



Empatica E4

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E4 is the wearable device for researchers that need access to real-world physiological data.

E4 enables you to take your research outside of the lab offering continuous data for ambulatory recording in a comfortable and compact wearable form. Research participants can contribute physiological measures from the comfort of their home while you can monitor 24/7 data through a secure cloud portal.

Key features

- The only wearable to combine EDA and PPG sensors in the same compact device.
- Download raw data in text format for processing in your preferred analytic environment.
- Access the secure Connect Platform for data management and visualization.
- High resolution Electrodermal Activity (skin conductance) data for measuring sympathetic activation / autonomic stress.
- Heart Rate and Inter-Beat-Interval data for parasympathetic activation and fitness.
- Access critical contextual data from peripheral body temperature and acceleration based activity information.
- Real time data access via a customizable platform with APIs for application development on iOS and Android.

Battery life

Streaming Mode: 20+hrs
Memory mode: 36+ hrs

Data Management

Flash memory



Bluetooth LE (Smart)



Form Factor

Small and comfortable
Case: 44 mm x 40 mm, height 16 mm
Weight: 25 gr



Certification

CE certification
FCC certification

Sensors



Photoplethysmography (PPG)
Continuous Heart Rate (HRV, Stress, Relaxation)



3-axis Accelerometer
Movement, Activity



Temperature + Heat flux
Activity, Context info



Electrodermal Activity (EDA)
Skin Conductance (Arousal, Excitement)



Operating modes

RECORDING MODE (indicated by a **red** light). In recording mode signals are temporarily stored in the E4's memory. The E4 has a memory capacity exceeding 48 hours of continuous data.

STREAMING MODE (indicated by a **blue** light). In streaming mode, signals are transferred live over a Bluetooth Low Energy (BLE) / Bluetooth Smart connection to a partner device for real-time visualization, recording and/or analysis. Streaming connections can be established using Empatica applications or via Empatica APIs from supported iOS and Android mobile devices.



More information

Setup and Documentation - <http://www.empatica.com/setup/>

Frequently Asked Questions - www.empatica.com/faq.html

Developer Documentation - www.empatica.com/docs

Sample data - www.empatica.com/demo/demo.php

Sample data is from predicate E3 device

E4 Sensors

- PPG (from which Heart Rate and Inter-Beat-Interval signals are derived)
- EDA (Skin Conductance)
- Optical Temperature
- 3- axis accelerometer

Photoplethysmography sensors (PPG)

- Sampling frequency 64 Hz. (Non customizable)
- LEDs operation wavelengths: Green (2 Leds), Red (2 Leds)
- Photodiodes: 2 units, total 14 mm² sensitive area
- Sensor output
 - Difference of light between oxygenated and non oxygenated peaks
 - Sensor output resolution 0,9 nW / Digit
- Motion artefact removal algorithm
 - Combines different light wavelengths
- Tolerates any external lighting condition
- Available from Connect as CSV file or through the API

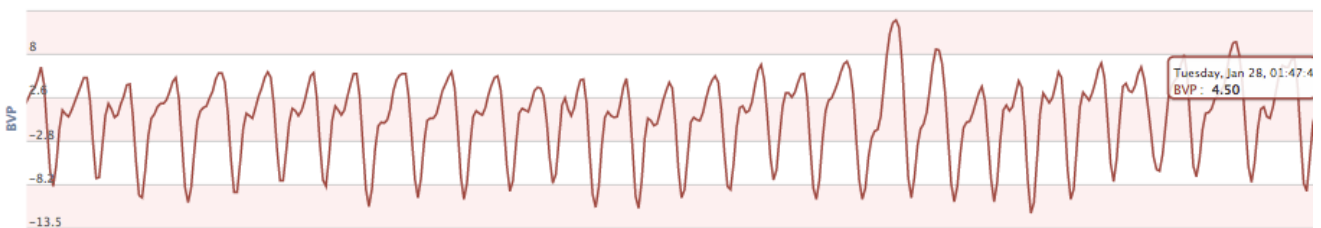


Figure 1: Example of PPG Signal

Inter beat interval (sec), Heart rate (BPM)

- Sampling frequency: n/a, provided as time-IBI pair
- Unit: seconds
- Resolution: 1/64 sec
- Typical use: designed for accurate recording of resting heart-rate during everyday scenarios. HR data estimated from the PPG sensor is not suitable for running or physical activity.
- IBI detection algorithm strategy is optimised for accurate IBI quantification
 - Non-prototypical beats are discarded
 - IBI sequence is not smoothed
- Available from Connect as CSV file or through the API

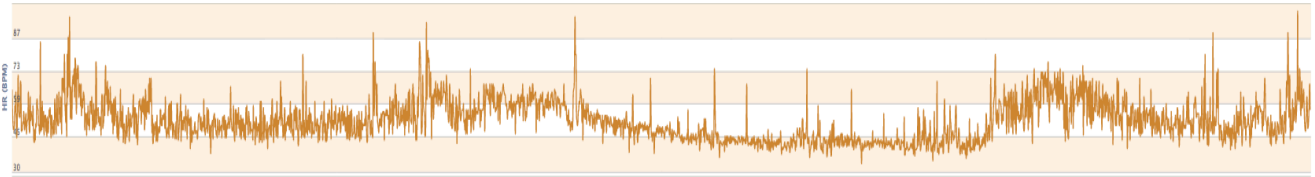


Figure 2: Example of HR Signal

Electrodermal activity (EDA)

- Sampling frequency: 4 Hz (Non customizable)
- Resolution: 1 digit ~900 pico Siemens
- Range: 0,01microSiemens - 100 microSiemens
- Electrode placement: bottom wrist
- Electrodes:
 - Placement on the ventral (inner) wrist
 - Replaceable (screw in desing)
 - Silver (Ag) plated with ABS core
 - Alternating current (8Hz frequency) with a maximum peak to peak value of 100microAmps (at 100microSiemes)
 - Electrode longevity: 4 - 6 months
- Available from Connect as CSV file of through the API
- EDA Operating range: Relative humidity 60 +/- 25% H.R.

