Huvitz

Service Manual

Auto Ref/Keratometer HRK-1

Precautions

This product may malfunction due to the electromagnetic wave that is generated from mobile phone, two-way radio, machinery controlled wireless and others. Do not place any device that may affect this product nearby.

We believe that the contents of this user manual are accurate in overall since they were reviewed carefully. However, Huvitz does not assume any kind of responsibility for the latent mistake or omission that results from the use of information included in this user manual.

Huvitz has the right to make any kind of modification to this product or product specs anytime without prior notice and modification may not be renewed on this document.

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Contents

1. Important Notice....3

2. Safety Information....4

2.1. Introduction....4

2.2. Safety Symbol....5

2.3. Environmental Considerations....6

2.4. Safety Precaution....8

3. Product Outline....10

3.1. Nomenclature....10

3.2. Optical System....12

3.3. Electrical System....15

3.4. Mode Setting....21

3.5. Principles of Measurement....22

4. Repair Standard....25

4.1. Checking and Control....25

4.2. Auto Tracking Setup....40

4.3. Pupil distance calibration (PD Setup)....43

4.4. Factory Data Setup....45

4.5. Color Test....46

4.6. Touch Setup....47

4.7. DPC (Dead Pixel Correction) Setup....49

4.8. IQC mode....51

4.9. Software upgrade....52

1. Important Notice

⚠ WARNING

Potential electromagnetic or other interference between medical equipments and other devices being operated together in the same environmental may expert an adverse influence on functioning of the medical equipment. Non-medical equipments not in compliance with the requirements of EN 60601-1 should not be used together in the same environmental as the medical equipments

This equipment has been tested and found to comply with the limits for medical devices in IEC 60601-1:2001. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation

Power Cord
For use of equipment in rated voltage less than 125Vac, minimum 6A, Type SJT or SVT, 18/3AWG, 10A, max 3.0m long: One end with Hospital Grade Type, NEMA 5-15P other end with appliance coupler. For use of equipment in rated voltage less than 250Vac,minimum 6A,Type SJT or SVT, 18/3AWG, 10A, max 3.0m long : One end terminates with blade attachment plug (HAR) Type, NEMA 6-15P.

This product may malfunction due to electromagnetic waves caused by portable personal telephones, transceivers, radio-controlled toys, etc. Be sure to avoid having objects such as, which affect this product, brought near the product.

The information in this publication has been carefully checked and is believed to be entirely accurate at the time of publication. HUVITZ assumes no responsibility, however, for possible errors or omissions, or for any consequences resulting from the use of the information contained herein.

HUVITZ reserves the right to make changes in its products or product specifications at any time and without prior notice, and is not required to update this documentation to reflect such changes.

2. Safety Information

2.1. Introduction

Safety is everyone's responsibility. The safe use of this equipment is largely dependent upon the installer, user, operator, and maintainer. It is imperative that personnel study and become familiar with this entire manual before attempting to install use, clean, service or adjust this equipment and any associated accessories. It is paramount that the instructions contained in this manual are fully understood and followed to enhance safety to the patient and the user/operator. It is for this reason that the following safety notices have been placed appropriately within the text of this manual to highlight safety related information or information requiring special emphasis. All users, operators, and maintainers must be familiar with and pay particular attention to all Warnings and Cautions incorporated herein.

⚠ WARNING

"Warning," indicates the presence of a hazard that could result in severe personal injury, death or substantial property damage if ignored.

NOTE

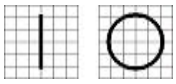
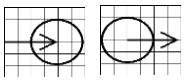
"Note," describes information for the installation, operation, or maintenance of which is important but hazard related if ignored.

⚠ CAUTION

"Caution" indicates the presence of a hazard that could result in minor injury, or property damaged if ignored.

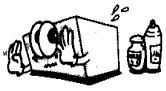
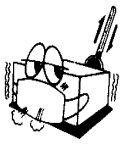
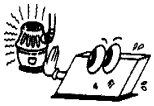
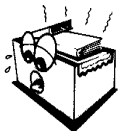
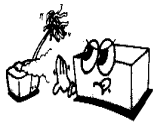
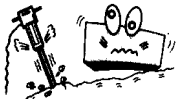
2.2. Safety Symbol

The International Electro technical Commission (IEC) has established a set of symbols for medical electronic equipment, which classify a connection or warn of any potential hazards. The classifications and symbols are shown below.

	I and O on power switch represent ON and OFF respectively.
	Type B Isolated patient connection
	It indicates the connection of signal input/output.
	This symbol identifies a safety note. Ensure you understand the function of this control before using it. Control function is described in the appropriate User's or Service Manual.
	It indicates the year of manufacture and the manufacturer.
	It indicates the hot surface.
	It indicates the safe ground point connected to the chassis of equipment. It is required to do the protective ground to the conductive section in the equipment of class I for the purpose of safety.
UL60601-1 CAN/CSA C22.2 NO.601.1	**MEDICAL EUIPMENT WITH RESPECT TO ELECTRIC SHOCK FIRE AND MECHANICAL HAZARDS ONLY IN ACCORDANCE WITH UL 60601-1, AND CAN/CSA C22.2 NO.601.1**
	Disposal of your old appliance 1. When this crossed-out wheeled bin symbol is attached to a product it means the product is covered by the European Directive 2002/96/EC. 2. All electrical and electronic products should be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or the local authorities. 3. The correct disposal of your old appliance will help prevent potential negative consequences for the environment and human health. 4. For more detailed information about disposal of your old appliance, please contact your city office, waste disposal service or the shop where you purchased the product.
	Alternating Current

2.3. Environmental Considerations

Please avoid the environment below for the operation and storage of the equipment.

	Where the equipment is exposed to water vapor. Don't operate the equipment with wet hands.		Where the machine can be exposed to the chemical or flammable substances.
	Where the machine is exposed directly to the sunlight.		Please keep the equipment out of dust and do not let inserted any metal parts such as coins, clips, etc.
	Where the temperature changes frequently (Normal temperature for operation of the machine is at the range of 10°C ~ 35°C, and the humidity is at the range of 30%~70%.		Do not disassemble or open the machine. The manufacture shall have no responsibility for any problems caused by these.
	Where any heaters are at the close distance to the machine.		Do not close the thermal ventilation outlet.
	Where the humidity is high and there are problems to the heat dissipation and/or ventilation		Do not connect the AC power plug into the outlet while not putting the parts of machine together completely. It can harm the equipment.
	Where the equipment is subject to excessive shocks or Vibrations.		Do not pull the plug out of outlet while holding the cord.

For the normal operation of the machine, please keep the ambient temperature is 10℃ ~ 35℃,

humidity is 30% ~ 75% and atmospheric pressure is 800 ~ 1060hpa. For the Transformation of the machine, please keep the ambient temperature is -40℃ ~ 70℃, humidity is 10% ~ 95% and atmospheric pressure is 500 ~ 1060hpa. For the Storage of the machine, please keep the ambient temperature is -10℃ ~ 55℃, humidity is 30% ~ 75% and atmospheric pressure is 700 ~ 1060hpa. Avoid environments where the equipment is exposed to excessive shocks or vibrations.

2.4. Safety Precaution

This equipment has been developed and tested in conformity with domestic & international safety standards and regulations, which guarantees the high stability of this product. This guarantees a very high degree of safety for this device. The legislator expects us to inform the user expressively about the safety aspects in dealing with the device. The correct handling of this equipment is imperative for its safe operation. Therefore, please read carefully all instructions before switching on this device. For more detailed information, please contact our Customer Service Department or one of our authorized representatives.

1. This equipment must not be used (a) in an area that is in danger of explosions and (b) in the presence of flammable, explosive, or volatile solvent such as alcohol, benzene or similar chemicals.

2. The device should neither be kept nor installed in the place with high humidity. For the optimal operation, the humidity should be at the range of 30%~75%. The machine should not be exposed to the place where water splashes, drips or sprays. Do not place containers containing fluids, liquids, or gases on top of any electrical equipment or devices

3. The equipment must be operated only by, or under direct supervision of properly trained and qualified person/s.

4. Modifications of this equipment may only be carried out by Huvitz's service technicians or other authorized persons.

5. Customer maintenance of this equipment may only be performed as stated in the User's Manual and Service Manual. Any additional maintenance may only be performed by Huvitz's service technicians or other authorized persons.

6. The manufacturer is only responsible for effects on safety, reliability, and performance of this equipment when the following requirements are fulfilled: (1) The electrical installation in the respective room corresponds to the specifications stated in this manual and (2) This equipment is used, operated and maintained according to this manual and Service Manual.

7. The manufacturer is not liable for damage caused by unauthorized tampering with the device(s). Such tampering will forfeit any rights to claim under warranty.

8. The equipment may only be used together with accessories supplied by Huvitz's. If the customer makes use of other accessories, use them only if there are usability under

technical safety aspects has been proved and confirmed by Huvitz or the manufacturer of the accessory.

9. Only persons who have undergone proper training and instructions are authorized to install, use, operate, and maintain this equipment.

10. User's manual or service manual should be kept in the place where the persons in charge of operation and maintenance can access easily any time.

11. Do not force cable connections. If a cable does not connect easily, be sure that the connector (plug) is appropriate for the receptacle (socket). If you cause any damage to a cable connector(s) or receptacle(s), let the damage(s) be repaired by an authorized service technician.

12. Please do not pull on any cable. Always hold on to the plug when disconnecting cables.

13. This equipment may be used for the international application related to Refractometry and Keratometry according to this manual.

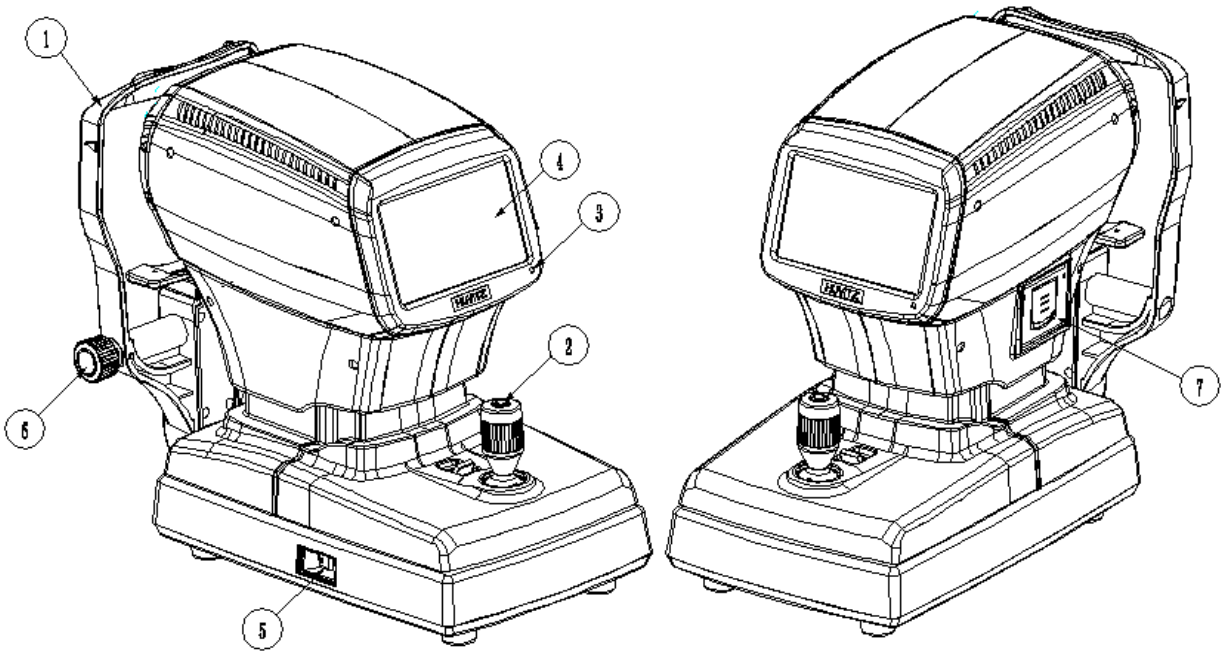
14. Before every operation, proceed with visual inspection on the equipment exterior to seek any mechanical damage(s) to ensure the proper functioning.

15. Do not obstruct any ventilation outlet for proper heat dissipation.

In case of any presence of smoke, spark or abnormal noise/smell from the machine, please power off immediately and pull out the plug.

3. Product Outline

3.1. Nomenclature



1. Head Rest: Preventing the vibration by fixing the head

2. Measurement Button: Performing the measurement by pressing it after focusing (Joystick Button)

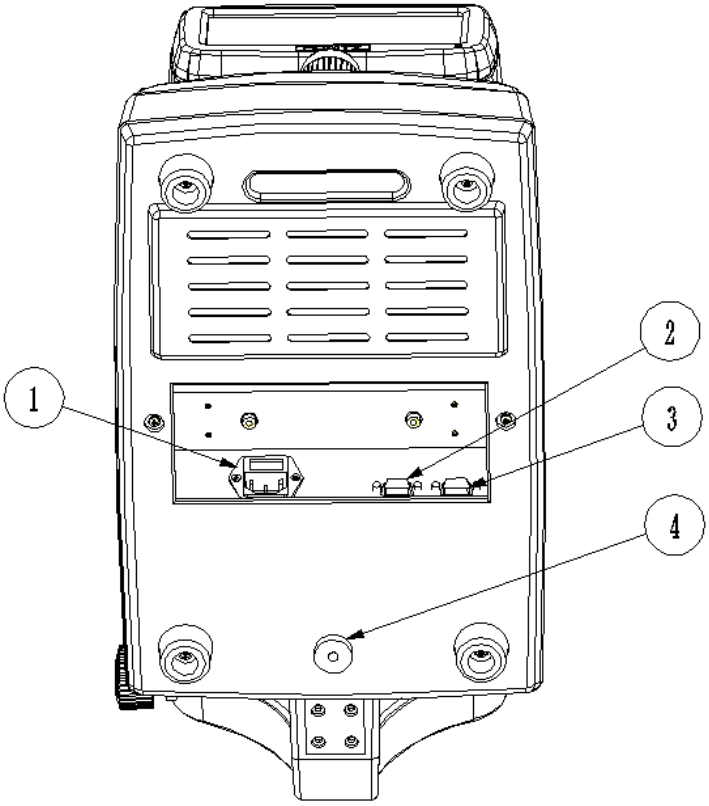
3. Movement indicator Lamp: Indicates whether or not the electric power is on

