PulseOn OHR Tracker (SP-2D-W) data sheet

Version 1.7
19 June, 2018

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1 PulseOn OHR Tracker device overview

1.1 Mission

PulseOn OHR Tracker, white label, ODM, device is for customers looking for a private label solution for their own services, applications, research and data collection purposes. PulseOn OHR tracker enables fast time to market and easy integration to existing solutions through open interfaces, API and example application.
The device is *Bluetooth®* enabled and designed for a wide range of use cases. Easy variant creation and co-branding is possible.

1.2 Key benefits

For B2B customers:

- Scientifically validated and accurate optical HR, beat-to-beat HR and activity data which works reliably on a wide range of users
- Exposed raw data
- Fast entry to market with a ready HW and API, example application solution
- Long autonomy (battery life time) enables various use cases
- Fast integration to customer's application or service with API or with open Bluetooth HR profile
- Simple usage minimizes need for end-user technical support
- Possibility for own design and branding
- Bluetooth low energy support

For end-users:

- Reliable all day activity and HR monitoring
- Up to 4-5 days usage time in sampled mode
- Very simple to use: no need to operate UI, only recharging and wearing required
- Automatic data transfer to application or service
- Several use cases enabled by a single device: HR, activity, etc.
- Minimalistic yet stylish design
- Common micro-USB cable/port for charging

1.3 Product communication and features

The product has three ways of transmitting information: open BLE HR profile, proprietary BLE API and physical display.

The open Bluetooth Heart Rate profile can be used directly with a 3rd party application or service as an option to replace the need for a HR chest strap. When HR measurement is started, HR and beat-to-beat HR are streamed over the HR service every second.

The proprietary BLE API provides full functionality for continuous HR and activity tracking. Raw data can be stored for up to 10 hours and other data for over 2 weeks. The data is synchronized with a service or application when connected.

The device display shows real-time HR and accumulated data on the screen.

Data available from the device.

Data element	Description	HR profile	Display	BLE API
HR	HR	x	x	x
HRQI	HR quality index for evaluating data reliability			x
HRV / IBI	Beat-to-beat interval	x		x
SQE	IBI quality index for evaluating data reliability			x
Raw data	Accelerometer, PPG sensor			x
Steps	Accumulated steps		x	x
	Accumulated steps separated for walking, running and biking.			x
Calories	Energy expenditure estimation based on activity data		x	x
Workout detection	Automatic detection of workout			x
Activity class	Accelerometer based information on the activity class including running, walking, other, rest			x

Table 1.

1.4 Key drivers and priorities

The device is mainly aimed as data collector for applications and services. The key drivers for the product are:

Key drivers	Criteria
Accurate HR and HRV measurement	On par or better than best competitor product on the market
Raw data collection	Enables collection of accelerometer and PPG sensor data
Simple and reliable to use	Beta testing satisfaction on intuitive ease of use and reliability. Minimal or no instructions needed. Reliable connectivity and operation – connectivity problems rare or non-existent with common Android devices.
Long battery life	30 hours minimum in continuous HR and HRV measurement, target 4-5 days in sampled mode
Well balanced small product suitable for various use cases	Customer acceptance and feedback
Easy variant creation	Lead customer acceptance and feedback
Watertight	IP 68 as target, IP 67 minimum

Table 2.

2 Use cases

This section shows the primary supported use cases from end-user point of view. In some cases the main implementation is on the third party service or application side but it does impact also the wristband implementation.

2.1 Continuous activity tracking use cases

Continuous activity tracking	Wristband	Third party

Daily activity		
Heart rate	x	x
Total calories burned	x	x
Total steps	x	x
Activity pattern		x
Activity history		
Activity data available in different time scales		x
Total energy consumption available in different time scales		x

Table 3.

2.2 Sport training use cases

Sport training	Wristband	Third party
Manual event start/stop	x	x
HR during event	x	x
Steps during event	x	x
Training time	x	x
Calories burned during event		x
Max and min HR during event		x

Table 4.

2.3 General use cases

General use cases	Wristband	Third party
Pair with app/service through API	x	x
Low battery warning and charging indicator	x	
Easy charging, no device specific cable needed	x	
Automatic sync of stored data with application/service when connected	x	x
Firmware update through app/service	x	x
Hardware reset option in case of an unrecoverable error	x	
Adjustable replaceable strap (size and design variants)	x	

Table 5.

3 Functionality

3.1 Usage modes and mode control

Reference design includes the following usage modes. These modes can be controlled and partly customized by a third party service/app over the BLE API.

Usage mode	Description
Continuous HR	Continuous HR and activity tracking based on green PPG. Mainly intended to be used during sports.
Sampled HR	Sampled HR and continuous activity tracking during daily life. Sampling interval configurable over the API.
Activity	Continuous activity tracking during daily life. No HR is measured.
Proximity	Only tracks whether the device is worn or not. Intended to detect when device is put back on hand.
Idle	No tracking, minimum power consumption.

