SleepSign System

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SSA100W *SleepSign System -* **Frequently Asked Questions**

1. Why should I use SleepSign software?
2. Can SleepSign import digital data generated from my BIOPAC system (or other current recording systems)?
3. How many animals can I record at a time?
4. What kind of animal can I apply SleepSign to?
5. Can I apply SleepSign to human sleep analysis?
6. Is epoch time configurable?
7. How accurate is the auto-scoring of SleepSign?
8. What is the price?

What are the main features of SleepSign software?

With SleepSign software, you can:

- observe the quantity, quality, and condition of sleep
- use EEG, EMG, ECG, Body Temperature, and other signals to detail various sleep stages
- apply automatic or manual Stage Scoring, Hypnogram & Trend information, and Frequency analysis.
- output Stage Graph (quantity), Average Spectrum (quality), and Vigilance State Parameters (condition)

See the SleepSign Overview for more information on acquisition and analysis.

Can SleepSign import digital data generated from my current recording system?

YES. SleepSign supports the following sorts of digital data format:

- BIOPAC MP System/Acq*Knowledge* data files
- European Data Format (EDF) files
  - SleepSign does not support EDF+ * SleepSign does not support EDF files which are recorded with Electro mode. Please contact us for more detail.
- DSI Dataquest A.R.T. Waveform and Parameter files *SleepSign supports Dataquest A.R.T. version 2.1, 2.2, 2.3, 3.0
- Text files (ASCII or CSV)

How many animals can I record at a time?

The BIOPAC MP150 data acquisition system can record up to 16 channels of analog data. Multiple MP150 systems can be used to accommodate more channels. The SleepSign software can analyze up to 32 channels. Therefore, if you record two channels (EEG and EMG) from each animal, you can record up to eight animals with one MP150, and 16 with two systems.

If you add video recording capability, you can record/playback up to four animals using a multiplexer. (SleepSign supports multiplexers, which divide the image into four parts.) You can record up to 16 channels of waveform data when you record video, too.

What kind of animal can I apply SleepSign to?

Although the majority of our clients use SleepSign for studies of rodents, you can apply it to any kind of animal as long as EEG and EMG are available. However, the auto-scoring might not work well if the transition in EEG and EMG among each sleep/wake stages is very subtle or not observed.

Is epoch time configurable?

You can select suitable epoch length from the following choices: 4, 8, 12, 5, 10, 15, 20, 30, 60 (sec)

How accurate is the auto-scoring of SleepSign?

If you differentiate by three stages (Wake, REM, NREM), the average agreement between auto-scoring and your manual scoring will be approximately 90% for Rats. However, if the transition of EEG and EMG between each stages is very subtle or not observed, the auto-scoring may not work properly.

Can I apply SleepSign to human sleep analysis?

We have not applied for the medical equipment approval from FDA since we are focusing on supporting researchers who work for basic animal research at the moment. Although SleepSign has more than enough capability to analyze human sleep as well, we prohibit using SleepSign for human analysis at the moment.


What is the price?

Contact BIOPAC for pricing on software and license packs.

SleepSign System User List - Partial List of Users

North America

🇺🇸 Cephalon Inc. (West Chester, PA)
🇨🇦 Dalhousie University, Department of Anatomy and Neurobiology (Halifax, Canada)
🇺🇸 Dartmouth Medical School, Department of Physiology (Lebanon, NH)
🇺🇸 Eli Lilly & Company, Lilly Research Laboratories (Indianapolis, IN)
🇺🇸 Harvard Medical School, Department of Neurology (Boston, MA)
🇺🇸 Johnson and Johnson Pharmaceutical Research and Development, LLC. (San Diego, CA)
🇺🇸 Merck Research Laboratories, Molecular Sleep Lab. (West Point, PA)
🇺🇸 Neurocrine Biosciences (San Diego, CA)
🇺🇸 Scripps Research Institute, Department of Neuropharmacology (La Jolla, CA)
🇺🇸 Scripps Research Institute, Department of Molecular Biology (La Jolla, CA)

🇨🇦 Simon Frazer University (British Colombia, Canada)
🇺🇸 Stanford University, Center for Narcolepsy (Palo Alto, CA)
🇺🇸 SRI International, Biosciences Division, Molecular Neuroscience (Menlo Park, CA)
🇺🇸 University of Pennsylvania, Department of Neuroscience (Philadelphia, PA)
🇺🇸 University of California, Irvine (Irvine, CA)
🇺🇸 University of Wisconsin - Madison, Department of Psychiatry (Madison, WI)
🇺🇸 Vanderbilt University, Peabody College, John F. Kennedy Center (Nashville, TN)
🇺🇸 Washington State University, Department of VCAPP (Pullman, WA)
🇺🇸 Western University (Pomona, CA)
🇺🇸 York College - CUNY, Department of Psychology (Jamaica, NY)

Europe

🇫🇷 Cephalon France (France)
🇬🇧 Eli Lilly Research Centre (UK)
🇩🇪 Georg-August-University, Abt. Klinische Neurophysiologie (Germany)
🇩🇪 German Primate Center (Germany)
🇬🇧 Huntingdon Life Sciences Ltd (UK)

