



Light is wearable  
Health Monitoring and Fitness Tracking

Light is OSRAM

**OSRAM**  
Opto Semiconductors

# Exactly what you need: high efficiency and great diversity

OSRAM Opto Semiconductors offers a great variety of innovative components for modern fitness tracking and health monitoring applications: green and red LEDs, photodiodes and infrared emitting diodes, in different packages, sizes and performance classes. All our sensor products are based on high-efficiency chip technology, ensuring low energy consumption and high signal quality for extremely reliable measurements at the same time. Simply choose the components you need for your special application.

## Ready to go new ways

Along with the “Quantified Self Movement” gaining popularity, there is an increasing interest in medical measurement methods that can be integrated in so-called wearable gadgets such as watches, smart phones or fitness bracelets. It started with fitness trackers determining the step frequency by using acceleration sensors. Now optical sensors expand the possibilities of self-observation, as they also offer a straightforward measurement of the heart rate and oxygen saturation of the blood. In addition, the pulse measurement on the wrist or fingers is much more convenient than, say, wearing a chest strap. Last but not least optical methods score in economic terms as well, as the new technologies for highly efficient LEDs allow for more energy-efficient and compact sensors.



## Sensor Products

### BIOFY® Sensor



Type	SFH 7060	SFH 7070	SFH 7072
Package	Black	White	White
Package dimensions (mm <sup>3</sup> )	7.2 × 2.5 × 0.9	7.5 × 3.9 × 0.9	7.5 × 3.9 × 0.9
Radiant sensitive area (mm <sup>2</sup> )	1.3 × 1.3	1.29 × 2.69	0.89 × 0.89
Photo diode sensitive area (mm <sup>2</sup> )			+ 1.29 × 2.69
Emitter color	Red (655 nm) Green (535 nm) Infrared (940 nm)	Two green (530 nm)	Red (655 nm) Green (530 nm) Infrared (940 nm)

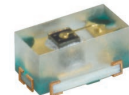
## Discrete Components

### G/R/IR Triple color CHIPLED® for Health Monitoring



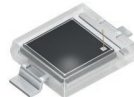
Type	SFH 7013
Package dimensions (mm <sup>3</sup> )	2.5 × 1.6 × 0.55
Forward voltage (V @ 20 mA)	3.0/2.1/1.3
Total optical flux (mW) @ 20 mA	11/12/10
Emitter color	Red (655 nm) Green (530 nm) Infrared (940 nm)

### Single Color LEDs for Health Monitoring



Type	Firefly CT DELSS1.12	PointLED LT PWSG	Firefly CH DELSS1.22	Mini MIDLED SFH 4441	CHIPLED (0402) SFH 4043
Package dimensions (mm <sup>3</sup> )	1.6 × 0.8 × 0.6	3.5 × 1.9 × 0.88	1.6 × 0.8 × 0.6	2.3 × 1.95 × 0.9	1.0 × 0.5 × 0.45
Forward voltage (V @ 20 mA)	3.2	3.2	2	1.3	1.3
Total optical flux (mW) @ 20 mA	1120 ... 2240 mcd	1800 ... 2800 mcd	180 ... 450 mcd	10	10
Emitter Color	True green (530 nm)	True green (528 nm)	Hyper red (660 nm)	Infrared (940 nm)	Infrared (940 nm)

### Photodiodes for Health Monitoring



Type	SMT DIL BPW 34S	SMT DIL SFH 2440	TOPLED® D5140 SFH 2200	TOPLED® D5140 SFH 2201	TOPLED® D5140 SFH 2240
Package dimensions (mm <sup>3</sup> )	6.5 × 3.9 × 1.15	6.5 × 3.9 × 1.15	5.1 × 4.0 × 0.85	5.1 × 4.0 × 0.85	5.1 × 4.0 × 0.85
Radiant sensitive area (mm <sup>2</sup> )	2.65 × 2.65	2.65 × 2.65	2.65 × 2.65	2.85 × 2.85	2.65 × 2.65
Capacitance (pF)	72	135	60	65	135
Spectral range (nm)	400 ... 1100	400 ... 690 (IR Filter)	300 ... 1100	300 ... 1100	400 ... 690 (IR Filter)

# How it works: heart rate monitoring and pulse oximetry

Optical sensors for the measurement of the heart rate and the oxygen saturation of the blood make use of the light absorption in the blood, more specifically of the hemoglobin contained in the blood.



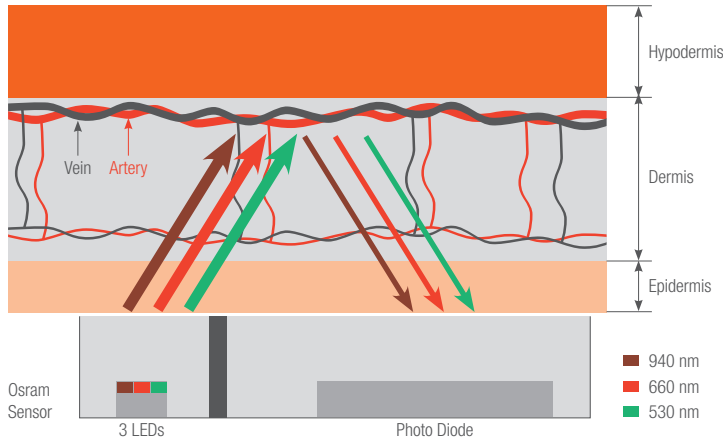
## Heart rate monitoring

Light strikes the body tissue, and then is transmitted, absorbed and reflected (figure 1) – the larger the irradiated blood volume, the lower the amount of light reflected. As the blood volume in the arteries changes with the cardiac cycle, the heart rate results from the periodicity of the detector signal (figure 2). This optical measurement of the change of blood volume in the blood vessels is referred to as photoplethysmography (PPG). In practice, the sensor consisting of juxtaposed light source and detector is located directly on the skin, usually on the wrist or fingers. Due to the location the measurement is made at different wavelengths – green light has established itself as the best option for the wrist, red and infrared light for the finger.

