Optical encephalography

Model: Spectratech OEG-16

User's Manual – Summary

Applied Technology Edition Rev 1.3

Note:

1) As this equipment was developed for **research purpose** use only, you are kindly requested not to use it for other purposes.
2) When a program, etc. is developed using the content of this Applied Technology Edition excluding the purpose of your own use, a separate licensing agreement with our company is needed. Please be forewarned. There is no special limitation as far as it is used for your own research purpose.
3) There is a possibility of becoming the products subject to the Wassenaar Arrangement when a new product is developed using SpectratechOEG-16.

Spectratech Inc.

Version	Date of issue	Remarks
V 1.3	November 8,2010	First version

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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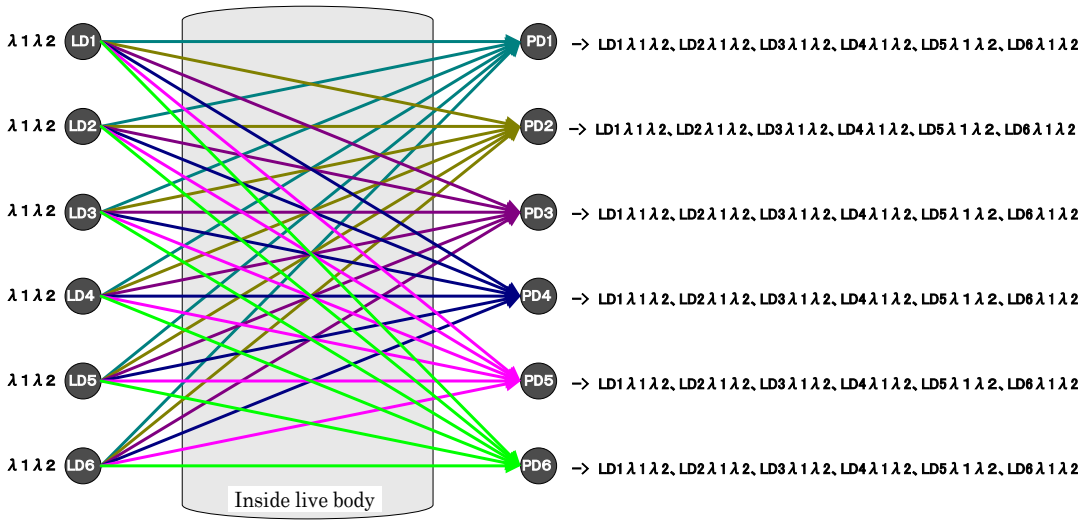
§1 Overview

In this Applied Technology Edition, the necessary explanation is described for usage of further research purpose beyond the extent of the application software OEG16.exe (User's Manual - Software Edition) that is accompanied with Spectratech OEG-16 as standard.

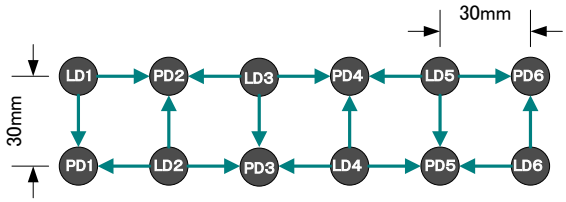
§2 Data obtained from Spectratech OEG-16

As for Spectratech OEG-16, the measurement channel used as standard is described as 16CH. However, the signals in the following combinations are taken out at the same time in an actual light demodulating circuit by taking advantage of the **characteristic where multi-channelization can be easily done**, that is the greatest feature of the spread spectrum modulation.

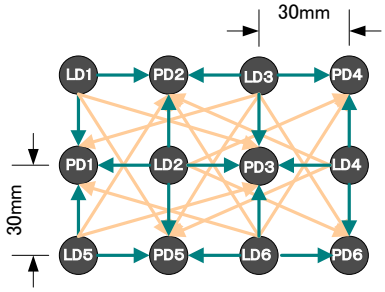


That is, in Spectratech OEG-16, the near-infrared lights emitted from the light-emitting parts of LD1~LD6 are measured at all the light-receiving parts of PD1~PD6 simultaneously regardless of each signal strength. Therefore, Spectratech OEG-16 measures the light wavelength signals of 6 light-emitting parts x 6 light-receiving parts = 36 channels simultaneously as a whole. Then, Spectratech OEG-16 measures 2 x 36 = 72 channels of the light signals exactly on the whole because each light-emitting part has two wavelength light sources λ1 and λ2.