🇬🇧 Imperial College London (London, UK)
🇬🇧 Merck Sharp & Dohme, Department of in-vivo neuroscience (UK)
🇭🇺 National Institute of Psychiatry and Neurology (Hungary)
🇬🇧 Pfizer Global Research & Development, Department Discovery Biology (UK)

Asia

🇯🇵 Banyu Pharmaceutical Co., Ltd. (Japan)
🇯🇵 Hokkaido University (Japan)
🇰🇷 Korea Institute of Science and Technology, National CRI Center for Calcium and Learning (Korea)
🇯🇵 Kyoto University (Japan)
🇯🇵 Mitsubishi Pharma Corporation. (Japan)

🇯🇵 Osaka Bioscience Institute (Japan)
🇯🇵 Tokyo Medical and Dental University (Japan)
🇯🇵 Takeda Chemical Industries, Ltd. (Japan)
🇯🇵 University of Tsukuba (Japan)

SleepSign Overview

Analysis program

1. Waveform Viewer

- You can select the page length from 4 seconds to 24 hours.
- Events are displayed on the waveform if events have been inserted by the acquisition program. With the Event Search function, you can jump to an epoch where an event is inserted.
- An FFT spectrum of the currently selected epoch is displayed on the right bottom of the window (Epoch FFT).
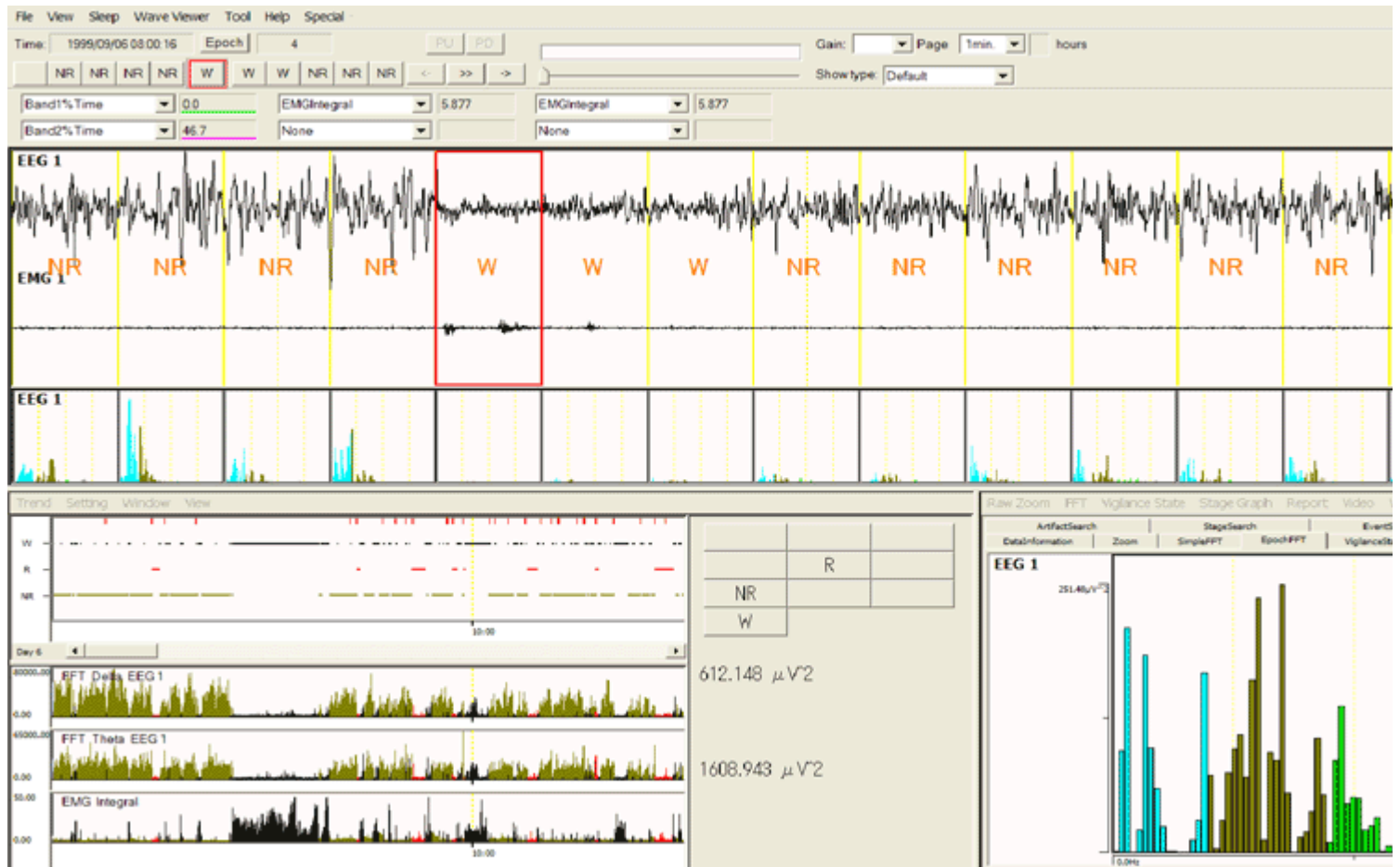
1 min/page display
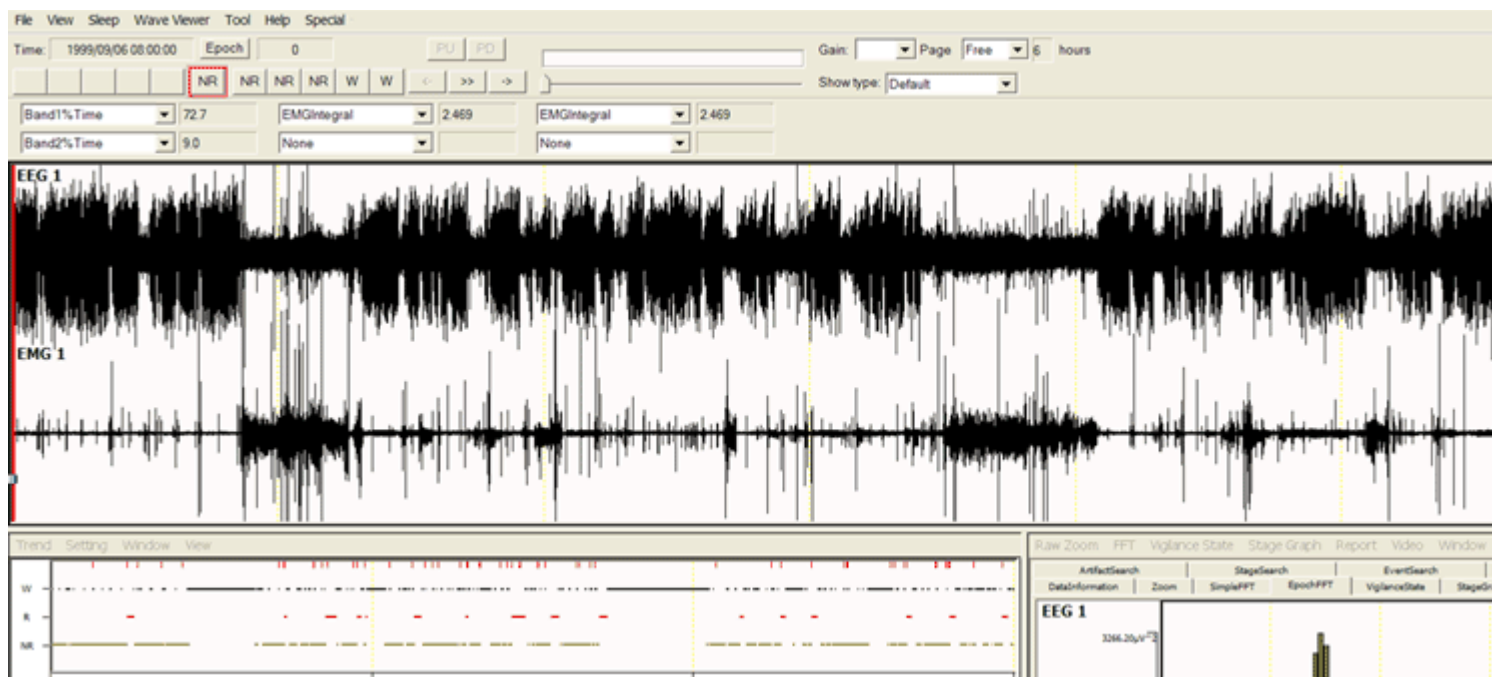
6 hours/page display