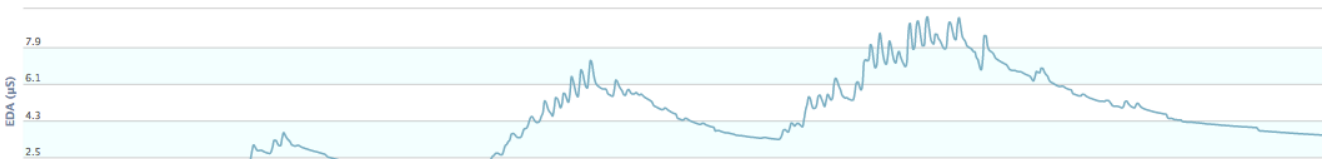
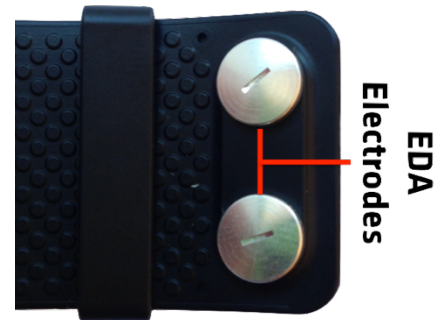
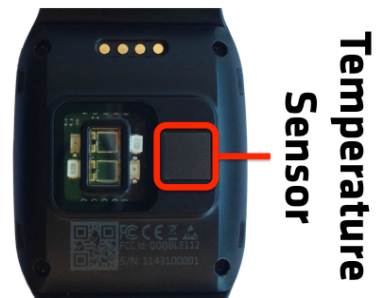


Figure 3: Example of EDA Signal

Temperature signal

- Sampling frequency: 4 Hz (Non customizable)
- Operation mode: Infrared thermopile
- Range:
 - -40...85°C for ambient temperature (if available)
 - -40...115°C for skin temperature
- Resolution: 0,02°C
- Accuracy +/-0,2°C within 36...39°C
- Available from Connect as CSV file of through the API



Ambient temperature available only in custom firmware releases

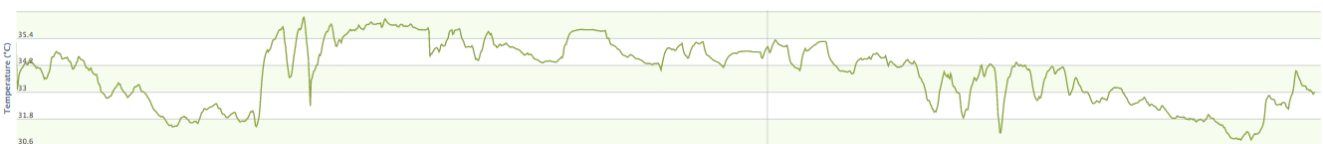


Figure 4: Example of a skin temperature recording



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3-axes acceleration signal

- Sampling frequency: 32 Hz (Non customizable)
- Number of axes: #3, X,Y and Z
- Range:
 - Default range $\pm 2g$
 - Ranges of $\pm 4g$ or $\pm 8g$ are selectable with custom firmware
- Resolution: 8 bit of the selected range
- Available from Connect as CSV file or through the API.

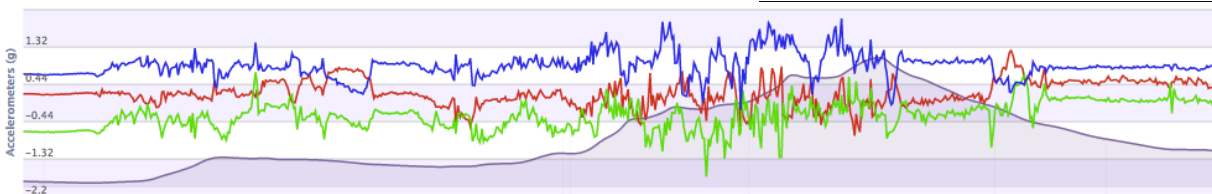


Figure 5: Example of X, Y, Z and acceleration signals

Additional Specifications

Battery

- Power supply:
 - Custom charging cradle with standard Micro USB connection USB port, 5V, 250mAh minimum supply
 - Lithium battery, 3.7V, 260 mAh capacity
- Charging time: <2 hours
- Battery Life in recording mode: >36 hours
- Battery Life in streaming mode: >20 hours

Weight

- 25 grams

Hardware Operating Conditions

- Relative humidity: 0-100% H.R.
- Admitted air pressure: 100KPa \div 35Kpa

Water Resistance

- TBD after final testing

E4 Size	mm	inches
Max band circumference	190	7.48
Min band circumference	110	4.33
E4 Case length	44	1.73
E4 Case width	40	1.57
E4 Case height	16	0.63

Charger Size	mm	inches
length	45	1.77
width	44	1.73
height	12	0.47