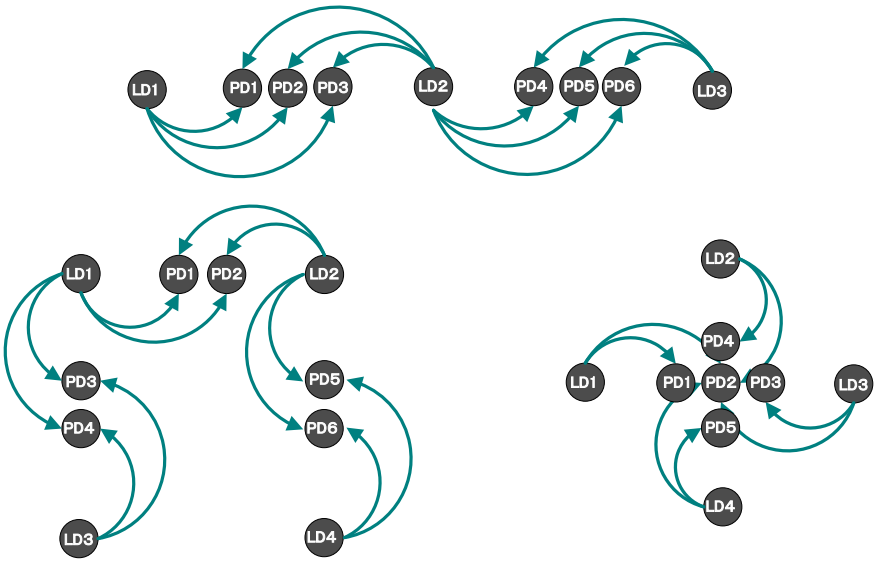
As for the spread spectrum modulation/demodulation circuit of SpectratechOEG-16, it can arrange naturally in the following factory default configuration because it does not care the alignment of LD1~LD6 and PD1~PD6. The measurement channel becomes 16CH in this arrangement.



The following arrangement is also possible if not limited by the arrangement of SpctratechOEG-16-01 head module. In this arrangement, the measurement channel becomes 17CH in the extent commonly understood (PASS indicated with blue arrow in the figure). Quite a lot of measurement channels are to be measured simultaneously because PASS in orange color is also measured at the same time. So, various experiments can be conducted.



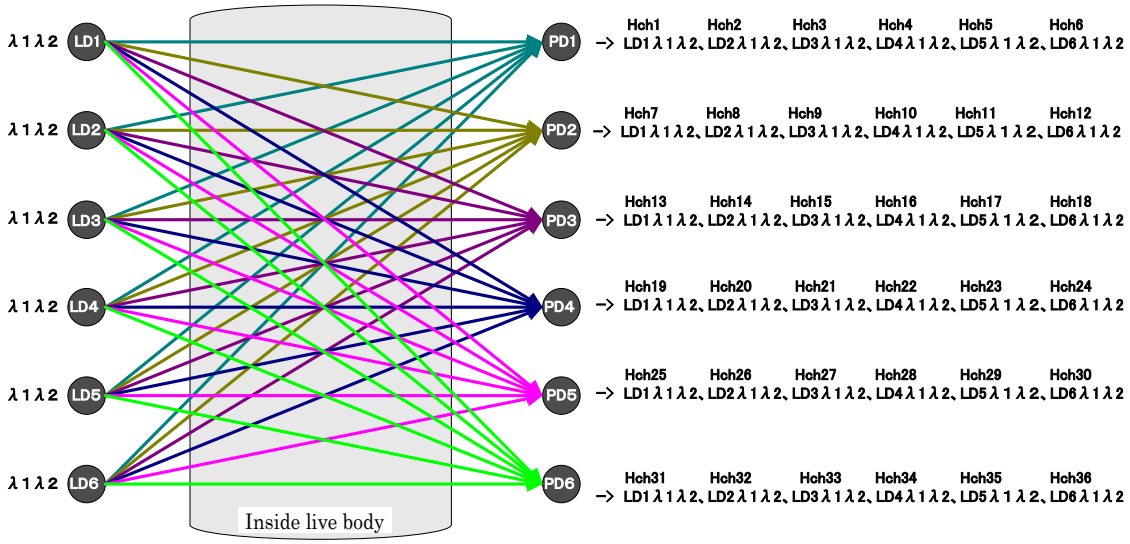
Furthermore, not the conventional single-layered model where μA (molar absorbance coefficient) is assumed to be 1 for the head, the following arrangement is possible for the latest research theme in which μA is understood in the two-layered model or the three-layered model of epidermal layer and brain layer, and only the brain layer signal is taken out. (However, it may not be able to control only by the gain adjustment of SpectratechOEG-16 depending on the distance with the light-emitting part. In such case, an optical attenuation adjustment such as ND filter might be necessary. Also, it may be necessary to newly develop and prepare the sensor itself in extra fine type depending on the alignment distance. For that case, please inquire of our company.)



§3 Definition of channel data on Spectratech OEG-16

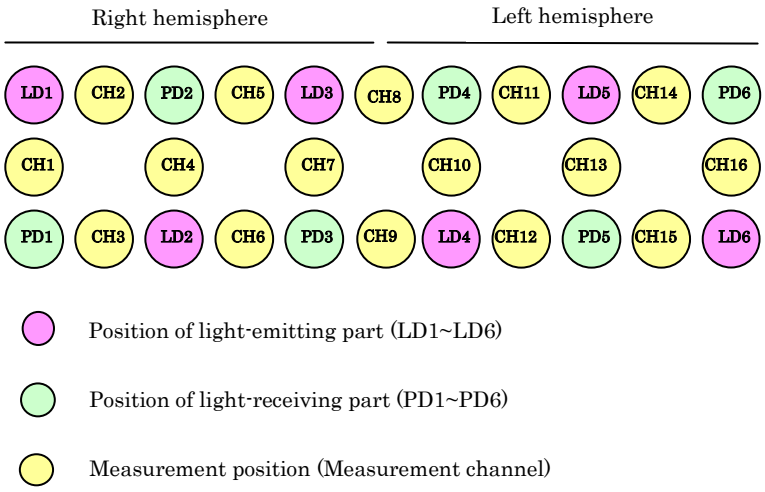
Hardware channel (Hch)

In Spectratech OEG-16, it defines the light signal of LD1 captured with PD1 as Hch1, and LD2 as Hch2, then up to Hch36 in order as follows.