4. Display Monitor: Monitor for measurement

5. Power switch: Power On/Off

6. Chin rest control Knob: Move up or down the chinrest.

7. Printer: Printing the measured results



11. Power Supply Socket (Fuse holder): A socket connecting to exterior power plug

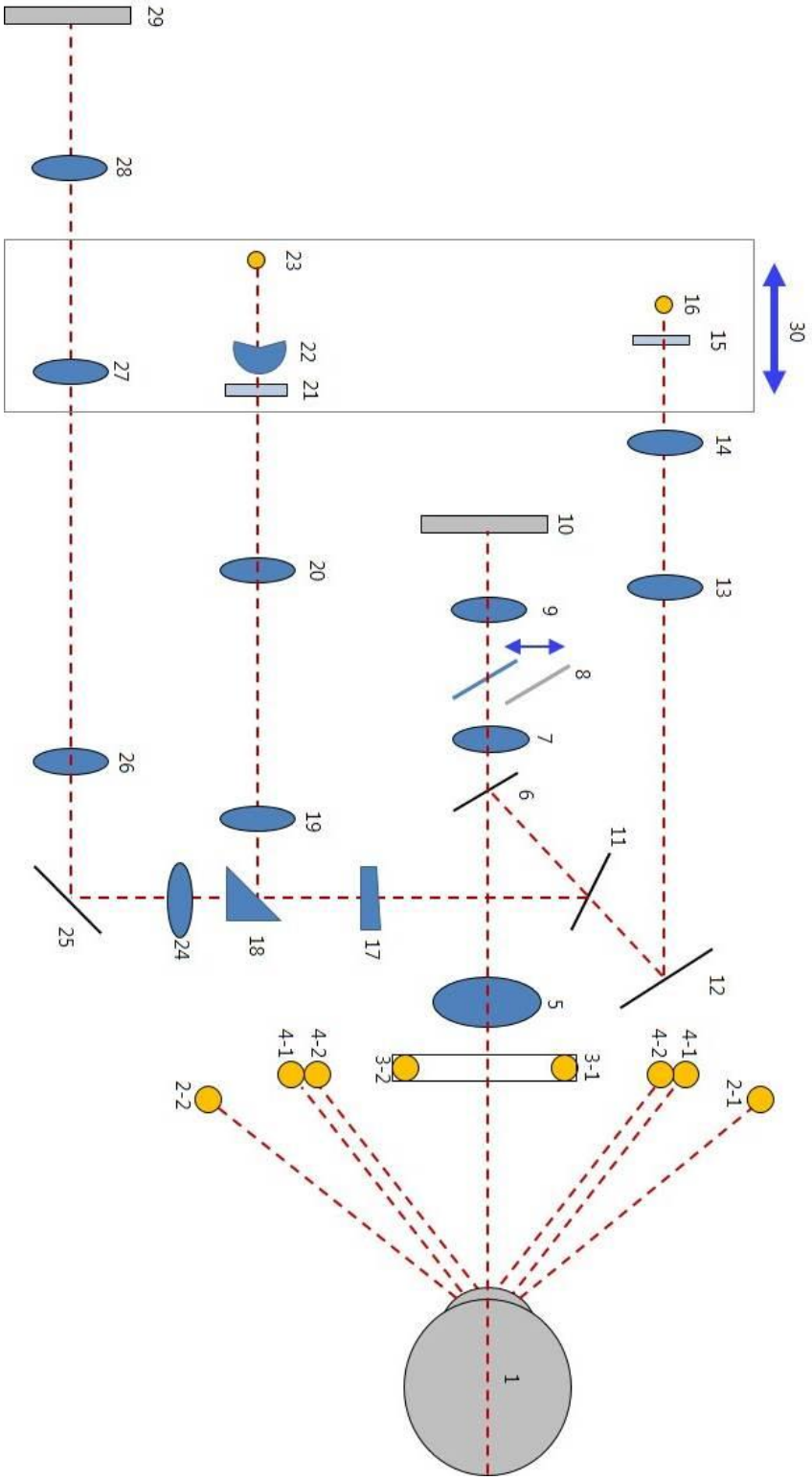
2. Serial Interface Connector: A terminal connecting to the exterior equipment

3. RGB Connector: Connecting into the exterior monitor

4. Clamping Bolt: Fixing the system stage

NOTE
Noise may appear on the screen when connecting with outside monitor due to the length and type of the cable, and monitor quality. Use signal amplifier if the distance with the outside monitor is significant.

3.2. Optical System



3.2.1. List of Optical Components

Patient's eye

2-1, -2: LED for lightening cornea

3-1, -2: Ring unit of the Keratometry

4-1: White LED

4-2: Blue LED

5: Objective lens

6: Half mirror

7: Relay lens

8: IR filter (K measurement)

9: Imaging lens

10: TV camera (K/C)

11: Half mirror

12: Reflection mirror

13: Relay lens

14: Imaging lens

15: Fixation chart

16: Illumination LED

17: Rotary Prism

18: Hole mirror

19: Relay lens

20: Relay lens

21: Ring aperture

22: Collimation lens

23: Light source(R)

24: Relay lens

25: Reflection mirror

26: Relay lens

27: Moving lens to compensate refractive power

28: Imaging Lens for Refractometer Signal

29: TV camera(R)

30: Moving module to compensate refractive power

R = Refractometer

K = Keratometer

C = Color imaging

3.2.2. Light Paths of the System

A : External illumination
(2-1, 2-2 ➔1)

B : Corneal observation system
(1➔5➔6➔7➔8➔9➔10)

C : KER measurement system
(3-1, 3-2, ➔1➔5➔6➔7➔8➔9➔10)

D : Projection system of the REF light source
(23➔22➔21➔20➔19➔18➔17➔11➔6➔5➔1)

E : Projection system of the REF measurement
(1➔5➔6➔11➔17➔24➔25➔26➔27➔28➔29)

F : Illumination system of the light source for Retro-Illume observation
(23➔22➔21➔20➔19➔18➔17➔11➔6➔5➔1)

G : Image capturing system of Retro-Illume observation
(1➔5➔6➔7➔8➔9➔10)

H : Projection system of the target chart
(16➔15➔14➔13➔12➔11➔6➔5➔1)

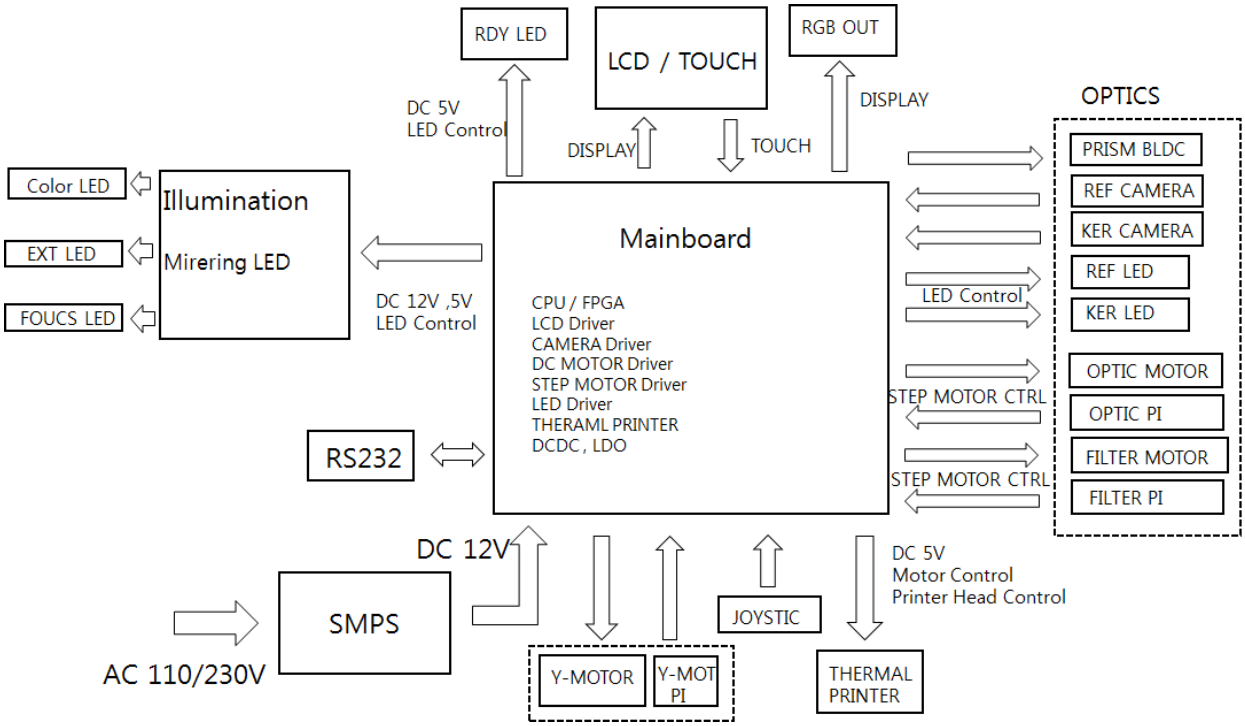
I: White LED & Blue LED illumination
(4-1, 4-2➔1)

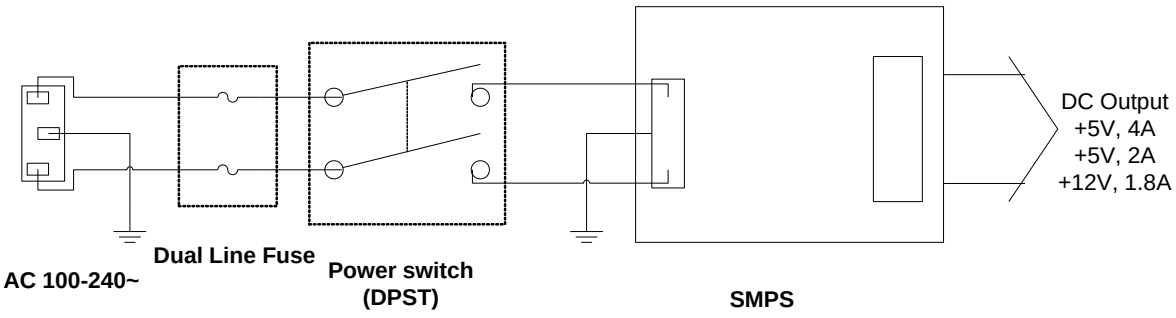
J: Color corneal observation system
(1➔5➔6➔7➔9➔10)

