

# Instruction Manual for Hb134 Measurement Display Program (Windows version)

This instruction manual is for the measurement display program for Brain Activity Monitor (Hb134).

## Handling precautions

- (1) The NIRS plate is made of flexible material and curve shaped to fit the shape of forehead. **Do not fold, bend, or straighten the NIRS plate by force. It may cause damage on the internal electric circuit and result in malfunction.**
- (2) **Make sure to turn off the device when replacing batteries.** It may cause damage on the internal electric circuit if the batteries are replaced while the power is turned on. A malfunction resulted from such handling behavior shall not be covered by our warranty.
- (3) This is a non-medical device. It cannot be used for medical practices. Please get approval for use by the ethics committee of university or medical institute.
- (4) Make sure that the NIRS plate is closely attached to the examinee's forehead. Any opening or space between the plate and forehead may lead to data loss.
- (5) Near-infrared light does not permeate hair. The device measures the oxygenation status of the frontal lobe of a human by closely attaching the device to the forehead.
- (6) This device is developed for indoor use. Please refrain from using it outdoors as sunlight may interfere the measurement.
- (7) If the surface of NIRS plate got dirty, wipe it with a soft and lightly moisturized cloth. Do not use alcohol or ethanol for cleaning. The synthetic rubber material may deteriorate.
- (8) This device uses Bluetooth-LE (Bluetooth Low Energy).
- (9) Two AAA batteries are used for the device. When placing batteries in the battery box, make sure that the polarity is correctly located.
- (10) The measurement display program is for Windows-PC.
- (11) The near-infrared light used during measurement is completely harmless to human body.

## Terminology

Term	Description
NIRS plate	The measurement plate. The flexible substrate with LEDs and photodiodes for measurement is covered with synthetic rubber.
Long press (of the power button)	To press and hold the power button for 2 seconds or longer.
Bluetooth-LE	A standard added in Bluetooth 4.0 that is specializing in providing considerably reduced power consumption and cost.
Value-initialization	The NIRS plate may gradually slip out of the initial position as facial muscle moves and the distance between radiated and received light may also shift. The measurement value shifts depending on the condition of sensor touching to the skin. It is a command to add a reset point that initializes the measurement values.
Event merge	A function to add the information of events into the file created after measurement. This will add recorded event marks into the displayed trend graph.

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## Features of Hb134

Hb134 has two measurement modes.

- Real-time mode  
Measured data will be displayed on smartphone, tablet, or computer in real-time by Bluetooth.
  
- Storage mode  
Measured data will be saved to the built-in flash memory of the NIRS plate. The saved data can be downloaded by Bluetooth later on. Therefore, it is possible to take measurement apart from smartphone, tablet, or computer.

### 1. Preparation

#### 1-1. Computer setup

Bluetooth pairing (“add a Bluetooth device”) is required for Windows-PC. Complete pairing your computer and Hb134 according to the instruction manual for the computer and Hb134 (enclosed).

### 2. Real-time mode

#### 2-1. Start measurement

- (1) Start the measurement display program.
- (2) Click “Start” in the upper left and choose the device to connect from the pull-down list for “Connect to” (a dialog pops up in the middle of screen). The serial number is assigned to each Hb134 device (same serial number as displayed when adding a Bluetooth device) (Figure. 1).
- (3) Choose a preferred sampling rate and click “OK”. Sampling rate is an interval for sampling data. If the measurement rate is “0.1 sec”, it will take 10 data for 1 second. Measurement rate can be selected from “0.1 sec”, “0.2 sec”, “0.5 sec”, “1.0 sec”, and “5.0 sec”.  
\*For “Check sensors”, see 2-3 Ambient light check section for more details.
- (4) It takes up to 10 seconds for the computer and the device to reflect the setting and start measurement.
- (5) Trend graphs will be displayed when the measurement started. The arrangement of trend graphs can be switched to horizontal/vertical from “Arrangement” (Figure. 2).
- (6) Click “End” to terminate the measurement. A dialog will appear to save data. Choose a location and name for the file. You can save data also from “File” tab in the upper left (Figure. 3).

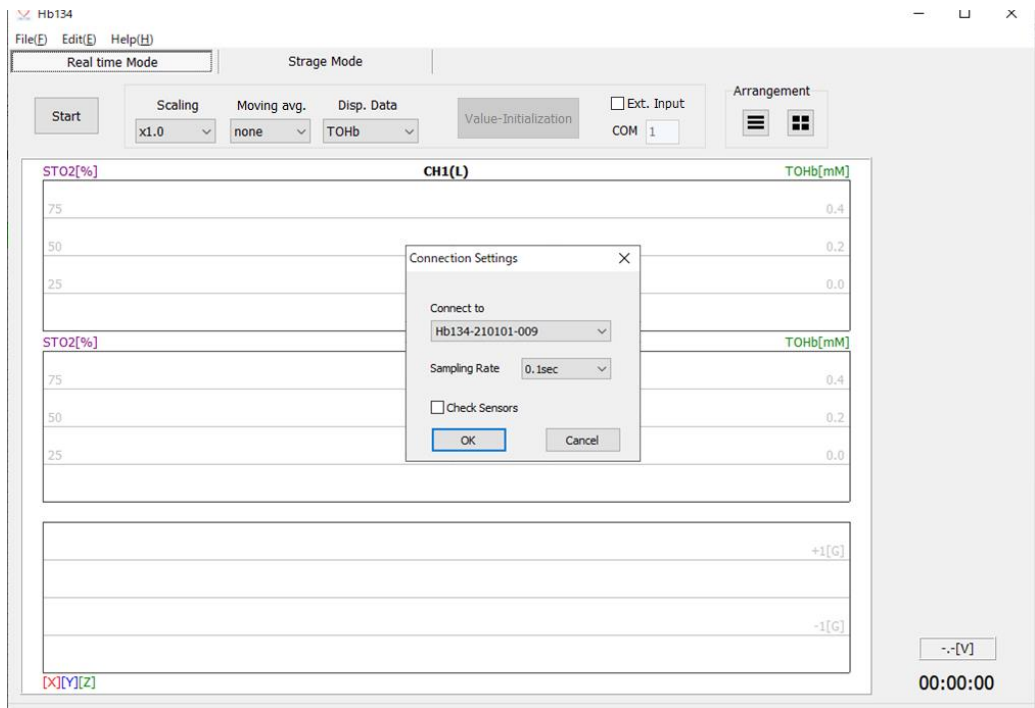


Figure 1. Connection settings

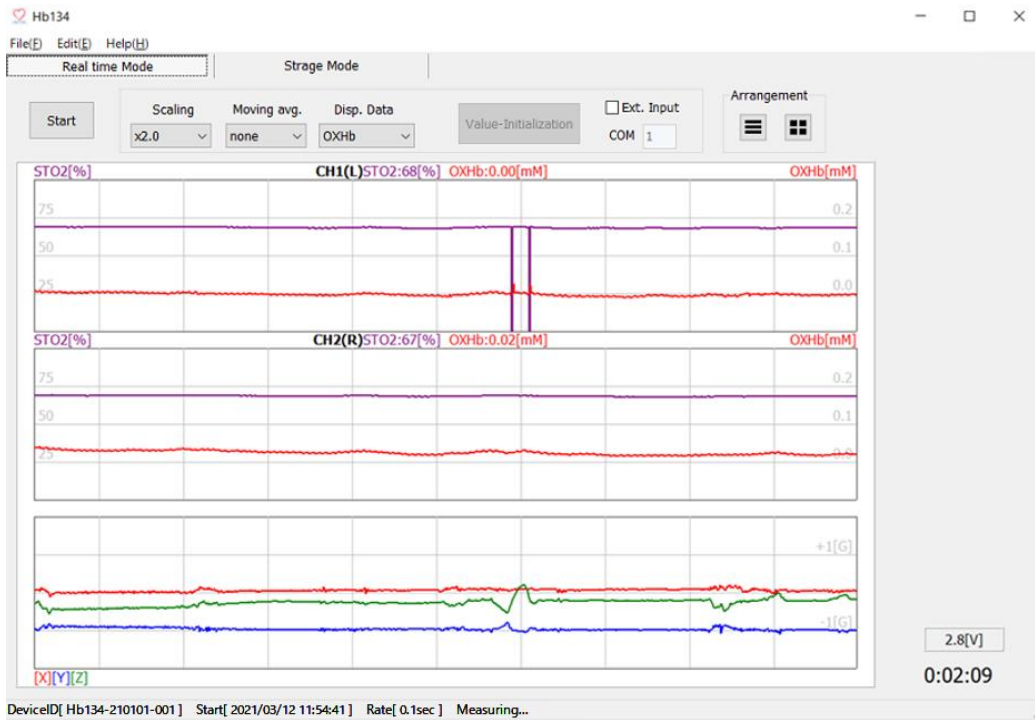


Figure 2. Trend graphs (Horizontal)

