Object-Tracker

'LightWatcher' Data Logger

DESCRIPTION

The '**LightWatcher**' data logger is a miniaturized portable data acquisition system that measures and records a unique combination of 11 environmental variables that are important in the study of human performance, of biological rhythms, and of the effect of the environment on biological systems.

Figure 1: 'LightWatcher' data logger

This small device measures and records **illuminance** (Lux), **light irradiance** in 5 spectral bands (UV, Red, Green, Blue, IR), acceleration in 3 axis (**actimeter**) and **temperature**. The measurement of **barometric pressure** and **relative humidity** are available as an option. The optical axis of the data logger points in longitudinal direction. An opaque window from PTFE protects the photo sensors. The data logger measures 20 x 10 x 50 mm and has a weight of only 12 grams.

The data logger is powered by a rechargeable Lithium Polymer battery, which is charged via the USB bus. One battery charge enables a stand-by time of up to 3 months and an operational time of days to weeks, depending on the selected recording rate.

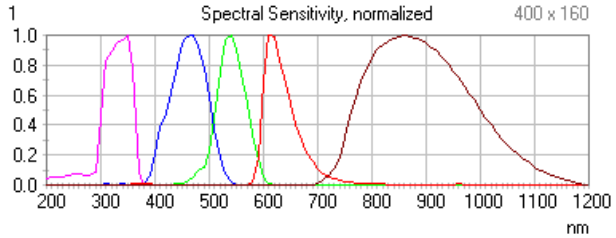


Figure 2: Normalized spectral sensitivity of photodiodes

The sampling and recording rate can be set to a value from 0.5 seconds to 30 minutes. A fast recording rate is available for the acceleration variables. Data are stored in Flash memory. Storage capacity is sufficient to record 1 data record per second for 18 hours, of 1 data record per minute for 6 weeks. Recording is toggled on / off with a single push button (push for 2 seconds). This push button serves also as an **event marker** if pushed for 0.5 seconds. A small LED and a sounder provide feedback to the user.

The device has a USB-2 data interface. Via this interface and a dedicated software program (OT-Sensor), the sensor can be configured for the particular monitoring task, and recorded data can be downloaded to the PC for display, analysis and archiving.

TECHNICAL SPECIFICATIONS

Variable	***Description***
Size	20 mm x 50 mm x 10 mm
Mass	12 grams
Power	Battery or via USB bus, 100 mA max.
Battery	Li-Polymer battery, 3.7 V, 100mAh
Charge time	1.5 hours
Data memory	4 MByte Flash
Recording cap.	64,000 data records
Recording rate	2 samples / sec. to 1 sample / 30 min. 32 samples / sec. for acceleration
Data interface	USB-2
Download time	~ 6 minutes for 64,000 data records
Variables	Illuminance (Lux) Irradiance: IR,R,G,B,UV Acceleration, 3-axis: -4.0 to +4.0 g Temperature: -50 to +80 deg C Barometric Pressure: 0 - 1500 hPa Relative Humidity: 10 to 98 %, optional
Real time clock	+- 10 ppm, +- 10 second/day
Stand-by time	~ 3 month
Anatomical mounts	Eyeglasses, Headset, Badge, Necklace

ACCESSORIES

Four types of anatomical mounts are currently available for studies with human subjects:

The **Eyeglass** anatomical interface is based on eyeglasses with zero diopter plastic glasses (several model available). The data logger is attached to one of the sidebars with double-sided adhesive tape. This mount keeps the optical axis of the data logger well aligned with the principal viewing direction of the subject.

Figure 3: Data logger with Eyeglass mount

The **Headset** anatomical mount is a light-weight mounting platform for the data logger and optional auxiliary devices. The headset is manufactured from stainless steel, has foam rubber padded temporal cushions, and a low weight of 25 grams. The headset guarantees comfort even if worn all day long. It provides good fixation of the sensor relative to the head during typical office work and low to medium impact physical activity, and keeps the optical axis of the data logger well aligned with the principal viewing direction of the subject.

Figure 4: Data logger with Headset mount

The **Badge** magnetic mount provides an easy, comfortable way to wear the data logger like a badge on a shirt or on a working coat. The optical axis of the data logger will point primarily upwards in vertical direction.

