

# FNIRS Explorer

## Data Sheet

FNIRS-EXP-30102019

### SPECIFICATIONS

- > **Integrated Sensors:** quad-LED-fNIRS<sup>1</sup> sensor, triaxial accelerometer (ACC)
- > **Sampling Rate (fNIRS):** up to 50Hz
- > **Sampling Rate (ACC):** up to 800Hz
- > **Resolution (fNIRS):** 16-bit (per channel)
- > **Resolution (ACC):** 14-bit (per channel)
- > **Auxiliary Ports:** none
- > **Emitter-Detector Distance:** 20mm
- > **Inclination:** LEDs positioned at a 45° angle<sup>2</sup>
- > **Internal Memory:** 16GB internal memory (storage of up to 222h of acquisition data)
- > **Battery:** 800mA 3.7V LiPo rechargeable (~50h in streaming; ~80h in logging)<sup>3</sup>
- > **Charging:** Inductive (Qi)<sup>4</sup>
- > **Infrared emitter\***
  - >Peak emission: 860nm
  - >Half intensity beam angle: ±13 deg
  - >Spectral bandwidth: 30nm
  - >Radiant intensity: 750mW/sr
- > **Red emitter\***
  - >Peak emission: 660nm
  - >Half intensity beam angle: ±18 deg
  - >Spectral bandwidth: 25nm
  - >Power output: 7mW
- > **Detector\***
  - >Wavelength of max sensitivity: 850nm
  - >Range of sensitivity: 400nm-1100nm
  - >Radiant sensitive area: 7.0 (mm<sup>2</sup>)
  - >Dimension of radiant sensitive area: 2.65mm x 2.65mm
- > **Infrared/Red emitter**
  - >Duty cycle: 12.5%
- > **Resolution:** 16bit

\* Parameters provided for T<sub>A</sub> = 25°C. For additional parameters please contact [plux@plux.info](mailto:plux@plux.info)

### FEATURES

- > Adjustable current for each LED using the API

<sup>1</sup> consisting of two pairs of infrared LED, red LED and detector

<sup>2</sup> see page 5 for better visualization of the PCB configuration

<sup>3</sup> estimations based on fNIRS intensities set to 80 and 40 (of 0...255) for red LED and IR LED respectively and 50Hz sampling frequency

<sup>4</sup> can be charged with any Qi certified inductive charging platform

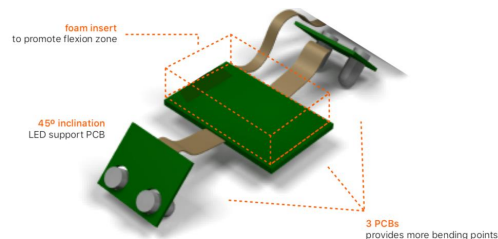


Fig. 1. fNIRS acquisition unit PCB design with 3 PCBs to provide more bending points enabling curved form factor.

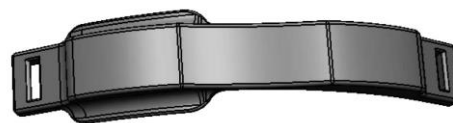


Fig. 2. fNIRS acquisition unit front (3D rendered).

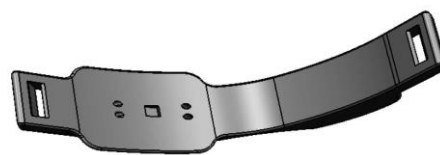


Fig. 3. fNIRS acquisition unit back (3D rendered).

**biosignalsplux**  
wearable body sensing platform

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REV A

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- > Pre-conditioned digital output
- > High signal-to-noise ratio
- > Ready-to-use form factor

## APPLICATIONS

- > Oximetry
- > Heart rate & heart rate variability
- > Life sciences studies
- > Biomedical research
- > Human-Computer Interaction

## USAGE NOTES

- > Should be placed on the center of the forehead for accurate readings

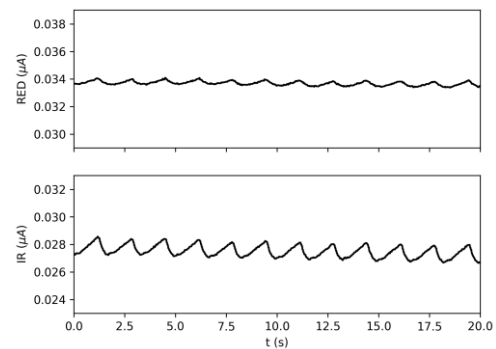


Fig. 4. Typical raw data of reflected red light (top) and infrared light (bottom).

