

Digital Controllers Maximize Efficiency Over Load Range

By David Morrison, Editor in Chief

The latest generation of Zilker Labs' digital power controllers, the ZL2006 and ZL2004, feature new algorithms that dynamically optimize efficiency as operating conditions change. These synchronous buck controllers adapt to changing load conditions autonomously, yet do not require any additional components. According to the company, these algorithms result in an improvement of greater than 15% in light-load efficiency in typical applications versus the performance achieved by the company's existing controllers.

The two latest-generation devices differ by their level of functional integration. The ZL2006 integrates a digital pulse-width modulation (PWM) controller, comprehensive power-management features and 3-A MOSFET drivers to support loads in excess of 40 A (see the figure). The ZL2004 omits the drivers and is optimized for use with integrated driver+MOSFET ICs or power train modules.

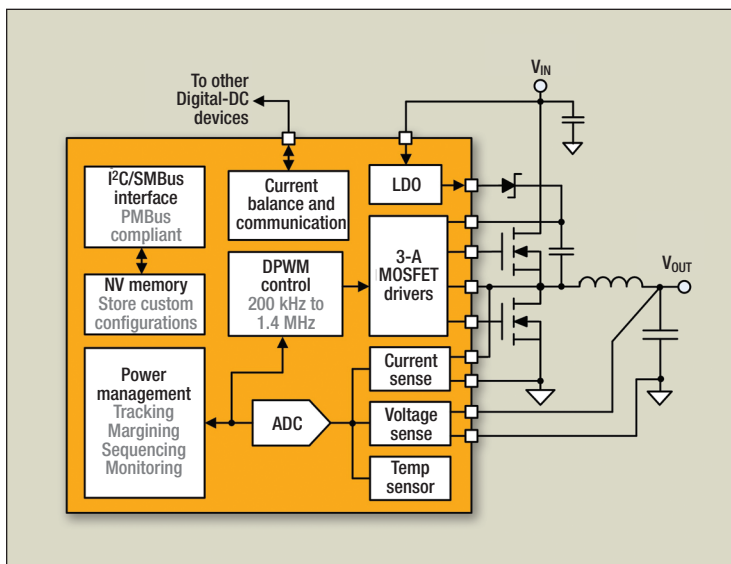
In addition, the ZL2004 integrates an external supply monitor that can be used to monitor the bias supply required by the external driver/FET IC. Both devices are housed in QFN packages, which measure 6 mm × 6 mm for the ZL2006 and 5 mm × 5 mm for the ZL2004.

Operating from a 3-V to 14-V input, the ZL2006 generates 0.54-V to 5.5-V output. The ZL2004 accepts a 4.5-V to 16-V input and produces a 0.5-V to 4-V output. Like the company's previous controllers such as the ZL2005, the new devices can be configured via pinstrapping, external resistors or over the I²C bus via PMBus commands.

The new controllers also employ the company's adaptive deadtime control to optimize efficiency over variations in voltage, current, temperature and component aging.

However, the ZL2006 and ZL2004 add features such as adaptive diode emulation, adaptive frequency control, phase adding/shedding and adaptive compensation. Adaptive diode emulation prevents a synchronous buck converter's low-side MOSFET from turning on at low current levels. This action prevents the converter from sinking current (and removing energy from the output capacitor, which lowers efficiency) to maintain regulation. Another feature for improving light-load efficiency — adaptive frequency control — enables the controllers to reduce switching frequency within a predefined range as load levels decrease.

The phase adding/shedding feature applies when ZL2006



Designed to implement a compact 40-A synchronous buck converter, the ZL2006 controller incorporates new algorithms that enhance efficiency at light loads, adapt compensation to loading conditions, and facilitate the adding and dropping of phases.

or ZL2004 controllers are configured for multiphase operation. Both controllers can turn phases on or off to optimize efficiency as load levels change. Phase dropping can also be used to remove one or more phases when a fault arises, which enables redundant operation. Adaptive compensation refers to the ability of the controllers to dynamically modify loop compensation coefficients in response to varying load conditions.

Both the ZL2006 and ZL2004 support accurate, robust current sharing between paralleled ICs through the company's single-wire Digital-DC bus, which is another new feature. This high-speed bidirectional bus also provides a flexible means for Zilker Labs' devices to perform autonomous, event-based sequencing and fault spreading between connected ICs, while eliminating the need for interaction by a host processor or the introduction of a secondary master on the SMBus interface.

The ZL2006 and ZL2004 are now available for general sampling. Pricing starts at \$2.95 each in quantities of 1000. Evaluation kits are also available for both products. The efficiency curves for the ZL2006 are shown in the online version of this article. For more information, see www.zilkerlabs.com.

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