

Buck-boost Converter Battery Life Time Estimation for Wireless Network Cameras

Julian Hagedorn



Japanese Version: 無線ネットワーク・カメラおよびビデオ・ドアベルのバッテリー駆動時間の延長
 Chinese Version: 延长无线网络摄像头和可视门铃的蓄电池寿命

Many wireless network cameras or video doorbells are designed to operate in locations where power cables might not be accessible. Those locations include the front door, a bookshelf, a tree in the garden, or others. The goal is to mount the camera easily at any location without the need to install power cables. In this situation, a very efficient power solution needs to be used to get the maximum possible battery lifetime.

Many cameras and doorbells use a single-cell Li-Ion battery. This battery powers different points of load which require various voltage levels where buck, boost, or buck-boost converters offer best solutions. WiFi®, Bluetooth® and LED modules usually require supply voltages that are within the battery output voltage range.

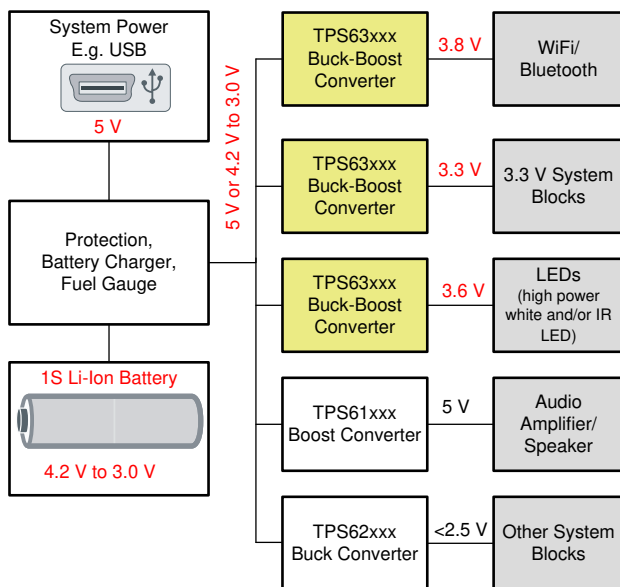


Figure 1. Wireless Network Camera or Video Doorbell System Block Diagram Example

In this case, buck-boost DC/DC converters provide stable supply voltages for these blocks over the whole battery operating range. Moreover, in the LED block, the buck-boost converter can be used as a constant current source.

A further use case of a buck-boost converter is voltage stabilization as shown in Figure 2. For example, if a high load, like the WiFi module or the camera, is enabled, the battery voltage drops due to its internal impedance. The drop can be below the targeted system voltage. A buck-boost stabilizes the output voltage in this case.

Both applications have in common that the battery lifetime is increased compared to other solutions.

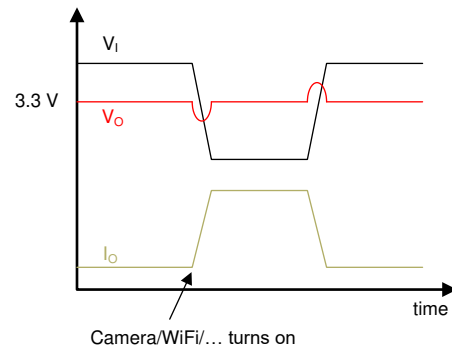


Figure 2. Buck-boost as Voltage Stabilizer

This document discusses the effects on battery lifetime of different power solutions based on a simulated LED driver example.

The example chosen is a high power white or infrared LED that consumes 200 mA at 3.6-V forward voltage. The system is supplied by a Li-Ion battery with 2.5-Ah capacity. The battery has a nominal operating voltage of 3 V to 4.2 V. A DC/DC converter is used to regulate the battery voltage to the required forward voltage. Figure 3 shows the simulation bench.

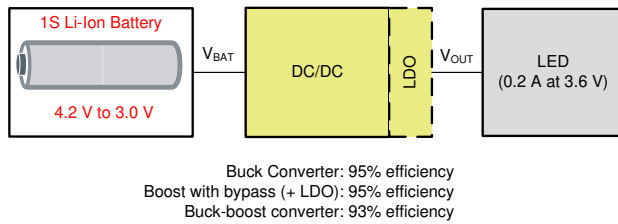


Figure 3. Simulation Bench

Figure 4 shows the discharge profile of the battery and the operating regions of different DC/DC converters.

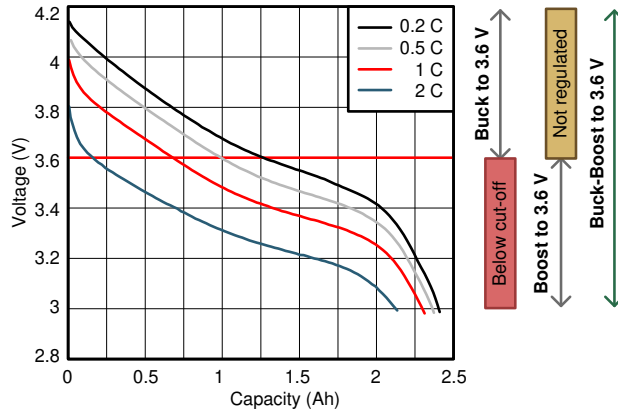


Figure 4. Li-Ion Battery Discharge Profile and Operating Regions of DC/DC Converter

This simulation compares three DC/DC converters. A buck-boost with 93% efficiency, a buck converter with 95% efficiency, and a boost with bypass with 95% efficiency. The boost with bypass is followed by an LDO to regulate the output voltage to 3.6 V. The LDO voltage drop is 20 0mV.

The simulation of the three converters in the given operating point shows that the battery lifetime varies significantly between the three solutions. The system with the buck converter runs less than 8h. With the boost with bypass and LDO the battery lasts 11.1h. The buck-boost converter provides the longest battery lifetime with 11.5 h.

Figure 5 shows the battery lifetime of the different converters over output voltage with a 200-mA constant current load. The figure shows that the buck-boost provides the best results in battery lifetime, when the needed output voltage is within the battery operating range.

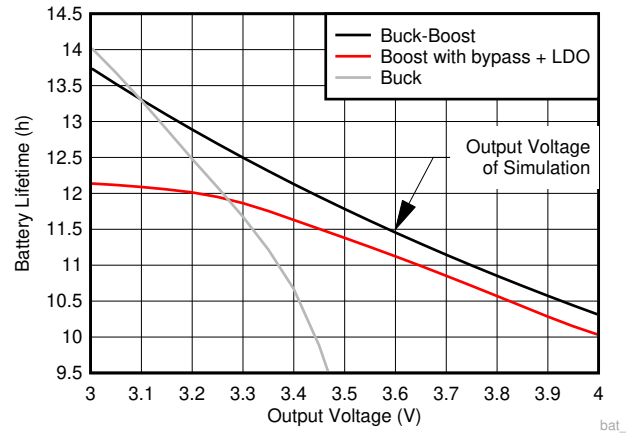


Figure 5. Battery Lifetime With a Constant Current Load Over Output Voltages

Table 1 lists the best-fitting buck-boost converters for this application.

Table 1. Recommended Buck-Boost Converters

TPS63050	Excellent efficiency
TPS63036	Smallest chip size
TPS63802	High output current, small solution size and improved light load efficiency
TPS63070	Higher V_I and V_O range and dynamic voltage scaling feature. See SLVAE62

References

- [Different Methods to Drive LEDs Using TPS63xxx Buck-Boost Converters Application Report \(SLVA419\)](#)
- [TPS63030 Single LED Driver Evaluation Module User's Guide \(SLVU391\)](#)

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated