

## ***NAC Eye Mark Recorder EMR-9 Quick Start Guide***



May 2009

NAC Image Technology Inc.

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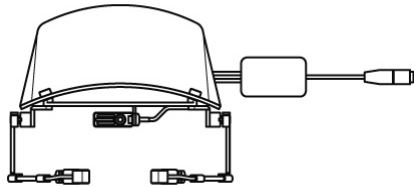
## 2. Basic Operations

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## 3. Specifications

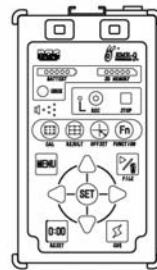
# 1. System Configurations

## 1.1. Standard Configuration

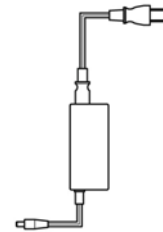


Head Unit

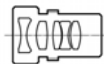
Cap-Type / Glasses-Type (see 1.2)



Controller



AC Adapter



View Lens 44deg.



SD Card 1GB



AV Cable

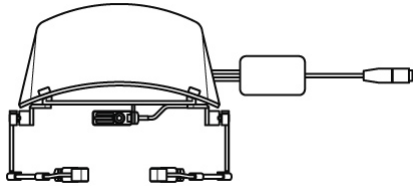


Carrying Case for Main Unit



Manual

## 1.2. Head Unit Variations



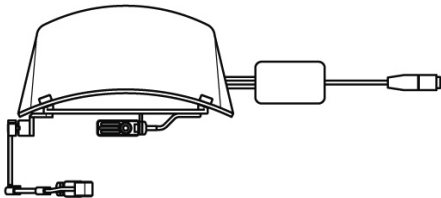
### Cap-Type, Dual-Eye Detection

- 1 x Head Unit
- 1 x Right Eye Detector
- 1 x Left Eye Detector



### Glasses-Type, Dual Eye Detection

- 1 x Head Unit
- 1 x Right Eye Detector
- 1 x Left Eye Detector



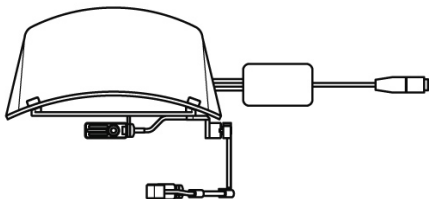
### Cap-Type, Right-Eye Detection

- 1 x Head Unit
- 1 x Right Eye Detector



### Glasses-Type, Right-Eye Detection

- 1 x Head Unit
- 1 x Right Eye Detector



### Cap-Type, Left-Eye Detection

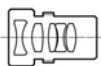
- 1 x Head Unit
- 1 x Left Eye Detector



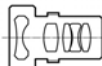
### Glasses-Type, Left-Eye Detection

- 1 x Head Unit
- 1 x Left Eye Detector

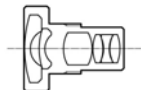
### View Lenses



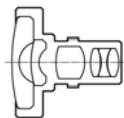
View Lens 44deg.  
(Standard)



View Lens 62deg.  
(Option)



View Lens 92deg.  
(Option)



View Lens 121deg.  
(Option)

### 1.3. Optional Items



LCD Viewfinder



Battery & Charger



View Lens

44deg., 62deg., 92deg., 121deg



Pointer



Serial Cable



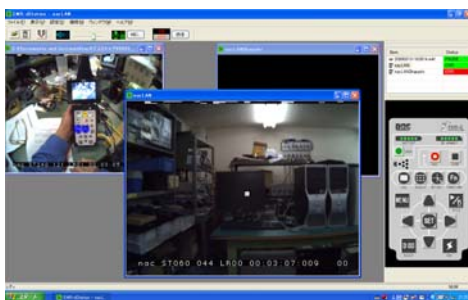
Cue Switch



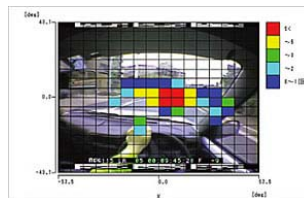
Event/Reset Cable



Head Unit  
Extension Cable, 3m



EMR-dStation  
Remote Control Software



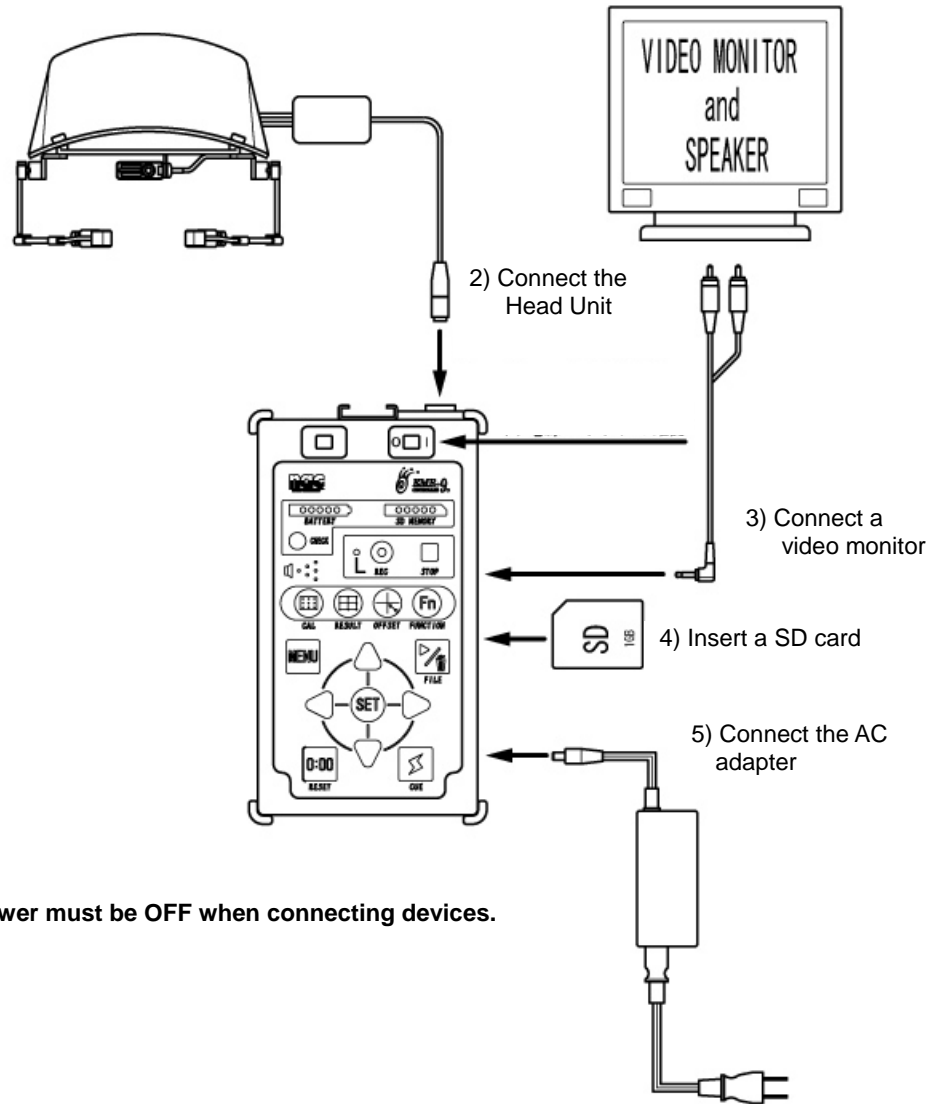
EMR-dFactory  
Eye Movement Analysis  
Software



