

# Monitor vital signs with optical sensing

Photoplethysmography sensor technology and algorithms for sports, health, and medical applications

Pulse rate  
89 BPM

Blood pressure  
119/81 mmHg

SpO<sub>2</sub>  
97%

Energy expenditure  
149 kcal

# Accelerate your time to market with CSEM's high-quality PPG technology



CSEM is a leader in photoplethysmography (PPG), a non-invasive optical technique that measures changes in blood volume. PPG can be used to monitor important vital signs, such as pulse rate, blood pressure, and oxygen saturation, for sports, health, or medical applications. We offer a complete technology solution, from designing sensors that capture high-quality PPG signals to developing algorithms that estimate the physiological parameters. We can help you design, integrate, and manufacture devices based on PPG sensors.

## Opto-inertial sensor integration

The quality of the PPG signal depends on the integration of the optical sensor. To achieve high-quality signals and accurate physiological estimates (pulse rate, blood pressure,  $\text{SpO}_2$ ), we can support you throughout the design, integration, and manufacturing process of your device, including:

- Choosing the best optical and electronic components
- Providing electronic PPG reference design
- Offering guidance and guidelines for optomechanical design
- Developing PPG analogue front end (AFE) drivers
- Implementing algorithms to estimate the main vital signs
- Support during certification and clinical validation

## Algorithm licensing for consumer health wearables and medical devices

CSEM's PPG algorithm portfolio for wearable or medical devices includes:

Algorithm	Description
AFE driver	Driver to control the PPG AFE and system functionalities (e.g., worn detection)
Breathing rate	Number of breaths per minute
Cardiac arrhythmia	Classification of various cardiac arrhythmias (e.g., atrial fibrillation, abnormal beats)
Pulse rate variability	Variation in the time intervals between pulse beats (e.g., SDNN, RMSSD, HF, LF)
Human kinetics	Activity, cadence, energy expenditure, gesture, speed, steps, swim, traveled distance, $\text{VO}_2/\text{VO}_2$ max, workout
Interbeat interval	Time interval between two consecutive heartbeats
Optical blood pressure	Trends of systolic, mean, and diastolic blood pressure (occlusion-free)
Pulse rate	Number of pulses per minute
Sleep	Sleep-related indicators and classification of sleep stages
$\text{SpO}_2$	Arterial oxygen saturation and perfusion measured with a pulse oximeter
Stress level	Autonomous nervous system balance (sympathetic vs parasympathetic)

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