Measurement channel (CH)

The measurement channels described in §8 of User's Manual - Technical Edition are as follows. As it may be already understood, Spectratech OEG-16 just assumes which Hch it assigns as which measurement (=display) channel on OEG16.exe.



§4 Wavelength data (raw data) file output by OEG16.exe

The wavelength data (raw data) file is output from the application software OEG16.exe following the concept described in §2 and §3. The wavelength data file is written in text data format, so it can be opened with WordPad or Notepad, which is included in Windows as standard.

```
[Start/Stop Time]
START=2009/08/13 12:29:35
STOP=2009/08/13 12:29:52
[Measurement Profile]
TITLE=test TASK 1
EVENT_MODE=Event-Related
EVENT_TYPE=AUTO
EVENT_T0=10,EVT1
EVENT_T1=20,EVT1
EVENT_T2=15,EVT1
EVENT_REPEAT=
[User Profile]
NAME=Taro Spectratech
AGE=26
GENDER=Male
Dominant Hand=Right-Handed
[HEADER]
TRG_MODE=0002
LED_POWER=0000
AGC_GAIN=0010,0010,0020,0010,0020,0020
[CH_CONFIG]
1,7,2,8,9,14,15,21,16,22,23,28,29,35,30,36
[CAL(CAL1-L1,CAL1-L2,...,CAL36-L1,CAL36-L2)(0:good/3:unuse/1:over/2:under)]
10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,
[DATA(EVENT,CH1-L1(840nm),CH1-L2(770nm),...,CH36-L1,CH36-L2)]
0000,2148,1969,2730,2325,355,328,95,107,57,60,42,49,2726,2486,1859,1607,2459,2072,134,145,82,89,
0000,2149,1969,2731,2325,355,328,95,108,57,60,42,48,2728,2485,1859,1606,2459,2072,134,144,82,89,
0000,2149,1970,2731,2325,355,328,95,108,57,60,42,49,2727,2485,1859,1606,2458,2072,134,145,82,89,
0000,2148,1970,2731,2325,356,328,95,108,57,61,43,49,2726,2485,1859,1606,2459,2072,134,144,82,90,
0002,2148,1969,2731,2325,355,328,95,107,56,61,42,49,2727,2485,1859,1607,2458,2072,134,144,83,90,
0000,2149,1970,2731,2325,355,328,95,107,57,61,42,49,2727,2485,1860,1607,2458,2072,134,144,83,90,
0000,2149,1969,2731,2325,355,328,94,107,57,60,43,49,2727,2485,1859,1607,2458,2072,135,145,82,89,
0004,2149,1970,2731,2325,356,328,95,107,56,60,42,49,2727,2486,1859,1607,2459,2072,134,144,82,89,
0000,2149,1969,2731,2326,356,328,95,107,57,61,42,49,2727,2484,1859,1606,2458,2072,134,144,83,90,
0000,2148,1970,2731,2326,355,328,96,107,57,60,43,49,2727,2485,1859,1607,2458,2072,135,144,82,89,
```

I

II

I Header information

START=2009/08/13 12:29:35 — **Time when measurement recording started is stamped.**
STOP=2009/08/13 12:29:52 — **Time when measurement recording ended is stamped.**

[Measurement Profile]
TITLE=test TASK 1 — **Title name described in Application software when measurement recording ended.**
EVENT_MODE=Event-Related — **Each setting condition of EVENT at relevant recording is stamped.**
EVENT_TYPE=AUTO
EVENT_T0=10,EVT1
EVENT_T1=20,EVT1
EVENT_T2=15,EVT1
EVENT_REPEAT=

[User Profile] — **Registered information of relevant examinee is stamped.**
NAME=Taro Spectratech — **Name**
AGE=26 — **Age**
GENDER=Male — **Gender**
Dominant Hand=Right-Handed — **Dominant hand**

[HEADER]
TRG_MODE=0002 **Trigger mode condition (1: External trigger mode, unconditional trigger mode)**
LED_POWER=0000 **LED output condition (0: Low power 1: High power)**
AGC_GAIN=0010,0010,0020,0010,0020,0020 **Gain value of AGC amp when measuring**
[CH_CONFIG] **How hardware channel (Hch) was assigned to measurement channel (CH) is stamped.**
1,7,2,8,9,14,15,21,16,22,23,28,29,35,30,36 **In case of the left, CH1=Hch1, CH2=Hch7, CH3=Hch2 · · · CH16=Hch36**

[CAL(CAL1-L1,CAL1-L2,...,CAL36-L1,CAL36-L2)(0:good/3:unuse/1:over/2:under)]
10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,03,03,03,03,03,03,03,10,10,10,10,10,10,
Display of calibration result

Calibration result before measurement recording was stamped in order of Hch1λ1, Hch1λ2 · · · Hch36λ1, Hch36λ2 from left.

