Energoelektronika

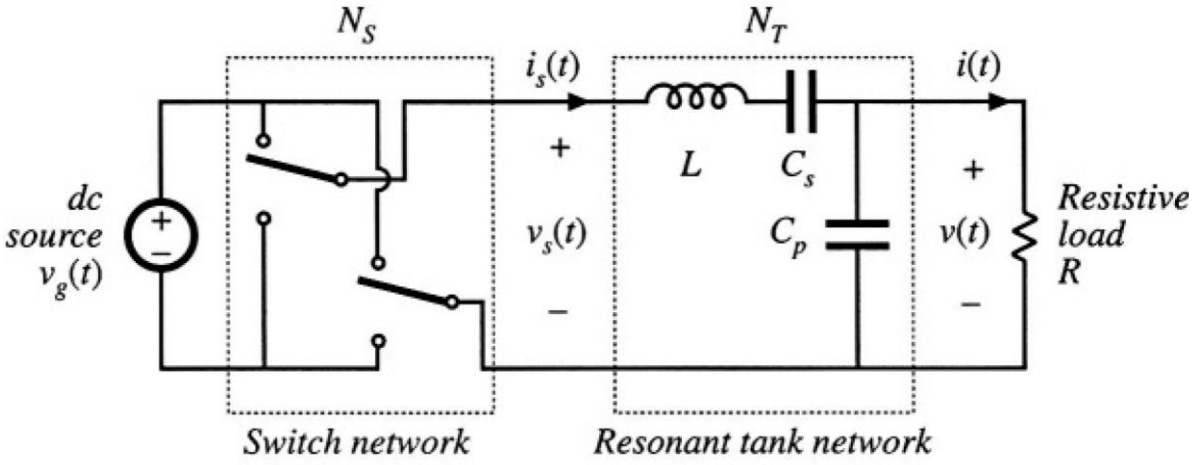
8. Resonant Converters

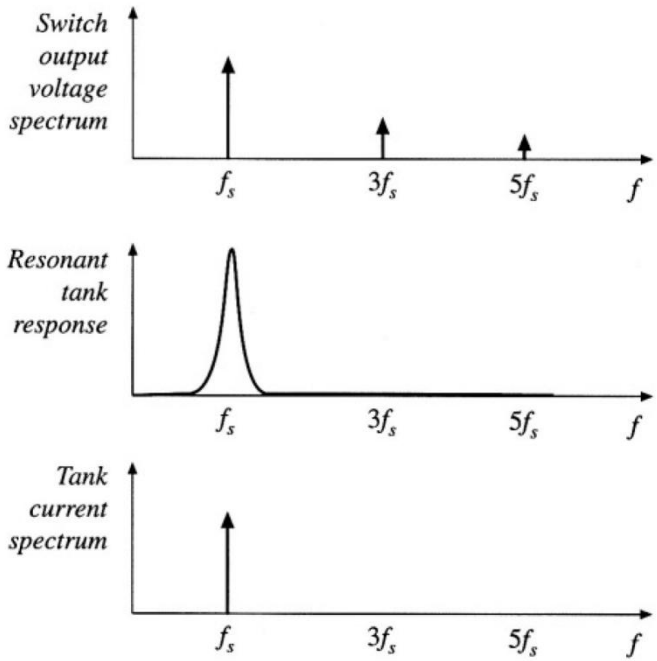
dr inż. Dariusz Janiszewski

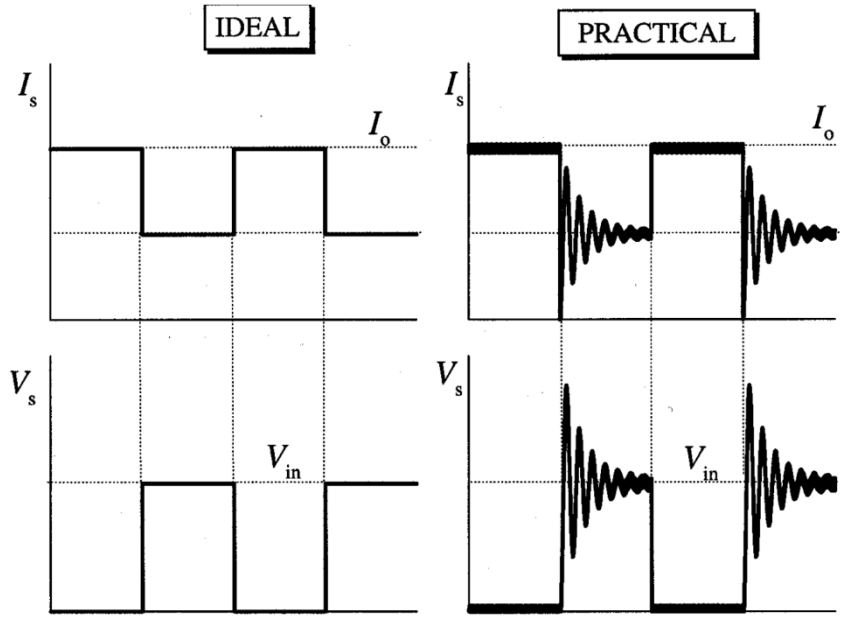
Plan

- Idea of Resonant Converter
- Zero Current Switch
- Zero Voltage Switch
- Resonant Filter
- Quasi Resonant Converters
  - ZC
  - ZV
- Full Resonant Converter
- Tank network
- Series Resonant Converter
- *Parallel Resonant Converter*

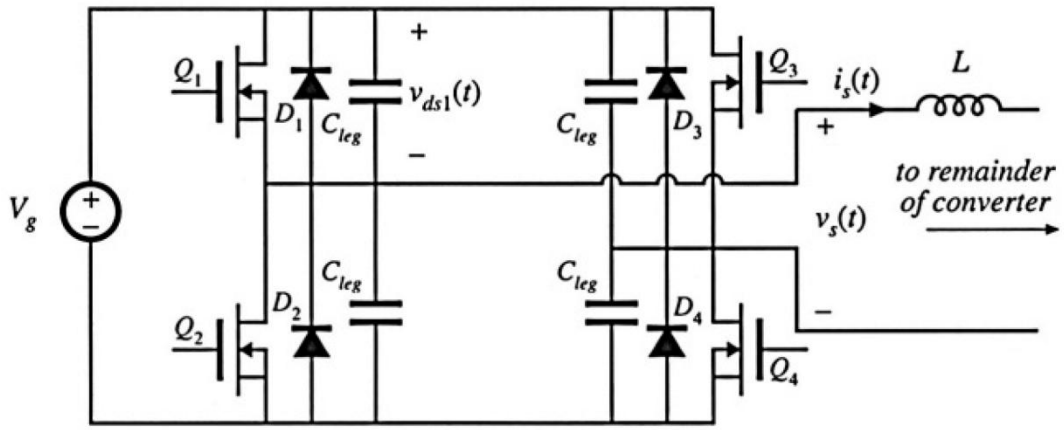
Idea

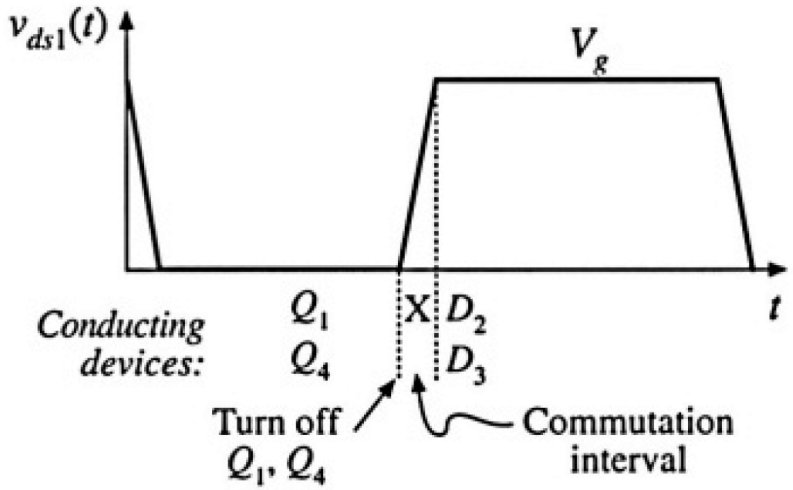

N_S
N_T
$i_s(t)$
$i(t)$
dc source $v_g(t)$
+
$v_s(t)$
−
L
C_s
C_p
+
$v(t)$
−
Resistive load R
Switch network
Resonant tank network


Switch output voltage spectrum
Resonant tank response
Tank current spectrum
f_s
$3f_s$
$5f_s$
f

