Pack More Power in Your Cool, Small Smart-Home Hub

By Jia Hu, Nazzareno (Reno) Rossetti and Sami Nijim, Maxim Integrated

Introduction

Smart hubs are fast becoming a common household item. Used to wirelessly control door locks, lights, thermostats, audio and electric appliances, they are also equipped to send notifications to the homeowner (Figure 1). These wall-powered, soap-sized gadgets are packed with electronics and often include backup batteries in case of power outage. To fit in such a small space while minimizing heat generation, the on-board power management system must be small and efficient. This article reviews a typical approach for powering a smart hub. It then presents a new solution that delivers more efficient power in a smaller space, enabling longer backup battery run-times and smaller form factors to accommodate today's smarter homes.

Figure 1: Smart-home Hub Illustration

Typical Power Management Implementation

As an example, a typical smart hub system (illustrated in Figure 2) wirelessly communicates with a smart vacuum cleaner. The smart hub is powered by a wall adapter and has a backup battery in case of a power outage.

In the event of a power outage, the backup battery should provide operation for up to 10 hours. In a typical implementation, four AA

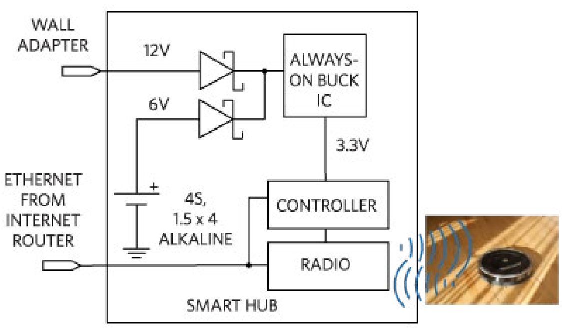

Figure 2: Typical Smart Hub System

alkaline batteries in series provide 6V and a 2Ah charge. Accordingly, the smart hub must consume less than 200mA on average to last for 10 hours during a power outage.

The power management circuit includes an always-on buck converter and two diodes that multiplex the two input power sources. The footprint of the smart hub's power circuit, including active and passive components, is shown in Figure 3.

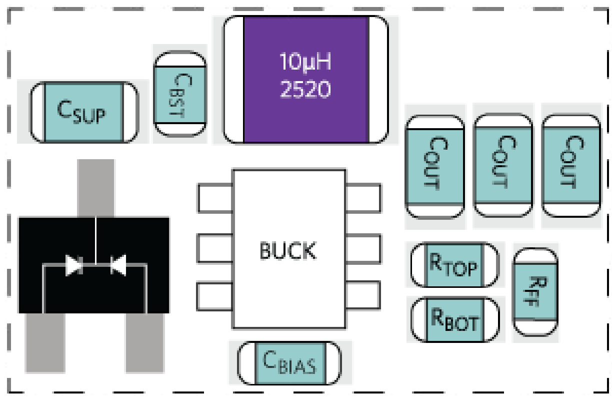

Figure 3: Typical Smart Hub Power Section Footprint (46mm^2)

This typical smart hub power solution, which requires two chips (represented with their SOT23-3 and TSOT-6L packages in Figure 3) and several passives, results in a board area footprint of about 46mm^2.

Integrated Power Management Solution

In Figure 4, the two ICs containing the buck converter and the dual diodes are integrated into a single chip leading to a much more compact solution. In addition, the two diodes, actively implemented with low RDS-ON MOSFETs, have virtually ideal performances.

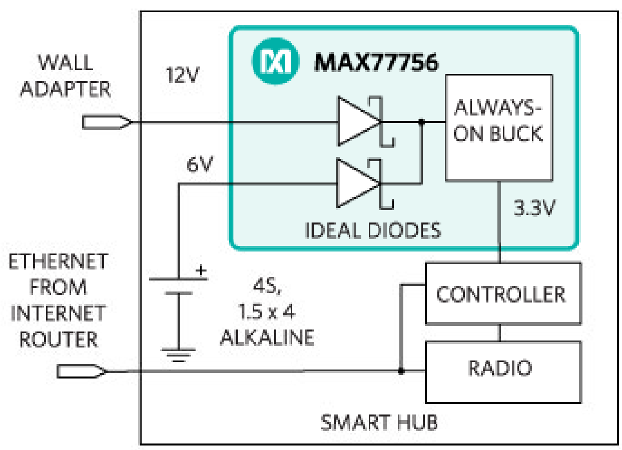

Figure 4: Integrated Power Solution

Integrated Buck Converter and Power MUX

An example of the integrated implementation can be found in the MAX77756 (Figure 5), a synchronous 500mA step-down converter with integrated dual-input power multiplexer (MUX). The MOSFET-based multiplexer minimizes the power losses associated with the diode implementation.

If the smart hub consumes an average of 200mA with 6V input (backup mode), then the current delivered by the buck converter at the output, while neglecting efficiency losses, will be 364mA on average.

