

Data Sheet

PulseOn OHR Module P-OHR1F

Version 0.95

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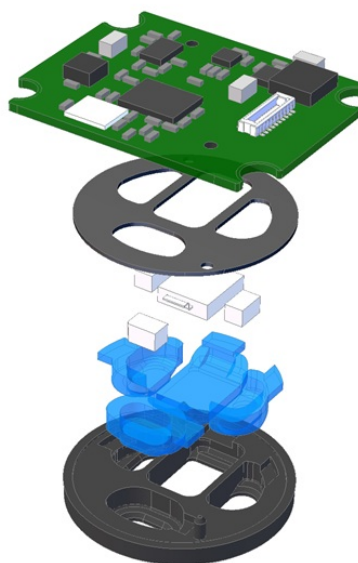


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1 Key Benefits and Features

- PulseOn patented and proprietary optical sensor design including opto-mechanical design, optics, ambient light protection and optical shielding, signal acquisition and MCU for integrated signal pre-conditioning, ambient light cancellation, movement cancellation, heart rate detection algorithms, and heart rate analytics (optional)
- Market's most accurate and reliable continuous optical heart rate, up to beat-to-beat accuracy comparable to ECG based heart rate variability
- Embedded algorithms for heart rate and heart rate variability extraction, and movement classification (steps, activity class, speed, distance)
- Sensors:
 - Optical HR (green + IR)
 - 3D accelerometer
 - Proximity sensor for low power and reliable off-hand detection
- Different modes provide optimal total power consumption from 3mW to 17mW
- Supported interface: SPI
- Supply voltages:
 - $V_{idg} = 1,8V$ (1.65V – 2.0V)
 - V_{bat} = Direct battery voltage connection (2,7V – 5,5V)
- Temperatures:
 - Operation: -20 - +55C
 - Storage: -40 - +85C



2 Usage modes

Mode name	Description	Available data	Sensor settings	Power consumption
Idle	No activity	N/A	Sensors OFF	N/A
On demand	Continuous activity tracking, HR on demand (intermittent value)	Steps (running, walking) Activity class (running, walking, other, rest, sleep) Speed and distance (inertia based) Heart rate (intermittent) Wrist detection	OHRM off, switched on for ~1m when demanded to read intermittent HR, 3D accelerometer on	<1-15mW
Sports	Continuous HR- and activity tracking during exercise	Steps Activity class Heart rate Speed and distance (inertia based) Wrist detection Energy consumption (kcal)* Oxygen consumption (%VO ₂ max)* Training effect* VO ₂ max (if speed available)*	Continuous OHRM, automatic optical channel selection, 3D accelerometer on	15mW
Sampled	Periodic HR measurements and continuous activity tracking during daily life	Steps Activity class Heart rate Speed and distance (inertia based) Wrist detection Energy consumption (kcal) ¹ Oxygen consumption (%VO ₂ max) ²	OHRM sampled with determined sampling ratio, automatic optical channel selection, 3D accelerometer on	3-15mW

Mode name	Description	Available data	Sensor settings	Power consumption
Sleep*	Continuous HR- and activity tracking during sleep	Steps Activity class Heart rate Wrist detection Energy consumption (kcal)* Oxygen consumption (%VO ₂ max) ³	Continuous OHRM, automatic optical channel selection, 3D accelerometer on	5-9mW
Firmware update	Special mode used for firmware update	Update status	Sensors OFF	N/A

* Not yet available

2.1 Mode descriptions

Only a single usage mode at a time is active and the module output depends on the usage mode. The module does not keep the absolute time and it supplies instead free-running timestamps. Accumulated values, such as energy expenditure and distance, can be reset by the host sending the message RESET_ACCU_DATA (see Section [Inbound Message IDs](#)).

2.1.1 On demand mode

In on demand mode device is tracking only 3D accelerometer signal and OHRM is turned off by default. When requested by the host, OHRM is turned on for as long as necessary in order to measure one reliable HR value or as long as requested for multiple values.