Factory testing mode	Factory testing for the three sensors (PPG, ACC, PROX) built in into the firmware itself.
Shipping mode	Very deep sleep while shipping.
Firmware update	Special mode used transmitting and applying the firmware update.

Table 6.

3.2 Data storage and sync functionality

HR and activity based data is continuously tracked when worn and stored to a flash memory for later upload. Exact parameters of the collected data (such as selected data, HR interval etc.) are set via API from the application. The device data storage can fit data from over 2 weeks. The data synchronization can be initiated automatically by the app/service without the need for user interaction on the device side.

3.3 Real time data streaming

HR profile is used to stream real-time data (HR and HRV) from the device. All the stored data from the device memory is transferred though Object Transfer Service. The real-time data is also available thought the Heart Rate Data Characteristic and Activity Data Characteristic inside the PulseOn proprietary Device Control Service.

3.4 Bluetooth interface for apps/services

PulseOn device implements several Bluetooth GATT services to enable communication between the device and customer's service. The BLE API is described in section 3.6.

The API includes services for the following:

- Controlling of the usage mode and mode related settings
- Setting user information (age, height, weight, gender) to the device
- Setting time for the device
- Transferring data from device to service from the device memory
- Getting general device information, including device name, firmware version and battery level
- Updating device firmware

3.5 Android device API library and example application

PulseOn provides a device API library and an example application that uses the library for Android platform. They both are delivered as one Gradle project that can be imported to e.g. Android Studio for customers to use in their development. The project includes the documentation in a Javadoc format.

The device library Includes services for communicating with the device over the BLE API, storing the received data into a native database and exporting it into csv files.

3.6 Device communication

3.6.1 Overview

PulseOn supports seven Bluetooth LE services. Five of these, Heart Rate Measurement-, Device Information-, Battery-, Current Time-, and the Object Transfer Service are GATT-services adopted by the Bluetooth consortium. The sixth is the Device Firmware Update Service provided by Nordic Semiconductor. The seventh is a PulseOn proprietary Device Control Service designed for the functionality of our library.

3.6.2 Heart Rate Measurement Service

The Heart Rate Measurement Service is described on the bluetooth.org website. PulseOn supports the optional RR-interval value but not Energy Expended.

3.6.3 Device Information Service

The Device Information Service is described on the bluetooth.org website.

3.6.4 Battery Service

The Battery Service is described on the bluetooth.org website.

3.6.5 Current Time Service

The Current Time Service is described on the bluetooth.org website.

3.6.6 Object Transfer Service

The Object Transfer Service is described on the bluetooth.org website. Note: Object Transfer Service is not standard as it doesn't support the L2CAP Connection Oriented Channel for data streaming but uses a custom GATT characteristic to stream the data as notifications instead. L2CAP is planned for implementation later.

The data is differentially encoded, compressed with Rice algorithm and stored into ~4KB objects. The PulseOn device API library for Android reads the objects over the OTS, compares the checksum, deletes the object from the device, decodes and decompresses the data and stores it into an externally accessible SQLite database.

3.6.7 Device Firmware Update Service

The Device Firmware Update Service is provided by Nordic Semiconductor and documented on the website.

3.6.8 PulseOn proprietary Device Control Service

The service UUID is **feca57d0-7aee-fbbd-a144-3c695a4baaeb.**

3.6.8.1 Service characteristics

The Device Control Service Contains six characteristics as shown in Table 7.

Characteristic	Description	Properties
Operational Parameters	UUID: **feca57d6-7aee-fbbd-a144-3c695a4baaeb** Defines the basic configuration of the library, including whether to measure heart rate continuously or periodically	Read, Write, and Notify
Operational Settings	UUID: **feca57d7-7aee-fbbd-a144-3c695a4baaeb** Some static properties of the library, for example whether distance estimation is enabled.	Read Only
User- and Device Data	UUID: **feca57d8-7aee-fbbd-a144-3c695a4baaeb** User data, such as age and gender, and device data, such as time and date	Read and Write

Activity Data	UUID: **feca57d9-7aee-fbbd-a144-3c695a4baaeb** Activity data, such as activity type (walking, running...)	Read and Notify
Heart Rate Data	UUID: **feca57da-7aee-fbbd-a144-3c695a4baaeb** Data related to heart rate, such as heart rate in beats-per-minute (BPM) and heart rate quality (a confidence estimate)	Read and Notify
PPG Data	UUID: **feca57db-7aee-fbbd-a144-3c695a4baaeb** Single channel reduced resolution PPG data to provide interface for drawing the live data	Read and Notify

Table 7. The characteristics in the Device Control Service

The maximum characteristic size is 20 bytes. Each characteristic contains fields grouped according to the type of its contents. All characteristics have Read access. The client can write to Operational Parameters and User- and Device data. The notify property applies to Operational Parameters and Activity- and HR Data. The Operational Settings are Read Only, and their values are static and never change.

