Flyback topology – Accurate Primary Side Sensing

Describes how CamSemi can achieve tight regulation with primary side sensing techniques

- Tight voltage regulation ±5%
- Proprietary and patented technique for tight current regulation ±5%
- Removal of up to 11 components used in feedback process

Overview

CamSemi primary side quasi-resonant flyback controllers are aimed at low power applications up to 8 watts, with some devices also targeting higher power >8 W. These controllers offers tight voltage and best in class current regulation without the need for secondary feedback found in the majority of today's flyback and RCC (ringing choke converter) approaches.

Primary Side Sensing controllers and the flyback topology have been around for a number of years, however the regulation on the output is poor ±10-15% and so unsuitable for applications where a tight voltage or current regulation is required, thus the need for feedback circuitry such as opto-couplers. CamSemi new techniques allow for a tight regulation (±5%) using primary side sensing using patented techniques.

Typical Flyback schematic with secondary side sensing

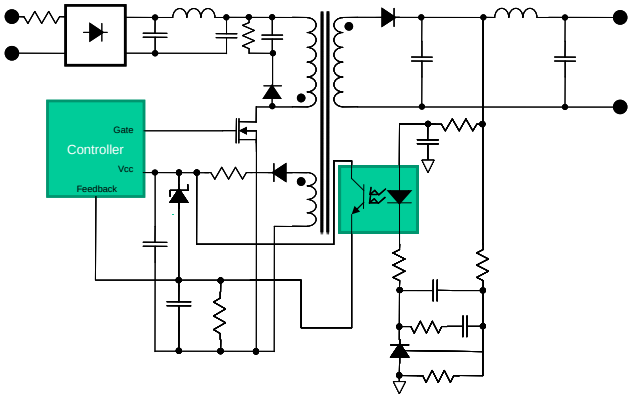


Figure 1: typical flyback schematic.

The above is a simplified schematic of a typical flyback circuit, with secondary side components such as an opto-coupler, voltage reference device and sundry others. Roughly 11 extra components are required at a cost of around US 20¢.

CamSemi Primary Side Sensing flyback circuit

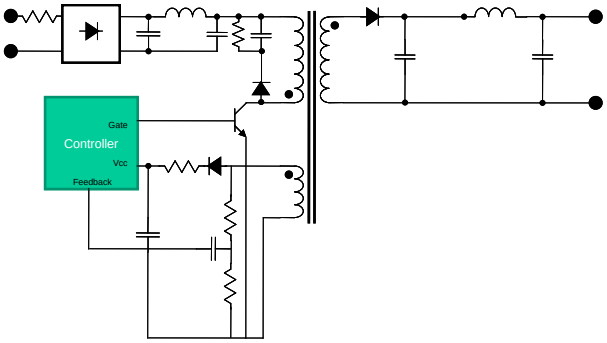


Figure 2:typical primary side sensing circuit

The above is a simplified schematic showing the removal of secondary side sensing components.

Note the primary switch is a Bipolar Transistor compared to a more expensive MOSFET which enables even more cost saving.

How tight output voltage regulation is achieved

Level Shifting and Capacitive Coupling

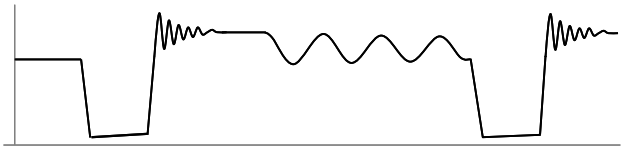


***Figure 3*: Full flyback waveform**

The above waveform is seen on the feedback pin of the controller.
Level shifting and Capacitive Coupling are used to allow full waveform to be examined

- Voltage divider placed directly across auxiliary winding gives visibility to total waveform
- Capacitive coupling used to block DC component
- Level shifting used on feedback pin to center waveform within power supply rail voltage

Accurate Voltage Signal on Auxiliary Waveform

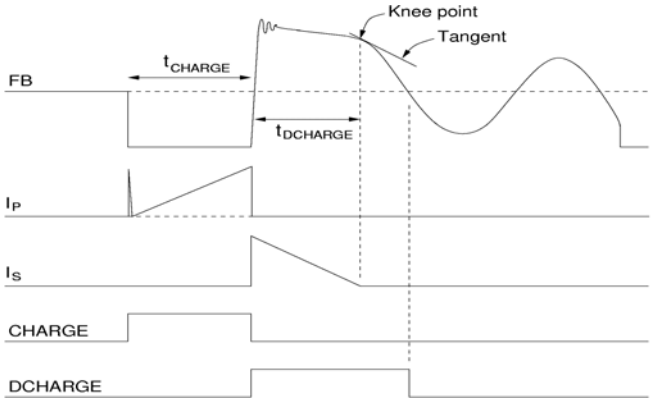


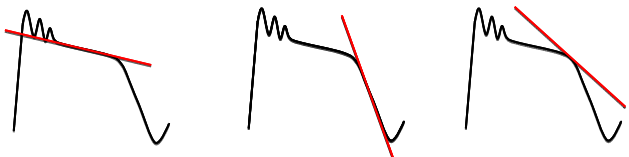
Figure 4: Waveforms in Flyback SMPS and C2160 IC

FB= Feedback pin on IC
Ip= Primary Current flowing
Is=Secondary current
Charge=Energy charge period
Discharge=Energy discharge period

- Output voltage only observable during "flyback" time, tDCHARGE
- When current flows in secondary, IS
  - Voltage drop across diode and secondary winding resistance
  - Accurate voltage measurement when current goes to zero
- Measure at knee to get an accurate measurement of output voltage

Tangent Detection

Determining the knee point is critical in getting very tight accuracy, CamSemi have developed a proprietary tangent detection method to do this.



Slope (dv/dt) determined by output current and circuit resistance known based on given power rating

Slope (dv/dt) determined by resonant frequency of transformer, known and controlled based on transformer design

By selecting an on chip reference (dv/dt) between these two slopes can accurately know when to sample the output voltage

Figure 5: Tangent detection method explained

How tight output current regulation is achieved

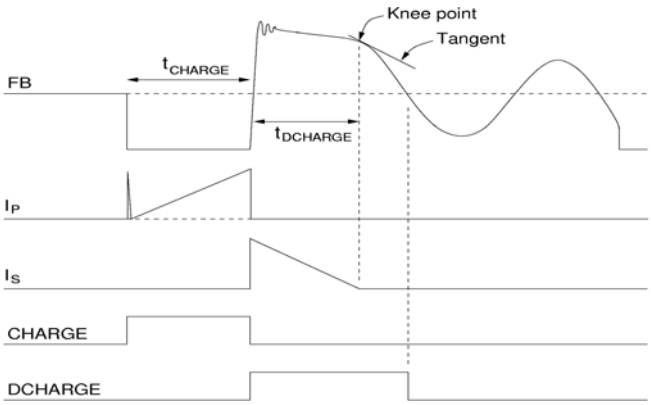


Figure 6: Waveforms in Flyback SMPS and C2160 IC

Primary current is monitored on the primary side via a current sense resistor providing good measurement for the average IP. The timings tCHARGE and tDCHARGE are available from FB waveform and switch timing
Knowing the various above parameters secondary current can be worked out using the below formula

$$I_{OUT} = K \frac{t_{DCHARGE}}{t_{CHARGE}} \langle I_P \rangle$$

Note: K is the transformer turns ratio

The key to the accurate current sensing is the accuracy of the tangent detection technique.

The above current regulation technique is proprietary and patented by CamSemi.

For more Information

For details of our channel partners and information on future product, technology or corporate announcements, visit www.camsemi.com

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