## Pulse oximetry

The oxygen saturation of the blood can be measured when infrared and red light are used at the same time (figure 3). This so-called pulse oximetry is based on the fact that hemoglobin (Hb) is changing its absorption behavior when it binds oxygen (oxyhemoglobin  $\text{HbO}_2$ ). The concentrations of these two variants of hemoglobin can be determined by measuring the absorption at two different wavelengths. This yields the oxygen saturation of the blood. Red (660 nm) and infrared (940 nm) light are the ideal choice, because here the absorption behavior of the two hemoglobin molecules deviates most from each other. In contrast to the pulse measurement, which is only considering the relative changes in light absorption, the light absorption of arterial blood must be measured in absolute terms here. In practice, the blood oxygen saturation can be expressed as a function of the ratio of the minimum and maximum detector signals ( $I_{\min}/I_{\max}$ ) at the respective wavelength.

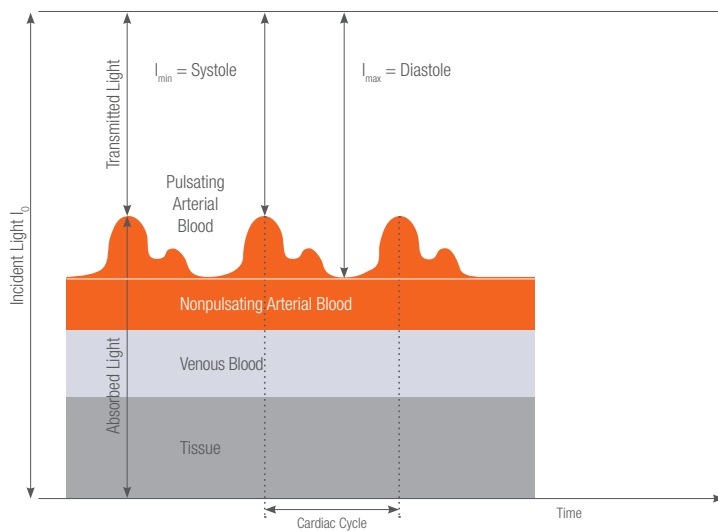
### Optical measurement of biometric data



**Figure 1**

The sensor is emitting green, red or infrared light, which irradiates skin or tissue and is absorbed or reflected. The amount of the reflected light registered by the detector varies with the amount of blood in the arteries (photoplethysmography). The measurement is carried out with green light on the wrist, with red or infrared wavelengths at the finger.

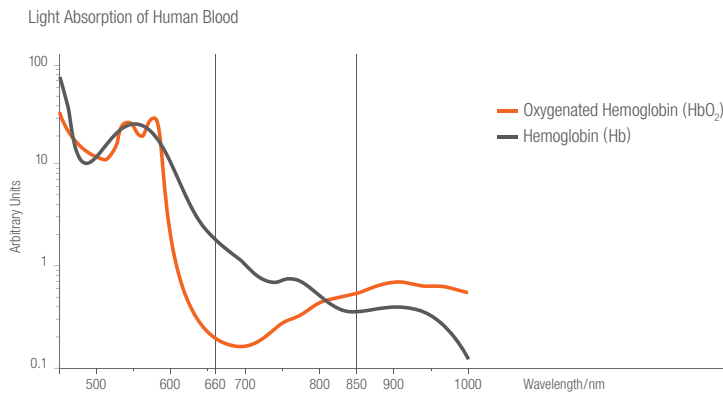
### Measurement of the heart rate



**Figure 2**

The periodicity of the detector signal  $I_+$  corresponds to the pulsation of the amount of blood in the arteries. The ratio of the minimum and maximum signal values ( $I_{min}/I_{max}$ ) is relevant for the determination of the oxygen saturation of the blood (pulse oximetry).

### Determination of the oxygen saturation of the blood



**Figure 3**

The absorption behavior of blood – or more precisely of the blood pigment hemoglobin (Hb) – changes at oxygen uptake (oxyhemoglobin or  $HbO_2$ ). By measuring the absorption of red and infrared light, the oxygen saturation of the blood can be determined.

**Asia**

OSRAM Opto Semiconductors  
(China) Co.,Ltd.  
28/F Harbour Ring Plaza  
No. 18 Xi Zang Middle Road  
Shanghai 200001  
P.R. China  
Phone: +86 21 5385-2669  
Fax: +86 21 5385-2868  
E-mail: prasia@osram-os.com

**Europe**

OSRAM Opto Semiconductors GmbH  
Leibnizstraße 4  
D-93055 Regensburg, Germany  
Phone: +49 941 850 1700  
Fax: +49 941 850 3302  
E-mail: support@osram-os.com

**USA**

OSRAM Opto Semiconductors Inc.  
1150 Kifer Road, Suite 100  
Sunnyvale, CA 94086, USA  
Main Phone number: (408) 962-3700  
Main Fax: (408) 738-9120  
Inbound Toll Free: (866) 993-5211  
E-mail: info@osram-os.com

**OSRAM**  
Opto Semiconductors