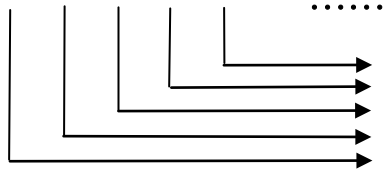
X0: Good Signal is good.
X1: over Signal is too strong. (Signal is recorded, but reliability is low.)
X2: under Signal is too weak. (Signal is recorded, but reliability is low.)
X3: unuse Affected by above X1Hch. (Signal is recorded, but reliability is low.)
1X: Hch to be displayed in OEG16.ini file, or in Measurement Point Config in Application software.
0X: Hch not to be displayed in OEG16.ini file, or in Measurement Point Config in Application software.

Example)
10: Signal is good for Hch to be displayed.
03: Hch not to be displayed.

Ⅱ Part of measured data

The longitudinal data from the starting point of measurement is enumerated up to EOF (End of File) of the file as much as having been measured and recorded.

[DATA(EVENT,CH1-L1(840nm),CH1-L2(770nm),...,CH36-L1,CH36-L2)]
0000,2148,1969,2730,2325,355,328,95,107,57,60,42,49,2726,2486,1859,1607,2459,2072,134,145,82,89,
0000,2149,1969,2731,2325,355,328,95,108,57,60,42,48,2728,2485,1859,1606,2459,2072,134,144,82,89,
0000,2149,1970,2731,2325,355,328,95,108,57,60,42,49,2727,2485,1859,1606,2458,2072,134,145,82,89,
0000,2148,1970,2731,2325,356,328,95,108,57,61,43,49,2726,2485,1859,1606,2459,2072,134,144,82,90,
0002,2148,1969,2731,2325,355,328,95,107,56,61,42,49,2727,2485,1859,1607,2458,2072,134,144,83,90,
0000,2149,1970,2731,2325,355,328,95,107,57,61,42,49,2727,2485,1860,1607,2458,2072,134,144,83,90,
0000,2149,1969,2731,2325,355,328,94,107,57,60,43,49,2727,2485,1859,1607,2458,2072,135,145,82,89,
0004,2149,1970,2731,2325,356,328,95,107,56,60,42,49,2727,2486,1859,1607,2459,2072,134,144,82,89,
0000,2149,1969,2731,2326,356,328,95,107,57,61,42,49,2727,2484,1859,1606,2458,2072,134,144,83,90,
0000,2148,1970,2731,2326,355,328,96,107,57,60,43,49,2727,2485,1859,1607,2458,2072,135,144,82,89,
· · · · · · · **Hereafter, it consists of one line up to Hch36λ1, Hch36λ2 in series.**



Hch2 λ2 signal (770nm)
Hch2 λ1 signal (840nm)
Hch1 λ2 signal (770nm)
Hch1 λ1 signal (840nm)
Event input information
0000: No event input at the time.
xx01: There was Soft Event input from PC.
xx02: There was EVENT button input on front side of OEG-16.
xx04: There was input from REMOTE on back side of Main unit.
xx08: There was input from EXT-EVENT2 on back side of Main unit.
xx10: There was input from EXT-EVENT1 on back side of Main unit.
01xx~**FF**xx: Event number given from UDP-IN (Described in §6)

Case other than the above:
Hardware input factors of the above 01~10, and value in combination of UDP-IN factors (Generated at the same time).

Calculation of elapsed time

The interval time of each measurement data per line is **0.655359 seconds**.

Based on this unit time, multiplying it by the number of data lines from START to the relevant position makes the time from beginning. When an absolute time is necessary, it can be obtained by adding the beginning time of the header part to the calculated value.

How to convert wavelength signal component to ⊿OxyHb and ⊿DeoxyHb information

Spectratech OEG-16 Application software uses the following expressions.

eo1=1022	εoxy_Hb (λ1=840nm) Molar absorption coefficient
ed1=692.36	εdeoxy_Hb (λ1=840nm) Molar absorption coefficient
eo2=650	εoxy_Hb (λ2=770nm) Molar absorption coefficient
ed2=1311.88	εdeoxy_Hb (λ2=770nm) Molar absorption coefficient

⊿OxyHb = (ed2*o1-ed1*o2) / (ed2*eo1-ed1*eo2)
⊿DeoxyHb = (eo2*o1-eo1*o2) / (eo2*ed1-eo1*ed2)
While o1 = -ln(V1/V10) (V1: λ1 Present value, V10: λ1 Initial value)
o2 = -ln(V2/V20) (V2: λ2 Present value, V20: λ2 Initial value)

There are two kinds of ideas to give the initial values of V10 and V20.

1) It begins to record, and the value that came from Spectratech OEG-16 first is assumed to be V10 and V20.
2) V1 and V2 at the timing of Event input are assumed to be V10 and V20 as new initial values, and they are used till next Event input.

In addition, it is recommended to assume the value moving-averaged at several points to be V10 and V20 when V1 and V2 are adopted as V10 and V20 because they accompany the noise.

Each value of obtained ⊿OxhHb and ⊿OeoxyHb is multiplied by 1000, and the unit becomes mMol･mm (Millimole･millimeter).

§5 Data file of concentration change length of oxyhemoglobin output by OEG16.exe

The below shows the data format of concentration change length of oxyhemoglobin output by OEG16.exe Application software attached to the Main unit as standard.

