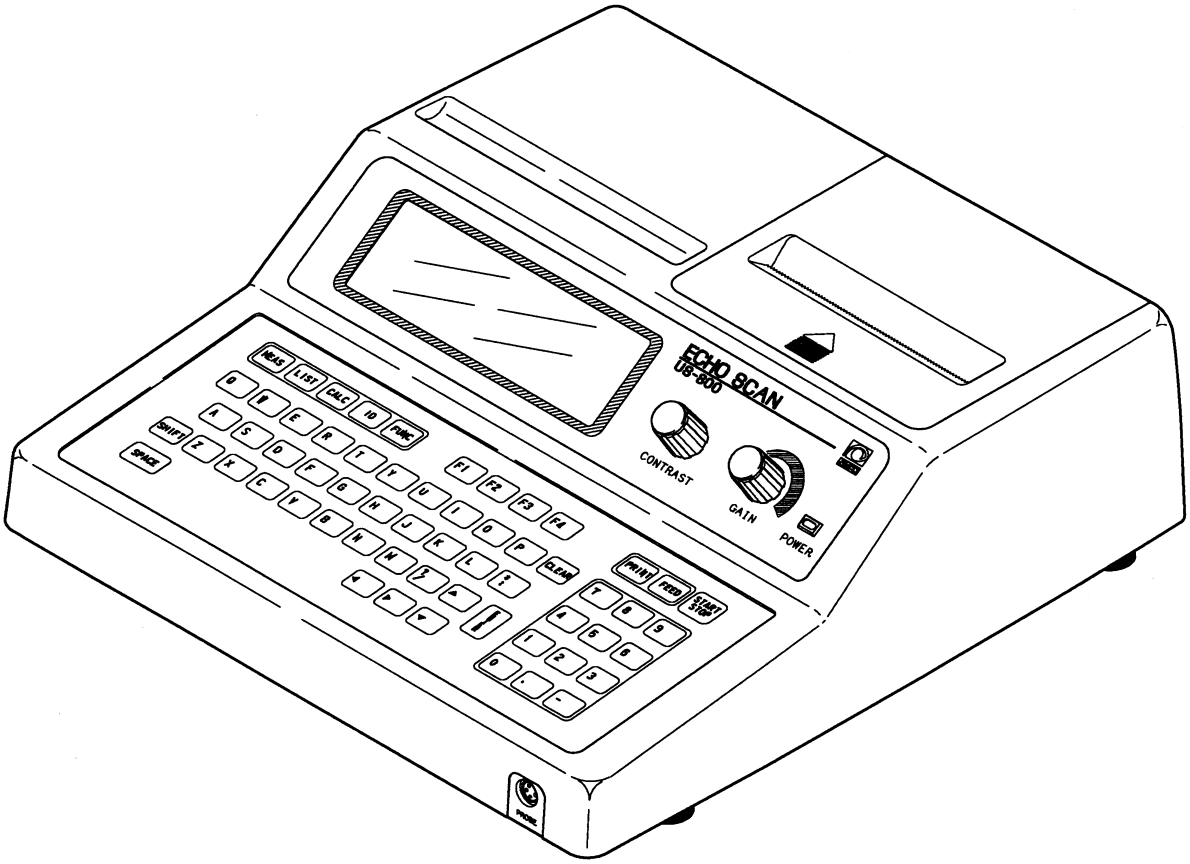
NIDEK

ECHOSCAN

Model: US-800

OPERATOR'S MANUAL



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* Specification and design are subject to change without notice for improvement.

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2000.3
14800-P902F
Printed in JAPAN

⚠ **BEFORE USE OR MAINTENANCE, READ THIS MANUAL.**

⚠ **THIS MANUAL CONTAINS ONLY INFORMATION TO UNDERSTAND THE OPERATING PROCEDURE AND MAINTENANCE.**

This manual contains information to understand the NIDEK Echoscan Model US-800. This manual provides general information of the instrument, cautions for safety, name and explanation of the configuration, operating procedures, maintenance, specifications and accessories. To understand the correct use of the instrument, this manual is needed. Especially, cautions for safety and operating procedure must be thoroughly understood before using this instrument. Be sure to keep this manual with the instrument and read it every time it is needed. Use of this instrument is limited to measurement of the axial length and calculation the refractive power of IOL by qualified physicians.
There are no user-serviceable parts inside the instrument except a printer paper and fuses. Therefore, if you find any problems or have questions about the instrument during operation, please contact your authorized distributor.

Table of Contents

§1 INTRODUCTION

1.1 Outline

NIDEK Echoscan Model US-800 is an ultrasonic instrument to measure the axial length which applies the ultrasonic pulse reflection method, consisting of the main unit, the solid probes, the foot pedal and the power cord.
When touching the probe to the cornea, ultrasonic pulse is transmitted by a transducer, reflected from each boundary face of intraocular tissue and its echo is received by the same transducer. US-800 measures the length of various intraocular tissue by measuring the time required for receiving echo pulse and converting it to the distance.
The axial length is measured as one of the parameters in order to determine the refractive power of IOL, when implanting IOL in the cataract surgery. In addition, by inputting other parameters, this instrument can calculate the refractive power of IOL, which is necessary for the medical treatment.

1.2 Principle

When voltage is applied to a built-in transducer of a probe, the transducer vibrates and the pulsed ultrasonic waves are emitted. The ultrasonic waves have the following properties similar to light in a condition under water or media like it.

① They have high tendency of traveling straight.
② They have phenomena such as reflection and refraction on the boundary faces of media which have different acoustic impedance.
(Acoustic impedance = Density of medium × Ultrasonic Velocity in the medium)

By touching the probe to the eyeball, the ultrasonic pulse travels inside the eye. A part of the pulses is reflected from each boundary face, between the probe tip and the cornea, the cornea and the anterior chamber, the anterior chamber and the lens, the lens and the vitreous, the vitreous and the retina. Their echoes are received at the same probe that the ultrasonic pulses are transmitted, which are then shown on the display as the electronic acoustic signals. Echo intensity is shown as the height of the waveform. It is possible to calculate each length of the intraocular tissue (axial length, anterior chamber depth, lens thickness and vitreous length) by converting the interval of releasing and receiving each echo into the distances. When the directions of the ultrasonic waves are not perpendicular to each boundary face, however, the echo is rather weak or does not return to the probe. For such reason, it is very important to coincide the direction of the ultrasonic wave with the visual axis in order to achieve the correct measurement.

1.3 Classification

[Classification under the provision of 93/42/EEC (MDD)] Class IIa

US-800 is classified into the Class IIa instrument.

[Protection method against electric shock] Class I

US-800 is classified into the Class I instrument.

Class I instrument in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such way that means are provided for the connection of accessible conductive parts to the protective (earth) conductor in the fixed wiring of the installation in such a way that accessible conductive parts cannot become live in the event of a failure of the basic insulation.

[Degree of protection against electric shock] Type B

US-800 is classified into Type B instrument.

Type B instrument with an internal electrical power source providing an adequate degree of protection against electric shock particularly regarding;

-- allowable leakage currents

-- reliability of the protective earth connection (if present).

[Degree of protection against ingress of liquids] IP20

US-800 is the ordinary unit (enclosed unit without protection against ingress of liquids). Be careful not to splash water on the instrument.

[Degree of safety of application in the presence of flammable anaesthetics and/or flammable cleaning agents]

US-800 should be used in environments where no flammable anaesthetics and/or flammable cleaning agents are present.

[Mode of operation]

Continuous operation

[Methods of disinfection recommended by manufacturer]

Disinfect the solid probe tip with following medical fluid.

- 0.1% Chlorhexdine Gluconate Solution
- Ethanol for Disinfection

1.4 Symbol Information

This symbol shows that the reference of operator's manual is necessary for the part before use.

This symbol means degree of protection against electric shock is for Type B instrument.

This symbol both sides of the power switch means that the power is ON.

This symbol both sides of the power switch means that the power is OFF.

This symbol means the fuse rating.

1.5 Voltage Check

US-800 is equipped a voltage selector for 100V / 120V / 220V / 240Vac in the fuse holder on the rear panel. Check if the indicated voltage matches to the wall outlet one.

§2 SAFETY

In this manual, Signal Words are used to designate a degree or level of safety alerting, whose definitions are as follows.

⚠**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage accident.

To avoid damaging to personnel and the delivery unit, follow all the instructions mentioned below.

2.1 Cautions in Use

⚠CAUTION

- Use this instrument only for measuring the axial length or calculating the refractive power of IOL.
  NIDEK assumes no responsibility for accident caused by using for other purposes.

- In the event of trouble, unplug the power cable and contact your authorized distributor without touching inside of the instrument.

- Do not modify or touch inside of the instrument.
  You may get an electric shock or the instrument may malfunction.

- Use the wall-outlet with protective earth which meets the requirement of the power specifications, and connect the supplied power cable.
  If the line voltage is too low or too high, the instrument cannot deliver full performance and will be damaged.

- Never pull the power cable to unplug it from wall-outlet. Always hold the plug to unplug.
  The metal cores may break. It may cause an ignition or an electric shock.

- Never put the weight on the power cable.
  The cable sheath may break. It may cause an ignition or an electric shock.

- Never pull the probe cable and the foot pedal cable forcefully.
  The metal cores may break.

⚠CAUTION

- If the metal cores of cable are exposed, replace it to normal one immediately.
  It may cause an electric shock or a fire.

- Be sure to verify that there is no scratch nor chip on the surface of the probe tip.
  If such probe is used for measurement, it may hurt the patient's cornea.

- Be sure to hold the plug when connecting or disconnecting the probe.
  The probe cable may be broken if you hold the cable only.

- Disinfect the probe tip for every patient.
  If the probe tip is not disinfected, the cornea may be infected.

- Be sure to disinfect the probe tip with medicament. Never autoclave the probe.
  The probe tip may break.

2.2 Storage and Transport Environmental Conditions

NOTE

- Avoid storing the instrument in places where are splashed rain or water, there is corrosive gas/liquid, or exposed to the direct sunlight.

- Store the instrument in a stable place where is vibration-free, shock-free, and level.
  Otherwise the instrument may drop or have troubles.

- Store the instrument in the following environment.
  Temperature: -20 to +60ºC (-4 to 140ºF)
  Humidity: 10 to 95% (Non-condensing)
  Others: No dust nor corrosive gas/liquid

2.3 In Transport

⚠CAUTION

- Never trail the power cable to transport the instrument.
  The instrument may have troubles caused by a shock, and the power cable may break when it is stepped on or pulled.

- Unplug the probe and store it to the attached box before transporting the instrument.
  If hitting the probe directly, the probe may have a permanent damage.

2.4 In Installation

⚠CAUTION

- Install the instrument in a level and stable place where is vibration-free and shock-free.
  The instrument may drop or may have troubles.

- Check that the line voltage is proper before plugging the power cable to the wall-outlet.
  The proper voltage is shown on the rating plate.
  If the line voltage is too low or too high, the instrument cannot deliver full performance and will be damaged.
  If the line voltage is different from the selected one of the voltage selector, you shall change the voltage of the voltage selector. (See "**5.4 Selecting of the Voltage"** (P.5-4).)

- Avoid installing the instrument in a place where is splashed water.
  If water gets into the instrument, you may get an electric shock and the instrument may have troubles.

- This instrument has been tested and found to comply with the limits for medical devices to the IEC 60601-1-2:1993, EN60601-1-2:1994, Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation. This instrument generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in particular installation. If this instrument does cause harmful interference to other devices which can be determined by turning the instrument off and on, the user is encouraged to try to correct the interference by one or more of the following measures;

  - Reorient or relocate the receiving device.
  - Increase the separation between the instrument.
  - Connect the instrument into an outlet on a circuit different from that to which the other device(s) are connected.
  - Consult the manufacturer or field service technician for help.

- When this instrument is used together with other equipment, the equipment shall be certified according to Standard IEC60601-1.
  If this instrument is used together with the equipment which is not certified according to Standard IEC60601-1, you may get an electric shock and the instrument may have troubles.

NOTE

- Install the instrument in the following environment.
  Temperature : 10 to 40ºC (50 to 104ºF)
  Humidity : 10 to 85% (Non-condensing)
  Others : No dust, corrosive gas/liquid nor scattering light

2.5 After Use

⚠CAUTION

- When the instrument will not be used for a long time, unplug the power cable from wall-outlet.
  If dust and moisture settle on the plug of the power cable, a short and a fire may occur.

- After using the instrument, turn OFF the power and put the dust cover on.
  If the instrument is not covered for an extended period, the accumulation of dust may get the instrument insanitary.

2.6 In Maintenance

⚠CAUTION

- Be sure to use the specified fuses when replacing the fuses.
  Otherwise the instrument may have troubles and a fire may occur.

NOTE

- Only a service technician properly trained in NIDEK can repair the instrument.
  NIDEK assumes no responsibility for accident caused by improper repair.

- Never use a solvent in organic/abrasive to clean the exterior of the instrument as it may ruin the appearance.

- When the instrument is sent back to NIDEK for repair or maintenance, wipe the surface of the instrument with a clean cloth dampened with cationic detergent, etc. (such as Benzalkonium chloride: 0.05 - 0.2% solution) which does not cause deformation or discoloration of the surface.

