Optical Encephalography

Model: Spectratech OEG-16

User's Manual – Summary

Software Edition Rev 1.3

Note:

As this equipment was developed for **research purpose** use only, you are kindly requested not to use it for other purposes.

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Version	Date of issue	Remarks
V1.3	November 8, 2010	First edition

Message for users

The equipment is just one that captures a change of blood flow rate in the frontal lobe if it is simply said. It is an indispensable equipment for a brain researcher to challenge the issue of brain function measurement of which importance has risen more and more in the 21st century. However, it also has a possibility in which the examinee may suppose that his/her heart was unwillingly looked into different from the researcher's intention unless it arranges an enough explanation, and carefully considered experimental environment and experimental issues for him/her before the experiment. We strongly hope you to understand and consider the issue when this equipment is used.

If the 20th century is assumed to be the age of shape diagnostics representing CT and MRI, the 21st century may be called the age of functional diagnostics with the equipments such as PET, fMRI, and fNIRS (Near-infrared reflectance spectrometry: Our device is a kind of fNIRS). However, it is said that the functional diagnostics still have a lot of issues to be researched. Understanding such historical background, we developed the Optical Encephalography Spectratech OEG-16 to be of some help for broadening the base of the research.

We agree that there still are a lot of issues that should be improved as an equipment. So, we will welcome the pep talks from you, the brain researchers.

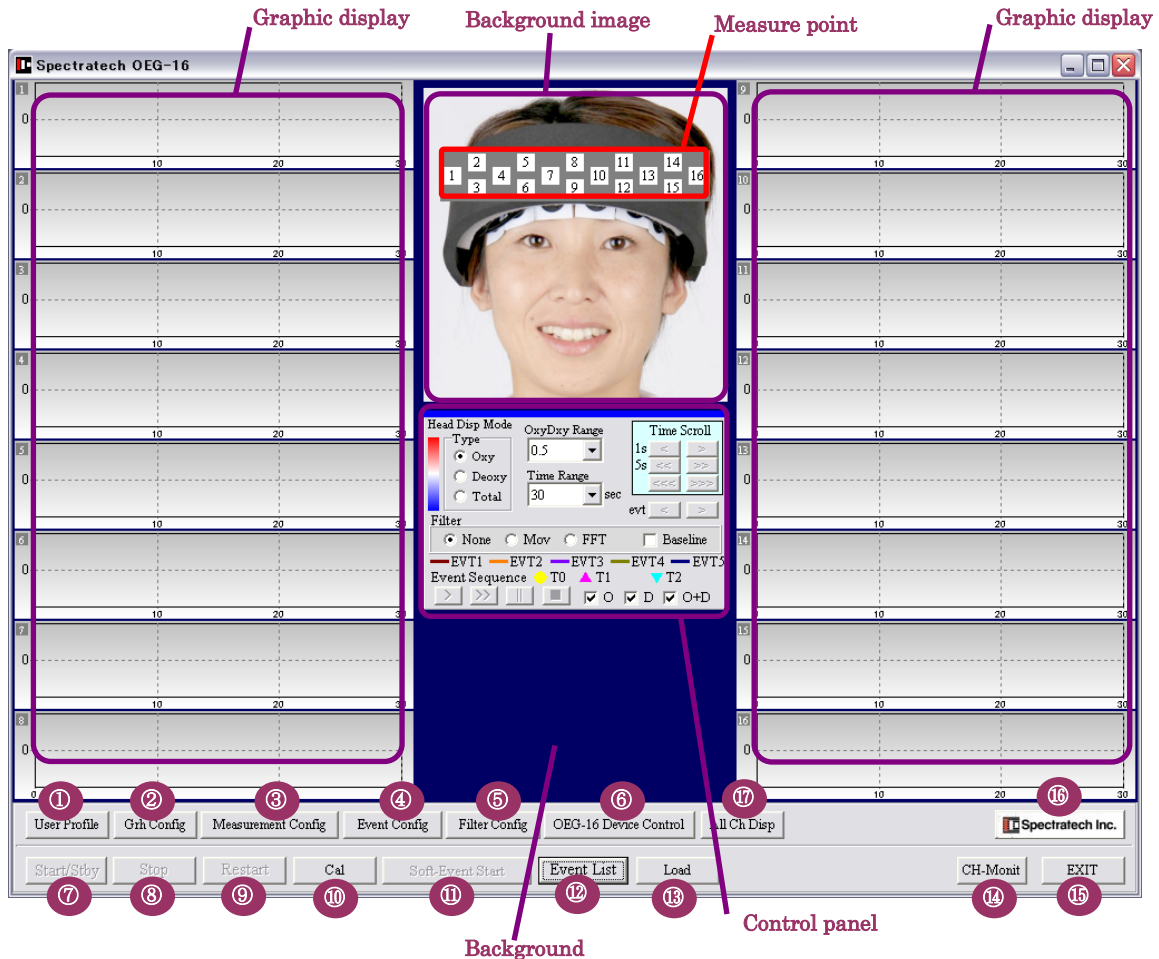We wish you, the brain researchers the best success in your researches.

