Electronic Design

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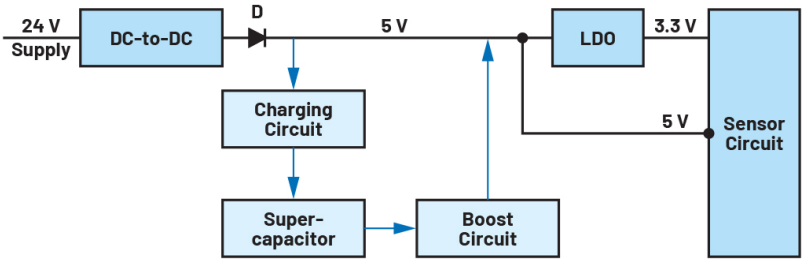
How to Design a Simple UPS with Supercapacitors

Continuous supply voltage via an uninterruptible power supply is crucial for a number of applications, but it can be tough to ensure at all times. This Idea for Design offers a reliable, compact solution that's easy to integrate.

In many applications, it's important for the supply voltage to be continuously available no matter what the circumstances. This isn't always easy to ensure, though. A new concept can provide an optimal solution for an uninterruptible power supply (UPS) with an extremely compact design.



1. Shown is a typical application for an uninterruptible power supply.

Several applications require an uninterruptible power supply. One example is the RAID system for redundant data storage, which must be protected so that no data is lost in the event of a power failure at an inconvenient time, such as during data backup activity. Systems with real-time clocks also must be supplied continuously with power. This can come from a battery or another backup solution. Other applications include telemetry applications in the automotive sector and systems for administering medications—for example, controlled insulin pumps used in the healthcare sector.

Figure 1 shows a typical industrial application for an uninterruptible power supply. Here, an industrial sensor is supplied with power. The reliability of the system mainly depends on this sensor's power supply.

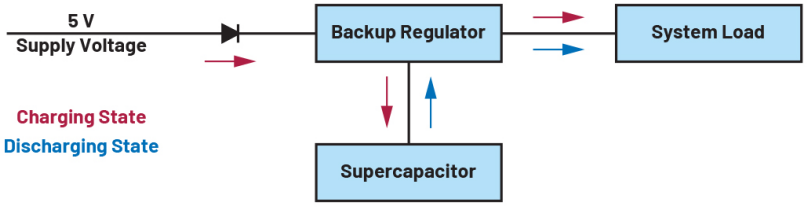
A linear charge regulator IC is used to charge a supercapacitor when there's available system voltage. If the system voltage drops, the energy from the energy-storage system is raised to the required supply voltage level with a boost regulator.

This system works well, but it's difficult to implement because many different energy converters are needed. Moreover, in many applications, it's important that no energy flows from the energy-storage system back to the power supply *(depicted in Fig. 1)*.

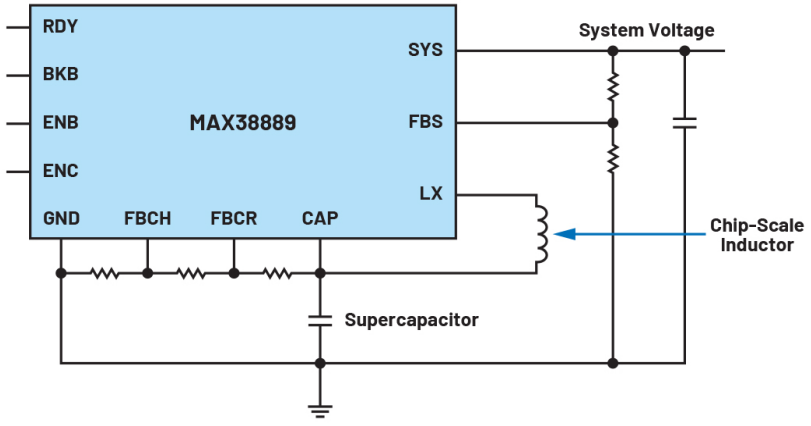
As shown in *Figure 1*, the supercapacitor should only power the sensor circuit and not any other electronics that may be attached to the 24-V line *(left side of Fig. 1)*. The energy-storage system is normally designed to supply the local load and not the complete system attached to the 24-V supply voltage. This makes diode D in *Figure 1* necessary.

Figure 2 shows a new concept supported by the MAX38889 from Analog Devices (ADI). It's a highly integrated backup solution called Continua for power rails up to 5 V. A single IC with a few passive external components is all that's required. The MAX38889 has an integrated half-bridge, operated alternately in highly efficient buck and boost modes.

A complete, operable circuit is illustrated in *Figure 3*. The logic and the power switches are all integrated, so just a small external chip-scale inductor and a few backup capacitors are required, apart from the supercapacitor.



2. The Continua backup concept has numerous integrated system functions.



3. This implementation features a tiny Continua backup solution with the MAX38889.

The integrated high-side power switch is executed with the True Shutdown technology developed by ADI. As a result, the system voltage can be separated from the CAP voltage so that no current flows from the CAP to the system if the CAP voltage is ever higher.

While plenty of backup solutions for various voltage and current ranges exist on the market, the compact MAX38889 Continua backup solution can easily be added to the 5- or 3.3-V supply line with minimal development and implementation effort. It also offers high conversion efficiency of up to 94% in charging and discharging modes to minimize the size and cost of the energy storage.

Frederik Dostal is a power-management expert with more than 20 years of experience in this industry. After his studies of microelectronics at the University of Erlangen, Germany, he joined National Semiconductor in 2001, where he worked as a field applications engineer, gaining lots of experience in implementing power-management solutions in customer projects. During his time at National, he also spent four years in Phoenix, Arizona working on switch-mode power supplies as an applications engineer. In 2009, he joined Analog Devices, holding a variety of positions working for the product line and European technical support. He currently brings in his broad design and application knowledge as a power-management expert. Frederik works in the ADI office in Munich, Germany.