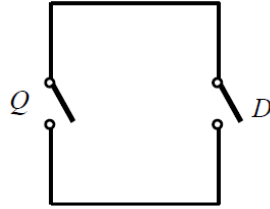
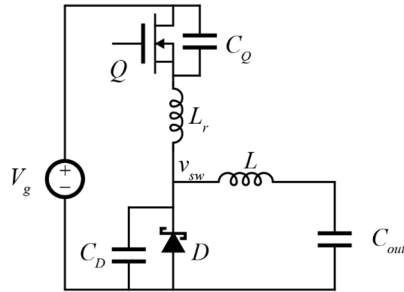


Wishlist: Multi-Resonant



ZVS-MR Buck



Operating Modes

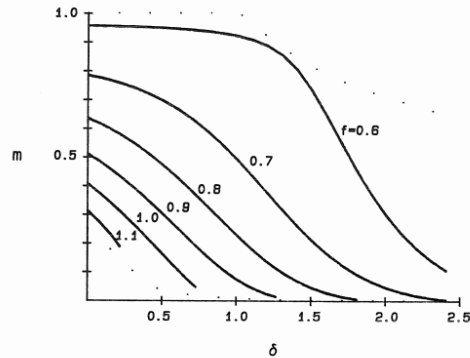


Figure 10.7: Load-to-output DC characteristics of a ZV-MR converter operating in modes (I, II)₁.

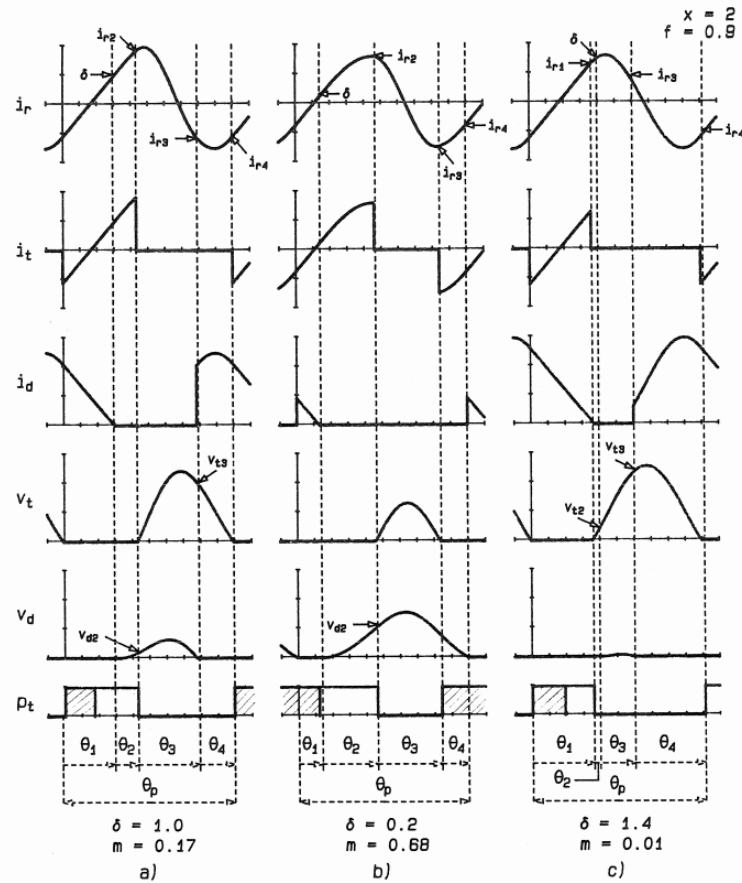
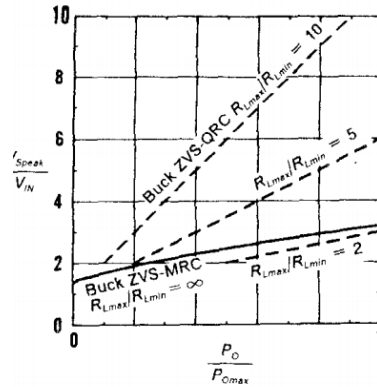
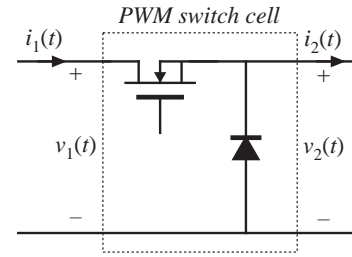
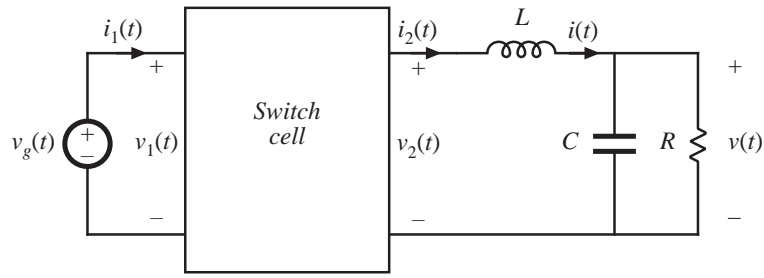
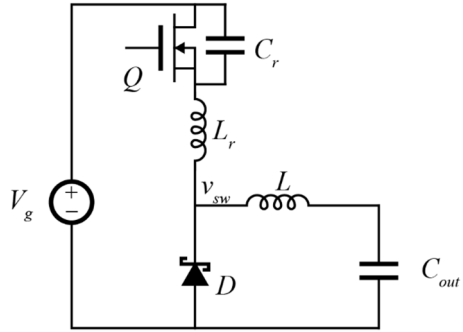