Carrying Case for  
Accessories

## 2. Basic Operations

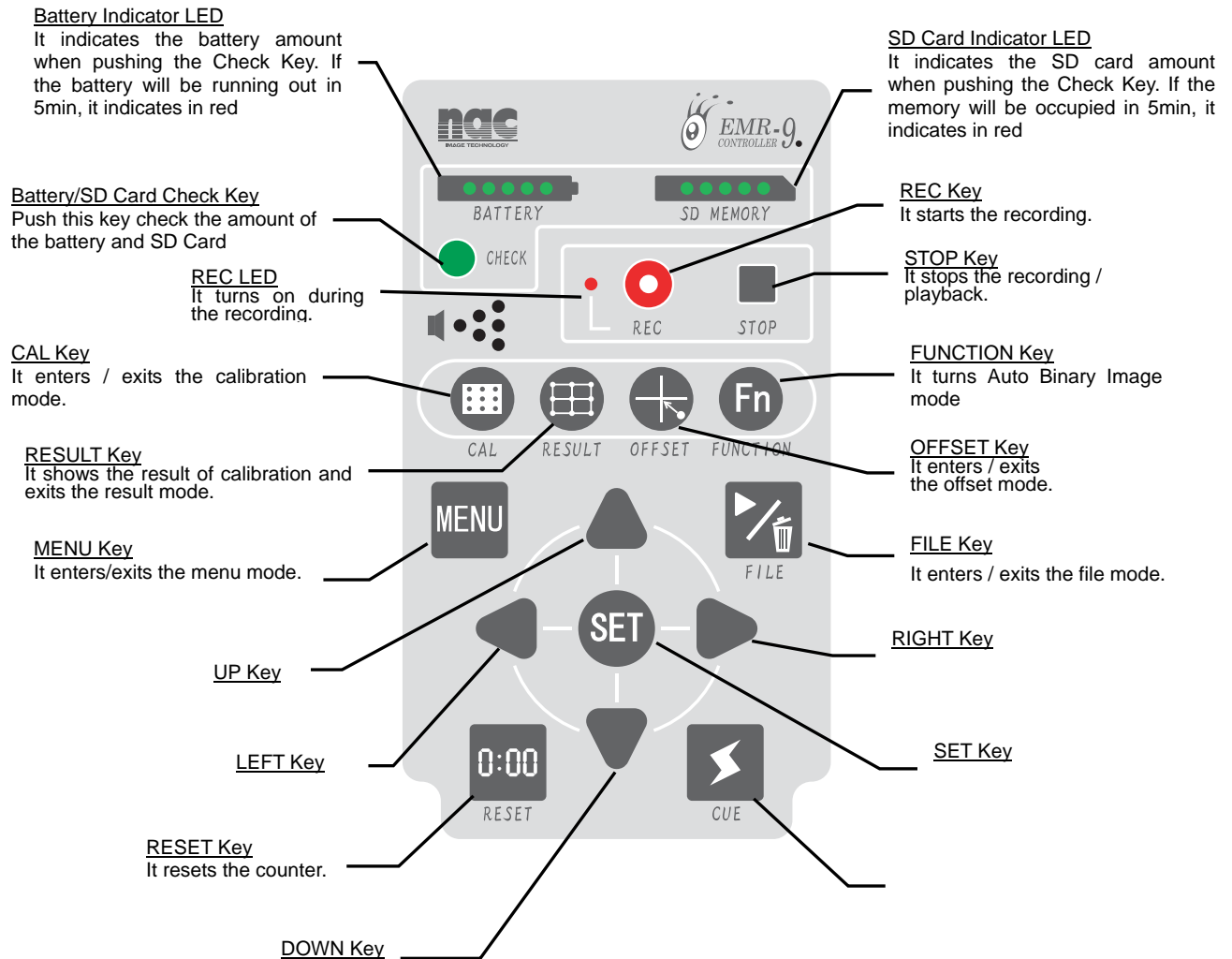
### 2.1 Connection



**Note:** Power must be OFF when connecting devices.

- 1) Turn off the power.
- 2) Connect the Head Unit and the Controller.
- 3) Connect a video monitor to an AV out of the Controller by the AV cable.
- 4) Insert a SD card (specified one) to a SD slot of the Controller.
- 5) Connect the AC adapter to the Controller. You can use a battery pack instead of the AC Adapter.
- 6) Turn on the power. It takes about 25sec for boot up. Then a message of "The system parameter was loaded from SD card." will appear about 60sec after power on. Push the **SET** key while a cursor is at OK.

## 2.2 Controller Key Functions



**Note:**

- ① During the recording, the recording is stopped if you push either [CAL] or [RESULT] or [OFFSET] or [MENU] or [FILE] key.
- ① Do not push multi keys at the same time which causes operation failure.

