

DESIGN NOTES

Simple High Efficiency Isolated Flyback Supply Without Optoisolator – Design Note 1011

Ryan Huff

Introduction

While simplicity and high efficiency (for cool running) are no longer optional features in isolated power supplies, it is traditionally difficult to achieve both. Achieving high efficiency often requires the use of advanced topologies and home-brewed secondary synchronous rectification schemes once reserved only for higher power applications. This only adds to the parts count and to the design complexity associated with the reference and optocoupler circuits typically used to maintain isolation. Fortunately, a breakthrough IC makes it possible to achieve both high efficiency and simplicity in a synchronous flyback topology. The LT[®]3825 simplifies and improves the performance of low voltage, high current flyback supplies by providing precise synchronous rectifier timing and eliminating the need for optocoupler feedback while maintaining excellent regulation and superior loop response.

High Performance 48V to 3.3V, 12A Supply

The circuit in Figure 1 shows an isolated, *no-opto*, synchronous flyback, 48V to 3.3V at 12A supply. Figure 2 shows its efficiency. The converter's efficiency of over 88% at the nominal input voltage of 48V and an output

current of 12A compares favorably to that of a higher parts count forward converter design. This is primarily the result of a simple, well-controlled implementation of synchronous rectification. Furthermore, due to its high efficiency operation, the greatest temperature rise of any component is only 60°C above the ambient temperature with a paltry 100LFM of airflow.

The use of the feedback winding to regulate the output voltage vs an optocoupler and secondary-side reference yields great results. The regulation curve shown in Figure 3 shows that $\pm 1.25\%$ is easily attainable. Figure 4 shows the supply's transient response for a 9A to 12A load step at a 10A/ μ s slew rate with a 48V input. With this 25% load step, the output voltage remains within $\pm 3\%$ of its set point.

LT3825 Operation

Instead of using a parts intensive secondary-side voltage reference and error amplifier to drive an optocoupler, the primary bias winding on the flyback transformer (T1) is

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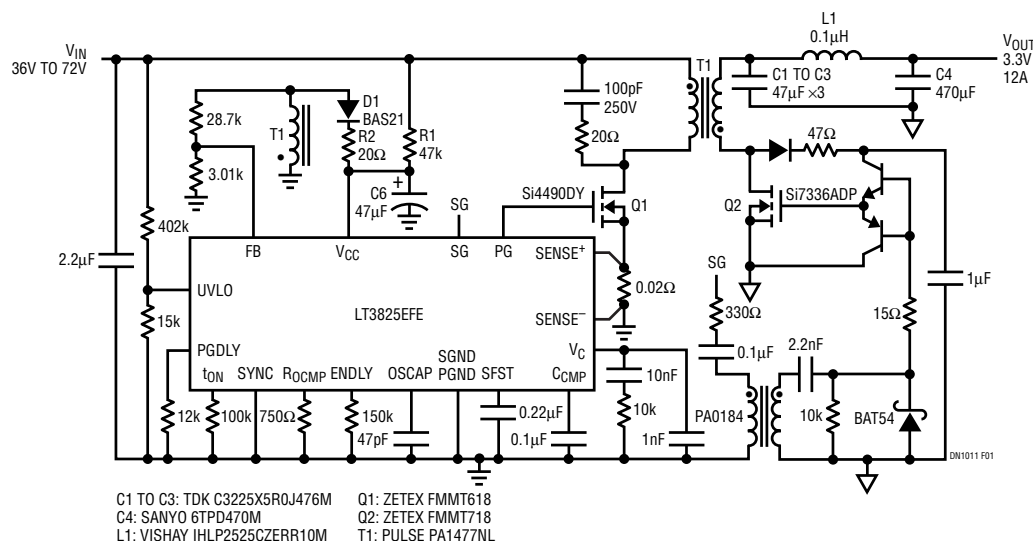


Figure 1. Simple, High Efficiency 36V_{IN}-72V_{IN} to 3.3V_{OUT} at 12A Synchronous Flyback