Figure 10.2: Typical waveforms for a ZV-MR converter operating in modes I₁ (a), II₁ (b) or III₁ (c).

Identification of Resonant Switch



Switching Cell Conversion Ratio



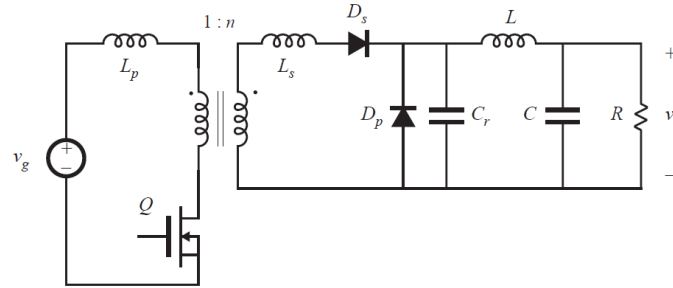
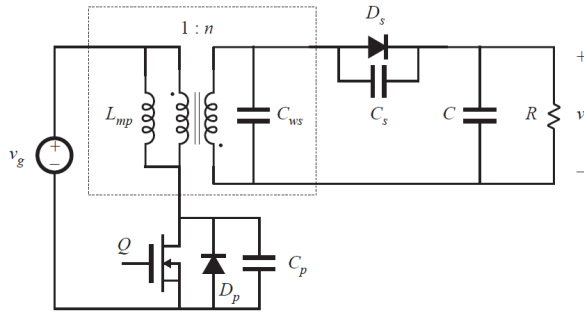
Conversion Ratios of Various Switch Cells

$$P_{1/2}(x) = \frac{1}{2\pi} \left[\frac{1}{2}x + \pi + \sin^{-1}x + \frac{1}{x} \left(1 - \sqrt{1 - x^2} \right) \right]$$

