Design Note

1000V Output, No-Opto Isolated Flyback Converter

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Introduction

Isolated flyback converters are used in automotive, industrial, medical and telecom applications where the power supply must be reliable, easy-to-use, high voltage and isolated, and must provide excellent regulation over load, line and temperature. LT®8304-1 is an isolated no-opto flyback converter specially optimized for high output voltage applications—providing outputs up to 1000V.

Traditionally, the regulation feedback loop requires a bulky high voltage divider to directly sense the high output voltage, along with opto-couplers to convey feedback information back through the isolation barrier. The bulky resistor solution results because a 1206 resistor can handle 200V maximum. So to sense 1000V, at least six 1206 resistors are required, plus a small bottom resistor.

1000V/15mA Output, from a 4V–28V Input

An LT8304-1 flyback converter design features a low component count. Figure 1 shows a complete 4V–28V input to 1000V output solution capable of supporting 15mA loads. The output current capability increases with input voltage, reaching 13mA when the input voltage is greater than 24V. The LT8304-1's ability to sense the output voltage through the primary-side waveform eliminates the need for a bulky high voltage divider, and no-opto coupler is required.

The guidelines for calculating voltage and current stress on the components surrounding the LT8304-1 are detailed in the LT8304-1 data sheet. Notably, this 1000V solution uses a transformer with three split-output windings on the secondary side. The primary side to secondary side turns ratio is 1:10:10:10, instead of a single-secondary-winding 1:30 transformer. The 1:10:10:10 transformer enables the output voltage stress to be split among three high voltage output diodes and three high voltage output capacitors. Individual component voltage ratings need only be one-third of the total voltage, facilitating more options for output diode and output capacitor selection.

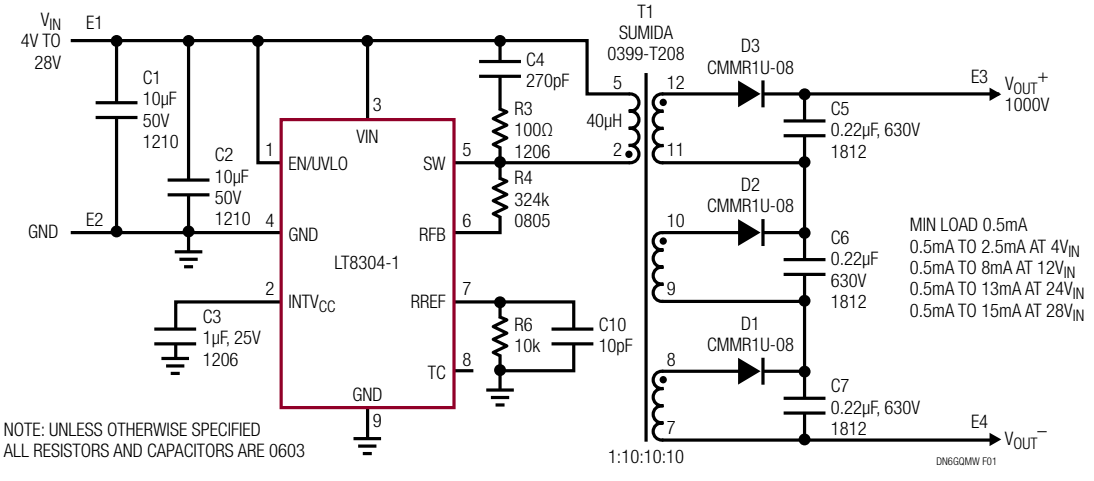

Figure 1. A Complete 1000V/15mA Isolated Flyback Converter from a 4V–28V Input

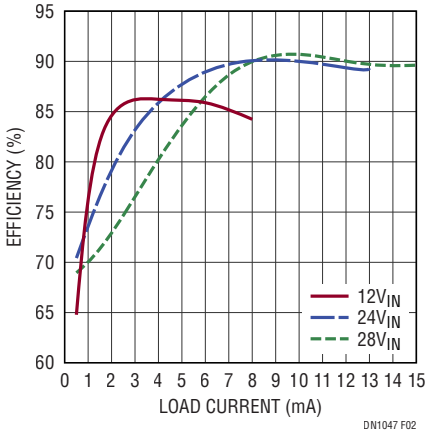

Figure 2. Efficiency of Figure 1 at Various Input Voltages

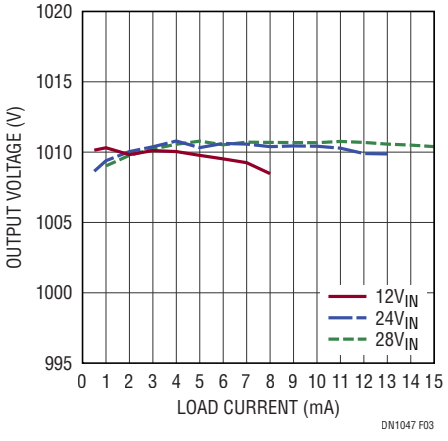

Figure 3. Load Regulation of Figure 1 at Various Input Voltages

Figure 2 shows efficiency at various input voltages. This flyback converter achieves 90.5% peak efficiency. Even with no opto-coupler, load regulation at different input voltages remains tight, typically 2% to 3%, as shown in Figure 3.