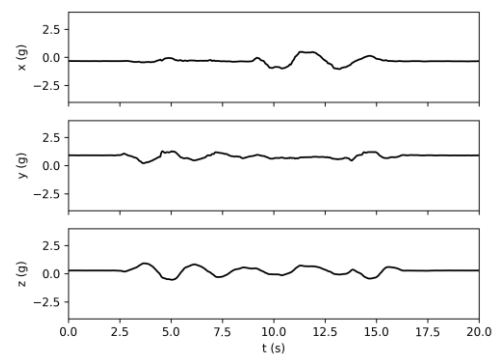


Fig. 5. Typical raw accelerometer data.

## GENERAL DESCRIPTION

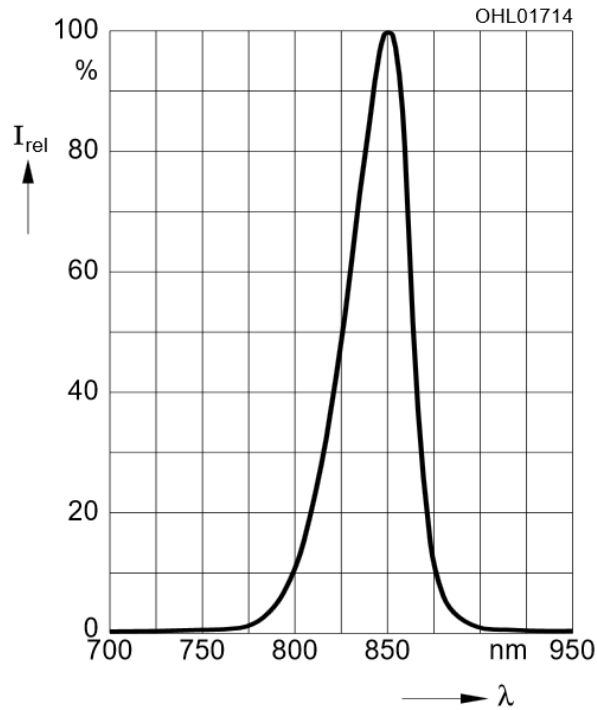
The fNIRS (functional near-infrared spectroscopy) sensor uses pairs of two emitting LED's one in the red region and the other in the infrared region of the spectrum. The reflected light of each one of these LED's is absorbed by a photodiode and then this current is converted into a digital value. This acquisition with two pairs of two emitting LEDs and detector can be used to estimate the local oxygen saturation level in the blood to derive information about the activity of the perfused tissue, for example, to measure and track activity of a specific brain region by measuring variations in oxygen saturation levels. Additionally, this sensor can be used to extract heart rate data.

The integrated triaxial accelerometer allows acquisitions of basic motion data to track head movements during fNIRS acquisitions. This system comes with an integrated rechargeable battery that can be recharged with any Qi certified charger and with internal memory to store acquired sensor data locally without the need for a constant Bluetooth connection and data streaming.

## OPTICAL CHARACTERISTICS

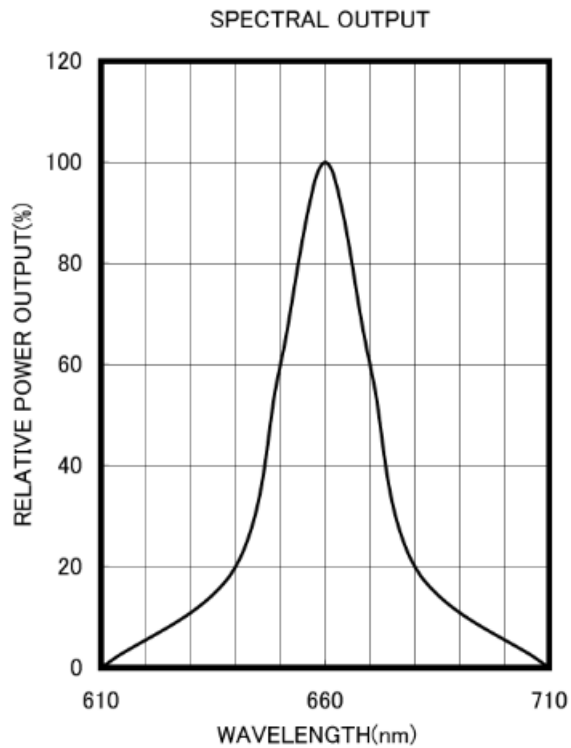
### Infrared emitter relative spectral emission