This mode is targeted to be enabled 24/7. Key targets:

- Continuous activity tracking
 - Low-power accelerometer tracking and processing
 - Activity data send every 1s by default (the host can set the interval or switch off activity messages if necessary)
- HR tracking on demand
 - HR is demanded by host and the result is sent as soon as a reliable HR is found
 - HR max, min, and mean value stored with timestamp
- Wrist detection

2.1.2 Sports mode

In sports mode⁴ device is tracking HR during sports for maximum accuracy and reliability. Firstbeat ETE library⁵ is used to calculate energy consumption, oxygen consumption, and

training effect. Key targets:

- Maximum HR reliability during sports
- Continuous HR tracking
 - HR data is sent every 3 seconds by default (the host can set the interval or switch off HR messages if necessary)
- Continuous Activity tracking
 - Activity data is sent every 1 second by default (the host can set the interval or switch off activity messages if necessary)
- Dynamic optical channel selection
- Wrist detection

2.1.3 Sampled mode

In sampled mode, HR is measured periodically (once every 60 seconds by default). Accelerometer related parameters are tracked continuously. Key targets:

- HR is provided to the host every 60 seconds by default (the interval between consecutive measurement can be set by the host)
- Continuous activity tracking as in on demand mode and sports mode.
- Sampled mode

2.1.4 Sleep mode

In sleep mode, HR- and activity are tracked continuously . Key targets:

- Continuous HR tracking during sleep for the purpose of calculating HR Variability
- Dynamic optical channel selection
- Wrist detection
- Currently not yet available

2.1.5 Firmware update mode

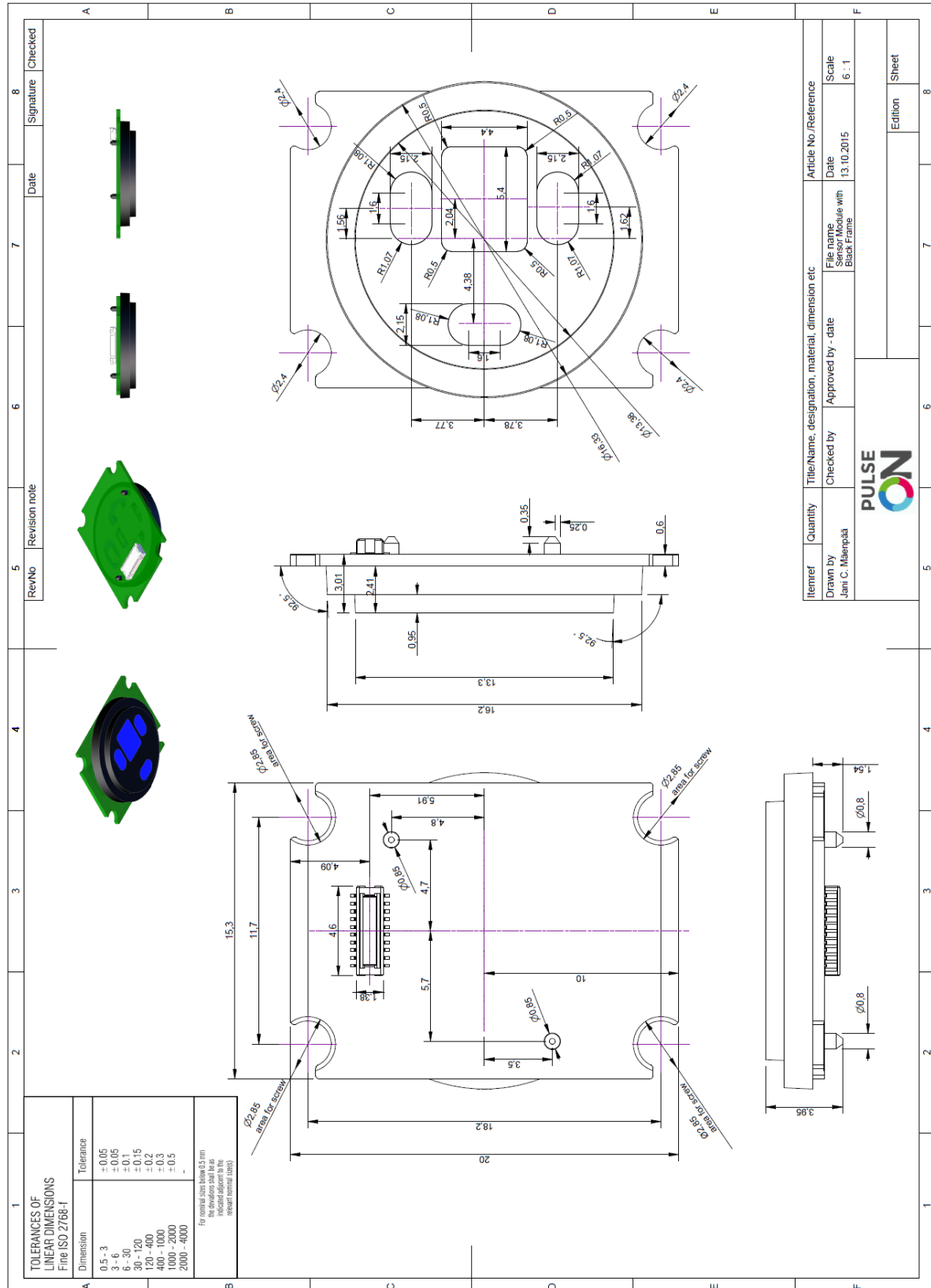
Special mode used for firmware update. Firmware update is initialized when mode is entered. Mode is exited automatically when the firmware update is finished. Firmware update is canceled if the update mode is exited before the update process has finished. Please see [Firmware Update](#) section for details.