3.3. Electrical System

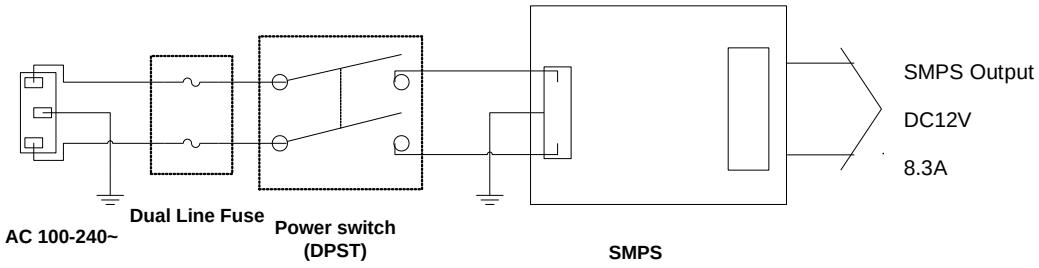
3.3.1. Electrical construction diagram

3.3.1.1. System functional block diagram



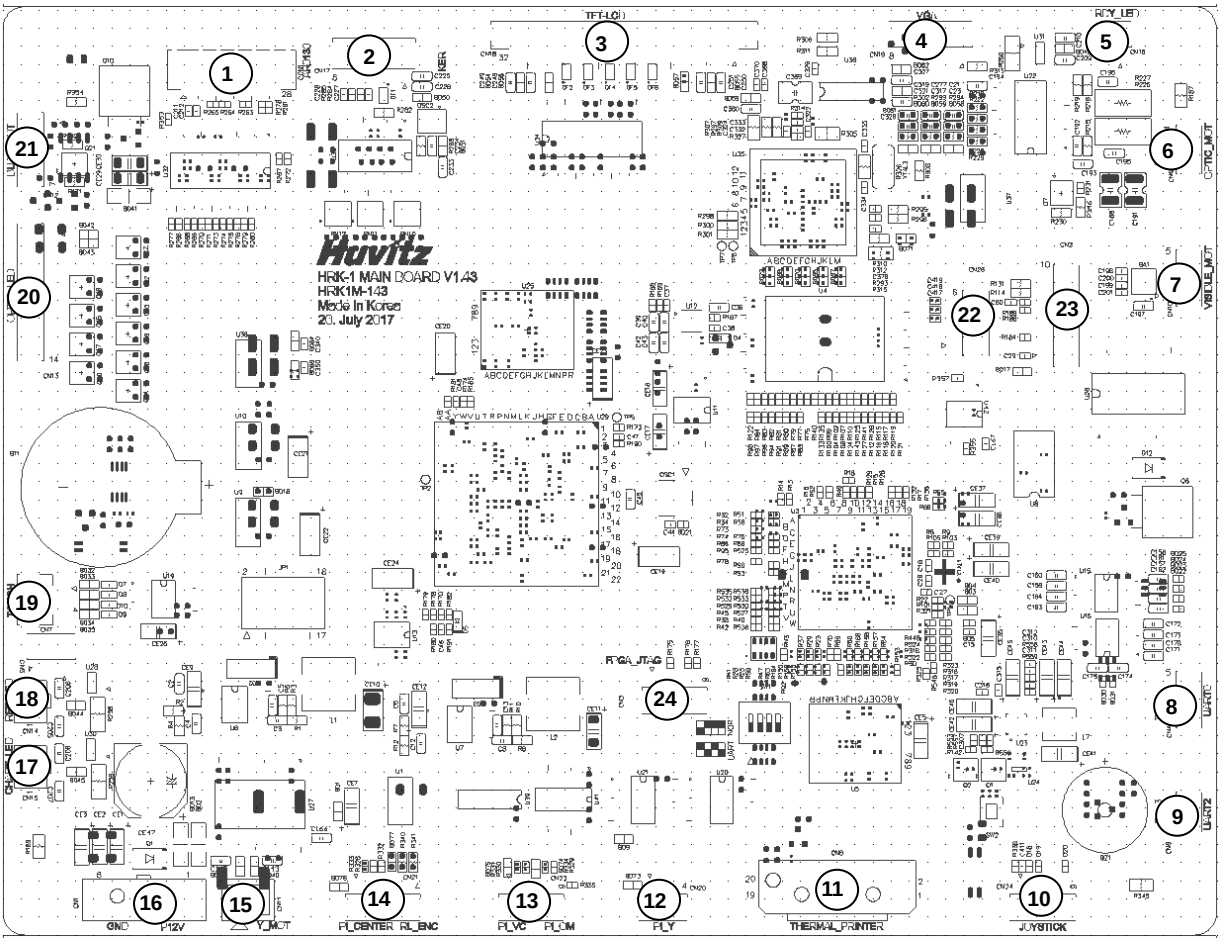


3.3.1.2. Power input electrical block diagram



3.3.2. Electrical wiring

3.3.2.1. Main Board

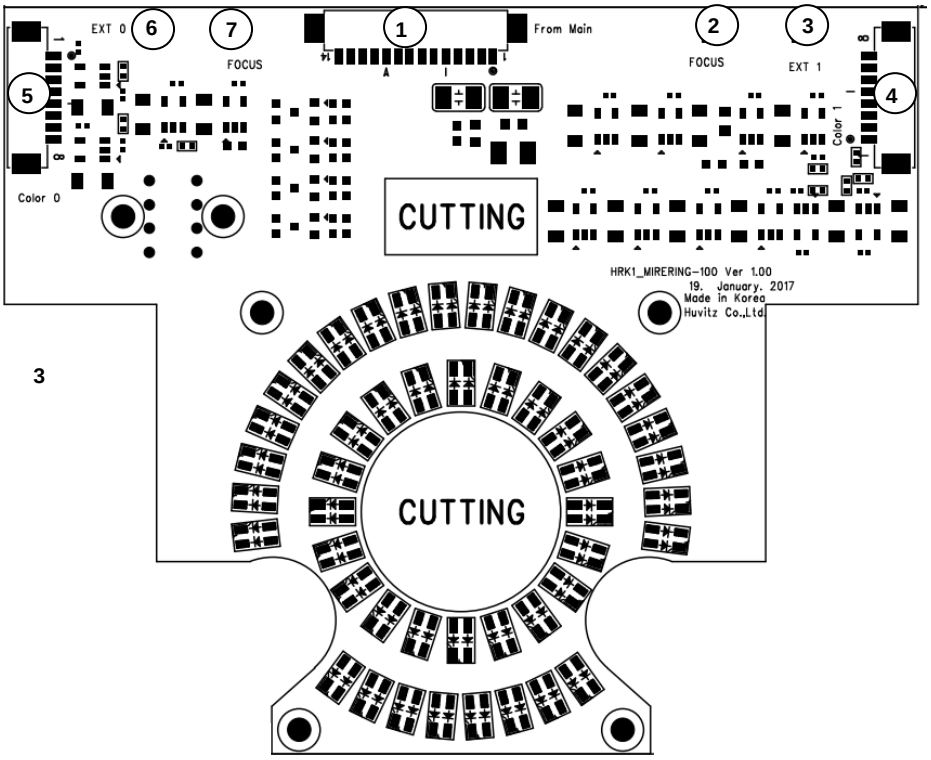


3.3.2.2. Description of wire harness connection of MAINBOARD

Connect No.	Description	Target connector
1 (CCN1)	REF CMOS CAMERA	AR1030 CAMERA BOARD
2 (CN17)	KER CMOS CAMERA	COLORCMOS CAMERA BOARD
3 (CN18)	LCD INTERFACE	LCD ASSY
4 (CN19)	RGB OUT	RGB OUT HARNESS
5 (CN16)	READY LED	READY LED HARNESS
6 (CN9)	OPTIC MOVEMENT MOTOR	OM MOTOR HARNESS
7 (CN10)	IR FILTER MOTOR	IR FILTER MOTOR HARNESS
8 (CN14)	UART0 PORT	UART HARNESS
9 (CN6)	UART2 PORT	UART HARNESS
10 (CN24)	JOY STICK	JOYSTICK ASSY - Joy-Link HANRESS - HRK ENCODER BOARD
11 (CN8)	THERMAL PRINTER	THERMAL PRINTER ASSY
12 (CN20)	Y MOTOR PI	Y MOTOR PI BOARD
13 (CN23)	OPTIC PI (OM , IR FILTER)	OM , IR FILTER PI BOARD
14 (CN21)	RL ENCODER, PI	RL ENCODER BAORD RL PI BOARD
15 (CN11)	Y MOTOR	Y MOTOR HARNESS
16 (CN1)	SMPS INPUT	SMPS OUT CONNECTOR
17 (CN15)	CHART LED	CHART LED BOARD
18 (CN14)	REF LED	REF LED HARNESS
19(CN7)	LCD TOUCH	LCD ASSY
19 (CN13)	OPTIC LED	MIRERING BOARD CN1
20 (CN12)	PRISM MOTOR	PRISM BLDC MOTOR
21 (CN26)	KEYPAD	Not Connect
22 (CN2)	CPU JTAG	Not Connect
23 (CN3)	FPGA JTAG	Not Connect

- OM : OPTIC MOVEMENT

3.3.2.3. MIRERING BOARD

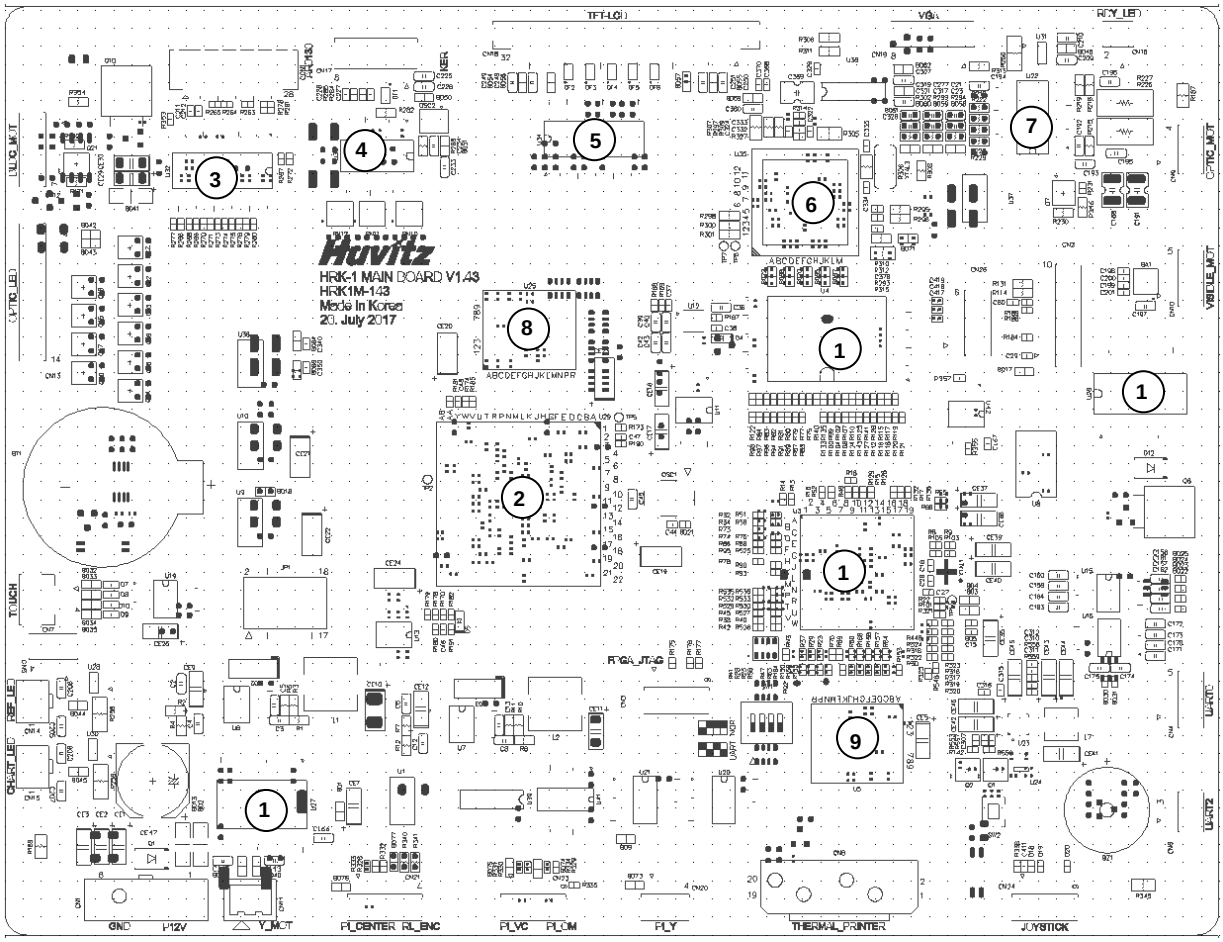


3.3.2.4. Description of wire harness connection of MIRERING BOARD

Connect No.	Description	Target connector
1 (CN1)	OPTIC LED INTERFACE	MAIN BOARD CN13
2 (CN3)	FOCUS LED (L)	FOCUS LED ASSY
3 (CN13)	EXTERNAL LED (L)	EXTERNAL LED BOARD
4 (CN5)	COLOR LED (L)	WHITE,BLUE LED HARNESS
5 (CN4)	COLOR LED (R)	WHITE,BLUE LED HARNESS
6 (CN12)	EXTERNAL LED (R)	EXTERNAL LED BOARD
7 (CN2)	FOCUS LED (R)	FOCUS LED ASSY

3.3.3. Layout diagrams for PCB

3.3.3.1. Picture of Main Board



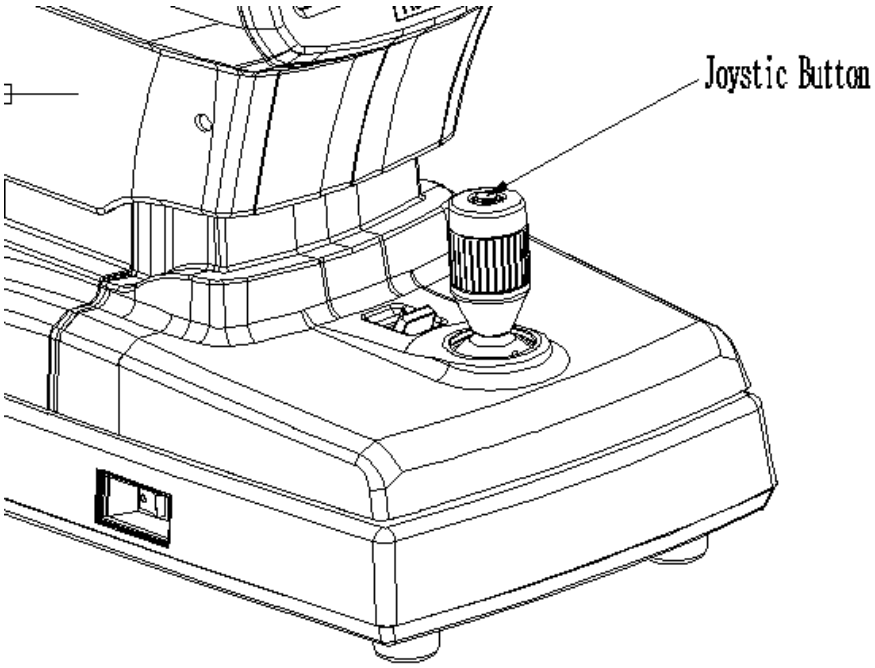
3.3.3.2. Description of Mainboard Part

ID	Ref No.	Part name	Description
1	U3	AM1808	TI ARM9 CPU
2	U29	XC6SLX25-2FGG484C	Xillinx FPGA (Logic Array)
3	U32	THC63LVDF84	LVDS Receiver
4	U33	DS92LV1212A	LVDS Deserializer
5	U34	THC63LVDF83R	LVDS Transmitter
6	U35	MDIN241	VGA Coverter
7	U22	DRV8825	STEP Motor Driver
8,9	U5,U25	K4T51163QQ	DDR2 Memory
10	U4	39VF3210	NOR FLASH Memory
11	U26	TD6206	STEP Motor Driver
12	U27	L6201	DC Motor Driver

3.4. Mode Setting

Turn-on the system with pressing button as following content of table.

Start Key	Description
Joystick Button	**[S/W Upgrade Mode]** Download OS program into ROM via serial port (Ex. COM) permanently. After downloading, always HRK-1 will start with new OS program.



3.5. Principles of Measurement

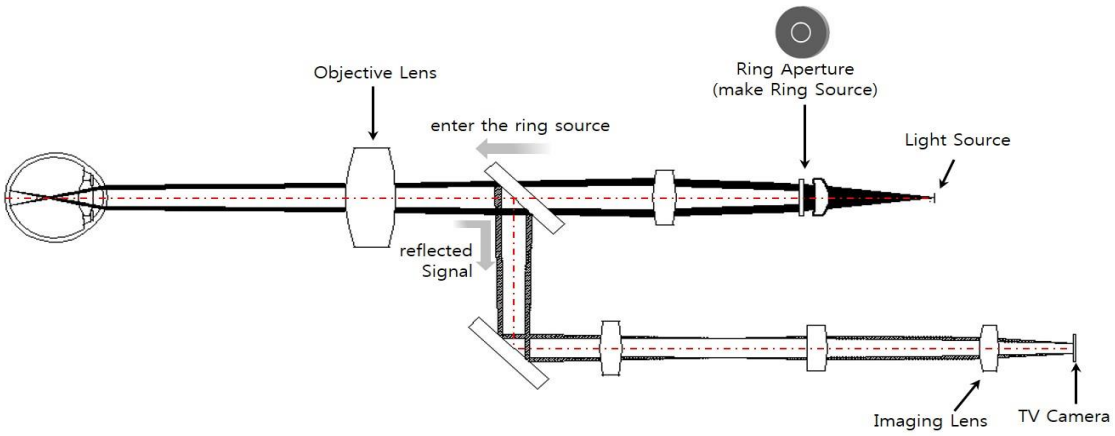
3.5.1. Measurement principle of refractometry

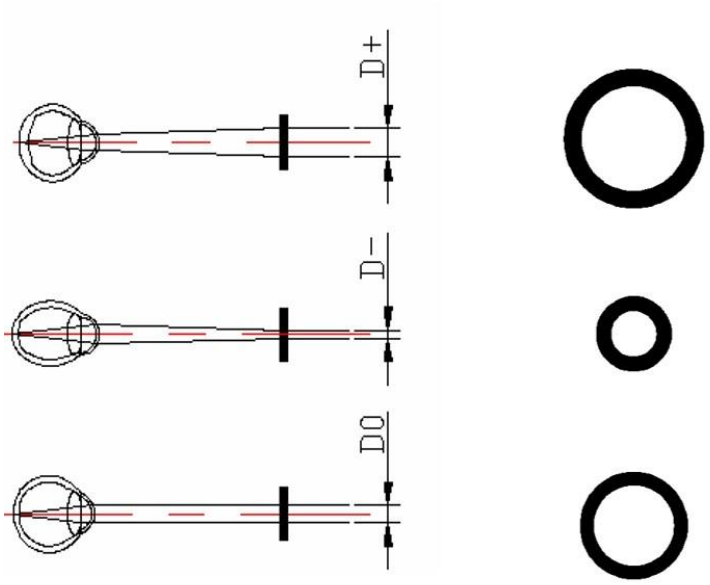
(1) Light beam from the ring source is incident on the examinee's eye and reflected from it's retina as in the Figure below.

(2) According to the refraction condition of the examinee's eye, that is, if the examinee's eye is emmetropia, hyperopia or myopia, the reflected light from the retina is parallel to the optic axis of the eye, diverge or converge, respectively.

(3) The light beam reflected from the examinee's eye will be relayed by the lens and mirror, divided by the prism with aperture and then imaged on the TV camera as ring signal.

(4) From the Ellipsoidal Fitting of the size of ring signal captured by TV camera, the values of SPH, CYL and AX of eye can be derived.





3.5.2. Measurement principle of keratometry

When the ring light source of the keratometry is projected on to the cornea, it is reflected as a circle or an ellipse in the case of the eye with corneal astigmatism, the size and the shape of reflected light are different according to the radius of curvature of the cornea because the cornea is not a sphere. By making the image of the reflected light (mire image) from cornea be captured on TV camera and then, read it's coordinates, processor unit in this instrument will calculate the diameter of major (2a) and minor axis (2b), and then, the rotational angle (θ, axis on the minor meridian). Furthermore, there is a correlation between the radius of cornea (R), the height of the projected ring image (H) which can be obtained from the captured image, the projection angle of ring light (ϕ). The correlation is as follows. Therefore, small and large radius of curvature of cornea can be calculated with respect to the minor and major axis.

