Remaining Switching Losses

Switching-related losses:
1. $C_{sw}$ → reduced (2nd function)
2. Overlap →
   - turn-on → reduced
   - turn-off → $\left( \frac{I_{sw}}{C_{sw}} \right)$
     - may increase (!)
3. Reverse Recovery → eliminated
4. $Q_g$ → no effect
5. Body diode conduction → reduce (at setting)
6. Shoot-through → alleviated
7. Additional parasites (L_d)
Chapter 20: Resonant Switch Topologies

• Introduction

• 20.1 The zero-current-switching quasi-resonant switch cell
  20.1.1 Waveforms of the half-wave ZCS quasi-resonant switch cell
  20.1.2 The average terminal waveforms
  20.1.3 The full-wave ZCS quasi-resonant switch cell

• 20.2 Resonant switch topologies
  20.2.1 The zero-voltage-switching quasi-resonant switch
  20.2.2 The zero-voltage-switching multiresonant switch
  20.2.3 Quasi-square-wave resonant switches

• 20.3 Ac modeling of quasi-resonant converters

• 20.4 Summary of key points

The resonant switch concept

General idea:
• PWM switch network is replaced by a resonant switch network
• This leads to a quasi-resonant or quasi-squarewave version of the original PWM converter

Example: realization of the switch cell in the buck converter
High Frequency Switch Network

Converter examples

High-frequency view of the switch network

Basic switch implementation options
- Q: single-quadrant (transistor)
- D: single-quadrant (diode)
- Q: current-bidirectional (e.g. MOSFET)
- D: current-bidirectional synchronous rectifier (e.g. MOSFET)

ZVS-QSW: Review

Converter examples

High-frequency view of the switch network

Basic switch implementation options
- Q: single-quadrant (transistor)
- D: single-quadrant (diode)
- Q: current-bidirectional (e.g. MOSFET)
- D: current-bidirectional synchronous rectifier (e.g. MOSFET)
Classification of Resonant-Switch Converters

ZVS-QR Buck
ZVS-QR State Plane

Averaging
Complete Solution

Wishlist: Multi-Resonant