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2. Stage Scoring

The auto-scoring function and many useful functions to assist your manual scoring drastically reduce the labor and time you spend on sleep/wake stage scoring.

A. **Auto-Scoring**

   SleepSign scores sleep/wake stages automatically based on EEG and EMG. The criteria of the auto-scoring can be configured flexibly to satisfy various criteria of each researcher. Auto-Scoring results can be manually modified very easily.

B. **Manual-Scoring**

   - You can manually score sleep/wake stages quite easily by using a mouse or a keypad.
   - Three or five rows of pages can be displayed, and scored at a time.
   - You can display FFT spectrums of each epoch in a page (Page divide FFT). You can refer to these FFT spectrums when you score sleep/wake stages.
   - You can list epochs which satisfy criteria of multiple stages of auto-scoring. This function helps you to review and modify the subtle part of auto-scoring results.

   Epoch length can be selected from: 4, 5, 8, 10, 12, 20, 30, 60 seconds.

   Stage classification can be selected from these pre-assigned stages: Wake, REM, NREM, Light, Deep, etc. -- *plus*, you can assign up to three custom stages.
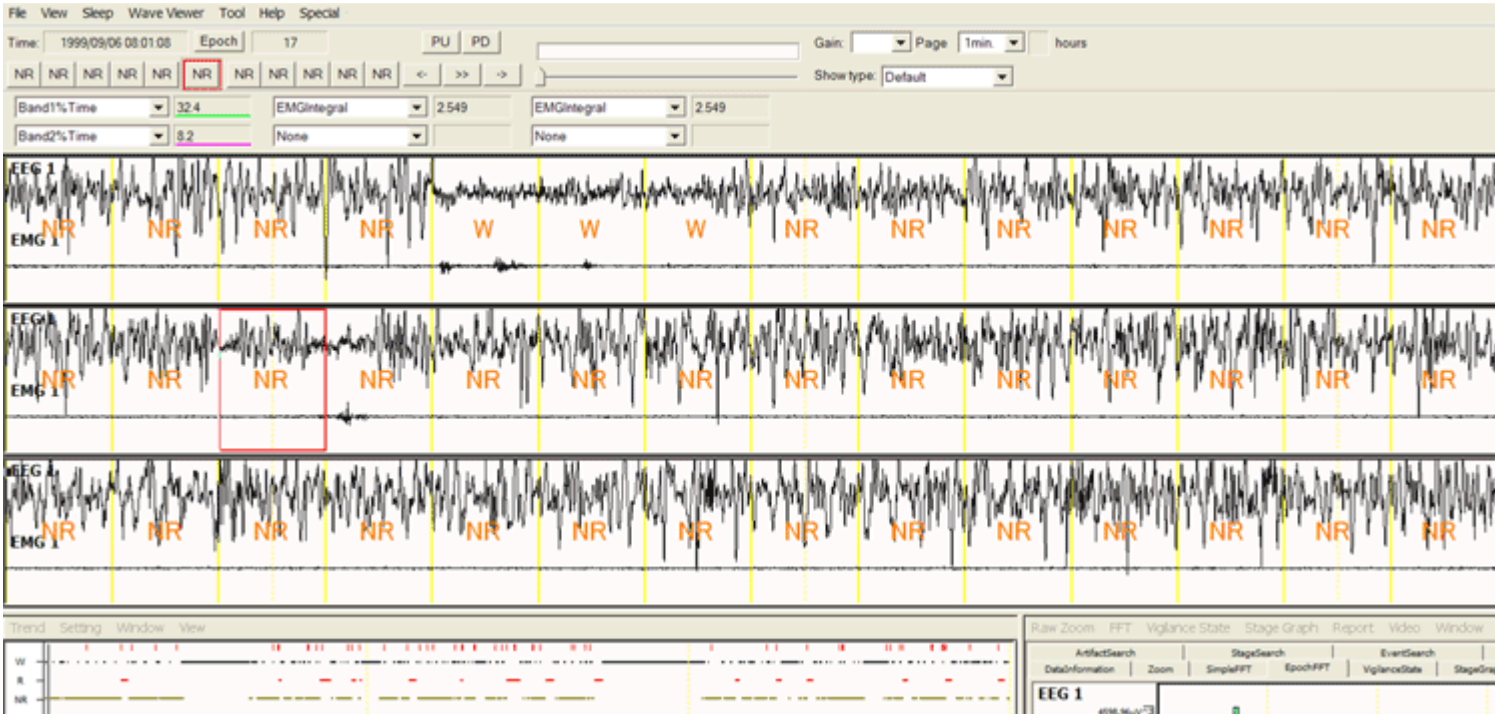
1 min/page three rows display
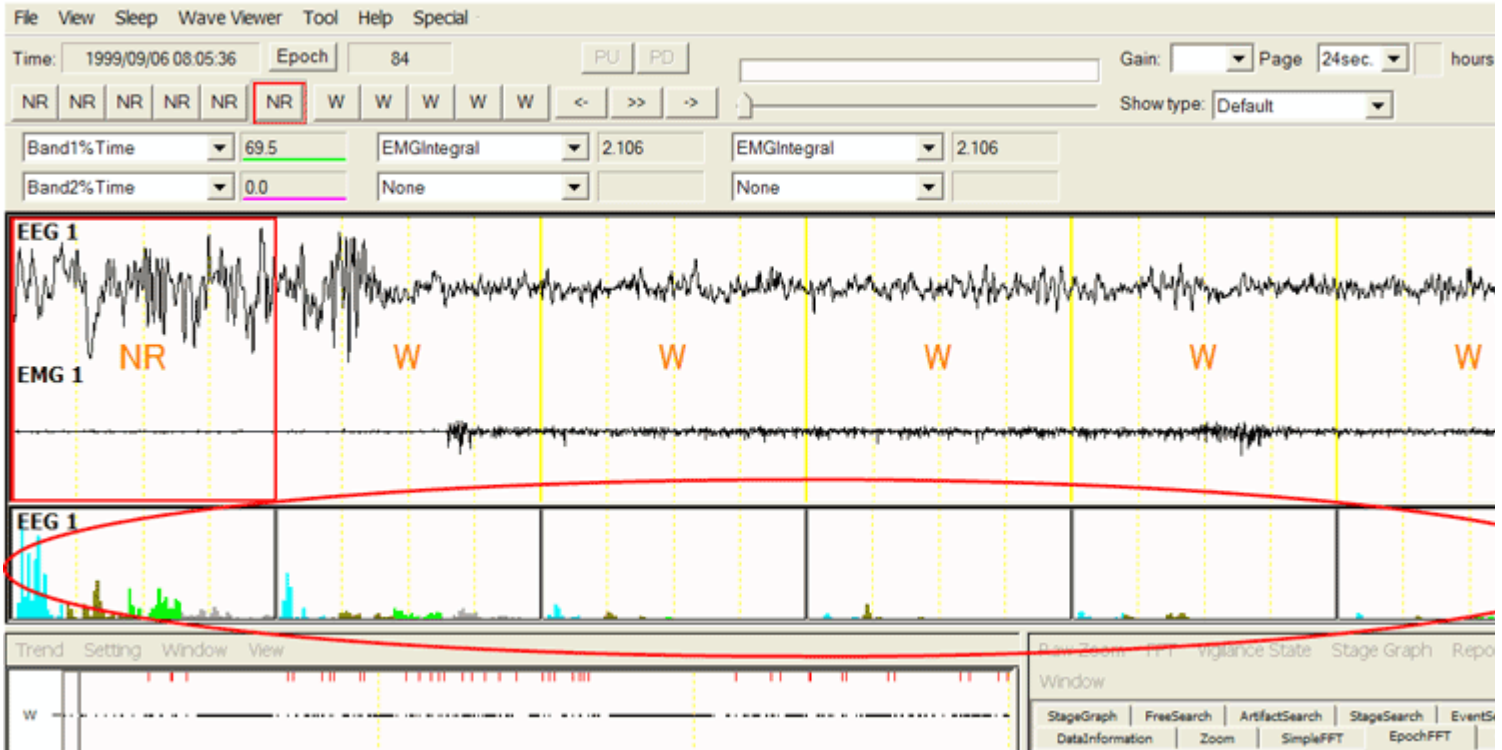
Page divide FFT

