LINEAR TECHNOLOGY

DESIGN NOTES

Isolated Converters Have Buck Simplicity and Performance

Design Note 377

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Buck converter designers have long benefited from the simplicity, high efficiency and fast transient response made possible by the latest buck controller ICs, which feature synchronous rectification and PolyPhase® interleaved power stages. Unfortunately, these same features have been difficult or impossible to implement in the buck converter's close relative, the forward converter, often used in isolated industrial and telecom applications. That is, until now. The LTC®3706 secondary-side synchronous controller and its companion smart gate driver, the LTC3725, make it possible to create an isolated forward converter with the simplicity and performance of a buck converter.

Simple Isolated 3.3V, 30A Forward Converter

Many isolated supplies place the controller IC on the input (primary) side and rely on indirect synchronous rectifier timing and optoisolator feedback to control the output (secondary). The circuit shown in Figure 1 offers a more direct approach using fewer components. The LTC3706 controller is used on the secondary and the LTC3725 driver with self-starting capability is used on the primary. When an input voltage is applied, the LTC3725 begins a controlled soft-start of the output voltage. As the output voltage begins to rise, the LTC3706 secondary controller is quickly powered up via T1, D1 and Q2. The LTC3706 then assumes control of the output voltage by sending encoded PWM gate pulses to the LTC3725 primary driver via signal transformer, T2. The LTC3725 then operates as a simple driver receiving both input signals and bias power through T2.

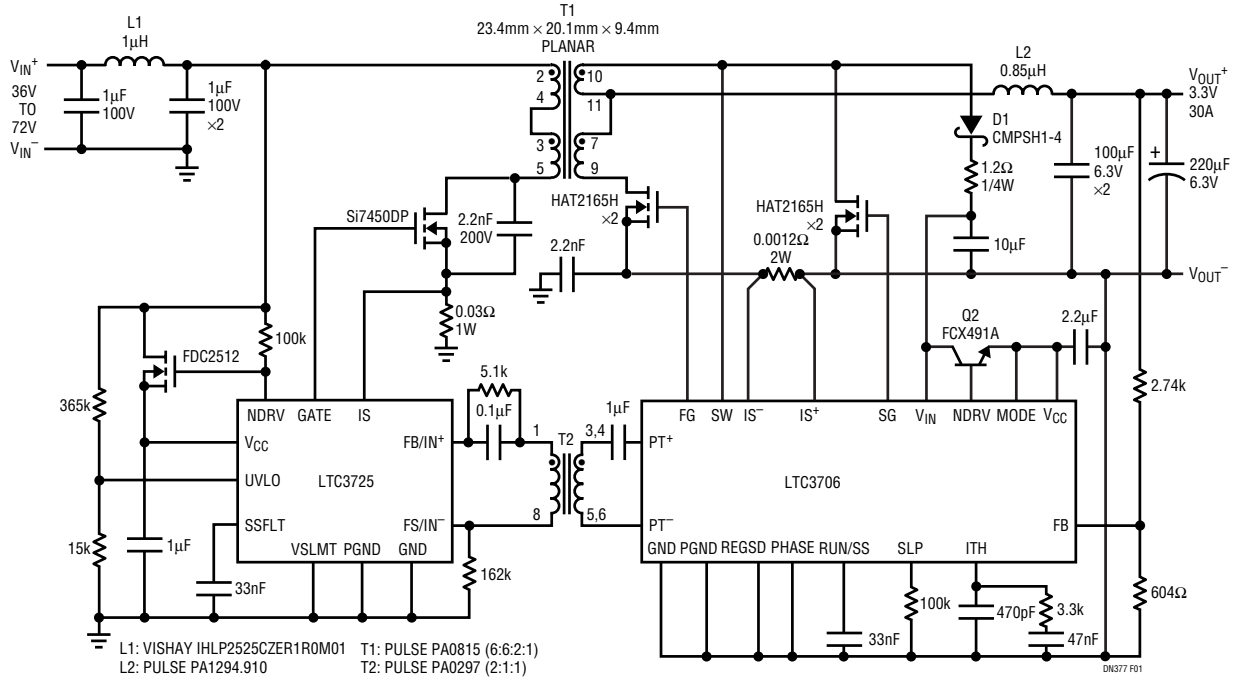

Figure 1. Complete 100W High Efficiency, Low Cost, Minimum Part Count Isolated Telecom Converter. Other Output Voltages and Power Levels Require Only Simple Component Changes