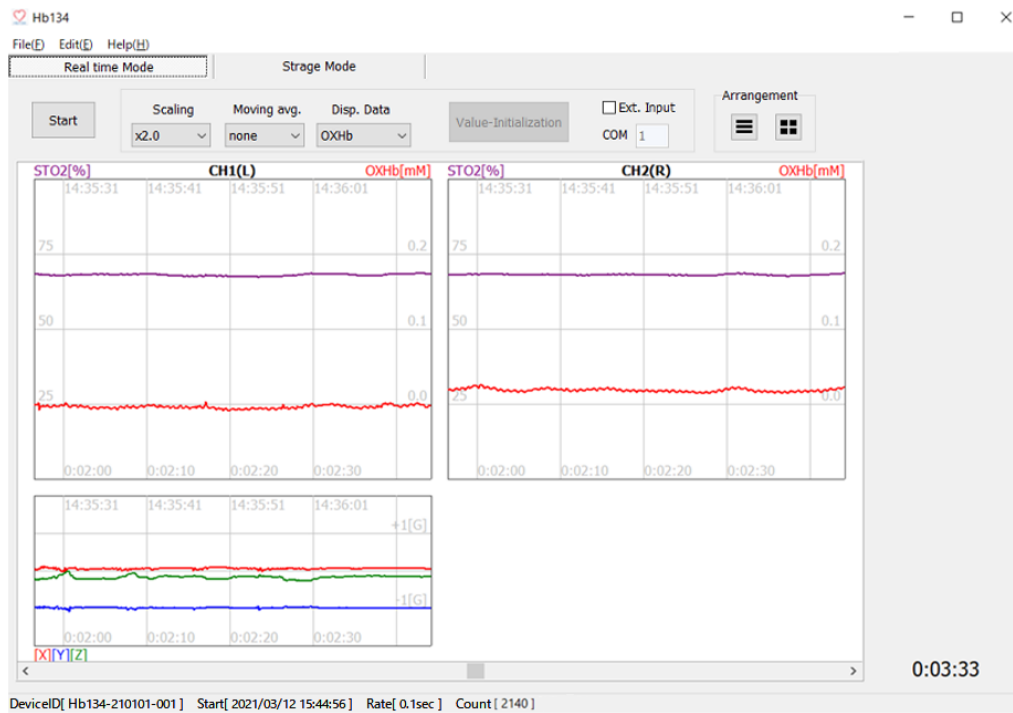


Figure 3. Trend graphs (Vertical)

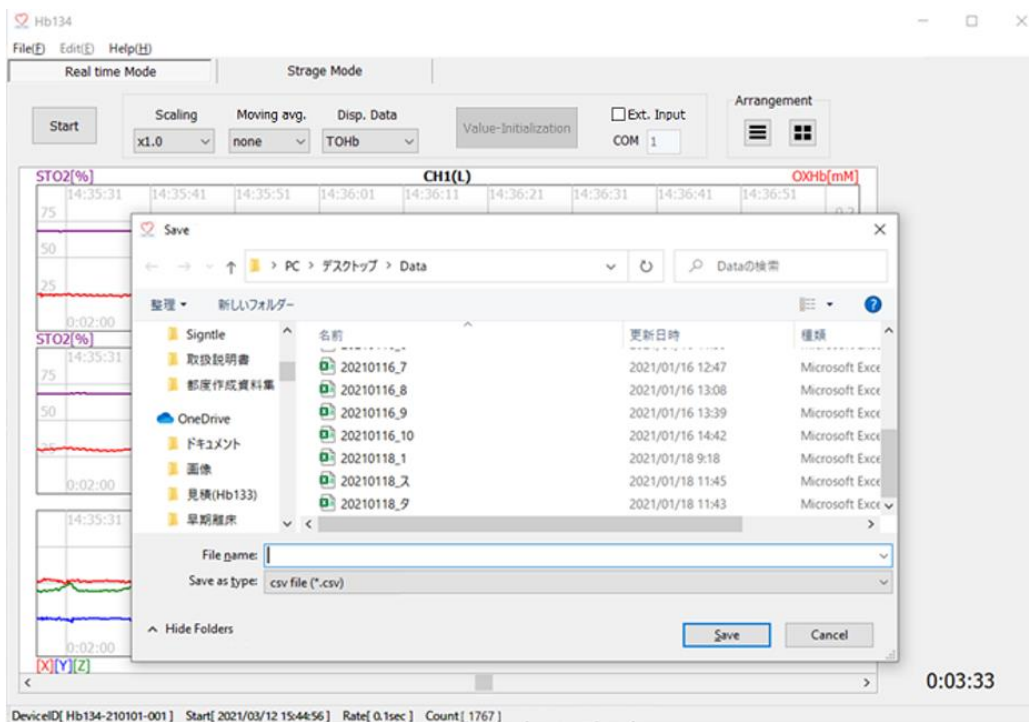


Figure 4. Save data

## 2-2. Setting and display items

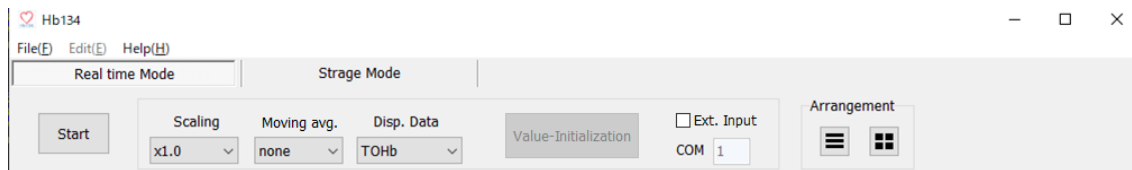


Figure 5. Display items

<div style="border: 1px solid black; display: inline-block; padding: 2px;">Start</div> / <div style="border: 1px solid black; display: inline-block; padding: 2px;">End</div>	Used for real-time mode.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Start</div>	Data communication between Hb134 and the computer begins.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">End</div>	Data communication between Hb134 and the computer ends.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Scaling</div>	Display magnification for the vertical axis can be selected from 0.5 to 8.0 times.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Moving avg.</div>	Moving average of measured data makes the trend graphs easier to read if there is too much fluctuation in the data. The range can be selected from “none”, “3 points”, “5 points”, “7 points”, “9 points”, and “11 points”.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Disp. Data</div>	Display items can be selected for the trend graph screen. In addition to Oxygen Saturation (StO <sub>2</sub> ), Oxyhemoglobin (OXHb), Deoxyhemoglobin (DXHb), and Total hemoglobin (TOHb) can be selected. The unit for StO <sub>2</sub> is %. The rest shows variation with the unit of mM.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Value-initialization</div>	All values except for Oxygen Saturation (StO <sub>2</sub> ) will be initialized to 0. These are the value of change and may largely fluctuate when the NIRS plate slips out of position. This is a command that forcibly initializes the values.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Battery voltage</div>	It shows the current voltage of batteries used for the device. The displayed numbers turn yellow when the battery voltage decreased to 2.5 V. It turns red when the voltage decreased to 2.2 V. In that case, please turn off the device and change batteries of the device. The device operates with the voltage lower than 2.2 V, however, the reliability of measurement may decrease (Figure. 6).