3.6.8.2 Operational Parameters Characteristic

The Operational Parameters Characteristic holds 11 fields as shown in Table 8. The fields create a continuous BitField so individual bits placed in the same byte.

Field	Description	Values	Data type
Operating Mode Changed	Status flag that indicates whether the operating mode has changed	Yes or No	1 bit
Operating Mode	The active operating mode	Described in 3.6.8.4	3 bits
Analysis Set	The active analysis sets	Described in 3.6.8.5	Uint8 (mask)
Raw Data	The active types of raw data being transmitted	Described in 3.6.8.6	Uint8 (mask)
Activity Data Interval	The interval between activity data updates	Milliseconds	Uint16
HR Data Interval	The interval between heart rate data updates	Milliseconds	Uint16
HR Sampling Interval	The interval between the start of consecutive heart rate measurements in sampled mode	Seconds	Uint16
HR Sampling Duration	If not zero makes the heart rate measurement initiated by a button press to	Seconds	Uint16

	run for the specified duration		
HR Max Seeking Duration	The maximum duration of a heart rate measurement in sampled mode	Milliseconds	Uint16
Workout Detection	Flag used to enable and disable the automatic workout detection (not implemented yet)	On or Off	1 bit
Reset Accumulated Data	Flag that when set causes the library to reset accumulated values to zero	On or Off	1 bit

Table 8. The fields in the Operational Parameters Characteristic

The client must never modify the Operating Mode Changed status flag. It can write to all other fields.

3.6.8.3 Operating Mode Changed

The Operating Mode Changed status flag can be set by the server either when the client requests the change or when the device changes the operating mode without interaction with the client. The latter happens for example when a workout is started manually by the user pressing a button. The Operating Mode Changed status flag is the only field in the Operational Parameters Characteristic that can cause a Notify message. The flag must never be modified by the client.

3.6.8.4 Operating Mode

The Operating Mode determines how the device works at the most fundamental level. There are eight operating modes.

Value	Name	Description
0x00	**Powerdown**	No sensors are active and no processing takes place.
0x01	**Activity**	Processes accelerometer data and calculates the results contained in the Activity Data Characteristic
0x02	**HwTesting**	A special mode that runs tests on the sensor hardware.
0x03	**Proximity_only**	Calculates the worn state only. Other sensors and processing are switched off. Intended for use when the user is not wearing the device.
0x04	**Sampled_Hr**	Takes one heart rate measurement at regular intervals, by default every 5 minutes. Activity Data is calculated continuously.
0x05	**Continuous_Hr**	Measures heart rate continuously. Intended for use when the user is exercising. Activity Data is calculated continuously.
0x06	**Firmware_update**	A special mode that allows flashing of a new firmware image. The device restarts into DFU mode.
0x07	**Auto**	The device chooses between Activity and Sampled_HR modes, depending on whether the device is worn on hand or not.

Table 9. The fields in the Operational Settings Characteristic

3.6.8.5 Analysis Set

The Analysis Set determines which results are calculated and which notifications are sent. The 8bit length analysis set field value can be a combination (bitwise-or) of the following values:

Value	Name	Description
0x00	**None**	No analysis
0x01	**HR**	Results are calculated for HR and HR quality in the Heart Rate Data Characteristic
0x02	**RAW**	Report RAW data (see table 11)
0x04	**Activity**	Results are calculated for activity related parameters.
0x10	**RESERVED**	Reserved for future use
0x20	**Sleeping**	Sleeping analysis. Sleep results can only be enabled if the Sleep Detection flag is set in the Operational Settings Characteristic. (not implemented yet)
0x40	**HRV (heart rate variability)**	Results are calculated for IBI (inter-beat-Intervals), IBI Quality and SQE (signal quality estimation for IBI).

Table 10. The fields in the Operational Settings Characteristic

The results reported depend on both the analysis set and the operating mode. For example, if the operating mode is Activity then no heart rate statistics is available regardless of the active analysis sets because heart rate is not measured in the Activity mode.

3.6.8.6 Raw Data

The Raw Data determines which types of raw sensor data is stored and sent.

Value	Name	Description
0x00	**None**	Disables raw data collection
0x01	**Acc**	Accelerometer samples in triples at 25 Hz
0x02	**Acc_PPG**	Accelerometer samples in triples and 2 PPG samples for LED and ambient phases at 25 Hz.
0x04	**Prox**	Raw proximity data (not implemented yet)
0x08	**AFE**	Raw optical bio-sensing analogue fronted (AFE) data (not implemented yet)
0x10	**ADL**	IBI data stored at each detected heart beat

Table 11. The fields in the Operational Settings Characteristic

3.6.8.7 Activity- and HR Data Interval

The Activity Data Interval and the HR Data Interval specify the time between consecutive notifications sent for the Activity Data Characteristic and Heart Rate Characteristic respectively. They also affect the rate at which data is stored to the device memory. The data is logged based on the smallest value set to Activity Data Interval and HR Data Interval fields. Whenever the set interval has passed, the software checks if any data has changed and logs it only in in case of changes. By default, the interval is 1 second.