Mitsuo Ohashi, President
Spectratech, Inc.
November 8,2010

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Table of content

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§1 List of functions

When OEG16.exe is started up, the main screen is displayed as follows.

① UserProfile   Profile of examinee is created and selected.
② Grh Config   Graph position is customized.
③ Measurement Point Config   Measure point is set.
④ Event Config   Detail of Event Input is set.
⑤ Filter Config   Detail of Filter is set.
⑥ OEG-16 Device Control (Sensor Config)   Basic settings of OEG-16 Main unit are set.
⑦ Start/Stby   Start/standby of measurement begins.
⑧ Stop   Measurement stops.
⑨ Restrat   Measurement restarts.
⑩ Cal   Cal screen opens to calibrate.
⑪ SoftEvent   Software event starts.
⑫ Event List   Measured data stores in PC, etc. are displayed.
⑬ Load   Data stored in Spectratech OEG-16 Main unit is read into PC.
⑭ CH-Monit   Input status of all hardware channels (Hch) is monitored and displayed.
⑮ EXIT   OEG16 software ends.
⑯ Version Information   Each version information of the firmware in OEG-16 Main unit and OEG16 software is displayed.
⑰ ALL CH DISP   The main screen is displaying the data now, of which graph at optional time is displayed on the main screen and another screen.

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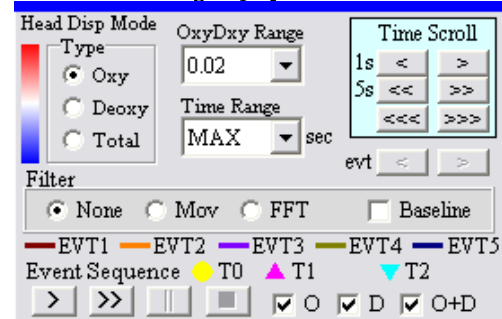
Control panel

The following shows the display control panel during measurement, and display of EventList.
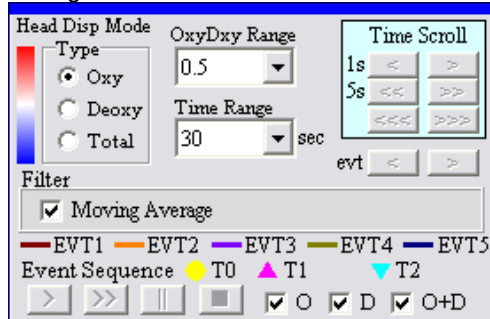
During measurement   **During display of Event List**

Type (Pseudocolor display method at measure point)
Oxy: Change of ΔCoxyHb is displayed.
Deoxy: Change of ΔCdeoxyHb is displayed.
Total: Change of ΔCtotalHb is displayed.
OxyDxy Range
Vertical axis of graphical display is set (Unit: mM·mm). For instance, 0.2 displays ±0.2mM·mm in full scale.
Time Range
Time width of vertical axis in graphical display is set. It can be set to 30~300 sec/whole width. If MAX is selected when EventList is displayed, whole measurement section is displayed in the entire graph.
Time Scroll
1s [<][>]   Graphical display scrolls in the time axis direction on the second time scale.
5s [<<][>>]   Graphical display scrolls in the time axis direction on the five seconds time scale.
[<<<][>>>]   Graphical display scrolls in the time axis direction in the set range (Time Range).
evt
[<][>] It is used to move it to the neighboring event when it is selected and displayed by Selected Event in Event List while events exist.

Filter
**During measurement:**
Moving Average   It is selected whether it is displayed while moving average filtering process is being done.
During display of Event List:
None   It is displayed without filtering process.
Mov   It is displayed after Moving Average processing. Detailed settings are done in Filter Config.
FFT   It is displayed after FFT processing. Detailed settings are done in Filter Config.
Baseline   It is displayed after baseline correction. Detailed settings are done in Filter Config.
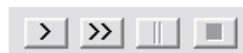
   When Event List is displayed, it redisplays in pseudocolor at the measurement point (on the background image).