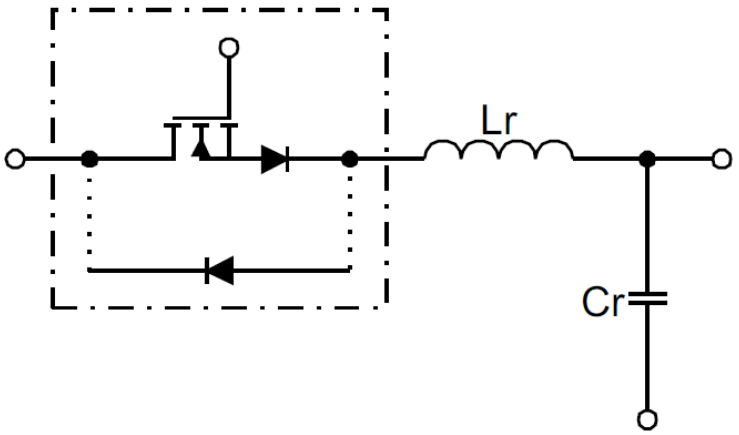

IDEAL
PRACTICAL
I_s
I_o
V_s
V_{in}

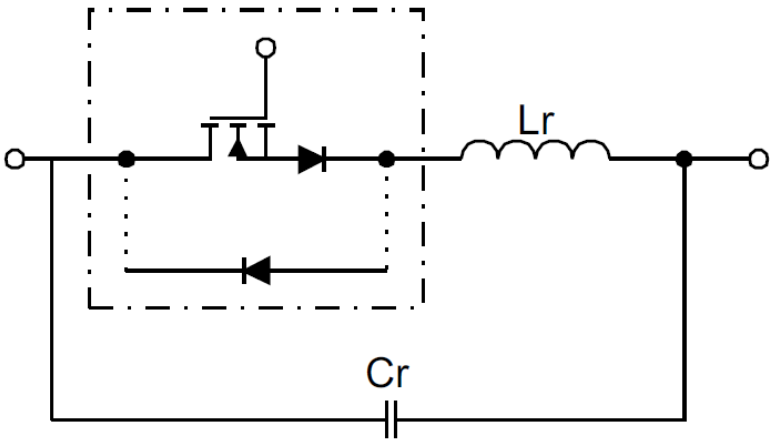
Small capacitor



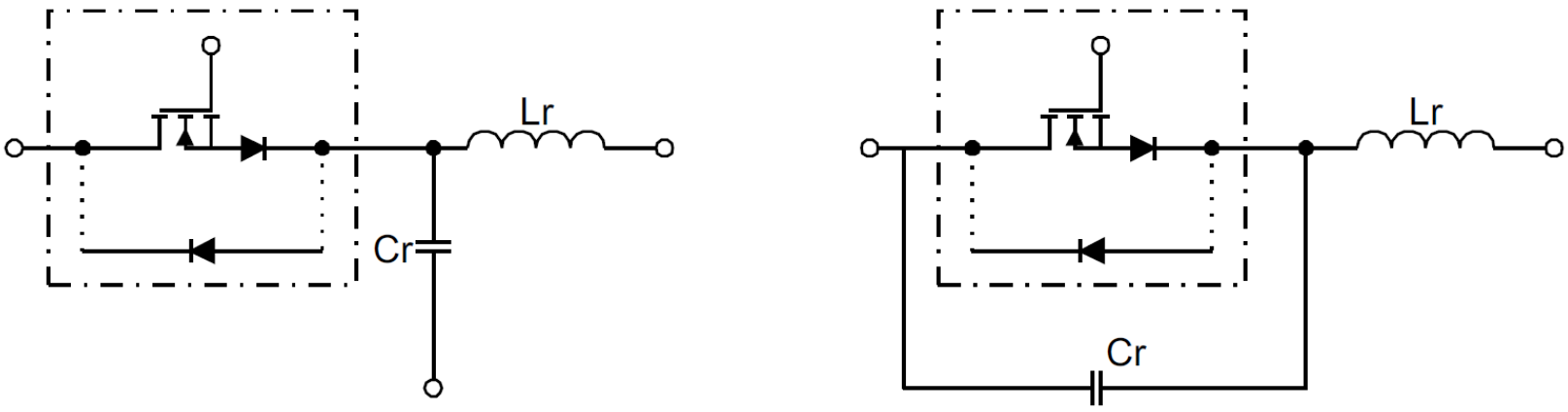


Zero Current Switch

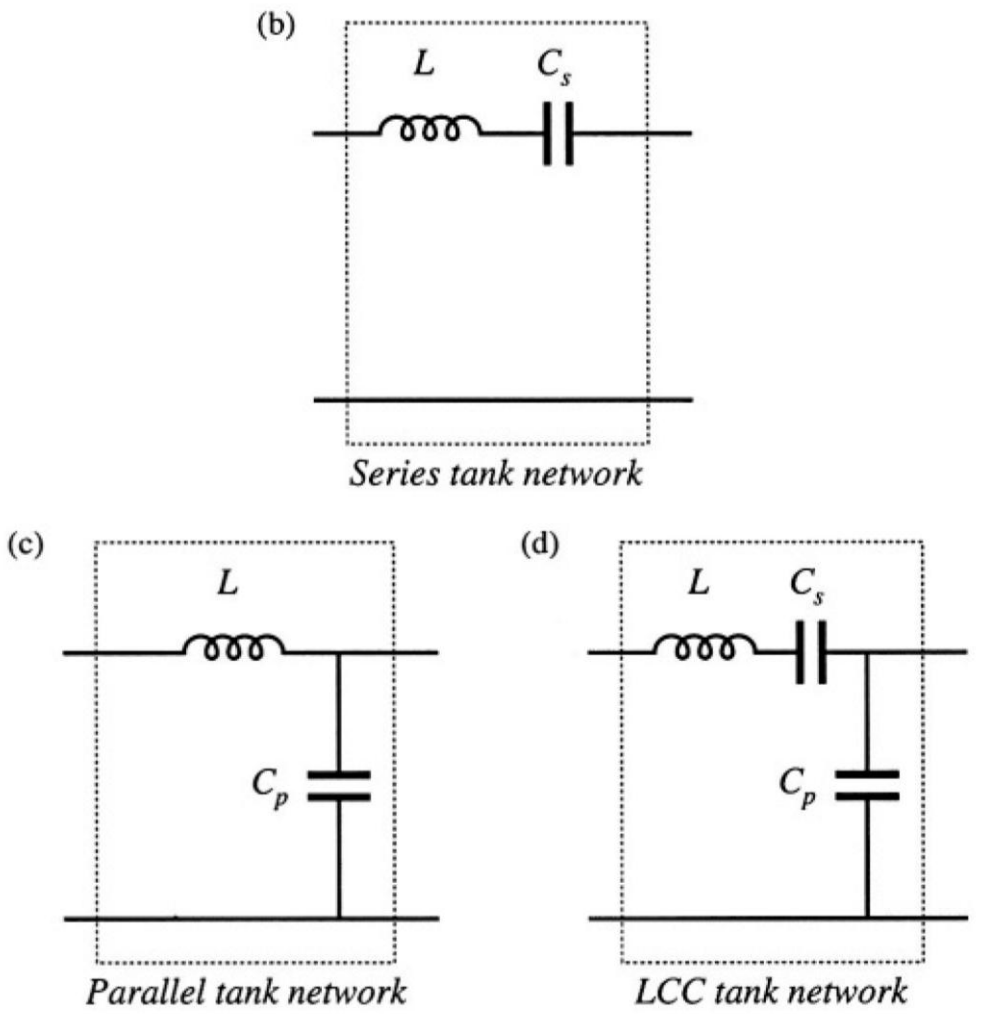


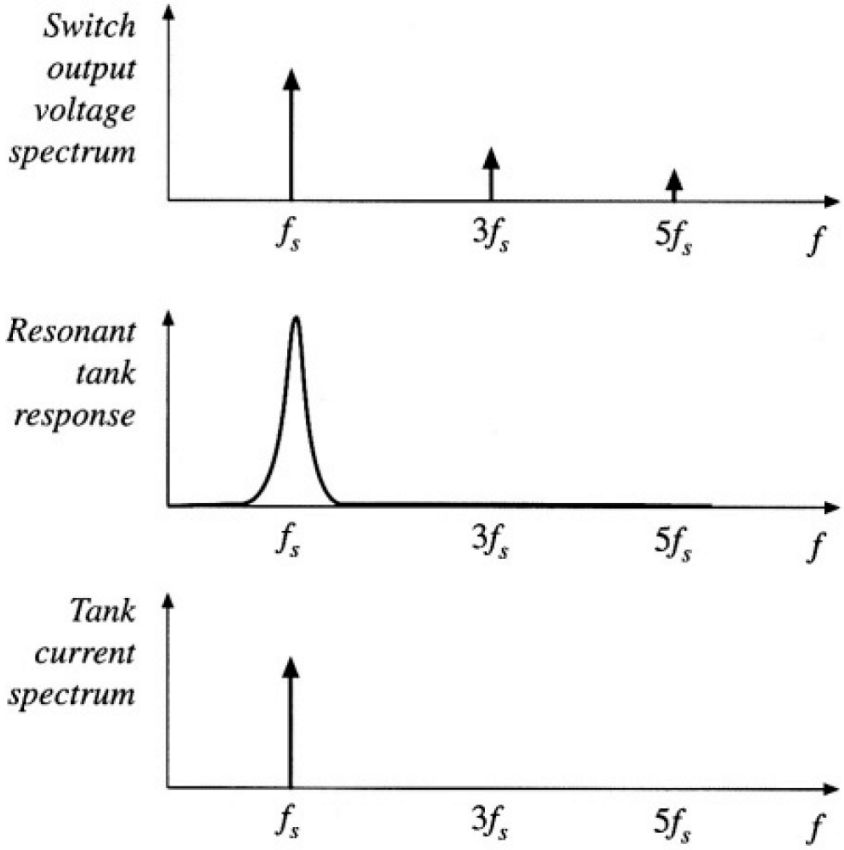


Zero Voltage Switch

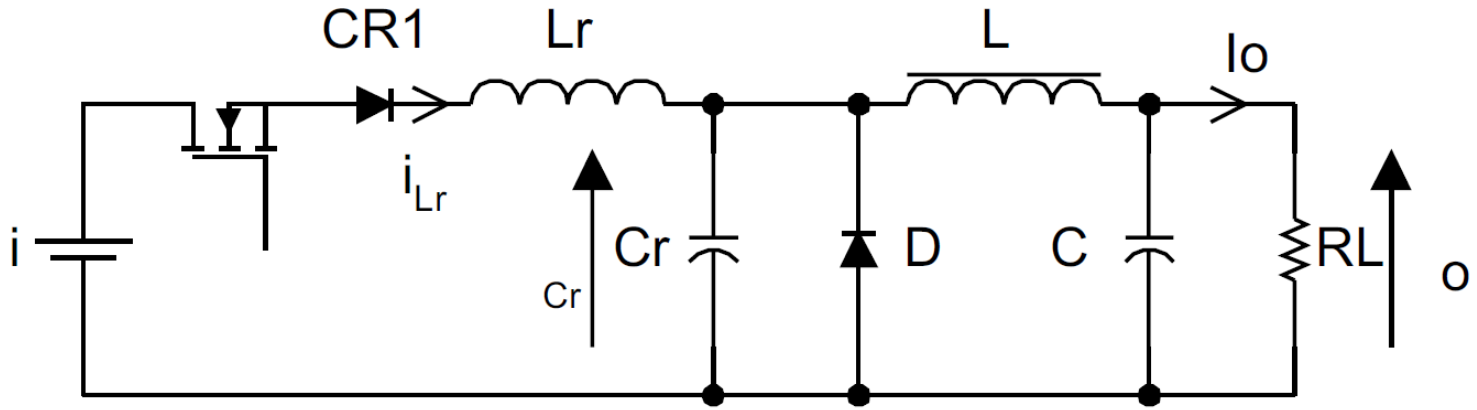


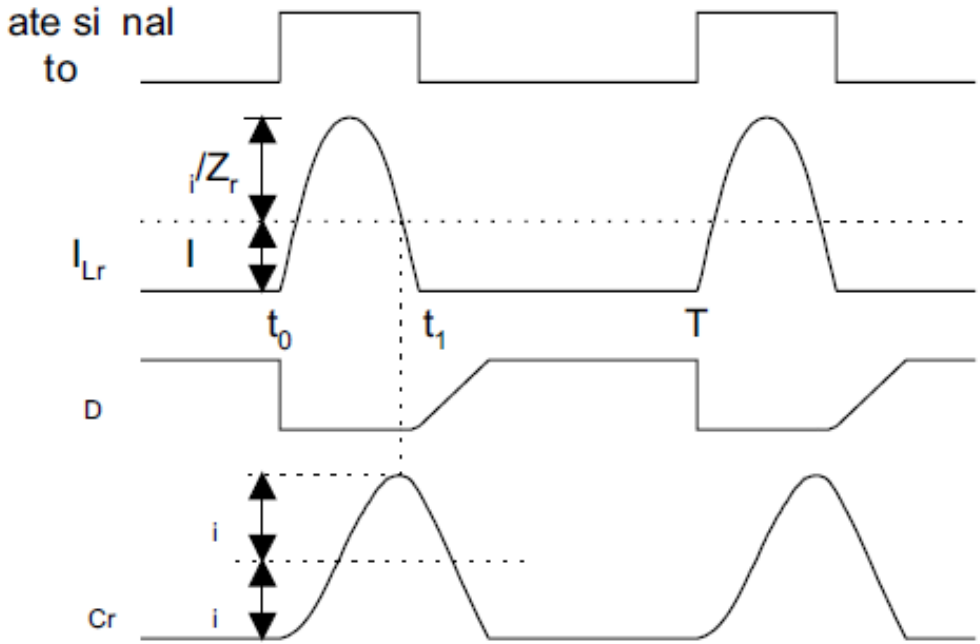
Resonant Filters