2.7 In Disposal

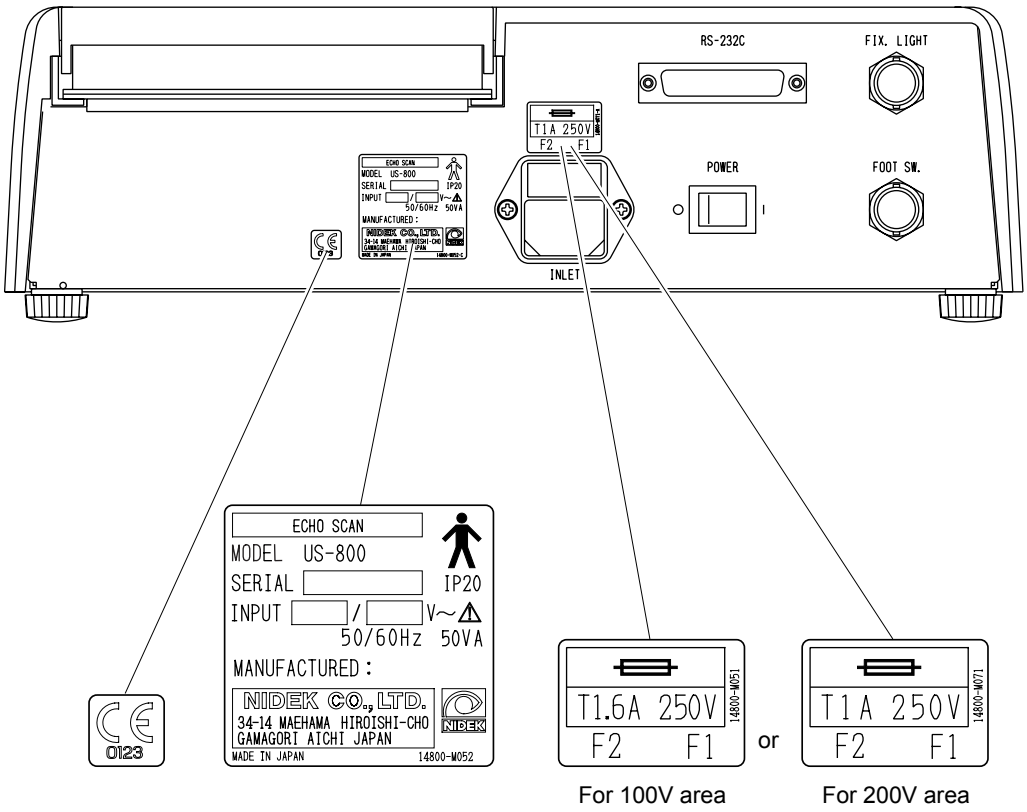
NOTE

- Follow local governing ordinances and recycling plans regarding disposal or recycling of device components when disposing the instrument.
  Especially the disposing method of lithium batteries varies according to the government. This instrument has electric circuit boards with lithium batteries in the instrument. When disposing the board, follow the instruction of the government.

- When disposing packing, sort them by the materials and follow local governing ordinances and recycling plans.

2.8 Labels

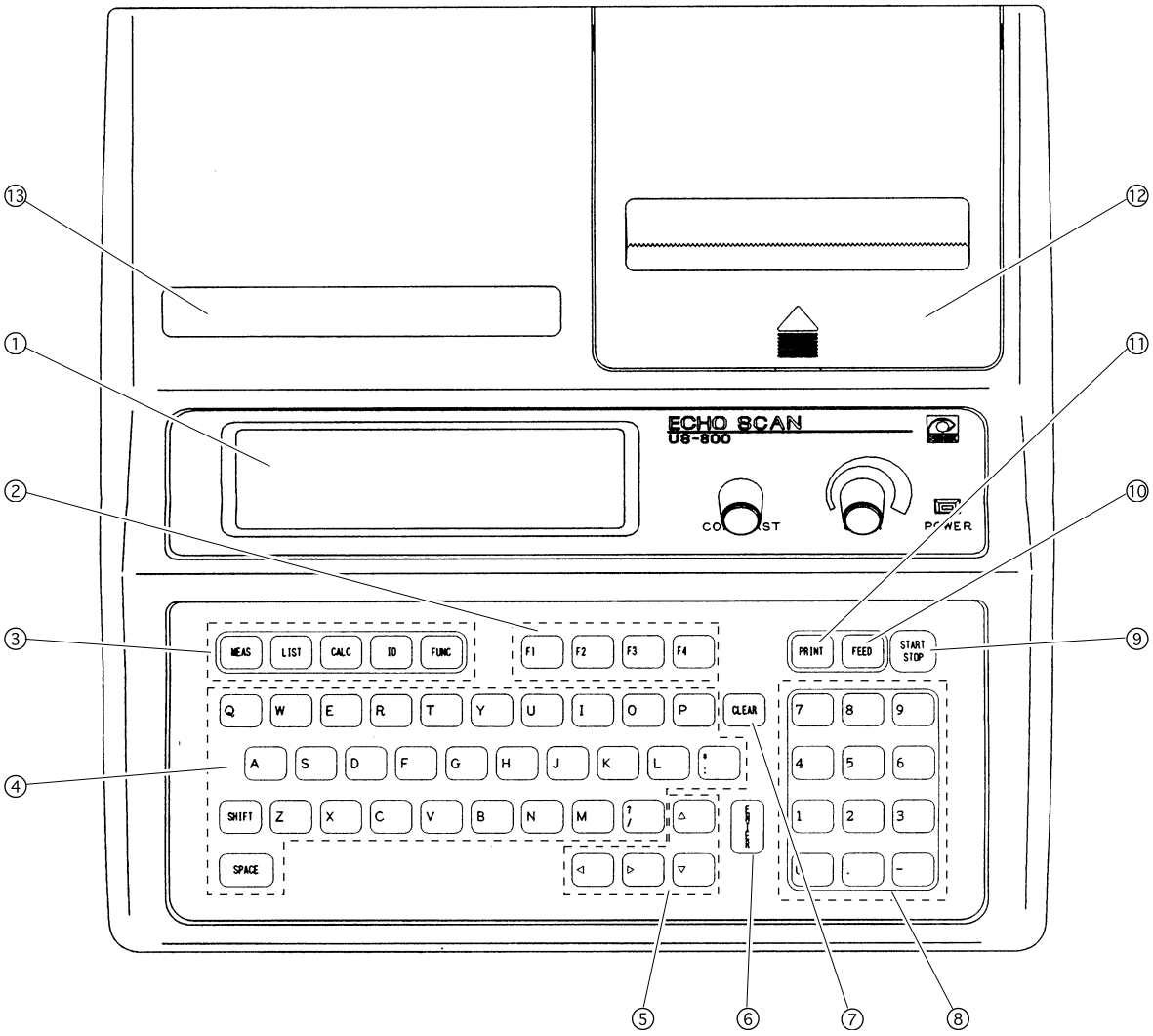
In order to draw the physician's attention, the appropriate warning labels are attached to the specified locations on the rear panel of the instrument.



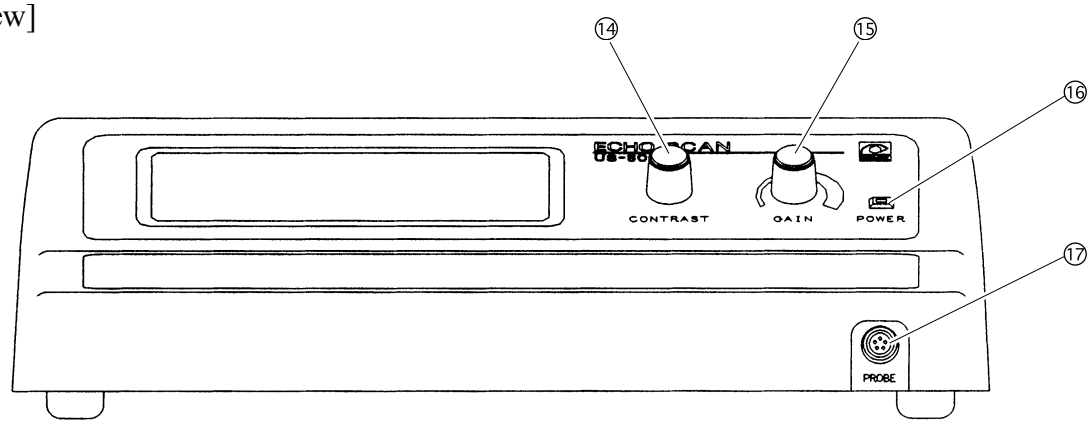
§3 CONFIGURATIONS

3.1 Main Body

[Top view]



[Front view]



① Display

The display shows the data, A-mode waveforms, etc..

② F keys [F1, F2, F3, F4]

These keys are used to operate and to set the function in the designated mode.
The functions of these keys are shown on the display.

③ Mode keys [MEAS, LIST, CALC, ID, FUNC]

These keys are used to set the modes ; Measuring mode, LIST mode, IOL mode, ID mode, and Function menu.

- MEAS key
  This key is used to set the measuring mode.
- LIST key
  This key is used to set the LIST mode which show the measured data list.
- CALC key
  This key is used to set the IOL mode for calculating the refractive power of IOL.
- ID key
  This key is used to set the ID mode in which the patient's data is inputted.
- FUNC key
  This key is used to set the mode of Function menu.

④ Alphanumeric keys

These keys are used to input the patient's data and IOL data.

⑤ Arrow keys [◄, ►, ▲, ▼]

These keys are used to move the manual gate, to set the items, and to set the time and date.

⑥ ENTER key

This key used to input figures and letters, and to set items.

⑦ CLEAR key

This key is used to correct the inputted figures and letters. By pressing this key, one letter at the left of cursor is deleted.

⑧ Numeric keys

These keys are used to input the figures and set the items.

⑨ START/STOP key

This key is used at the measuring mode to changeover freeze condition to measuring condition alternately instead of the pedal.

⑩ FEED key

This key is used to feed the printer paper.

⑪ PRINT key

This key is used to print out the data on the display.

⑫ Printer cover

This cover is opened and closed when changing the printer paper.

⑬ Probe rest

This is used to place the probe on when it is not in use.

⑭ Contrast control [CONTRAST]

This is used to control the contrast on the display. Adjust the contrast for the clear vision.

⑮ Sensitivity control [GAIN]

This is used to adjust the sensitivity as [GAIN] of the echo. By turning it clockwise, the gain increases.

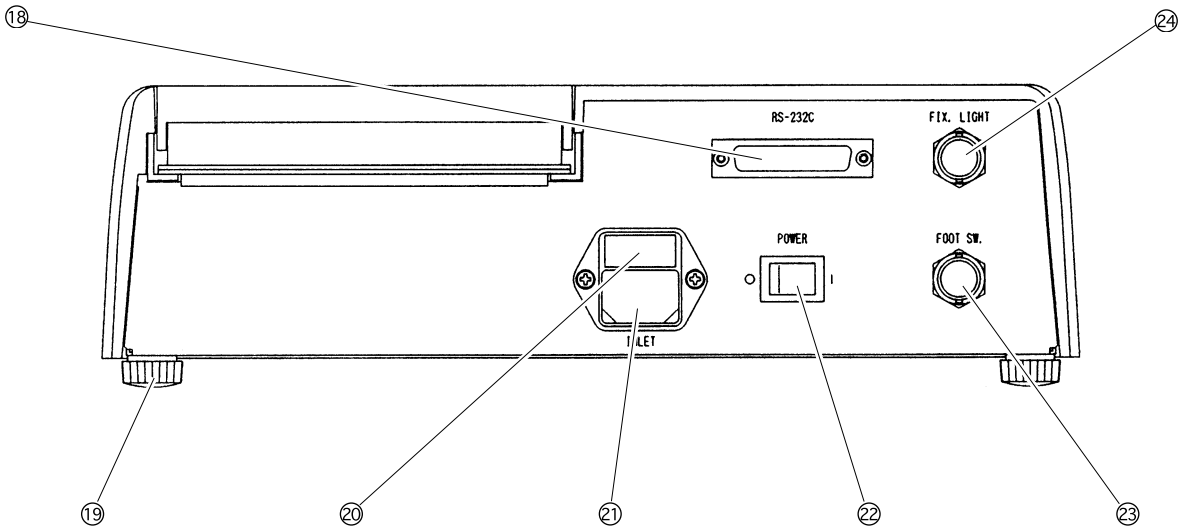
⑯ Pilot lamp [POWER]

This lights while power is ON.

⑰ Probe connector [PROBE]

The solid probe for axial length measurement is connected to this plug.

[Rear View]



⑱ External interface [RS-232C]

External personal computers can be connected through this interface.

Accessory equipment connected to the analog and digital interfaces must be certified according to the representative appropriate national standards (for example, UL 1950 for Data Processing Equipment UL 2601-1 for Medical Equipment, and CSA C22.2 No. 601-1, EN 60601-1 and IEC 60601-1.)

Further more all configurations shall comply with the system standard IEC 60601-1-1. Everybody who connects additional equipment to the signal output part configured a medical system, and is therefore responsible that the system complies with the requirements of the system standard IEC 60601-1-1. If in doubt, consult the technical service department or your local representative.

⑲ Adjuster foot

By turning this adjuster foot, you can adjust the inclination of device to get a clear vision of display.

⑳ Fuse holder

It contains voltage selector as well as implanted fuses.

㉑ Power cord inlet [INLET]

㉒ Power switch [POWER]

㉓ Pedal plug [FOOT SW.]

The cable of the foot pedal is connected to this plug.

㉔ Fixation light plug [FIX. LIGHT]

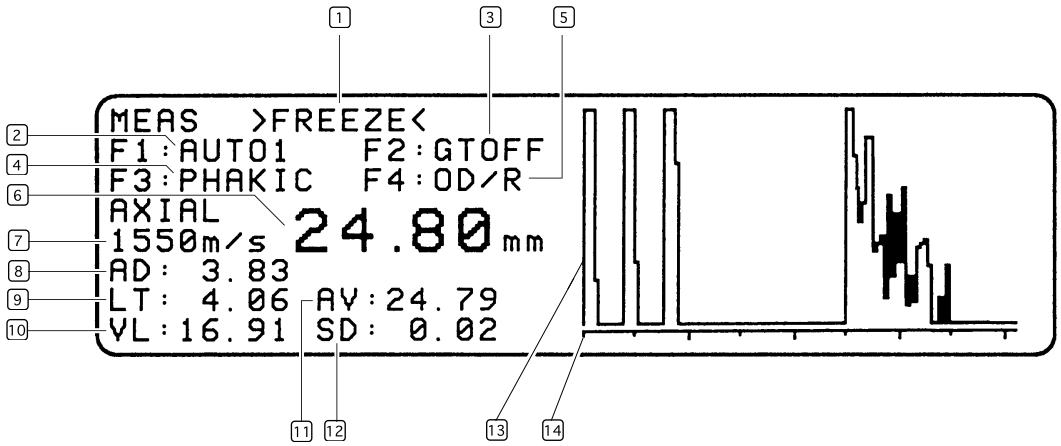
This plug is for the fixation light.