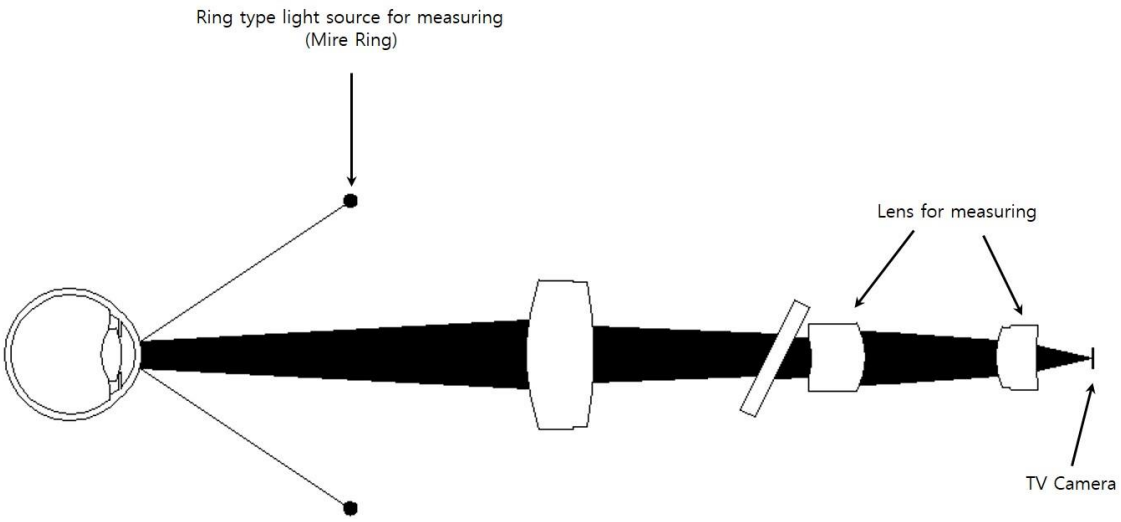
$$R = \frac{H}{\sin(\phi/2)}$$

And there is the following relation between the radius of cornea (R), the refractive power of cornea (D), and the refraction index (n). From this equation, strong and weak refractive powers of cornea (D) are calculated in regard to large and small radius of curvature (R).

$$D = \frac{1000\ (n-1)}{R(mm)}$$

The following 3 values can be selected
for corneal equivalent refractive index (n)

$n = 1.3375, 1.336, 1.332$



3.5.3. The principle of Retro-Illumination observation

3.5.3.1. Principle of retro-illumination observation

The incident lights of the infrared LED (spot light) onto the fundus of the eye are retro-scattered from it. The scattered lights from the fundus illuminate the vitreous humor and some of it go through the crystalline lens and the iris. If it is captured by TV camera, any turbid part of the transparent vitreous humor, lens and cornea can be observed.

3.5.3.2. Usage of Retro-Illumination observation

The turbid part of the cataract and the frontal glass can be observed and the change of it can be taken up with. Therefore, the reason of the degradation of eyesight can be known whether it is caused by the simple refractive abnormality or the advance of the cataract.

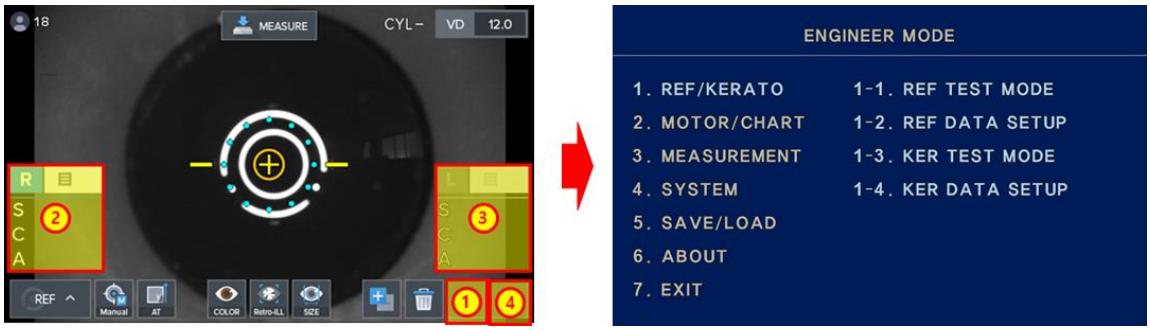
4. Repair Standard

4.1. Checking and Control

If your device shows suspicious measurement result repeatedly, you can suspect internal problem.

In that case, checking internal status at Engineer Mode can be helpful.

4.1.1. Enter the Engineer Mode

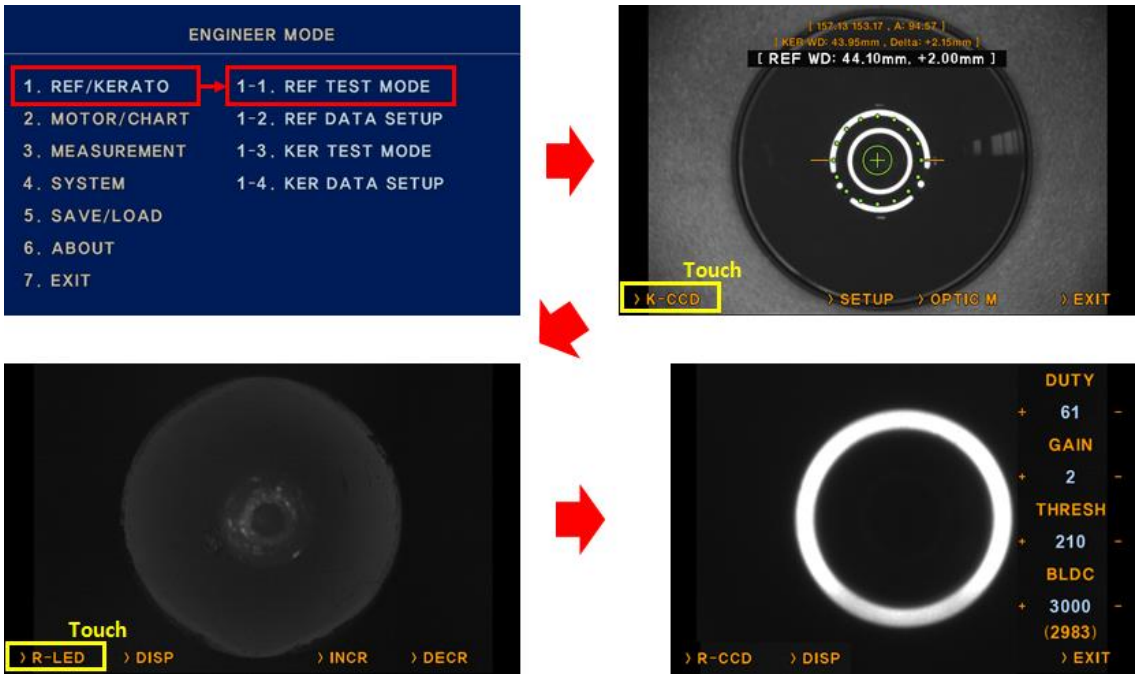


To enter the Engineer Mode, take following steps.

1) Touch print button
2) Touch measurement data for right side.
3) Touch measurement data for left side.
4) Touch user setup button

4.1.2. Check REF signal

If there are some problems in REF measurement, the first thing you can check is REF signal quality.

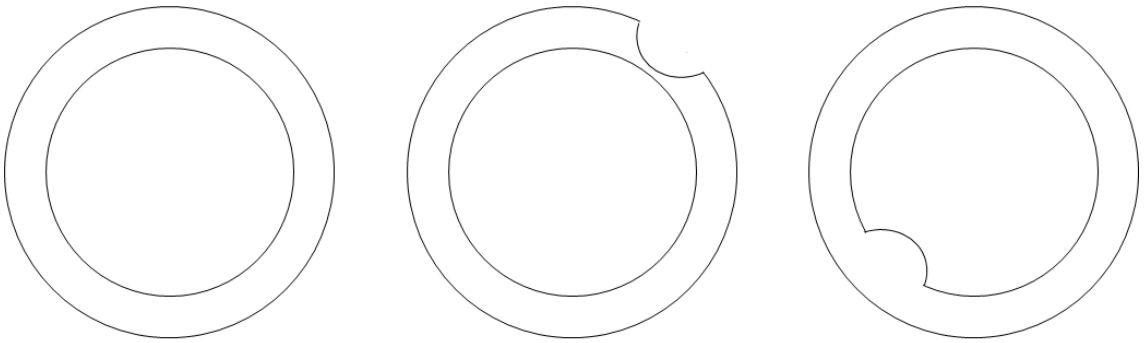


1) Set any model eye on the chin rest.
2) Enter the “1-1. REF TEST MODE”
3) Change mode to “R-CCD”.
4) Check the quality of signal.

REF signal has a ring shape.

If there are apparent defects at the signal, you can suspect that the optic module has been damaged or contaminated.

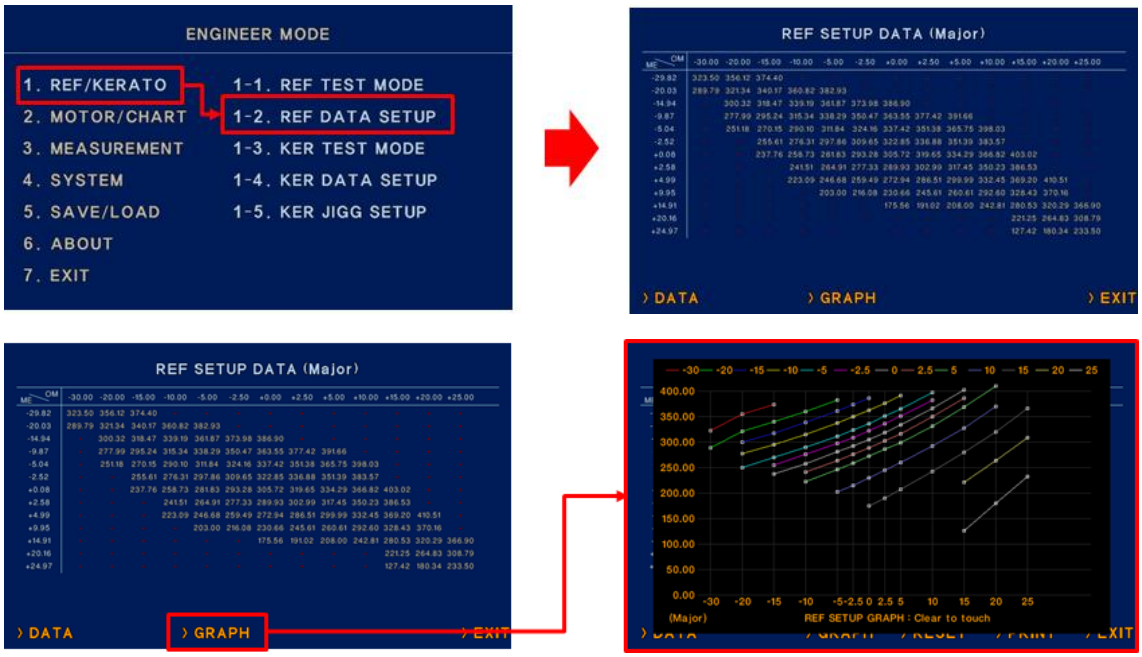
In that case, you should report it to the FA Team of Huvitz.



Good Bad Bad

4.1.3. Check REF calibration data

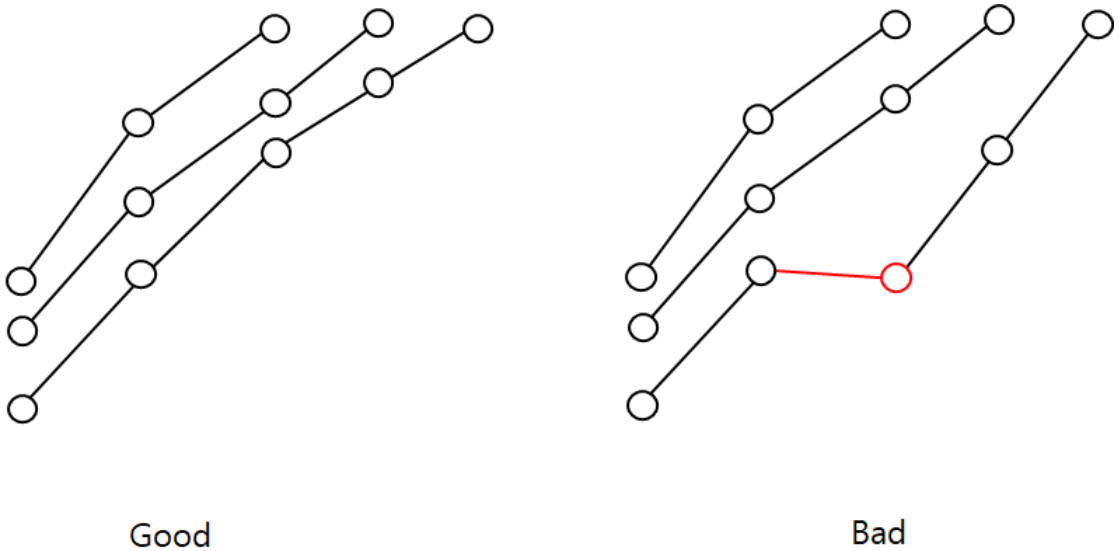
If the signal quality is not bad, you can check calibration data in the second place.



1) Enter the “1-2. REF DATA SETUP”
2) Touch “> GRAPH” button.
3) Check the shape of data current.

Regarding calibration data, ascending or descending current is important.

If there are any points stand against the current, you should take a re-calibration



4.1.4. REF calibration

If some problems are found in calibration data, you should take a calibration again.

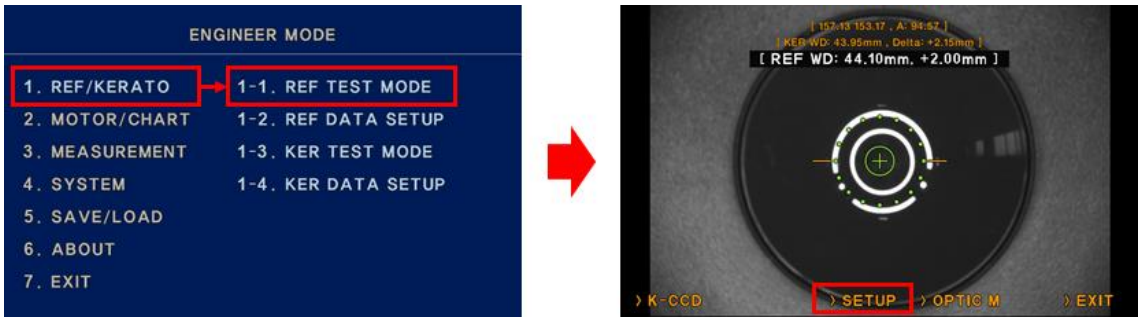
Or though the calibration data has no problem, if the physical condition of the device is changed from initial status, re-calibration can be a solution.

Of course, all of our product release after passing strict examinations for durability and consistency.

But “if” is always exist, and for unexpected physical change, re-calibration can be an answer.

