Bi-directional DC/DC power supplies: Which way do we go?

Steve Taranovich - December 13, 2016

This article is part of EDN and EE Times’ Hot Technologies: Looking ahead to 2017 feature, where our editors examine some of the hot trends and technologies in 2016 that promise to shape technology news in 2017 and beyond.

The bi-directional DC/DC converter has been around for a while, but new applications are quickly emerging which necessitate the use of this architecture in so many more systems. Applications today require better energy efficiency and such systems as green power with solar or wind generation, need storage so that when there is no wind or sun available the electricity flow is not interrupted.

A bi-directional DC/DC converter could find use in an energy storage system. (Image courtesy of TDK Lambda)

Battery back-up systems need bi-directional DC/DC converters since the batteries are charging during the time when there is an available power source, but in the event of loss of power, the battery now becomes the source of stand-by power. Vicor has a great solution for that area with their new bi-directional DC/DC topology.
Vicor built a prototype with 300W input charging a battery and 1500W output supporting a bus load. Higher powers can be designed by using paralleling techniques and some re-configuring. Vicor has an excellent article entitled “A New High Efficiency Isolated Bi-Directional DC-DC Converter for DC-Bus and Battery-Bank Interface” by Xiaoyan Yu and Paul Yeaman.

In the automotive arena we now have to think about managing batteries in EV/HEVs with a high voltage power supply architecture. Hybrid automobiles have regenerative braking and store that energy for that extra energy boost needed during acceleration periods. The EV/HEV dual-voltage systems have 12V and 48V batteries and need bi-directional DC/DC conversion.

Intersil has developed the ISL78226, which is the first 6-phase bi-directional DC/DC controller. This device can deliver up to 3.75 kW with more than 95% efficiency.

The following image is a vehicle with a 48V mild hybrid powertrain. A few changes have been made to a standard non-hybrid powertrain. A 48V battery has been added, along with the 12V starter and alternator being replaced by a 48V starter-generator. Finally, a DC/DC converter is added that bridges the 48V and 12V buses. This allows the power generated by the 48V starter-generator to be used to charge the 12V battery and operate all of the unchanged 12V electronics. The ISL78226 forms the heart of the DC/DC converter.
So we expect to see many more such applications emerging in 2017 using the bi-directional DC/DC converter architecture as we move forward. We have even seen an all-SiC DC/DC bi-directional DC/DC converter. GaN is also a power element that will be used in these systems, so you can expect to see more designs with that technology as well.

Also watching:

- **Wireless power**: Wireless power transfer is due for a boost in 2017. Wurth Elektronik is enabling designers with a Wireless Power Design Kit in conjunction with ROHM Semiconductor for fast time to market in addition to their Wireless Power Reference Designs. Efficient Power Conversion (EPC) has some really good eGaN power element solutions for wireless power with some excellent application notes as well as very designer-friendly evaluation boards. The Wireless Power Consortium is bringing Qi standard solutions and momentum to the market. In 2015, the Alliance for Wireless Power (A4WP) and the Power Matters Alliance merged. In November 2016, the Wireless Power Summit had in attendance Dell, HP, Disney, Haier, ZPower, and more, so this bodes well for some progress in 2017. Apple have not yet launched their integrated wireless charging solution but there is talk of an Apple iPhone case that will enable wireless charging for their newest phone. In addition, there are already numerous wireless charging cases for the iPhone 7 out there now by third party developers. Watch CES 2017 for more developments in this area next year.

- **Power in wearable electronics**: The Internet of Things (IoT) will be growing quickly in 2017, especially in the area of wearables for fitness and medical applications. Some tough problems will be making the battery last longer between charges and supply bias noise from switching regulator usage that may interfere with spread spectrum communications devices and navigational and positioning devices. Companies like TransSiP have approached these challenges head on with their proposed solution for switching noise jitter (SNJ) conditioning JC-PFM technology. Linear Technology has also offered some new solutions for wearable power. Their LTC3388-1, an ultralow quiescent current synchronous buck converter, takes care of the low power needs along with their LTC3335, a nanopower high efficiency synchronous buck-boost converter with an onboard precision coulomb counter. The LTC3331 is an energy harvesting solution IC and another idea for generating power in a smart wearable. More innovations to come in 2017 for sure.
Also see:

- The latest in electric vehicle power management
- Bidirectional converter aids energy storage battery systems
- Wearables enhance the human condition with efficient, low power conversion ICs
- Powering wearable electronics: a new dimension

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