3.6.8.8 HR Sampling Interval and HR Max Seeking Duration

HR Sampling Interval and HR Max Seeking Duration are used in Operating Mode Sampled Hr. If for example we want to measure the user's heart rate every five minutes then HR Sampling Interval is 300. HR Max

Seeking Duration is the maximum time the optical heart rate measurement is allowed to take. If a valid heart rate has not been found after the HR Max Seeking Duration, the measurement is stopped. If a valid heart rate is found before then the measurement is stopped immediately.

3.6.8.9 Workout Detection

The Workout Detection flag can be enabled or disabled by the client. When it is disabled, the Workout State in the Activity Data Characteristic never changes.

3.6.8.10 Reset Accumulated Data

When the Reset Accumulated Data flag is set by the client, the Steps, Distance, and kCalories in the Activity Data Characteristic are set to zero, and the Reset Accumulated Data flag is cleared.

3.6.9 Operational Settings Characteristic

The Operational Settings Characteristic is shown in Table 12.

Fields	Description	Values	Data type
RESERVED		0	6 bits

Table 12. The fields in the Operational Settings Characteristic

The Operational Settings are static properties of the device. This characteristic is not implemented yet.

3.6.10 User- and Device Data Characteristic

The User- and Device Data Characteristic holds 6 fields as shown in Table 13. The fields create a continuous BitField so individual bits placed in the same byte.

Fields	Description	Values	Data type
Age	User age in years	1-115	Uint8
Weight	User weight in kg	30-200	Uint8
Height	User height in millimeters	1200-3000	Uint16
Gender	User gender	Male (0) or Female (1)	1 bit
Time and Date	Not used	Not used (zero)	Uint32
Turn Off Screen During Workout	Indicates whether the screen should be on all the time when a workout is active (not implemented yet)	Yes (1) or No (0)	1 bit

Table 13. The fields in the User- and Device Data Characteristic

3.6.10.1 Age, Weight, Height, and Gender

The client must set the user data to values in the ranges given in Table 5, otherwise they won't be updated internally in the device. If the values are not set, the following default values are used: Age 30, Weight 78, Height 1754, Gender Male.

3.6.10.2 Time and Screen

The current time is not used now, and the screen turn off functionality is not implemented yet.

3.6.11 Activity Data Characteristic

The Activity Data Characteristic holds 14 fields as shown in Table 14. The fields create a continuous BitField so individual bits placed in the same byte.

Fields	Description	Values	Data type

RESERVED		0	4 bits
Workout Status Changed	Flag to indicate whether the workout status has changed	Yes or No	1 bit
Worn Status Changed	Flag to indicate whether the worn status has changed	Yes or No	1 bit
Activity data changed	Flag to indicate whether the activity data	Yes or No	1 bit
Rolling Counter	Counter that is incremented by one every time the characteristic is updated	Integer	Uint32
kCalories	Energy Expenditure in kCalories since last reset of accumulated data	Energy Expenditure in kCalories	Uint24
Speed	Instantaneous speed in hundreds of meters per hour	Integer	Uint16
Steps	Number of steps since last reset of accumulated data	Integer	Uint24
Distance	Distance in meters since last reset of accumulated data	Integer	Uint24
Activity Type	The physical activity type	Described in 3.6.11.6	4 bits
Workout State	Indicates whether the user is in a workout or not	Yes or No	1 bit
Worn State	Indicates whether the user is wearing the device or not	Yes or No	1 bit

Table 14. The fields in the Activity Data Characteristic

3.6.11.1 RESERVED

Reserved

3.6.11.2 Workout- and Worn Status Changed

The Workout Status Changed flag is set when a workout is started or stopped. The automatic workout detection requires five minutes of vigorous exercise to detect the start of a workout and three minutes of less strenuous physical activity to detect the end of a workout. For example, if the workout flag is set at ten minutes and cleared at 30 minutes then in reality the workout started at five minutes and ended at 27 minutes.

The Worn Status Changed flag indicates the user has just started wearing the device or has just stopped wearing the device.

3.6.11.3 Activity Data Changed

The Activity Data Changed flag is set when one or more of the values of kCalories, Speed, Steps, Distance, and Activity Type has changed.

3.6.11.4 Rolling Counter

The Rolling Counter is incremented by one every time some data in the Activity Data Characteristic is updated.