3.2 Display

This chapter explain words and abbreviations indicated on the display and printed papers.

A. Measuring mode

This mode is for measuring axial length.



1 Conditions [>FREEZE</>START<]

>FREEZE< is indicated while in frozen condition and >START< is indicated while measur ing.

2 Measurement [AUTO1/AUTO2/AUTO3/MANU]

It shows whether the measurement is automatic or manual.

Use [F1] key to set AUTO1, AUTO2, AUTO3 or MANU.

In auto measurement, A-mode waveform are automatically judged.* When it becomes good, measured data will be shown on the display and frozen automatically.

In manual measurement, measurement is continued without freezing though measured data is shown on the display. When good A-mode waveform is obtained, step on the foot pedal or press [START STOP] key to freeze it.

3 Manual gate [GTOFF/GTON]

It shows whether manual gate function is on or off.

The position of gate is indicated with dotted line (⋮) in the A-mode waveform.

Use [F2] key to set ON/OFF of the manual gate.

4 Condition of patient's eye [PHAKIC/APHAKIC/IOL]

It shows the condition of patient's eye.

Set PHAKIC for phakic eye, APHAKIC for aphakic eye, and IOL for IOL implanted eye.

Use [F3] key set to the condition of patient's eye.

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* For details, see page 4-2.

5 OD/R or OS/L display

This shows whether measuring eye is right eye (OD/R) or left eye (OS/L).
Use F4 key to set OD/R or OS/L.

OD/R: Oculus Dexter/Right eye
OS/L : Oculus Sinister/Left eye

6 Axial length

This shows the measured axial length in mm unit.

7 Sonic velocity for conversion

This is sonic velocity used in calculating axial length.

8 Anterior chamber depth [AD]

This shows the measured anterior chamber depth in mm unit.

9 Lens thickness [LT]

This shows the measured lens thickness in mm unit.

10 Vitreous body length [VT]

This shows the measured vitreous body length in mm unit.

11 Average [AV]

This shows the average of the measured axial length.

12 Standard deviation [SD]

This shows the standard deviation of the measured axial length.

13 A-mode waveform

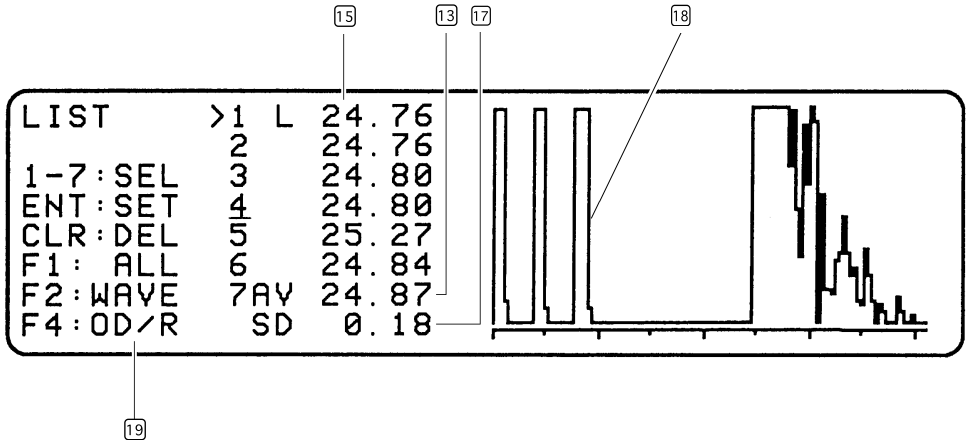
This shows the condition of the echo received by the probe. The vertical lines show the intensity of the echo, and the horizontal lines show the time that the echo takes to travel through the several tissues in the eye.

14 Scale

This scale is a standard guideline of A-mode waveform when the converting sonic velocity is set at 1550m/s and the horizontal line is converted to the distance. One graduation corresponds to 5mm.

B. LIST mode

This mode is to check the measured values and A-mode waveform and to set the measured value which is used for calculating IOL refractive value.



15 Axial length [L]

This shows the last six value of axial length including the latest value. (Column 1)

16 Average [AV]

This shows the average of measured axial length.

17 Standard deviation [SD]

This shows the standard deviation of the measured axial length.

18 A-mode waveform

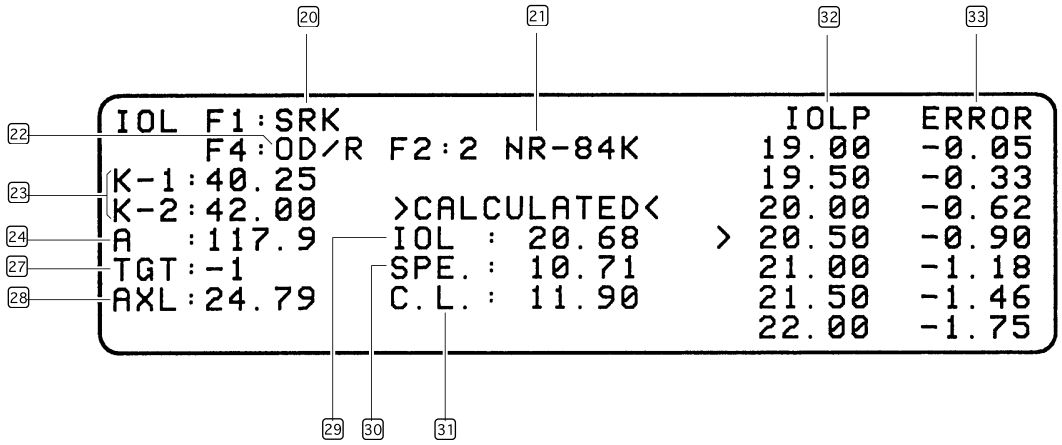
This shows the A-mode waveform of value where the cursor ( ) points.

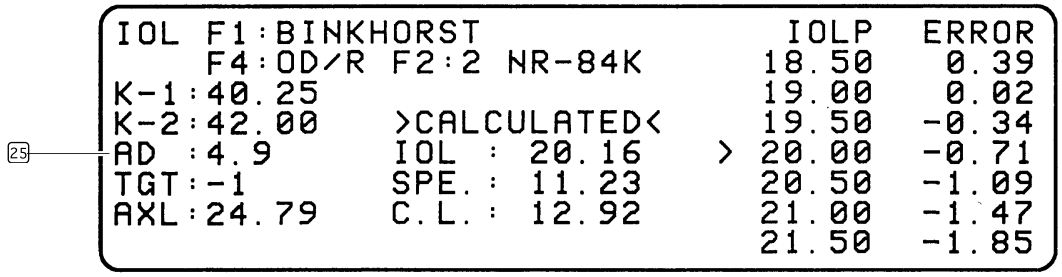
19 OD/R or OS/L display [OD/R or OS/L]

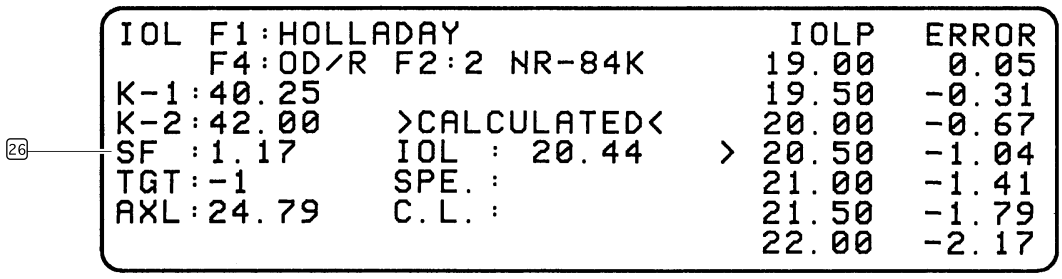
It shows that displayed data is either for right eye (OD/R) or for left eye (OS/L).
Use [F4] key to set this item.

C. IOL mode

In this mode, IOL refractive power is calculated.







20 IOL formula [SRK/SRK-2/SRK-T/BINKHORST/HOLLARDAY]

This shows the IOL formula for calculation. Use F1 key to set IOL formula.

21 IOL style

This shows the IOL style used for calculating IOL refractive power. Use F2 key to set this item.

22 OD/R or OS/L display [OD/R or OS/L]

This shows the right eye (OD/R) or left eye (OS/L) which IOL refractive power is calculated. Use F4 key set to OD/R or OS/L.

23 Corneal curvature [K-1, K-2]

This is a column to input the data of corneal curvature, which is one of the parameter for the IOL refractive power calculation.
The data can be inputted in either mm unit (Corneal radius) or D unit (Corneal refractive power).

*Corneal refractive power (D) = 337.5/Corneal radius (mm)

24 A-constant [A]

This is a column to input the A-constant of IOL which is one of the parameters for IOL refractive power calculation.

25 Predictable anterior chamber depth of postoperation [AD]

This is a column to input the predictable anterior chamber depth of postoperation which is one of the parameters for IOL refractive power calculation.

26 Surgeon factor [SF]

This is a column to input the surgeon factor which one of the parameters for IOL refractive power calculation.

27 Desired postoperative refractive power [TGT]

This is a column to input the desired post operative refractive power which is one of the parameters for IOL refractive power calculation.

28 Axial length [AXL]

This is a column of axial length which is to be used for designated calculation in LIST mode.

29 Ametropic IOL refractive power [IOL]

This shows the calculated ametropic IOL refractive power.

30 Spectacle refractive power for aphakic correction [SPE.]

This shows the calculated spectacle refractive power for aphakic correction.

31 Contact lens refractive power for aphakic correction [C.L.]

This shows the calculated contact lens refractive power for aphakic correction.

32 IOL refractive powers in diopter [IOLP]

This shows the table as the IOL refractive power which would exist and close to the value displayed on the IOL column. “>” shows the closest value to the calculated ametropic IOL refractive power.

33 Predictable postoperative refractive power [ERROR]

The predictable postoperative refractive power in the case that the IOL of the power which is displayed at [IOLP] is implanted.

§4 OPERATION

4.1 Preparation

1. **Plug the power cord in the wall outlet.**

2. **Connect the cable of the foot pedal to the pedal plug [FOOT SW.] of the rear panel.**

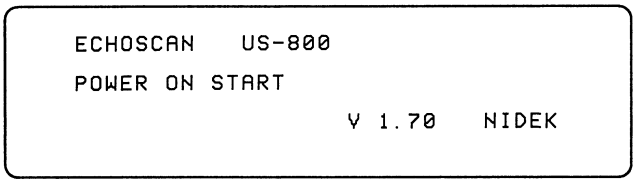
3. **Connect the cable of the solid probe to the probe connector [PROBE].**

   Insert the connector with its red mark up.

4.2 Axial Length Measurement

4.2.1 Basic operation of axial length measurement

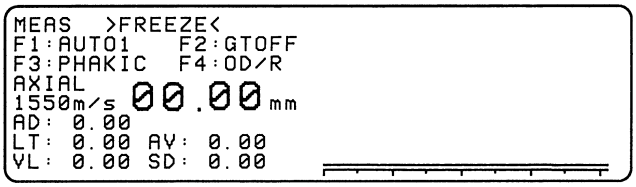
1. **Turn the power switch [POWER] ON.**
   Pressing the | side of the power switch of the rear panel will make the instrument turned ON and the POWER ON display will appear. Pressing O side of the power switch will make the instrument turned OFF.



2. **Press [MEAS] key.**

   It turns to the measuring mode.

   This key is also available for turning other mode to this measuring mode.

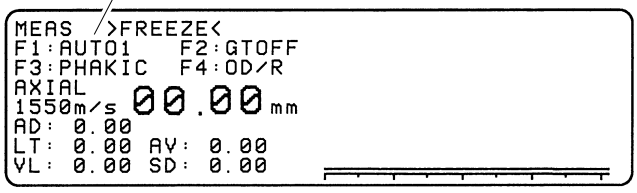


NOTE

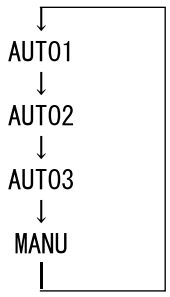
- Check the measurement and measured value by using the test piece before measure the patient's cornea. (See "**4.7 Using the Test Piece"** (P.4-28).)

3. By pressing [F1] key, select the measurement mode.

AUTO1 / AUTO2 / AUTO3 / MANU



The measurement mode changes in the following order for every pressing [F1] key.



- **Auto measurement 1 (AUTO1)**
  After the A-mode waveform is judged, the measured data will be frozen automatically.

- **Auto measurement 2 (AUTO2)**
  AUTO2 calculates the difference of two consecutive measured values, in addition to the judgement of A-mode waveform. When the difference is little, the measured data becomes frozen automatically.

- **Auto measurement 3 (AUTO3)**
  In order to freeze steady value, AUTO3 calculates the differences of three consecutive measured values, in addition to the judgement of A-mode waveform. When the differences are little, the measured data becomes frozen automatically.

- **Manual measurement (MANU)**
  Measuring will be continued without freezing though measured data is shown on the display. When good A-mode waveform is obtained, press the foot pedal or [START STOP] key to freeze it.