Figure 5: Data logger with Badge mount

The **Necklace** mount provides an easy, comfortable way to wear the data logger like a necklace. The optical axis of the data logger will point primarily upwards in vertical direction.

Figure 6: Data logger with Necklace mount

The data logger is supplied in a plastic transport box together with useful accessories such as a dark calibrator, a wall charger, and a USB cable.

Figure 7: Subjects wearing a data logger attached to eyeglass (left), headset (center), neckband (bottom), and armband (bottom). Transport box with accessories (bottom)

SOFTWARE

The sensor is supplied with a license of the **OT-Sensor** software program. OT-Sensor is running under MS-Windows and provides all functions that are necessary to work with the sensor, i.e., sensor configuration, real time data acquisition, data download, data display, data storage, data retrieval, and the creation of reports. Prior to use, the program must be activated with a license key. The user interface of the program is organized in sections.

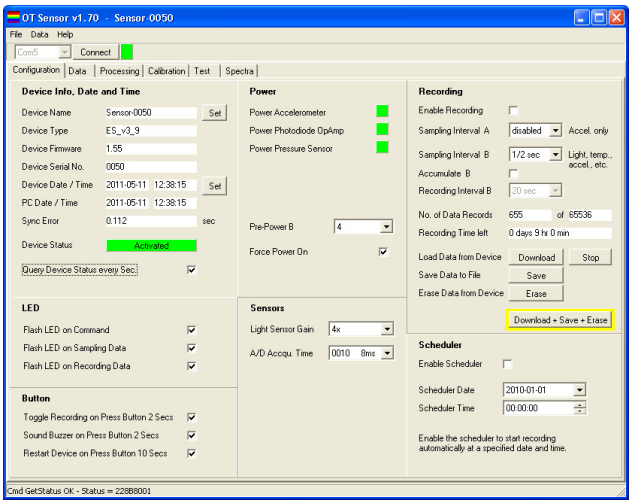


Figure 8: Screen of OT-Sensor program, section 'Configuration'

Section 'Configuration' displays important device properties and provides controls to set key device parameters such as date and time, data sampling and recording rates, and power settings. All configuration settings are stored in the flash memory of the data logger and will be remembered even if the device is not powered. Recorded data may be downloaded from the data logger to the PC, and saved to a file in binary and/or text format. A scheduler is available that can be configured to start data recording at a defined date and time.

Section 'Data' displays acquired data in numerical format and in a graph. The user can select a particular variable from the list of variables (left side) and inspect the time course of the selected variable in an associated graph (right side). The x- and y- axis of the graph can be easily adjusted to the particular requirement of the user. A utility is provided to acquire and display data in real-time.

Section 'Calibration' contains utilities that support the calibration process of the data logger. Calibration coefficients are calculated automatically based on a list of calibration points (i.e., measured value / true value data pairs) that must be provided by the user. All calibration coefficients are stored in the data logger.

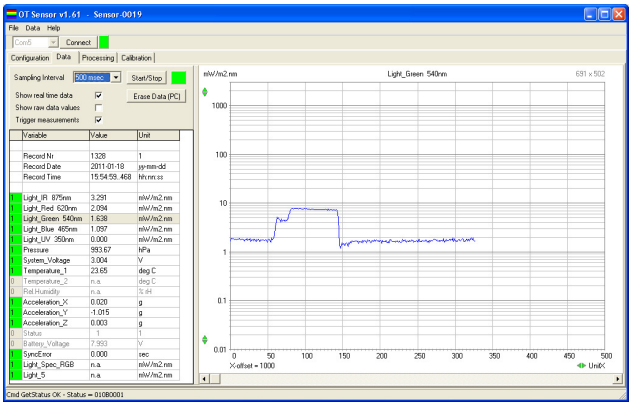


Figure 9: Screen of OT-Sensor program, section 'Data'.