$I_{rel}=f(\lambda)$ ,  $T_A=25^\circ\text{C}$ ,  $I_F=20\text{mA}$



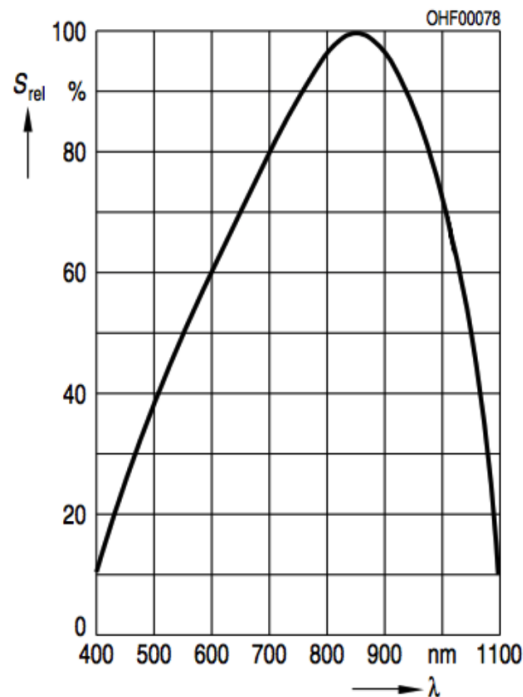
### Red emitter relative spectral emission

$I_{rel}=f(\lambda)$ ,  $T_A=25^\circ\text{C}$ ,  $I_F=20\text{mA}$



## Detector relative spectral sensitivity

$S_{rel}=f(\lambda)$ ,  $T_A=25^{\circ}\text{C}$



## TRANSFER FUNCTION FNIRS

[ $0\mu\text{A}$ ,  $0.15\mu\text{A}$ ]

$$\text{Current}(\mu\text{A}) = \frac{0.15 * \text{ADC}}{2^n}$$

$\text{Current}(\mu\text{A})$  – Photodiode current in microamperes ( $\mu\text{A}$ )

$\text{ADC}$  – Value sampled from the channel

$n$  – Number of bits of the channel<sup>5</sup>

## TRANSFER FUNCTION ACCELEROMETER

[-4G, 4G]

$$\text{ACC}(g) = \left( \text{ADC} - \frac{2^n}{2} \right) * \frac{8}{2^n}$$

$\text{ACC}(g)$  – Accelerometer value in  $g$

$\text{ADC}$  – Value sampled from the channel

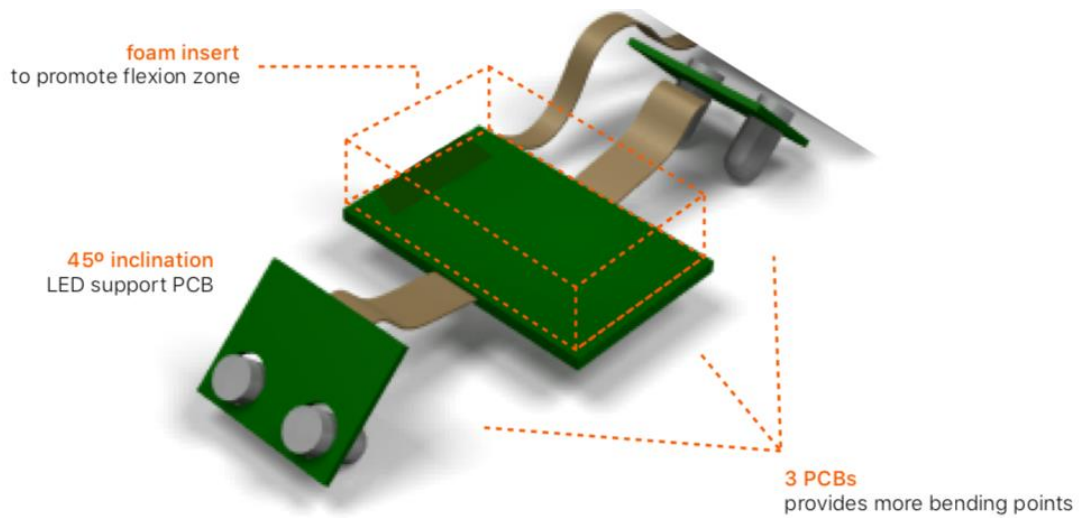
$n$  – Number of bits of the channel<sup>6</sup>

## PHYSICAL CHARACTERISTICS

<sup>5</sup> The number of bits for each channel depends on the resolution of the Analog-to-Digital Converter (ADC); in biosignalsplux the default is 16-bit resolution ( $n = 16$ ), although 8-bit ( $n = 8$ ) may also be found.

<sup>6</sup> The number of bits for each channel depends on the resolution of the Analog-to-Digital Converter (ADC); in biosignalsplux the default is 16-bit resolution ( $n = 16$ ), although 8-bit ( $n = 8$ ) may also be found.

> Red and infrared emitters angle with horizontal plane: 45°



## **OTHER NOTES**

This sensor has been developed in cooperation with the R&D company Charles River Analytics to provide a new miniaturized fNIRS sensor allowing acquisitions of high-quality data in brain activity-tracking applications.

## **ORDERING GUIDE**

Reference	Package Description
SENSADV-FNIRS18	Functional near-infrared spectroscopy sensor (fNIRS) acquisition unit with internal triaxial accelerometer, internal memory and inductive charging capabilities.