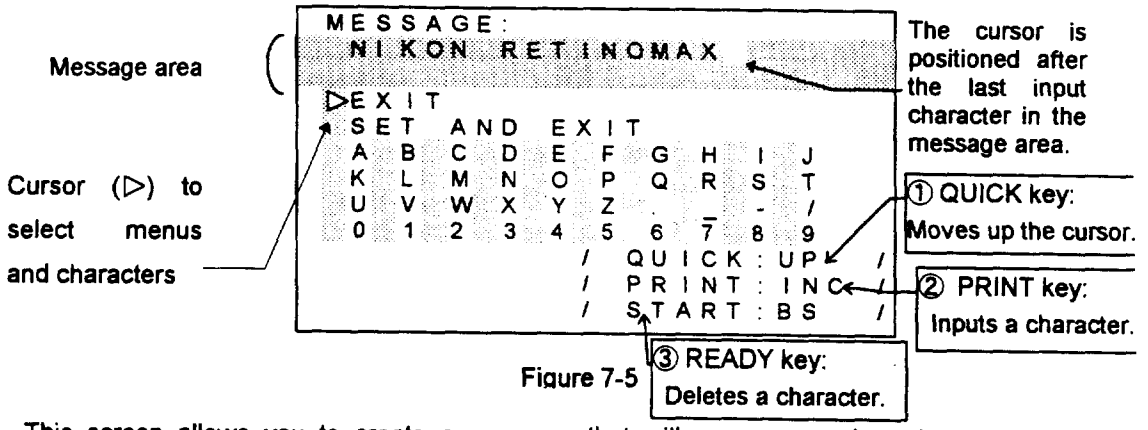


Figure 7-5

This screen allows you to create a message that will appears on the printouts. Enter the message in the message area (the second and third lines).

Characters that can be entered are as follows alphabetic letters, numbers, space, period, minus sign, and slash.

You can enter up to 48 characters (24 characters per line).

When the cursor (▷) is positioned to either of the following two items, this screen can be used in the same way as the other screens.

Item	Function	Value
EXIT	Returns to the SETUP screen.	-----
SET AND EXIT	Saves the changes and returns to the SETUP screen.	-----

When the cursor is in the character list, the following keys can be used to move the cursor and enter or delete a character.

② PRINT key	③ READY key	R/L key	Axis rotation key	① QUICK key
Enters a character at the cursor position.	Deletes a character preceding the cursor.	Moves the cursor (▷) to the right.	Moves down the cursor (▷).	Moves up the cursor (▷).

Pressing the QUICK key when located at the top line in the character list moves the cursor (▷) to the bottom line in the list. Pressing the ▼ key when located at the bottom line in the character list moves the cursor (▷) to the item "EXIT". Pressing the R/L ▸ key when located at the last character in a line moves the cursor (▷) to the first character in the same line.

(5) OUTPUT unit pre-setting Screen

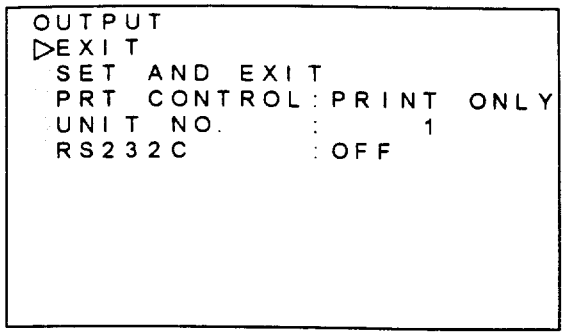


Figure 7-6

This screen allows you to define an output device.

*PRT CONTROL

You can select one of the following options to specify what process the printer should perform when receiving measurement data via infrared rays.

PRINT ONLY	: Only print the data.
PRINT/SEND	: Print and send the data through the RS232C port on the printer.
SEND ONLY	: Only send the data through the RS232C port on the printer.
OFF	: Neither print nor send the data.

*UNIT NO.

You can assign a unique address to each printer to prevent radio interference when two or more printers are used. Four addresses (1 through 4) can be assigned.

When the measuring unit address is set to something other than "1", you need to make the DIP switch settings of the printer match that address. For more information about setting the printer DIP switch, see page 34.