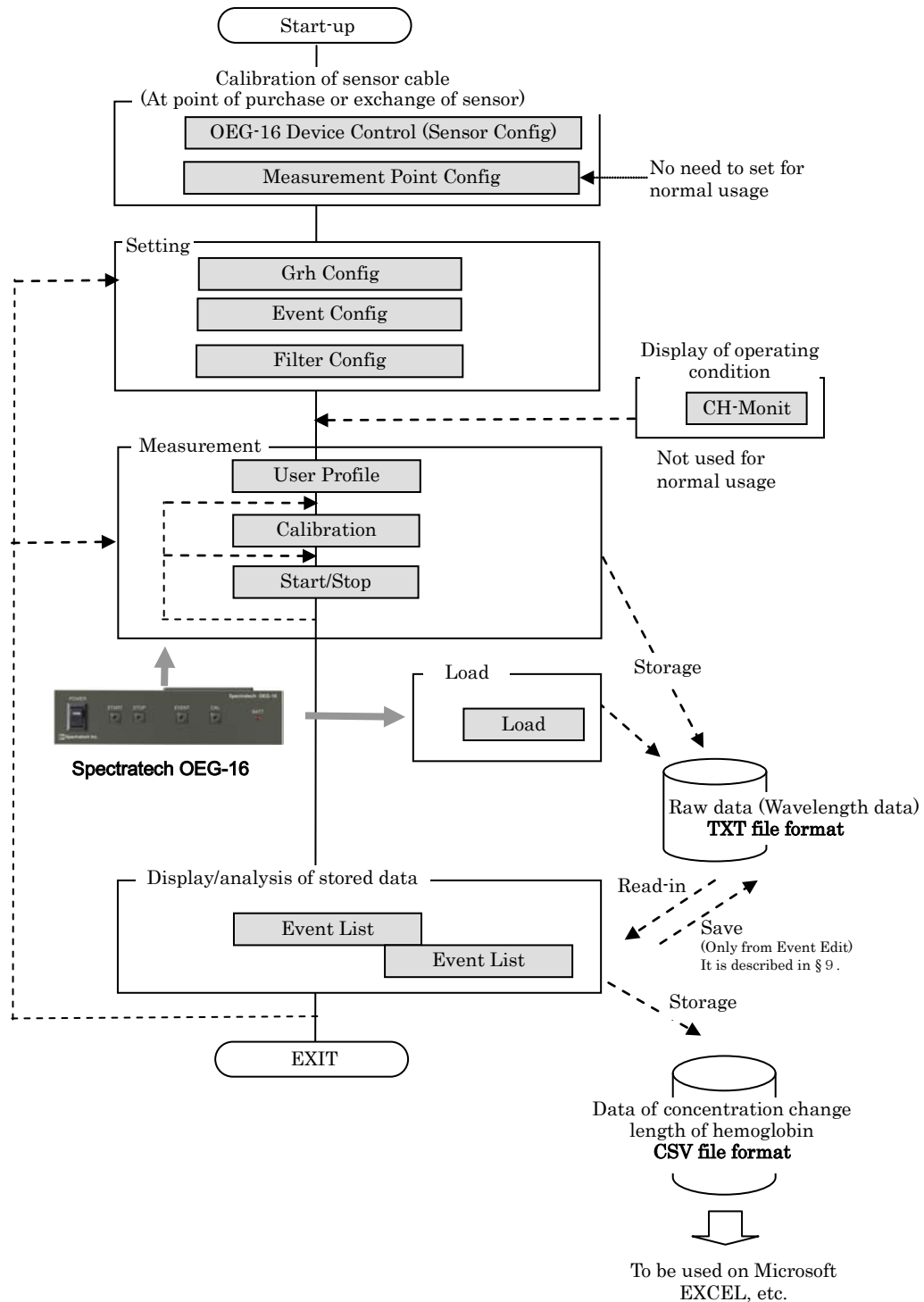 Replay at 1X speed
 Replay at 10X speed
 Temporary stop
 Stop

O,D,O+D
It specifies what is displayed on the graphical display.
O: ΔCoxyHb is displayed.
D: ΔCdeoxyHb is displayed.
O+D: ΔCtotalHb is displayed.

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§2 Flow of process

Please confirm the flow of all processing of OEG16.exe.

```
                        ┌──────────────────┐
                        │     Start-up     │
                        └──────────────────┘
                                 │
                   Calibration of sensor cable
              (At point of purchase or exchange of sensor)
         ┌───────────────────────────────────────────────┐
         │   ┌─────────────────────────────────────────┐  │
         │   │ OEG-16 Device Control (Sensor Config)   │  │
         │   └─────────────────────────────────────────┘  │        No need to set for
         │   ┌─────────────────────────────────────────┐  │◄······  normal usage
         │   │        Measurement Point Config         │  │
         │   └─────────────────────────────────────────┘  │
         └───────────────────────────────────────────────┘

         ┌─ Setting ──────────────────────────────────────┐
         │   ┌─────────────────────────────────────────┐  │
         │   │              Grh Config                 │  │
         │   └─────────────────────────────────────────┘  │
         │   ┌─────────────────────────────────────────┐  │
         │   │             Event Config                │  │
         │   └─────────────────────────────────────────┘  │       Display of operating
         │   ┌─────────────────────────────────────────┐  │             condition
         │   │             Filter Config               │  │      ┌─────────────────────┐
         │   └─────────────────────────────────────────┘  │      │      CH-Monit       │
         └────────────────────────────────────────────────┘      └─────────────────────┘

         ┌─ Measurement ──────────────────────────────────┐        Not used for
         │   ┌─────────────────────────────────────────┐  │        normal usage
         │   │             User Profile                │  │
         │   └─────────────────────────────────────────┘  │
         │   ┌─────────────────────────────────────────┐  │
         │   │             Calibration                 │  │
         │   └─────────────────────────────────────────┘  │
         │   ┌─────────────────────────────────────────┐  │
         │   │             Start/Stop                  │  │
         │   └─────────────────────────────────────────┘  │
         └────────────────────────────────────────────────┘
```

Spectratech OEG-16

Load

Load

Storage

Raw data (Wavelength data)
TXT file format

Read-in

Save
(Only from Event Edit)
It is described in §9 .

Storage

Display/analysis of stored data

Event List

Event List

┌──────────────────┐
│   EXIT   │
└──────────────────┘

Data of concentration change
length of hemoglobin
CSV file format

To be used on Microsoft
EXCEL, etc.