1) Enter the calibration mode

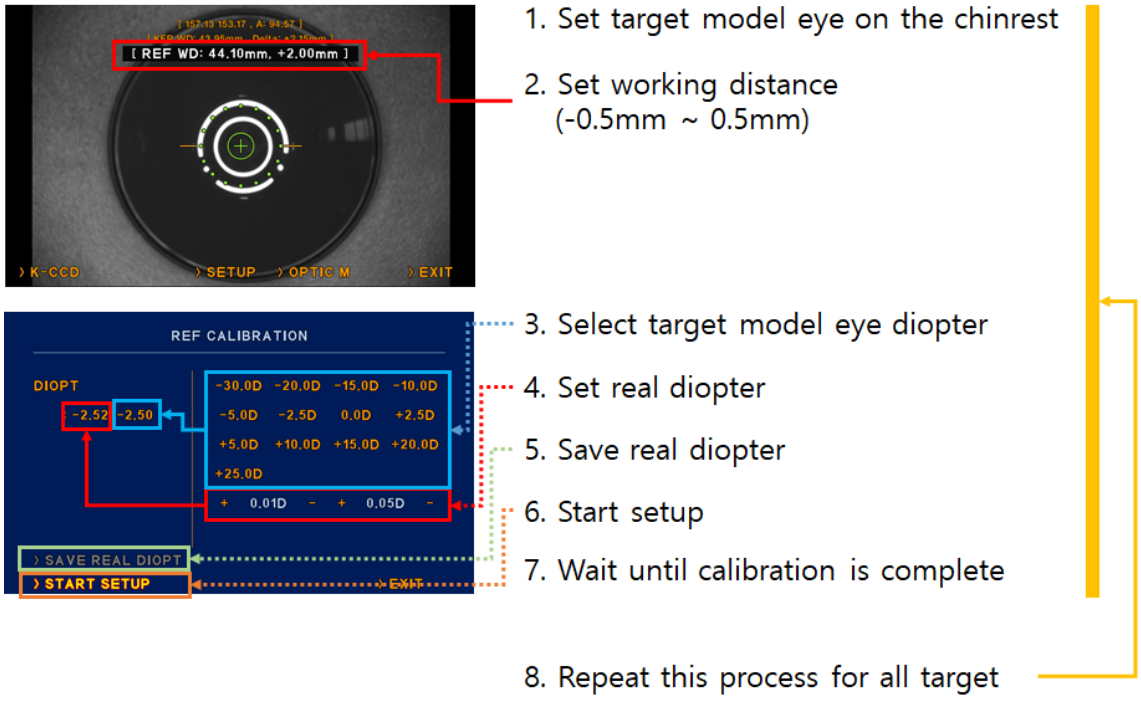
To start REF calibration, go to “1-1. REF TEST MODE”.



2) Run calibration

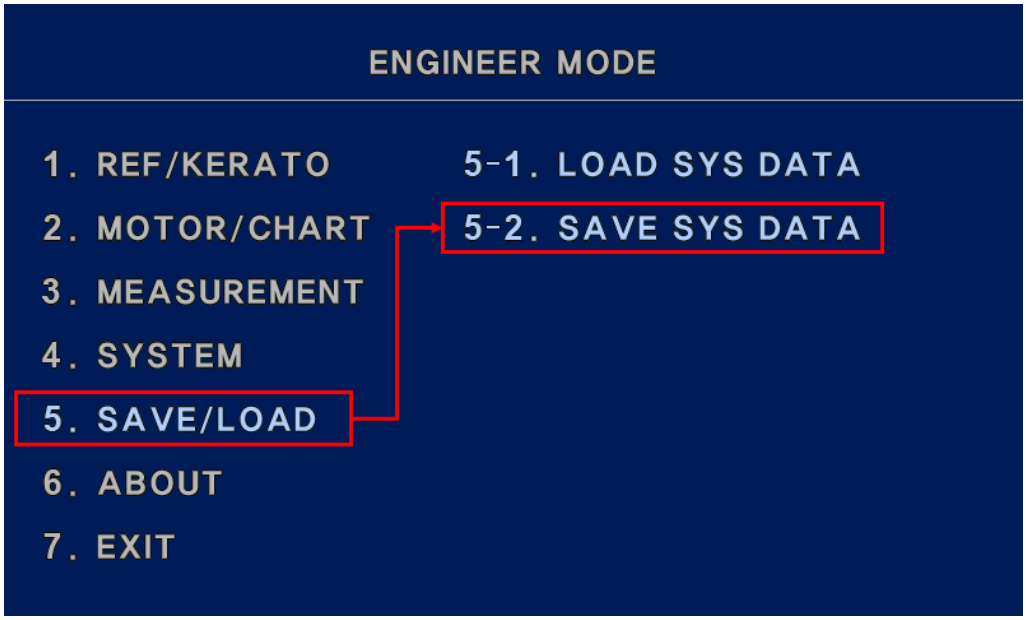
The number of calibration points are thirteen. (-30.0D ~ +25.0D)

REF calibration should be taken for all of them.



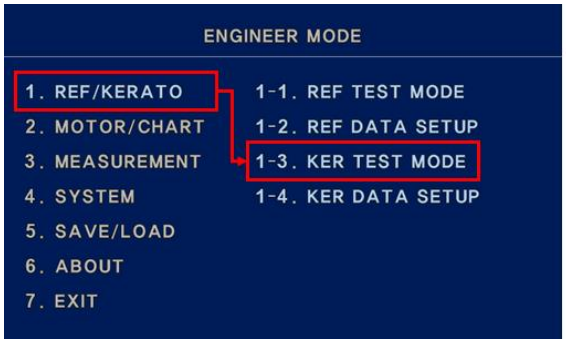
3) Save the result

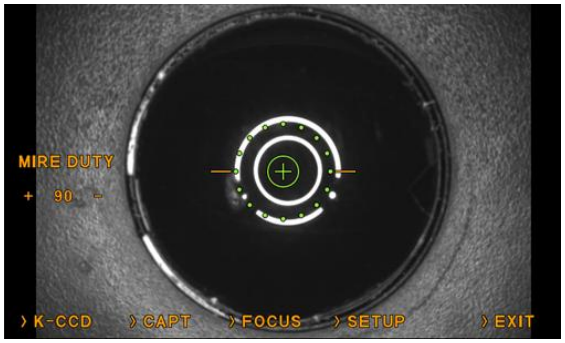
After calibration, you have to save it to FRAM.



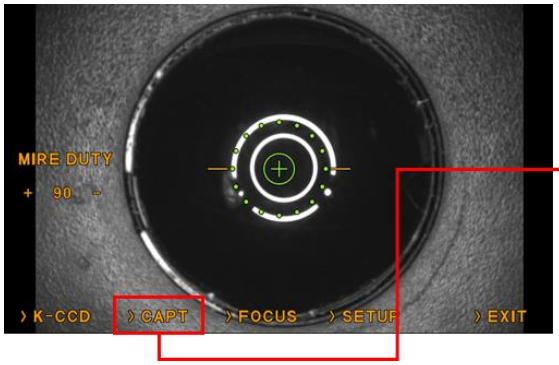
4.1.5. Check KER signal

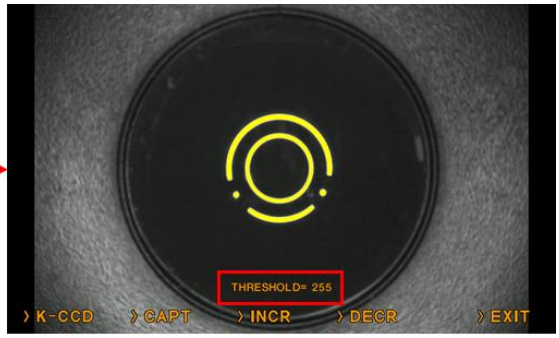
If there are some problems in KER measurement, the first thing you can check is KER signal quality.



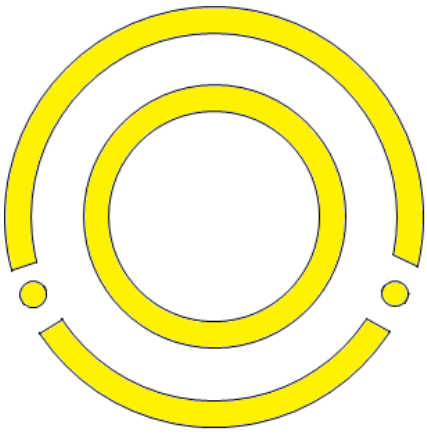


Mire led quality can be checked with following steps.

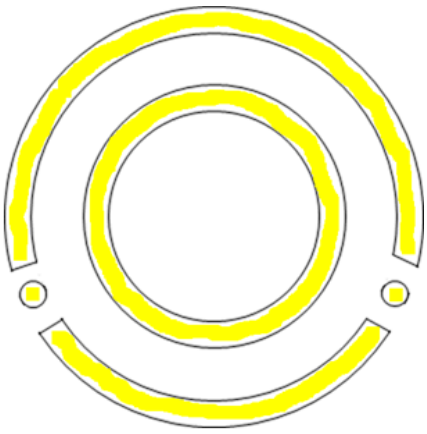




1) Touch “> CAPT” button to capture current signal.
2) Increase threshold to upper limit.
3) If the yellow mark covers mire ring enough, the signal is strong enough.



Good

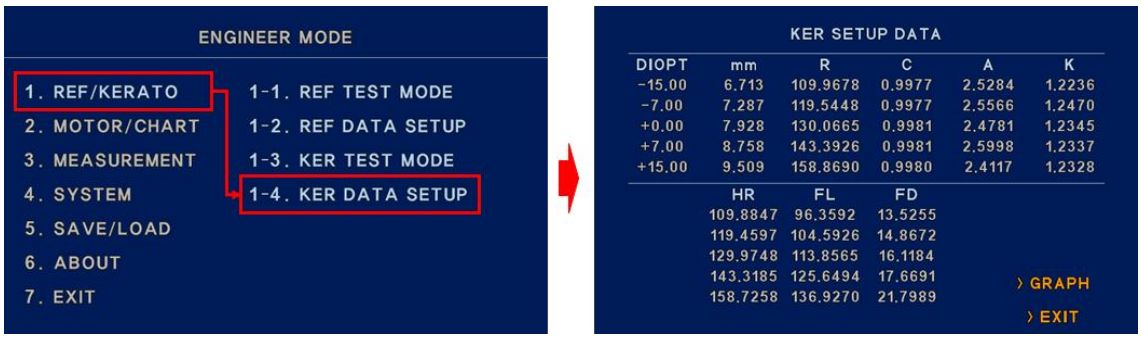


Bad

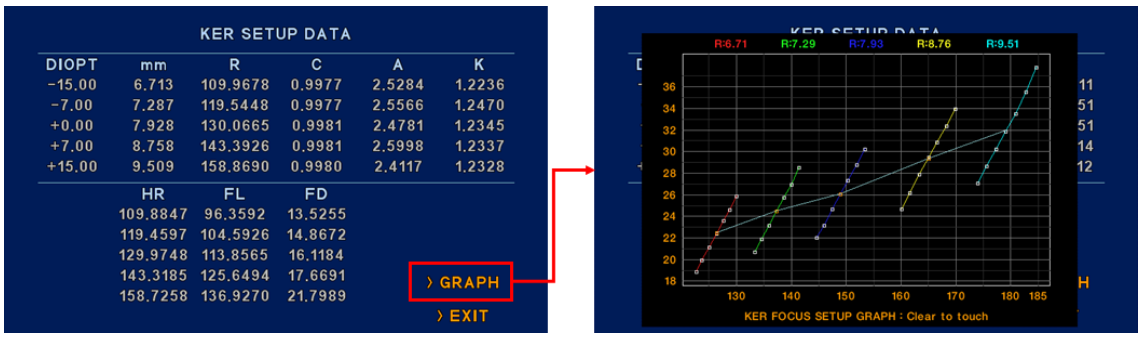
4) If the yellow marked area is too small, and there are relatively big white areas, you could increase Mire duty at SYSTEM settings to cover it.

4.1.6. Check KER calibration data

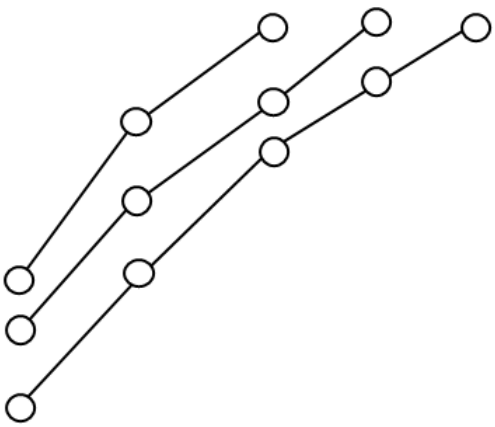
If KER signal has no apparent problem, you can check calibration data.
Checking KER calibration data is available at “1-4. KER DATA SETUP”.



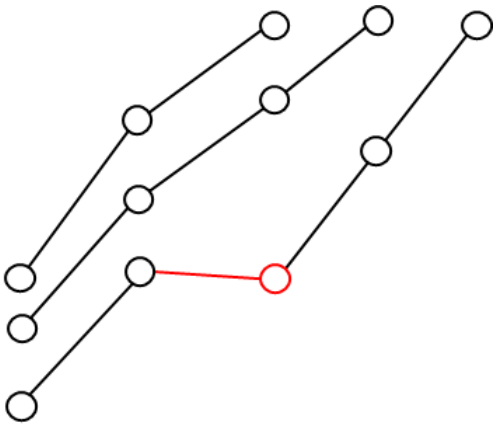
Like REF calibration data, ascending or descending current is important.



If there are any points stand against the current, you can say the calibration data is invalid.



Good



Bad

In that case you should take a calibration again.

4.1.7. KER calibration

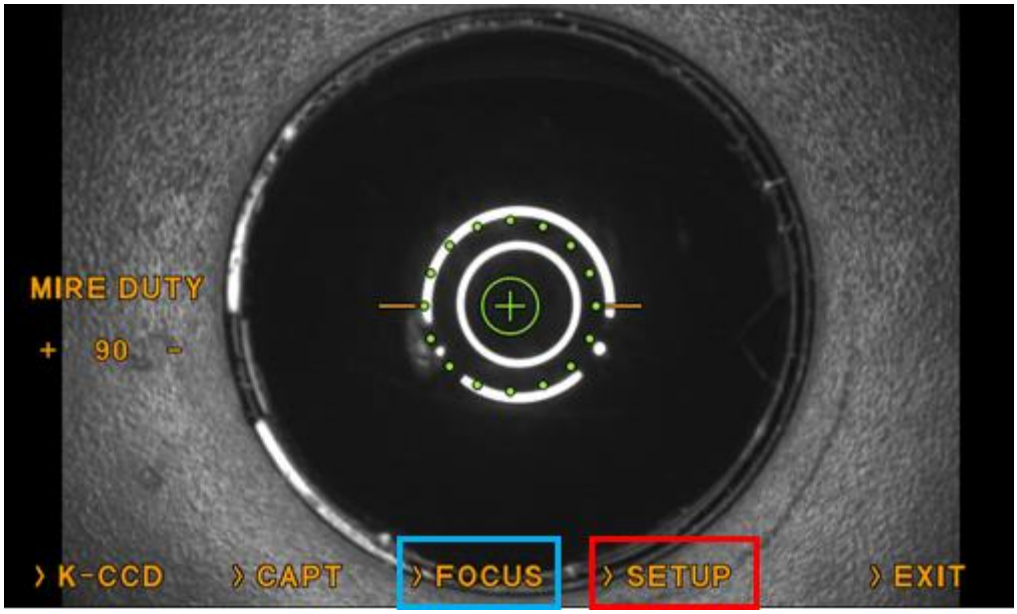
If some problems are found in calibration data, you should take a calibration again.

Or though the calibration data has no problem, if the physical condition of the device is changed from initial status, re-calibration can be a solution.

Of course, all of our product release after passing strict examinations for durability and consistency.

But “if” is always exist, and for unexpected physical change, re-calibration can be an answer.