3.6.11.5 kCalories, Speed, Steps, Distance

The four fields contain quantitative data about the user's physical activity. **Speed** is an instantaneous value whereas **kCalories**, **Steps**, and **Distance** are accumulated values.

3.6.11.6 Activity type

An instantaneous value, described the type of the physical activity. Possible values of the type of the activity can be seen in the following table:

Name	Value
REST	0x00
OTHER	0x01
WALKING	0x02
RUNNING	0x03
BIKING	0x04
OTHER_RYTHMIC	0x05
SLEEPING_UNDETERMINED	0x06
SLEEPING_LIGHT	0x07
SLEEPING_DEEP	0x08

Table 15. Possible values of the type of activity in Activity data characteristic

3.6.11.7 Worn- and Workout State

Worn State indicates whether the user is wearing the device or not and Workout State indicates whether the user is in a workout or not.

3.6.12 Heart Rate Data Characteristic

The Heart Rate Data Characteristic holds 8 fields as shown in Table 16. The fields create a continuous BitField so individual bits placed in the same byte.

Fields	Description	Values	Data type
Rolling Counter	Counter that is incremented by one every time the characteristic is updated	Integer	Uint32
HR Reliable	Flag set when a reliable heart rate is found	Yes or No	1 bit
HR at Timeout	Flag set when timeout in a sampled mode measurement is reached	Yes or No	1 bit
New IBI Data	Flag set if new IBI data is available	Yes or No	1 bit
HR	Heart rate in beats per minute	Integer	Uint8
HR Quality	Confidence estimate in percent	0-100	Uint8

RESERVED			Uint16
RESERVED			Uint8

Table 16. The fields in the Heart Rate Characteristic

3.6.12.1 Rolling Counter

The Rolling Counter is incremented by one every time some data in the Heart Rate Data Characteristic is updated.

3.6.12.2 HR Reliable

The HR Reliable flag is set when a valid heart rate is found in the Operating Mode Sampled_Hr. The flag is cleared at the beginning of the next measurement

3.6.12.3 HR At Timeout

The HR At Timeout flag is set if a heart rate measurement in Operating Mode Sampled_Hr is stopped after HR Max Seeking Period as specified in the Operational Parameters Characteristics has expired.

3.6.12.4 HR and HR Quality

The HR and HR Quality fields contain the results of the latest heart rate measurement regardless of the Operating Mode and the time the measurement was made. The HR value given by this characteristic is equal to the Heart Rate Measurement service's (described in section **3.6.2**) HR value at all time.

3.6.12.5 RESERVED

Reserved.

3.6.13 PPG Data Characteristic

The PPG Data Characteristic is used for demonstrational purposes to plot the real-time PPG signal. To reduce the BLE traffic, it contains down sampled PPG data which should not be used for analysis purposes. The PPG Data Characteristic holds one field, contains 5 single channel, 16bit PPG data, and timestamps attached to them. The PPG data downshifted from 20 bits to 16 and down sampled by a factory of 3.

Fields	Description	Values	Data type
ppg_array	Array of 5 PPG data	5 x ReducedPPGData	ReducedPPGData

The ReducedPPGData structure looks like as the following table shows:

Fields	Description	Values	Data type
timestamp	Timestamp of the data (milliseconds)	Integer	UInt16
ppg	Single channel PPG data	Integer	UInt16

3.7 Device usage times

Target usage time is 4-5 days in Sampled HR mode and 30 hours in Continuous HR mode.

3.8 OTA firmware update

OTA firmware update from the third party service or application is supported.

3.9 User interface

Reference design includes a device application logic / UI. The UI elements are based on:

- One button for device control
- Display
- Vibration motor

Details of UI can be found in a separate document (*Maxim reference design display UI.pptx*).

4 Mechanical design

4.1 Industrial design drivers

Main drivers for industrial design are:

- Aimed for continuous use and measures HR also during exercise
- Physical shape well suited for continuous HR measurement
- Size and shape suitable for both men and women
- Modern and good looking
- Easy and logical variant creation
- Changeable strap

A preliminary design is shown in the picture below, subject to slight modifications for final design.

