

20 years of innovation in sleep software



SLEEPRT

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## 1. SleepRT: New hardware solutions



### Schwarzer PSG headbox

#### Channels

The Schwarzer PSG Amplifier and optional interface box together offer up to 62 channels. Pressure, oximetry and temperature/light inputs are built-in, while external devices can be connected via one of the 12 high-level DC inputs.

#### Methods of use

Online use via USB.

#### Special features

High sampling rates: up to 40 kHz.

For research purposes, you can use two headboxes together.



### Micromed Morpheus recorder

#### Channels

The Morpheus recorder offers 34 channels in pocket size: Oximetry, body position, disposable Inductive Effort bands, 2 Pressure signals, 12 Common Reference EEG Channels, 12 User Selectable Bipolar/ Common Reference signals, and 2 DC channels for external devices.

#### Methods of use

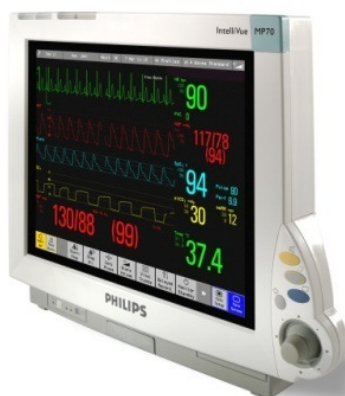
Online use via USB or Bluetooth.

Ambulatory use via built-in CF card.

#### Special features

LCD display for ambulatory check of signal quality.

Light-weight (250 grams) and small (11 x 8 x 3 cm).



### Philips IntelliVue monitor

#### Channels

The Philips IntelliVue monitor Series has different modules to enable the broad spectrum of measurable signals: Cardiac output, SpO<sub>2</sub>, SrcO<sub>2</sub>, tcCO<sub>2</sub>, etCO<sub>2</sub>, aEEG, temperature, blood pressure, etcetera. All signals and related analyses can be recorded in real time and synchronized with the hardware shown above.

#### Methods of use

Online use via serial link or RC232.

#### Special features

Touch-screen monitor can be used to register events and medication supply.

Analysis results coming from Philips monitor can be saved, viewed and reported with SleepRT software.

## 2. Cameras for optimal night recordings

SleepRT takes effort to produce high quality video recordings. You can record video directly to the server, or offline to a memory stick/HDD.

SleepRT offers a choice of different cameras for these different purposes. You can find an overview of our latest cameras below.

- All cameras have Night Shot functionality (with infrared light) and include simultaneous Audio Recordings.
- All Video Recordings are synchronized with recorded signals.
- With Zoom functionality in SleepRT, you can zoom in on the head, legs or other body parts.

	<p><b>Sony Network camera SNC-ER521</b></p> <p>Network SD rapid dome camera, supporting H.264, MPEG-4, and JPEG compression formats.</p> <p><b>Technical details</b> Highest resolution: 720 x 480. Max frame rate: 25 fps.</p> <p><b>Usage</b> Online usage: view and control camera via network access.</p>
	<p><b>Sony HD Network camera SNC-DH180</b></p> <p>Additional features in comparison to SCN-ER521: High Definition images, Sony's latest image enhancement technology Exmor R™.</p> <p><b>Technical details</b> Highest resolution: 640 x 480, Max frame rate: 25 fps.</p> <p><b>Usage</b> Online usage: view and control camera via network access.</p>
	<p><b>Sony HD Handy-cam HDR-HC9E</b></p> <p>High Definition DV format.</p> <p><b>Technical details</b> Highest resolution: 640 x 480. Max frame rate: 25 fps.</p> <p><b>Usage</b> Online usage with FireWire connection to PC.</p>
	<p><b>Sony HD Handy-cam HDR-CX550VE</b></p> <p>High Definition handy-cam, stores in MPEG-4 or MPEG-2. Features Sony's latest image enhancement technology Exmor R™.</p> <p><b>Technical details</b> Highest resolution: 640 x 480. Max frame rate: 25 fps.</p> <p><b>Usage</b> Offline usage: store on HDD/Memory Stick.</p>