The AUTO2 and AUTO3 prevent the measured data affected by movement of eyeball and/or probe from being frozen. Select LTD mode in AUTO2 or AUTO3, and more steady measured data can be memorized.

When the instrument is not in LTD mode, any measured value which is obtained is memorized regardless of whether the display is frozen or not.

Press the [L] key to select LTD mode, and "LTD"(=Limited) appears on the lower section of axial length value. In this LTD mode, only when display is frozen automatically, the measured data are memorized as follows. The LTD mode works only when the measurement mode setting is AUTO2 or AUTO3.

• **LTD mode in AUTO2**
When the display is frozen automatically, the two consecutive measured data which are used to judge the stability of measured value are memorized.

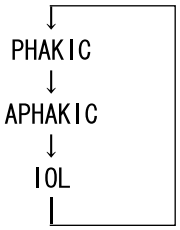
• **LTD mode in AUTO3**
When the display is frozen automatically, the three consecutive measured data which are used to judge the stability of measured value are memorized.

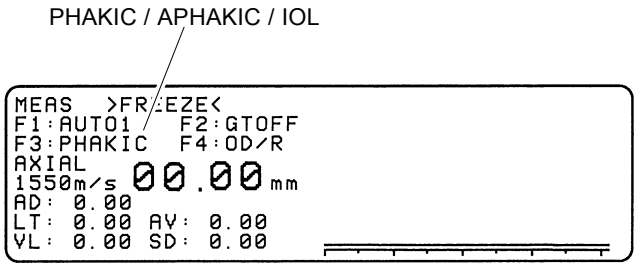
Press [L] key again, and the instrument returns to the normal condition.

The setting for measurement mode and LTD mode will remain even if the power is turned OFF.

4. By pressing [F3] key, select the condition of the patient's eye.

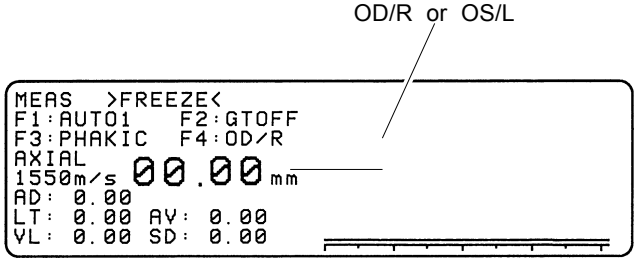
The Patient's eye condition changes in the following order for every pressing [F3] key.





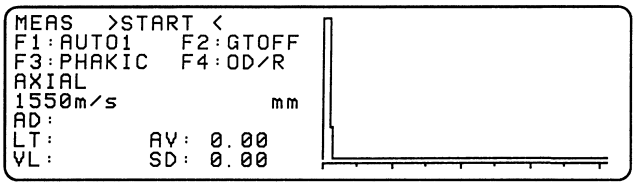
5. By pressing [F4] key, select right or left for the patient's eye.

The right eye (OD/R) and left eye (OS/L) appear alternately for every pressing [F4] key.
OD/R : Oculus Dexter/Right eye
OS/L : Oculus Sinister/Left eye



6. Press the foot pedal or [START/STOP] key.

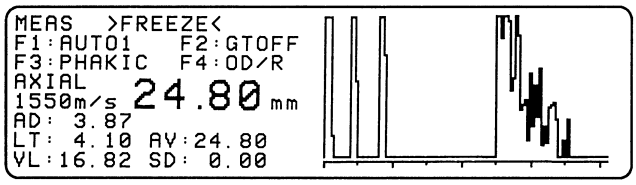
Axial length measurement starts.



7. Put the probe on the center of patient's cornea.

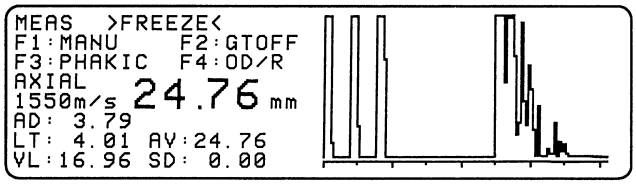
A-mode waveform and measured values appear on the display.

◎ In auto measurement (AUTO1, AUTO2, AUTO3), measured data and A-mode waveform is judged, and when good measured value is obtained, it freezes automatically.



Peep sounds give a notice that it is frozen and the measurement is finished.

◎ In manual measurement, make it freeze as soon as you recognize a good A-mode waveform by pressing the foot pedal or [START STOP] key.



The data become frozen and the measuring will be finished.
To start measurement again, press the foot pedal or [START STOP] key again. The measurement starts.

NOTE

- When measuring aphakic eye, anterior chamber depth (AD) and lens thickness (LT) are not measured.
  When measuring IOL implanted eye, lens thickness (LT) is not measured. The distance between the cornea and the anterior surface of IOL is measured as anterior chamber depth (AD).

- Auto measurement (AUTO1, AUTO2, AUTO3) is a just function to make the operation easier and is not appropriate for clinical judgement. It is essential for the operator to check the measured data before using the data to IOL refractive power calculation.

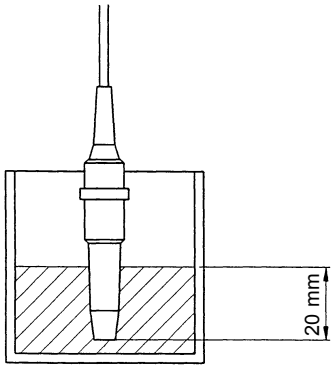
- The sonic velocity for conversion in axial length measurement is as follows.

Phakic eye	: 1550m/s (Axial length)
	: 1532m/s (Anterior chamber and Vitreous body)
	: 1641m/s (Lens)
Aphakic eye	: 1532m/s (Axial length)
IOL implanted eye	: 1554m/s (Axial length)

  * If you want to change the sonic velocities for conversion other than above, see "**4.6.4 Change of sonic velocity for conversion**"(P.4-23).
  * The sonic velocity for conversion is indicated on the left of measured data.

4.2.2 Cautions on measurement

(1) Disinfect the probe tip for every patient like the following method. And verify that there is no scratch nor chip on the surface of the probe tip.
Soak the probe tip (max. 20mm) for 10 minutes.



The medical fluids are:
1. 0.1% Chlorhexdine Gluconate Solution
2. Ethanol for Disinfection

(2) After disinfection, wipe the probe tip with the disinfected absorbent cotton containing ethanol for disinfect, and dry the probe tip before using.

(3) Instruct the patient not to move eyes. (When the patient is strained, instruct him/her to relax.)

(4) Make sure that the probe is in contact with the cornea at the center without applanation.
The contacting condition on the cornea is very important factor to obtain a correct value. Find the best position to obtain the best A-mode waveform by changing the probe contact angle. An A-mode waveform in good condition means that it has 3 echoes which are of cornea, of anterior and posterior surfaces of crystalline lens, and also has large retina echo which rises sharply and accompanied with small sclera echo in A-mode waveform display, decrease the sensitivity by turning the GAIN control counterclockwise.

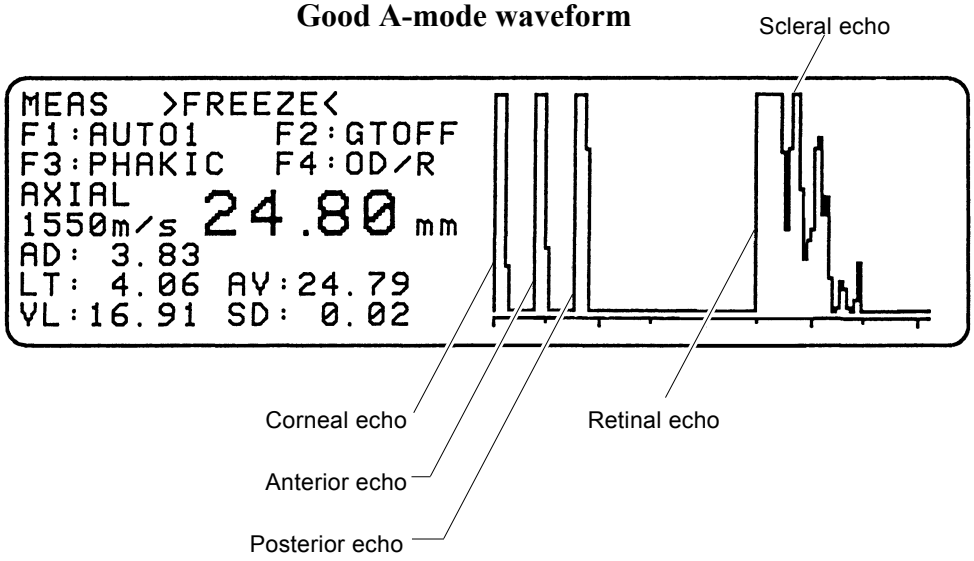
Make sure the following items before freezing the measured value.
(a) Is a good A-mode waveform obtained?
(b) Is the probe in contact with the cornea properly?
(c) Is the patient's eye fixed?
(d) Are the measured values stabilized?
(Is the tolerance of measured values within ±0.05mm?)

* If you try to measure quickly, you cannot obtain the correct values. Calm down and have time to measure.

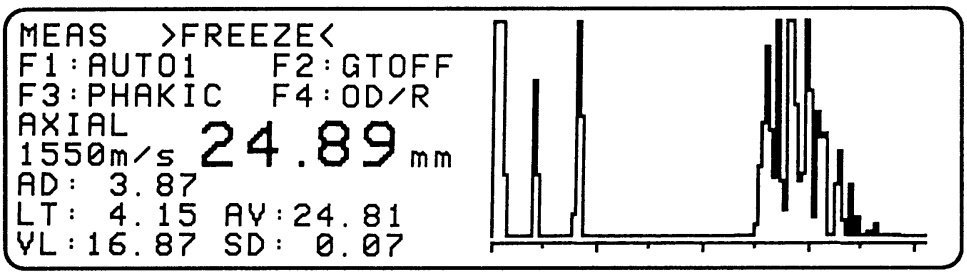
(6) In AUTO1/AUTO2/AUTO3 measurement, if the display does not freeze though measured values are shown, the reason may be; the retinal echo does not stand well, or there is no lens echo is too small (at PHAKIC measurement).

Referring to the A-mode waveform on the display, change condition of the probe contact on the cornea or the angle of the probe and measure again.

Good A-mode waveform



Bad A-mode waveform



4.2.3 Manual gate

This is used when there is an extra large echo in front of the actual retinal echo. (Including the case that there are many multiple echos of IOL when the implanted eye is measured.)

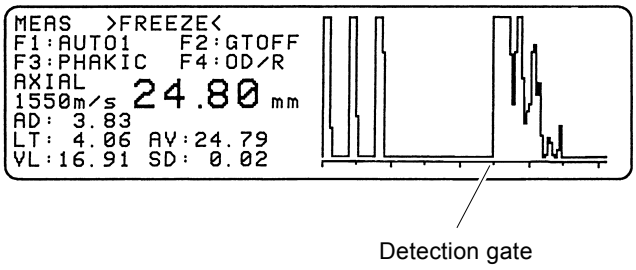
1. **Press [F2] key to input the manual gate function ON.**

   The display of "GTOFF" changes to "GTON" and the detection gate (dotted line on the A-mode wave form) appears on the display.

2. **Press arrow keys [◄] or [►] to adjust the detection gate to the position where you desire to put the manual gate.**

   Pressing arrow keys [◄] or [►] simultaneously with [SHIFT] key makes the cursor move consequently.

   Position the detection gate just to the left of rising point of the true retina echo. Any echo es at the left of detection gate are not regarded as retinal echo.



[Cautions in using manual gate]

1) When the manual gate is moved in the frozen condition, the measured value does not change simultaneously. Release the frozen condition once and measure again so that the data using the manual gate will obtained.

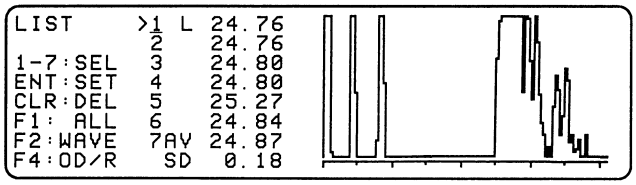
2) By pressing [F2] key again, the manual gate function can be released.

4.3 Check and Setting of the Measured Value and A-mode Waveform

(a) This instrument can memorize last 6 measured data and A-mode waveforms. It is available for you to check the measured data and A-mode waveform on the LIST mode.

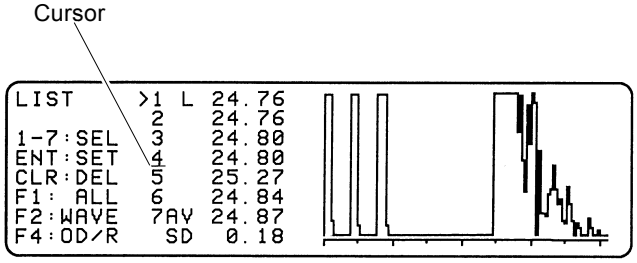
1. Press [LIST] key.

The display changes to LIST mode.



2. Press the numeric key of the desired number of the measured value for checking the A-mode waveform.

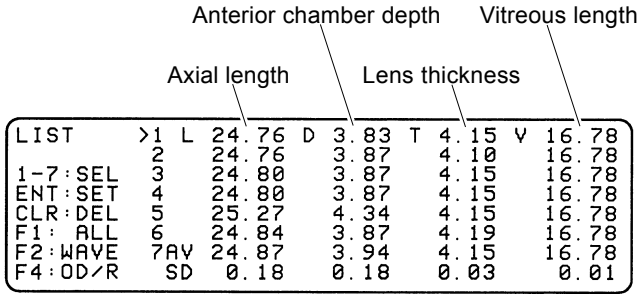
The cursor ( ) will move and the A-mode waveform will change to the corresponding No.