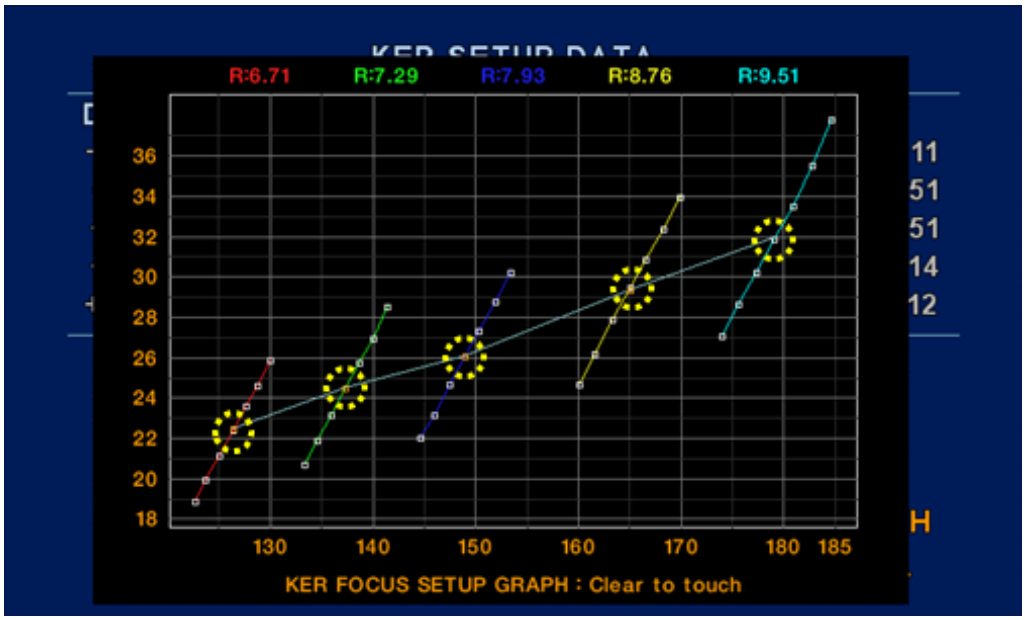
KER calibration is consisted with two procedures.



One is On-focus calibration and the other is Defocus calibration.

[On-focus calibration]

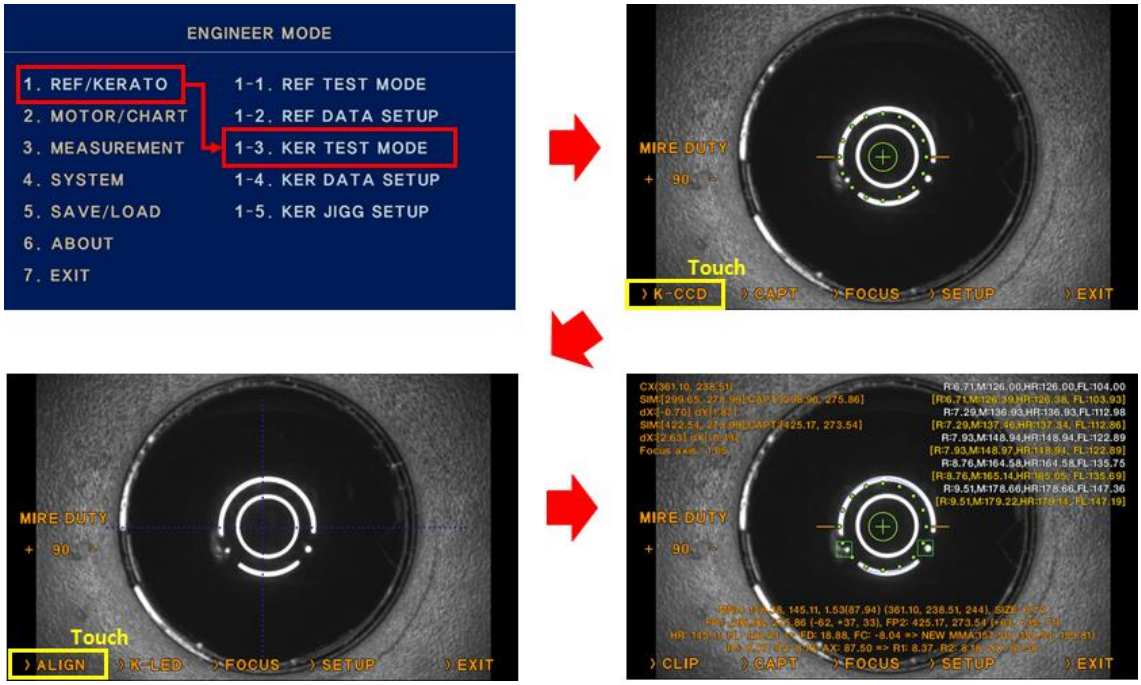
The first thing you have to do is on-focus calibration.



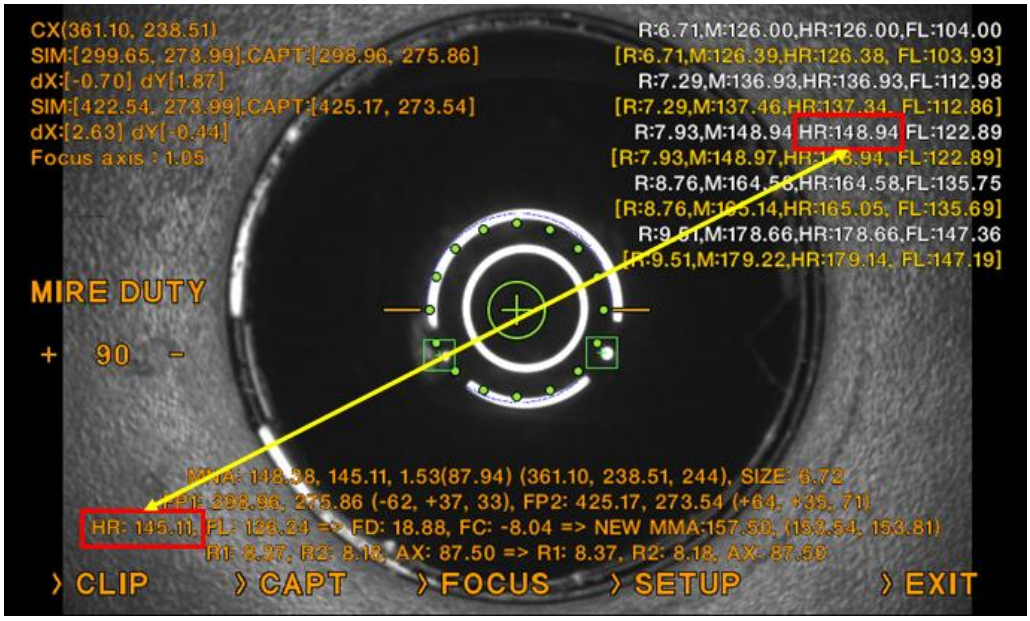
On-focus calibration is for yellow points on KER data graph.

1) Set KER 0D model eye on the chin rest and enter the KER TEST MODE.

2) Enter the KER signal clip test mode.

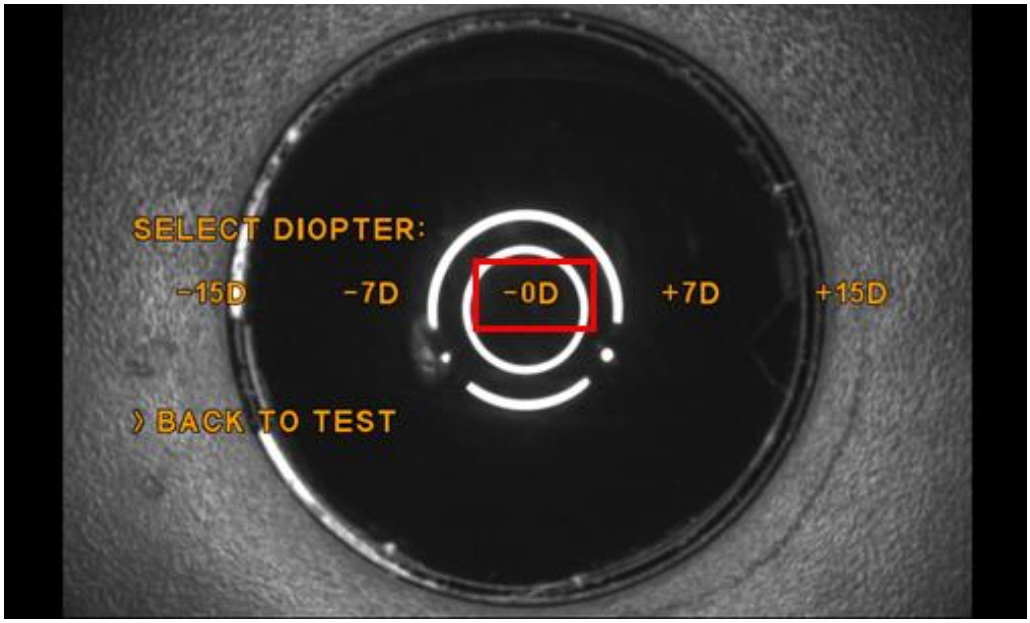


3) Control working distance to match “HR”.

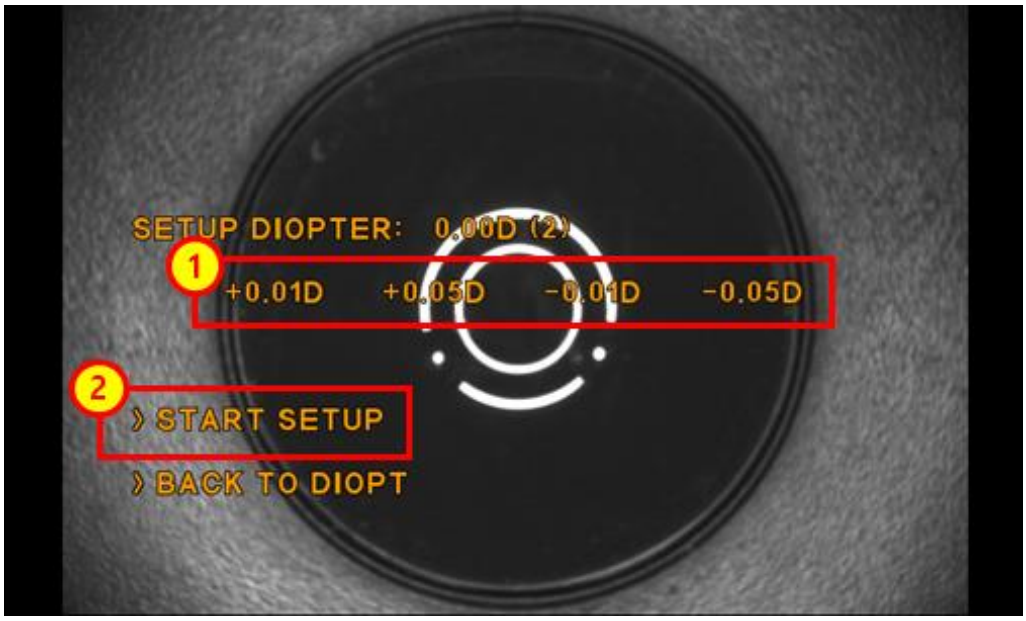


4) Touch SETUP button.

5) Touch 0D target.



6) Set real target diopter and touch START SETUP button.

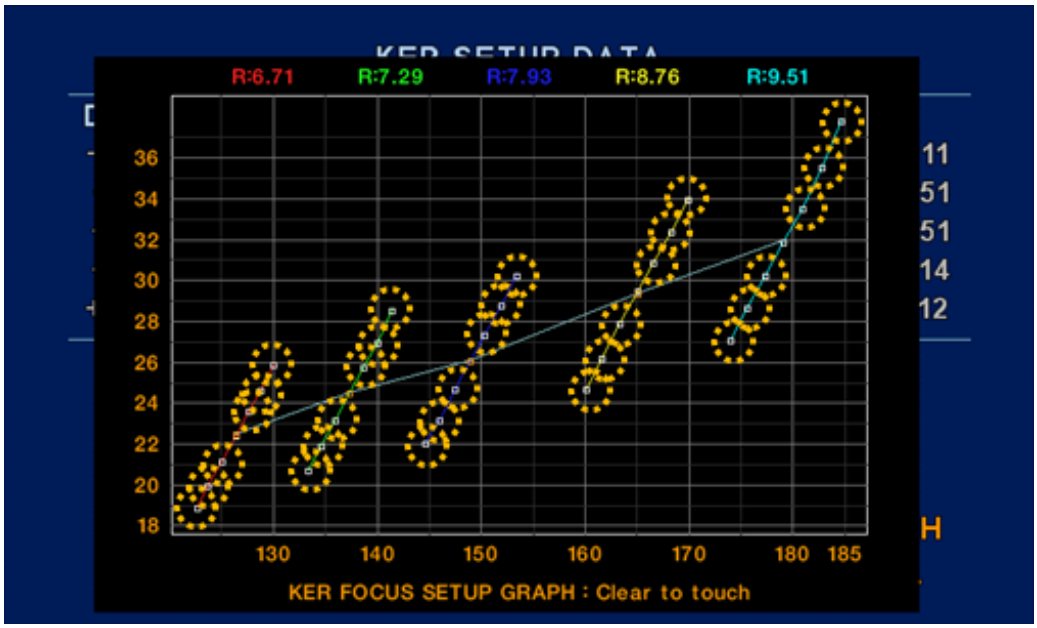


7) Calibration for target diopter would run automatically.

8) Repeat this process to other diopters.

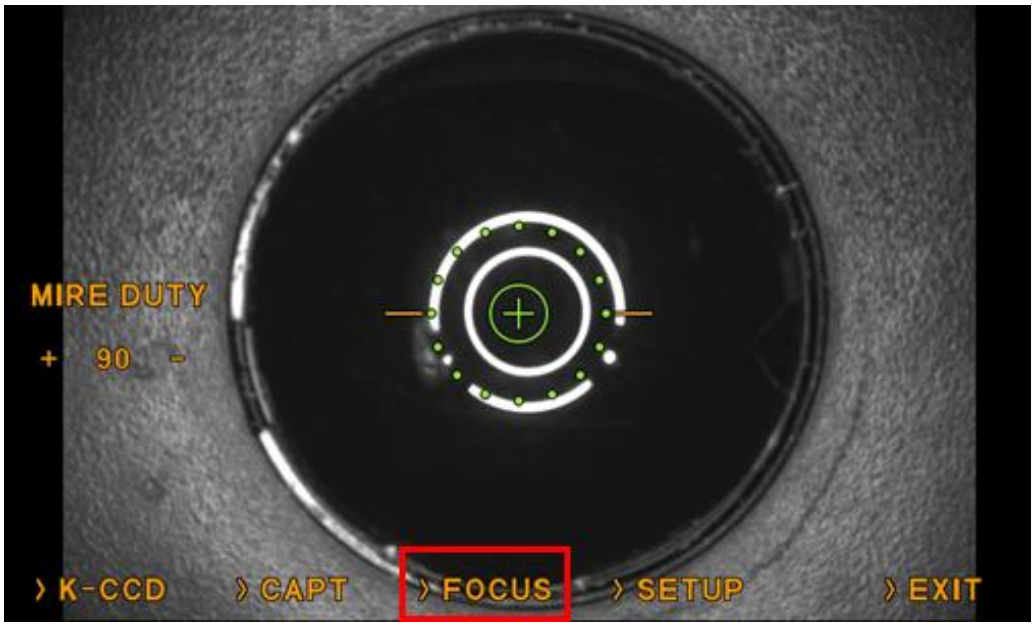
[De-focus calibration]

De-focus calibration is for these points.