The transition from primary to secondary control occurs seamlessly at a fraction of the output voltage. From that point on, operation and design simplifies to that of a simple buck converter. Secondary sensing eliminates delays, tames large-signal overshoot and reduces output capacitance. The design shown in Figure 1 features off-the-shelf magnetics and high efficiency (see Figure 2).

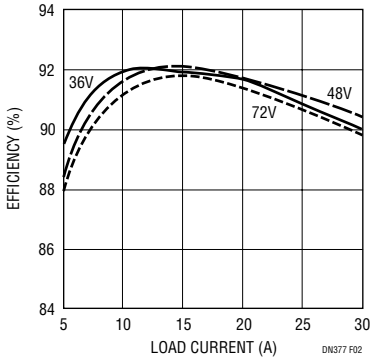

Figure 2. 36V to 72V_{IN} to 3.3V_{OUT} Efficiency

PolyPhase Design Ups Power Limit

The LTC3706 defies typical forward converter power limits by allowing simple implementation of a PolyPhase current share design. PolyPhase operation allows two or more phase-interleaved power stages to accurately share the load. The advantages of PolyPhase current sharing are numerous, including much improved efficiency, faster transient response and reduced input and output ripple.

The LTC3706 supports standard output voltages such a 5V, 12V, 28V and 52V as well as low voltages down to 0.6V. Figure 3 shows how easy it is to parallel two 1.2V supplies to achieve a 100A supply. Figure 4 shows the excellent output inductor current tracking during a 0A to 100A load current step and the smooth handoff during start-up to secondary-side control at 0.5V output.

Related Products

The LTC3705 is a dual switch forward driver version of the LTC3725 single switch forward driver. The LTC3705 includes an 80V (100V transient) high-side gate driver. The 2-switch topology eliminates transformer reset concerns, further simplifying design.

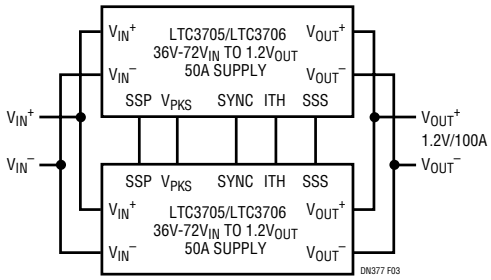

Figure 3. Paralleling Supplies for Higher Power Operation

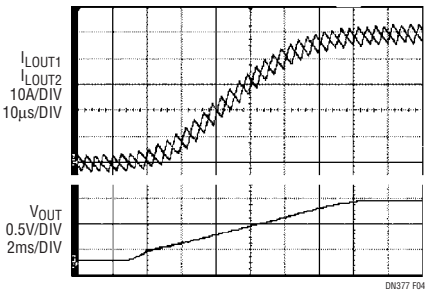

Figure 4. 1.2V, 100A Load Current Step (Top Trace) and Start-Up (Bottom Trace)

The 16-pin LTC3726 secondary controller is an option to the 24-pin LTC3706. The LTC3726 does not include the remote voltage sensing or the linear regulator features found in the LTC3706, so it is suitable in a single phase design or as a PolyPhase slave device. Both controllers may be used without the primary driver for nonisolated applications.

Features

These ICs include features that provide robust performance with few external parts and a simple feedback loop. For example, the LTC3725 primary driver includes a linear regulator controller and internal rectifier, eliminating the need for a primary bias supply. The LTC3725 also includes a volt-second and primary current limit. The LTC3706 controller includes a synchronous rectifier crowbar and remote voltage sensing.

Conclusion

The new LTC3706 controller and LTC3725 driver bring an unprecedented level of simplicity and performance to the design of isolated supplies. These two devices work together to offer high efficiency, low cost solutions using off-the-shelf external components.

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