Since it is written in CSV format, it can be opened directly with WordPad or Excel, which Windows includes as standard.

```
[Start/Stop Time]
START=2009/08/13 12:29:35
STOP=2009/08/13 12:29:52
[Measurement Profile]
TITLE=test TASK 1
EVENT_MODE=Event-Related
EVENT_TYPE,AUTO
EVENT_T0=10,EVT1
EVENT_T1=20,EVT1
EVENT_T2=15,EVT1
EVENT_REPEAT,
[User Profile]
NAME=Taro Spectratech
AGE,26
GENDER,Male
Dominant Hand,Right-Handed
[HEADER]
TRG_MODE=0002
LED_POWER=0000
AGC_GAIN=0010,0010,0020,0010,0020,0020
[CH_CONFIG]
1,7,2,8,9,14,15,21,16,22,23,28,29,35,30,36
[CAL(CAL1-L1,CAL1-L2,...,CAL36-L1,CAL36-L2)(0:good/3:unuse/1:over/2:under)]
10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,
[Oxy(O)/Deoxy(D)(mM･mm)]
evt,ch1(O),ch1(D),ch1(O+D),ch2(O),ch2(D),ch2(O+D),ch3(O),ch3(D),ch3(O+D),ch4(O),ch4(D),ch4(O+D),ch5(O),
0000,    0.00000000,    0.00000000,    0.00000000,    0.00000000,    0.00000000,    0.00000000,    0.00000000,
0000,    0.00002424,    0.00002025,    0.00004449, -0.00014927,    0.00017620,    0.00002693, -0.00004495,
0000,    0.00006578, -0.00009710, -0.00003132, -0.00038858,    0.00039703,    0.00000845, -0.00012406,
0000,    0.00001730, -0.00013758, -0.00012028, -0.00033644,    0.00032006, -0.00001638, -0.00012406,
0002, -0.00016273,    0.00001612, -0.00014661, -0.00033644,    0.00032006, -0.00001638, -0.00017978,
0000,    0.00001730, -0.00013758, -0.00012028, -0.00005213,    0.00007695,    0.00002482, -0.00012406,
0000,    0.00001730, -0.00013758, -0.00012028, -0.00005213,    0.00007695,    0.00002482, -0.00012406,
0004, -0.00003118, -0.00017806, -0.00020924, -0.00037432,    0.00028771, -0.00008661, -0.00006835,
0000, -0.00009695, -0.00008098, -0.00017793, -0.00037432,    0.00028771, -0.00008661, -0.00006835,
0000, -0.00009695, -0.00008098, -0.00017793, -0.00023217,    0.00016615, -0.00006602,    0.00002154,
```

I

II

I Header information

START=2009/08/13 12:29:35 **Time when measurement recording started is stamped.**
STOP=2009/08/13 12:29:52 **Time when measurement recording ended is stamped.**

[Measurement Profile]
TITLE=test TASK 1 **Title name described in Application software when measurement recording ended.**
EVENT_MODE=Event-Related **Each setting condition of EVENT at relevant recording is stamped.**
EVENT_TYPE,AUTO
EVENT_T0=10,EVT1
EVENT_T1=20,EVT1
EVENT_T2=15,EVT1
EVENT_REPEAT,

[User Profile] **Registered information of relevant examinee is stamped.**
NAME,Taro Spectratech **Name**
AGE,26 **Age**
GENDER,Male **Gender**
Dominant Hand,Right-Handed **Dominant hand**

[HEADER]
TRG_MODE,0002 **Trigger mode condition (1: External trigger mode, unconditional trigger mode)**
LED_POWER,0000 **LED output condition (0: Low power 1: High power)**
AGC_GAIN,0010,0010,0020,0010,0020,0020 **Gain value of AGC amp when measuring**

[CH_CONFIG] **How hardware channel (Hch) was assigned to measurement channel (CH) is stamped.**
1,7,2,8,9,14,15,21,16,22,23,28,29,35,30,36 **In case of the left, CH1=Hch1, CH2=Hch7, CH3=Hch2 · · · CH16=Hch36**

[CAL(CAL1-L1,CAL1-L2,...,CAL36-L1,CAL36-L2)(0:good/3:unuse/1:over/2:under)]
10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,03,03,03,03,03,03,03,03,10,10,10,10,10,10,
Display of calibration result

Calibration result before measurement recording was stamped in order of Hch1λ1, Hch1λ2 · · · Hch36λ1, Hch36λ2 from left.

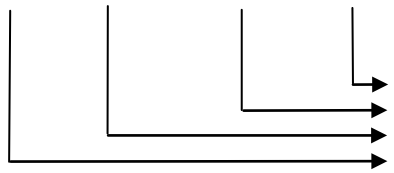
X0: Good Signal is good.
X1: over Signal is too strong. (Signal is recorded, but reliability is low.)
X2: under Signal is too weak. (Signal is recorded, but reliability is low.)
X3: unuse Affected by above X1Hch. (Signal is recorded, but reliability is low.)
1X: Hch to be displayed in OEG16.ini file, or in Measurement Point Config in Application software.
0X: Hch not to be displayed in OEG16.ini file, or in Measurement Point Config in Application software.

Example)
10: Signal is good for Hch to be displayed.
03: Hch not to be displayed.