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§3 Setup

② Grh Config

Graph Position
The desired display form of the graph can be selected.
When the Center is selected, the Layout can be adjusted further in detail. The Width can adjust the width and the height of each graph, and the Height can do the entire position (Up, Right, Left, Down).

Example 1 Center   Example 2 Left1x16   Example 3 Top 8x1 Bottom 8x1
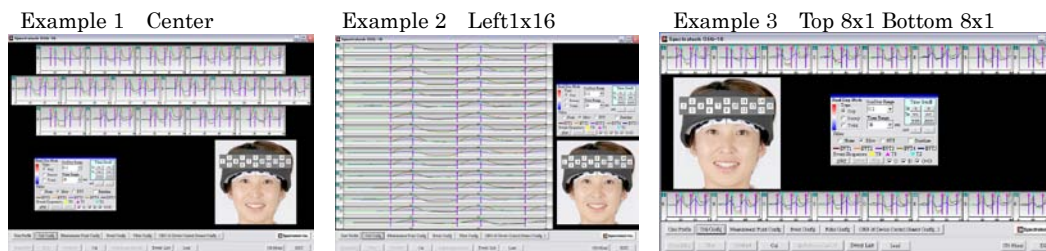
Graph Display Mode
Original Signal: It is selected to display the graphical display on the MAIN screen with the wavelength data (raw data).
OxyHb/DeoxyHb/TotalHb: It is selected to display the graphical display on the MAIN screen with the concentration change length data of hemoglobin.
     The unit is mM·mm, and it can select ±0.005~±10.0 in a full range on the vertical axis.
     The unit given here will be the default value when a measurement is started.

Time Range (sec)
The time width in the graphical display is set. It can set 30~300sec. The unit given here will be the default value when a measurement is started.

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② Event Configuration

Here, the event condition at measurement is set.
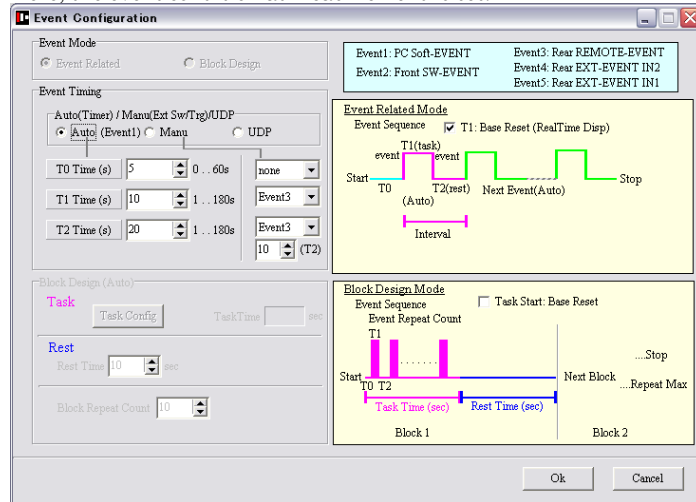
Event Mode

Event Related or Block Design is selected. The operation of each mode is shown in the yellow part in the above figure.

It should be used usually in this mode because the Block Design being called in the optical encephalography world is often understood as the repetitive operation of T1 and T2 in this Event Relate mode.

The Block Design used in the above figure corresponds to the method in the world where it is utilized together with EEG (Electroencephalography).

(The Block Design Mode will be provided later.)

Event Timing (Both Mode)

Auto: The mode in which it is started up in Event1 (SoftEvent/Start button in the OEG16 MAIN screen). The event is automatically issued repeatedly after that.

 T0: Initial REST time (0~60sec) is set. "0sec" for no T0.

 T1: TASK time (1~180sec) is set.

 T2: REST time (1~180sec) is set.

Manual : The mode in which the event is input from external factor.

Five kinds of external factors are prepared.

 Event1: SoftEvent/Start button in the OEG16 MAIN screen

 Event2: Event button on the front side of Spectratech OEG16 Main unit

 Event3: Input from REMOTE terminal on the back side of Spectratech OEG16 Main unit

 Event4: Input from Ext-Event IN2 terminal on the back side of Spectratech OEG16 Main unit

 Event5: Input from Ext-Event IN1 terminal on the back side of Spectratech OEG16 Main unit

 T0: Event is selected from (Event1~Event5, none). none for no T0.

 T1: Event is selected from (Event1~Event5).

 T2: Event is selected from (Event1~10sec, (T2)sec). The elapsed time from an event generation at T1 can be selected for T2 besides an external factor. 1~10sec is prepared as standard. If it is not sufficient, or optional time is required, select **(T2)sec** in this T2, and set an optional time into the **(T2)** window right below.

In addition, the maximum number of issuable events per measurement is 100 times for both Auto and Manual.

UDP: Mode to input Event signal from the network by UDP-IN function.

The event signal sent from the application software developed according to the rule described in **User Manual - Applied Technology Edition V1.2** is accepted on the same network as the PC on which OEG16.exe is operating.
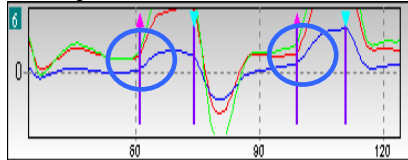
An optional Event number of 1~127 in decimal notation can be given to the event signal, and each has the following meaning.