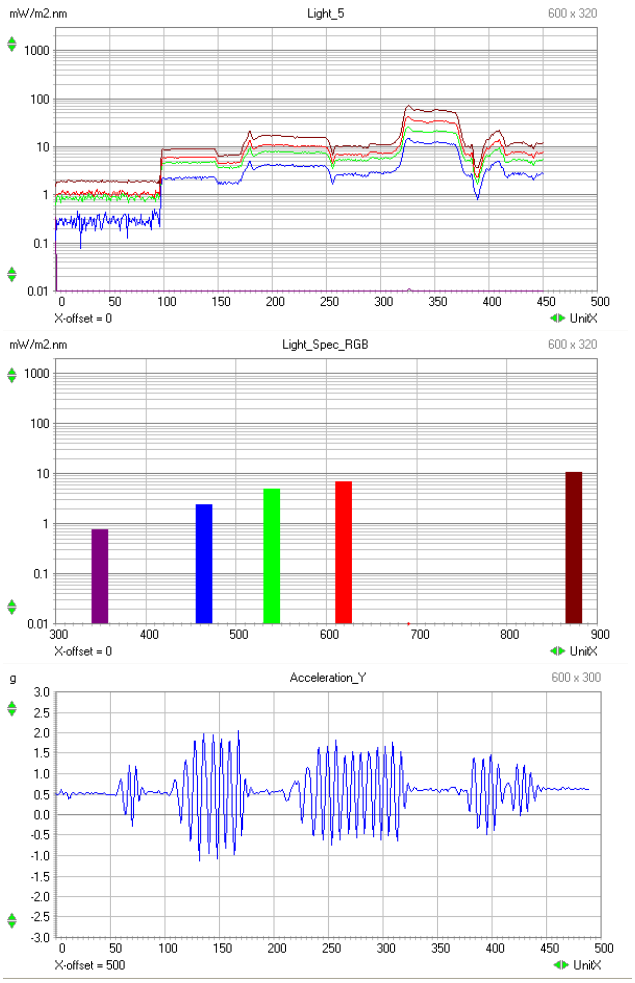
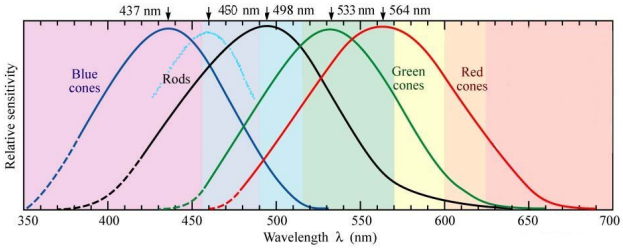


Figure 10: Graph of light irradiance in 5 spectral bands (UV, Blue, Green, Red, IR). Graph of acceleration measurement (bottom).

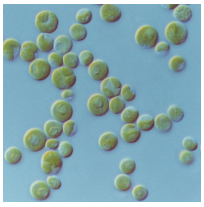
APPLICATION AREAS

Chronobiology research, occupational health: Our data loggers monitor a unique combination of variables that are of key importance in chronobiology research and occupational health related research. Test subjects can comfortably wear our data loggers for periods up to several weeks to collect extensive datasets that contain information on light irradiance, subject activity, and other environmental variables.



Architecture: Modern energy efficient buildings require energy-efficient lighting through an appropriate combination of day lighting and various types of electric light sources. Recent insights into the effect of spectral composition of illumination on circadian rhythm, alertness, cognitive performance and mood suggest to strongly consider the spectral composition of illumination during lighting design. Our data logger measures light irradiance in 5 spectral bands and is therefore an attractive tool to support lighting design in modern buildings.

Space research: Our data loggers monitor a unique combination of variables that are important in many life science and physics experiments. Scientists place our data loggers in experiment containers and transport containers to monitor the specimen / sample and its environment throughout the whole space mission (experimenter's lab --> transport --> launch --> storage --> experiment --> fixation --> storage --> reentry --> transport back). The data logger may also be used to monitor experiments during parabolic flights and inside centrifuges.



Metrology: The environmental data logger has been successfully flown on a stratospheric balloon up to an altitude of 25000 m.

Sports, training assist device: Our data loggers have been applied in various sports disciplines (track running, cross country running, skiing, tennis, glider plane flight, moto-cross) as a training assist device. In a typical setup, several data loggers are attached to body segments and/or sports equipment, and acceleration profiles together with environmental variables are monitored. The analysis of recorded data reveals interesting details of the athlete's patterns of movement (left-right symmetry, change due to fatigue or during recovery from injury, and more), which may support the athlete to improve his/her technique, to avoid injury, to monitor his/her progress during training, and to compare his/her patterns of movement with the ones of other athletes.

CONTACT

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