Ⅱ Part of measured data

The value converted to the data of concentration change length of oxyhemoglobin from the starting point of measurement is enumerated up to EOF (End of File) of the file as much as having been measured and recorded. As for this data, only the data of measurement channel (CH) is stored.

```
[Oxy(O)/Deoxy(D)(M･mm)]
evt,ch1(O),ch1(D),ch1(O+D),ch2(O),ch2(D),ch2(O+D),ch3(O),ch3(D),ch3(O+D),ch4(O),ch4(D),ch4(O+D),ch5(O),
0000,   0.00000000,   0.00000000,   0.00000000,   0.00000000,   0.00000000,   0.00000000,   0.00000000,   0.00000000, ,,,,,,,,,,,,,,,,
0000,   0.00002424,   0.00002025,   0.00004449, -0.00014927,   0.00017620,   0.00002693, -0.00004495, ,,,,,,,,,,,,,,,,,
0000,   0.00006578, -0.00009710, -0.00003132, -0.00038858,   0.00039703,   0.00000845, -0.00012406, ,,,,,,,,,,,,,,,,,,
0000,   0.00001730, -0.00013758, -0.00012028, -0.00033644,   0.00032006, -0.00001638, -0.00012406, ,,,,,,,,,,,,,,,,,,
0002, -0.00016273,   0.00001612, -0.00014661, -0.00033644,   0.00032006, -0.00001638, -0.00017978, ,,,,,,,,,,,,,,,,,,
0000,   0.00001730, -0.00013758, -0.00012028, -0.00005213,   0.00007695,   0.00002482, -0.00012406, ,,,,,,,,,,,,,,,,,,
0000,   0.00001730, -0.00013758, -0.00012028, -0.00005213,   0.00007695,   0.00002482, -0.00012406, ,,,,,,,,,,,,,,,,,,
0004, -0.00003118, -0.00017806, -0.00020924, -0.00037432,   0.00028771, -0.00008661, -0.00006835, ,,,,,,,,,,,,,,,,,,
0000, -0.00009695, -0.00008098, -0.00017793, -0.00037432,   0.00028771, -0.00008661, -0.00006835, ,,,,,,,,,,,,,,,,,,
0000, -0.00009695, -0.00008098, -0.00017793, -0.00023217,   0.00016615, -0.00006602,   0.00002154,,,,,,,,,,,,,,,,,
```



・・・・・・・ **Hereafter, it consists of one line up to CH16⊿CoxyHb, ⊿CdeoxyHb, ⊿Ctotal in series.**

CH1 ⊿ctotal (Unit: M･mm)
CH1 ⊿CoxyHb
CH1 ⊿CoxyHb
Event input information
0000: No event input at the time.
xx01: There was Soft Event input from PC.
xx02: There was EVENT button input on front side of OEG-16.
xx04: There was input from REMOTE on back side of Main unit.
xx08: There was input from EXT-EVENT2 on back side of Main unit.
xx10: There was input from EXT-EVENT1 on back side of Main unit.
01xx~**FF**xx: Event number given from UDP-IN (Described in §6)

Case other than the above:
Hardware input factors of the above 01~10, and value in combination of UDP-IN factors (Generated at the same time).

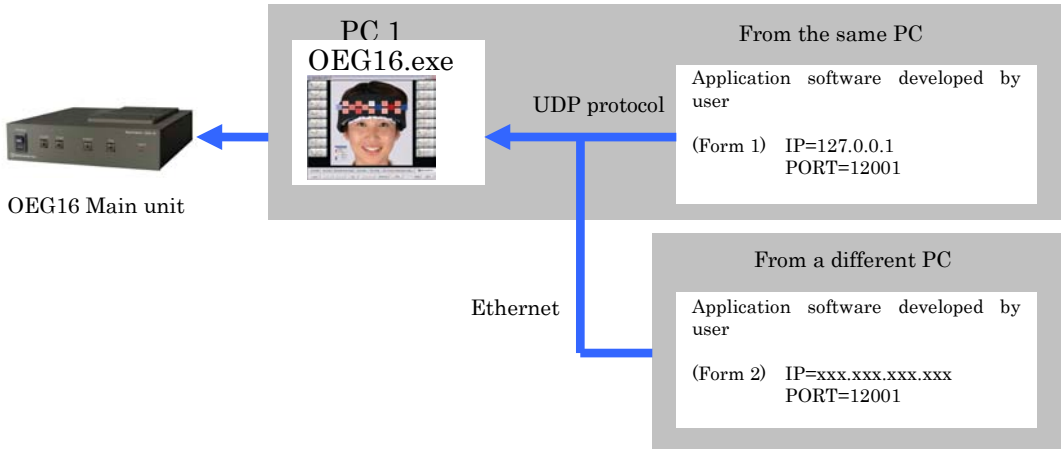
Calculation of elapsed time

The interval time of each measurement data per line is **0.655359 seconds**.

Based on this unit time, multiplying it by the number of data lines from START to the relevant position makes the time from beginning. When an absolute time is necessary, it can be obtained by adding the beginning time of the header part to the calculated value.