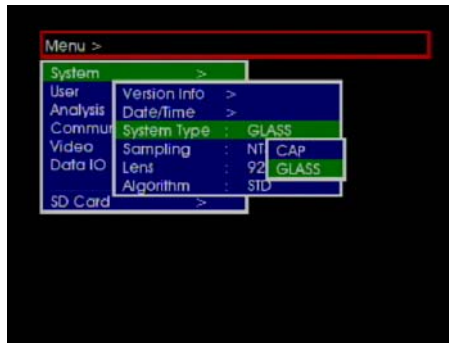
## 2.3 Head Unit Adjustments

### 1. Preparations

Set the parameters regarding configuration according to system configuration. Following shows the path of essential parameters. Push the **MENU** key to enter/exit Menu mode. Go to and/or change the parameters using UP▲/DOWN▼/LEFT◀/RIGHT▶ keys. The **SET** key will not be used for parameter settings.

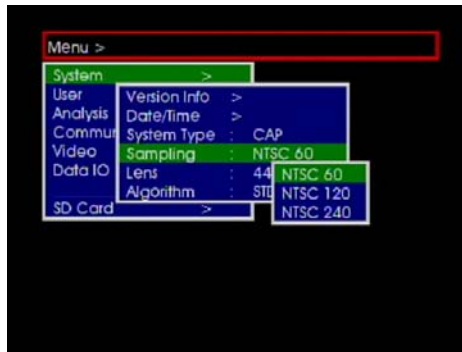
#### 1) System Type

Menu > System > System Type > CAP / GLASSES



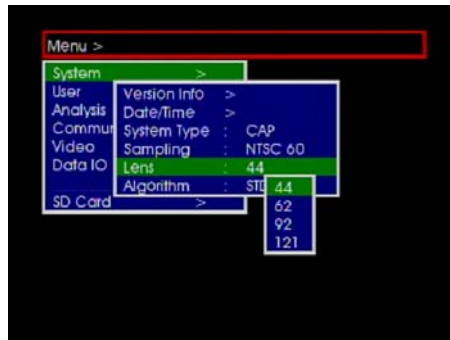
#### 2) Sampling Rate (in case of 120/240Hz version)

Menu > System > Sampling > NTSC 60 (60Hz) / NTSC 120 (120Hz) /NTSC 240 (240Hz)



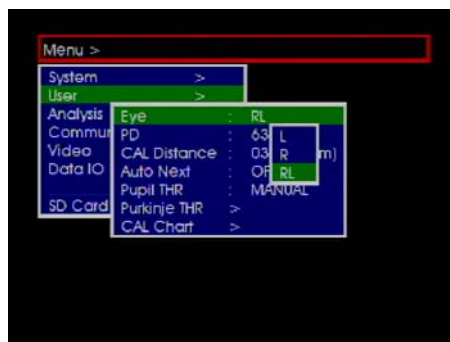
### 3) View Lens

Menu > System > Lens > 44/ 62 / 92 / 121

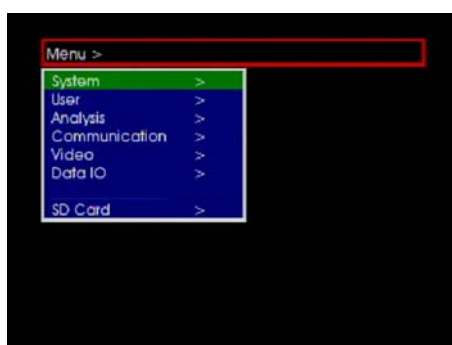


### 4) Eye to be detected

Menu > User > Eye > L / R / RL



## 2. Head Unit Adjustments in case of the Cap-Type

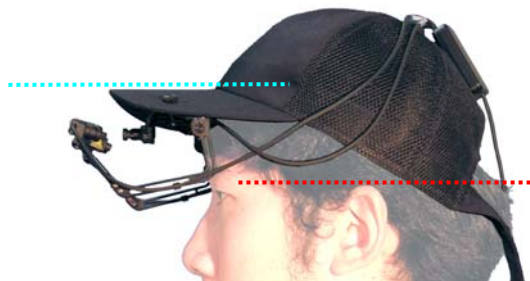
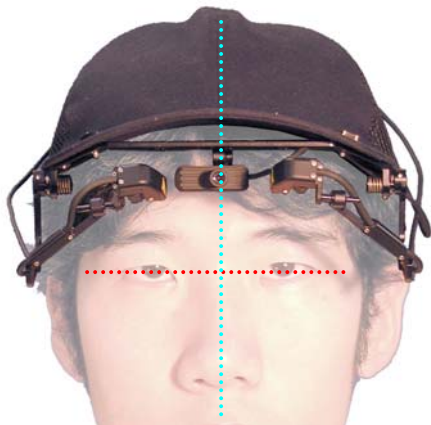


1) Push the **MENU** key to enter Menu mode. In Menu mode, a LED of eye detector is off, and a subject can wear the Head Unit safely.

Or just close eyes when wearing the Head Unit for eye protection (Recommended!).



2) Wear the Head Unit as shown in the following pictures.



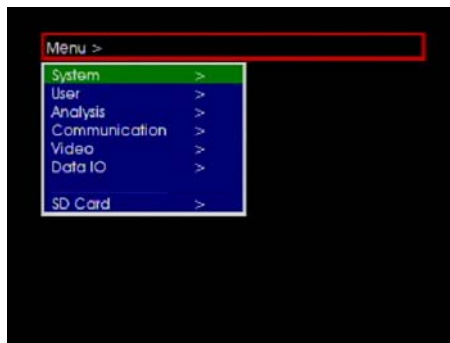
3) Push the **MENU** key to get back the view image.



4) Adjust the view camera position so that an object in the view image becomes center while a subject watches the object slightly below (about 10degree).

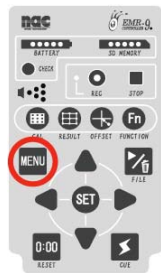


### 3. Head Unit Adjustments in case of the Glasses-Type

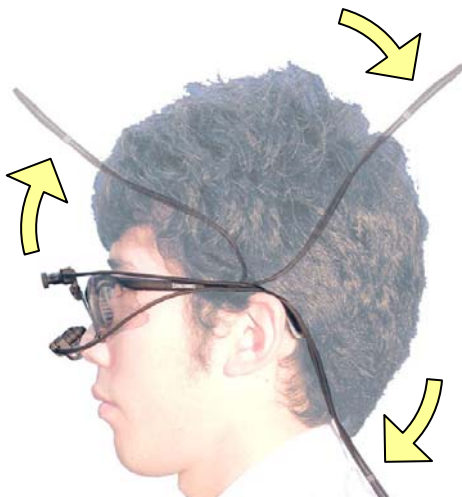


1) Push the **MENU** key to enter Menu mode. In Menu mode, a LED of eye detector is off, and a subject can wear the Head Unit safely.