1~49	It is interpreted as T1 by Spectratech OEG16
50~99	It is interpreted as T2 by Spectratech OEG16
100~109	It is interpreted as T0 by Spectratech OEG16
110~127	It is interpreted just as Event signal by Spectratech OEG16

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Event Sequence T1: Base Reset (real Time Disp)

Event Related Mode
Event Sequence ☐ T1: Base Reset (RealTime Disp)

When this checkbox was checked, it displays while resetting Base at the time of T1 generation when measuring.
(See the position marked with blue circle.)

Example without Base Reset   Example with Base Reset
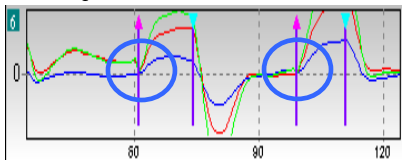
Setting of Event Related   Example 1
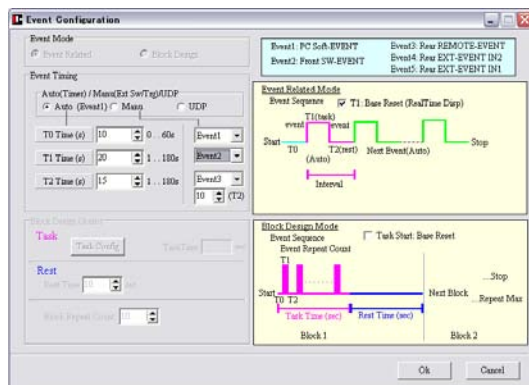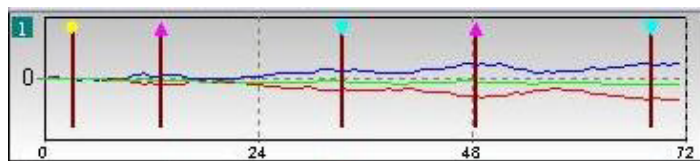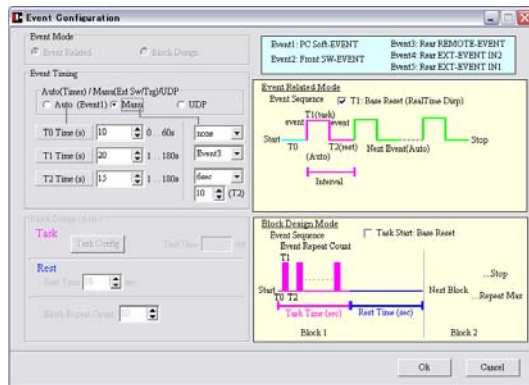

In Auto mode, when
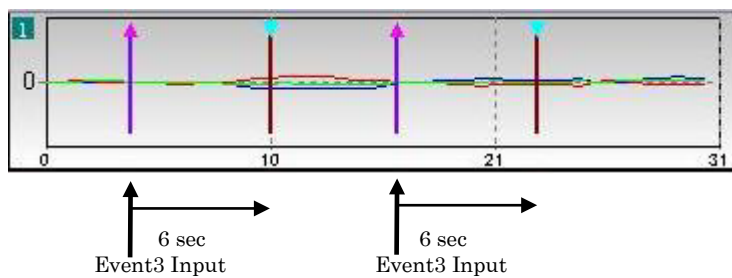 T0   10 sec
  T1   20 sec
  T2   15 sec
were set.

10s   T1(20s)   T2(15s)   T1(20s)   ………… To be continued up to STOP
T0(Event1) was generated at this point.

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Setting of Event Related　Example 2

In Manual mode, when
　T0　none
　T1　Event3
　T2　6 sec
were set.

6 sec　　　　　　6 sec
Event3 Input　　Event3 Input

Event-related setting　Example 3
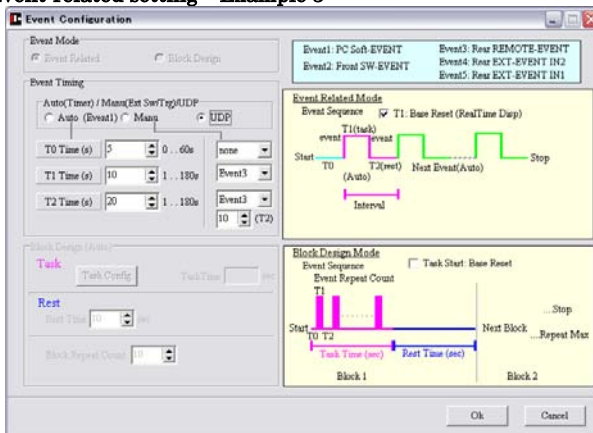
In case of UDP mode setting
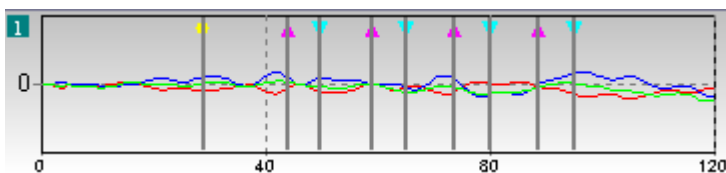
　　　It is automatically sorted to T0, T1, and T2 according to the value of Event number sent from UDP, interpreted, and accepted.

