Technical Article

Multiphase DC/DC Converters Provide Low Ripple, Integrated Solution for FPGA Power Designs

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For years, multiphase DC/DC converters have powered multicore processors in servers, mobile phones, tablets and PCs. Today's modern field-programmable gate arrays (FPGAs) now integrate multicore processors, such as the Xilinx Zynq-7000 series, which features an ARM dual-core Cortex-A9 processor. As multicore processors spread into FPGA, industrial and automotive applications, multiphase DC/DC converter usage continues to grow because of its ability to meet size and thermal constraints.

Multiphase converters have many advantages for powering multicore processors and FPGAs in several applications due to their reduced power losses, low output ripple and fast transient response. To better understand these advantages, let's review the Xilinx® Zynq®7000 series 5W Small, Efficient, Low-Noise Power Solution reference design (TIDA-00574), which demonstrates how the LP8758-B0 multiphase converter can provide a low-ripple, compact-solution-size, FPGA power solution for industrial designs with effective sequencing (see Figure 1). This reference design can help to improve an engineer's design cycle by providing a verified design and layout that meets the power requirements for several 5W Zynq FPGAs. The smallest components were chosen to minimize the amount of board space used, while still providing the performance needed to power FPGA rails.

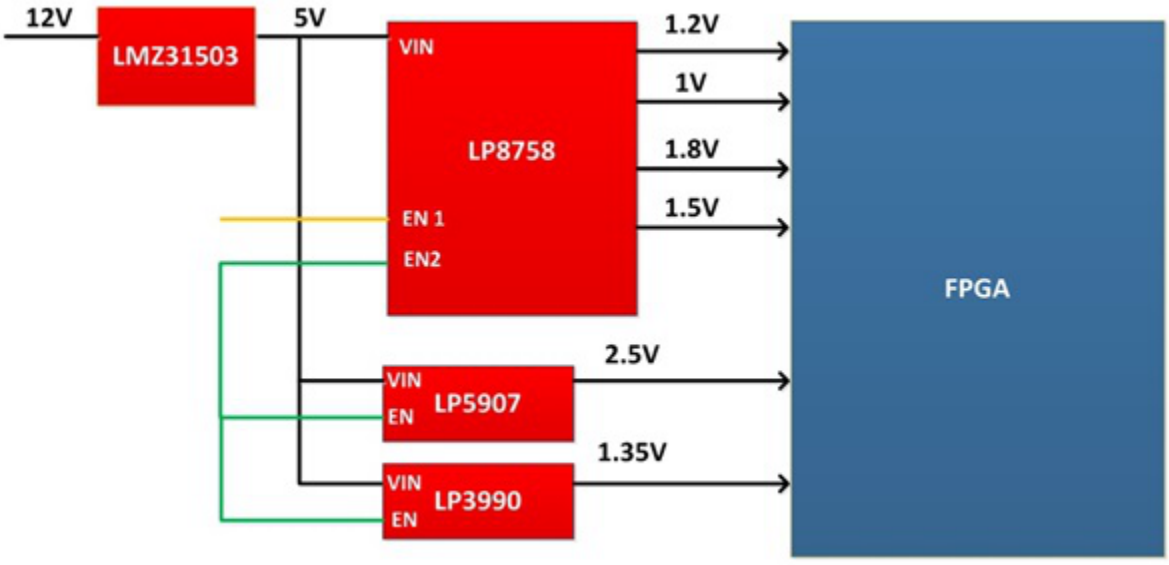

Figure 1. Xilinx Zynq 5W Small-solution-size Power Design

In this design, the LMZ31503, a 3A step-down converter module, supports conversion from a 12V intermediate rail, while offering a small footprint, 2.8mm height and good efficiency over the load range. The LMZ31503 module features an integrated inductor and only one input and output capacitor. The LP8758-B0 is configured to allow multiple output rails to support the Zynq's power requirements. For this FPGA's lowest power rails, the design uses a tiny LP5907 low-dropout regulator (LDO)with the market's smallest 0.65mm-by-0.65mm package, which features an enable pin for sequencing power rails.

The high switching frequency of the LP8758-B0 allows for an overall solution size of ~67mm² with 2010 or 2016 size inductors with 1mm height. This compact design allows for point-of-load capacitor placement very close to

the FPGA supply pin to meet the required supply ripple of <30m (see Figure 2). The LP8758 evaluation module (EVM) also has the option to add several point-of-load capacitors to optimize for transient performance.

GTP Transceiver (XC7Z015 Only)					
$V_{MGTAVCC}$ (11)	Analog supply voltage for the GTP transmitter and receiver circuits	0.97	1.0	1.03	V
$V_{MGTAVTT}$ (11)	Analog supply voltage for the GTP transmitter and receiver termination circuits	1.17	1.2	1.23	V

Figure 2. Xilinx XC7Z015 Transceiver Voltage Supply Requirements.