4.2 Display information

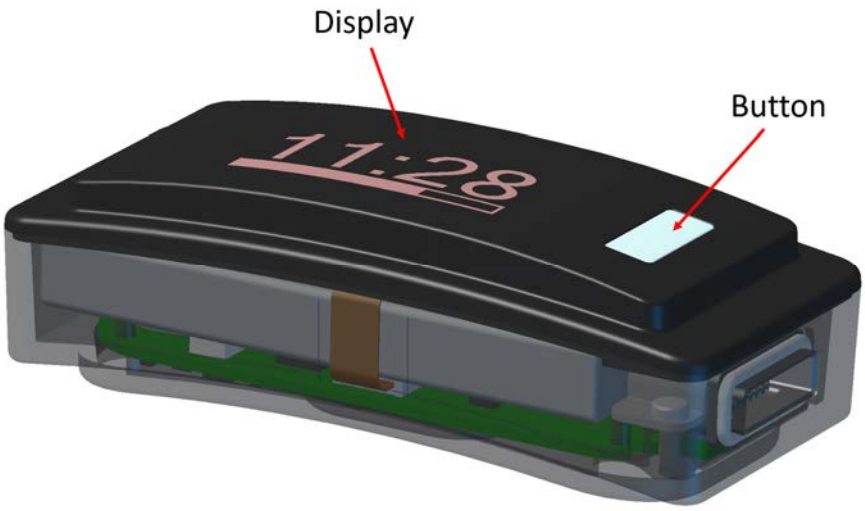
Reference design integrates a mono color OLED display that allows instant information to be seen from the device.

Display details	
Resolution	96 x 24 px
Pixel Pitch	0.188 x 0,191 mm
Active Area	18,024 x 4,560 mm
Glass Size	22,30 x 9,00 mm
Colour of Illumination	White
Gray Scale	2
Luminance	450 cd/m²
Drive Method	Passive Matrix
Mass	0,49 g

Table 16.

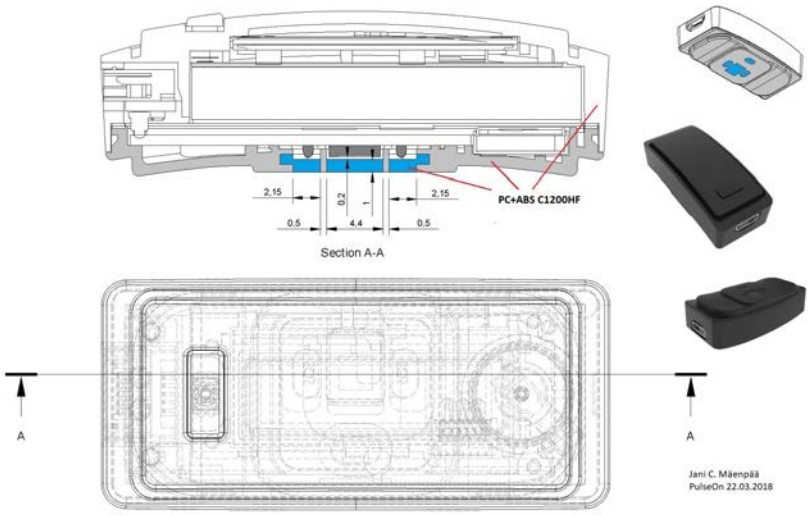
4.3 Physical UI

Device has two main components for the physical UI, the display and one button. In addition, the UI is enhanced with a vibration motor.