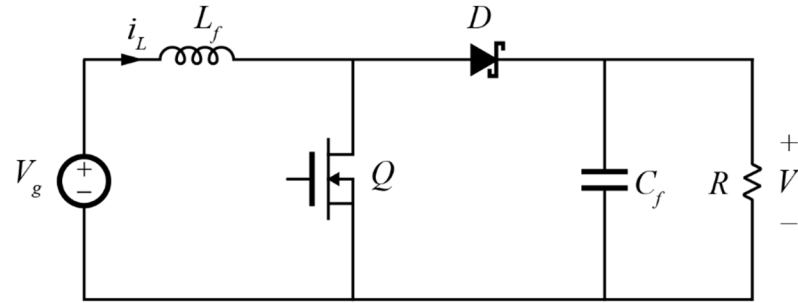
$$P_1(x) = \frac{1}{2\pi} \left[\frac{1}{2}x + 2\pi + \sin^{-1}x + \frac{1}{x} \left(1 - \sqrt{1 - x^2} \right) \right] \approx 1$$

| Switch Cell | Conv. Ratio μ | Current Range | Conv. Ratio Range | Requirements on Q |
|---------------|--|--------------------------|---------------------|-------------------------|
| PWM | D | N/A | $0 \leq \mu \leq 1$ | |
| ZVS-QR (half) | $1 - FP_{\frac{1}{2}}\left(\frac{1}{J_L}\right)$ | $1 \leq J_L \leq \infty$ | $0 \leq \mu \leq 1$ | |
| ZVS-QR (full) | $1 - FP_1\left(\frac{1}{J_L}\right)$ | $1 \leq J_L \leq \infty$ | $0 \leq \mu \leq 1$ | Bidirectional voltage |
| ZCS-QR (half) | $FP_{\frac{1}{2}}(J_L)$ | $0 \leq J_L \leq 1$ | $0 \leq \mu \leq 1$ | Unidirectional Current* |
| ZCS-QR (full) | $FP_1(J_L)$ | $0 \leq J_L \leq 1$ | $0 \leq \mu \leq 1$ | |

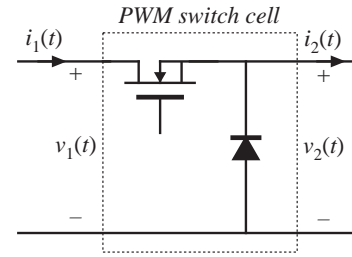
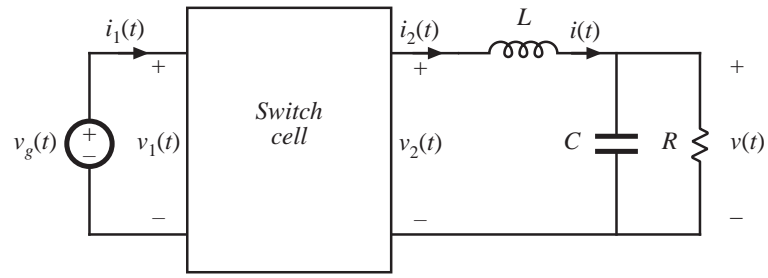
Resonant Switch Identification Examples