800V/10mA Output, from 4V–18V Input

Figure 4 shows a complete 4V–18V input to 800V output solution capable of providing up to 10mA output current. This flyback converter achieves 88.2% peak efficiency when the input is 18V and the load current is 10mA. Figure 5 shows the efficiency curve at different input voltages; Figure 6 shows the excellent load regulation. This solution also features a low component count.

Conclusion

The LT8304-1 is an easy-to-use monolithic micropower isolated flyback converter optimized for high output voltage applications. By sampling the isolated output voltage directly from the primary-side flyback waveform, complete solutions maintain tight regulation without either output voltage divider or opto-isolator. The output voltage is simply programmed with two external resistors and a third optional temperature compensation resistor. Boundary mode operation enables a small magnetic solution with excellent load regulation. A 2A, 150V DMOS power switch is integrated, along with all the high voltage circuitry and control logic, in a thermally enhanced 8-lead SO package. The LT8304-1 operates an input voltage range of 3V to 100V, and delivers up to 24W of isolated output power.

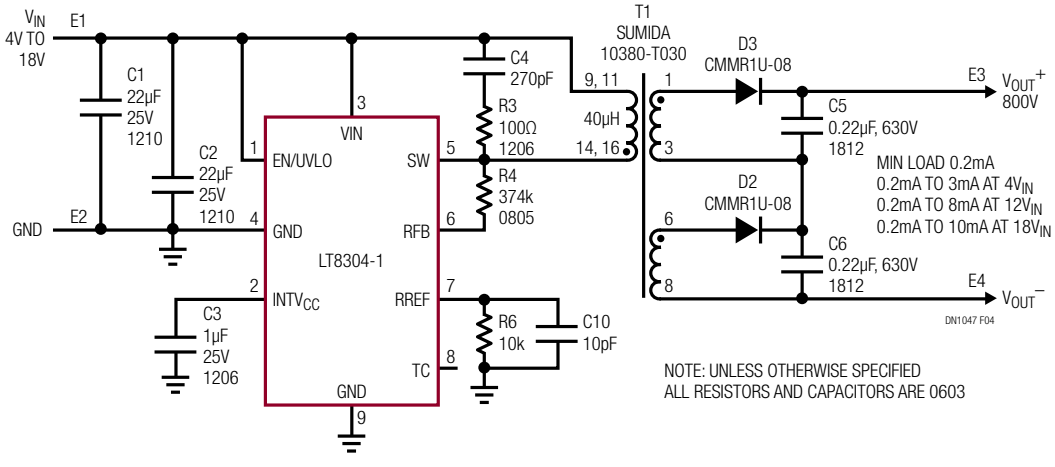

Figure 4. A Complete 800V/10mA Isolated Flyback Converter from a 4V–18V Input

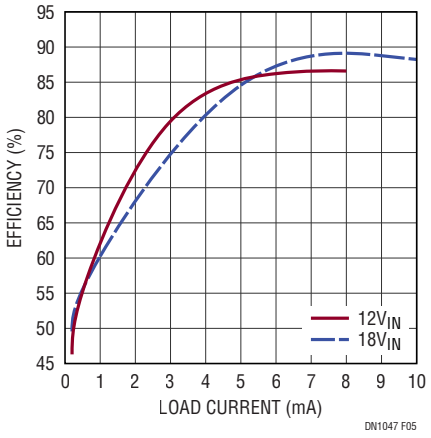

Figure 5. Efficiency of Figure 4 at Various Input Voltages

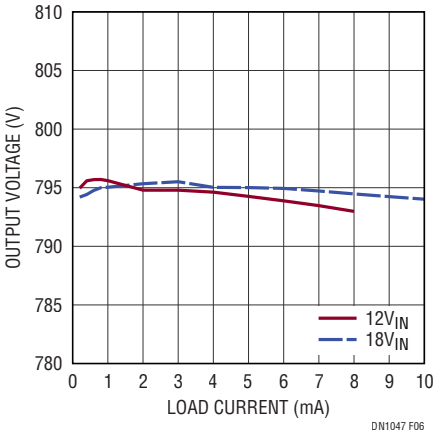

Figure 6. Load Regulation of Figure 4 at Various Input Voltages

Data Sheet Download
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