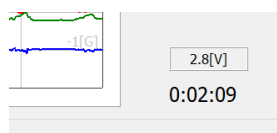


Figure 6. Battery voltage

<div style="border: 1px solid black; display: inline-block; padding: 2px;">Elapsed time</div>	It shows the elapsed time since the measurement started.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">Accelerometer</div>	An accelerometer is embedded in the middle of NIRS plate. X axis is set for right and left, Y axis for up and down, and Z axis for front and back direction.



The accelerometer is located in the middle of NIRS plate.

Max. 2G

Left	X	–	Right	X'
Up	Y	–	Down	Y'
Front	Z	–	Back	Z'

' (apostrophe) stands for negative signals

Figure 7. Accelerometer

### 2-3. Ambient light check (Check sensors)

The ambient light check mode begins if “Check sensors” box is checked at “Connection settings”. This mode tests the measurement environment and checks whether the NIRS plate is correctly attached. All LEDs used for measurement are turned off in this mode. Therefore, detected data at photodiodes reflect the ambient light in the measurement environment and will be displayed with a trend graph.

Even the photodiodes detect high values (the degree of ambient light is high), the device can normally measure oxygen saturation as long as it (the ambient light) is stable. If there are fluctuations, it may influence measurement. Therefore, it is better and more accurate to take measurement in the environment with less ambient light. If the value stays high and unstable, turn off the room light or cover the head with e.g. a light-blocking cloth.