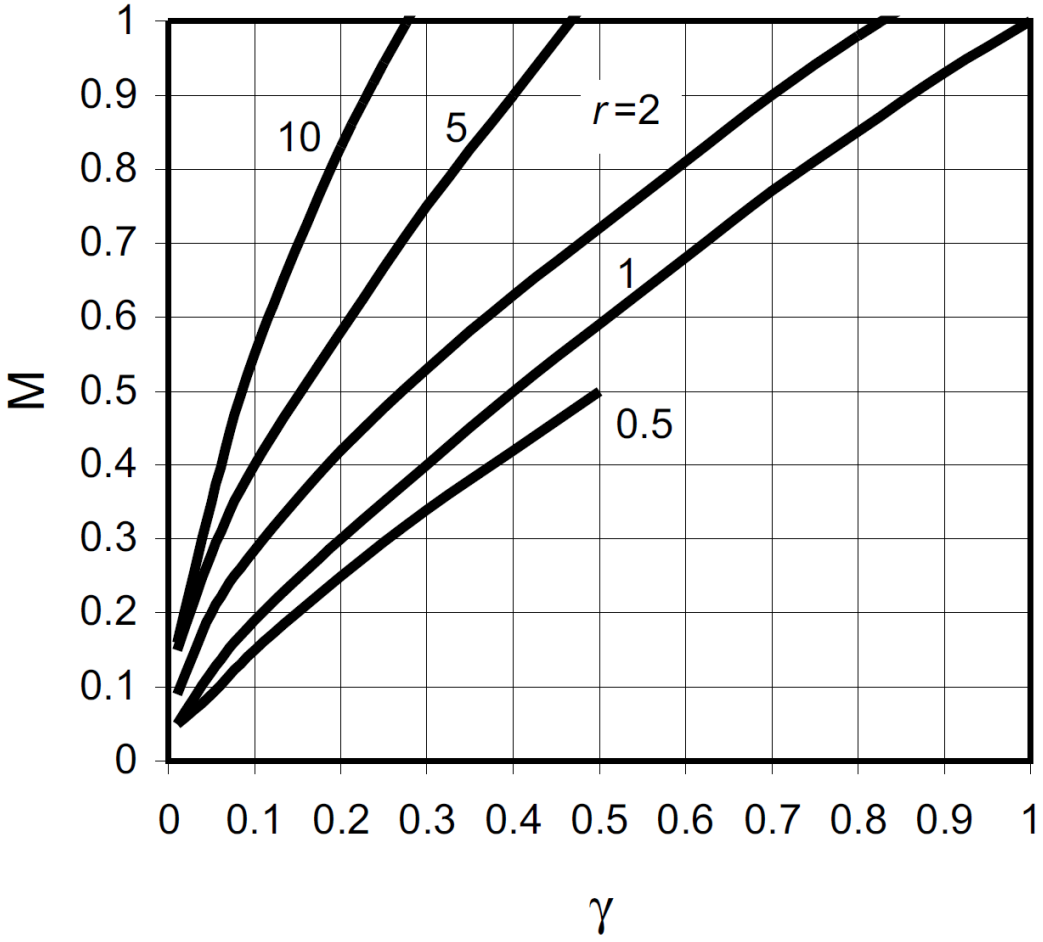


Quasi Resonant ZC





Quasi Resonant ZC

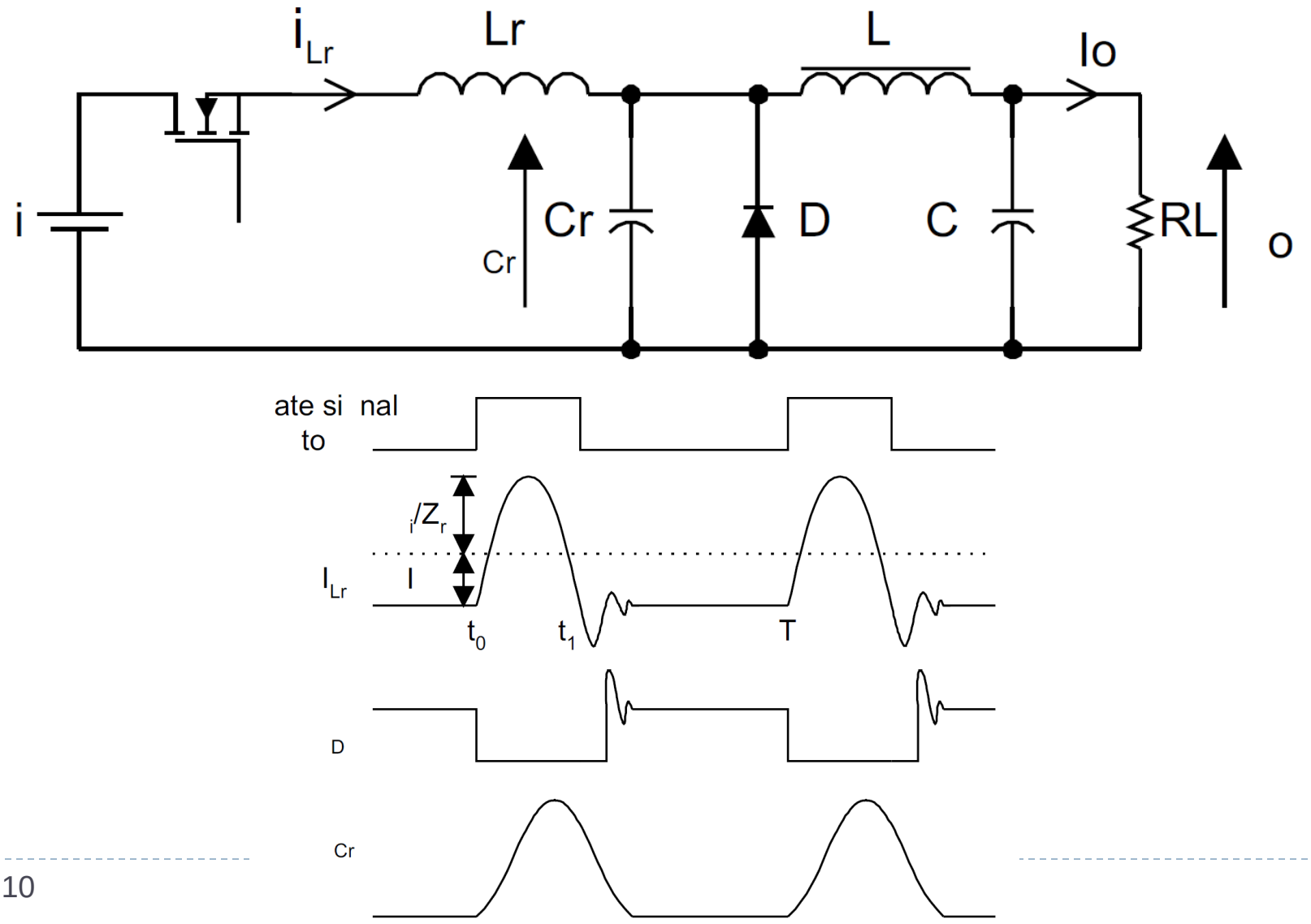


$$M = \frac{V_o}{V_i}$$

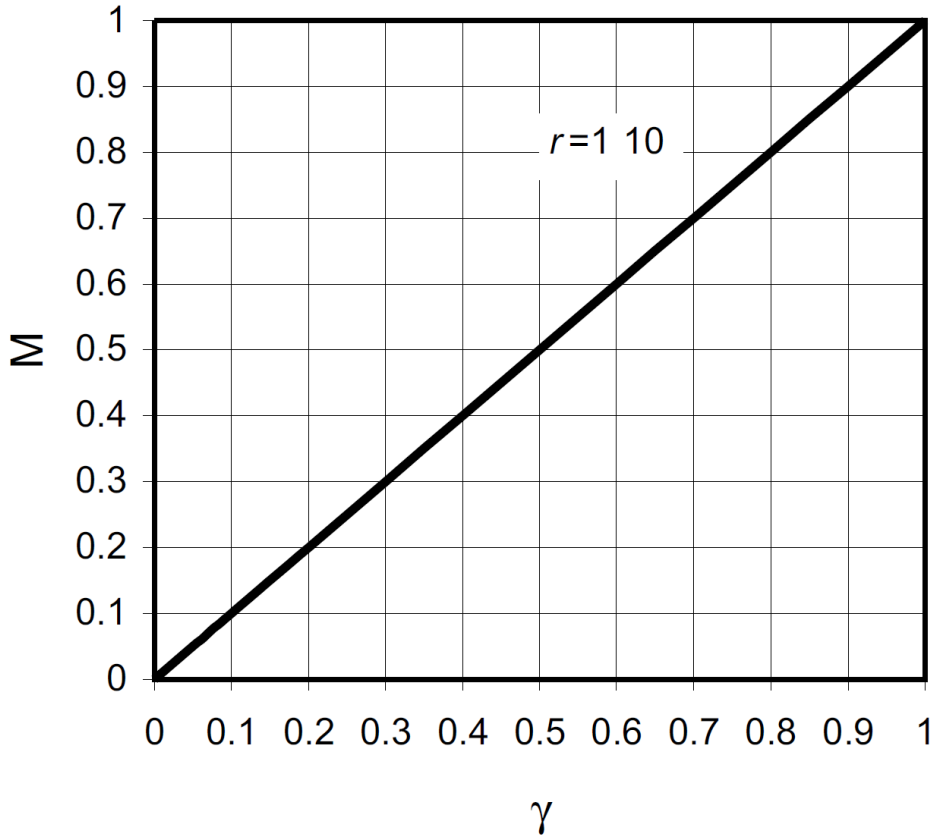
$$r = \frac{R_L}{Z_r}$$

$$\gamma = \frac{f_s}{f_r}$$

Quasi Resonant ZV



Quasi Resonant ZV

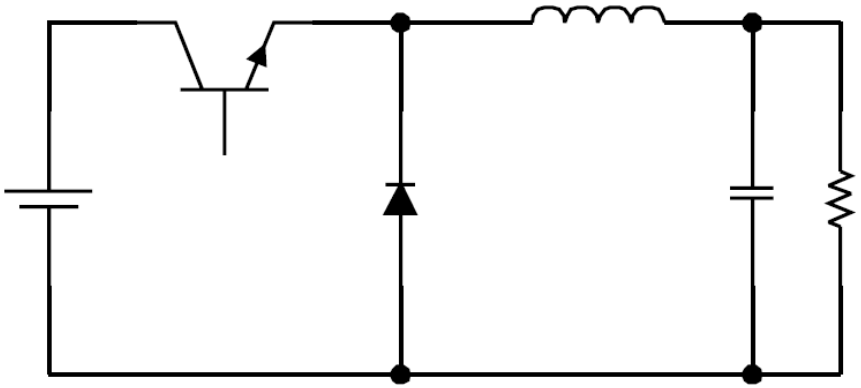


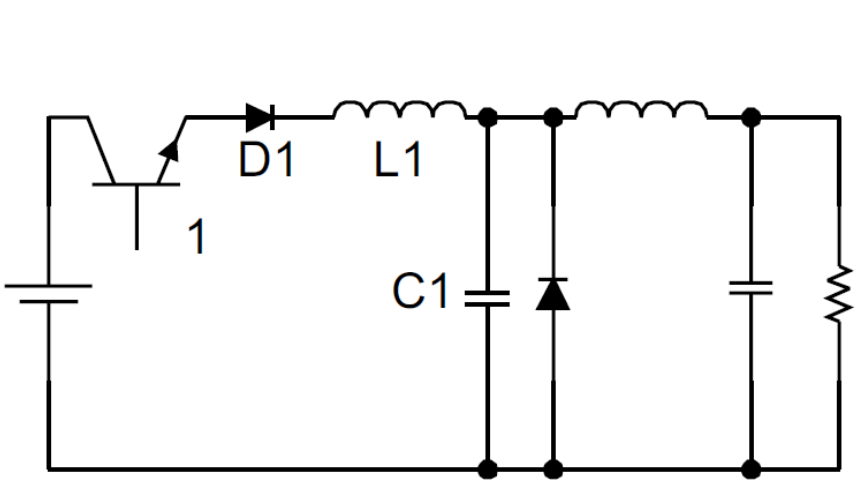
$$M = \frac{V_o}{V_i}$$

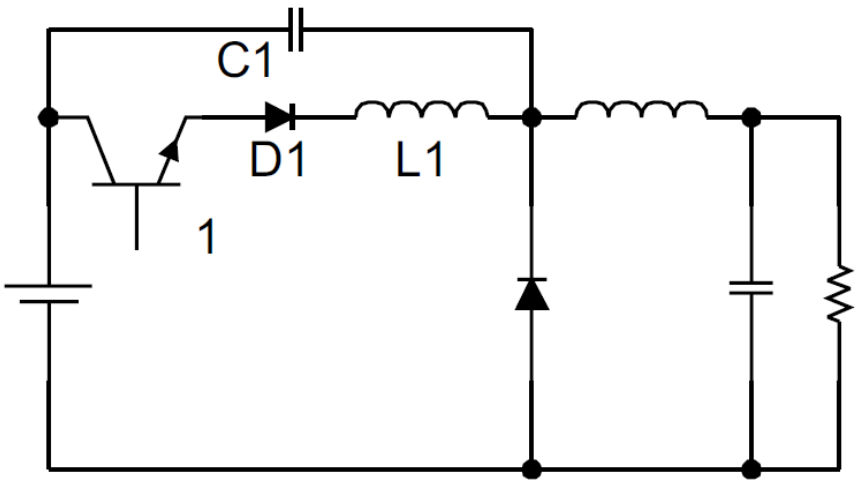
