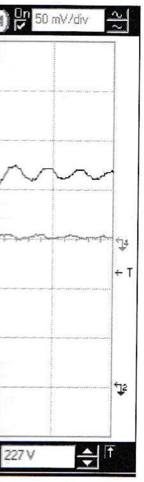

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(7-60a)

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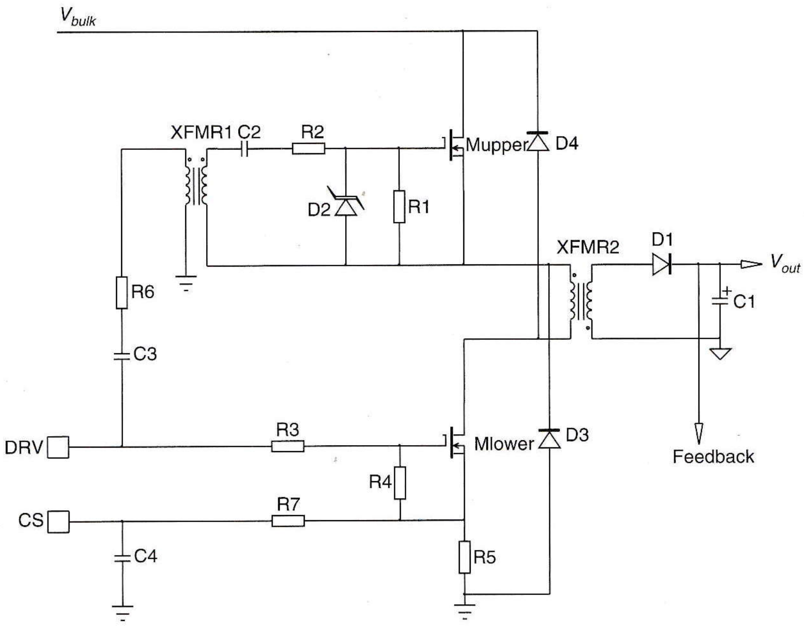

FIGURE 7-24a A two-switch flyback converter recycles the leakage energy at the opening of switches.

now uses two high-voltage MOSFETs but of smaller BV_{DSS}, compared to the single-switch approach. For instance, on a 400 V rail (assuming a PFC front-end stage), 500 V types can be implemented, implying a slightly better $R_{DS(on)}$ than their 600 V counterparts. The MOSFETs are turned on and off at the same time (same control voltage applied on the gate, the upper side floating with respect to ground). When both switches are conducting, the primary winding "sees" the bulk voltage. As the primary current reaches the peak limit, the controller classically instructs the switches to open. The current keeps circulating in the same direction and finds a path through the freewheel diodes D_3 and D_4. The transformer primary inductor immediately clamps to the reflected output voltage, and the leakage inductance resets with the following slope:

$$S_{leak} = \frac{V_{bulk} - \dfrac{V_{out} + V_f}{N}}{L_{leak}} \tag{7-60b}$$

If you carefully observe Fig. 7-24b, the current circulates via the bulk capacitor, naturally recycling the leakage energy: the efficiency clearly benefits from this fact. The secondary-side diode current ramps up at a pace imposed by the leakage reset, rather slow given the longer leakage reset time inherent to the structure. Yes, you have guessed it; if you reflect more voltage than the input voltage, your colleagues are going to applaud at the first power-on!

Figure 7-24c offers a way to simulate the two-switch flyback using a dedicated current-mode controller. You could also try to reproduce the Fig. 7-24a transformer-based driving circuit, but it would take a longer simulation time. By the way, best practice would be to use a transformer made of two secondary windings for a perfect propagation delay match between the two transistors. If you understand the sentence "cost down!" then you understand why it becomes a single winding based. A bootstrapped solution could be used, but at the expense of a small refresh circuitry for the capacitor. We will come back to this with the two-switch forward example. Figure 7-24d collects all pertinent waveforms obtained from the simulator. As you can see on