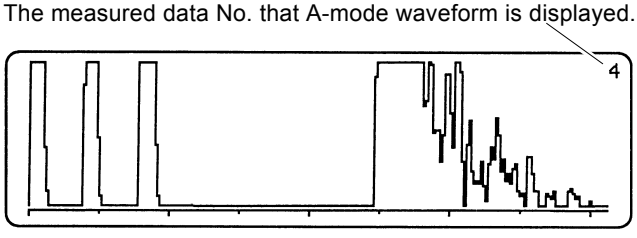
NOTE

- The cursor ( ) shows the No. of the measured value of which the A-mode waveform is shown on the display.
- The lowest number shows the latest frozen data.

Press [F1] key to check anterior chamber depth, lens thickness, and vitreous length.



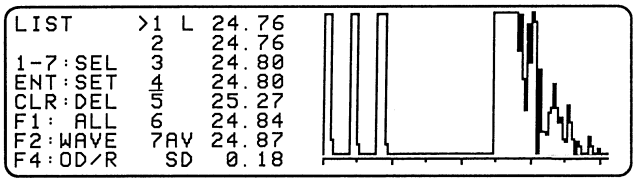
Press [F2] key to magnify the A-mode waveform for checking.
The A-mode waveform will be enlarged double in horizontal direction.



(b) Operate as follows to set the measured data which is used for the calculation of IOL refractive power.

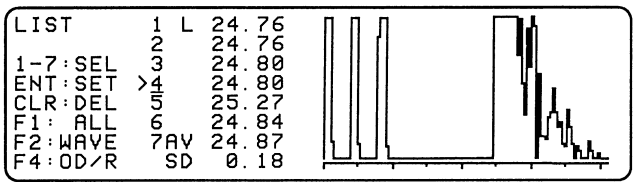
1. In LIST mode, press a numeric key ([1] - [7]) of the measured data No. which is used for calculating.

No.7 shows the average value of No.1 - No.6.



2. Press [ENTER] key.

">" mark is indicated at the selected number.



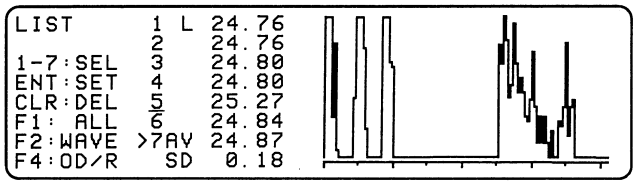
NOTE

- The measured value of the number with ">" mark is used for the calculation of IOL refractive power. (This value is automatically inputted at IOL refractive power calculation.)
  The ">" mark is usually indicated at No.1, so the latest measured value is used for calculating unless it is changed in above steps.
- The measured value No.1 in which the value of L (Axial Length) is 0.00 cannot be used for IOL refractive power calculation.
- If you set No.7, the average (AV) of the measured values No.1 - 6 will be used for IOL refractive power calculation.

(c) For using the average measured value of No.7 for IOL refractive power calculation, the measured value which vary widely can be erased by edit function to decrease the standard deviation [SD].

1. Press the number key ([1] - [6]) of the measured value to be erased.

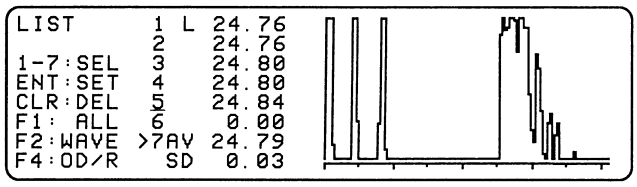
Cursor ( ) will move and the A-mode waveform changes to the corresponding one of number.



2. Press [CLEAR] key.

The line of the selected measured value will disappear and the next line moves up.

The average and standard deviation will be calculated again and indicated on the display.

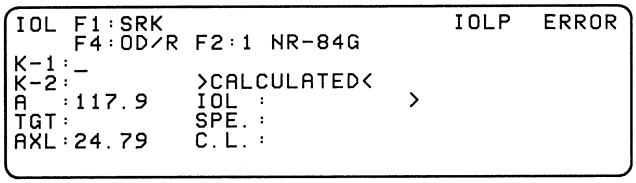


4.4 Calculation of IOL Refractive Power

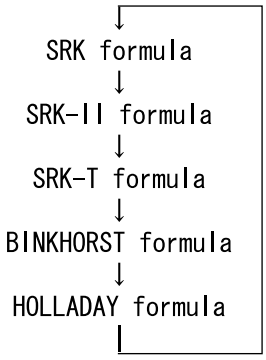
4.4.1 Calculation

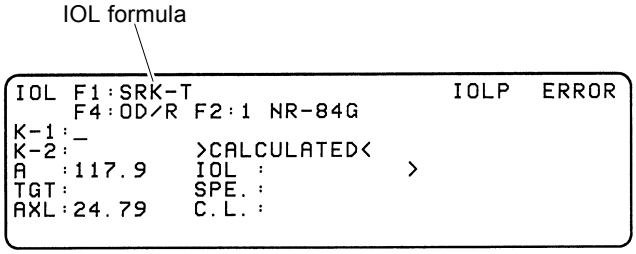
1. **Press [CALC] key.**

   The display changes to IOL mode. The IOL A-constant (for SRK formula, SRK-II formula, and SRK-T formula), ACD value (for BINKHORST formula), or SF value (for HOLLADAY formula) and measured axial length will be automatically inputted. (See Note 4th item).)



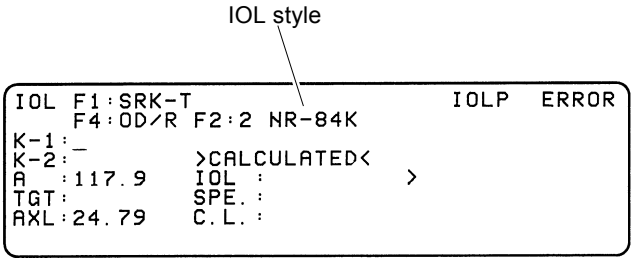
2. **Press [F1] key to select the IOL formula.**





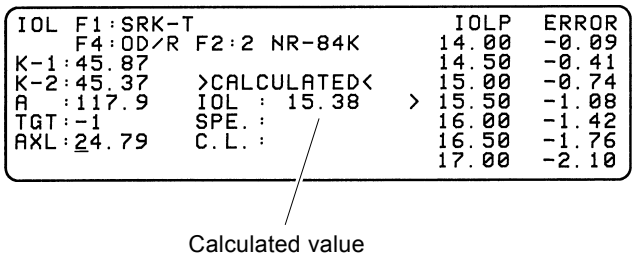
3. **Press [F2] key to select the IOL style which is used for calculating.**

   IOL can be select from the IOL styles which is inputted at "**4.6.1 Registration of IOL**"(P.4-18).
   By selecting the IOL style, the IOL A-constant, ACD value, or SF value is automatically determined. If you have no registered IOL data, follow the instructions in step **4.** to input A-constant, ACD value, or SF value.



4. Input the data necessary for calculation. After inputting each data with the numeric keys, press [ENTER] key.

After inputting all the data, calculated data will be indicated.



* K-1 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.)
  K-2 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.) Corneal refractive power [D] = 337.5/Corneal radius [mm]
  AXL : Axial length [mm]
  TGT : Desired postoperative refractive power [D]
  A : A-constant
  AD : Predictable postoperative anterior chamber depth (ACD)
  SF : Surgeon factor
  IOL : Ametropic IOL refractive power [D]
  SPE. : Spectacle refractive power for aphakia correction
  C.L. : Contact lens refractive power for aphakia correction

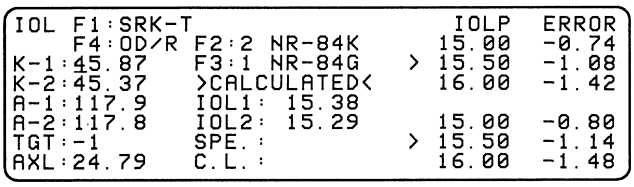
NOTE

- For the line that the data is already inputted, just press [ENTER] key to proceed.
- On the right of computed data, the display shows the predictable postoperative refractive power (ERROR) when the IOL of which IOL refractive power would exist (IOLP) is implanted.
- There are some IOL formulas that SPE. and C.L. values are not calculated. (For details, see "**6. IOL Formula**"(P.6-1).)
- The measured value of the axial length which is inputted automatically is the data that you set in the process of "**4.3 Check and setting of measured Value and A-mode Waveform**"(P.4-8).

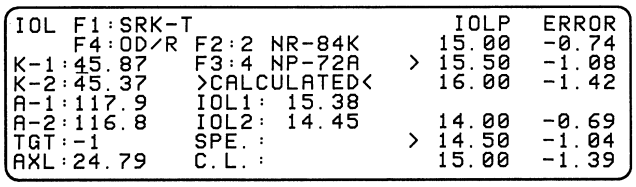
[How to compare with other IOL calculated data]

5. Press [CALC] key.

The display shows IOL mode that the results of calculated data of 2 IOLs are displayed simultaneously.
By pressing the [CALC] key again, the display returns to the previous IOL mode.



6. Press [F3] key to select the other IOL data to be calculated.



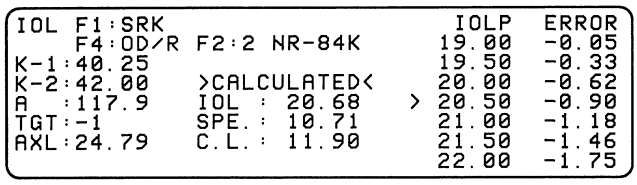
* A-1 : A-constant of IOL which is set with [F2] key.
A-2 : A-constant of IOL which is set with [F3] key.
AD1 : Predictable postoperative anterior chamber depth (ACD) of IOL which is set with [F2] key.
AD2 : Predictable postoperative anterior chamber depth (ACD) of IOL which is set with [F3] key.
SF1 : The surgeon factor of IOL which is set with [F2] key.
SF2 : The surgeon factor of IOL which is set with [F3] key.
IOL1 : Ametropic IOL refractive power [D] which is set with [F2] key.
IOL2 : Ametropic IOL refractive power [D] which is set with [F3] key.

NOTE

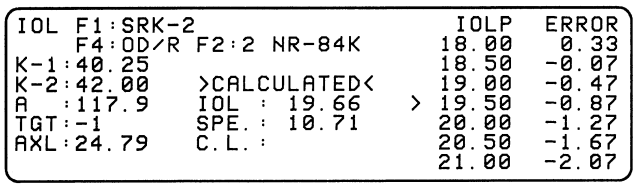
- On the right of the computed data, the display shows the predictable postoperative refractive power (ERROR) that the IOL of which IOL refractive power would exist (IOLP) is implanted. The data of IOL, which is set with [F2] key comes to the upper position, and the other data of IOL which is set with [F3] key comes to the lower position.

4.4.2 Examples of IOL refractive power calculation

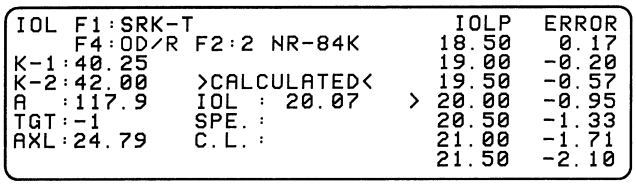
Ex. (1) Calculation with SRK formula



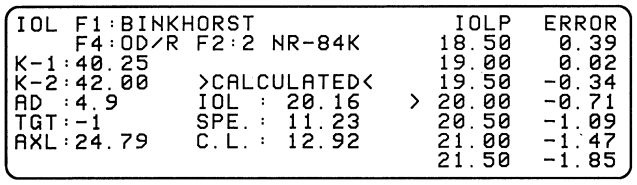
Ex. (2) Calculation with SRK-II formula



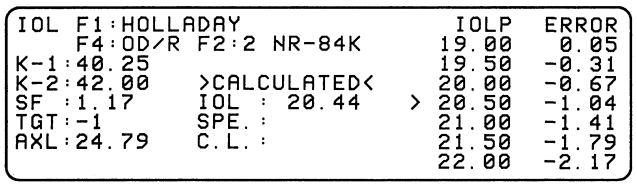
Ex. (3) Calculation with SRK-T formula



Ex. (4) Calculation with BINKHORST formula



Ex. (5) Calculation with HOLLADAY formula

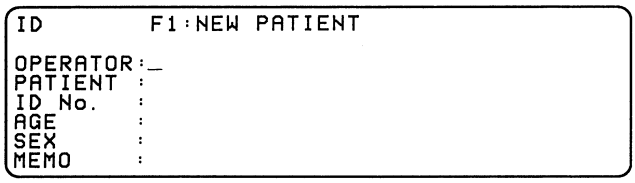


4.5 ID Function

4.5.1 Inputting of patient's data

1. **Press [ID] key.**

   The display changes to the ID mode.

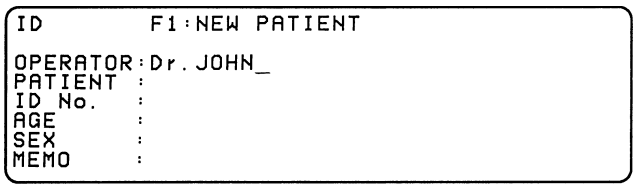


2. **Input the operator's name with alphabetic keys.**

   To input small letters, press alphabetic keys while pressing [SHIFT] key.

   To correct the misinput, press [CLEAR] key.

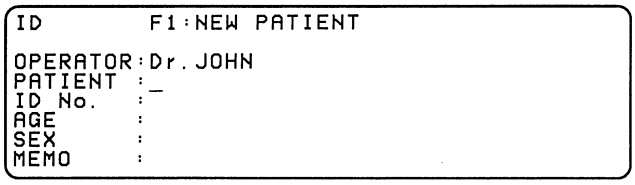
   It is available to input up to 30 letters.