Or just close eyes when wearing the Head Unit for eye protection (Recommended!).

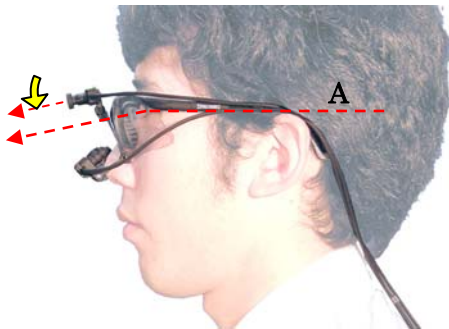
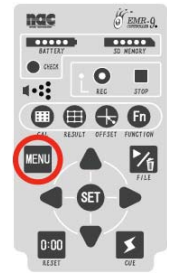


2) Wear the Head Unit as shown in the following pictures.



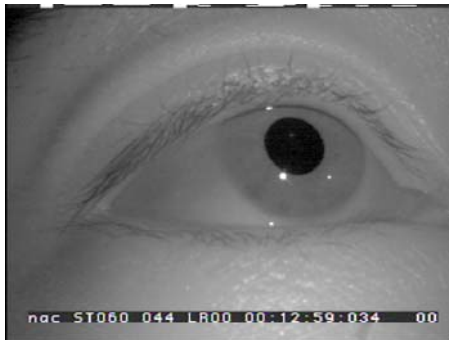


3) Push the **MENU** key to get back the view image.



4) Adjust a view camera position so that an object in the view image becomes center while a subject watches the object slightly below (about 10degree).

## 2.4 Eye Position Adjustments



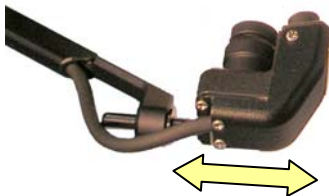
1) Display an eye image on the monitor. You can change the monitor image by pushing the LEFT ◀ or RIGHT ▶ keys.



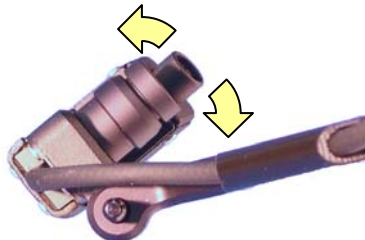
Ex. View image > Right Eye > Left Eye > Quad image > View image

2) Verify if an eye is displayed within a frame and in focus.

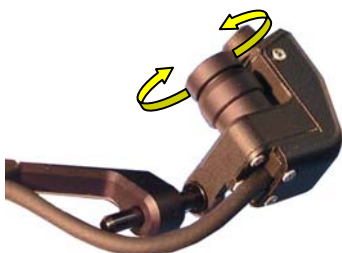
3) If the eye is out of frame or out of focus, adjust the eye detector as shown in pictures left.



For horizontal adjustment



For vertical adjustment



For focus adjustment

## 2.5 Pupil Detection Adjustments

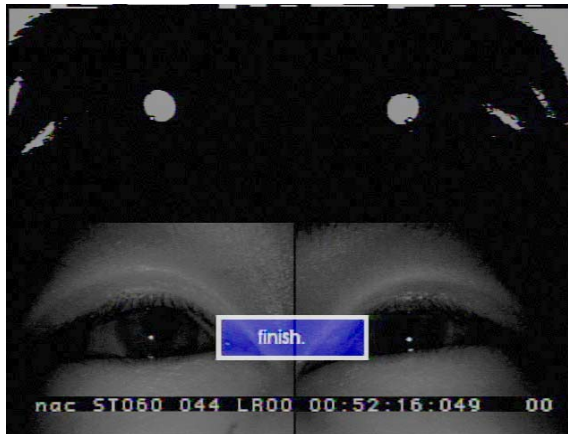
### 1. Auto Binary Image Adjustment for Pupil Detection

It allows you to adjust the binary image level of Pupil and Purukinje automatically. If you set "AUTO", the binary image adjustment automatically starts when you enter the calibration mode.

1) In order to set auto binary image adjustment, enter Menu and go to:

Menu > User > Pupil THR:

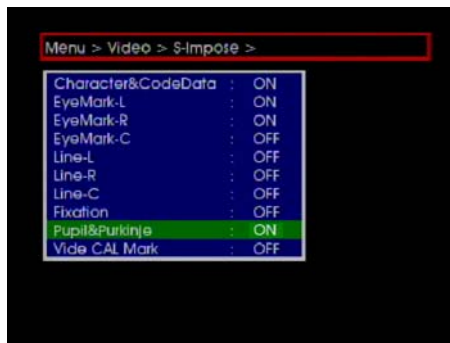
- AUTO : Binary image adjustment automatically starts when you enter the calibration mode, then goes back to the calibration mode upon completion of the auto binary image adjustment.
- MANUAL (default) : Binary image adjustment is performed manually.



2) When the auto binary image adjustment is completed, a message of "finish" is displayed. If the auto binary image adjustment is failed, a message of "failure" is displayed. In the later case, adjust the binary image level of Pupil and Purukinje manually as per 2.5.2.

Note: When you push the FUNCTION **Fn** key in eye mark mode, the binary image adjustment automatically start regardless of above Pupil THR setting.

## 2. Manual Binary Image Adjustment for Pupil Detection

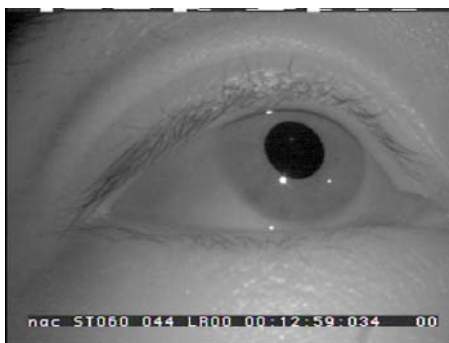
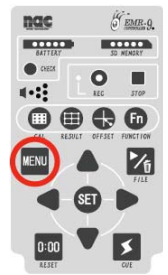


1) Enter Menu and go to:

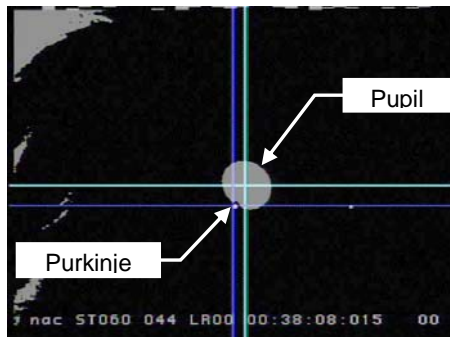
Menu > Video > S-Impose > Pupil & Purkinje.