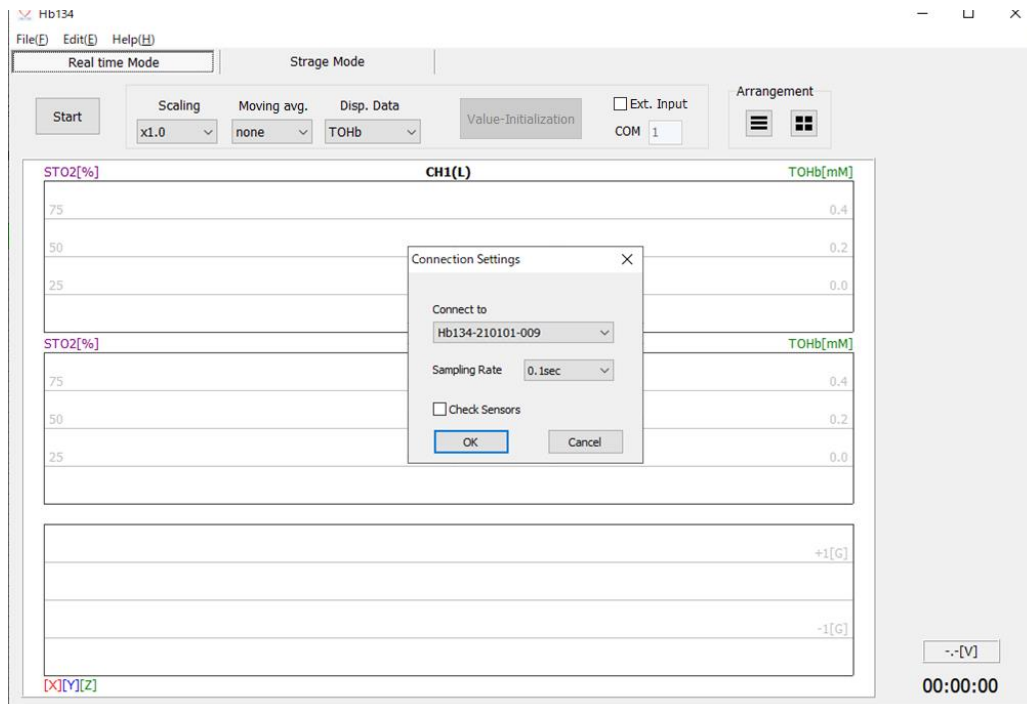


Figure 8. Connection settings screen



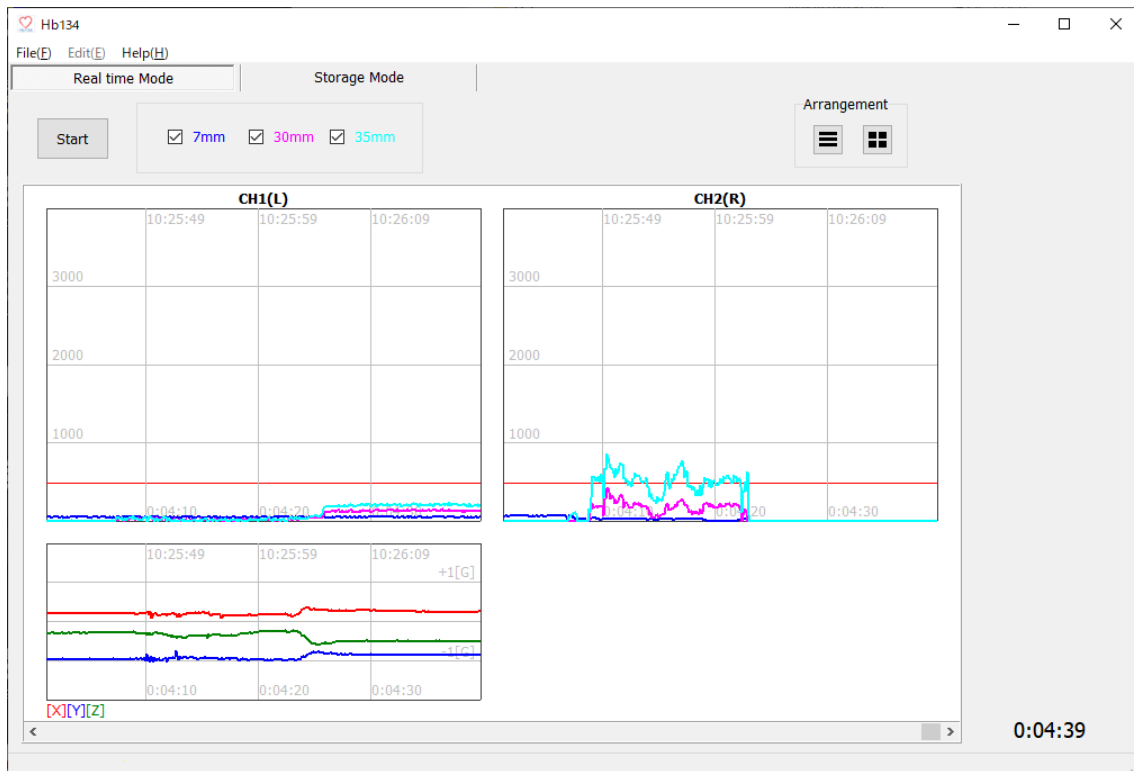


Figure 9. Connection settings screen (CH2 has ambient light)

The trend graph of each photodiode can be displayed/hidden by checking/unchecking the check boxes of 7 mm, 30 mm, or 35 mm (Figure. 10). This function is used for troubleshooting. Photodiodes are located at 7 mm, 30 mm, and 35 mm from LED as the measurement algorithm uses space - resolved spectroscopy.



Figure 10. Distance of photodiodes from LED

## 2-4 Event mark insertion

The program has a function to insert a mark into the trend graphs when a task was given to the examinee during the measurement. There are two ways to add a mark:

### Numeric keypad on computer (that is connected to the device)

A vertical line will be inserted in the trend graph by inputting a number on numeric keypad. If input key "1", a line with "1>" will be inserted. This can add only "start" mark.

### An input from external input



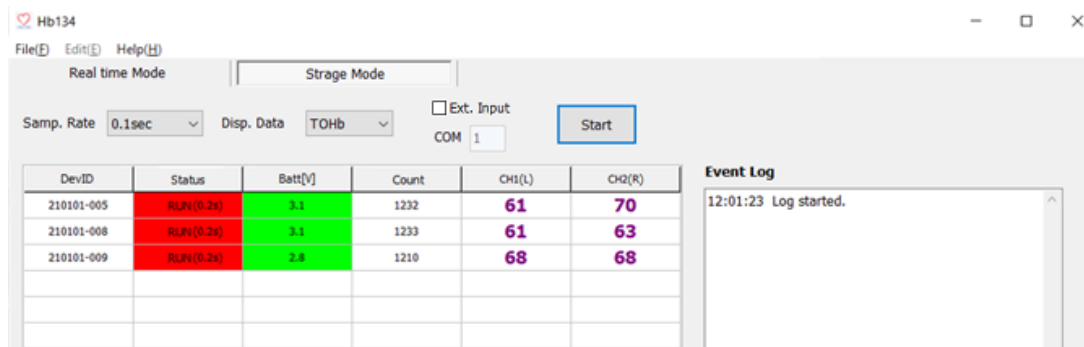


Figure 13. Storage mode monitor with several devices connected

Samp. Rate

Select the measurement rate. This setting will be applied when the device starts measurement by the instruction from the PC.

Disp. Data

Select the measurement items to be displayed on CH1 / CH2. The default is set to oxygen saturation.

Start / End

Start/End the storage mode and event recording.

It may take some time to start measurement when starting the storage mode from the computer as Bluetooth communication needs some time to process.

A short-press of the power button on the device can immediately start measurement in the storage mode. The sampling rate will be the one displayed in ( ) in status column (the previous setting will be remembered).

A press of power button terminates the storage mode measurement and remotely turns off the device. If this does not work, press and hold the power button on the device to turn it off. Measured data will not be extracted after measuring in the storage mode unless the device is turned off.

Device ID

List of connected Hb134 device IDs.

Status

**WAIT:** Device turned on and measuring in the real-time mode.

The number in ( ) indicates sampling rate.

**RUN:** Measuring in the storage mode.

The number in ( ) indicates the sampling rate.

Count

**During WAIT:** Status of extractable data (size).

**During RUN:** The number of current measurements

CH1/CH2

Figures of each channel. The items selected in the "Display data" will be shown.

It will show “NG” if there is any error during the measurement.

### Event log

Following items will be logged and displayed: measurement started time, event inserted time, and measurement ended time. Event file will be created in the computer and each event will be recorded there.

### 3-2. Insert events

Event log in the right side of the screen shows inserted events. The event log will be stored in the event file.