$$r = \frac{R_L}{Z_r}$$

$$\gamma = \frac{f_s}{f_r}$$

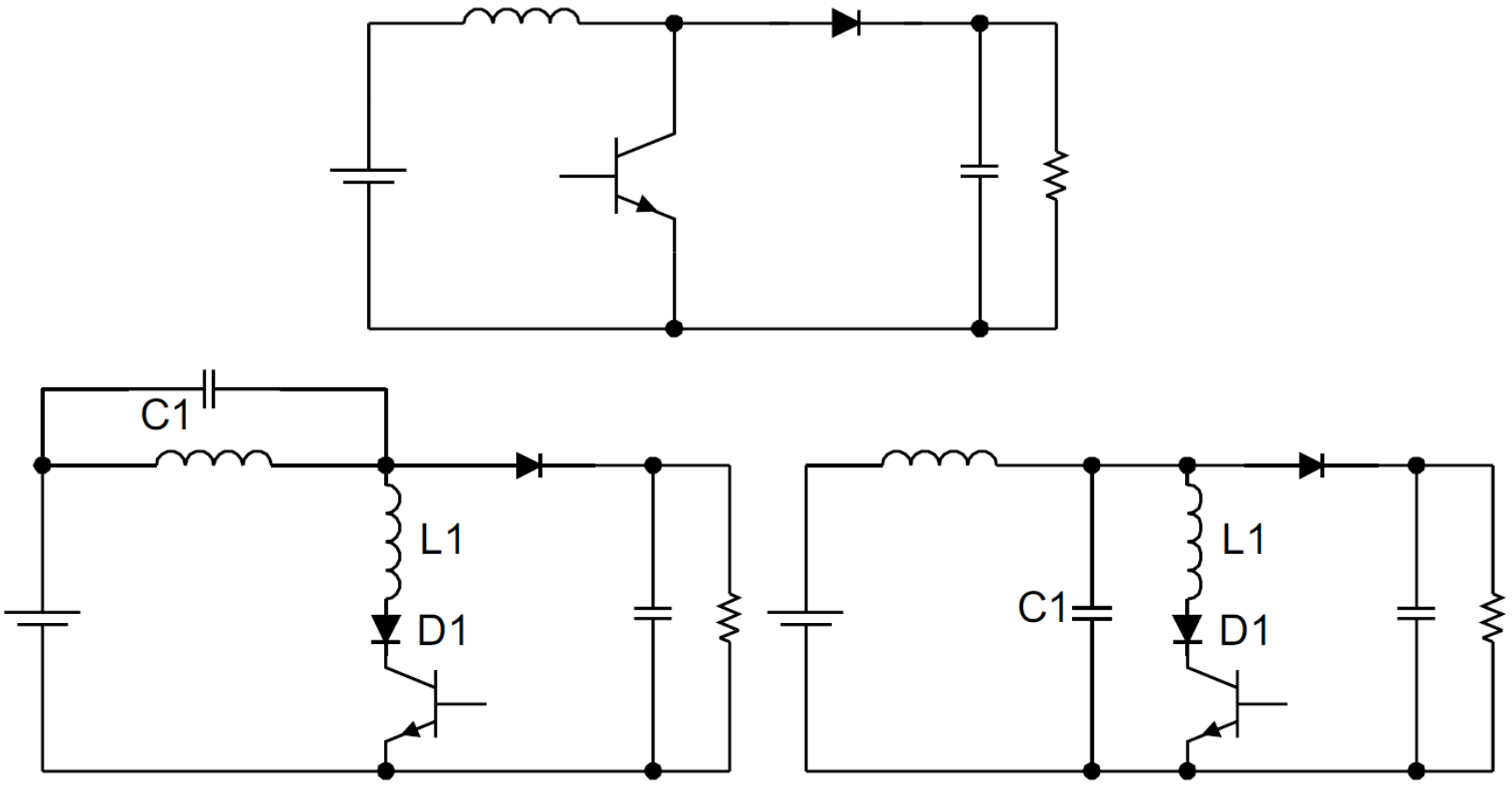
DC BUCK as Quasi Resonant ZCV



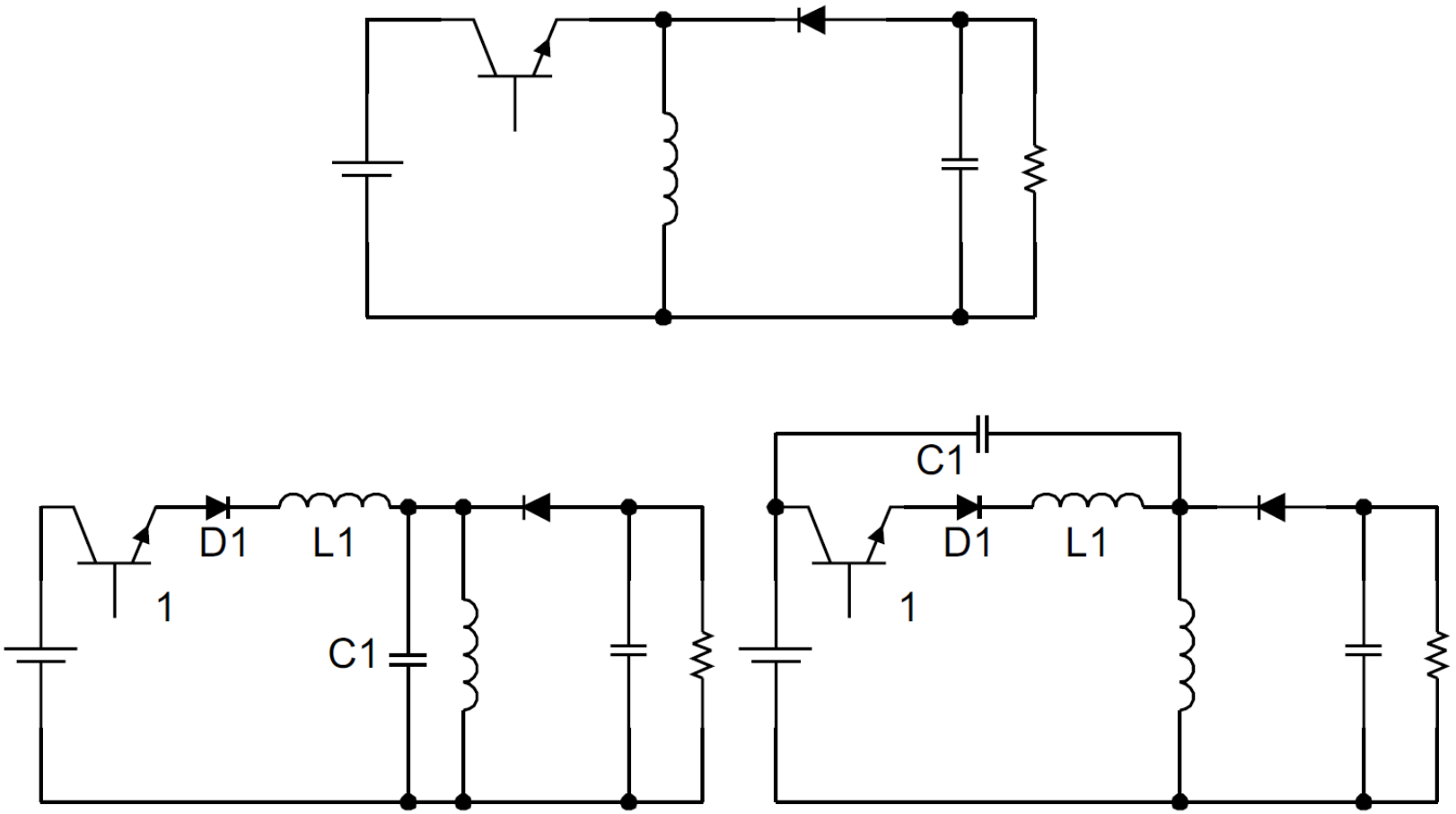




Boost as QR ZCV



Buck-Boost as QR ZCV



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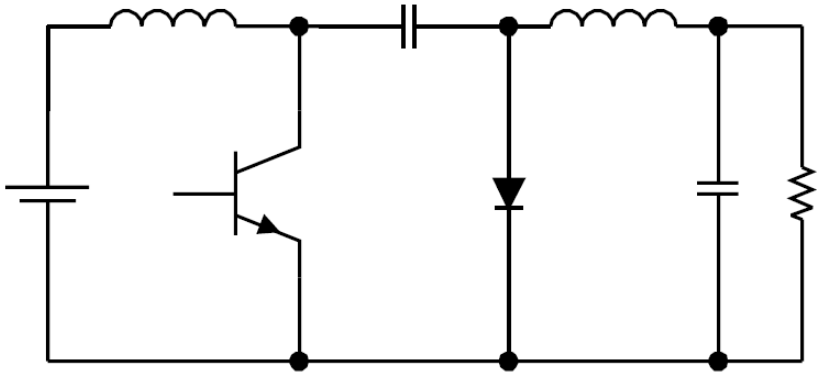
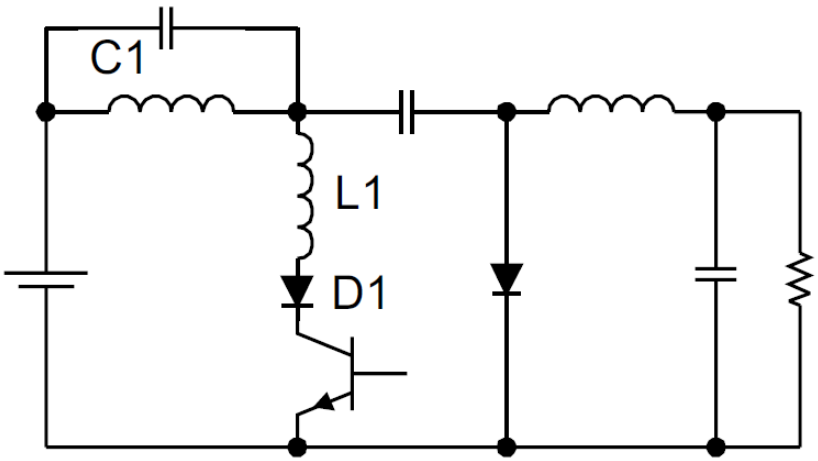
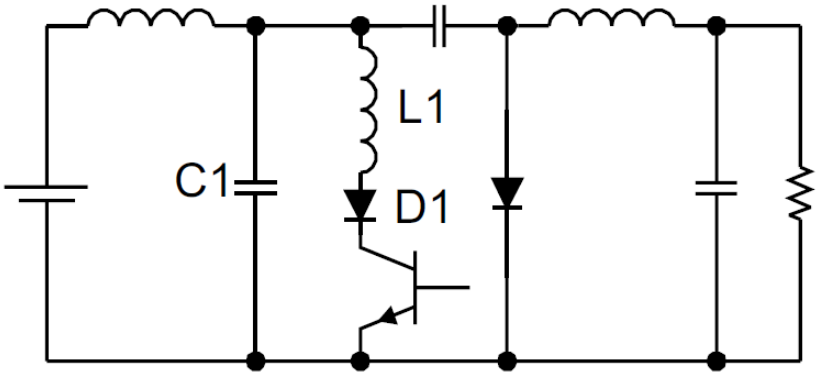
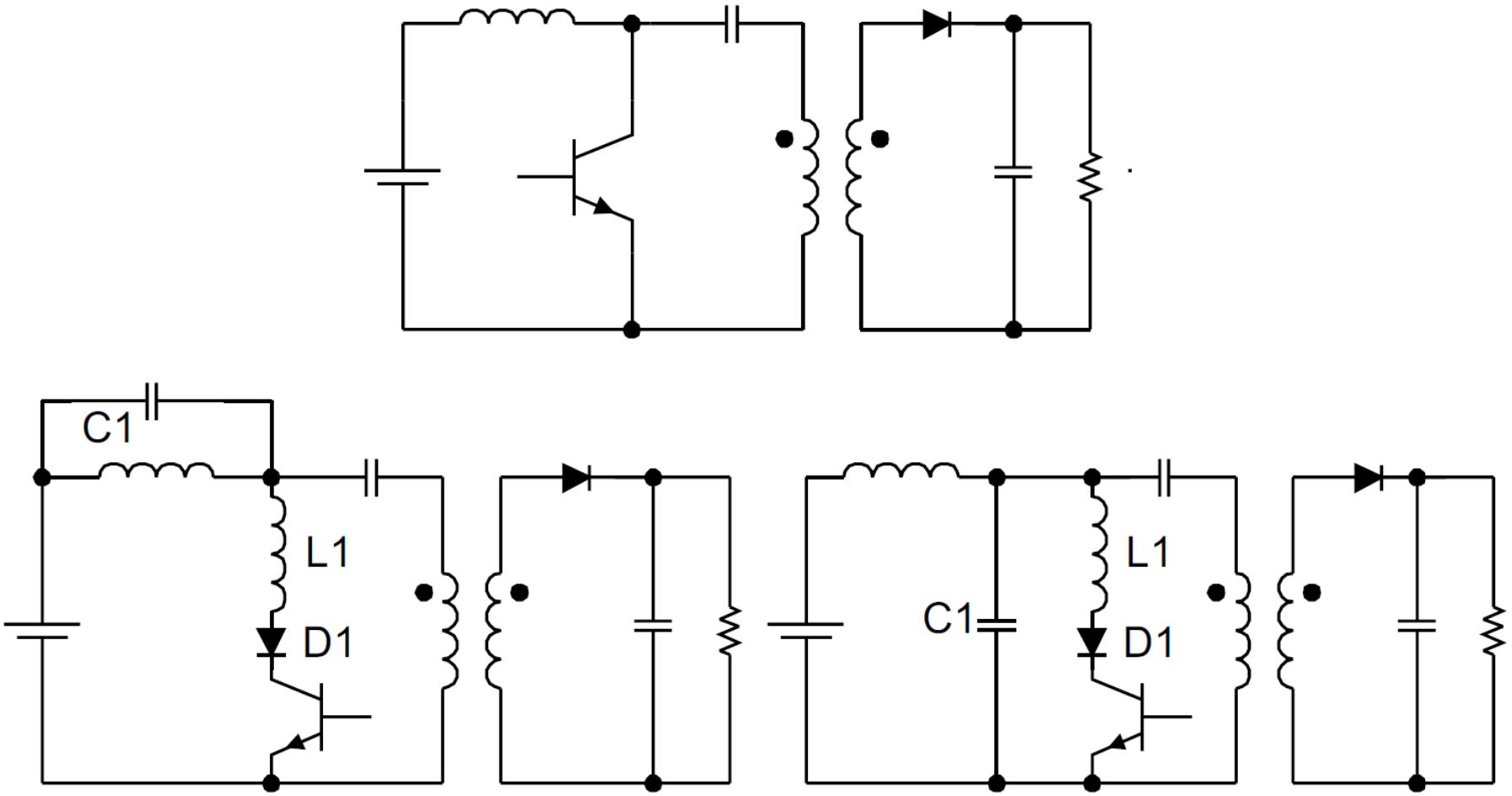