Turn ON the Purkinje by pushing the UP ▲ or DOWN ▼ keys.

Note: The **SET** key will not be used for parameter settings.



2) Display an eye image to be adjusted on the monitor. You can change the monitor image by pushing the LEFT ◀ or RIGHT ▶ keys.



3) Push the **SET** key to show a binary image.

Adjust the binary image level by pushing the UP ▲ or DOWN ▼ keys so that Pupil and Purkinje images are displayed clearly meantime reduce level of binary image of other parts, such as eyelashes, an eyelid and skin, as much as possible.





【NG】 Too weak



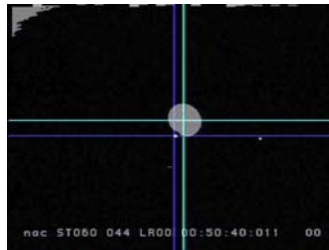
【NG】 Too weak



【NG】 Weak



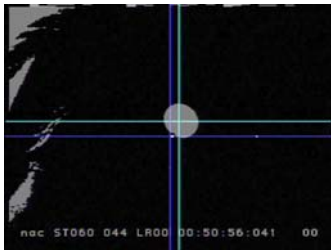
【OK】 Fine though bit weak and a pupil diameter may be measured bit smaller than actual



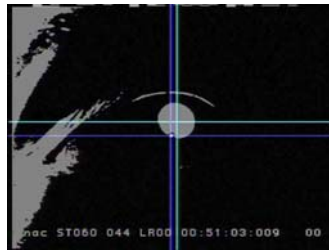
【OK】 Fine



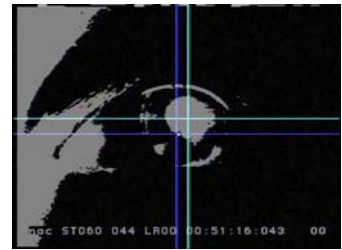
【OK】 Acceptable though bit strong



【OK】 Acceptable though bit strong



【NG】 Strong

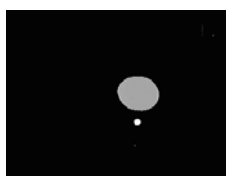


【NG】 Too strong

- 4) Adjust the binary image level by pushing the UP ▲ or DOWN ▼ keys so that cross lines appear on Pupil image. Make the subject see upper right, upper left, lower right and lower left and verify the Pupil and Purkinje images are detected properly.



Upper Right



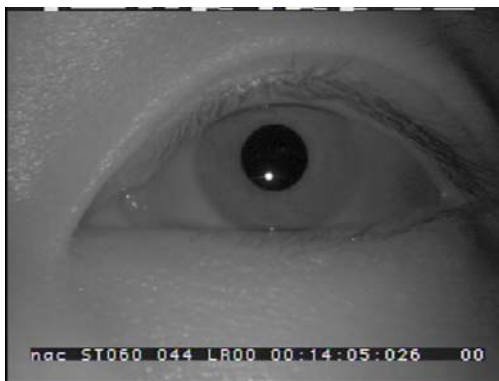
Upper Left



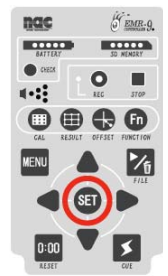
Lower Right



Lower Left



5) Push **SET** key to go back to the normal image from the binary image.



6) Display the view image on the monitor. You can change the monitor image by pushing the **LEFT** or **RIGHT** keys.

Ex. View image > Right Eye > Left Eye > Quad image > View image

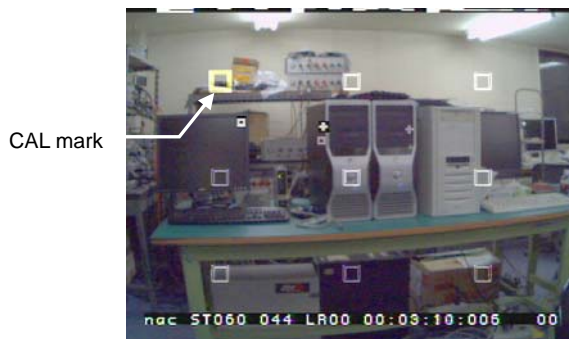


**Note:**

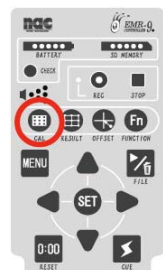
- ① To show the cross lines, go to Menu > System > Algorithm.
  - When you select "STD" or "PUPIL", the cross lines of both Pupil and Purukinje appear on display.
  - When you select "PURUKINJE", only the cross lines of Purukinje appear on display.

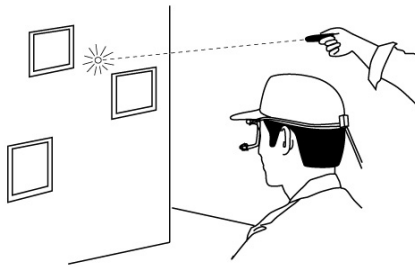
## 2.6 Calibration

### 1. Calibration



1) Push the **CAL** key to go calibration mode. Nine CAL marks appear on display (in standard calibration mode).






2) Point out a position where the CAL mark appears on the view image using a laser pointer or a something stick, such as a pen.


Tips:

- ✓ It is easier to calibrate on a wall or a fixed plane.
- ✓ If a laser point may not be visible on the display, use the stick to point out the CAL mark.




3) When the subject see the pointed CAL mark (calibration target point), push the CUE  key (or the Cue switch). Then the calibration target point moves to next CAL mark.





4) Repeat seeing the pointed CAL mark and pushing the CUE  key until end of calibration (9 calibration points).

Upon completion of the calibration, an eye mark appears on the view image.

