Technical Article

How to design wearables that are smaller and go longer between charges

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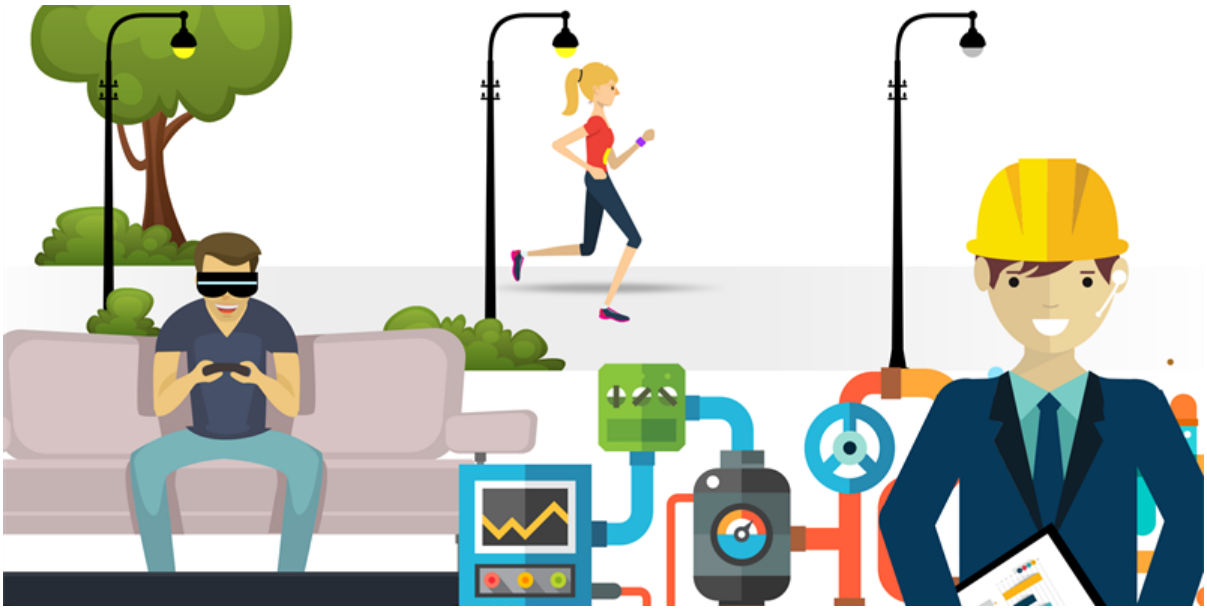

Earlier this year, I wrote about wearables and how they can do so much and be so small. Well, wearable devices are about to get smaller, do more and last longer thanks to innovations in battery charging, low quiescent current operation, smart power management and high integration.

Battery charging for wearables is challenging because you have to use batteries that are both small in size and capacity. For example, charge currents vary greatly depending if you are using a 40 mAh, 100 mAh or 200 mAh battery, and whether you want to charge at 0.5 C, 1 C or 2 C to achieve fast charge and charge cycle life goals. The key is to include a programmable fast charge current into your design. The BQ25120A battery management solution offers programming from 5 mA up to 300 mA to support a wide variety of batteries and charging profiles.

While it is important to charge quickly, it is also important to get as much energy into the battery as possible. To do this, the termination current must be very accurate and have the ability to terminate reliably at 1 mA or below.

The battery must power the microprocessor (MCU), radio and sensors between charges. To maximize battery life, you need to focus on components that can consume low power when operating, as well as consume very low power when shut down. The buck converter is the most important feature for low Iq operation, since it is the power supply to the MCU and must be operating at all times. Consider implementing a product that integrates a very low current DC/DC converter such as the BQ25120A. This product enables 700 nA Iq while the 1.8 V rail is on and powering the MCU at no load. If your wearable needs an additional low Iq buck, the TPS62743 or TPS62843 is a great choice. TPS62843 is the new generation of ultra-low-IQ buck converter. With operating quiescent current 275-nA typical, the device extends a high efficiency at light-load down to 100-µA and below. It is optimized for 1uH inductor and down to 4.7 uF Cout. With the tiny 6-pin WCSP package (0.8 mm x 1.05 mm) and small passive components it supports a total solution size down to 5.7 mm². The wide output voltage range (0.4 V – 3.6 V) and 600 mA output current make the device fit for most of battery powered applications, such as wearable electronics, earbuds, TWS, medical sensors, hearing aids and IoT.

Some sensors and radios are not used all the time and can be shut down completely, requiring so a low leakage shutdown mode is needed. The BQ25120A integrates a load switch that can turn off components when not used, and can also be configured as a regulated LDO output if needed.

Some wearables have displays or heart rate monitors (HRMs) that require boost converters. Different displays have different voltage requirements, so the most flexible solution is to implement the boost with discrete devices. If the display is an organic light emitting diode (OLED), consider a device like the TPS61046 , which provides the 12-V and is small with low Iq. If the display is an LCD, E Ink display or a Heart Rate Monitor (HRM), the TPS61240 is ideal for providing the 5V. HRMs require a 5V supply for the LEDs, and the TPS61240 has a very low leakage disconnect switch for turning them off completely when not in use.

As you can see, TI has a variety of small, power-efficient components to create wearable devices that really stand out in today's market. Here's to living healthier with TI technology.

Additional resources

- Watch a video: "How can I increase the life of the wearable I'm designing?"
- Check out this Tiny Wireless Receiver for Low Power Wearable Applications TI Designs reference design.
- Read these blog posts on the TI E2E™ Community:
  - Batteries not included (and not needed): Tiny ICs enable battery-free IoT.
  - Giving the gift of wearables this holiday? Don't forget to look at the battery charger!
  - 3 Keys to Ultra-Low-Power in Wearable Designs.

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