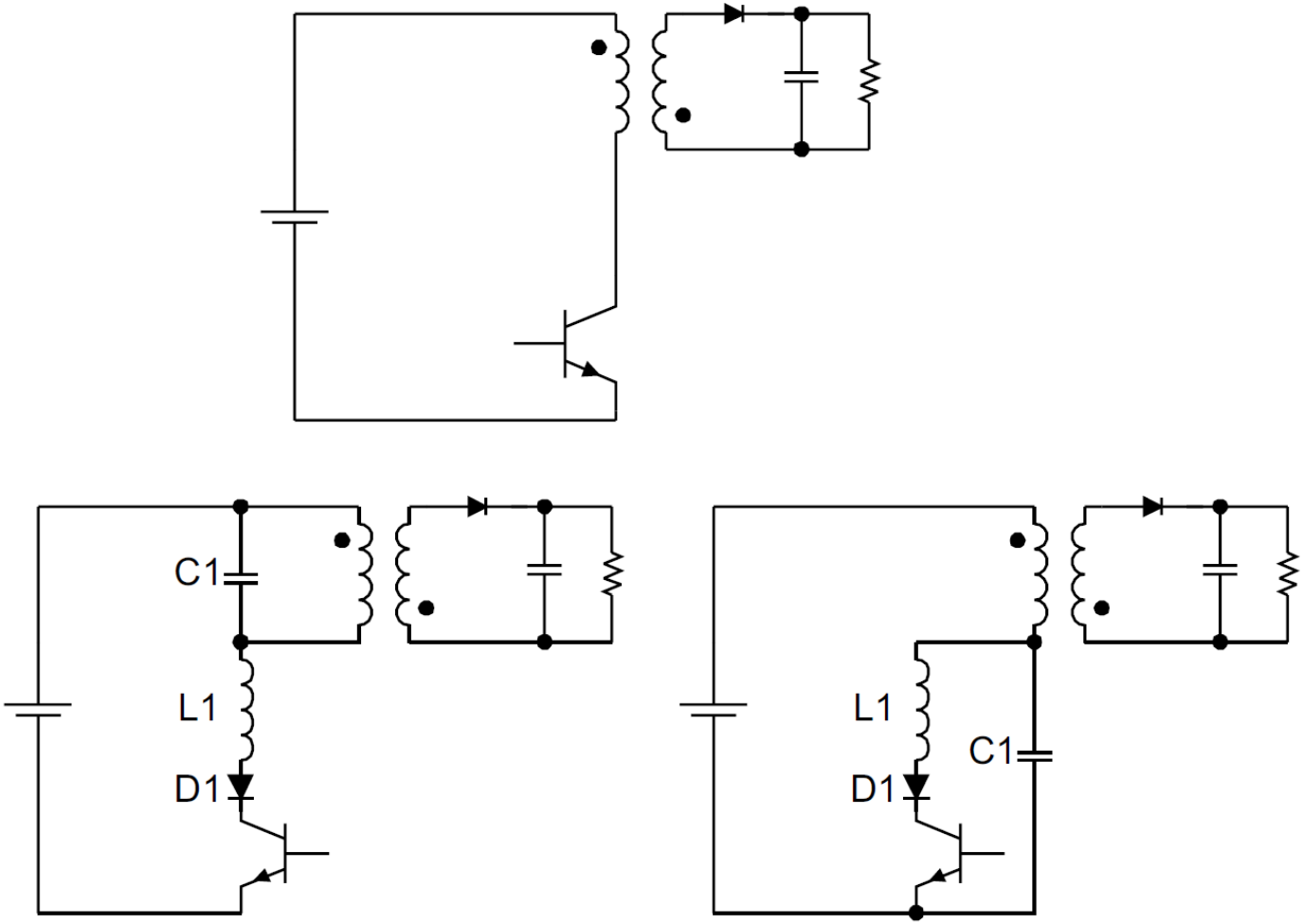




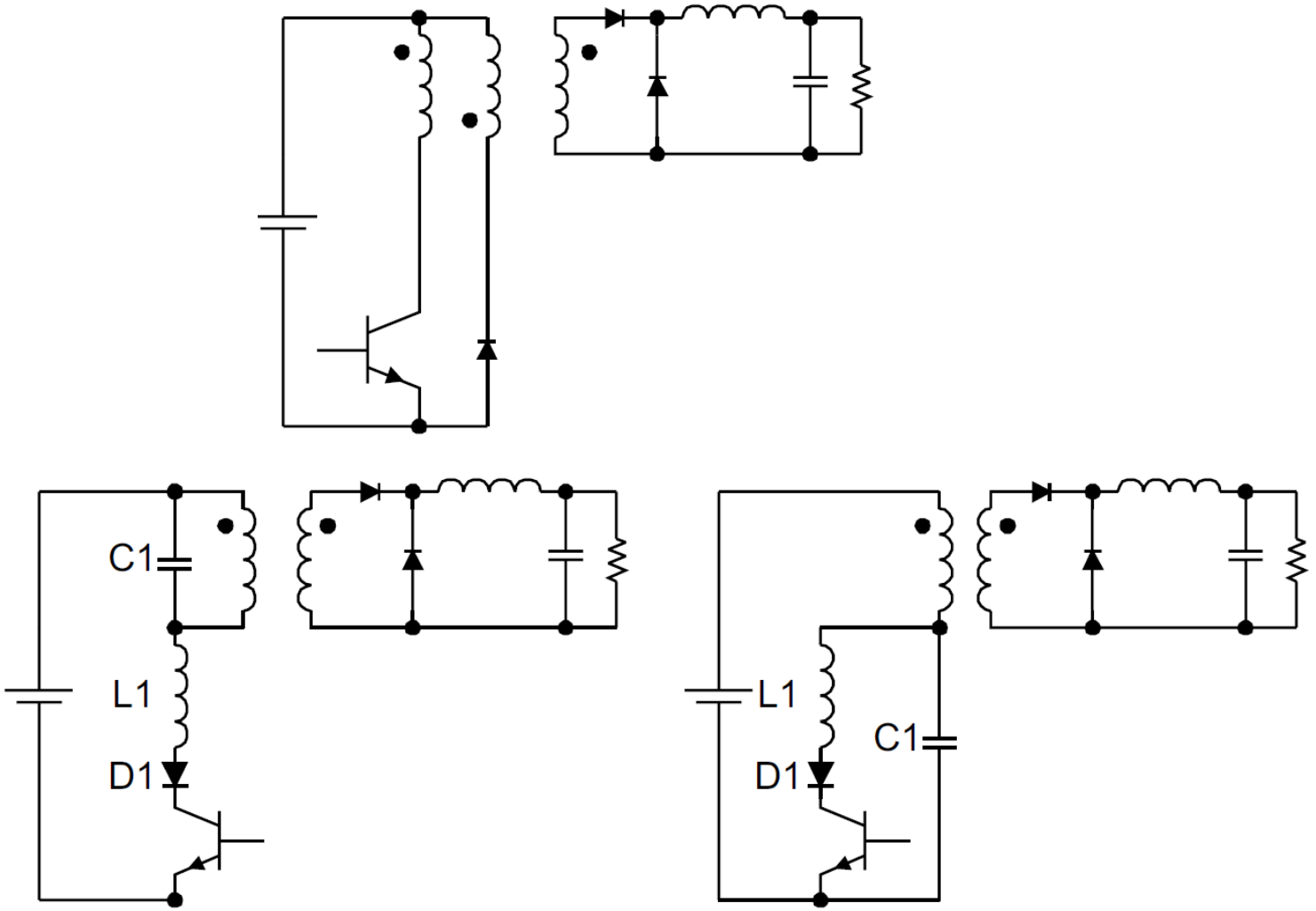
SEPIC as QR ZCV



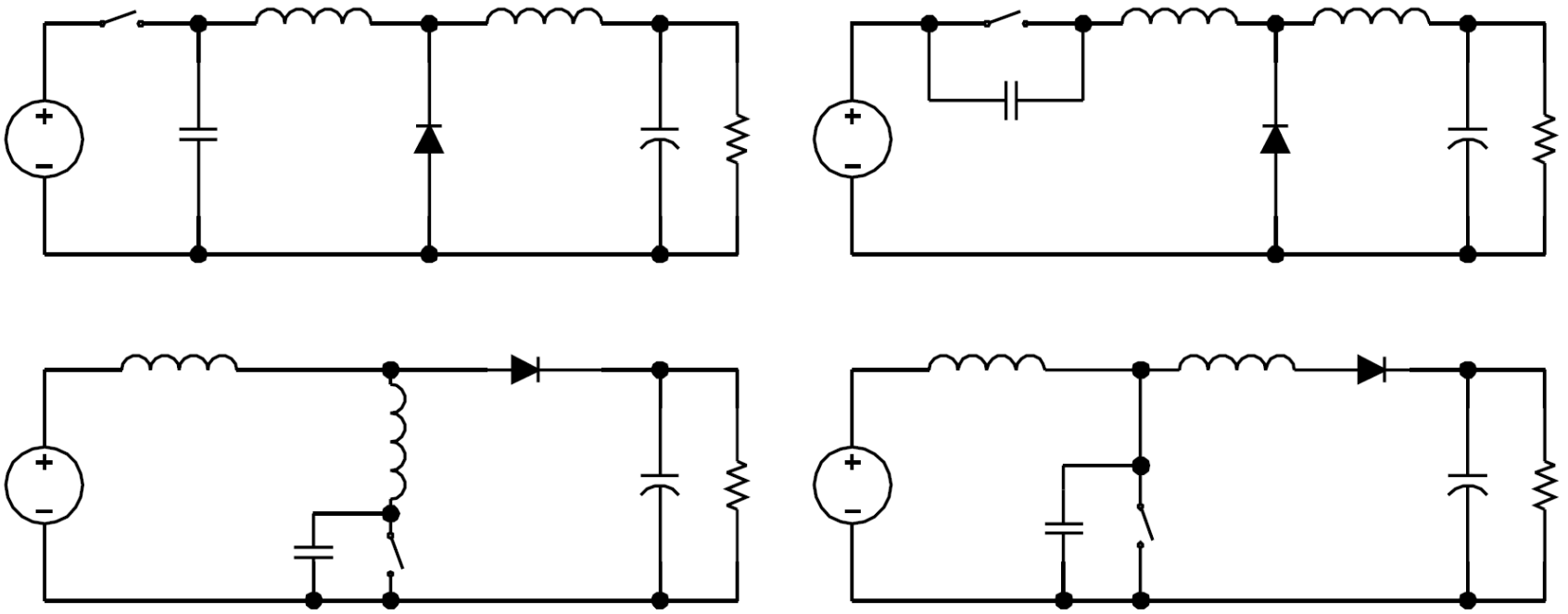
Flyback as QR ZCV



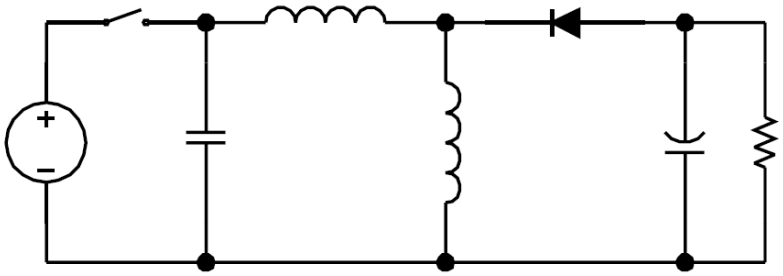
Forward as QR ZCV

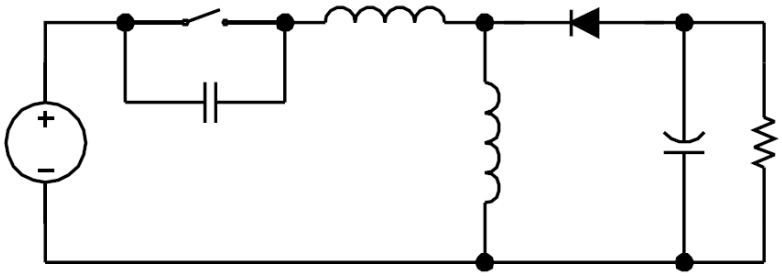


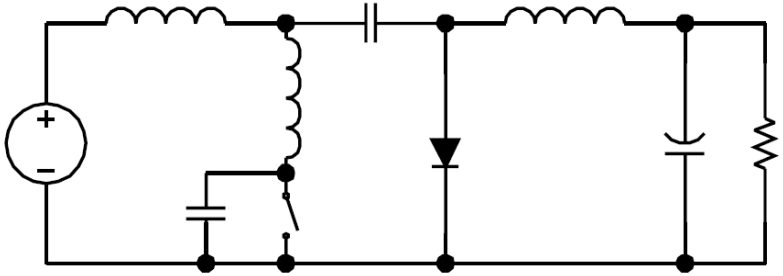