** The initial value of the measuring unit address is "1". The printer address is also initially set to "1".

*RS232C

The AC-adapter (option) has an RS232C port. This screen allows you to specify whether to use this port.

Item	Function	Value selection item
EXIT	Returns to the SETUP screen.	-----
SET AND EXIT	Saves the revises and returns to the SETUP screen.	-----
PRT CONTROL	Specifies the printer operation mode.	PRINT ONLY→PRINT/SEND→SEND ONLY→OFF
UNIT NO.	Sets the measuring unit address.	1→2→3→4
RS232C	Enables/disables the RS232C port of the AC-adapter (option).	ON→OFF

8. Maintenance

(1) Replacing a Paper Roll

① When the print paper nears the end of the roll, a red line will appear on both sides of the paper. It is now time to replace the paper roll.

Turn the printer upside down. Open the paper holder cover and pull the two paper holder knobs outward.

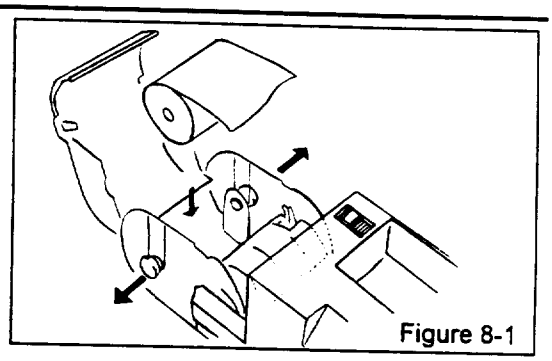


Figure 8-1

Pull down the release lever and remove the paper roll.

② Remove the shipping tape from the new paper roll (see Figure 8-2).

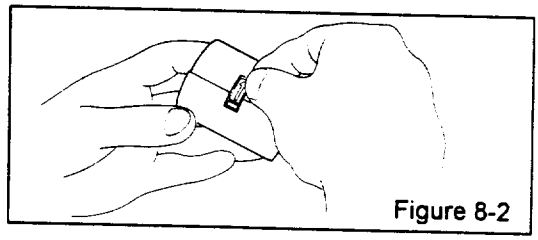


Figure 8-2

③ Pull out the paper one revolution of the roll and fold it then (see Figure 8-3).

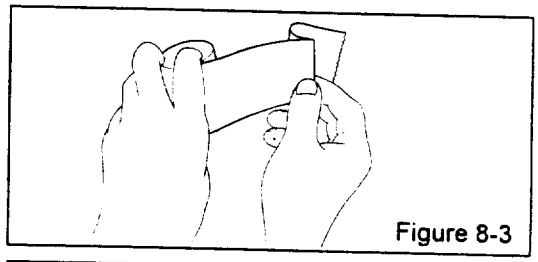


Figure 8-3

Gently cut the paper along the fold (see Figure 8-4).

(The purposes of this process is to avoid printing on the remaining adhesive after the securing tape has been removed, and to make the paper roll easier to insert into the paper slot.)

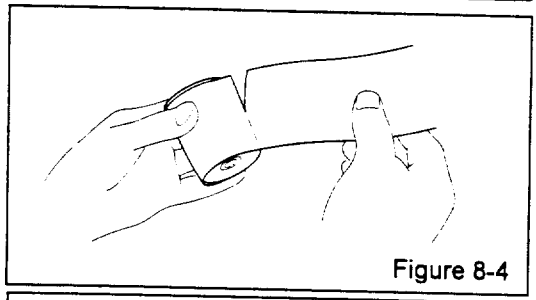


Figure 8-4

④ Install the paper roll as shown in Figure 8-5 and fasten into place the paper roll core with the paper holder knobs.

lever is in the upward position.

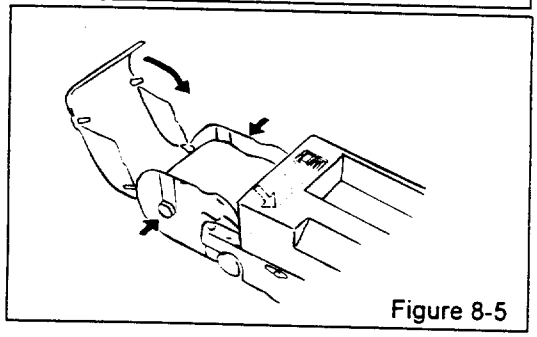


Figure 8-5

There are two ways to operate the unit. The first way is by AC Voltage operation, please refer to procedure (A) . The second way is by battery operation, please refer to procedure (B).