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④ Filter Configuration

Here, it sets the details of **Filter** in the control panel on the MAIN screen.
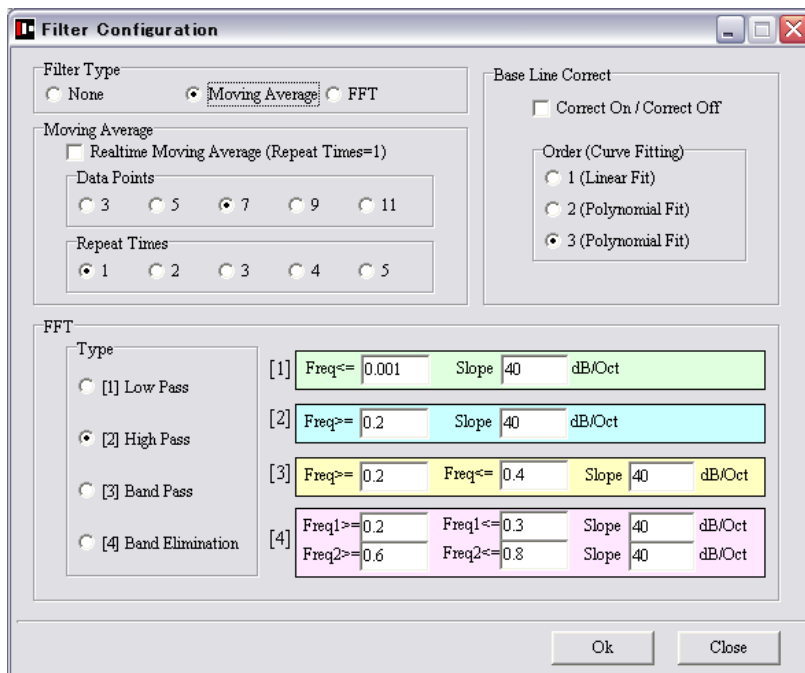
Filter Type
The default where it displays when a measurement ended, or the data read out from Event List in graph on the MAIN screen:

None	It displays without filtering process.
Moving Average	It displays after moving average filtering process.
FFT	It displays after FFT filtering process.

Moving Average
Realtime Moving Average
Turn it on to display while processing moving average when measuring it. When a measurement is started, it is treated as default. Of course, it is possible to turn it on and off from the control panel on the MAIN screen while measuring it. It is displayed a little bit behind real time because of being displayed as processing the moving average while measuring it.
Data Points
It selects a data number (3, 5, 7, 9, 11) for processing the moving average.
Example: Equation when "5" is selected: $newD(t0)=\{D(t-2)+D(t-1)+D(t0)+D(t+1)+D(t+2)\}/5$
Repeat Times
In the above, repeat count (1~5) of the moving average processing is selected. It is usually used with "1" though it is prepared for the signal with very strong noise.

FFT
Low Pass (Low-pass filter)
The signal at set Freq or less is passed. And, the inclination is set with Slope(dB/Oct).
High Pass (High-pass filter)
The signal at set Freq or above is passed. And, the inclination is set with Slope(dB/Oct).
Band Pass (Band-pass filter)
The signal in the set range (Freq>= ~ Freq<=) is passed. And, the inclination is set with Slope(dB/Oct).
Band Elimination (Band cutoff filter)
The signal in the set ranges (Freq1>= ~ Freq1<=) and (Freq2>= ~ Freq2<=) is cut off.
And, the inclination is set with Slope(dB/Oct).

Note: The unit of frequency is Hz, and FFT is processed to the wavelength data (raw data). And, the concentration change length data of oxyhemoglobin is calculated after FFT processing. The FFT processing after converted into a concentration change length data of oxyhemoglobin is being planned for the future.

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Base Line Correct

Correct On/Correct Off
　　　It selects whether it displays after baseline was corrected or not.

Order(Curve Fitting)
　　　1(Linear Fit)　　　　　Baseline correction process by linear interpolation
　　　2(Polynorminal Fit)　　Baseline correction process by quadratic curve interpolation
　　　3(Polynorminal Fit)　　Baseline correction process by cubic curve interpolation

Example:

Display without baseline processing

Display after baseline correction by linear interpolation
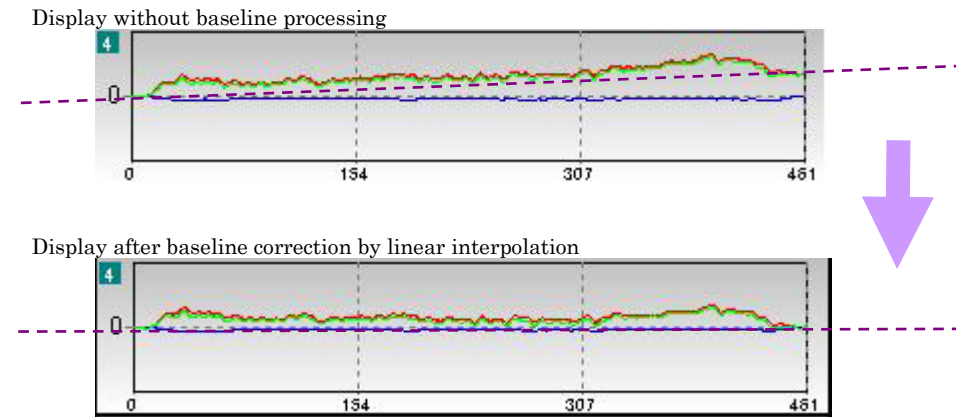
　　The further, detailed settings are necessary for the baseline correction processing. The detailed settings are explained in the paragraph of Main Window Display Mode in the EventList screen. Here, please be understood that it is briefly directed whether a baseline processing should be done or not, and if to be done which interpolation curve should be used.