Buck/Boost QR Zero Voltage Switching

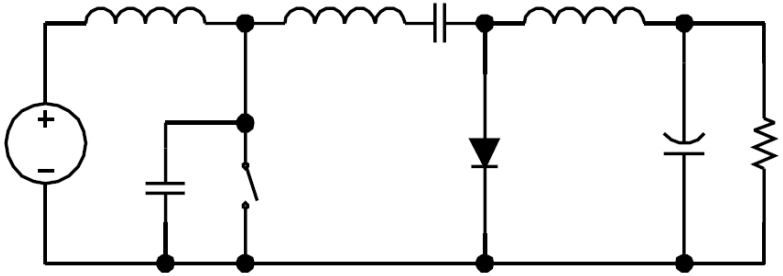


B-B Ćuk QR ZVS

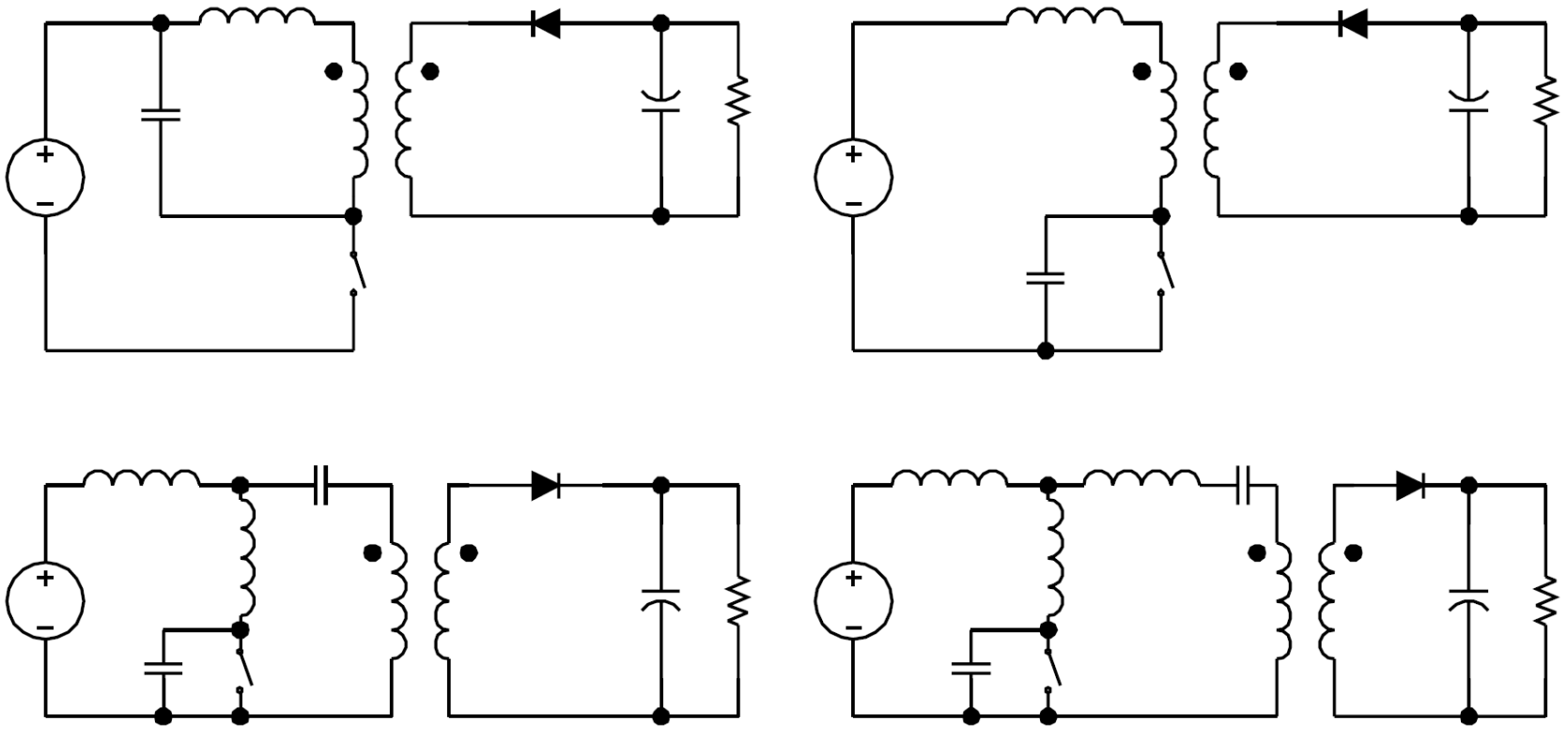




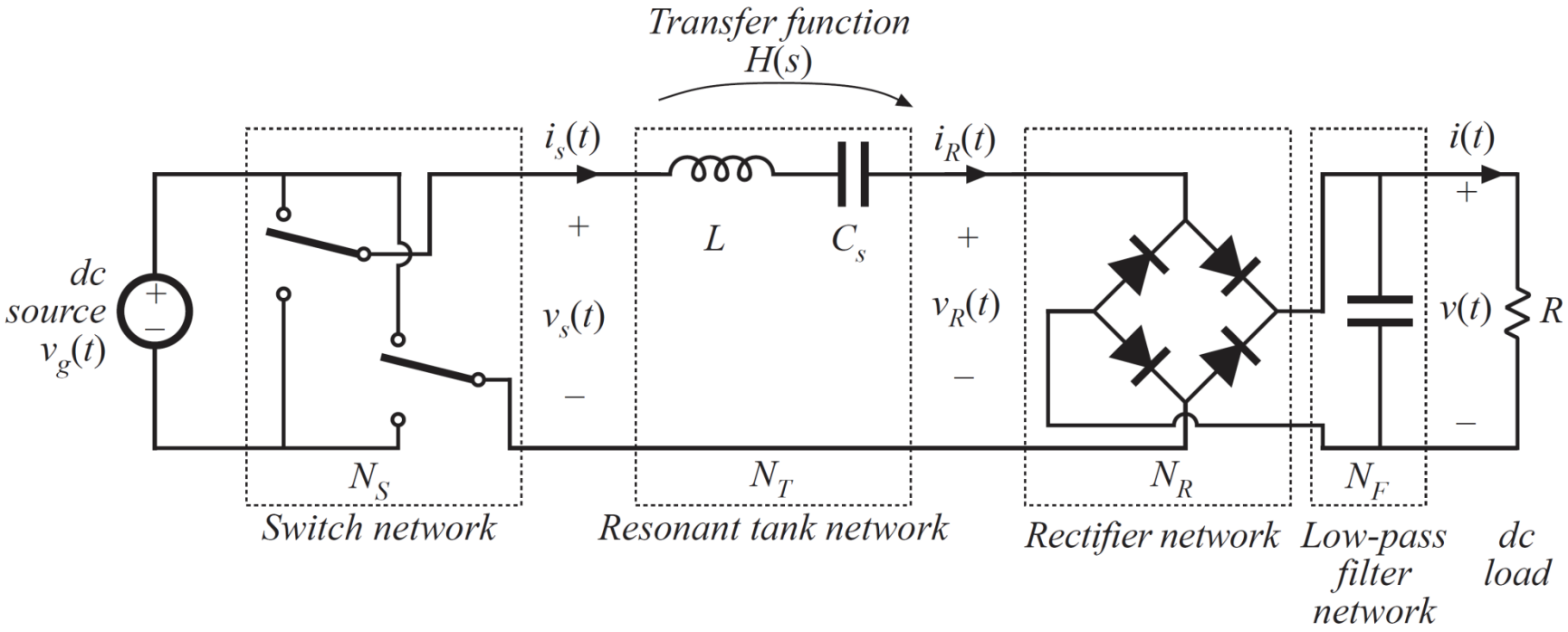




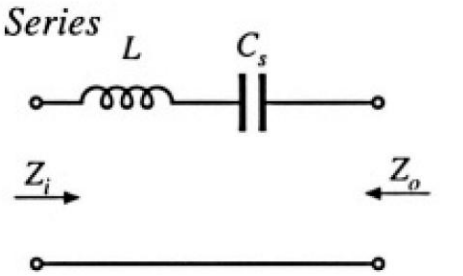
Flyback SEPIC QR ZVS

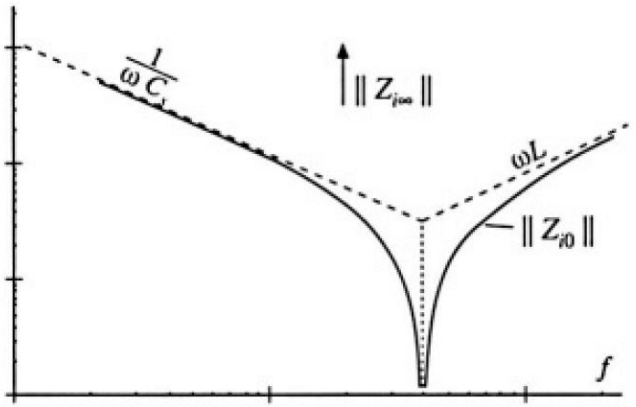


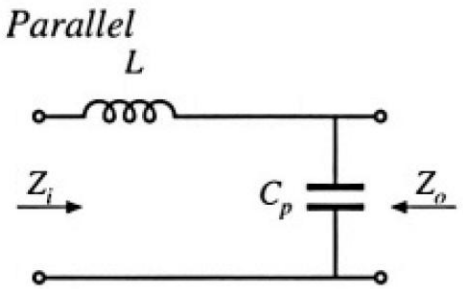