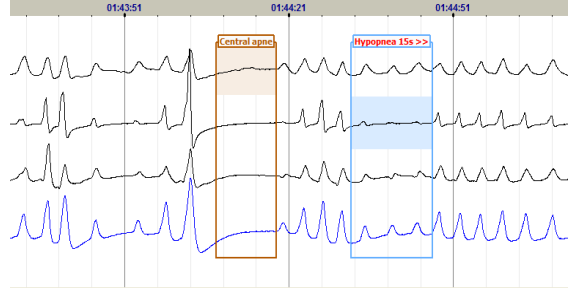
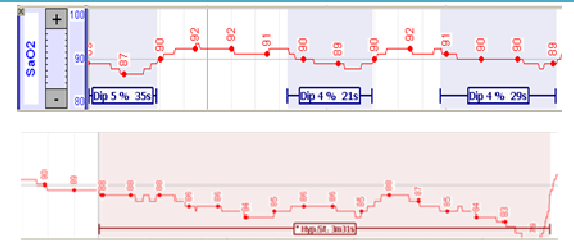
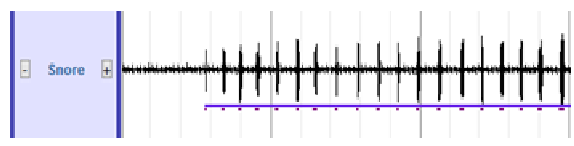
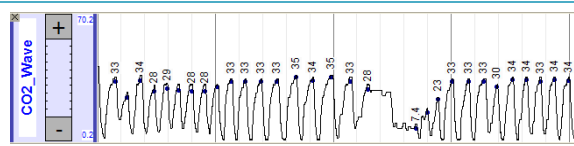
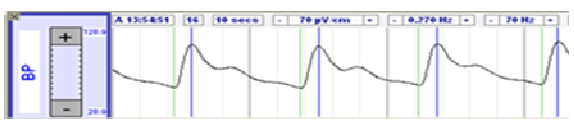
### 3. Automatic sleep- related analyses in SleepRT

Sleep related events such as sleep stages, respiratory events, saturation dips, leg movements, snores and arousals are detected automatically with SleepRT software. The analyses work for ambulatory measurements, but also **Real Time**, during the acquisition! And it's fast: you can run a full analysis of a 12h sleep recording in two minutes.

Did the patient move a lot and lose some sensors? You can easily rerun any of the analyses using a different channel. You can also correct the body position, using the video images.

#### Respiration related analyses

The association between hypopneas and dips/arousals is detected automatically in SleepRT. The report counts only hypopneas associated with dips and/or arousals to determine AHI (check Chapter 5 for more information).

	Analysis and results	Examples of analysis results
Respiration	<p><b>Detection of respiratory events:</b></p> <ul style="list-style-type: none"> <li>Apneas (Central, Obstructive, Mixed)</li> <li>Hypopneas (followed by dip or arousal)</li> </ul> <p>The default parameter set corresponds to AASM rules.</p>	
SaO <sub>2</sub>	<p><b>Detection of saturation events:</b></p> <ul style="list-style-type: none"> <li>Saturation Dips</li> <li>Hypoxical states</li> </ul>	
Snoring	<p><b>Detection of snoring:</b></p> <ul style="list-style-type: none"> <li>Individual snores</li> <li>Snoring periods</li> </ul>	
CO <sub>2</sub>	<p><b>Detection of CO<sub>2</sub> curves</b></p> <ul style="list-style-type: none"> <li>Detection of End Tidal CO<sub>2</sub> value</li> </ul>	
BP	<p><b>Detection of blood pressure waves</b> <b>NEW</b></p> <ul style="list-style-type: none"> <li>Systole</li> <li>Diastole</li> <li>Mean value</li> </ul>	

## Analyses of EXG signals (EEG, EOG, EMG, ECG)

Sleep stages are scored based on feature detection in EEG, EMG and EOG signals. The ECG signal is analyzed to obtain the heart rate variability.

Event Detection		Examples
EEG	<p><b>Detection of EEG rhythmicity:</b></p> <ul style="list-style-type: none"> <li>Delta waves</li> <li>Spindles</li> <li>Alpha waves</li> <li>Theta waves</li> </ul>	
EOG	<p><b>Detection of Eye Movements:</b></p> <ul style="list-style-type: none"> <li>Slow Eye Movements (SEM)</li> <li>Rapid Eye Movements (REM)</li> <li>Eye Blinks</li> </ul>	
EMG	<p><b>Detection of Movements:</b></p> <ul style="list-style-type: none"> <li>Chin movements</li> <li>Leg movements</li> <li>Twitches</li> </ul> <p><b>Classification in</b></p> <ul style="list-style-type: none"> <li>-Periodic Leg Movements</li> <li>-REM Sleep Behavior Disorder</li> </ul>	
Hypnogram	<ul style="list-style-type: none"> <li>Detection of sleep stages based on EEG, EOG and EMG</li> <li>Detection of arousals.</li> </ul>	
ECG	<p><b>Detection of Heart Beats</b></p> <ul style="list-style-type: none"> <li>QRS complexes</li> <li>Bradycardia and tachycardia</li> <li>Interictal Tachycardia</li> <li>Baroreflex sensitivity</li> </ul>	