Procedure (A) AC Voltage operation

⑤ Insert the leader of the paper into the paper slot.

⑥ Pull down the release lever. Turn the paper feed knob to feed it through the opening. Insert the leader of the paper into the paper slot. The paper is automatically fed out from the outlet. If the paper is fed out at an angle, pull down the release lever and manually straighten the paper.

Make sure that the release lever is in the lock position.

⑦ Close the paper holder cover by pushing it down until it clicks shut.

⑧ Connect the printer with the station.

Procedure (B) Battery operarion

⑤ Turn ON the printer and make sure that the release

⑥ Insert the leader of the paper into the paper slot. The paper is automatically fed out from the outlet. If the paper is fed out skewed, pull down the release lever and make manually the paper straight.

Make sure that the release lever is in the look position.

⑦ Close the paper holder cover by pushing it down until it clicks.

Note: Do not insert the paper upside down.

(2) Fuses replacement

After turning on the power switch of the station, if the power lamp does not light up, it is possible that the fuses may have blown.

To check the fuses, first turn the unit OFF by the power switch and disconnect the power cable from the wall outlet.

Press inward on the tabs on both sides of the fuse holder with a small flat-top screwdriver and pull it out. Remove the two fuses from the fuse holder and check to see if they have blown. If so, replace the fuses with the recommend fuses.

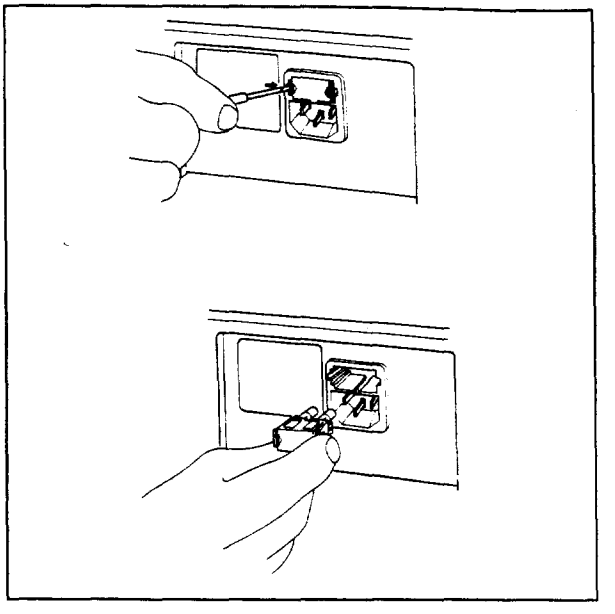


Figure 8-6

Use the recommended fuses only:

Please place an order with your local Nikon distributor for spare replacement fuses.
For A.C. 100V/120V area: Time-delay fuse 125V 2A ϕ 5.2 x 20 mm
type NAGASAWA ELECTRIC WORKS, LTD. □SB2□
or NIPPON SEISEN □FBT2□
For A.C. 230V area: Time-delay fuse 250V 1A ϕ 5.2 x 20 mm
type NAGASAWA ELECTRIC WORKS, LTD. □ES3-1000□
or HAMAI DENKYU □TDI-1A□

(3) Cleaning the Forehead Rest

Periodically wipe the surface of the forehead rest with a soft cloth or tissue paper moistened with lens cleaning liquid or ethyl alcohol.

(4) Cleaning the Measuring Window

The measuring window has a dust protection glass. If any dust on the glass is visible from the patient side, use the blower provided to remove the dust by powerfully blowing air several times. If the dust cannot be removed, gently wipe the measuring window with a soft and clean cotton cloth (such as gauze) moistened with pure alcohol.
For details on the cleaning, consult with your dealer's Service Division.