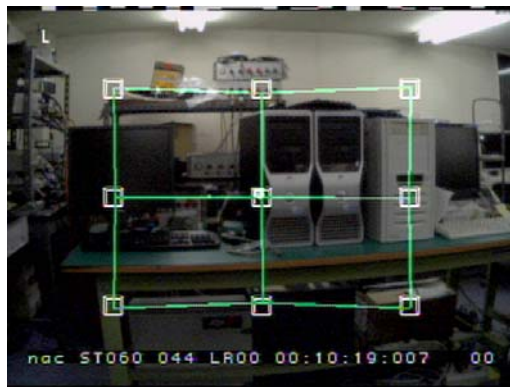
Remarks:

If the subject fails to see the CAL mark, push the FUNCTION  key to go back the previous CAL mark.

If the CAL mark doesn't move even push the CUE  key, the Pupil and Purkinje images may not be detected properly. Please cancel the calibration mode (push the CAL  key again) and readjust binary image level as per 2.5).

## 2. Calibration Result Check





In case of the 9-point calibration, you can check if the calibration is OK or NG, as follows. If the lines are on all of 9 CAL marks, the calibration went well. On the other hand, if the lines are not on or are away from one/some of 9 CAL marks, the calibration was NG.



OK



NG

- 1) Push the Result  Key. The 9 CAL marks and lines appear to show the result of calibration.
- 2) You can switch the calibration result of the left eye and the right eye by pushing the LEFT  or RIGHT  keys.
- 3) Push the Result  Key again to go back the view image (eye mark mode).



## 2.7 Measurement and Recording (Data Storage)

### 1. Eye Mark Mode

Immediately after the calibration, the eye mark (the gazing point of the subject) appears on the view image. This state is called as Eye Mark mode (but the data recording is not made in this mode). In the Eye Mark mode, you can display eye marks (a left, a right and/or a compensated eye mark(s)), trajectory of eye mark, real time fixation points.

### 2. Recording



Then (in the Eye Mark Mode), push the REC Key  to start the recording. The data is recorded on the SD card.

**Note:**

You can record the eye marks which are superimposed on the view image. However, there is a time lag up to 3/29.97sec between the eye marks and the view image.


You cannot record the trajectory of the eye marks and the fixation points superimposed on the view image to the SD card. But you can display those on view image using optional EMR-dFactory software.



1) Scene Number Setting  
 You can change the scene number by the UP  or DOWN  keys.



### 2) Recording

Push the REC  key to start the recording. The data is recorded on the SD card.

During the recording, an access lamp of SD indicator LED flashes.





During the recording, the trajectory or fixation points are not displayed.

Remarks: During the recording, the recording is stopped if you push either [CAL] or [RESULT] or [OFFSET] or [MENU] or [FILE] key.






Caution


Do not turn off the power during the recording (while the REC LED   is ON).



### 3) Frame Counter Reset

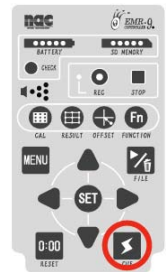
Press the RESET  key to reset the frame counter if necessary. This function may be convenient to set the start point of measurement.







### 4) Cue

Press the CUE  key to record the cue signal on set the frame counter if necessary.

You can change the scene number by the UP  or DOWN  keys.



- 5) Press the STOP  key to stop the recording. The REC LED   turns off. Then upon completion of data storage from the system memory to the SD card, the access lamp of SD indicator LED  turns off.

Note: After about 1 hour recording, the access lamp may flashe for several ten seconds. It is because of a transfer time from the system memory to the SD card, and is not malfunctioned.

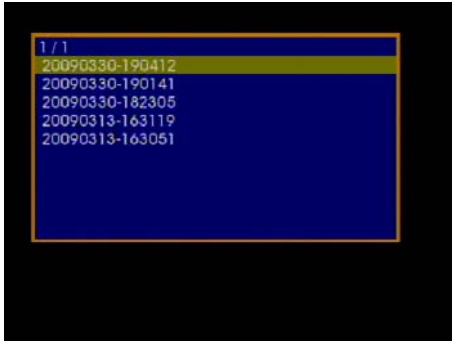



Caution

Do not push any key while the access LED is flashing (during the data transfer to the SD card after the REC LED is off).



## 2.8 Playback

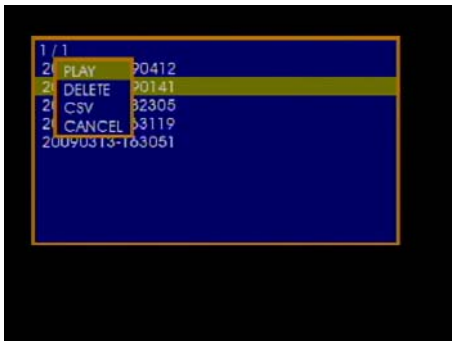
You can playback the measured view images from the measurement file saved in the SD card






1) Push the FILE key  to enter file management mode. The data files saved in the SD card are listed. The data files are named as date and time (Y/M/D-H/M/S) when the files are created.



If there are many data files which are not listed within one page, the files are shown in next page. You can change pages by pushing the LEFT  or RIGHT  keys.



2) Select the data file by the UP  / DOWN  keys, then push the SET key . Sub menu appears.

Push the SET key  on a menu of:






- PLAY for playback
- DELETE to delete the file
- CSV to create a CSV file \*
- CANCEL to cancel this act.



\* This function will be available in ver. 2



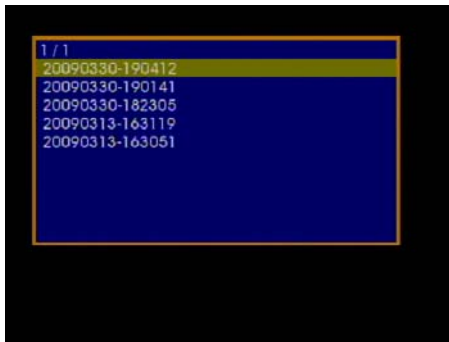
3) During playback, the following keys act as;


- SET  : pause
- RIGHT  : play / forward search
- LEFT  : backward play / reverse search
- UP  : moves to a first frame
- DOWN  : moves to a last frame




And except normal replay, the following comment appears at upper left on the display

- [FFx32] : Forward Search
- [PAUSE] : Pause
- [RWx1] : Backward Play
- [RWx32] : Rewind Search



4) Push the STOP  key to stop playback and then back to the file management mode.



