Technical Article
How an auxless GaN flyback converter can solve AC/DC adapter design challenges

TEXAS INSTRUMENTS

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The increasing demand for smaller, more efficient power supplies is driving the rapid proliferation of gallium nitride (GaN)-based power stages. In the AC/DC adapter market, manufacturers are quickly leveraging GaN flyback converters to help scale the growth of USB Type-C® connectivity with increasingly powerful, yet smaller adapters.

Although this is exciting, power-supply designers must also simultaneously reduce both system cost and complexity. Recent innovations in flyback converter design have made it possible to eliminate the use of the auxiliary winding for device bias ("auxless") without sacrificing efficiency.

In this article, I'll explore how the UCG28826 integrated GaN flyback converter from TI can help you overcome AC/DC adapter design challenges.

Removing the transformer auxiliary winding

A common obstacle to achieving a superior flyback design arises from the need to generate converter bias. As shown in Figure 1, typical flyback power supplies will generate converter bias through an auxiliary transformer winding, which alongside the additional bias power-conversion circuitry becomes a source of higher cost, higher component count, and power loss.
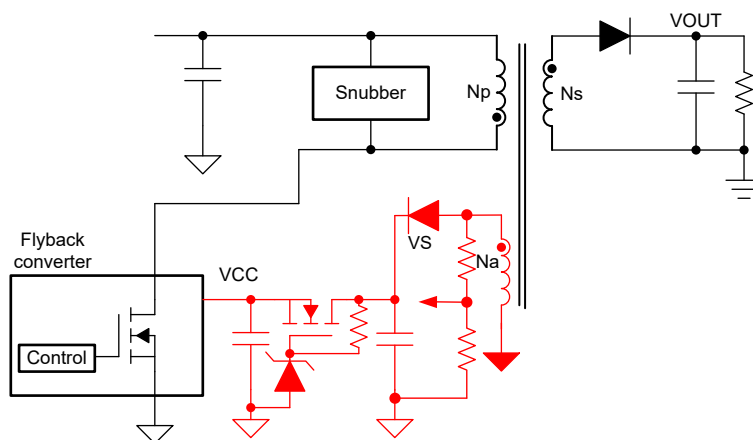

Figure 1. Typical VCC bias power-conversion and sensing circuitry

The undesirable effects of generating converter bias are more apparent in the case of USB Power Delivery (PD) adapters, which provide variable output voltages in order to accommodate different load requirements. Since the auxiliary winding voltage is directly proportional to the output voltage, you must set the turns ratio to ensure that the bias supply voltage (VCC) remains higher than the minimum operating voltage when the output voltage is at its lowest. Thus, a transition from the lowest to highest output voltage will increase the auxiliary winding voltage many times over (as shown in Figure 2), causing high voltage stress on the VCC pin. This necessitates the use of an additional bias power-conversion stage that decreases efficiency and increases solution complexity.

Output voltage		Auxiliary winding voltage	
6x increase	3.3V	**6x increase**	10V
	20V		60.6V

Figure 2. Example of flyback output voltage impact on the auxiliary winding voltage

The UCG28826 resolves this challenge by introducing self-bias management. As shown in Figure 3, self-biasing enables the device to efficiently gather bias energy through the connection to the switch node. The device then transfers the harvested energy to charge the VCC capacitor, and the power supply can achieve efficient bias supply management without the use of an auxiliary winding, bias power-conversion circuitry and any additional related components. An auxless flyback design helps reduce system cost, size and complexity while simultaneously improving efficiency.
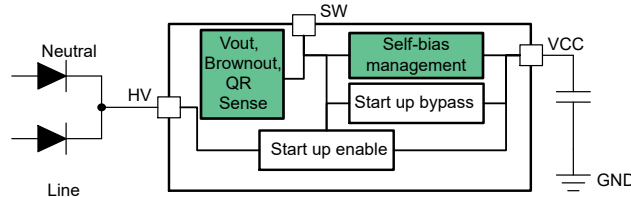

Figure 3. Block diagram of the UCG28826 with self-bias and auxless sensing

Mitigating EMI with an integrated converter solution

A common drawback when using converters that provide higher levels of integration is a decrease in design flexibility. For example, in order to reduce electromagnetic interference (EMI), a popular technique is to leverage a resistor in series with the gate of the metal-oxide-semiconductor field-effect transistor (MOSFET). Adjusting the resistor value accordingly adjusts the switch-node slew rate, providing an easy way to fine-tune the EMI generated by the flyback. Of course, integrating the MOSFET into the flyback converter makes this impossible, reducing tunability and increasing the design time needed to achieve EMI compliance.

The UCG28826 introduces numerous options for design configurability. By adjusting the value of the resistor connected to one of the dedicated configuration pins, you can modify a few different parameters, including the gate drive strength. You can then adjust the switch-node slew rate at MOSFET turn-on to fine-tune the EMI.
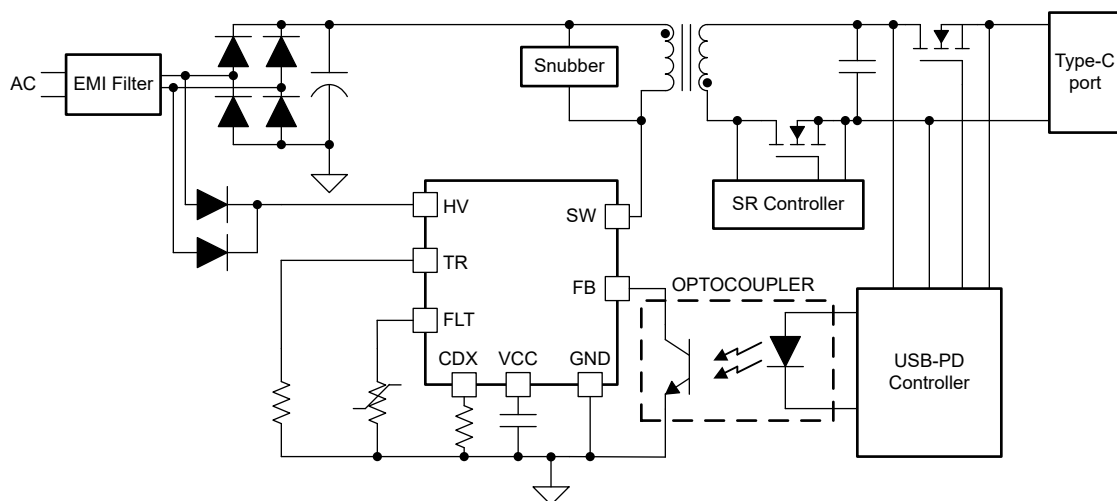

Figure 4. The UCG28826 in a simplified flyback design

Conclusion

With the proliferation of the USB Type-C ecosystem in our everyday lives, the demand to create smaller, more powerful and increasingly efficient AC/DC adapters continues to grow. Devices such as the UCG28826 auxless GaN flyback converter enable you to create such power supplies while simultaneously reducing system cost and complexity.

Additional resources

- Download the UCG28826 data sheet.
- View the UCG28826 evaluation module user's guide.
- Check out the flyback and flybuck architecture page, the GaN technology page and the USB Type-C technology page.

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