3. **Press [ENTER] key after inputting the name.**

   The cursor ( ) moves from "OPERATOR" to "PATIENT".

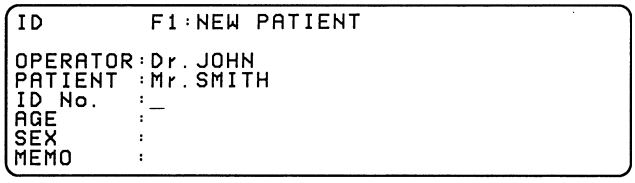
   The operator's name stays after power is turned OFF, so you do not have to re-input the operator's name unless there are any changes. Just press [ENTER] key. If you do not have any changes for other items, just press [ENTER] key as well.



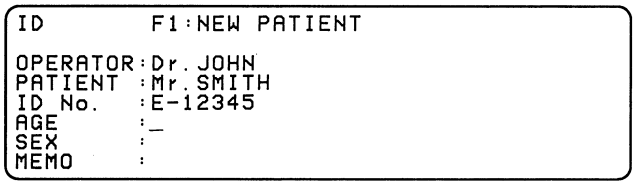
4. **Input the patient's name with alphabetic keys and press [ENTER] key.**

   It is available to input up to 30 letters.

   The cursor ( ) moves from "PATIENT" to "ID No.".



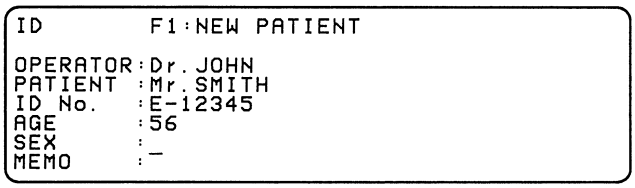
5. Input the ID No. of the patient with numeric keys and alphabetic keys. The press [ENTER] key.



It is available to input up to 30 letters.

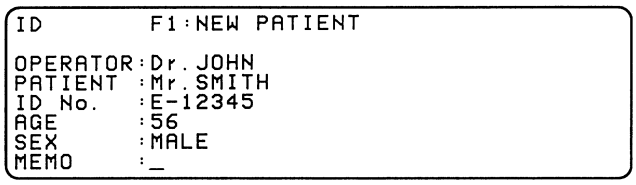
The cursor ( ) moves from "ID No." to "AGE".

6. Input the patient's age with numeric keys and press [ENTER] key.



The cursor ( ) moves from "AGE" to "SEX".

7. Input the patient's sex with numeric keys and press [ENTER] key.



It is available to input up to 6 letters.

The cursor ( ) moves from "SEX" to "MEMO".

8. It is available to input anything in this MEMO space if necessary, using either alphabetic keys or numeric keys. After the input, press [ENTER] key.

It is available to input up to 30 letters.

To change the inputted comments, press [ENTER] key to move the cursor until it comes to desired item, and re-input as shown above.

4.5.2 Delete function

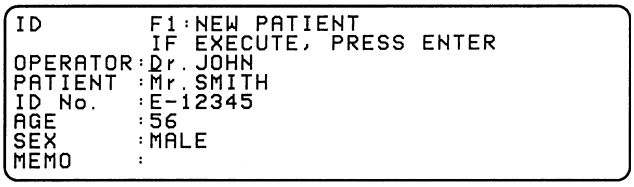
When measuring new patient, it is convenient to delete the previous patient's data such as A-mode waveform, measured data, and patient's data (except the operator's name) with delete function.

1. **Press [ID] key.**

   The display changes to ID mode.

2. **Press [F1] key.**

   If you pressed [F1] key by mistake, press any key except [ENTER] key to return the ID mode.



3. **Press [ENTER] key.**

   All the peculiar data for individual patients will be deleted.

NOTE

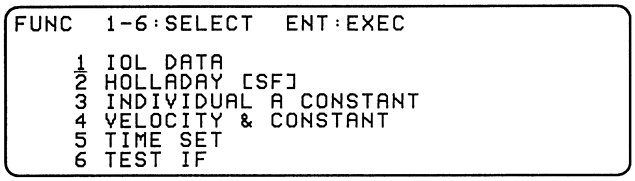
- Data which is deleted with this operation:
  Patient's name, ID No., age, sex, memo, OD/R or OS/L, A-mode waveform, measured value, measuring eye condition, inputted values for IOL calculation (except ACD value, A-constant, and SF value), and computed value.
  * Operator's name, sonic velocity, IOL formula, IOL data, and the constant are not deleted.

4.6 Other Functions

4.6.1 Registration of IOL data

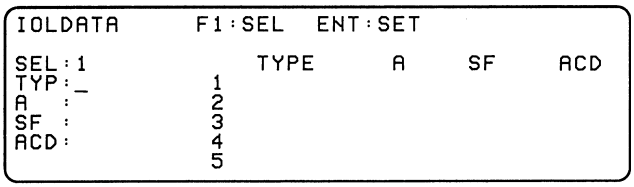
1. **Press [FUNC] key.**

   The display changes to the function menu.



2. **Press numeric key [1] to set the IOL data registration function "1 IOL DATA", then press [ENTER] key.**

   The display changes to IOL data registration mode.

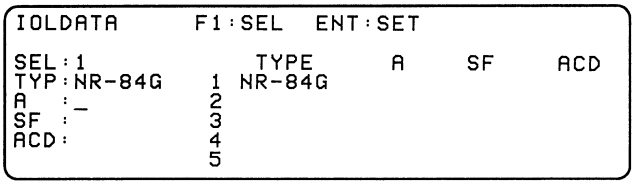


3. **Press [F1] key to set open space or IOL data No.(1 - 5) that you want to exchange.**

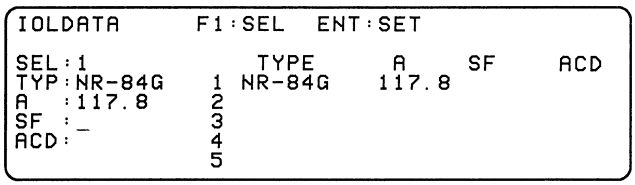
   The set No. will be shown on the SEL column on the left.

4. **Input the IOL style name with alphabetic keys and numeric keys, then press [ENTER] key.**

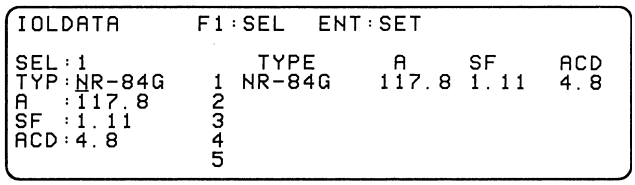
   It is available to input up to 8 letters.



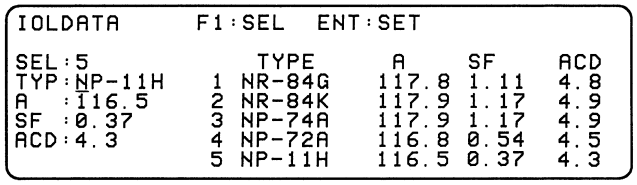
5. Input A-constant of the IOL with numeric keys, and press [ENTER] key.



6. Input SF value and ACD value as well.



7. To continue further registration, repeat the steps of 3. - 6.



NOTE

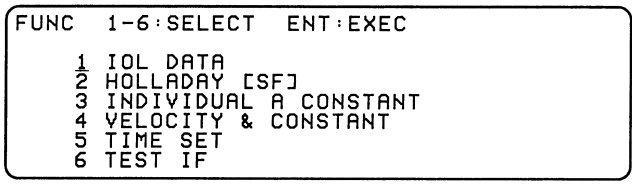
- Registration of IOL data can be made up to 5 IOLs.
- The registered IOL data will be kept in a memory though the power is turned OFF since it has an internal battery.

4.6.2 SF value reverse calculation function

According to Dr.Holladay's reverse calculation formula, SF value can be calculated reversely with IOL refractive power and the measured postoperative refractive power.
SF value is the correction value of each operator for each IOLs.

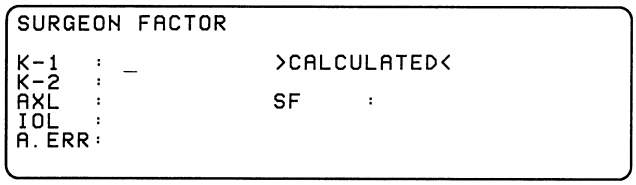
1. **Press [FUNC] key.**

   The display changes to the Function menu mode.



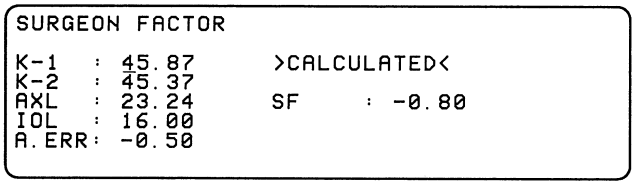
2. **Press numeric key [2] key to set SF value reverse calculation function "2 HOLLADAY [SF]". Then press [ENTER] key.**

   The display changes to SF value reverse calculation mode.



3. **Input the required data for calculation. After inputting data for each items with numeric keys, press [ENTER] key.**

   When all the data is inputted, the calculated value will be indicated.



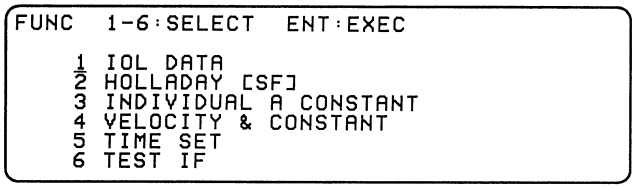
* K-1 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.)
K-2 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.)
Corneal refractive power [D] = 337.5/Corneal radius [mm]
AXL : Axial length [mm]
IOL : Actual power of IOL implanted [D]
A.ERR : Actual postoperative refractive power [D]
SF : Surgeon factor

4.6.3 Individual A-constant calculation function

According to the formula of Dr. Sanders, Dr. Retzlaff, Dr. Kraff, individual A-constant can be calculated from IOL postoperative refractive power and measured refractive power.
Individual A-constant is an A-constant including the correction of each operator for each IOL style.

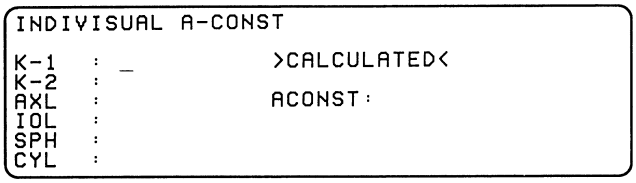
1. **Press [FUNC] key.**

   The display changes to Function menu.



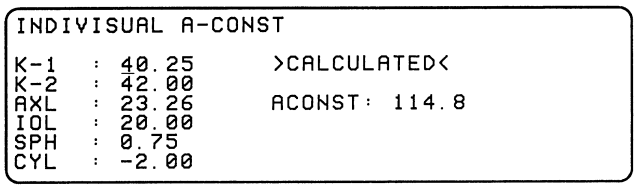
2. **Press numeric key [3] to set individual A-constant calculation function "3 INDIVIDUAL A CONSTANT". Then press [ENTER] key.**

   The display changes to individual A-constant calculation mode.



3. **Input the required data. After inputting data to each item with numeric keys, press [ENTER] key.**

   When all the data is inputted, the calculated value will be indicated.



* K-1 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.)
K-2 : Corneal curvature (Either Corneal radius [mm] or Corneal refractive power [D] can be inputted.)
Corneal refractive power [D] = 337.5/Corneal radius [mm]
AXL : Axial length [mm]
IOL : Refractive power of IOL implanted [D]
SPH : Actual postoperative spherical refractive power [D]
CYL : Actual postoperative cylindrical refractive power [D]
ACONST: Calculated A-constant

* Concerning to the patient of one surgeon, sum up calculated A-constant for each style IOL and get their average value to make it as individual A-constant. Use this individual A-constant instead of the A-constant that makers offer as a reference value so that you utilize it for more precise calculation of IOL refractive power. If there are some data which is extremely large or small among the calculated A-constant, it may give bad effect to the individual A-constant. Eliminate such values which are varied widely for getting more precise individual A-constant. The more data the calculation is based on, the more precise the individual A-constant becomes.

NOTE

- Individual A-constant can only be added and divided for each IOL style and for each individual surgeon. It is no use mixing IOLs of different style or different maker or mixing the data of two or more surgeons.

4.6.4 Change of sonic velocity for conversion

Usually, sonic velocity for conversion is set as follows.

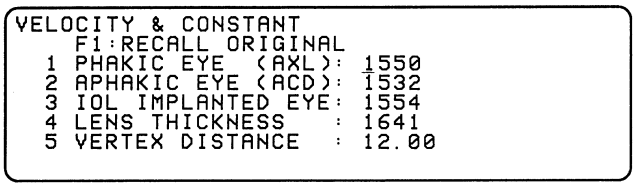
[Axial Length measurement]
Phakic eye
Axial length : 1550m/s
Anterior chamber and vitreous body : 1532m/s (Same as Aphakic eye)
Lens: : 1641m/s
Aphakic eye : 1532m/s
IOL implanted eye : 1554m/s

1. **Press [FUNC] key.**

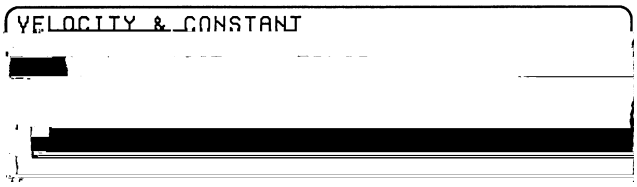
   The display changes to the function menu.