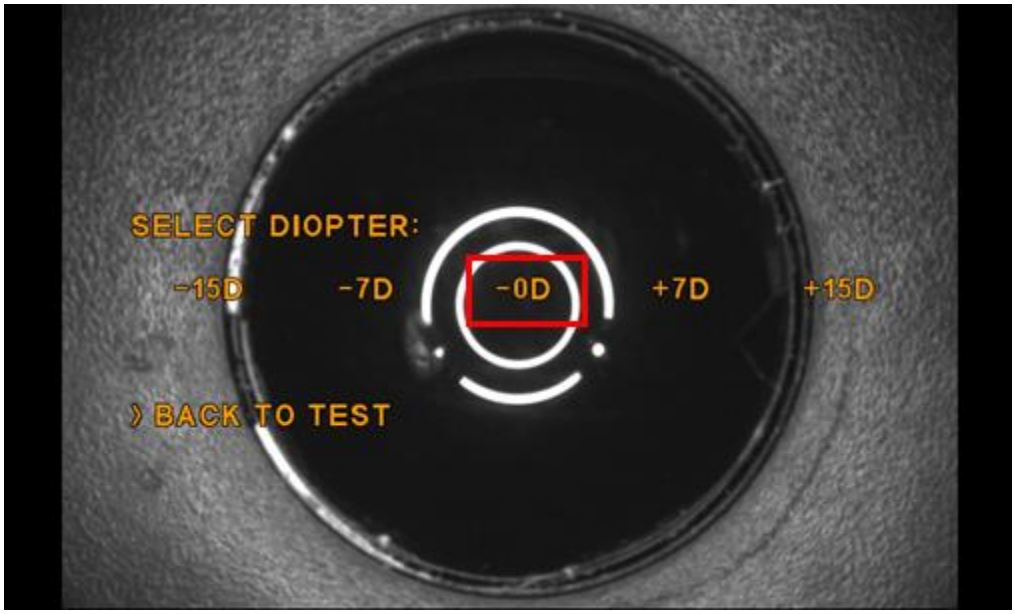


1) Set KER 0D model eye on the chin rest and enter the KER TEST MODE.

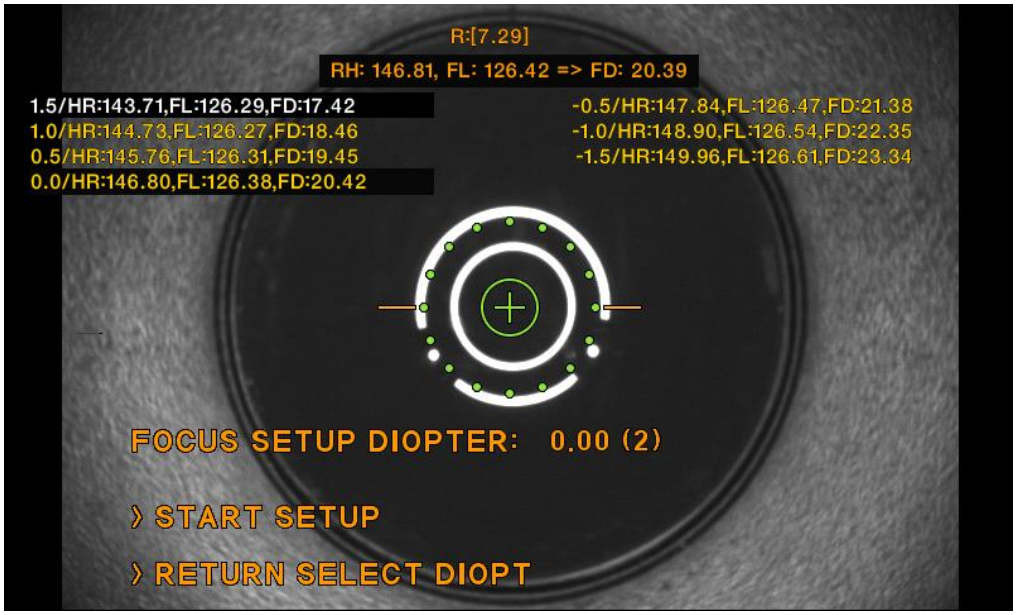
2) Touch FOCUS button.



3) Select 0D target.



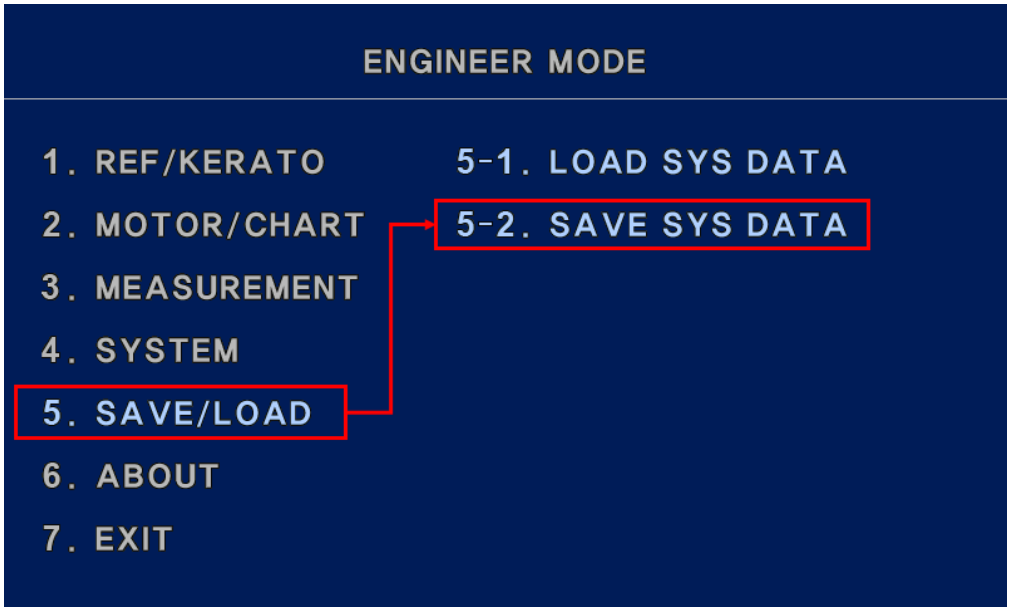
4) Run calibration for each points from -1.5 to 1.5.



5) Repeat this to all other diopters.

[Save]

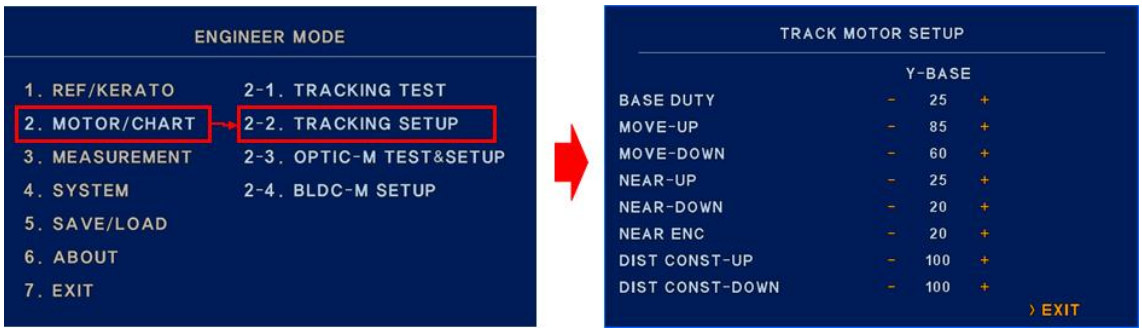
After calibration, you have to save it to FRAM.

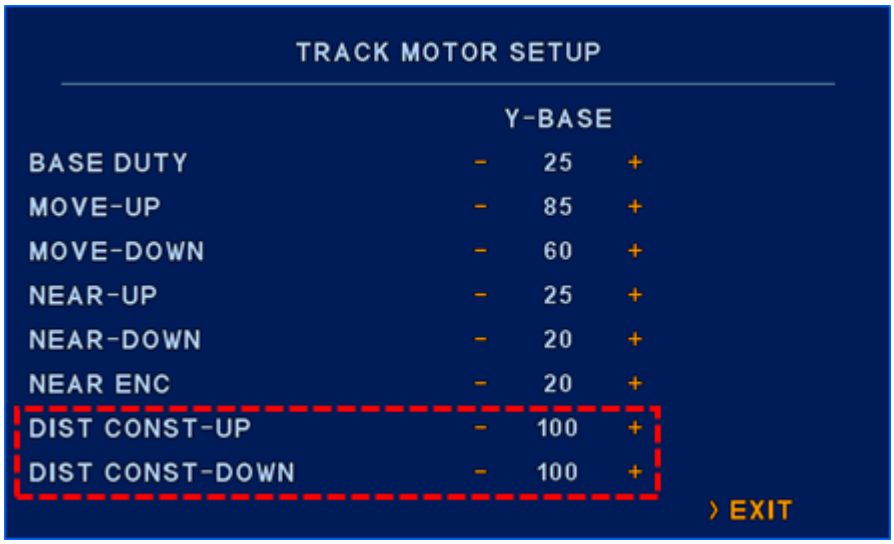


4.2. Auto Tracking Setup

If auto tracking power is too big or too weak, you can adjust coefficients to control the tracking power.

Menu for tracking coefficients control is “2-2. TRACKING SETUP”





Bottom two items are for auto tracking.

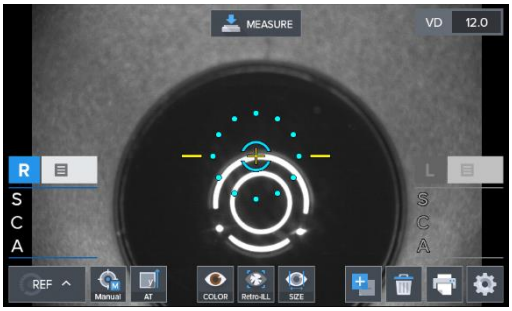
Others are for joystick scrolling, and they are not for you. You do not need to touch those items for any cases.

We recommend following procedure to find appropriate coefficients.

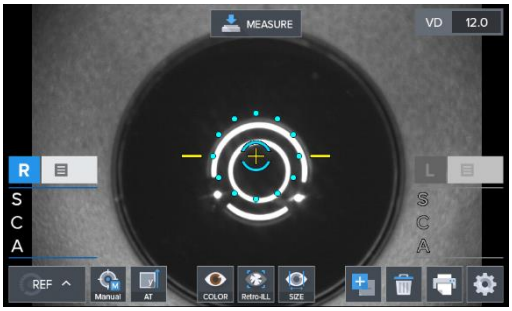
1) Start with default value.

2) Test tracking performance.

A. Move focus cross to outer mire ring edge.



B. Leave the joystick out, and watch the tracking action.



C. If the cross passed the center of mire ring then you can say that the test is failed.

D. If the cross stopped at the center of mire ring without passing, then the test is success.

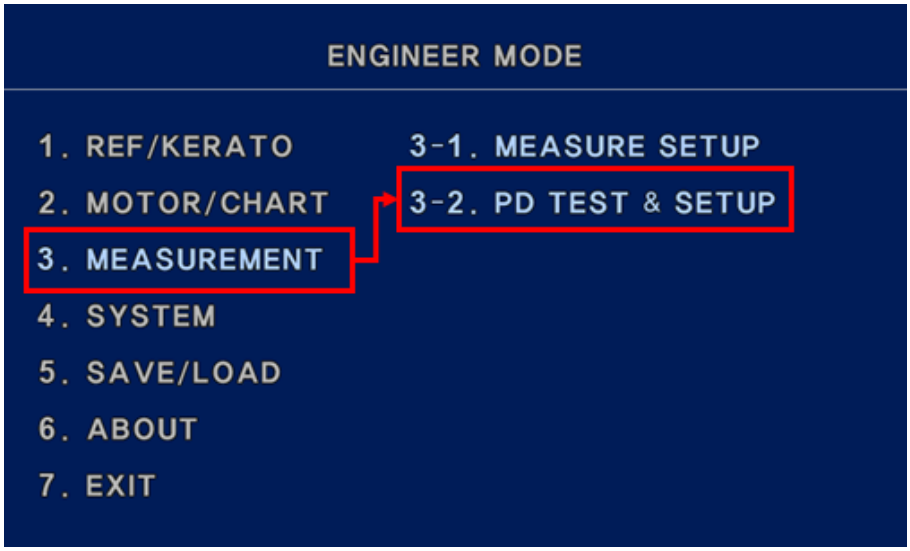
3) If Step 2. is failed, increase setting value and retry.

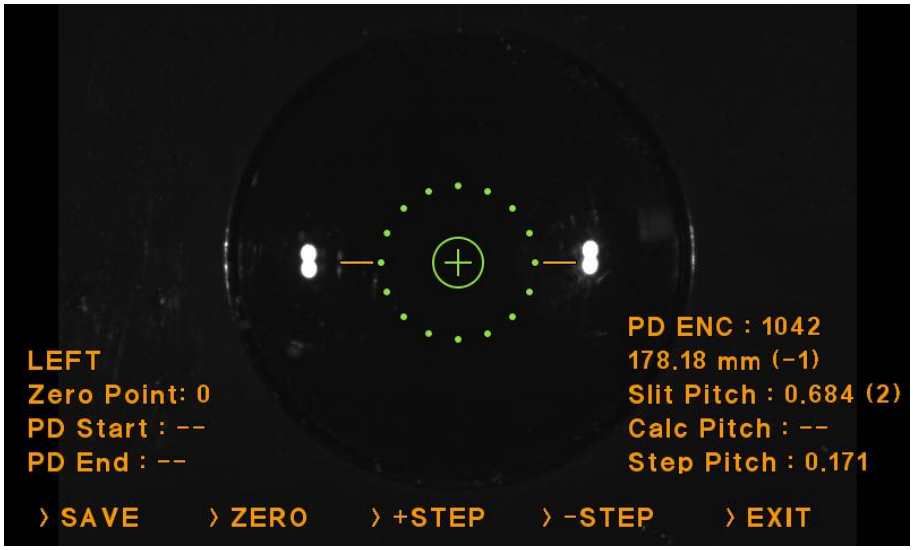
4) If Step 2. is succeed current values are the answer.

5) Repeat these process to the other side.

4.3. Pupil distance calibration (PD Setup)

PD Setup is available at 3-2. PD TEST & SETUP.





A. Engineer mode of the PD Setup begins.

B. PD Setup in the menu is as follows.

1) SAVE

- Changed the temporary storage of PD are set.

2) ZERO

- The current value of the X-axis encoder must specify the initial position.

3) + STEP

- The offset of the slit spacing (Slit pitch Offset) increases.

4) - STEP

- The offset of the slit spacing (Slit pitch Offset) decreases.

5) EXIT

- PD Setup will exit.

 Slit pitch Offset is changed, the screen update interval of the slit is measured from which pupil distance (PD) is also changed.