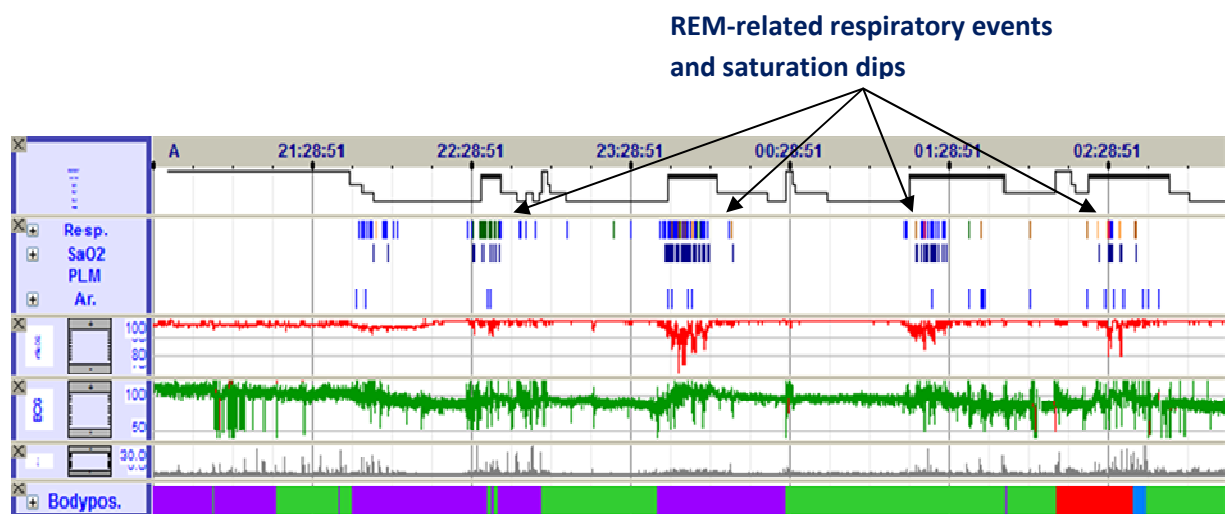
## 4. Sleep scoring with SleepRT

Sleep scoring with SleepRT includes several advantages:

- You can select a shortcut key for each sleep stage.
- Manual hypnogram scores are automatically saved to prevent accidental losses.
- The automatic hypnogram helps you to score sleep stages.
- You can score sleep stages for neonates, babies and children. The following stages are included: Active Sleep, Quiet Sleep and N. **NEW**
- All sleep stages have AASM nomenclature.
- You can already score during the night, while the measurement is running!



- With the possibility to have several overviews, it is convenient to check the hypnogram of the entire night. In the example below, one glance is sufficient to see that the patient has a REM-related respiratory problem.



## 5. Reporting with SleepRT: 7 major advantages

SleepRT makes it easy to make reports. Some of its major advantages:

- MS Word versions 2003, 2007 and 2010 are supported.
- You can send the report to the Electronic Patient Record with one click on the button.
- You can save the report as a PDF.
- You can make a (preliminary) report during the measurement, add notes during the recording, update results, etcetera.
- There is a standard PSG, PG, MSLT and MWT report. You can add or delete items from these reports to produce your own version of the report. An example of an MSLT report is shown below.

MSLT								
Number of SLT's		4						
SLT#	Start	Stop	Duration	B. Sleep	Latency	Lat. N1	Lat. N2	Lat. REM
1	09:02	09:32	30,2 min	09:08	5,8 min	5,8 min	7,3 min	
2	12:03	12:33	30,2 min	12:08	4,9 min	4,9 min	6,4 min	
3	14:08	14:38	30,2 min	14:19	11,0 min	11,0 min	12,0 min	
4	16:07	16:37	30,4 min	16:18	11,6 min	11,6 min	14,6 min	25,1 min
Average					8,3 min	8,3 min	10,1 min	25,1 min

- With the SleepRT report tool, you can take a screenshot of an interesting part of signals and paste it into the report – it takes only two clicks!
- The report methods are conform AASM recommendations. For example, the AHI is based only on hypopneas that are associated to dips or arousals. Hypopneas that are not associated to dips or arousals are listed in red as extra information, but are not used in other calculations. This principle is illustrated in the Respiration Events Summary below.