§6 UDP-IN function (To accept Event signal from Network)

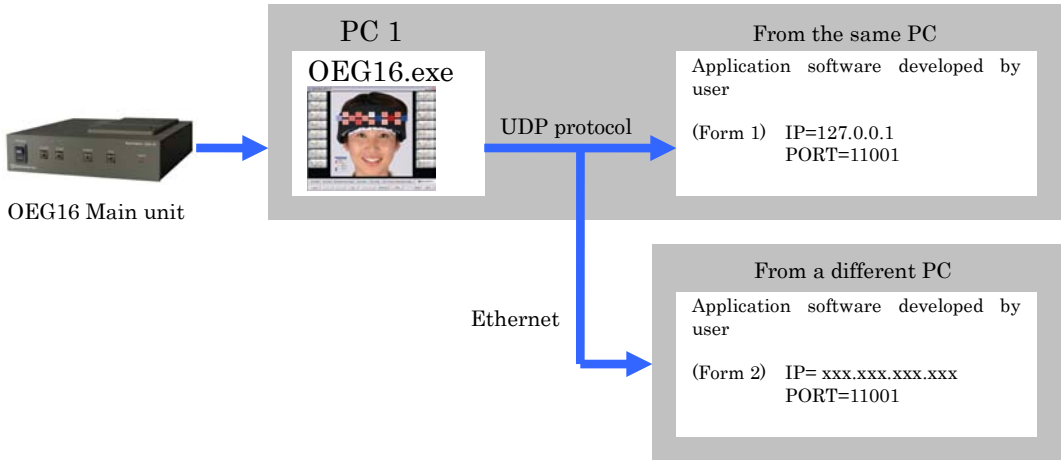
It has prepared the function that can give Event signal from the application software (Task presentation software, for example) developed by the customer via the network while Spectratech OEG16 Main unit is measuring online using OEG16.exe application software. It is supported for OEG16.exe V1.3 or later.



UDP (User Datagram Protocol) corresponds to OSI reference model's transport layer, that is a kind of the standard protocol used on the Internet. On the Internet, TCP is generally used as a protocol in the transport layer, and UDP is also widely used for the streaming, etc. that requires a real-time process such as our company's utilization form this time.

§7 UDP-OUT function (To output data to Network in real time)

It has prepared the function that can use the measured data from OEG16 Main unit online via the network with the application software developed by the customer while it is measuring online with OEG16.exe application software. It is supported for OEG16.exe V1.3 or later.



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§8 Method to directly drive Spectratech OEG-16

Here, it describes the necessary information to directly drive Spectratech OEG-16 Main unit with customer's own application software not using OEG16.exe Application software attached as standard. It may be utilized when various devices are driven directly with the biological signal from Spectratech OEG-16 for the purpose such as BMI.

Spectratech OEG-16 operates by communicating with PC exchanging the text commands in ASCII code. Timely issuing these commands from PC can control Spectratech OEG-16.

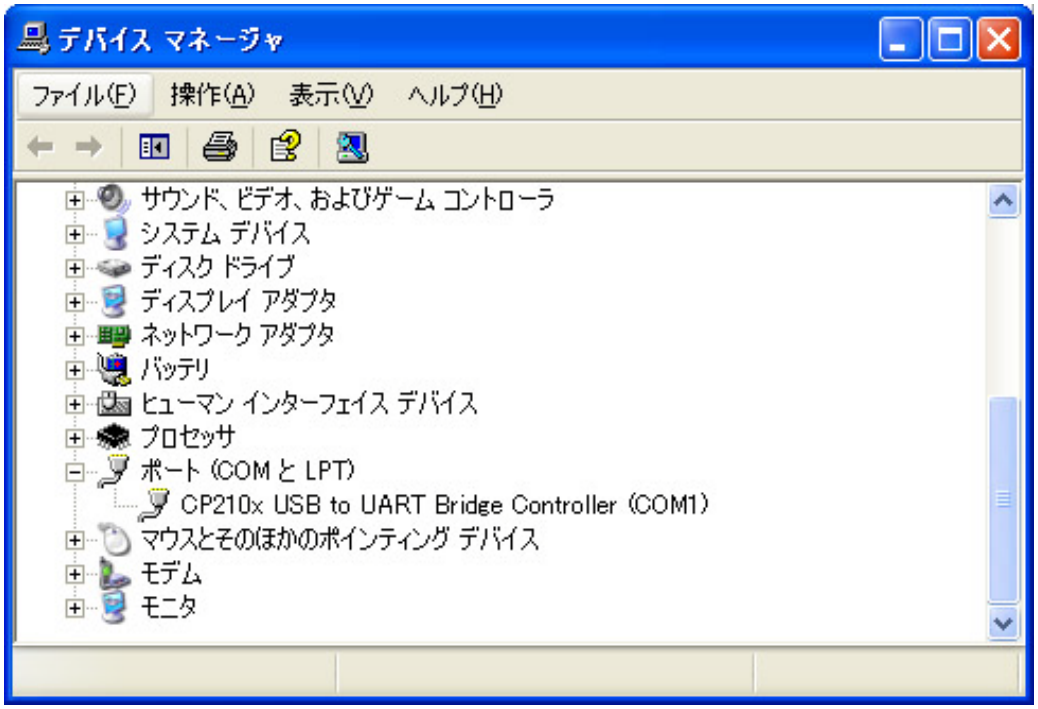
[Introduction]

It explains about the commands to control Spectratech OEG-16 by the PC in which Windows is installed (Hereafter, it is called PC). Spectratech OEG-16 is connected with PC via USB in "Virtual COM port" method, therefore it is a communication via COM port (serial port) when seeing from PC side.

“Virtual COM port" is incorporated in by CP210x driver of Silicon Laboratories Inc, and an optional COM port number is assigned.

This "COM port number" changes depending on PC used, so it is necessary to confirm it with Device Manager in Windows after connecting Spectratech OEG-16 with PC.