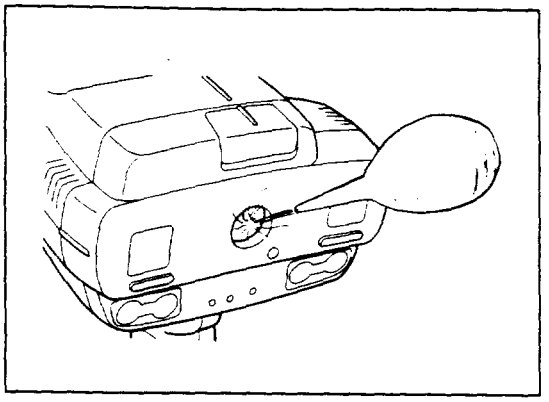


Figure 8-7

Caution

Because the dust-resistant glass is fragile, do not press on it too hard!

(5) Model Eye

When correct measured values cannot be obtained with the provided model eye, its lens surface could possibly have become contaminated by dust or a finger print. Use the blower provided to blow air to remove the dust. If necessary, gently wipe the model eye with a soft and clean cotton cloth (such as gauze) moistened with a little cleaning solution or absolute alcohol being careful not to scratch it. (Never use a handkerchief or absorbent cotton wool.)

A microscopic scratch on the lens surface of the model eye may reduce the accuracy of its measurement. Be careful not to bump the model eye against a hard object or drop it on the floor as this may cause damage.

9. Connection with an External Device

The printer has an interface connector complying with EIA RS-232C (see page 11). This connector can be used to send measured values to an external device such as Nikon Auto Optester.

If Retinomax is connected with the Nikon Auto Optester (such as OT-3A, OT-5A, OT-7A or OT-8A), the objective measurement data may be automatically loaded into the Optester for a faster and more efficient subjective examination.

For more information about the interface connection, consult with your Nikon distributor.

10. Using the AC-adapter (Option)

When you use AC-adapter and DC-code of option, the measuring unit drive for AC-adapter.

Nomenclature

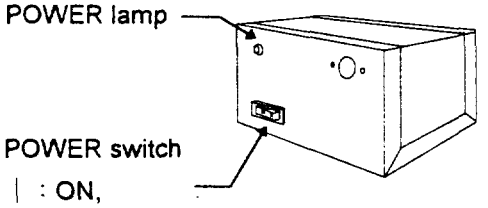


Figure 10-1

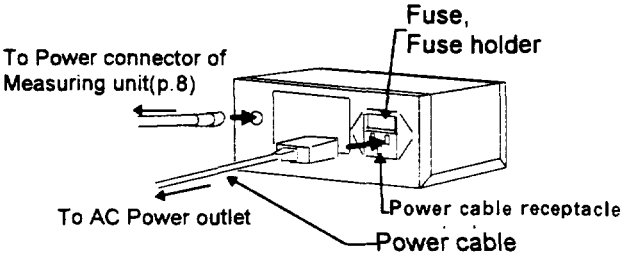


Figure 10-2

Method

Make sure that the power switches of the measuring unit and AC-adapter is set to OFF, and set the AC-adapter as shown in the figure 10-2.

When you use the AC-adapter, Turn the AC-adapter power switch on.

After using the AC-adapter, Turn OFF.

11. Troubleshooting

If any problems occur on Retinomax, inspect it by using the following table before calling for repair.

Measuring unit

Problem	Check Point	Cause and Action
The power lamp does not light up when turning Retinomax on.	It seems that the battery pack has been fully discharged.	The battery pack may have been fully discharged immediately after Retinomax is delivered or has not been used for a long time. Charge the battery pack.
The battery pack cannot be inserted into the measuring unit.	Are you not installing the battery pack in a reverse orientation?	Check if the battery pack is in a correct orientation (see page 15).

