High Frequency Power Electronics

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ECE 581 Lecture 29
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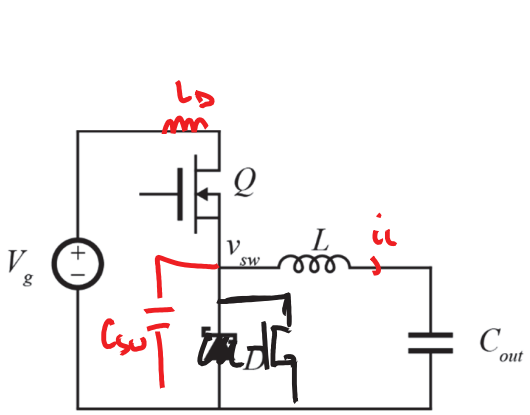
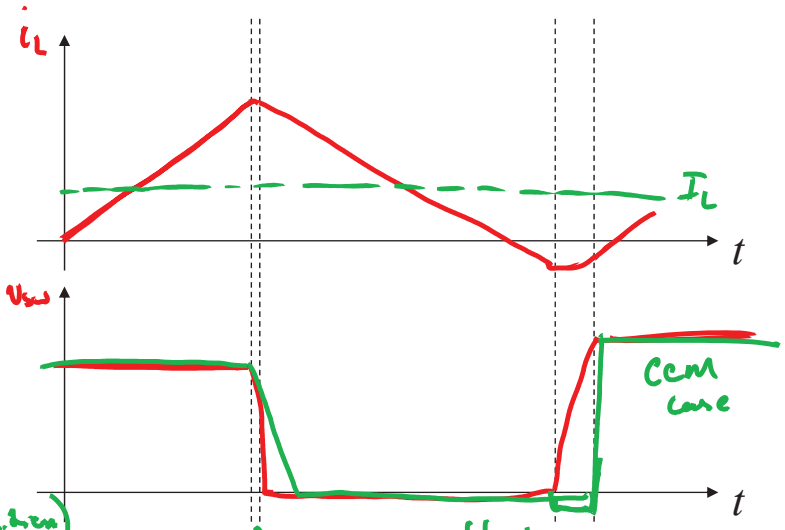
THE UNIVERSITY OF TENNESSEE KNOXVILLE

Remaining Switching Losses





Switching-related losses

1. C_{sw} → reduced (2^{nd} transition)
2. Overlap → { turn-on → reduced; turn-off → ($\frac{I_L}{C_{sw}} \ll \frac{i_{ind}}{C_{gd}}$) L_D may increase (!) }
3. Reverse Recovery → eliminated
4. Q_g → no effect
5. Body diode conduction → reduce (dt setting)
6. Shoot-through → alleviated
7. Additional parasitics (L_D) ?

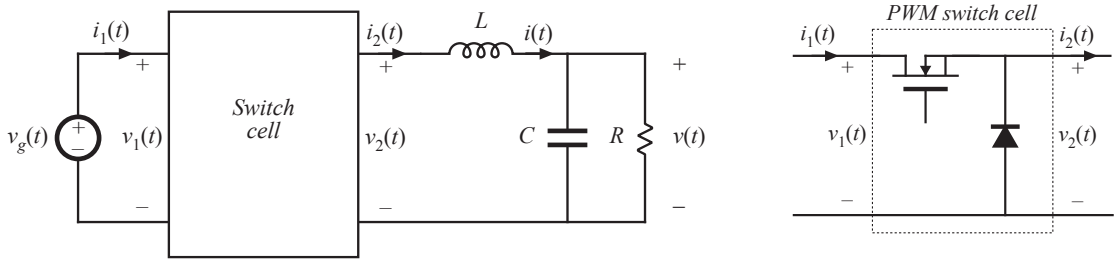
Chapter 20: Resonant Switch Topologies

- 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:

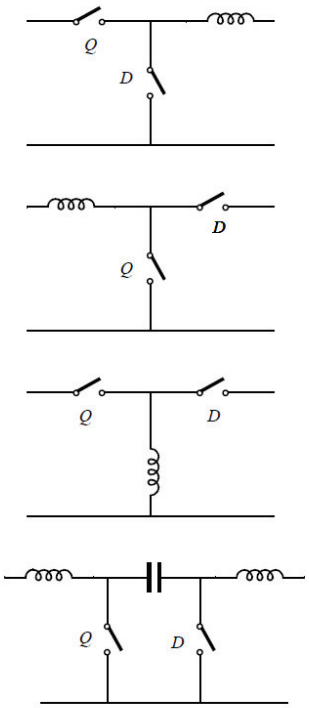
- PWM switch network is replaced by a resonant switch network
- This leads to a quasi-resonant or quasi-squarewave version of the original PWM converter



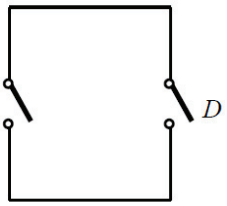
Example: realization of the switch cell in the buck converter