A number can be given from 1 to 9 to each event by using numeric keyboard on the computer. When an event was inserted with the numeric keyboard “1”, the event will be named as “Event1”. The Hb134 app needs to be focused to activate the event insert by numeric keys (it will not work if some other application is focused).

External input can insert both start/end event with number 1 – 9.

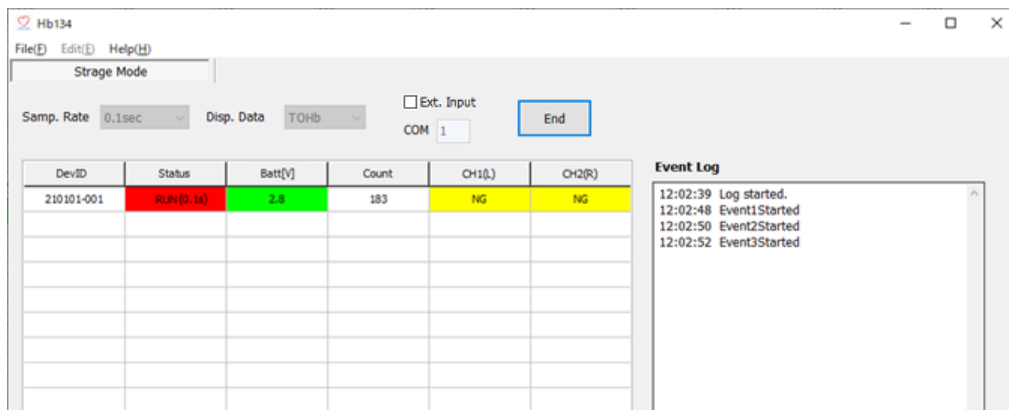


Figure 14. Event log

### 3-3. Finishing the storage mode

The Hb134 device can be remotely turned off by clicking “End”. If this does not turn off the Hb134 device, conduct a long press of the power button of the device.

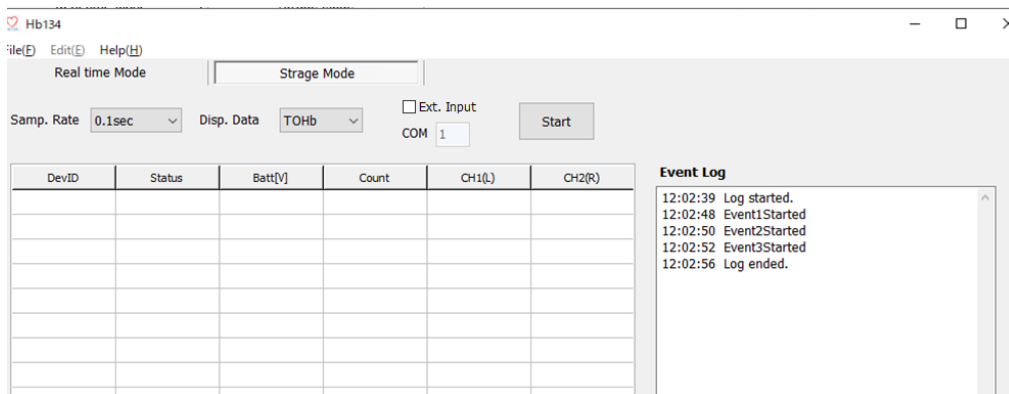


Figure 15.

### 3-4. Exporting (uploading) storage mode data

Exportable data exist unless the “count” shows “none” while the device is in the WAIT mode. Select the device ID to export data and click “Upload” and the data will be exported (uploaded) to the computer. The latest data will be exported.

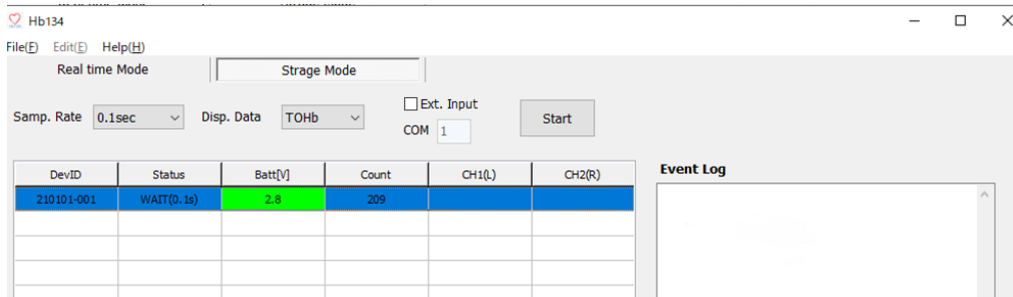


Figure 16.

The LED lamp of the device flashes (green) every second while the data are being uploaded.

If you check "Merge events" to the left of the "Upload" button, event information will be added to the data.

