AN0009 Application Note
Smart Band

Abstract:

This application note presents briefly how much of the consumption of a smart band can be compensated using energy harvesting (EH) technology. It also shows how and in which situations a smart band can benefit from energy harvesting.

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1. Overview

This application note shows briefly how much a low power smart band consumes by investigating its battery life and battery capacity. It shows that in outdoor cases, it can extend the battery life of this smart band by 85%. To address this question, first the average battery life of smart band is extracted. Then, this average operating time is divided by the battery capacity of the device. The result is the average energy consumption. Having this energy consumption helps us to calculate how much energy harvesting can add to such a device.

2. Energy consumption

The smart band under investigation has 15 days of battery life based on the manufacturer data. This device is equipped with a 135mAh battery with operating voltage of 4.35 volts. Dividing the battery lifetime of the band by capacity of the battery results in 9mAh of consumption per day. Dividing this consumption by 24 hours of a day results in 0.375mAh of consumption.

Table below summarizes the consumption of the device with basic functionalities. It needs to be noted that in this document the efficiency of Nowi PMIC is considered 80%.

Product	Lifetime (with one charge) (hours)	Current Consumption (mAh)	Energy Consumption/h (Joules)	Consumption/day (mAh/day)	% Compensated (For 2 hours/day)
Xiaomi Band 4	480	0.375mAh	3.6	9	83

Table 1: *Energy consumption and compensation of the smart band*

3. Harvesting

Harvesting energy depends on many different factors such as type of light, surface area of PV, the hours that PV is exposed to light, and the efficiency of the harvesting system. Generally, we can divide the into two types of indoor and outdoor. The difference between indoor and outdoor light is their intensity and the spectrum of light. We will not study the spectrum of light in this document and only distinguish these two by calling them indoor and outdoor light. Indoor light is the artificial light that is emitted by any type of light sources such as LED, fluorescent, or incandescent lamps. On the other hand, outdoor light is the light emitted by the Sun. Each type of PV is designed for one of these two different types of light.

As the table 1 shows, 83% of the consumption can be compensated. This table is extracted by the surface area of 1.84cm2 of a PV under outdoor light of 1 Sun for 2 hours. Obviously, exposing the PV for longer hours under light or increasing the surface area of PV can compensate more of the consumption.

Depending on the type of design, indoor or outdoor PV can be chosen. However, measurements and experiments show adding EH by having indoor light as the source only compensates a few percents of the consumption. Adding more PVs to the smart band is not a feasible solution as the available surface area on smart band is quite limited.

Figure 1 shows two of the potential places to put PVs, which can be dial (1) or wrist band (2) of the smart band.

Figure 1: *Smart band with possible places to embed PV*

4. Conclusion

The purpose of this application note is about adding energy harvesting technology to smart bands and studying their battery lifetime extension by energy harvesting technology. Due to low power generated out of PVs made for indoor light, it is shown only for outdoor light that can compensate enough the consumption of such devices. Another challenge with adding energy harvesting technology to smart bands is their limited size area. This makes smart band manufacturers to come up with new designs to benefit from EH technology.