2. **Press numeric key [4] to set the change function of sonic velocity for conversion and IOL formula constant "4 VELOCITY & CONSTANT", then press [ENTER] key.**

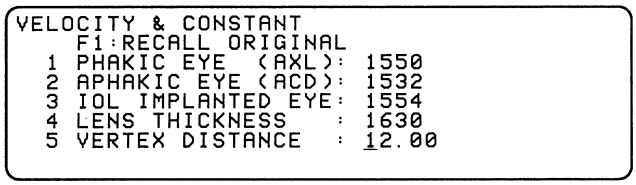
   The display changes to the change function of sonic velocity and constant.



3. **Press [ENTER] key to bring the cursor ( ) to the column of the sonic velocity that you want to change.**



4. **Input the new sonic velocity and press [ENTER] key.**



NOTE

- To return to usual present values, press [F1] key.
- To change the sonic velocity for conversion of phakic anterior chamber and vitreous, change the sonic velocity of aphakic eye.
- The sonic velocity for conversion will be kept in a memory though the power is turned OFF since it has an internal battery.

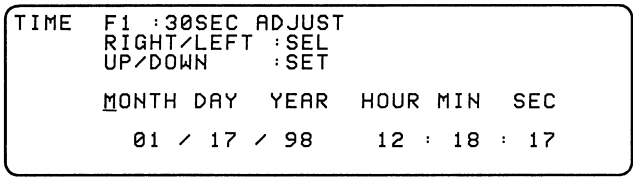
4.6.6 Setting of date and time

1. **Press [FUNC] key.**

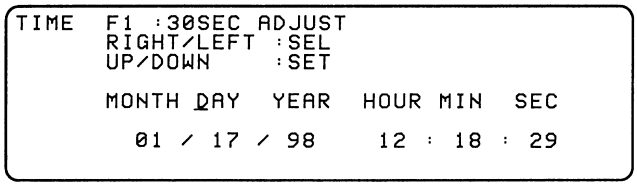
   The display changes to Function menu.

2. **Press numeric key [5] to set the date and time setting function "5 TIME SET", then press [ENTER] key.**

   The display changes to the date and time setting mode.

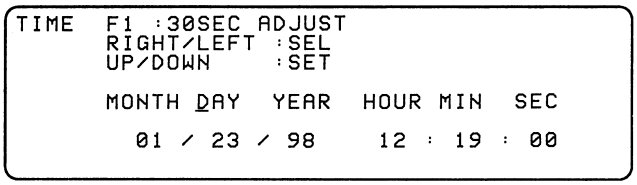


3. **Press arrow keys ([◄],[►]) to bring the cursor ( ) to the item that you want to change.**

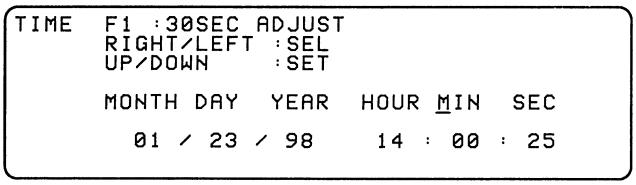


4. **Press arrow keys ([▲],[▼]) to change the parameter to desired number.**

   Input the hour "HOUR" with 24 hours' indication.

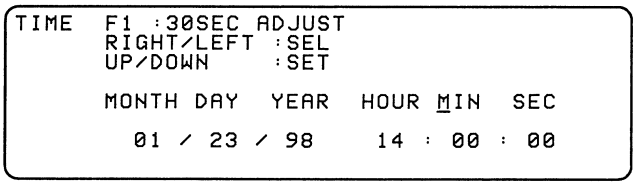


5. **Repeat the step 3. and 4. to set the rest of the items.**



6. **Press [F1] key to set the seconds.**

   By pressing [F1] key,
   N:00 - N:29 sets to N:00
   N:30 - N:59 sets to N+1:00



NOTE

- Since the instrument has internal battery, the clock keeps on working even though the power is cut off.

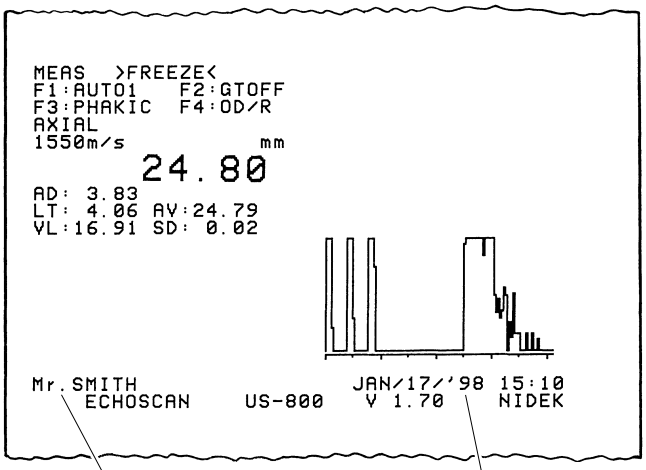
4.6.7 Check of communication function

The “6 TEST IF” in the function menu is the mode that service person uses to check the communication function. Nobody except the service person should use this mode.

4.6.8 Printing out

By pressing [PRINT] key, the contents shown on the display can be printed out.

- Characters are printed on the upper part and A-mode waveform is printed at the lower part.
- The date of the operation is printed at the bottom.
- If you have registered the patient's name at ID mode, it will be printed at the left bottom.



Patient's name

Date and time of printing out

NOTE

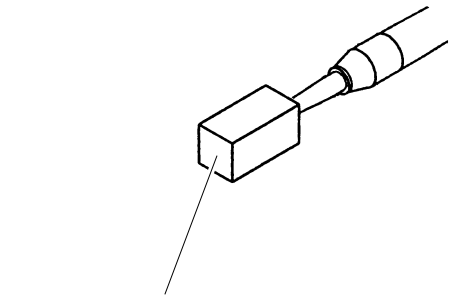
- Do not press the [PRINT] key when printer paper is not set. It peeps and the printer stops operation. Set the printer paper and press [FEED] key to make the printing operation available.
- Do not touch the printer paper while printing out. The printing may be disturbed or too light.
- On measurement mode, the display needs to be freeze condition when printing out.
- No other operation is available while printing out.

4.7 Using the Test Piece

The test piece is attached to the Axial length measuring solid probe to check the measurement and measured value.

1. **Wet the tip of the solid probe with water.**

2. **Put the tip of the probe vertically on the square surface of the test piece, and measure according to the instruction in "4.2.1 Basic operation of axial length measurement".**
   If the measured data is within the range of the numbers written on the test piece, it shows that the instrument is working well.



NOTE

- When anything contacts to the surface opposite to the probe-contacted side of the test piece, enough echo may not be obtained. Be careful not to contact anything on the opposite surface when measuring.
- Measure with the temperature of test piece at 20ºC.
- Set the condition of the patient's eye to "PHAKIC" for measuring.
- If the sonic velocity for conversion is changed, reset the value back to "Axial Length : 1550m/s". (See "**4.6.4 Change of sonic velocity for conversion"** (P.4-23).)

§5 MAINTENANCE

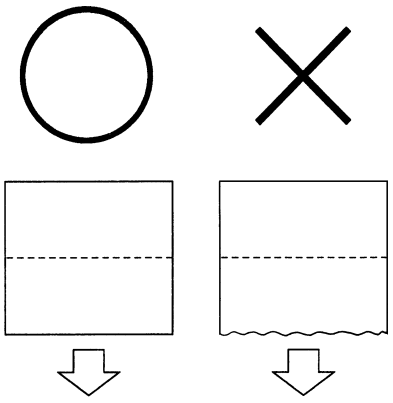
5.1 Replacement of Printer Paper

When a pink line appears on either side of printer paper, it means that the paper is running short. In such a case, stop using the printer and replace the paper with new one.

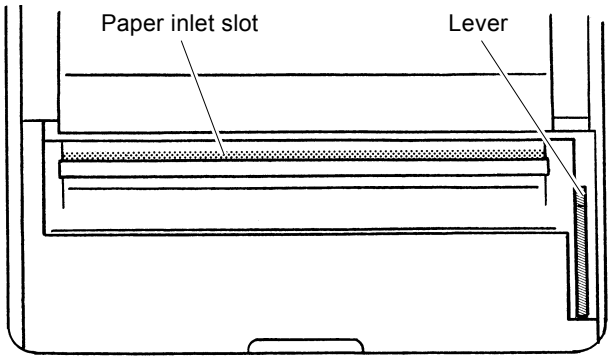
NOTE

- Do not press [PRINT] key when printer paper is not set. If you do so, it peeps and the printer stops operation. Set the printer paper and press [FEED] key to make the printing operation available.
- Do not pull the paper in the printer forcefully.

1. **Open the printer cover.**
2. **Cut off the old printer paper and let the rest of the paper out by pressing [FEED] key.**
3. **Take out the old printer paper roll.**
4. **Cut off the tip of the paper with scissors to straighten it.**

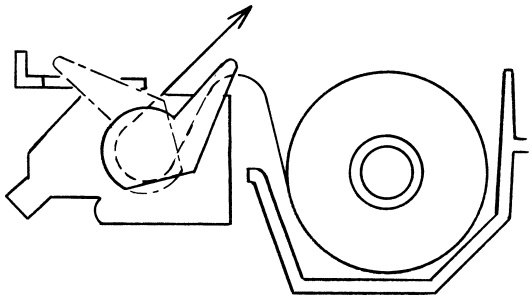


5. **Pull the lever.**



6. **Put the printer paper into the paper inlet slot and pass it through the printer.**

   Insert the paper with its outer side down.



7. **After checking that the printer paper is set straight, lay the lever down toward yourself.**

8. **Pass the printer paper through the printer cover.**

9. **Shut the printer cover.**

NOTE

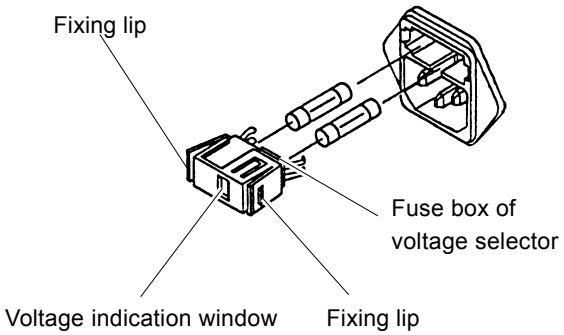
- Be sure to lay the lever down before closing the printer cover. It you press [PRINT] key at the condition that the lever is up, it peeps and the printer stops operation. Set the printer paper and press [FEED] key to key make the printing operation available.

5.2 Replacement of Fuse

When the instrument does not work though the power is ON (|), the fuse may be blown. In such a case, replace them.

1. **Turn the power OFF (○) and unplug the power cord from the power cord inlet.**

2. **Push the both sides of the fuse holder to release the fixing lips, and pull it out.**



NOTE

- The fuse holder is also used as the voltage selector. Be careful not to change the numbers which is indicated at the voltage indication window.

3. **Exchange the fuses and put the fuse holder back to where it was.**

NOTE

- Use the fuses of slow-blow type (5×20mm) which is indicated on the label at the side of fuse holder.
- Be sure to replace both two fuses at the same time.
- If the fuse is blown again, contact your authorized distributor.

5.3 Cleaning of Exterior

When the instrument becomes dirty, wipe it with a dry and soft cloth. To remove stubborn dirt, immerse a cloth in a neutral detergent, wring the it well, then wipe the instrument to remove the dirt. Wipe it with a dry and soft cloth after that. Never use the organic/abrasive solvent to clean the exterior of the instrument as it may ruin the appearance.

5.4 Selecting of the Voltage

When the line voltage is different from the rating plate of the voltage selector, change the voltage of the voltage selector as follows.

1. **Turn the power off (○) and unplug the power cord from the power cord inlet.**
2. **Push the both sides of the fuse holder with voltage selector to release the fixing lips, and pull it out.**
3. **Pull the fuse box of the voltage (illustrated in the figure on P. 5-3), and change the voltage of the voltage selector.**
4. **Put the fuse holder.**

(Setting range of the voltage selector)
100: 100V~
120: 120V~
220: 220V~
240: 230 · · 240V~

NOTE

- After changing the voltage by the above procedures, check the number which is indicated at the voltage indication window.

5.5 List of Parts for Replacement

ARTICLES	Unit	Order Number
Printer Paper	1 roll	80620-00008
Fuse T1.6A (for 100, 120V)	2 pcs.	80402-02040
Fuse T1A (for 220, 240V)	2 pcs.	80402-02039

§6 IOL FORMULA

6.1 Outline of IOL Formula

(1) **SRK (SANDERS-RETZLAFF-KRAFF), SRK-II, and SRK-T formula**
These programs are based on the formula of Dr. Sanders, Dr. Retzlaff and Dr. Kraff. SRK formula is the most famous one among the regression formulas. SRK-II is the corrected SRK formula, and SRK-T is a theoretical formula.

(2) **BINKHORST formula**
This program is based on the formula of Dr. Binkhorst in order to calculate the refractive power of IOL. This is the most famous formula among the theoretical formulas.

(3) **HOLLADAY formula**
This program is based on the formula of Dr. Holladay. It calculates reversely the SF value from the stable postoperative refractive power to make correction of the operator for each IOL.