Respiration Events Summary							
	Number (TST)	Index (TST)	% / Total	Max. Duration	Mean duration	Total duration	
Central Apneas	21	4,6/h	6,8%	37,8 s	19,2 s	6,3 min	
Obstructive Apneas	103	22,8/h	33,3%	55,4 s	23,6 s	39,5 min	
Mixed Apneas	114	25,2/h	36,9%	48,4 s	31,4 s	58,5 min	
Other Apneas	0	0,0/h	0,0%	0,0 s	0,0 s	0,0 min	
All Apneas	238	52,6/h	77,0%	55,4 s	27,0 s	104,3 min	
Hypopneas + Dip, [Arousal]	67	14,8/h	21,7%	62,1 s	31,6 s	34,9 min	
Hypopneas + Arousal	4	0,9/h	1,3%	59,7 s	39,2 s	2,6 min	
All Hypopneas	71	15,7/h	23,0%	62,1 s	32,0 s	37,5 min	
Flow Limitations and RERAs	0	0,0/h	0,0%	0,0 s	0,0 s	0,0 min	
<b>Total</b>	<b>309</b>	<b>68,3/h</b>	<b>100,0%</b>	<b>62,1 s</b>	<b>28,1 s</b>	<b>141,9 min</b>	
(Hypopneas not associated)	11	2,4/h		54,6 s	32,7 s	5,5 min	

## 6. Use SleepRT to analyze all your ambulatory measurements

SleepRT allows you to import EDF and EDF+ files, and measurements from Titanium recorders. EDF is a standard output format; most recorders can produce an EDF file. EDF+ is basically the same as EDF, but includes event and hypnogram info, and the possibility to have multiple tracks (for MSLT's and MWT's). Here are some recorders with EDF output:



You could use the recorder-specific software for all these recorders. However, **using ONE single sleep software to analyze all recordings is an advantage:**

- There is uniformity in the way you evaluate your measurements. The signals are always presented in the same way, which makes it easy to compare. And of course, the analysis parameters are the same for each measurement.
- New technicians have to learn only one software package. This will greatly enhance the speed of learning.

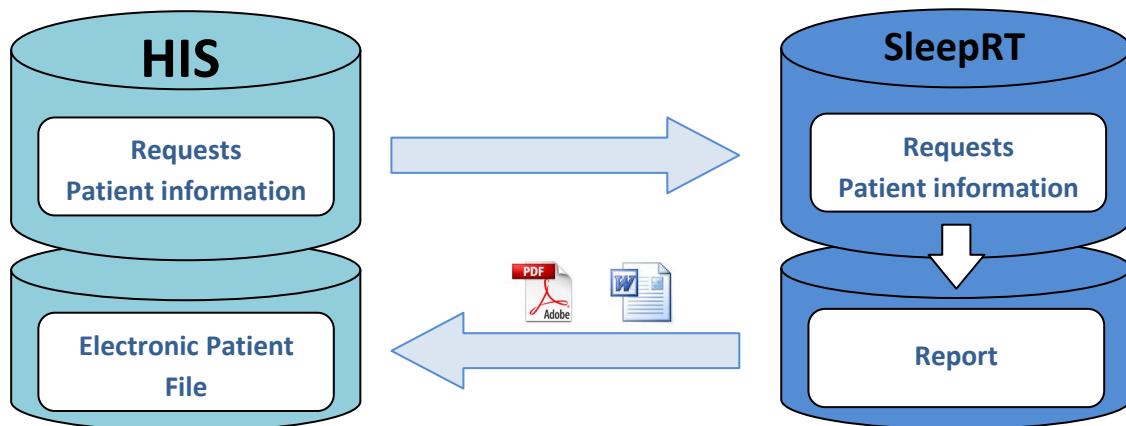
**Why use SleepRT for analyzing your measurements?** The answers are right here:

- You have to define new EDF formats only once. After that, SleepRT saves the EDF specifications in a protocol. The next time you import this type of EDF file, SleepRT will recognize the format and use the protocol that you configured the first time.
- Inside the protocol, you can make layouts to display the signal. No need to make the same layouts every time before starting to score! After import of the measurement, you can immediately start scoring.
- The analysis settings of EDF signals are specified in the import protocol. After defining these settings once, analyzing new measurements with SleepRT will take only one click on the analysis button.
- Did the patient move a lot and lose some of the sensors? No problem! You can easily rerun any of the analyses using a different channel. It's fast and it's accurate.

## 7. SleepRT in the Hospital

### Communication with the Hospital information system

Many hospitals have a Hospital Information System (HIS) to manage the enormous amount of data circulating in the hospital. SleepRT communicates with HIS to obtain measurement requests and patient information. SleepRT can also send reports to the Electronic Patient File, in PDF or Word format. This guarantees correct patient information and reduces the amount of print-outs.



### Take a look at ongoing measurements at home

All measurements are stored on a central location – a server. That means you can open measurements from any computer with SleepRT installed on it. The recorded signals and video are immediately sent to the server. This is useful for doctors who have to look at an ongoing recording: they can check it **live** from their own computer. You can even work from home by using internet access to the SleepRT server.