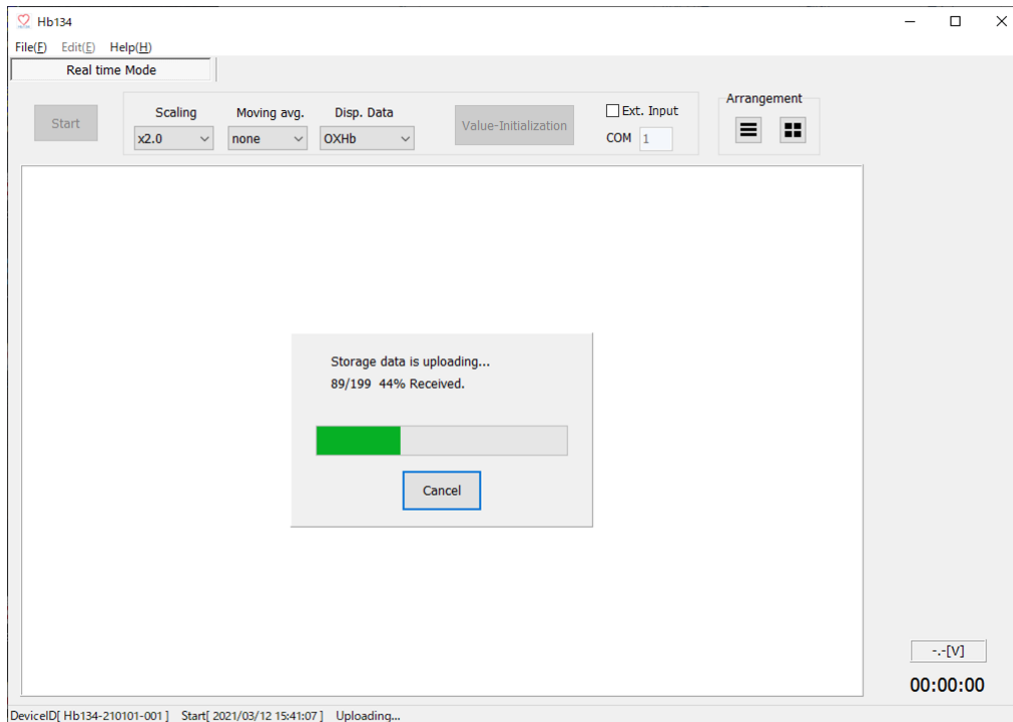


Figure 17. Uploading data

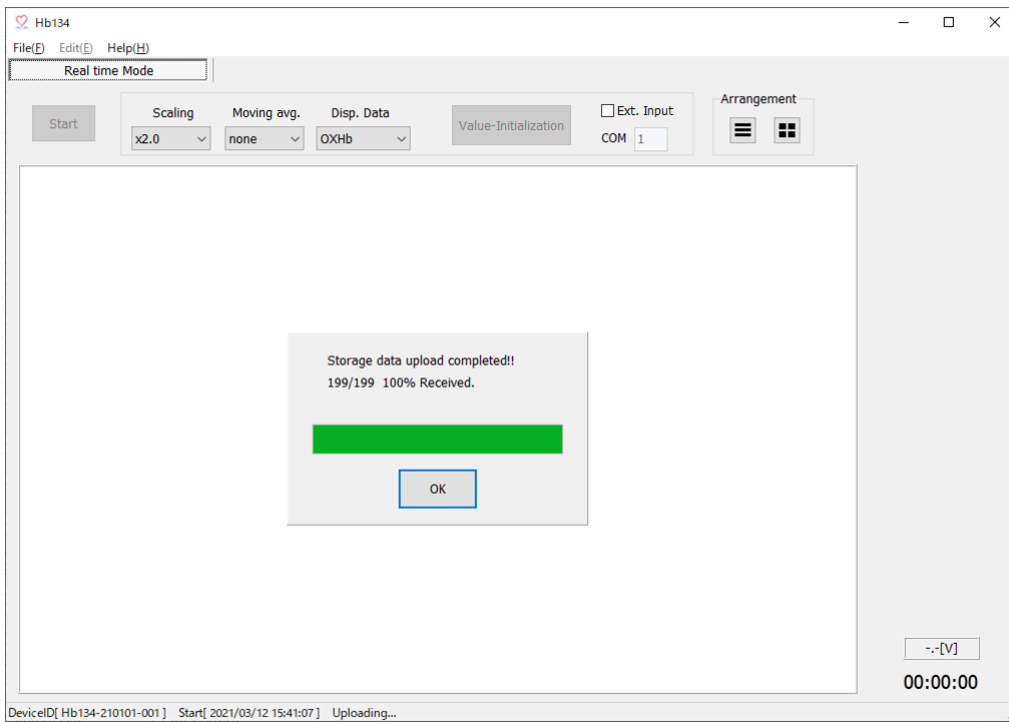


Figure 18. Upload completed

### 3-5. Trend graph display after completing the upload

Trend graphs will be displayed once the export (upload) is completed.



Figure 19. Trend graph

### 3-6. Value-initialization points

The hemoglobin values often get fluctuated as the NIRS plate slips out due to facial muscle movements. There is a function to correct those fluctuation of values.

A readout cursor will appear by clicking any trend graph. This enables to insert “value-initialization point”. A value-initialization point will be inserted at the point the readout is placed and values measured after the point will be recalculated and corrected.

Beware that this function is not available for the data taken in the real-time mode or imported CVS data.

All inserted value-initialization points can be removed by selecting “Clear value-initialization points” of “Edit” menu.



Figure 20. An example of corrected trend graph after inserting an initial value reset point (readout cursor).

### 3-7. Merging events

Information of saved events in the computer can be added by selecting “Merge events” from the “Edit” menu.



Figure 21. Merged trend graphs

This function can be used for imported CVS data. Remember to save the file after inserting value-initialization points or merging events.

