



# **XMetrics FIT e PRO**

## **Functional description**

### **Abstract**

This document describes the functionalities of XMetrics FIT and PRO

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## Revisione

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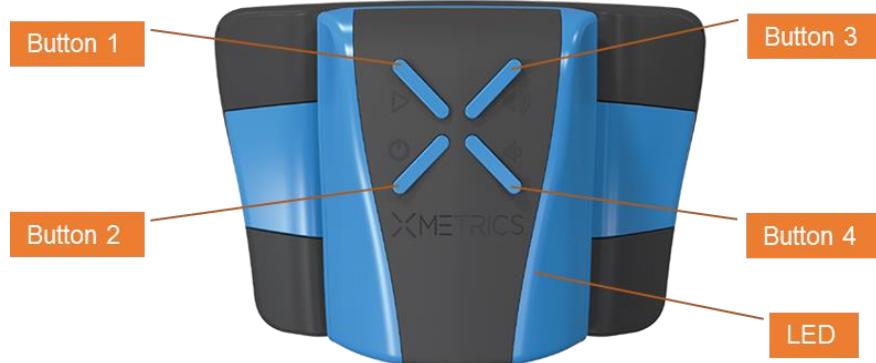
Revisione	Data	Autore	Descrizione
DRAFT1	5/9/2014	E. Vazzoler	Document start
DRAFT2	1/10/2014	E. Vazzoler	Micro modified
DRAFT3	14/11/2014	E. Vazzoler	Added flash + usb
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## Introduction

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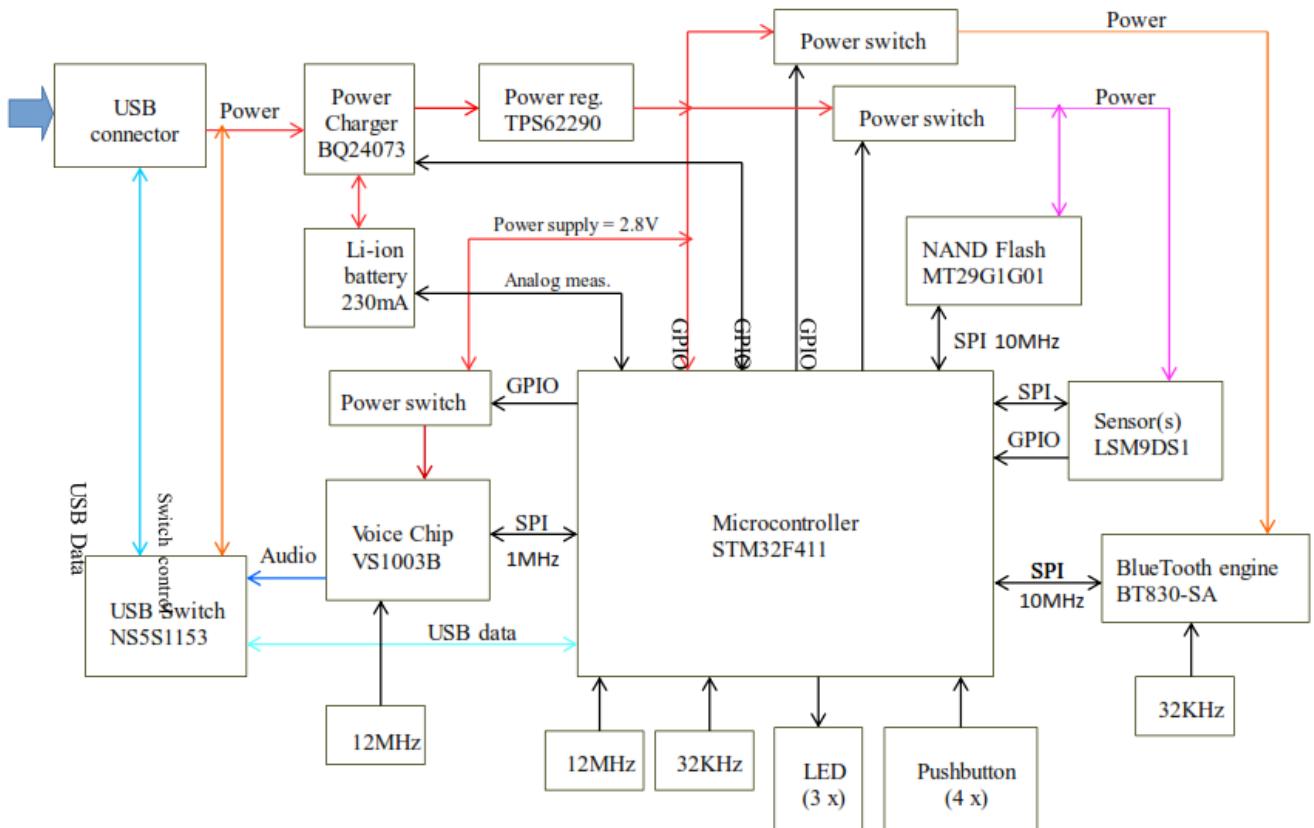