Printer

Problem	Check Point	Cause and Action
The printer connected with the station is turned ON but does not operate.	Is not the station OFF?	When the printer is connected with the station, it does not operate unless the station is ON. Turn the station on.
Although the battery pack has been installed in the printer, it is turned ON but the power lamp does not light up.	① Is not the battery pack installed in a reverse orientation? ② Does not the battery lamp light up green and yellow alternately or only yellow?	① Check if the battery pack is in a correct orientation (see page 17). ② Charge the battery pack.
The printer power lamp flashes on and off.	① Is not the battery pack nearly empty? ② Is the paper roll correctly installed? ③ Is not the printer release lever left free?	① Charge the battery pack. ② See "8. Maintenance" (page 41) to reinstall the paper roll. ③ Push down the printer release lever.
A continuous beeping sound	① Is the paper correctly installed? ② Is there proper RS-232C connection with an external device or is the external device working properly?	① Refer to □8 Maintenace□ (page 41). Re-insert the paper correctly. ② Malke sure the interface cable is properly connected on both ends. Read the external device manual carefully.
Nothing is printed.	① Do you use a designated printer roll? ② Is not the printer release lever left free? ③ Is not the paper roll inserted upside down?	① Use a designated printer roll. ② Push down the printer release lever. ③ See "8. Maintenance" (page 41) to reinstall the paper roll.
The printer does not receive measurement data sent from the measuring unit.	Does the measuring unit address correspond with the printer address?	Check the setting on the OUTPUT unit presetting screen (see page 40) and the printer DIP switch (see page 34) and make the two addresses match.

12. Specifications

(Retinomax measuring unit)

Measurement range	S+C	:	-18.00 ~ +22.00D (0.25D step)
	C	:	- 8.00 ~ + 8.00D (0.25D step)
	AX	:	1 ~ 180° (1° step)
Measurable minimum pupil diameter		:	ϕ 2.7 mm
Corneal vertex distance		:	Selectable from 12, 13.5, 13.75, 15.0, 0.0 mm
Measurement time		:	0.005 sec. (measured value storing time)
			0.2 sec. (entire measurement time up to display)
Continuous measurement time		:	1 hour (when full charged)
Automatic shutoff		:	Retinomax is turned OFF if no operation is done for 3 minutes.
View finder		:	0.6 inch, monochrome
Fixation target		:	Landscape chart
Right and left eyes identification		:	Automatic and manual can be switched.
			Automatic R/L reading is possible in measurement from the front.
Output		:	External exclusive printer (infrared communication)
Driving method		:	Battery-drive (when battery pack is installed)
			AC adapter-drive (when optional AC adapter and DC cord are used)
Battery		:	Nickel-hydrogen battery (DURACELL DR10)
			Working time: About 1 hour with each full charging
			Charging time: About 1.5 hour
Weight		:	900g (excluding battery pack)
			1080g (including battery pack)
Dimensions		:	163 (w) x 226 (h) x 236 (d) mm

(Retinomax station)

Battery charge	:	Automatic and manual charge are possible.
Power supply	:	100 VA
Fuse	:	Time-delay fuse 125V 2A (ϕ 5.2 x 20 mm) for 120V
		Time-delay fuse 250V 1A (ϕ 5.2 x 20 mm) for 230V
Weight	:	1.25 Kg
Dimensions	:	179 (w) x 105 (h) x 257 (d) mm

(Retinomax printer)

Print paper width	:	58 mm
Driving method	:	Powered from the station (when connected with station) Battery-drive (when separated from station and a battery pack is installed)
Battery	:	Nickel-hydrogen battery (DURACELL DR10) Working time : About 1 hour with each full charging Charging time : About 1.5 hour
Input	:	Measuring unit (infrared communication)
Output	:	External eye examination machine or computer RS232C (external connector)
Weight	:	770g (excluding battery pack, including print paper)
Dimensions	:	93 (w) x 77 (h) x 266 (d) mm

(Battery pack)

Battery	:	Nickel-hydrogen battery (DURACELL DR10)
Nominal voltage	:	DC 6 V
Nominal capacity	:	1600 mAhr
Weight	:	180g
Dimensions	:	46 (w) x 18.2 (h) x 89.3 (d) mm

13. Index

M

O

P

Q

R

S

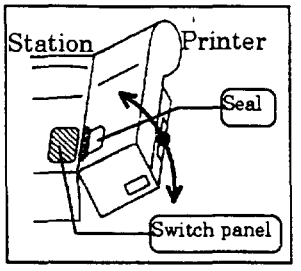
T

V

We would like to revise the instruction manual for Nikon Retinomax is revised as follows :

●Add the following paragraph to 2) Automatic charging "2" on Page 18:

Match the right corner of the switch panel of the station to the left side of the label on the surface of the printer in order to connect the printer to the station easily.



●Revise "1)" clause as follows and add the following "6)" clause to "(6)Advise and confirmation" on Page 21:

(Wrong) 1) If is normal for the battery to become warm after use or charging.

