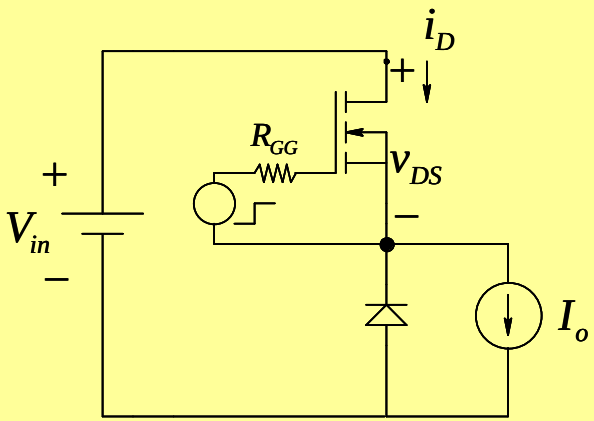
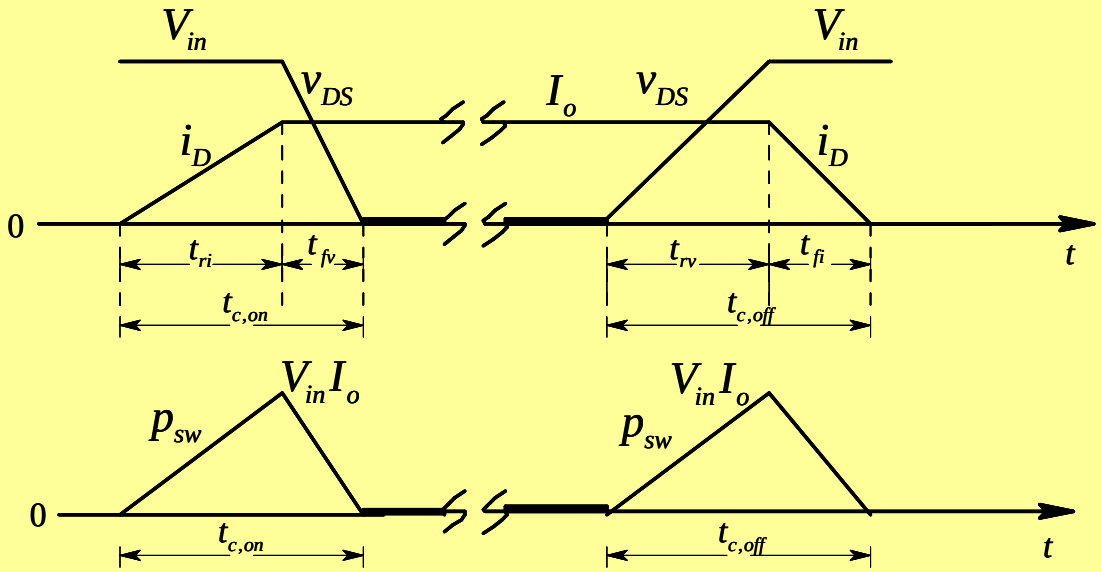
Soft-Switching in DC-DC Converters

HARD-SWITCHING IN SWITCHING POWER-POLES



(a)



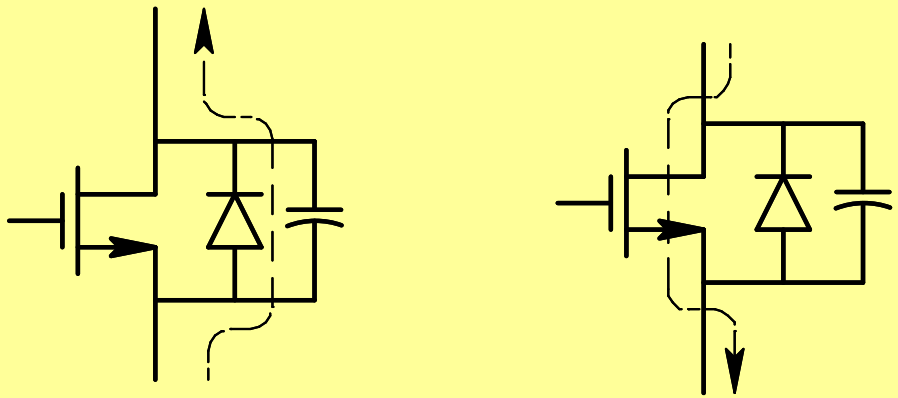
(b)

$$P_{sw} \propto f_s \left(t_{c(on)} + t_{c(off)} \right)$$

SOFT-SWITCHING IN SWITCHING POWER-POLES

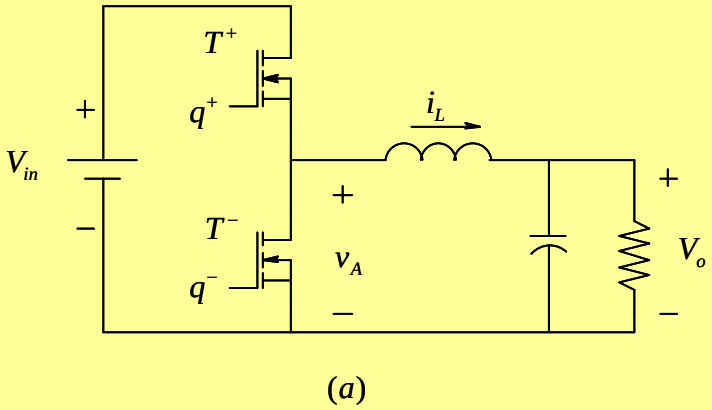
- ZVS (zero voltage switching), and
- ZCS (zero current switching)