XMetrics FIT and PRO are activity trackers for swimmers. Both devices, despite external different enclosures, share the same electronic boards. Differences are managed by firmware.

External interface consists of:

- 4 buttons
- A three-color LED
- A 3.5" 4-poles jack connector, acting both as audio connection and as USB connection
- On PRO model, a Bluetooth connection is available

## Block diagram



## Microcontroller

Selected controller is STM32F411VC, part of dynamic efficiency family. This controller is scalable in terms of memory and performances. It executes basic firmware and performs analysis of data collected through sensors. The micro, running at 74MHz, keeps a Real Time Clock always on, when battery is connected.

Consumption in standby mode permits min 10gg standby time for whole device.

## Flash memory

The devices use an external NAND memory to keep audio files and to store logs. The memory can be 128MB for FIT and PRO and can go up to 2GB for MP3 version.

It's connected to the microcontroller through a 10MHz SPI connection.

## Audio

Audio is managed through an external decoder called VS1003. This device manages entirely the decoding and amplification process.

It's connected to the microcontroller by a 4MHz SPI connection.

## Sensors

XMetrics uses a 9-axes sensor (gyroscope, accelerometer, magnetometer).

The sensor is connected to the microcontroller through a 4MHz SPI connection.

## Bluetooth

PRO device uses a Laird Bluetooth 4.0 module, class 1.

Bluetooth must be explicitly turned on by user and is configured as SPP (Serial Port). It's used to transfer data to the PC or mobile application.

## USB

USB connection is available through 3.5" jack connection. USB is used both for transferring data from device o PC and vice versa and to recharge the device.

The 3.5" jack is used also for audio feedback. Audio connection is the default. An automatic switch senses the presence of USB Vbus and performs the disconnection of audio path and the connection of USB data path. VBus is used to recharge the battery and is also sensed by microcontroller.

## Power management

The device uses a 240mAh Li-ion battery, charged by USB Vbus. Battery current is 400mA, hence assuring a charging time <1h.

Standby duration exceeds 20d, while consumption in normal mode assures a running time above 10h. Real duration depends on effective usage of device and level of audio feedback.

Microcontroller can measure both VBus and the actual battery voltage, in order to be informed about actual levels.

In order to achieve an optimal power management level, power switches has been inserted in schematic to permit the micro to switch off selectively areas of circuit.