↓

(Correct) 1) It is normal for the battery to become warm after renewing or charging.

(Add) 6) Do not cover the main body, printer, and station with unique covers when charging the main body battery of printer battery. Charging generates heat, which makes the main body, printer, and station overheated if the covers are attached. This exerts bad influence on the batteries, which makes their lives shorter.

●Add the following description to "④" on Page 24:

In the automatic eye identification mode, the buzzer will beep when an eye to be examined changes to the other during measurement. Use this mode to check which eye you are measuring.
However, the buzzer may beep repeatedly if the eye identification is not performed properly because the sensor is in between a right and left eyes.
Note: In this case, the buzzer will beep even when you set the BUZZER option to OFF in the initial setting (SETUP).

●Add the following description to Page 26:

About the astigmatism measuring range

Values of astigmatism measurement range from -8.0 to +8.0 . However, values ranging from -12.0 to -8.0 and from +8.0 to +12.0 are also displayed as the reference data.
The measurement values within these extended ranges are displayed with the characters "C-COVER" shown under the cylindrical power indication. However, the cylindrical power is printed out without the "C-COVER" characters.

●Revise the description in the section "When the measurement is not successfully done due to instability or quick movement of eyes (QUICK mode)" on Page 28 as follows.

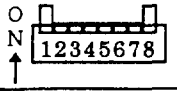
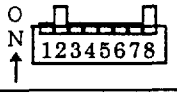
(Wrong) · The QUICK mode increases the speed of measurement due to the automatic fagging being disabled, but may lose measurement values may generate measured values that have low accuracy or vary over a wide range. You should not use the QUICK mode for during normal eye measurement.

↓

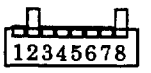
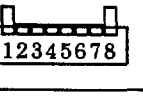
(Correct) · The measurement time in the QUICK mode is about half of that in the Normal mode. However, measurement values may vary over a wide range due to the fogging operation in the QUICK measurement. You should not use the QUICK mode for during normal eye measurement.

●**Revise the description on Page 34 as follows:**

(Wrong)

Address	Setting of DIP switch
2	
3	

(Correct)

Address	Setting of DIP switch
2	
3	

●**Revise the description on Page 35 as follows:**

(Wrong)

Battery operation of the Printer

When the printer operate with the battery pack, separate the printer from the station (complete the reversal of the steps shown in Figure 5-8 in page 18) and install the battery pack in the printer.
When you install the battery pack in the printer, the printer BATTERY lamp lights up.
The color of the lamp indicates the batteries charge level as shown in the following table:

Color of BATTERY lamp	Charge level
Green	Charge level is enough.
Alternate light-up of green and yellow	The battery pack is almost empty.
Yellow	The battery pack is empty and needs to be charged.

(Correct)

Battery operation of the Printer

When the printer operate with the battery pack, separate the printer from the station (complete the reversal of the steps shown in Figure 5-8 in page 18) and install the battery pack in the printer.
When you turn the printer power switch on, the printer BATTERY lamp lights up, and shows the status of charge level.
When the lamp lights up in Green, Charge level is enough.
When the lamp lights up in Green and Yellow alternately, charge level becomes lower. When the printer operates by station power, the lamp lights up in Green only and does not show the status of charge level.

●**Revise the table on Page 36 as follows:**

(Wrong)

Item	Function	Value
VD	Sets the base VD for glasses.	12.0→13.5→13.75→15.0→0.0

↓

(Correct)

VD	Sets the base VD for glasses.	12.0→13.5→13.75→14.0→15.0→16.0→0.0

●**Revise the description on Page 48 as follows:**

(Wrong) Measurement range S+C : -18.00 ～ +22.00D (0.25D step)
C : - 8.00 ～ + 8.00D (0.25D step)
Corneal vertex distance : Selectable from 12, 13.5, 13.75, 15.0, 0.0 mm

↓

(Correct) Measurement range S+C : -18.00 ～ +22.00D (0.25D step, case VD=12.0)
C : - 8.00 ～ + 8.00D (0.25D step, case VD=12.0)
Corneal vertex distance : Selectable from 12.0, 13.5, 13.75, 14.0, 15.0, 16.0, 0.0 mm