6.2 SRK Formula

(1) IOL refractive power for ametropia (IOL)
$IOL = A - 2.5 \times AL - 0.9 \times (-DR) \times (0.0875 \times A - 8.55)$

(2) Postoperative refractive error (ERROR)
$ERROR = (A - 2.5 \times AL - 0.9 \times K - LP) / (0.0875 \times A - 8.55)$

(3) Refractive power for aphakic spectacle correction (SPECS.)
$SPECS. = 80.4 - 1.65 \times AL - 0.7 \times K$

(4) Refractive power for aphakic contact lens correction (C.L.)
$C.L. = 85.8 - 1.87 \times AL - 0.67 \times K$

Note
K : Corneal refractive power [D]
AL : Axial length [mm]
A : A-constant
DR : Desired postoperative refractive power of corrective lens [D]
(+value: hyperopia, –value: myopia)
LP : IOL refractive power to be implanted [D]

6.3 SRK-II Formula

(1) IOL refractive power for ametropia (IOL)
$IOL = A' - 2.5 \times AL - 0.9 \times K - DR \times CR$

(2) Postoperative refractive error (ERROR)
$ERROR = (A' - 2.5 \times AL - 0.9 \times K - LP) / CR$

(3) Refractive power for aphakic spectacle correction (SPECS.)
$SPECS. = 80.4 - 1.65 \times AL - 0.7 \times K$

(4) Individual A-constant
$A_{INDIV} = SEQ \times R_F + LP + 2.5 \times AL + 0.9 \times K - C$

Note
AL : Axial length [mm]
K : Corneal refractive power [D]
A : A-constant
DR : Desired postoperative refractive power of corrective lens [D]
(+value: hyperopia, –value: myopia)
LP : IOL refractive power to be implanted [D]
A′ : Correction value of A-constant $A' = A + C$
C :
$AL < 20.0mm$ C = 3
$20.0mm \leqq AL < 21.0mm$ C = 2
$21.0mm \leqq AL < 22.0mm$ C = 1
$22.0mm \leqq AL < 24.5mm$ C = 0
$24.5mm \leqq AL$ C = –0.5
CR : Constant for calculation
$P \leqq 14.0$ CR = 1.00
$P > 14.0$ CR = 1.25
* $P = A' - 2.5 \times AL - 0.9 \times K$
SEQ : $SEQ = SPH + (CYL / 2)$ [D]
SPH : Actual postoperative spherical refractive power [D]
CYL : Actual postoperative cylinderical refractive power [D]
R_F : $LP > 16$ $R_F = 1.25$
$LP \leqq 16$ $R_F = 1.00$

6.4 SRK-T Formula

(1) IOL refractive power for ametropia (IOL)

$$IOL = \frac{1000 \times n_a \times (n_a \times R - n_c ml \times LO - 0.001 \times DR}{(LO - AD') \times (n_a \times R - n_c ml \times AD' - 0.001 \times DR} \quad \frac{\times (V \times n_a \times R - n_c ml \times LO) + LO \times R))}{\times (V \times n_a \times R - n_c ml \times AD') + AD' \times R))}$$

(2) Postoperative refractive error (ERROR)

$$ERROR = \frac{1000 \times n_a \times (n_a \times R - n_c ml \times LO) - LP \times (LO - AD')}{n_a \times (V \times (n_a \times R - n_c ml \times LO) + LO \times R) - 0.001 \times LP} \quad \frac{\times (n_a \times R - n_c ml \times AD')}{\times (LO - AD') \times (V \times (n_a \times R - n_c ml \times AD') + AD' \times R}$$

Note

- R : Corneal radius [mm] $R = 337.5/K$
- LO : AL + RT [mm]
- RT : Retinal thickness [mm] $RT = 0.65696 - 0.02029 \times AL$
- AL : Axial length [mm]
- AD′ : Estimated postoperative anterior chamber depth for patient [mm]
  $AD' = H + OF \quad OF = AD - 3.336$
- AD : Predictable postoperative anterior chamber depth [mm]
  $AD = 0.62467 \times A - 68.747$
- A : A-constant
- H : Height of corneal dome [mm] $H = R - \sqrt{R \times R - ((C_w \times C_w)/4)}$
  However, in the case of $(R \times R - ((C_w \times C_w)/4)) < 0$, $H = R$
- C_w : Computed corneal width [mm] $C_w = -5.41 + 0.58412 \times LC + 0.098 \times K$
- LC : Corrected axial length [mm]
  In the case of $AL \leqq 24.2$, $LC = AL$
  In the case of $AL > 24.2$, $LC = -3.446 + 1.716 \times AL - 0.0237 \times AL^2$
- DR : Desired postoperative refractive power of corrective lens [D]
- LP : IOL refractive power to be implanted [D]
- V : Vertex distance (= 12mm)
- n_a : Refractive index of aqueous and vitreous (= 1.336)
- n_c : Refractive index of cornea (= 1.333)
- $n_c ml$: $n_c - 1$ (= 0.333)

6.5 BINKHORST Formula

(1) IOL refractive power for ametropia (IOL)

$$IOL = \frac{1000 \times N2 \times (N2 \times R - (N1 - 1) \times AL' - 0.001 \times DR}{(AL' - AD) \times (N2 \times R - (N1 - 1) \times AD - 0.001 \times DR}$$

$$\times (VD \times (N2 \times R - (N1 - 1) \times AL') + AL' \times R))$$
$$\times (VD \times (N2 \times R - (N1 - 1) \times AD) + AD \times R))$$

(2) Postoperative refractive error (ERROR)

$$ERROR = \frac{1000 \times N2 \times (N2 \times R - (N1 - 1) \times AL') - LP \times (AL' - AD)}{N2 \times (VD \times (N2 \times R - (N1 - 1) \times AL') + AL' \times R) - 0.001}$$

$$\times (N2 \times R - (N1 - 1) \times AD)$$
$$\times LP \times (AL' - AD) \times (VD \times (N2 \times R - (N1 - 1) \times AD) + AD \times R + \frac{1}{RD}$$

(3) Refractive power for aphakic spectacle correction (SPECS.)

$$SPECS. = \frac{1000 \times N2 \times (N2 \times R - (N1 - 1) \times AL')}{N2 \times (VD \times (N2 \times R - (N1 - 1) \times AL') + AL' \times R)} + \frac{1}{RD}$$

(4) Refractive power for aphakic contact lens correction (C.L.)

$$C.L. = \frac{1000 \times N2 \times (N2 \times R - (N1 - 1) \times AL')}{N2 \times AL' \times R} + \frac{1}{RD}$$

Note
- AL′ : AL + B – T × (1 – N2/N3)
- N1 : Corneal refractive index (= 4/3 (= 1.333…))
- N2 : Refractive index of aqueous and vitreous (= 1.336)
- N3 : IOL refractive index (= 1.49)
- B : Distance from the vitreoretinal interface to the visual cell rayer (= 0.25mm)
- T : IOL thickness to be implanted (= 0.5mm)
- RD : Refractive distance (= 6m)
- R : Corneal radius [mm] R = 337.5/K
- AD : Predictable postoperative anterior chamber depth [mm]
- AL : Axial length [mm]
- LP : IOL refractive power to be implanted [D]
- DR : Desired postoperative refractive power of corrective lens [D] (+value: hyperopia, –value: myopia)
- VD : Vertex distance (Spectacles : 12mm, Contact lens : 0mm)007 Tc=0.003Sn1=cleT) 1Spe C

6.6 HOLLADAY Formula

(1) IOL refractive power for ametropia (IOL)

$$IOL = \frac{1000 \times N \times (N2 \times R - (N1 - 1) \times Alm - 0.001 \times DR}{(Alm - AD - SF) \times (N2 \times R - (N1 - 1) \times (AD + SF) \times 0.001 \times DR}$$

$$\frac{\times (VD \times (N2 \times R - (N1 - 1) \times Alm) + (Alm \times R))}{\times (VD \times (N2 \times R - (N1 - 1) \times (AD + SF)) + (AD + SF) \times R))}$$

(2) Postoperative refractive error (ERROR)

$$ERROR = \frac{1000 \times N2 \times (N2 \times R - (N1 - 1) \times Alm) - LP \times (Alm - AD - SF)}{N2 \times (VD \times (N2 \times R - (N1 - 1) \times Alm) + Alm \times R) - 0.001 \times LP}$$

$$\frac{\times (N2 \times R - (N1 - 1) \times (AD + SF))}{\times (Alm - AD - SF) \times (VD \times (N2 \times R - (N1 - 1) \times (AD + SF)) + (AD + SF) \times R)}$$

(3) Surgeon factor

$$SF = \frac{-BQ - \sqrt{BQ \times BQ - 4 \times AQ \times CQ)}}{2 \times AQ} - AD$$

Note

$Alm = AL + RT$

$AQ = (N1 - 1) - (0.001 \times ER \times ((VD \times (N1 - 1)) - R))$

$BQ = ER \times 0.001 \times ((Alm \times VD \times (N1 - 1)) - (R \times (Alm - VD \times N2))) - (((N1 - 1) \times Alm) + (N2 \times R))$

$CQ = (Alm \times N2 \times R) - (0.001 \times ER \times Alm \times VD \times R \times N2) - (1000 \times N2 \times ((N2 \times R) - ((N1 - 1) \times Alm) - (0.001 \times ER \times ((VD \times ((N2 + R) - ((N1 - 1) \times Alm))) + (Alm \times R))))) / LP$

$AD = 0.56 + Rag - \sqrt{Rag \times Rag - Ag \times Ag / 4}$

$AG = 12.5 \times AL / 23.45$ If $AG > 13.5$, then $AG = 13.5$

N1 : Corneal refractive index (= 4/3 (= 1.333…))

N2 : Refractive index of aqueous and lens (= 1.336)

RT : Retinal thickness (= 0.200mm)

R : Corneal radius [mm] $R = 337.5/K$

AD : Predictable postoperative anterior chamber depth [mm]

AL : Axial length [mm]

LP : IOL refractive power to be implanted [D]

DR : Desired postoperative refractive power of corrective lens [D] (+value: hyperopia, –value: myopia)

VD : Vertex distance (Spectacles : 12mm)

SF : Surgeon factor

ER : Actual postoperative refractive power [D]

Rag : $R \geqq 7mm$ $Rag = R$

$R < 7mm$ $Rag = 7mm$

NOTE

- **Feature of Holladay formula;**
  The correction value (SF value : surgeon factor) of each surgeon for each IOL by stable post operative refractive power is calculated reversely and its result can be used in the calculation of IOL refractive power. It is possible to compensate the IOL data occured by the operator's habit of surgery and obtain the SF value with the following formula, register as the IOL data and use it for calculation IOL refractive power. (For details, see "**4.6.1 Registration of IOL data"**(P.4-18).)

  $SF = (A \times 0.55663) - 65.60$

  SF : SF value (Surgeon factor)
  A : A-constant

  ex.) In the case of A-constant = 116.7
  $SF = (116.7 \times 0.5663) - 65.60 = 0.48721$
  Use SF value, 0.49

  When reversely calculated postoperative SF value become stable after many surgical experiences, register the value as the IOL data agin and use it for calculating IOL refractive power. (For details, see "**4.6.2 SF value reverse calculation function"** (P.4-20).)

⚠CAUTION

- As to SRK-II formula, A-constant is revised for the case except the range of axial length 22 to 24.5mm, which is said to be the most reliable in the SRK formulas. Also calculating constant for IOL refractive power for ametropia and postoperative refractive power for emmetropia. Thus, terms are added and SRK-II formula becomes non-linear calculation formula. Therefore when calculation is made with the value close to each condition, the result will bechanged about 0.5 to 1D.

  ex.) K = 45D, DR = –2D, A = 116.5

	SRK,	SRK-II,	SRK-T
In the case of AL = 21.99mm	IOL = 24.31D,	24.53D,	23.87D
In the case of AL = 22.00mm	–) IOL = 24.29D,	23.50D,	23.84D
Difference	0.02D,	1.03D	0.03D

  As stated above, the calculated results of SRK-II formula varies much, depending on axial length and IOL refractive power for ametropia. When calculating with the values close to the conditioned values, take notice of it.

- As this US-800 has limit of internal calculation digit, a little error in calculated value may occur.

§7 SPECIFICATIONS

Axial length Measurement Probe

Type	: Solid Probe
Frequency of transducer	: 10MHz
Internal Fixation light	: LED (Red Color)

Axial Length Measurement

Measuring method	: Ultrasonic pulse reflective method
Measured value	: Axial length, Anterior chamber depth, Lens thickness, Vitreous length
Clinical accuracy	: ±0.1mm
Measuring range	: 15 - 40mm
Amplifier gain	: Changeable
Ultrasonic Velocity for conversion	: Phakic eye 1550m/s (Axial Length) 1532m/s (Anterior Chamber and Vitreous) 1641m/s Aphakic eye 1532m/s (Axial Length) IOL implanted eye 1554m/s (Axial Length)

IOLnpower calculation

Internal IOL formula	: SRK, SRK-II, SRK-T, BINKHORST, HOLLADAY
Calculative accuracy	: ±0.01D

Power supply

Voltage	: 100, 120, 220, 240Vac±10%
Frequency	: 50/60Hz
Power consumption	: under 50VA

Dimensions

322(W) × 320(D) × 100(H)mm

Weight

5kg

Environment

Temperature	- In use	: 10 to 40ºC
	In storage / transport	: –20 to 60ºC
Humidity	- In usage	: 10 to 85%
	In storage / transport	: 10 to 95%
Installation place		: In the room
Installation categories		: II
Degree of pollution		: 2

* Specifications and appearance are subject to change without notice for improvement.

§8 ACCESSORIES

8.1 Standard Accessories

- Main body
- Solid probe for measurement of axial length
- Power cord
- Foot pedal
- Dust cover
- Test piece
- Printer paper (2 rolls)
- Operator's manual

§9 ACOUSTIC FIELD EMISSIONS

A. The following data are the highest known acoustic field emissions for preenactment ophthalmic diagnostic devises:

1. Spatial Peak-Temporal Average Intensity (mW/cm^2) 17

2. Spatial Peak-Pulse Average Intensity (W/cm^2) 28

B. The following data are the measurements of NIDEK US-800 acoustic field emissions:
Axial length Measuring Probe

1. Spatial Peak-Temporal AverageIntensity (mW/cm^2) 0.005

2. Spatial Peak-Pulse Average Intensity (W/cm^2) 13.9

NOTE

- System control parameters affecting acoustic field emissions are fixed as far as end users are concerned.