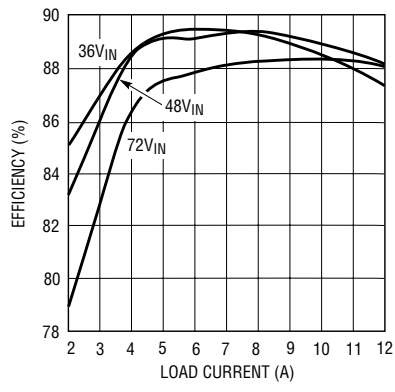


Figure 2. Efficiency of Circuit in Figure 1

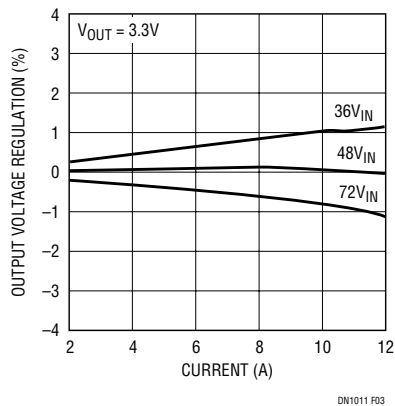


Figure 3. Output Voltage Regulation of Circuit in Figure 1

used (see Figure 1). Proprietary feedback circuitry inside the LT3825 reads the reflected output voltage information on this winding during the flyback pulse. This voltage is then compared to a precision internal reference and an error signal is obtained. The error signal is used to modulate the on-time of Q1 in such a way as to regulate the output voltage. An important benefit of this technique is that output voltage information arrives at the controller instantly after the switching cycle is terminated. In a conventional optocoupler-based design, delays of tens to hundreds of microseconds occur in the optocoupler alone, severely limiting the converter's transient response.

The synchronous rectifier output (SG pin) of the LT3825 makes driving the synchronous rectifier MOSFET (Q2) simple while maintaining a low parts count. Setting the dead-time of Q2 relative to Q1 only requires one resistor to program. Avoiding traditional, more

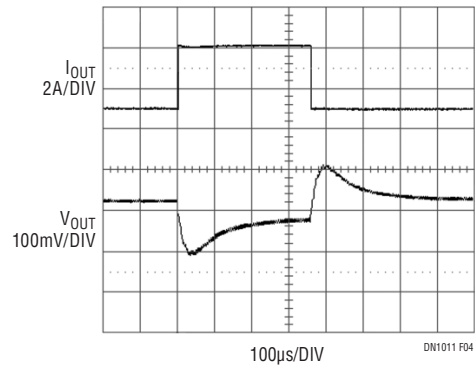


Figure 4. 9A to 12A to 9A Load Current Step (Top Trace) and Output Voltage (Bottom Trace) Response for Circuit in Figure 1

complicated, discrete timing circuits allows the designer to set optimum dead-times since this timing is well controlled within the LT3825. The LT3825 also precludes the need for a secondary-side synchronous controller IC and its associated circuitry.

Additional Features

An optional, resistor programmable, input undervoltage lockout is available. The slew rate of the output voltage during start-up can be controlled with an optional soft-start capacitor; this also limits the inrush current of the input power supply. Since the LT3825 incorporates current mode control, both short-circuit behavior and ease of loop compensation are improved over voltage control schemes. Switching frequency is selectable from 50kHz to 250kHz optimizing the solution size vs efficiency. The switching frequency can be synchronized to an external system clock for further flexibility.

Related Controller

For lower input voltages (5V to 18V) and an even simpler design, the LT3837 is available to compliment the LT3825. The LT3837 starts up and runs with the input voltage connected directly to the V_{CC} pin, so no bias supply is needed, eliminating components D1, C6, R1, and R2 from the schematic in Figure 1.

Conclusion

The LT3825 allows a designer to improve the performance of isolated flyback circuits while lowering parts count, simplifying implementation and eliminating the need for an optoisolator.

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