2.1.6 Idle mode

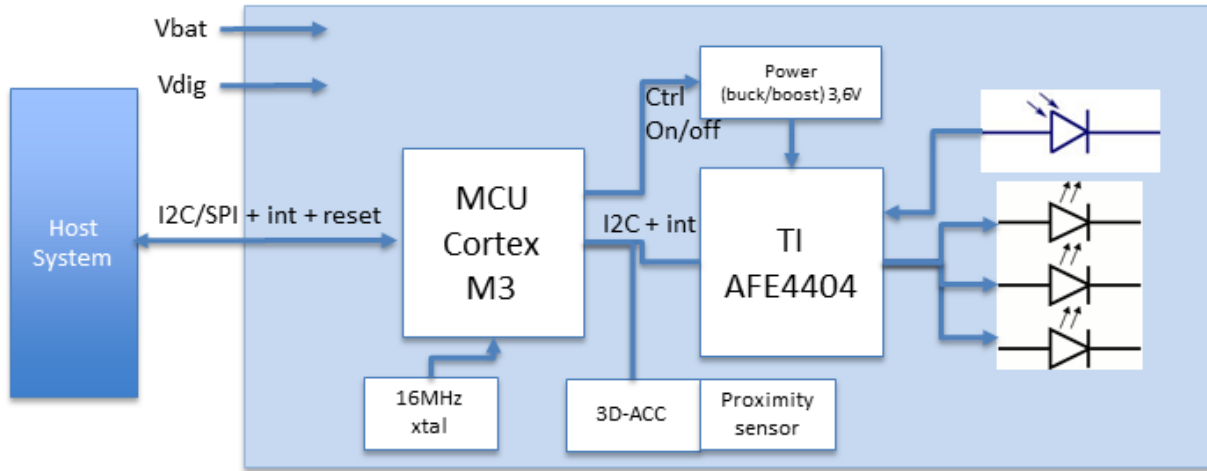
In idle mode the module doesn't actively measure anything. This is more or less transitional state and host is expected to use this mode only temporarily during transitions. For example after startup the device is in idle mode and host is expected to set mode to what is applicable at that time.

3 Module dimensions

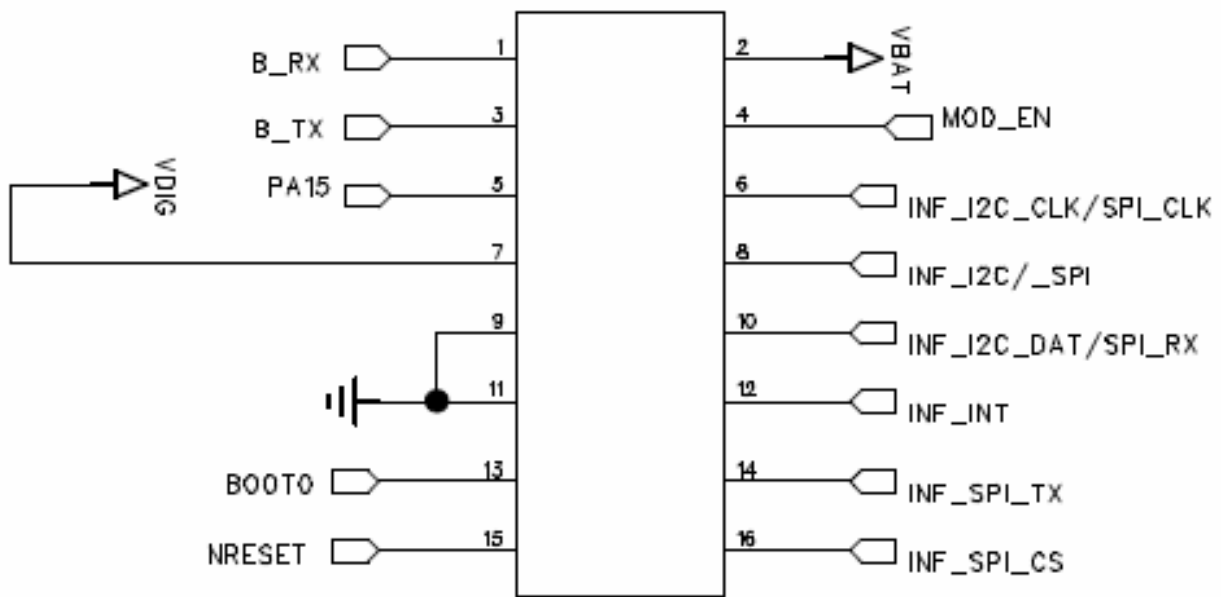
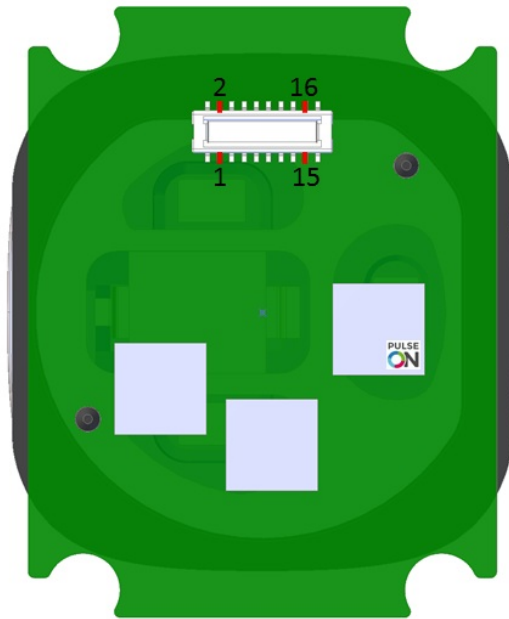
Picture below shows the module dimensions. Please use the provided .STP files for the mechanical design.