Resonant DC-DC converter

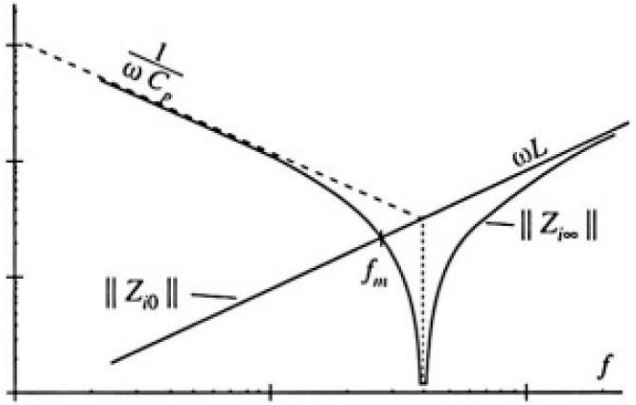


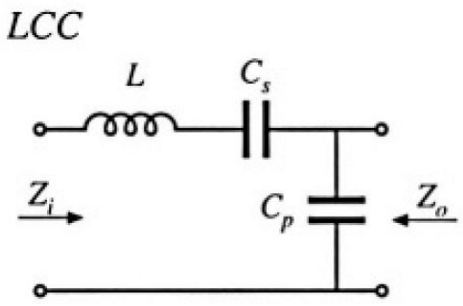
Tank network

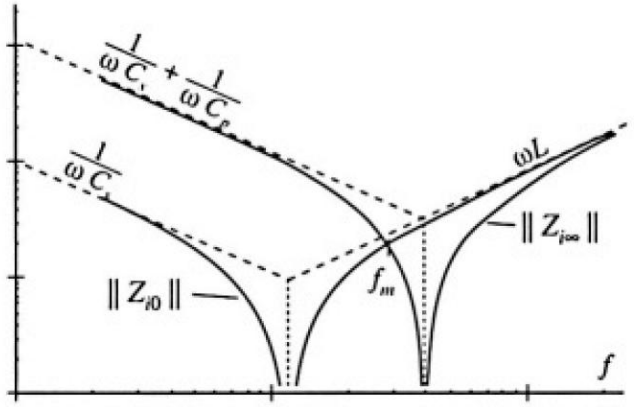




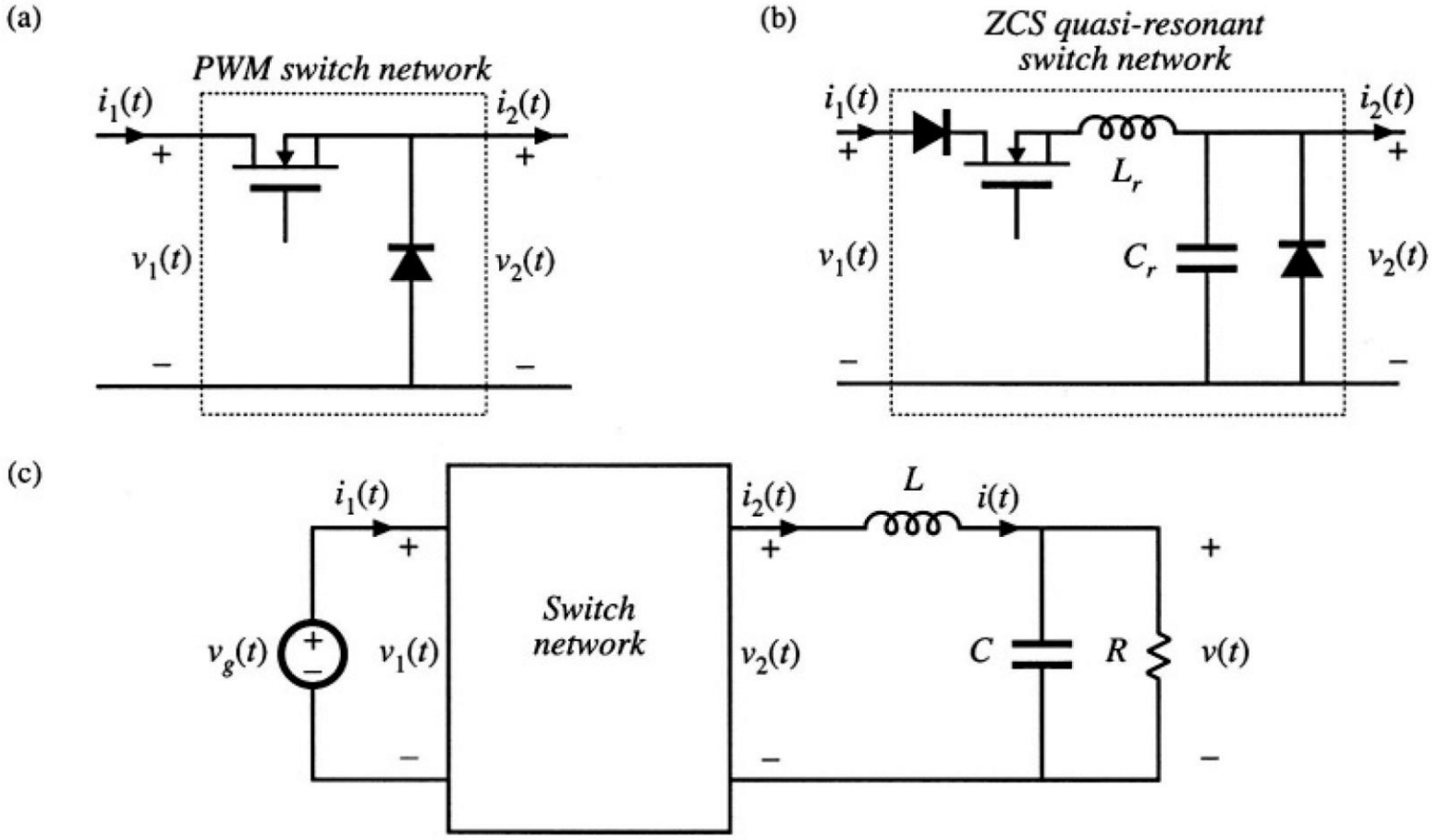




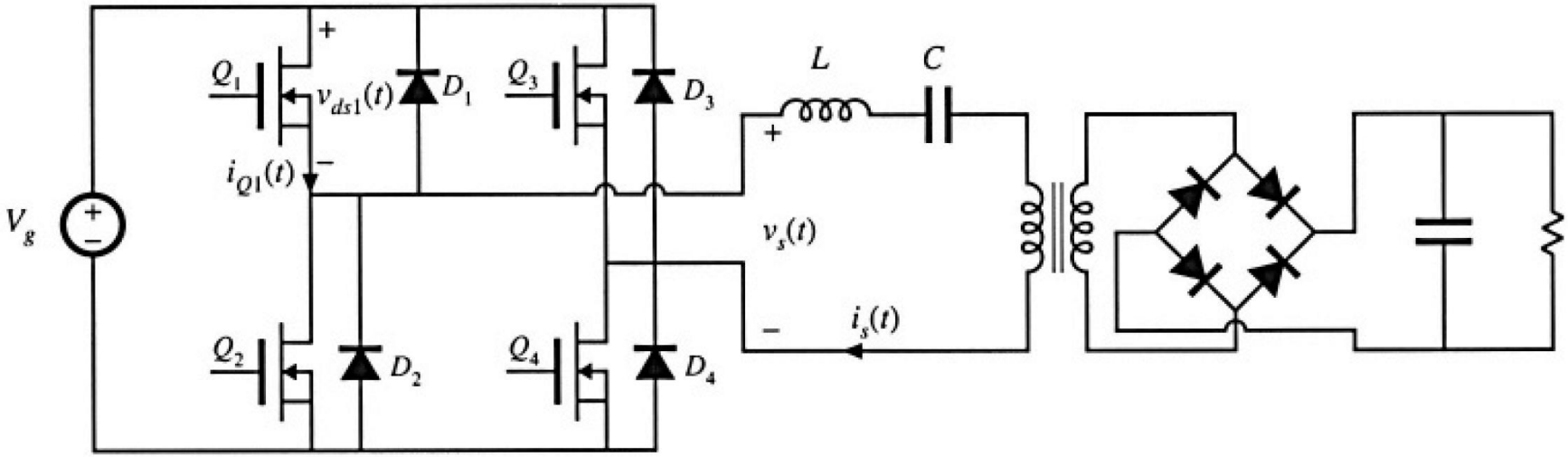




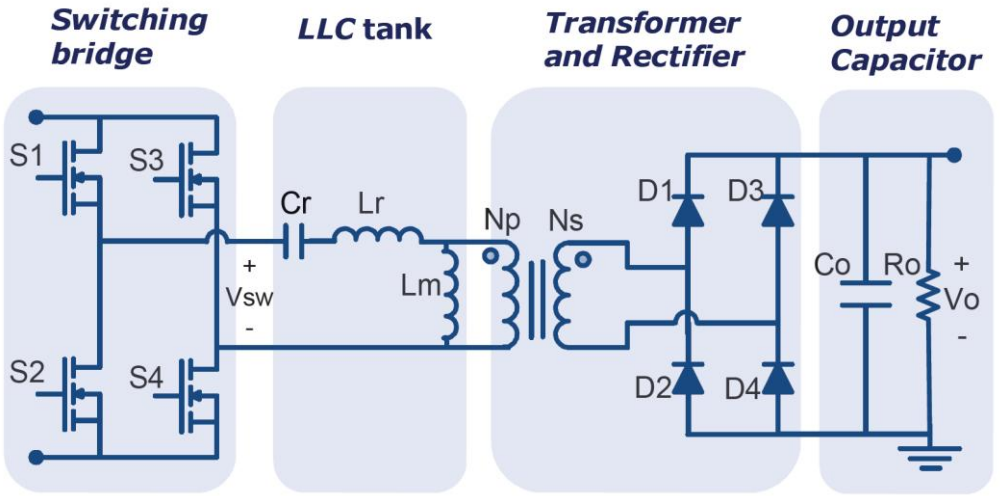
Switch networks