The multiple output LP8758-B0 offers integrated FETs, low bill of materials and features effective thermal performance because of its efficiency, as shown in Figure 3. The LP8758-B0 has the ability to sequence with multiple EN inputs, meaning an external sequencer such as the LM3880 is not required. At maximum power dissipation, the LP8758 only reaches a maximum temperature of 49°C. Due to the ability to maintain low temperatures, the TIDA-00574 design will be robust and provide reliability to power FPGA's in space-constrained applications.

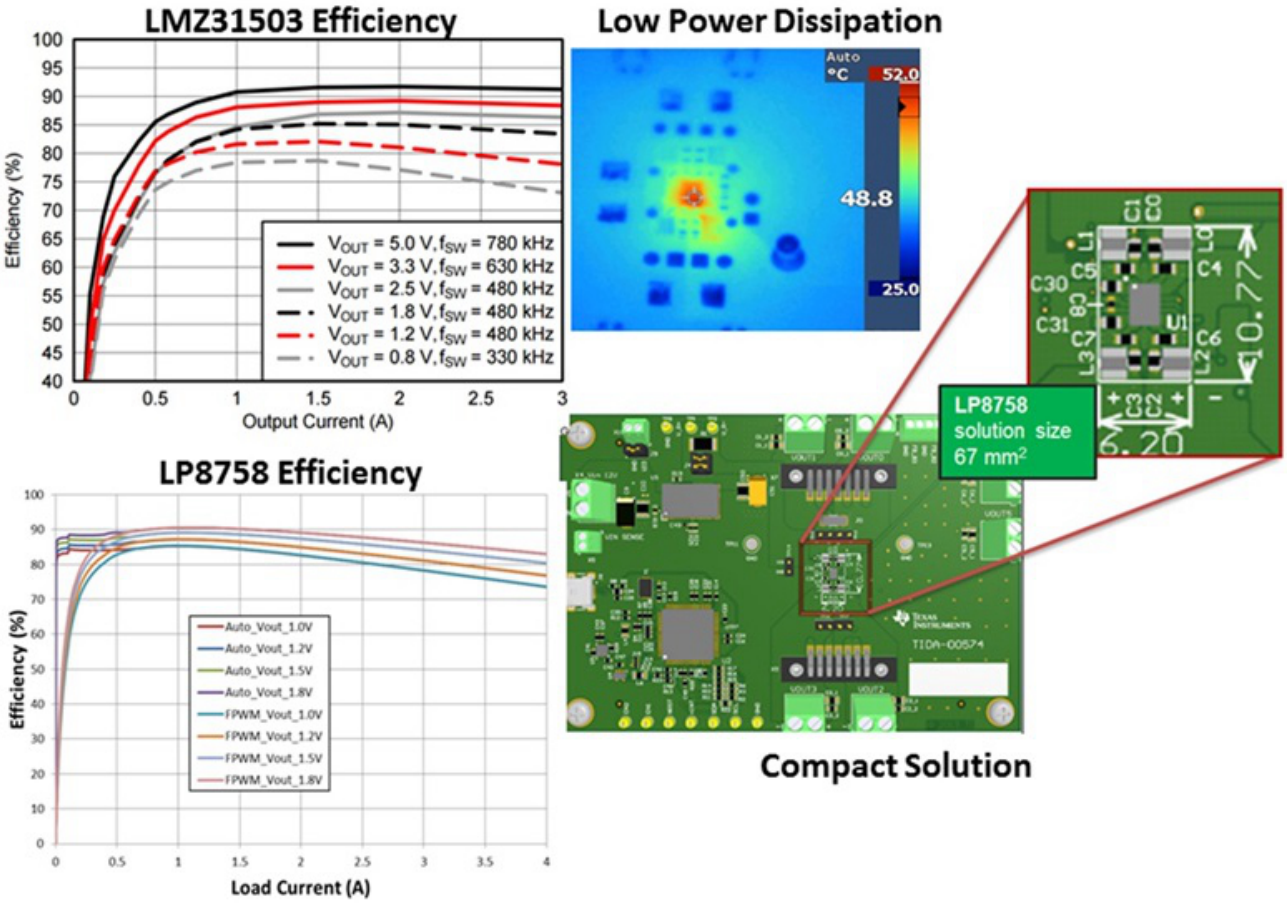

Figure 3. See LMZ31503 Efficiency, LP8758 Efficiency Plots for 2.5V, 1.8V, 1.2V, 1.0V Outputs over Different Load Current, Layout Area, and Thermal Image of Design

This design is only one of the many ways to use multiphase DC/DC converters to provide low-ripple, fast transient, and compact board space to power FPGAs or processors. To learn more ways to use small multiphase converters, read my upcoming posts.

Additional Resources

- View the LP8754 product folder.

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