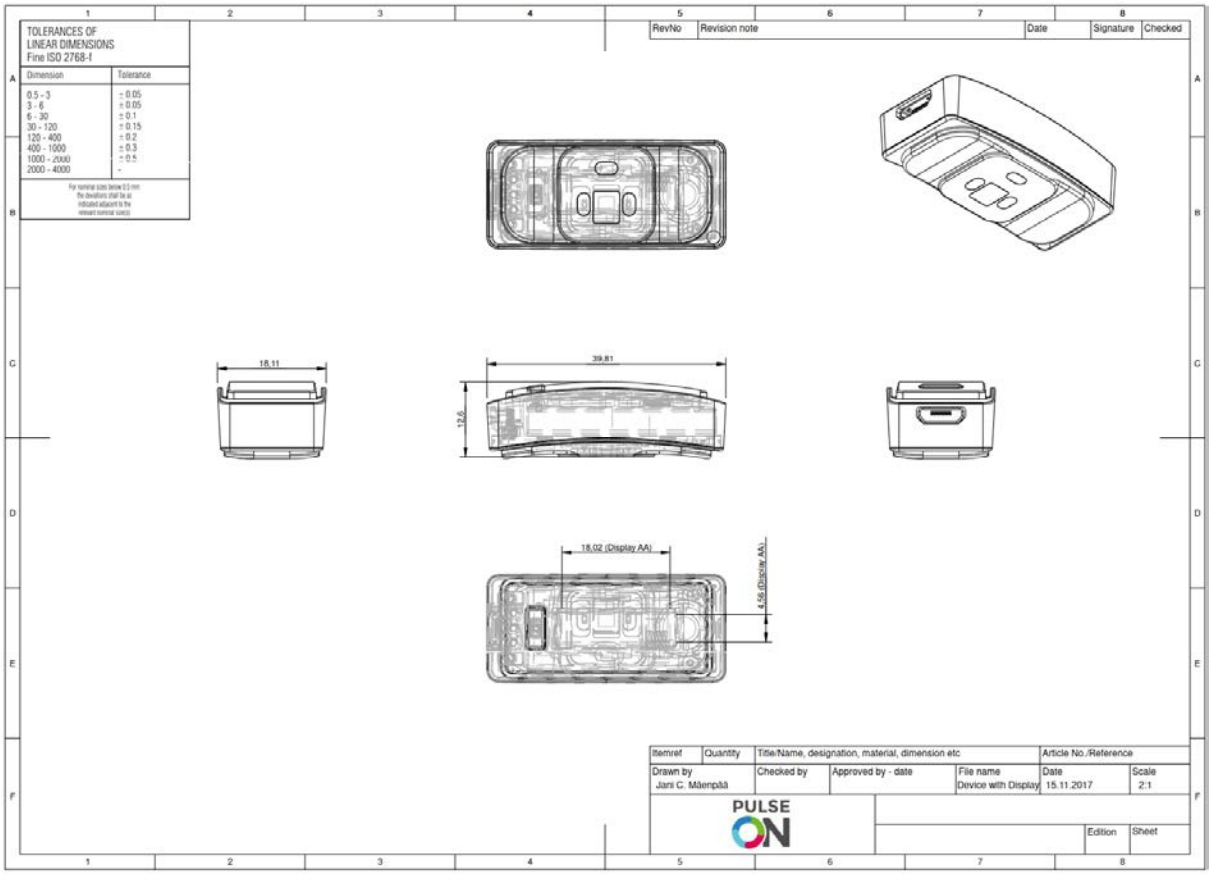
4.4 Structure and material

Structure and materials of the device are presented below. Strap material and its possible silicon treatment can be modified based on customer requirements. Lenses are clear PC+ABS.

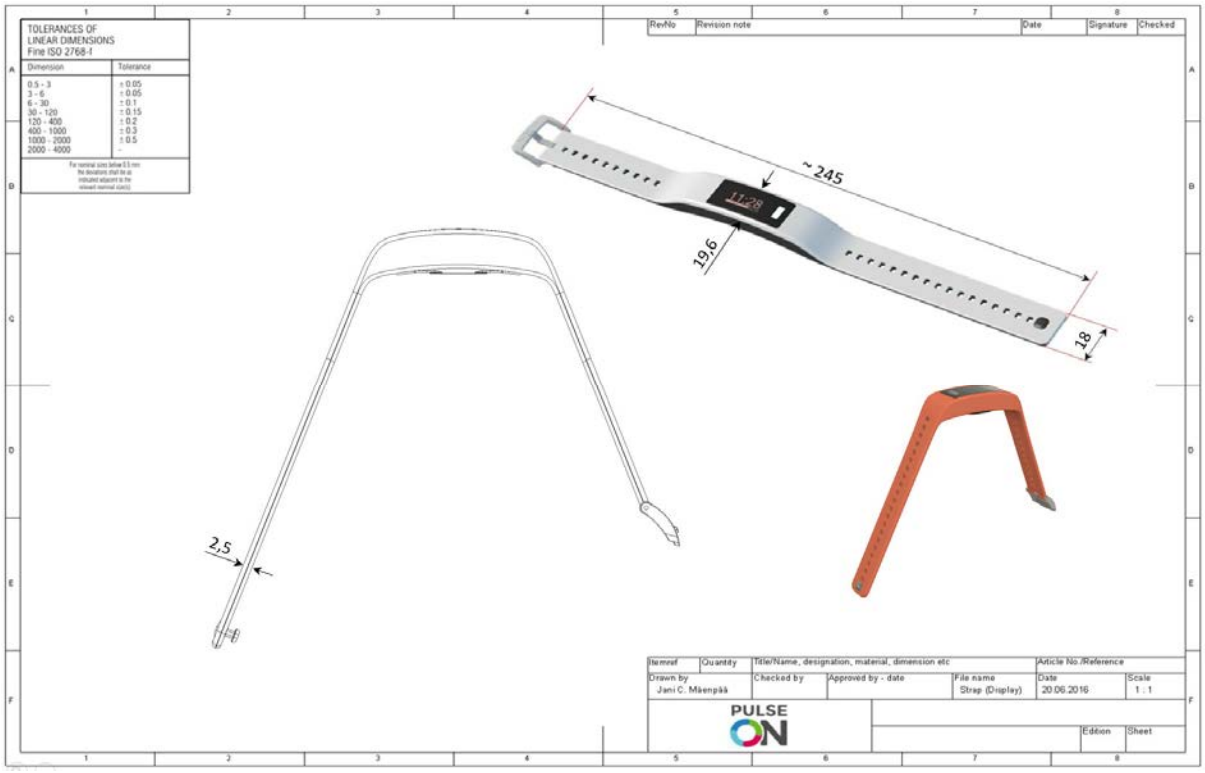


4.5 Physical dimensions

The size of the device module is shown on the picture below. The device is watertight (IP68 targeted, IP67 minimum).