## 4. Menu

### 4-1. File menu

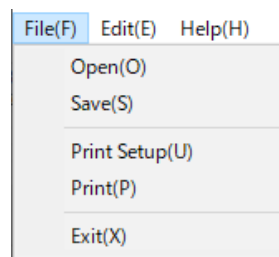


Figure 22. File menu

Open (O)	Import CVS file and display trend graphs
Save (S)	Save displayed trend graph data as CVS file
Print Setup (U)	Setup for printing
Print (U)	Print the display image
Exit (X)	Exit the program



## 4-2. Edit menu

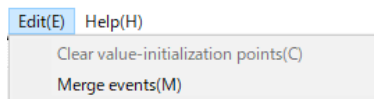


Figure 23. Edit menu

Clear value-initialization points (C)	Remove all value-initialization points. See 3-6 for more details.
Merge events (M)	Insert information of events into the displayed trend graphs. See 3-7 for more details.

## 4-3. Help menu

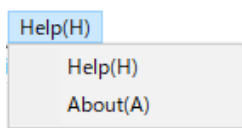


Figure 24. Help menu

Help (H)	This document will open.
About (A)	The information of the program will be displayed.

## 5. Troubleshooting

“ERR” will be displayed on a corresponding trend graph of the channel if any errors are caused. Place the cursor on the trend graph displaying ERR for details of the error. Details of the ERR will be displayed in “Error status” box. Read the details and take appropriate actions.

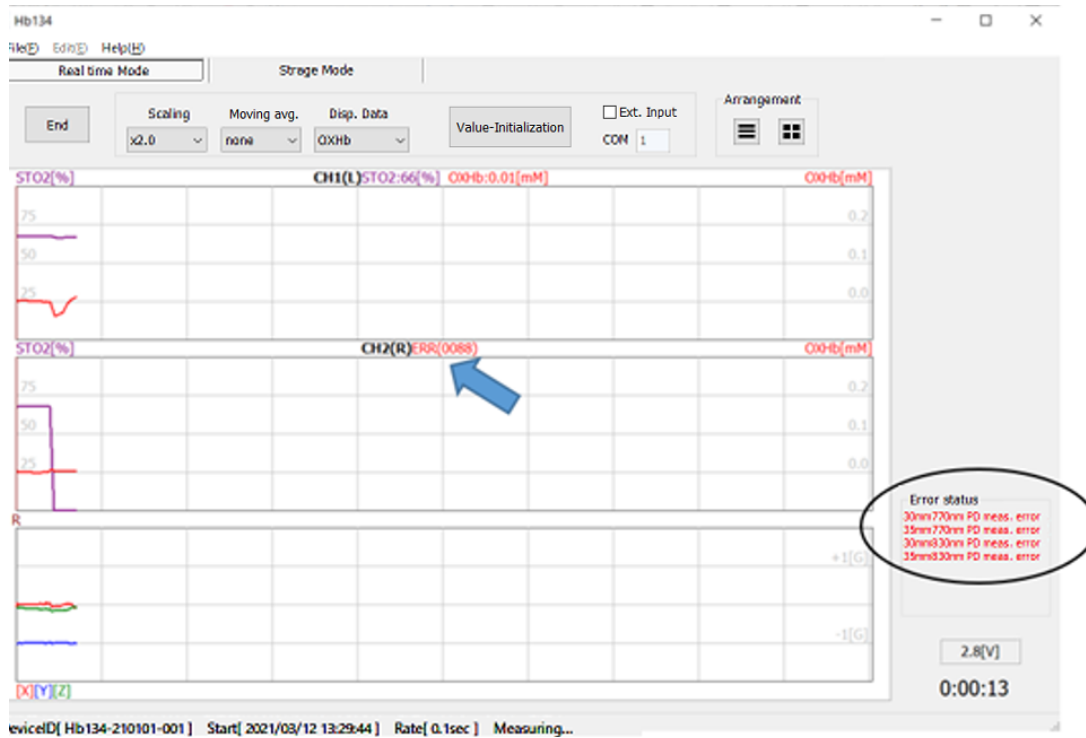


Figure 25. Error messages

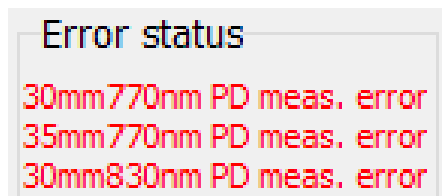


Figure 26. Details of the error

7mm770nm PD meas. error
30mm770nm PD meas. error
35mm770nm PD meas. error
35/30 770nm ratio error
7mm830nm PD meas. error
30mm830nm PD meas. error
35mm830nm PD meas. error
35/30 830nm ratio error
OXHb,DXHb calc. error
STO2 calc. error

Table 1. List of error messages

## 6. External input communication specifications

Communication specifications for external input of events into Hb134 application by serial communication are as follows:

### 1. Command

(1) Start event (External device → measurement application)

[STX] Sn[ETX]

n: Event number 1 to 9 (ASCII decimal 1 digit)

(2) End event (External device → measurement application)

[STX] En[ETX]

n: Event number 1 to 9 (ASCII decimal 1 digit)

### 2. Communication conditions

Communication method	RS-232C
Communication speed	9600 bps
Character length	8 bit
Parity	None
Stop bit length	1 bit

Product designs and specifications are subject to change or be improved without prior notice. Please check the version of the software you are using.

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