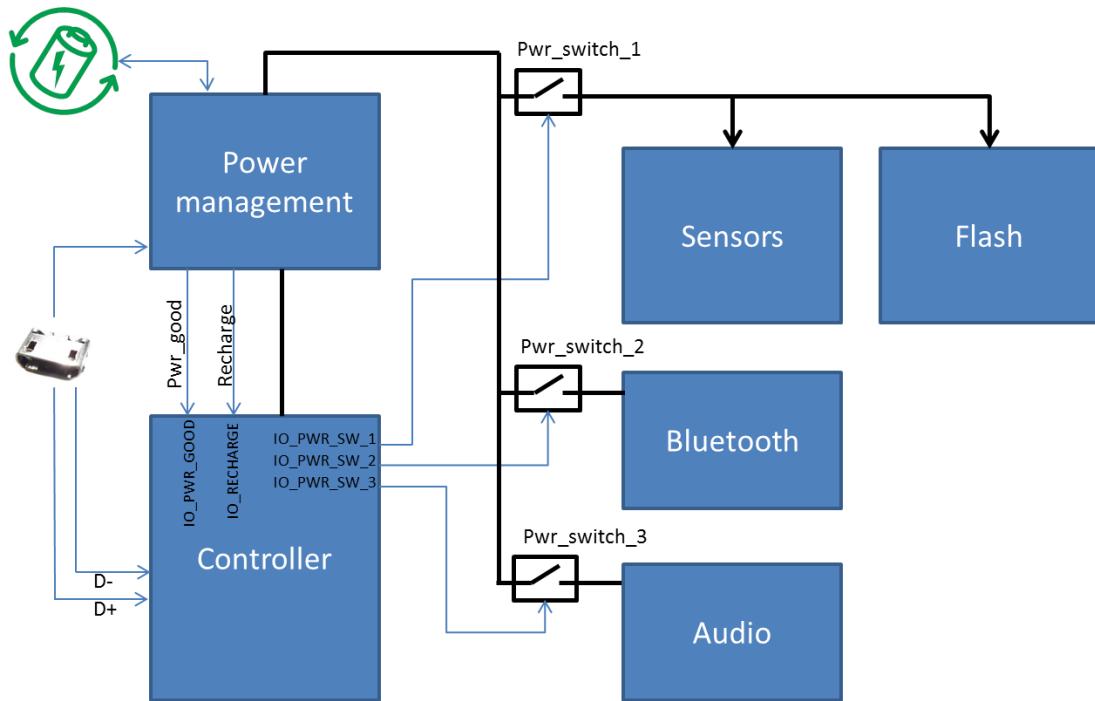


Figure 1 - Schema a blocchi del power management

## Reset

Reset is managed by a *smart reset* device connected to buttons 1 and 4. Keeping them pressed together for  $t > 6\text{sec}$  causes an hard reset signal to the microcontroller.

## Operational description

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The microcontroller, after initial boot, remains in standby mode. Consumption, in this mode, is extremely reduced (<0.5mA), assuring a battery lifetime greater than 30days in this condition.

Once device is turned on (button 1), the device acts on power switches to turn on memory, sensor and audio area. On PRO version, Bluetooth is kept off.

The device is operative but is not executing or registering. If no event happens within 5 minutes, the device automatically enters standby mode.

If a specific START command is provided by clicking button 2, recording is activated. The device samples all sensors with the given period. Raw data is filtered in order to remove sensor bias and offsets, then are stored inside internal flash.

Every given period of time, a mathematical model analyses the raw data over and calculate basic parameters. According to parameters, the device can decide to provide an audio feedback sending a predetermined MP3 through voice chip VS1003 to the earphones. Two buttons + and – (3 and 49 permit to customer to modify the volume.

About connectivity, both devices (FIT and PRO) use an USB interface mapped on 3.5" jack. The connection is shared with audio and managed through an analog switch. Normally, audio is connected to the jack. If the switch senses the presence of Vbus voltage of USB, automatically switches connecting the micro to the jack, enabling USB. The device communicates through a proprietary protocol to PC-based application XMetrics links.

PRO version have also a Bluetooth connection. Bluetooth must be explicitly turned on by applying a long-press on button 4 once the device is ON. Once enabled, the device is visible and can be paired; SPP class is used in order to create a virtual com port. The protocol used for Bluetooth communication is the same used by USB.