4 Simplified Block Diagram



5 Pin Configuration and Functions



Please notice-the compatible host connector type made by SMK CPB0316-0150F

PIN#	Pin Name	Description
1	B_RX	DNC
2	Vbat	Battery voltage in (2,7V - 5,5V)
3	B_TX	DNC
4	MOD_EN	DNC
5	PA15	RES
6	INF_I2C_CLK/SPI_CLK	Clock signal from host for selected interface (I2C or SPI)
7	VDIG	1,8V input from host (1,65V - 2,0). Vdd.
8	INF_I2C/_SPI	Interface selection input - (1=I2C / 0=SPI). Reused as SPI request signal after startup.
9	GND	Ground
10	INF_I2C_DAT/SPI_RX	I2C Data or SPI_RX (MOSI) for module
11	GND	Ground
12	INF_INT	Interrupt signal from OHRM module for host.
13	BOOT0	DNC
14	INF_SPI_TX	SPI MISO from module
15	NRESET	Reset signal for module
16	INF_SPI_CS	SPI bus Chip select for the module.

INF signals are the main interface signals for the host. They are having the following parameters:

Vol max: 0,45V (Iio = 4mA).

Voh min: Vdd-0,45V (Iio = 4mA).

Vil max: 0,3*Vdd

Vih min: 0,39*Vdd+0,59V.

Vih max: 5.5VInputs

NRESET: Vih max = Vdig + 0,3V having internal pull-up to Vdig. Preferred reset driving method: Activate reset by pulling down reset line with HOST's open-drain output.

6 HW Specifications

6.1 Absolute Maximum Ratings

- Supply voltage range
 - Vdig 1,65V – 2.0V
 - Vbat 2,7V – 5,5V
- Voltage applied to digital inputs
 - -0,3V – 5.5V
 - NRESET: -0.3V – Vdig + 0.3V (having internal pull-up to Vdig).