High Frequency Switch Network

Converter examples



High-frequency view of the switch network



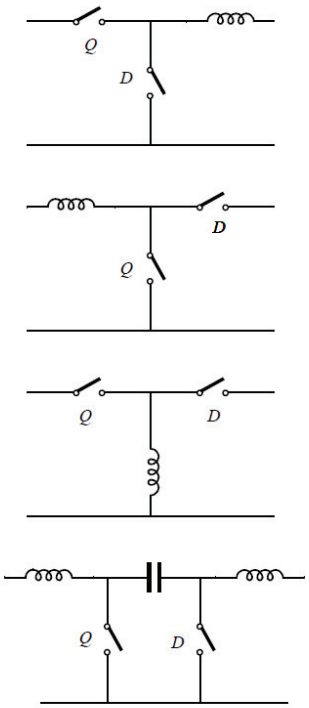
Basic switch implementation options

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



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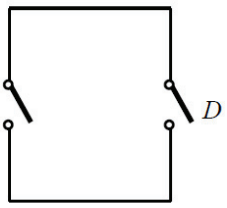

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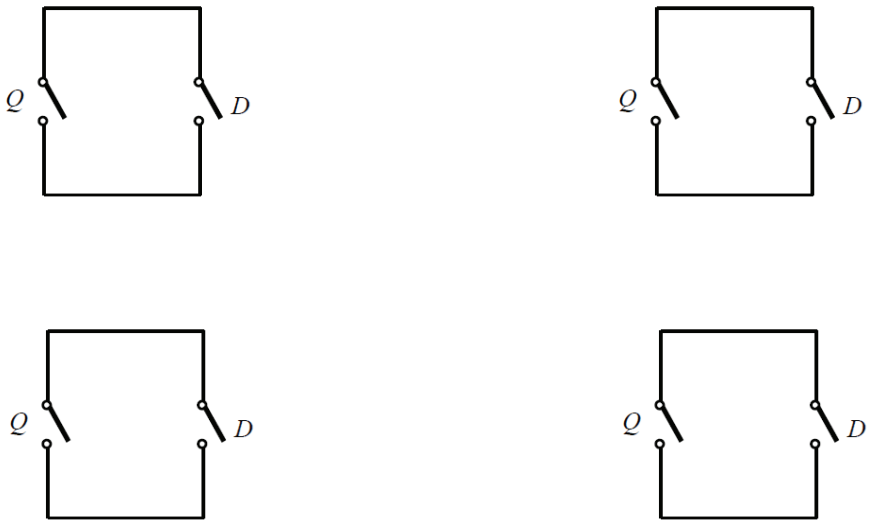
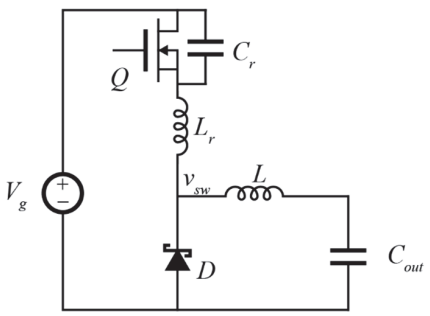
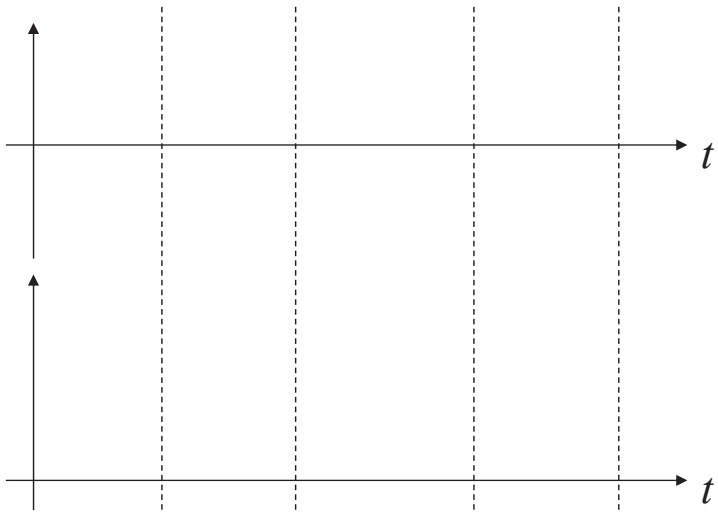
Classification of Resonant-Switch Converters

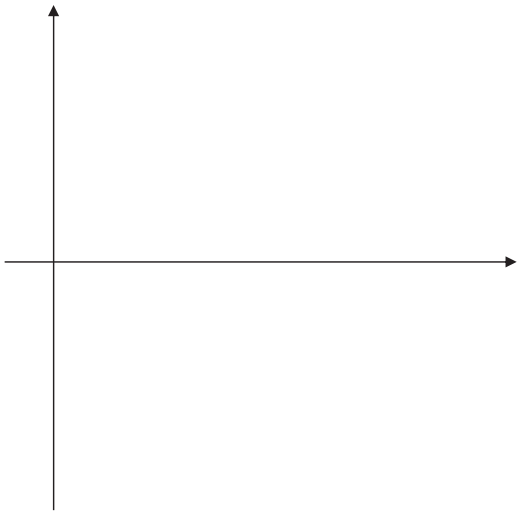


ZVS-QR Buck





ZVS-QR State Plane



Averaging

Complete Solution

Wishlist: Multi-Resonant