Note: The baseline correction processing is done after it was converted into the concentration change length data of oxyhemoglobin.

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§4 Measurement

After the preceding Chapter (§3 Setup) was completed, then the measurement work will be started.

① User Profile

　In the User Profile, it selects or newly creates examinee to be measured. A specific examinee, who is already registered in the Current User can be selected from the examinee list. A new examinee is registered in the New User.

Current User
　A specific examinee already registered is selected from the examinee list. Press the OK button when a selection was completed. The following measured data is stored in this examinee file.

New User
　Examinee information is newly created. "Name", "Age", "Gender", and "Dominant hand" (right-handed or left-handed) are registered. Press the OK button when the registration was completed. The following measured data is stored in this examinee file.

DATA Folder
　When examinees are registered here, a folder that consists of the examinees' names is created in the DATA Folder in the OEG16 folder where OEG16.exe exists. The following measured wavelength data (raw data, TXT file) will be stored in this folder.

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❿ Cal

After completion of mounting the head module (sensor band and headband) to an examinee's frontal lobe, the Calibration work is implemented to first confirm if the sensors are mounted correctly, and to adjust the gain of sensor at each measure point.
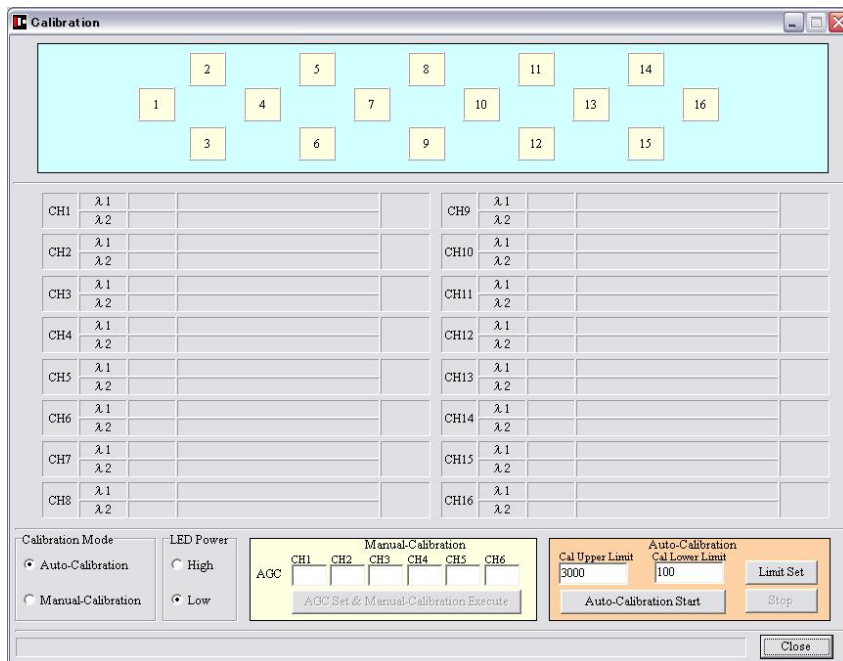

Calibration Mode
Auto Calibration It selects the mode to perform Calibration automatically. This method is used usually.
Manual Calibration It is the method for the user to assign the gain of each sensor by himself/herself.

Auto Calibration (It is activated when the Auto Calibration is selected in the Calibration Mode.)

Auto Calibration Start
It starts the Auto Calibration. It is completed for about 25 seconds if it is mounted appropriately.
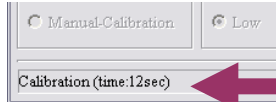
The elapsed time is displayed in the lower left part in the Cal screen. It may be referred as a guide.

Example: All channels are normal.   Signals of CH1 and CH2 are weak.

Good: Within Cal Upper Limit and Cal Lower Limit.
Under: Smaller than Cal Lower Limit. (Signal is recorded, but low reliability.)
Over: Larger than Cal Upper Limit. (Signal is recorded, but low reliability.)
Unused: Strongly affected by the strength of other measure points. (Signal is recorded, but low reliability.)

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⑦ Start/Stby

When the Calibration work has ended, this Start/Stby button becomes active, and is ready to start a measurement.