C. **Artifact Stage**

You can indicate epochs which contain artifacts as artifact stages automatically or manually. Artifact stages are excluded from the calculation of average FFT, which represents sleep quality, while they are counted for the Stage Graph and the Vigilance State

Parameters, which represent sleep quantity. An asterisk is displayed above the stage name if the epoch is indicated as an artifact stage.

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3. Hypnogram/Trend Graph

The stage scoring result is displayed as the Hypnogram. In addition, various sorts of information can be displayed as Trend Graphs on the same time scale as the Hypnogram. The sorts of Tend Graphs are as follows;

- FFT analysis result
- Percentage or frequency of a particular waveform (such as Delta, Theta, Spindle) per epoch.
- EMG integral
- Maximum or minimum value in an epoch (useful for plotting parameters such as temperature, blood pressure).
- Plus many other parameters

*You import data files of DSI Dataquest A.R.T system, you can display parameters saved in the parameter file (such as activity, temperature, heart rate) as Trend Graphs.

 You can print the Hypnogram and Trend Graphs as well as save each as a text file or a bitmap file.

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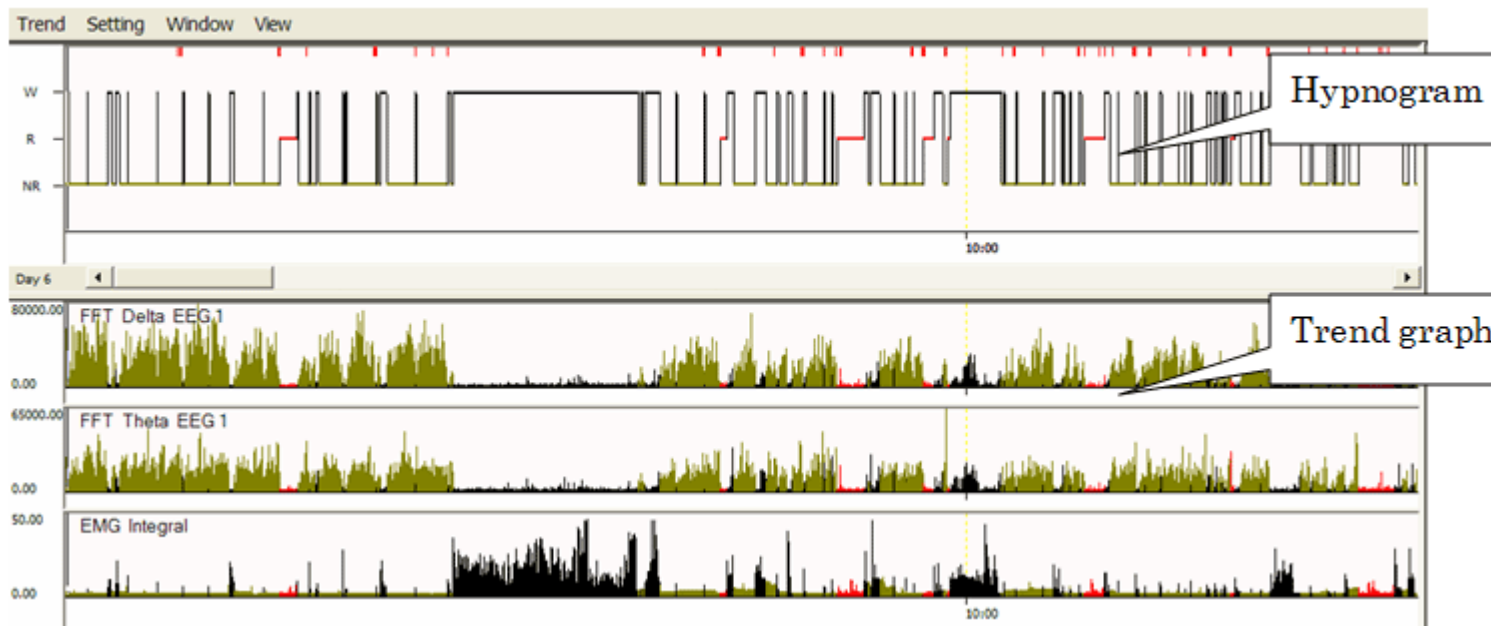
4. Stage Graph