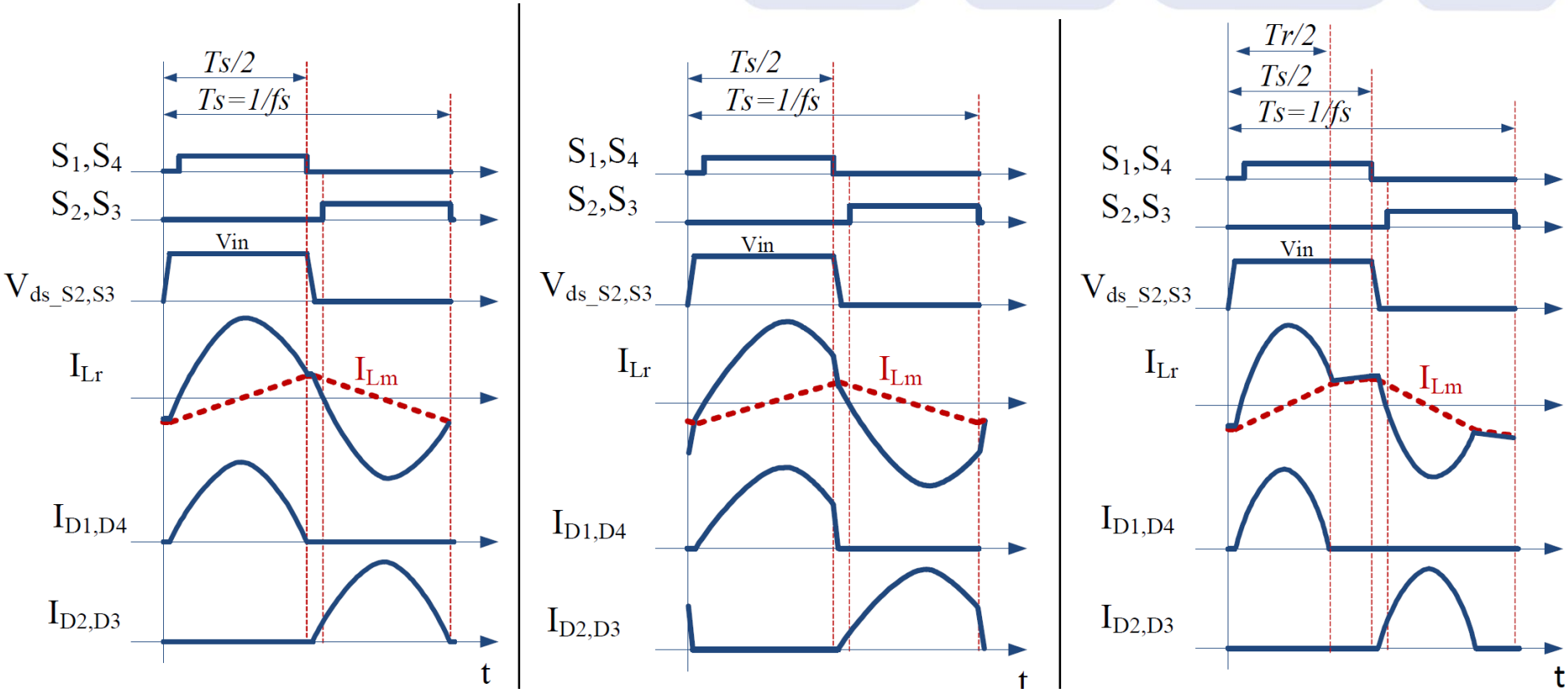


Series Resonant conv.

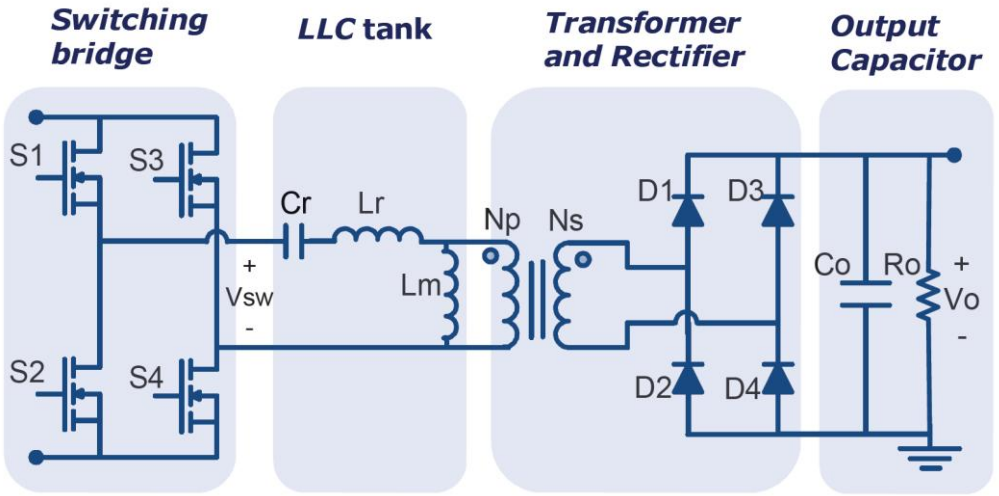


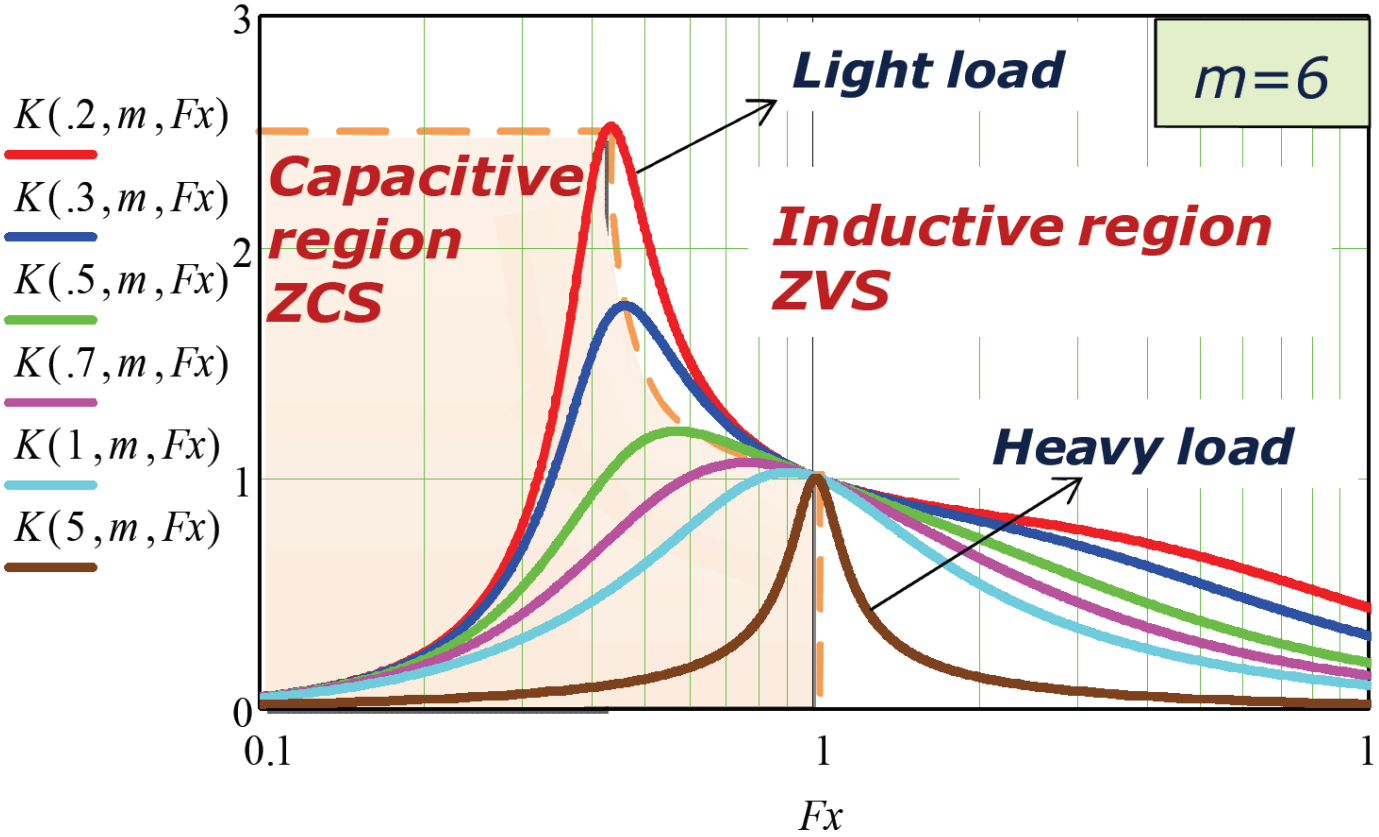
Resonant series operation





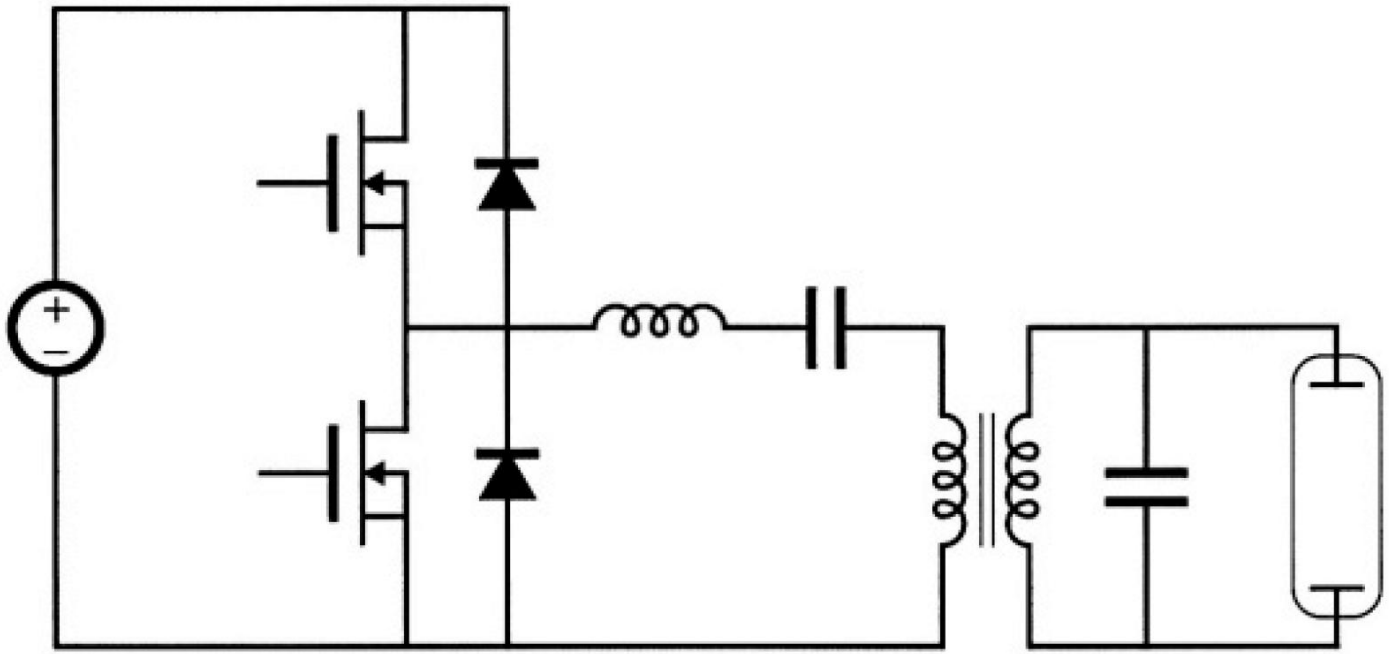
Resonant series region of oper.





$$m = \frac{L_r + L_m}{L_r}$$

Half-bridge LCC ballast



Homework