5) Push the FILE  key to exit the file management mode, then back to the eye mark mode.



Remarks:

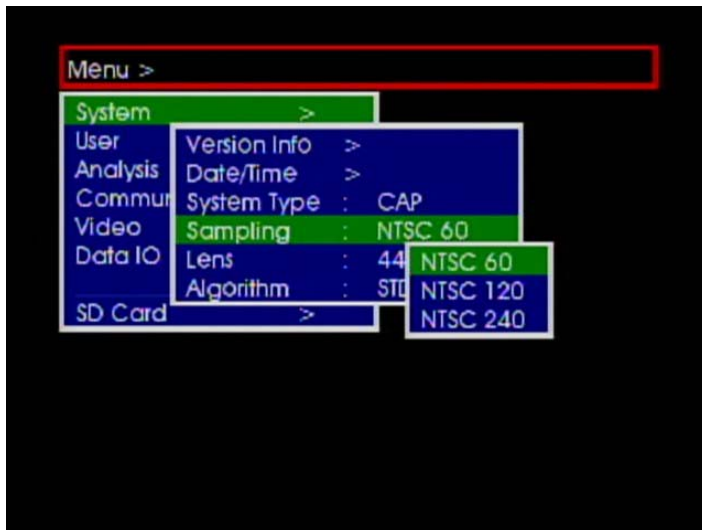
- ✓ The trajectory and fixation points are superimposed on playback image in the same condition as data recording.
- ✓ When you change the SD card, load the system settings to the SD card or save the data file once. If the controller cannot read the SD card properly, a message of “NO FILE” displays in the file management mode. In this case, push the FILE key to get back the eye mark mode. Then, go to Menu > SD card > Load, and push the FILE key again to list the files properly.
- ✓ If the eye mark was set at OFF during the recording, the eye marks are not displayed on playback images. Use optional EMR-dFactory software in order to display the eye marks, the trajectory, the fixation points, .

## 2.9 Parameter Settings

You can change the parameter settings according to a subject/applications. Following shows the path of major parameters. Push the **MENU** key to enter/exit Menu mode. Go to and/or change the parameters using UP▲/DOWN▼/LEFT◀/RIGHT▶ keys. The **SET** key will not be used for parameter settings.

### 1) Sampling Rate (in case of 120/240Hz version)

Menu > System > Sampling:



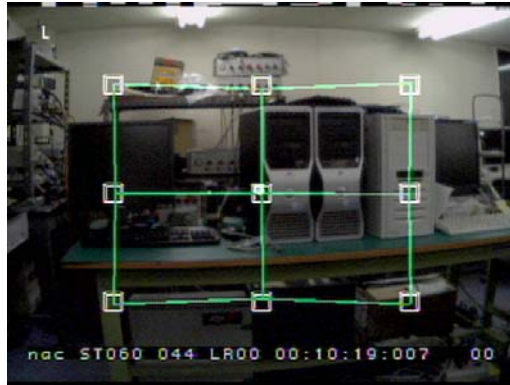
### 2) Eye Mark Detection Method

Menu > System > Algorithm >:

- STD : Combination of Pupil center method and purukinje method
- PUPIL : Pupil center method
- PURUKINJE : Purukinje method

3) Number of Calibration Target Points (CAL marks)

Menu > User > CAL Chart > Target Number > 9 or 2



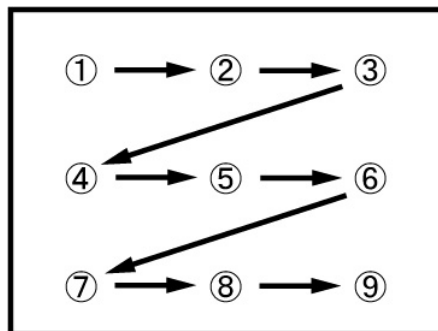
9 points (default)



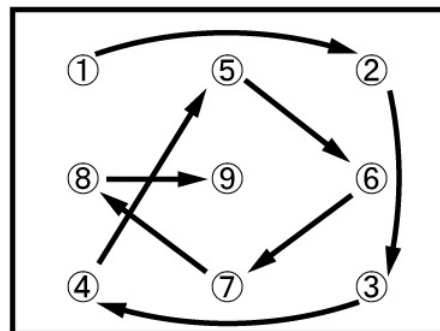
2 points

4) Order of Calibration Target Points (in case of 9 CAL marks)

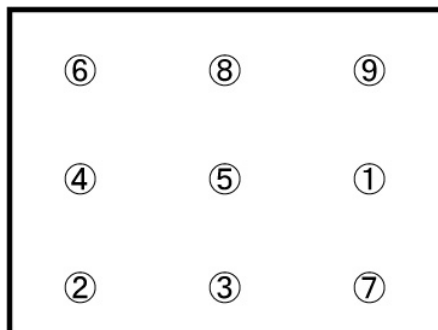
Menu > User > CAL Chart > Target Number > 9 >:



ZIGZAG (default)



SKIP



RANDOM (example)

5) Shape of CAL mark

Menu > User > CAL Chart > Mark Type >:

- SQUARE : Square (default)
- CROSS : Cross

6) Color of CAL mark

Menu > User > CAL Chart > Color >:

- WHITE
- YELLOW (default)
- RED
- GREEN
- CYAN

7) Auto Next mode

Menu > User > Auto Next >:

- ON: A calibration target point automatically moves to next CAL mark when the subject watches the CAL mark in a specified period. And in case of ON, set a limit range and a limit time to determine if the subject watches the calibration target point, as follows.
- OFF: Auto Next mode is off.

Menu > User > Auto Next > ON >:

- Limit Range : Set a radius between 3 - 120pixels (default: 10pixels)
- Limit Time : Set a gazing time between 1.5 - 20.0sec (default: 5sec)

## 8) Lower CAL chart mode

Menu > User > CAL chart > Layout >:

- Center : CAL chart appears at center position. (default)
- Lower : CAL chart appears at lower position. In some cases, the calibration can be performed properly in lower position rather than center position according to the subject. In this case, accuracy of eye tracking may not be good at upper position.