**Screen before measurement** (Start/Stby button is active.)
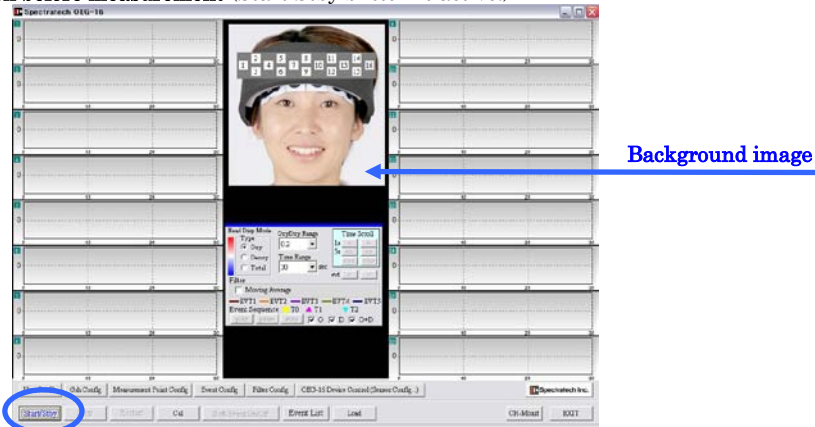
Background image

Timer operation (Elapsed Time)

The elapsed time from the record beginning can be displayed. The mouse cursor is taken to the **background image**, it right-clicks, and **Elapsed Time Disp** is selected. Then, drag it to select **Manual(On/Off)** or **Auto(On/Off)**.

Manual: Click to select it, and the Elapsed Time window opens on the MAIN screen. Click it again, or close with [X] in the window.
The count starts when a measurement is started.

Auto: When Auto has been selected, the Elapsed Time window opens automatically when Start/Stby is clicked. The count starts when a measurement is started, and it is automatically closed after File Save.
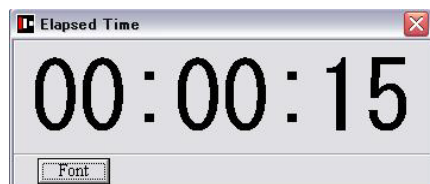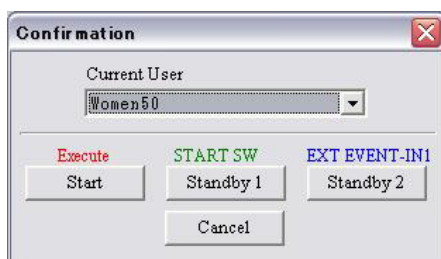

Font: Size, font style, and color, etc. of the font can be changed.

Size of the window can be changed with the mouse as usual. (It must be operated in the Manual mode.)

Start

The following confirmation screen appears when the Start/Stby button is clicked.

Start confirmation screen

The confirmation screen appears when the Start/Stby button is pushed. If Current User has been selected, the relevant examinee's name is displayed. In addition, the Current User can also be changed at this point.

There are three kinds of methods to start a recording.

Start: It immediately starts with clicking the Start button in the confirmation screen. It is the normal starting method.

Standby1: It starts with pressing down the Start button on the front side of OEG-16 Main unit. It is a starting method when PC operator and the starter to begin an experiment are away from each other, etc.

Standby2: It starts with a trigger input from Ext-Event IN1 on the back side of OEG-16 Main unit. It is a starting method when a recording starts by synchronizing it with an external device.

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Screen during measurement
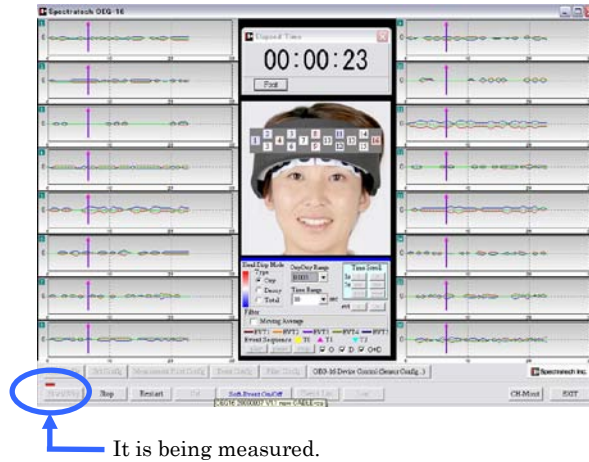
 Waiting status for Standby1

 Waiting status for Standby2

If the start condition becomes complete in either waiting state of the above, the screen in the left figure appears and starts a recording.

It is being measured.

Stop screen

When it clicks the Stop button on the MAIN screen, or presses the STOP button on the OEG16 Main unit, the end confirmation screen below appears.

Title (or Comment)

Enter any title or comment for the data to be stored as needed.

File Name

A file name to which the time was automatically assigned is displayed. You may change it here if you want to assign a different name.

The **Yes** button is clicked to store the wavelength data (raw data). After that, it can be called out from Event List, or used by other softesres as TXT file as it is.

Detail of the TXT format is described in **User's Manual - Applied Technology Edition**.

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§5 Display and analysis of stored data

The measured and stored biological information can be read out from this Event List, and various filtering processes or the average processing can be given to those data to be examined. In addition, the examined and processed **concentration change length data of oxyhemoglobin** can be output in CSV file. It may be used for further analytical work with other software. The details of CSV format is described in **User's Manual - Applied Technology Edition**.

⓬ Event List

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