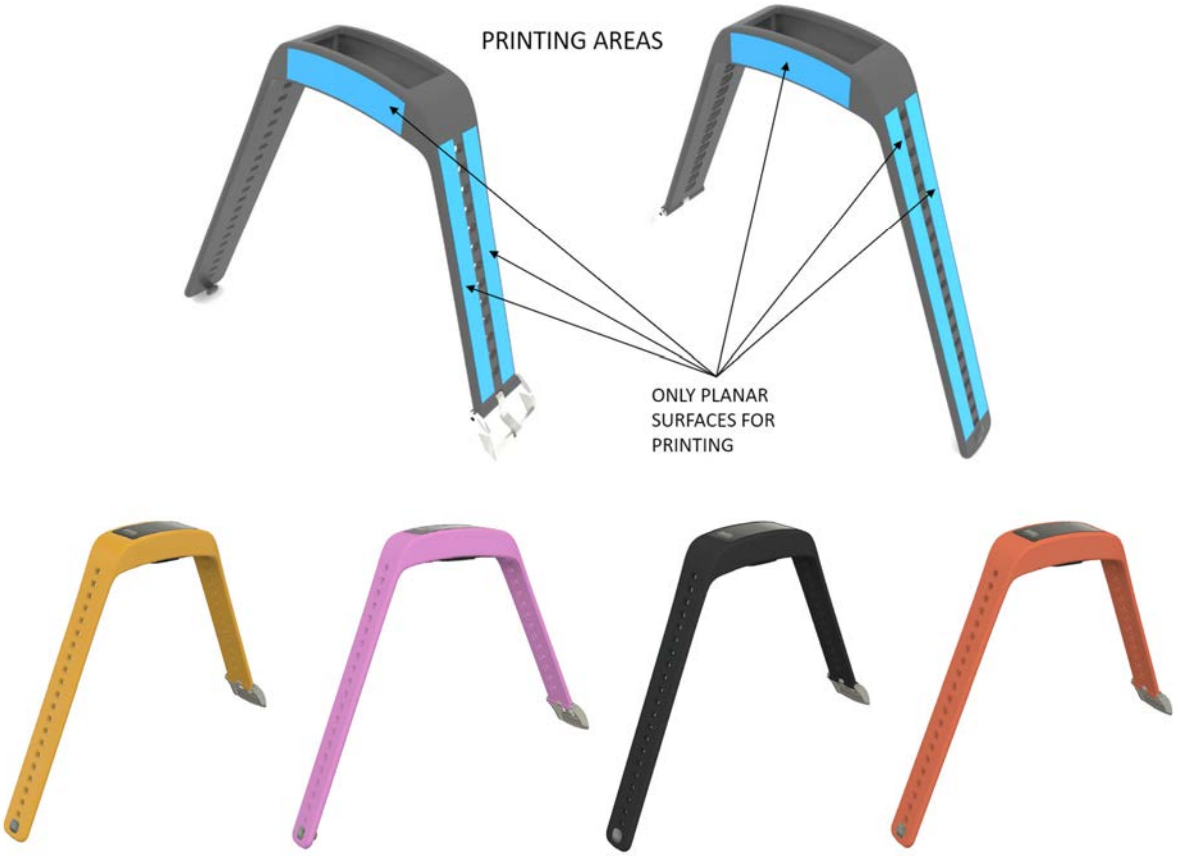


The product is designed to have three strap lengths. On the picture below are the dimensions for medium (M) size strap with total length of 245 mm (small 195 mm and large 275 mm). Dimensions can be modified based on customer needs.



4.6 Customer variant creation options

The easiest way to create variants for B2B customer is by changing the strap (shape, colors, buckle, logo).



Possible design variants:

- Strap design
- Strap materials
- Strap colors (2 colors maximum in one strap)
- Print logos on the strap
- Buckle (additional cost if not standard)

5 Electronics design.

5.1 Electronics design drivers

Main drivers for electronics are:

- Low power consumption
- High performance
- Easy to use – single button UI with simple low cost display
- CM4 core
- Small size

5.2 Open source components

- FreeRTOS

http://www.freertos.org/index.html

License: modified GNU General Public License

- micro-eec

https://github.com/kmackay/micro-ecc

License: BSD 2-clause

- Nordic SDK

https://www.nordicsemi.com/eng/Products/Bluetooth-low-energy/nRF5-SDK

License:
Multiple http://developer.nordicsemi.com/nRF5_SDK/nRF5_SDK_v12.x.x/doc/12.3.0/licenses.html

- BluetoothLeGatt

https://github.com/googlesamples/android-BluetoothLeGatt

License: Apache License Version 2.0

- Android Open Source Project

http://www.apache.org/licenses/LICENSE-2.0

License: Apache License Version 2.0