ZCS-QR Boost

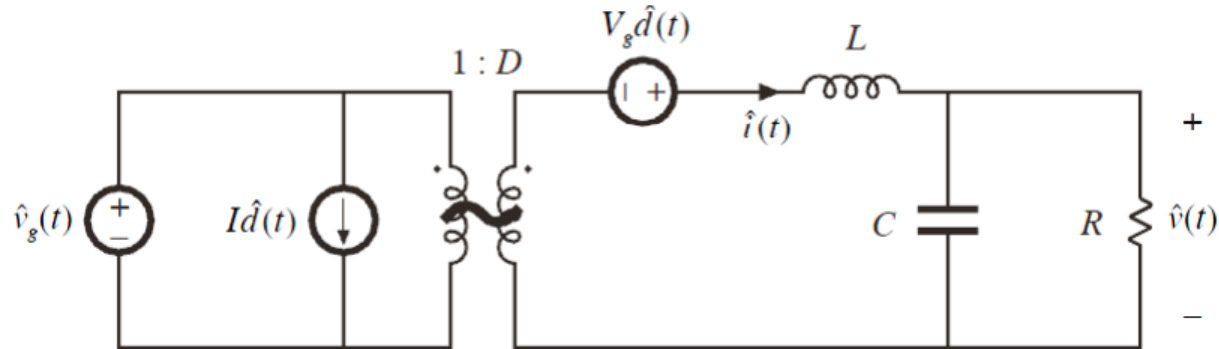


SSM - PWM Parent



SSM, PWM Case

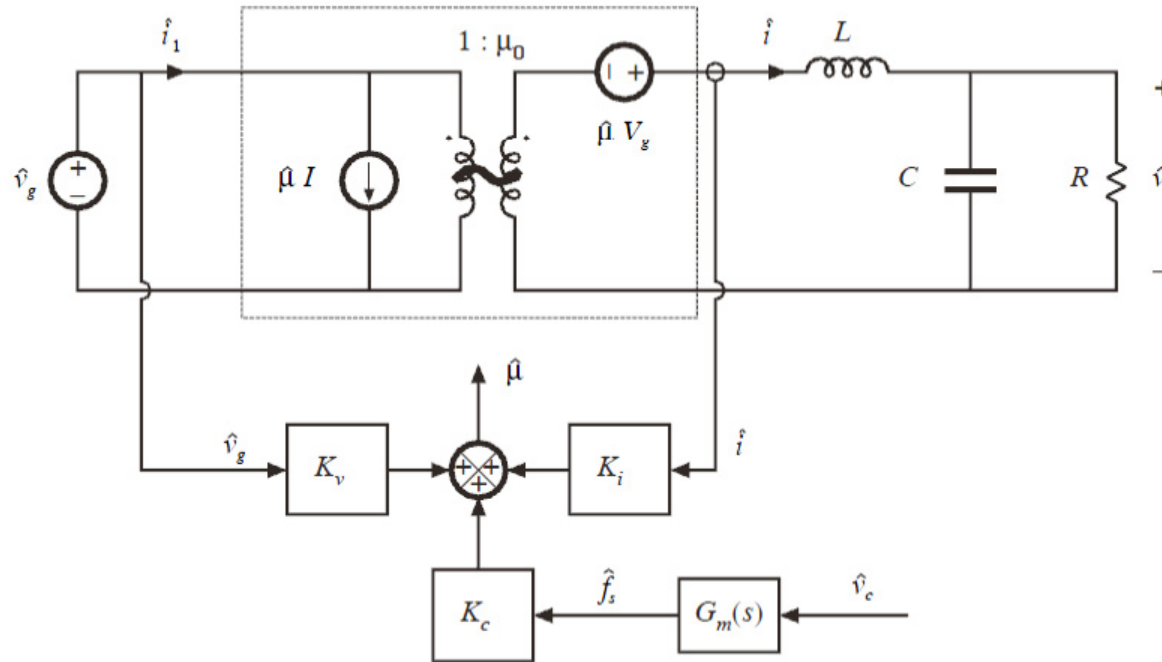
Textbook, Fig.7.17(a)