C. PD measurements in the following order, depending on setting.

1) PD measurements and those mounted on the stand, the focus is adjusted on the screen.
2) PD-right party based on the scale and press the joystick button. Screen, the starting value for the PD (PD Start) in the current encoder value is output.
3) PD-left party based in the scale and press the joystick button. Screen, the exit value for the PD (PD End) will be printed in the current encoder values.
4) PD distance marked on the top right of the screen if appropriate, SAVE button and press Save. If you are not adequate, adjust the offset of the slit spacing, and try again seen.

D. After PD Setup, engineer mode by pressing the SAVE SYS DATA is stored.

4.4. Factory Data Setup

1) MAKE SYSTEM BACKUP
   - It is for our factory worker.
   - Please do not touch it.

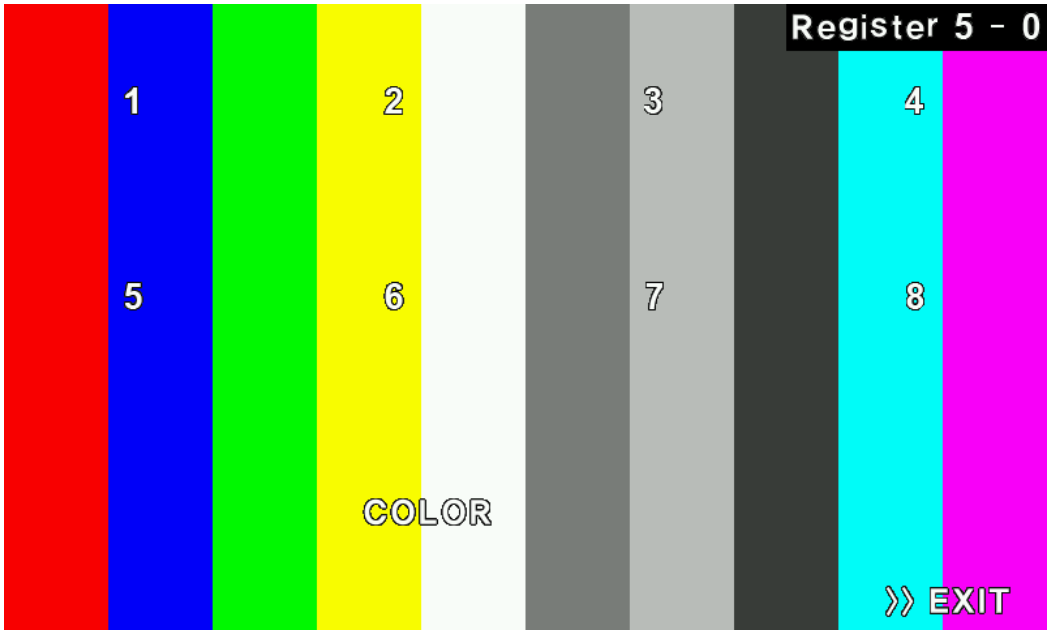
2) VERIFY BACKUP DATA
   - Check if the valid system backup is stored.

3) RESTORE SYSTEM
   - Restore all system data to factory backup.

4) COPY FRAM
   - Copy backup data to another FRAM.

4.5. Color Test

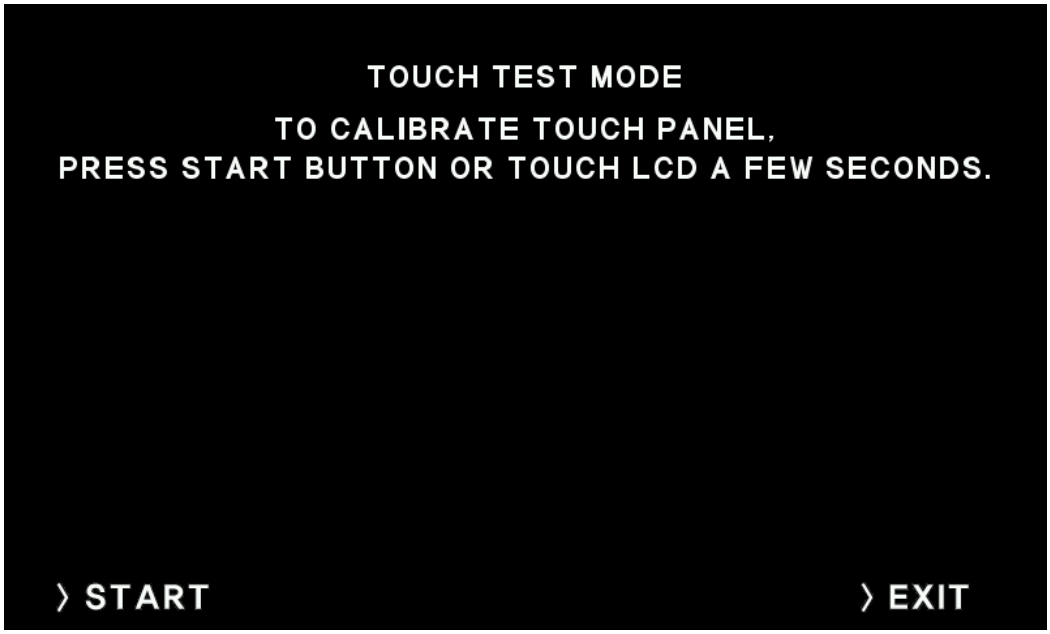
Verify the LCD Color temperature



1) Each number on the screen is color temperature.

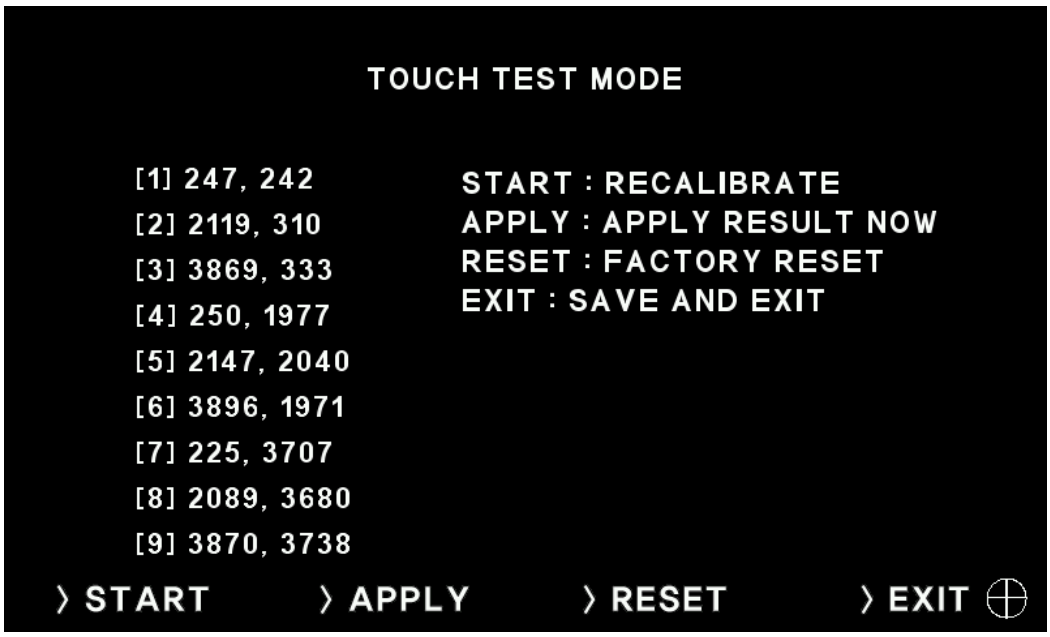
2) Bigger number is warmer color.

4.6. Touch Setup



1) Start touch setup button in the engineer mode.
2) Press start button or touch LCD a few seconds.

3) Press the cross marker (9 section) until beep sound.



4) Touch APPLY button to apply the result of calibration.

4.7. DPC (Dead Pixel Correction) Setup

1) DPC Setup begins in engineer mode.

2) DPC Setup in the menu is as follows.
   - VIEW
     i. The selected Pixel color camera and the location of the Dead Pixel is displayed as a rectangle on the screen.
   - CLEAR
     i. Stored information to initialize all the Dead Pixel, DPC function is off.
   - CAMERA
     i. KER CCD Camera Color CCD and is one of the select.
     ii. Selected camera is displayed on the screen of the kind.
   - COLOR
     i. Dead Pixel color is selected as one of the White and Black.
     ii. The selected Pixel color is printed on the screen.
   - EXIT
     i. DPC Setup will exit.

3) White Dead Pixel of KER CCD Setup is as follows.
   - CAMERA Press to select KER CCD.
   - COLOR Select White Pixel Press.

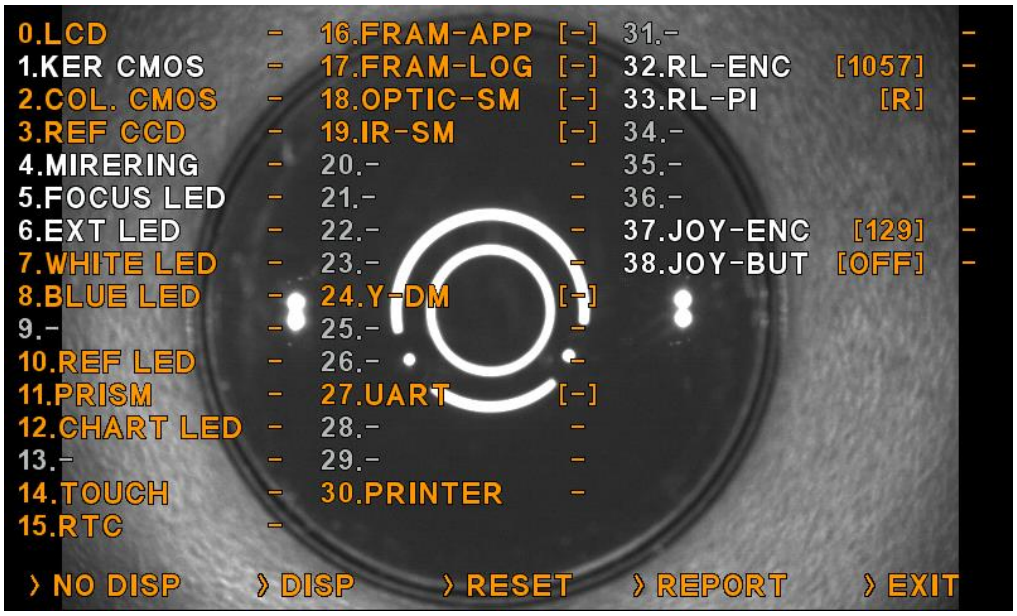
- If you press the joystick, Dead Pixel beginning of the search and discovery of the Dead Pixel count is displayed on the screen. Ten thousand days When Buffer Full output with the message, DPC compensation will exceed the number of possible Dead Pixel.

4) C in the same way and then Setup and then to the Dead Pixel.
   - KER CCD's White Pixel
   - KER CCD’s Black Pixel in
   - COLOR CCD's White Pixel
   - COLOR CCD’s Black Pixel in

5) After DPC Setup, engineer mode by pressing the SAVE SYS DATA is stored.

6) HRK-1 restarts, and were being corrected by the camera from the screen Dead Pixel Check.

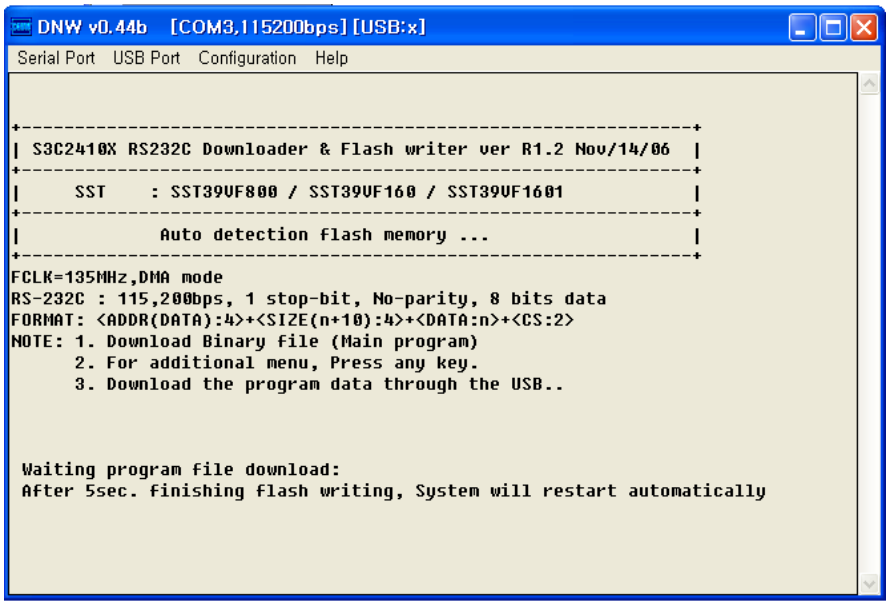
4.8. IQC mode



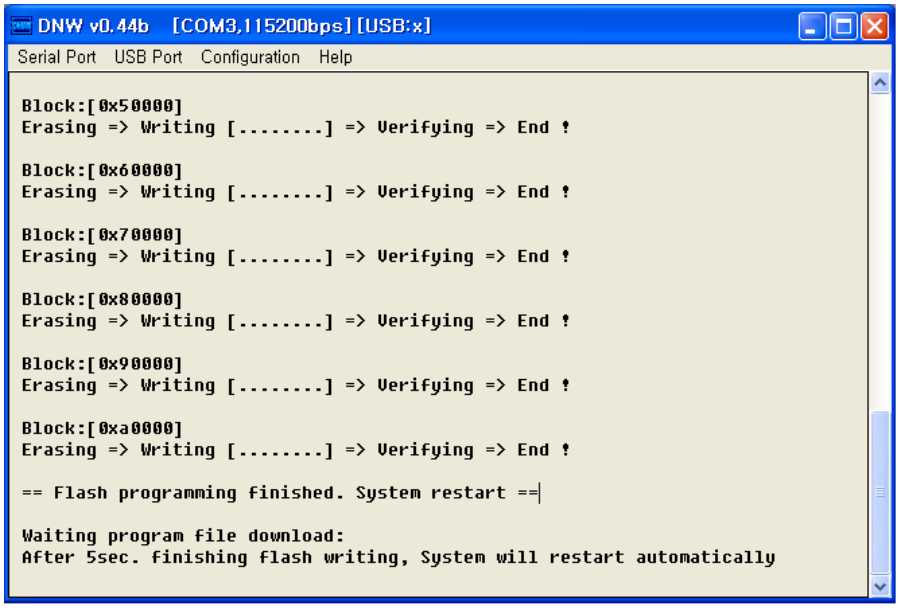
1) Test procedure
   - Start IQC Mode in the engineer mode.
   - Test the each mode.
   - If Test is success or fails, select pass or fail on pass and fail button.
2) Menu
   - NO DISP
     : All of the sections disappear on the screen.
   - DISP
     : All of the sections appear on the screen.
   - RESET
     : Pass and fail data of all of the sections are reset.
   - REPORT
     : Print the report
   - EXIT
     : Go to engineer mode.

4.9. Software upgrade

1) Turn off HRK-1.
2) Start DNW program, set your PC's COM port number, 115200 Bps.
3) Connect PC to HRK-1 with serial cable.
4) Pressing the 5th key, then turn on HRK-1.



5) DNW program will show the following screen.
6) Select Serial Port => Transmit menu, then File Dialog box pops up.
7) Choose HRK_xxx.bin file, then press OK button.



8) After downloading, turn off and on the HRK-9000A.
9) Confirm the changed SW version on boot screen.