SleepSign calculates the total duration or percentage of each sleep/wake stage by any time bin and time range, and draws the Stage Graph. You can print the Stage graph as well as save it as a text file or a bitmap file.

Total duration in each time bin

Time	W	R	NR
1999/09/06 08:00:00	816	140	2644
1999/09/06 09:00:00	1676	376	1548
1999/09/06 10:00:00	1148	496	1956
1999/09/06 11:00:00	2216	356	1028
1999/09/06 12:00:00	1256	332	2012
1999/09/06 13:00:00	1464	364	1772
1999/09/06 14:00:00	2508	176	916
1999/09/06 15:00:00	944	424	2232
1999/09/06 16:00:00	1784	412	1404
1999/09/06 17:00:00	1212	404	1984
1999/09/06 18:00:00	2020	372	1208
1999/09/06 19:00:00	1356	384	1860
1999/09/06 20:00:00	3084	216	300
1999/09/06 21:00:00	3456	0	144
1999/09/06 22:00:00	2304	412	884
1999/09/06 23:00:00	2764	228	608
1999/09/07 00:00:00	2528	312	760
1999/09/07 01:00:00	2576	212	812
1999/09/07 02:00:00	2436	240	924
1999/09/07 03:00:00	2716	164	720
1999/09/07 04:00:00	2884	0	716

5. Vigilance State Parameters

SleepSign displays a time series list of each episode (a series of sleep/wake stages) along with duration of each episode. In addition, frequency, mean duration, and standard deviation of each episode are displayed. You can calculate and display Vigilance State Parameters by any time bin and time range (ex: light period vs. dark period, or every 6 hours). With this function, you can grasp the transition of sleep/wake patterns easily.

- You can save the Vigilance State parameters result in a text file.
- You can also obtain the frequency of each episode sorted by duration

ArtifactSearch		StageSearch		EventSearch		
DataInformation	Zoom	SimpleFFT	EpochFFT	VigilanceState	StageGraph	

No.	Epoch No.	Time	Episode	Count	Duration(sec.)
1	0	1999/09/06 08:00:00	NR	4	16
2	4	1999/09/06 08:00:16	W	3	12
3	7	1999/09/06 08:00:28	NR	37	148
4	44	1999/09/06 08:02:56	W	1	4
5	45	1999/09/06 08:03:00	NR	40	160
6	85	1999/09/06 08:05:40	W	8	32
7	93	1999/09/06 08:06:12	NR	8	32
8	101	1999/09/06 08:06:44	W	7	28
9	108	1999/09/06 08:07:12	NR	16	64
10	124	1999/09/06 08:08:16	W	2	8
11	126	1999/09/06 08:08:24	NR	57	228
12	183	1999/09/06 08:12:12	W	2	8
13	185	1999/09/06 08:12:20	NR	49	196
14	234	1999/09/06 08:15:36	W	4	16
15	238	1999/09/06 08:15:52	NR	49	196
16	287	1999/09/06 08:19:08	W	1	4

> Time series list of each episode and duration

Division start	Stage	Count	Mean duration(sec.)	SD(+-)
1999/09/06 08:00:00	W	261	70	243
	R	40	105	58
	NR	263	78	57
		0	None	
1999/09/06 20:00:00	W	153	221	
	R	20	90	
	NR	153	49	
		0	None	0

> Total epoch number, mean duration, and SD of each stage by time bin

Vigilance State Report

1999/9/6 8:00						1999/9/6 20:00					
Stage	Count	Mean duration(sec.)	SD(+-)			Stage	Count	Mean duration(sec.)	SD(+-)		
W	261	70	243			W	153	221	527		
R	40	105	58			R	20	90	42		
S	263	78	57			S	153	49	34		
	0	None	None				0	None	None		