6.2 Recommended Operating Conditions

Operating temperature range -20C - +55C

6.3 Electrical Characteristics

- SPI interface
 - Max SPI clock speed 12MHz

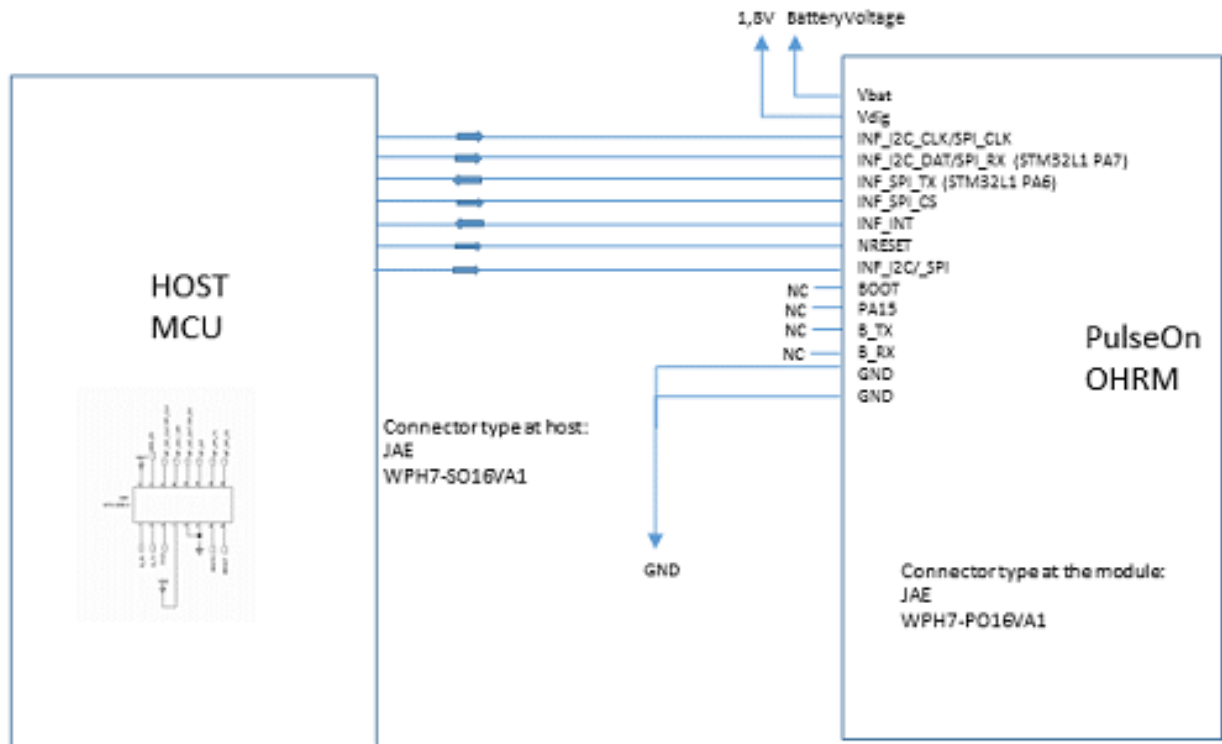
6.4 Power Supply Recommendations

- No special sequencing required for powering of the module.
- If digital supply voltage line drops under 1.65V over 50 μ S it will cause internal module reset

7 HW Reference Implementations

7.1 SIP Reference Implementation

SPI interface ref design for PulseOn OHRM.



Note: Please, add **ferrite bead** to the voltage lines as well **capacitor** behind it.

Glossary and List of Acronyms {unnumbered}

ACC

Accelerometer

DNC

Do not connect

HR

Heart rate

Heart rate quality indicator (HRQI)

An indicator of the source and reliability at which the heart rate estimation was

made (HRQI = 0 for estimated samples).

Heart rate variability (HRV)

The physiological phenomenon of variation in the time interval between heartbeats. It is measured by the variation in the interbeat interval.

Interbeat interval (IBI)

The time interval between individual heartbeats. Measured in units of milliseconds. In normal heart function, each IBI value varies from beat to beat. This natural variation is known as heart rate variability (HRV).

I²C

Inter-Integrated Circuit, pronounced I-squared-C, is a multi-master, multi-slave, single-ended, serial computer bus. It is used for attaching lower-speed peripherals to processors on embedded systems.

Operating mode

Usage mode and operating mode are used interchangeably.

Optical Heart Rate (OHR)

A heart rate that was measured with the analysis of a photoplethysmogram.

P-OHR1F

A PulseOn optical heart rate sensor module.

R-R interval (RRI)

The interval between successive Rs, where R is a point corresponding to the peak of the QRS complex of the ECG wave.

RRIQI

RRI quality indicator.

SPI

Serial Peripheral Interface (SPI) is a synchronous serial data protocol used by microcontrollers for communicating with one or more peripheral devices.

VO₂Max

The maximum or optimum rate at which the heart, lungs, and muscles can effectively use oxygen during exercise, used as a way of measuring a person's

individual aerobic capacity. VO_2max is expressed as a relative rate in millilitres of oxygen per kilogram of body mass per minute (e.g., mL/(kg·min)).

1. Requires Firstbeat ETE Library license. [↵](#)
2. Requires Firstbeat ETE Library license. [↵](#)
3. Requires Firstbeat ETE Library license. [↵](#)
4. Algorithm is closely identical to PulseOn Sports & Fitness product algorithm [↵](#)
5. Requires Firstbeat ETE Library license. [↵](#)