The MAX77756 500mA current capability can handle an average load with room to spare for peak current demand, making it an ideal choice for this application.

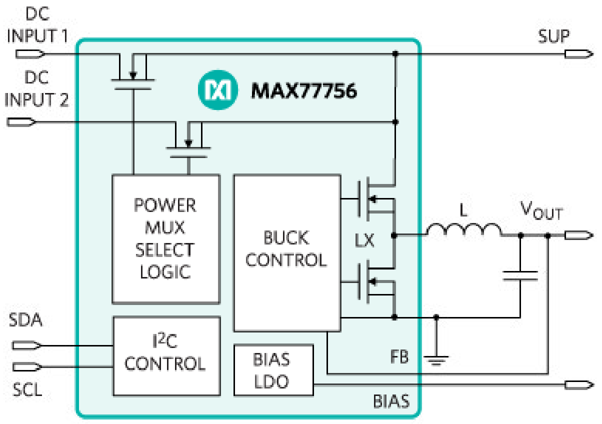

Figure 5: MAX77756 Block Diagram

The MAX77756 operates from an input supply as low as 3.0V and as high as 24V. Default output voltage is factory-programmed to either 1.8V, 3.3V, or 5.0V. Output voltage is further adjustable through external resistors or an I^2C serial interface.

Size Advantage

The MAX77756 application footprint in Figure 6, highlights the passive components and the single MAX77756 in a tiny 2.33mm x 1.42mm (0.7mm max height), 15-bump wafer-level package (WLP).

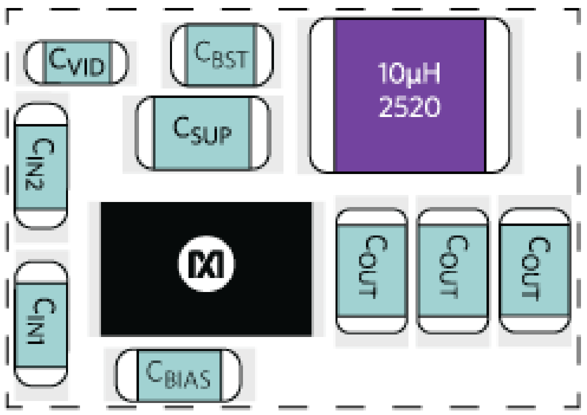

Figure 6: Integrated Smart Hub Power Solution with MAX77756 (33mm^2)

The high level of integration leads to a footprint of only 33mm^2 or 28% smaller than the typical implementation.

Efficiency Advantage

Figure 7 shows the MAX77756 efficiency curve for a 12V input (DC INPUT 1 or 2 in Figure 5) and a 3.3V output. The superb 87% peak efficiency, which includes the buck converter and MUX MOSFET losses, makes this device the best in class. The buck converter has

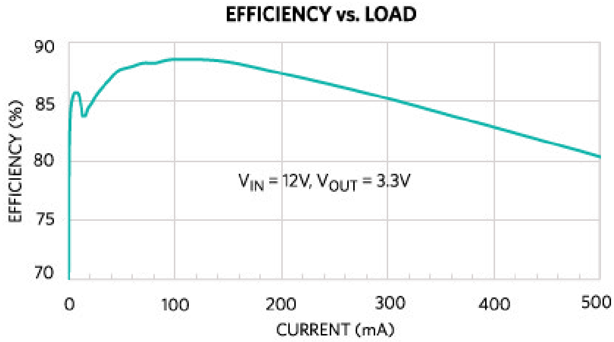

Figure 7: MAX77756 Efficiency Curve

the advantage of several efficiency points compared to alternative solutions.

High efficiency and small footprint go hand in hand. Less heat generation helps in designing a smaller, cooler smart hub, easing the concerns for device overheating. Higher efficiency is also important in case of power outage. For example, a 5% efficiency advantage will translate directly into an equal extension of the backup battery run time of 5%.

Conclusion

Smart hubs are small, cool gadgets that require space and power-efficient solutions. By integrating an always-on buck converter and a MOSFET-based input MUX into a single chip, it's possible to achieve a 28% reduction in the power management footprint and have best-in-class efficiency as shown by the MAX77756.

www.maximintegrated.com

About the Authors

Jia Hu is an Executive Business Manager in the Mobile Power group at Maxim Integrated. He has 20 years of experience in the semiconductor industry. Jia holds a master's degree in Electrical Engineering from the University of Washington, and bachelor's degrees in Electrical Engineering and Economics from the University of California, Berkeley.

Nazzareno (Reno) Rossetti, Principal Marketing Writer at Maxim Integrated, is a seasoned Analog and Power Management professional, a published author and holds several patents in this field. He holds a doctorate in Electrical Engineering from Politecnico di Torino, Italy.

Sami Nijim is a product definer in Maxim Integrated's Mobile Power group who focuses on optimizing the customer product experience through better power management. He joined Maxim in 2013 as an applications engineer and moved to his current role in 2016. Sami holds a BSEE degree from Case Western Reserve University.