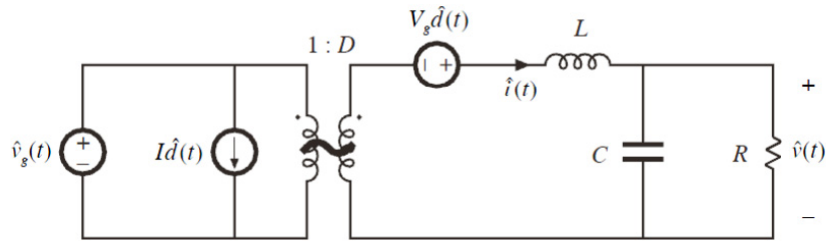
ZVS-QR Switch Cell SSM



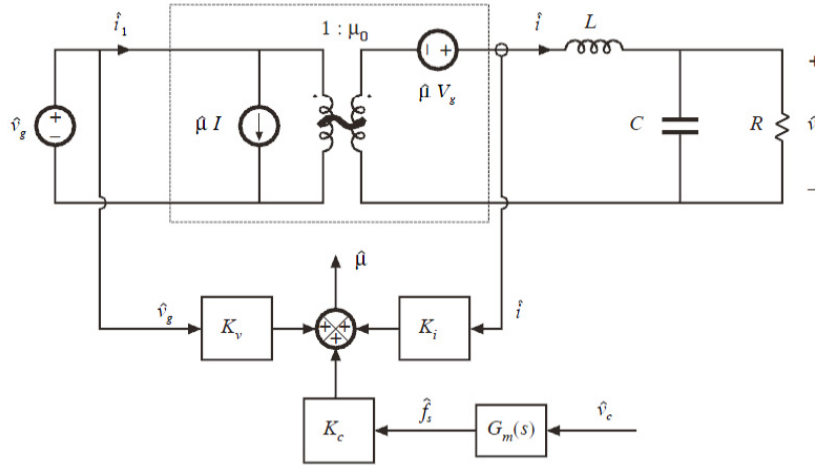
SSM, Soft-Switching Buck



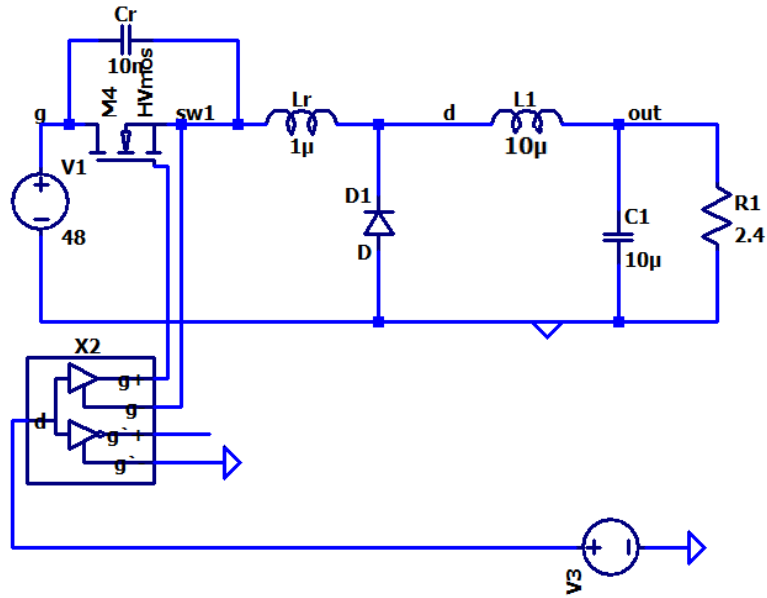
PWM Transfer Functions



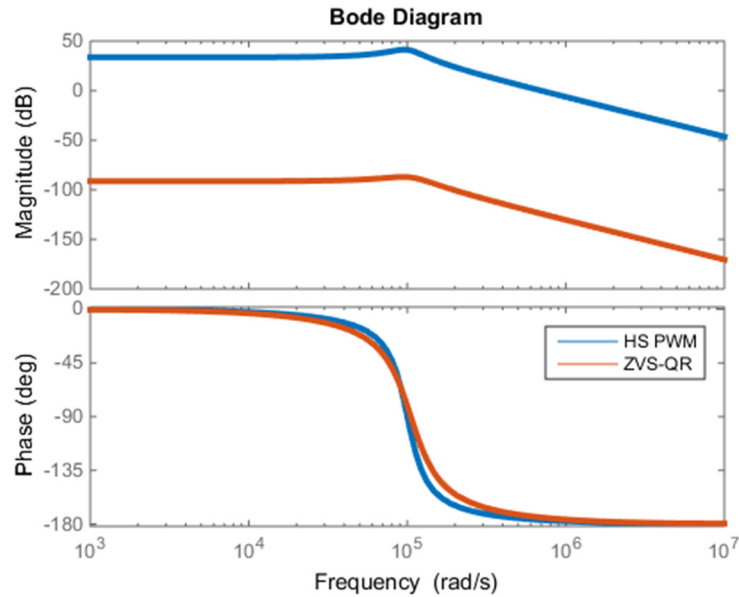
QR Transfer Functions



Example



Control-to-Output Transfer Function



Control-to-Output Transfer Function

