

Introduction

Wearable devices have become increasingly integrated into our lives. In addition to being used in fitness devices, they have also worked their way into other fields, including medical care, entertainment, security, and finance. In all applications, battery life and component size are two key concerns.

In regards to component size, applications require the main board within the wearable device to have a small size and low BOM, which means a small package and high integration are required for each IC on the main board. For example, smart bands, a very popular wearable device, require a small main body size (usually 20mmx20mm). The main board within the body is even smaller. The battery pack takes up a large portion of the board space, leaving components to be mounted on the other sides of the board and severely limiting the size and height of components.

For this reason, the chip scale package (CSP) is an ideal package choice in wearable applications, since this package is at a chip scale level with a low height (see Figure 1). With regards to the chip size, an optimized circuit design and process take an important role.

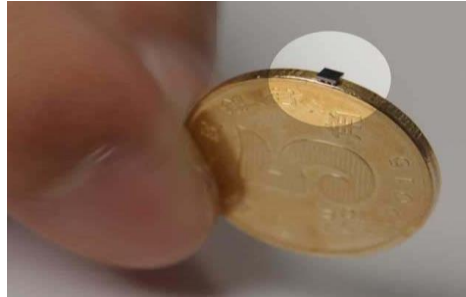


Figure 1: Chip in a CSP Package

High integration of power MOSFETs and control circuitry is another way to reduce board size in [wearable applications](#). Higher integration reduces the number of external components of the IC on the main board, reducing the total size (see Figure 2).

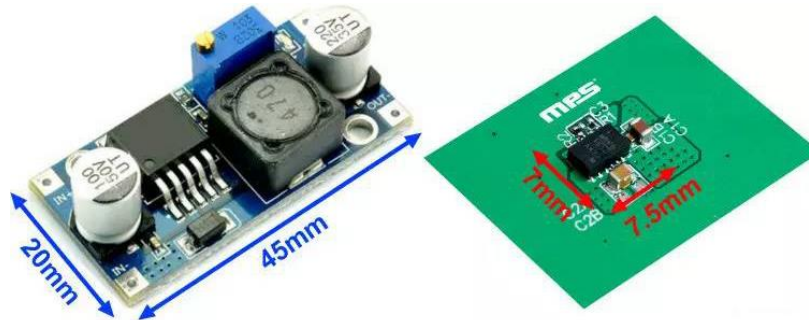


Figure 2: Traditional Solution vs. Highly Integrated Solution

Programmability is also an important feature in wearable applications. For example, the charging parameters can be programmed in real application scenarios, which provide a better customer experience. Battery charger ICs with an I²C interface are ideal for customers needing to meet various requirements and can also allow the host to flexibly monitor any status and fault during charging.

The battery is a critical component of wearable equipment. The [charger IC](#) should charge the battery safely and ideally have a separate bidirectional control between the system and the battery. This way, the charger IC can power the system even with a dead battery by regulating the system to a minimum voltage level and operating the battery switch as a linear regulator. When the system load exceeds the input source capability, the battery can supplement power to the system to enable higher power draw for brief periods of time. Normally, the charger IC can implement power path management with input voltage and current loops to achieve the above functions (see Figure 3).

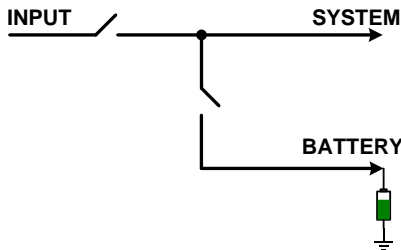


Figure 3: Separate System and Battery Control

With the help of the power path, the charger IC can also provide battery discharge protection, such as over-current protection (OCP) and battery under-voltage lockout (UVLO) when only the battery is present. In applications where the system runs in and out of control, it is important to reset the system to prevent any unexpected damage. With the help of the power path, the charger IC can reset the system safely, even during shipping mode.

The battery in wearable applications is small (in the range of several tens of mAh to 100+ mAh), while customer usually expect several days of runtime. The charger IC should also have a low quiescent battery discharge current to extend the battery runtime. Using a 70mAh battery as an example, three days of runtime is typically required, so the average consumption current is less than 1mA. Achieving a quiescent current less than 10µA is challenging for a charger IC while it is enabled with only a battery connected. This is because a low quiescent current impacts system response and accuracy. For example, battery under-voltage lockout (UVLO) is a key parameter in preventing a battery over-discharge, which requires high-accuracy circuits to be active to monitor the battery voltage and control the battery MOSFET.

In addition to an accurate charging control, such as accurate charging current and charging voltage, the charger IC should also have battery over-voltage protection (OVP), temperature monitoring, and other robust safety features.

An ideal solution for wearable devices would have a small size, low BOM, high integration, flexible charging configurations, and a number of protection features. MPS has that ideal solution in the MP266x family of linear chargers. MP266x devices come in ultra-compact WCSP packages while maintaining fully integrated power switches with no external block MOSFETs required and less than 13µA quiescent current in standby (battery only) mode.

Conclusion

Small size and low quiescent current are key concerns for battery chargers in wearable applications. An ideal solution can achieve these two requirements while being highly integrated and offer programmable charging parameters for use with a wide variety of batteries. The MP266x linear charger family from MPS is an excellent solution for charger ICs in wearable applications. These devices take advantage of MPS's industry-leading power MOSFET and programmable analog technology to optimize wearable designs.

To learn more about the MP266x family of linear chargers, visit our [Linear Battery Chargers page](#).