It is set to “COM1” in the case below.



Spectratech OEG-16 confirms the connection with PC by "DTR" signal on PC side.

Though "DTR" is turned on usually when the COM port is opened, please turn on "DTR" when "DTR" is controlled individually by program on PC side, etc.

Confirming turning on of "DTR", Spectratech OEG-16 turns on "CTS", and enters the state where it can communicate. This state is called "Hardware connection state".

In "Hardware connection state", it doesn't accept except "CONNECT" command, which will be explained hereafter.

[Command]
Each command is transmitted in ASCII character string of English one-byte characters.

Each command adds
Carriage return CR (0x0D)
Linefeed LF (0x0A)
as terminator.

In the following text
Carriage return [CR]
Linefeed [LF]
Space _ (Underscore)
are described.

1. CONNECT [CR][LF]

[Comment]
Connection request to Spectratech OEG-16 from PC
On receiving this command, Spectratech OEG-16 moves into “Software connection state” in which various commands can be received, from “Hardware connection state”.

[Return value]
Normal case READY [CR][LF]
Abnormal case BUSY [CR][LF] (When collecting data, or calibrating)

2. DISCONNECT [CR][LF]

[Comment]
Disconnection request to Spectratech OEG-16 from PC
On receiving this command, Spectratech OEG-16 moves into “Hardware connection state” in which only “DISCONNECT” command can be accepted, from “Software connection state”.

[Return value]
Normal time DISCONNCTED [CR][LF]
Abnormal time BUSY [CR][LF] (When collecting data, or calibrating)

The following commands of 3~33 are effective during standby state.
During measurement, calibration, and standby state for external trigger
[Return value]
BUSY [CR][LF]
is shown.

3. MODE [CR][LF]
[Comment]
Inquiry about trigger mode
SpectratechOEG-16 has two kinds of methods in START mode to start a measurement. The unconditional trigger mode is a mode in which it suddenly starts a recording by START command from PC. The external trigger mode is a mode in which it first starts a recording by a starting trigger from EXT-EVENT1 after START instruction executed from PC.
[Return value]
1 [CR][LF] External trigger mode
2 [CR][LF] Unconditional trigger mode

4. MODE_Set value [CR][LF]
[Comment]
Setting of trigger mode
Set value 1: External trigger mode 2: Unconditional trigger mode
[Return value]
OK [CR][LF]

5. START [CR][LF]

[Comment]

Start of measurement

In case of START in the unconditional trigger mode, START-LED on the front side of Spectratech OEG-16 turns on, and start a measurement. In case of START in the external trigger mode, START-LED on the front side of Spectratech OEG-16 blinks to wait for an input of EXT-EVENT1. When an input of EXT-EVENT1 was confirmed, the LED changes into lighting, and a measurement starts.

[Return value]

RH: Year, Month, Day, Hour, Minute, Second, Trigger mode, LED POWER, AGC1~AGC6 [CR][LF]
OK [CR][LF]
RD: Event data, Hch1λ1, Hch1λ2, ~, ~, ~, Hch32λ1, Hch32λ2 [CR][LF]

Return value of numerical number is all given in hexadecimal. Each value of Hch is a raw output signal from the spread spectrum modulation/demodulation circuit.

To use it as biological signal, it is treated as **Hch – 32767 (in decimal) = Biological signal.**

In addition, the biological signal may be less 32767, so it is treated as 0 when it becomes a negative value as biological signal.

Example)

RH:0009,0004,0006,0013,0022,0041,0002,0000,0090,0090,0090,00FF,00B0,0090
OK
RD:0000,8015,8006,8085,8034,807B,804E,7FFE,7FFE,7FFF・・・・・・

6. EVENT4 [CR][LF]
7. EVENT4_Set value [CR][LF]
8. EVENT5 [CR][LF]
9. EVENT5_Set value [CR][LF]
10. STATUS [CR][LF]
11. GET [CR][LF]
12a. GET_MR [CR][LF]
12b. GET_M set value [CR][LF]
13. GET_File number [CR][LF]
14. DEL_File number [CR][LF]
15. DEL_ALL [CR][LF]
16. DEF [CR][LF]
17. DEF_Max VAL,Min VAL,AGC Range,Restart Time,Low Batt,SW Time,
e23 LED,Cal Trg LED,Cal Err LED,Cal Tout,Batt Delta [CR][LF]
18. CAL [CR][LF]
19. CAL_R [CR][LF]
20. CAL_W_AGC1, AGC2, AGC3, AGC4, AGC5, AGC6 [CR][LF]
21. CAL_D? [CR][LF]
22. CAL_D_setting value [CR][LF]
23. LED_R [CR][LF]
24. LED_W_setting value Hch1~Hch36,LED1~6 [CR][LF]
25. LED_setting value [CR][LF]
26. LED_ER [CR][LF]
27. TIME_setting value [CR]]LF]
28. RDTM [CR][LF]
29. CALMODE_R [CR][LF]
30. CALMODE_setting value [CR][LF]
31. LEDPWR_R [CR][LF]
32. LEDPWR_setting value [CR][LF]
33. VER [CR][LF]
34. STOP [CR][LF]
35. STOP [CR][LF]
36. RESTART [CR][LF] (Valid only in the unconditional start mode)
37. STOP [CR][LF]

www.spectratech.co.jp

Spectratech Inc.

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