No.	Epoch No.	Time	Episode	Count	Duration(sec.)	No.	Epoch No.	Time	Episode	Count	Duration(sec.)
1	0	1999/9/6 8:00	S	4	16	1	10800	1999/9/6 20:00	S	6	24
2	4	1999/9/6 8:00	W	3	12	2	10806	1999/9/6 20:00	W	39	156
3	7	1999/9/6 8:00	S	37	148	3	10845	1999/9/6 20:03	S	12	48
4	44	1999/9/6 8:02	W	1	4	4	10857	1999/9/6 20:03	R	34	136
5	45	1999/9/6 8:03	S	40	160	5	10891	1999/9/6 20:06	W	373	1492
6	85	1999/9/6 8:05	W	8	32	6	11264	1999/9/6 20:30	S	5	20
7	93	1999/9/6 8:06	S	8	32	7	11269	1999/9/6 20:31	W	265	1060
8	101	1999/9/6 8:06	W	7	28	8	11534	1999/9/6 20:48	S	6	24
9	108	1999/9/6 8:07	S	16	64	9	11540	1999/9/6 20:49	W	2	8
10	124	1999/9/6 8:08	W	2	8	10	11542	1999/9/6 20:49	S	6	24
11	126	1999/9/6 8:08	S	57	228	11	11548	1999/9/6 20:49	W	3	12
12	183	1999/9/6 8:12	W	2	8	12	11551	1999/9/6 20:50	S	4	16
13	185	1999/9/6 8:12	S	49	196	13	11555	1999/9/6 20:50	W	3	12
14	234	1999/9/6 8:15	W	4	16	14	11558	1999/9/6 20:50	S	6	24
15	238	1999/9/6 8:15	S	49	196	15	11564	1999/9/6 20:50	W	6	24
16	287	1999/9/6 8:19	W	1	4	16	11570	1999/9/6 20:51	S	6	24

Vigilance State parameters saved as text

1999/9/6 8:00

Stage	Duration(sec.)	Count
W	4	27
W	8	31
W	12	25
W	16	32
W	20	22
W	24	9
W	28	11
W	32	11
W	36	14
W	40	7
W	44	6
W	48	5
R	24	2
R	32	1
R	36	2
R	40	1
R	44	2
R	48	2
R	52	1
R	60	1
R	64	1
R	80	1
R	84	3
R	104	2
R	220	1
R	300	1
S	4	4
S	8	4
S	12	6
S	16	12
S	20	10
S	24	12
S	28	10
S	32	9
S	36	10

1999/9/6 20:00

Stage	Duration(sec.)	Count
W	4	22
W	8	19
W	12	8
W	16	7
W	20	7
W	24	8
W	28	5
W	32	11
W	36	3
W	40	5
W	44	1
W	48	4
W	1584	1
W	1608	1
W	1656	1
W	1680	1
W	1704	1
W	1908	1
W	2276	1
W	2712	1
W	2772	1
R	20	1
R	24	1
R	28	1
R	144	1
R	152	1
S	8	3
S	12	3
S	16	12
S	20	10
S	24	13
S	28	10
S	32	10
S	36	7
S	40	7

Vigilance State parameters sorted

6.Average FFT

SleepSign calculates average FFT spectrums of each sleep/wake stage by each time bin and time range. The result can be saved as a text file. The average FFT spectrum is referred to as an index of sleep quality by comparing them by units or different periods of time (ex: light period vs. dark period, sleep deprived vs. control).

14	Free comment 8		
15	Free comment 9		
16	Free comment 10		
17			
18	Time Divis	1	2
19			
20	Stage	R	R
21	Hz	μV^2	μV^2
22	0	18.0226	18.7288
23	0.25	90.6307	89.9128
24	0.5	141.521	144.14
25	0.75	155.387	149.439
26	1	159.084	140.738
27	1.25	159.59	134.155
28	1.5	160.84	134.75
29	1.75	152.389	141.994
30	2	142.782	129.882
31	2.25	144.706	109.204
32	2.5	131.381	116.727
33	2.75	128.909	121.781
34	3	126.182	113.744
35	3.25	132.17	114.736
36	3.5	123.473	115.577
37	3.75	116.797	117.01
38	4	112.671	111.469
39	4.25	104.293	96.1701
40	4.5	102.204	89.7063
41	4.75	100.465	86.2181
42	5	96.9443	90.9232
43	5.25	99.7386	95.2406
44	5.5	100.589	93.2576
45	5.75	103.24	93.1217
46	6	107.434	94.1069
47	6.25	110.939	99.249
48	6.5	109.125	101.861
49	6.75	104.15	111.541
50	7	95.2963	104.934
51	7.25	87.9066	93.9187
52	7.5	79.7136	85.38
53	7.75	73.6533	68.6227
54	8	60.6838	65.3464	None