Center Layout of CAL Chart

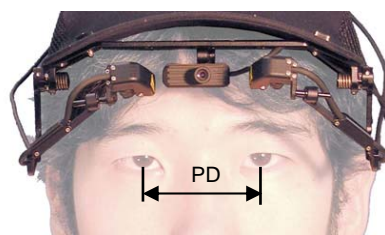


Lower Layout of CAL Chart

## 9) Pupil Distance Adjustment

Menu > User > PD:

Set a distance between pupils of the subject from 40 – 80mm (default: 63mm)



## 10) Calibration Distance

Menu > User > CAL Distance:

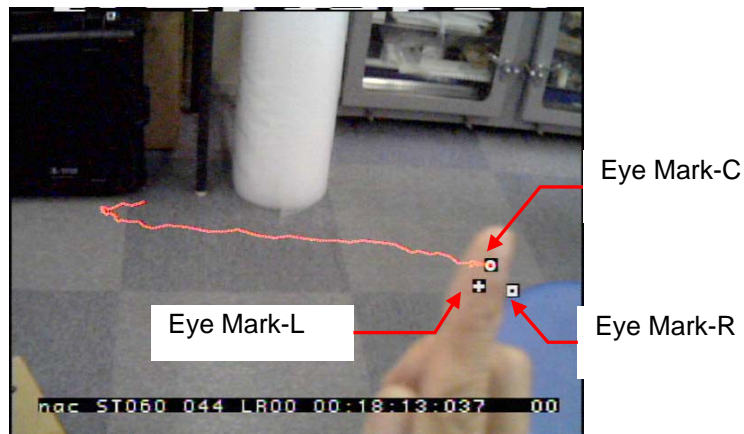
Set a distance between a calibration plane and the subject from 0 – 30,000mm (default: 3,000mm)

### 11) Superimpose

Menu > Video > S-Impose >:

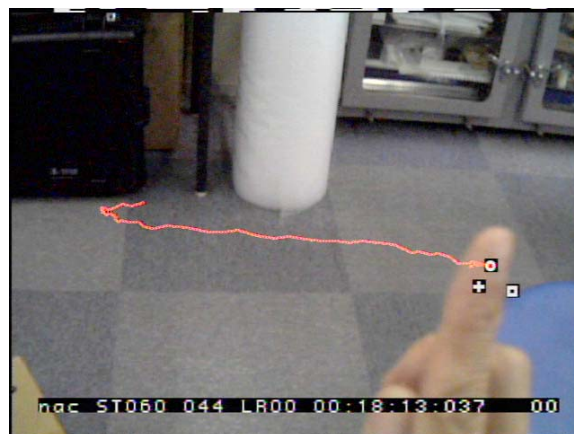
#### Eye Marks

- Eye Mark L :displays the left eye marks (default: ON)
- Eye Mark R :displays the right eye marks (default: ON)
- Eye Mark C :displays the compensated eye marks between L and R (default: OFF)



#### Trajectory

- Line L : displays the trajectory of left eye marks (default: OFF)
- Line R : displays the trajectory of right eye marks (default: OFF)
- Line C : displays the trajectory of compensated eye marks between L and R (default: OFF)

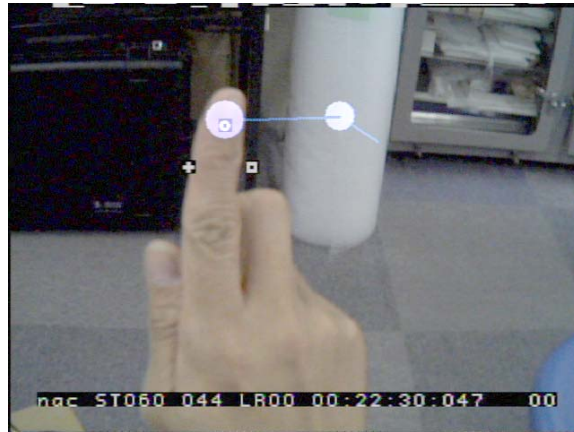


You can change duration of trajectory display as follows.

Menu > Video > S-Impose > Line L/R/C > ON > Duration: set as 1/ x sec (default:100 (=1/100sec))

### Fixation Points

- Fixation : displays the fixation points (default: OFF)
  - ON .> Eye > L (left) or R (right) or C (compensated point between L and R)



You can change duration of fixation points display as follows.

Menu > Video > S-Impose > Fixation > ON > Duration: set as 1/ x sec (default:100 (=1/100sec))

#### Note:

- It can not displays the trajectory and the fixation points at the same time.
- In the superimposed mode, the view image becomes darker. It is due to a video output spec of the controller, not a system failure.

### 3. Specifications

Detection Method	: Purkinje (Pupil / Cornea Reflection) Method, Pupil Center Method
Sampling Rate	: 60Hz / 120Hz / 240Hz (Sampling rate of 120Hz / 240Hz is available on the 240Hz model.)
Detection Resolutions	: Eyeball Movement: 0.1 deg. in horizontal and vertical Pupil diameter: 0.02mm
Detection Range :	: Eyeball Movement: +/- 40deg. in horizontal, +/- 20deg. In vertical Pupil diameter: 2.5 – 7.0mm
Head Unit	: Cap-type or Glasses-type
View Lenses	: 44 (standard), 62, 92 and 121 deg. (options)
View Finder (option)	: 3.5" LCD
Video Recording	: MPEG4, 640x480
Data to be recorded	: View image with eye marks, audio, measurement data (in binary format)
Storage Media	: SD card (a specified SD card)
Recording Time	: approx. 60min. (with/ a specified SD card of 1GB, Class 6)
Network	: 100base-TX, wireless LAN using EMR-dStation (option)
Event Signal Output	: Event signal is output according to settings of pupil diameter, number of blinking, a duration of fixation points
Data Analysis	: EMR-dFactory (option, ver.2.1 or later)
Input Signals	: Counter reset signal (TTL/contact), Cue signal (TTL/contact)
Output Signals	: Video (View image superimposed with eye marks, counter), Audio (mono), Serial data (frame counter, XY coordinate data of gazing point, pupil diameter), Event signal (TTL)
Power Source	: 100-240Vac (via the standard AC adapter), or the optional battery
Power Consumption	: approx. 21watts
Operational Temperature	: 0-40deg.C, 30~80%RH, No dew
Weight	: Glass-type Head Unit: approx. 75g Cap-type Head Unit: approx. 150g Controller: approx. 590g
Size	: Controller 85(W) x 147 (D) x 63 (H) mm

Note: Above specs are subject to change without notice.

# MEMO