REM
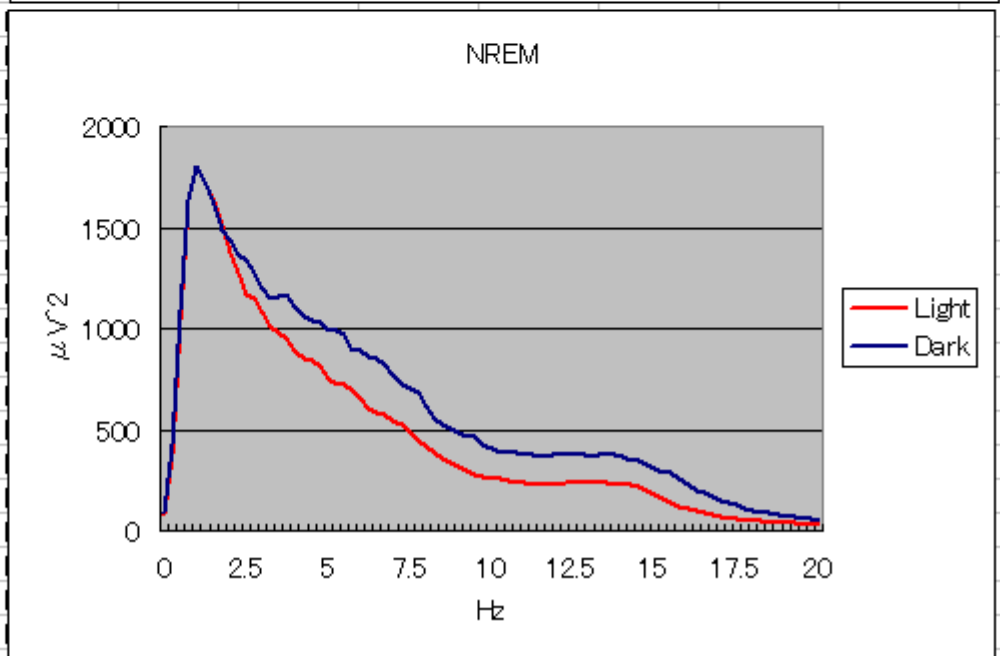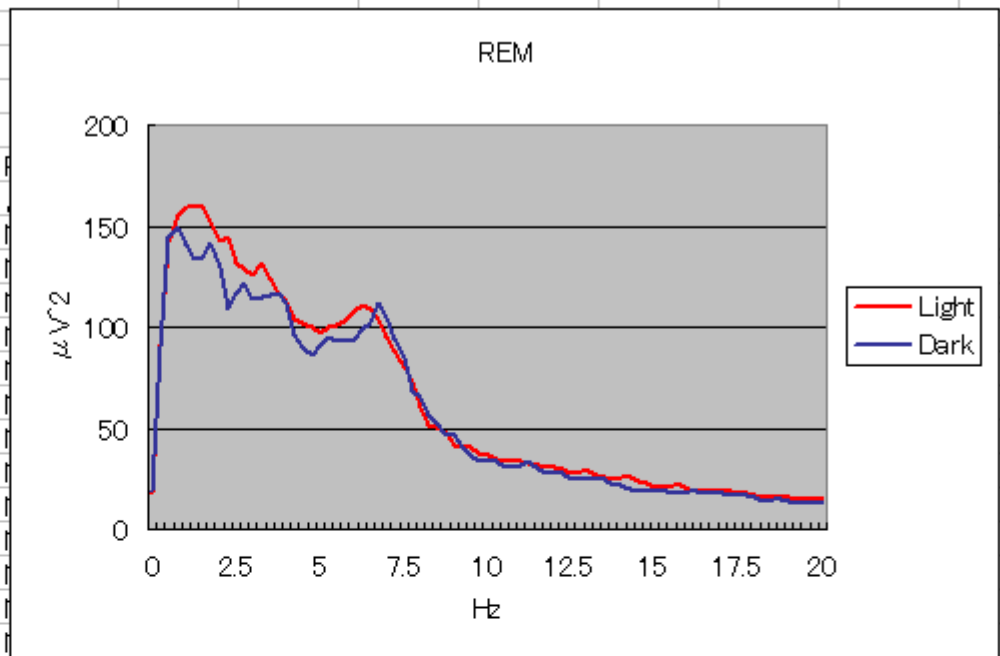
NREM

Average FFT of NREM and REM in light period and dark period

7.Other functions

- **Digital filter** You can apply low path filter, high path filter, band path filter, band stop filter, or smoothing to each channel.
- **Save as a bitmap file** You can save the following images as a bitmap file: Whole window, waveform, Hypnogram/Trend Graph, Stage Graph, etc.
- **Print** You can print the following images: waveform, Hypnogram/Trend Graph, Stage Graph
- **Save as a text file** You can save the following values as a text file: raw data, Hypnogram/Trend Graph, FFT result, Vigilance State Parameters, Stage Graph, etc. You can print auto-scoring parameters or save them as a text file.

Import digital data from BIOPAC or third-party acquisition systems

SleepSign can import following digital data directly;

- BIOPAC Acq*Knowledge* data files
- DSI Dataquest A.R.T. waveform and parameter data files
- EDF (European Data Format) files
- Text files

Synchronous video recording

You can record video data synchronously with physiological data by installing additional hardware (MPEG encoder board, cameras). You can record up to four video inputs at a time by applying a multiplexer.