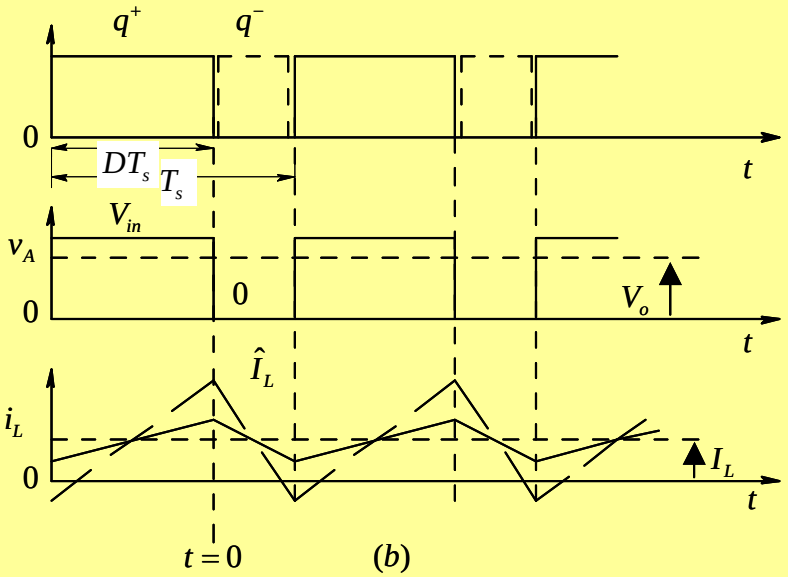
Zero Voltage Switching (ZVS)

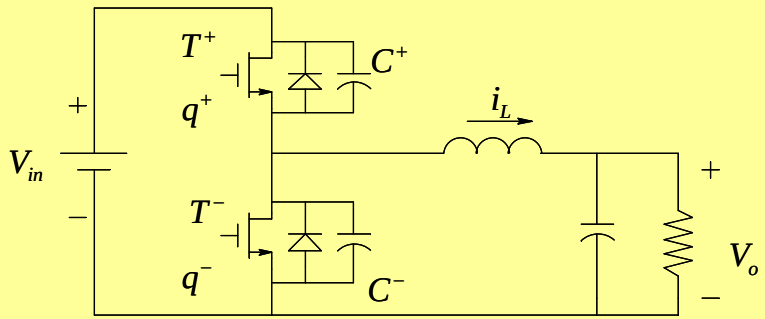


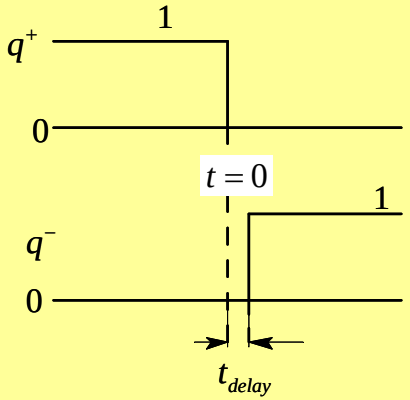
(*a*) (*b*)

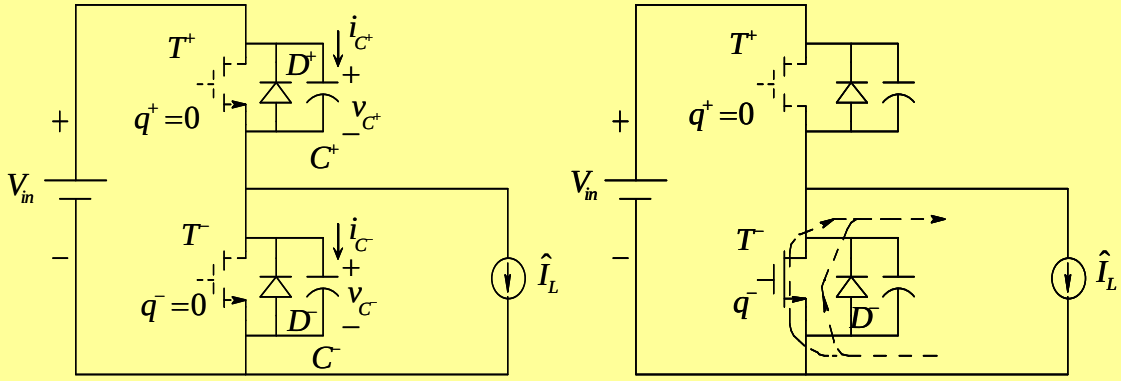
Synchronous Buck Converter with ZVS











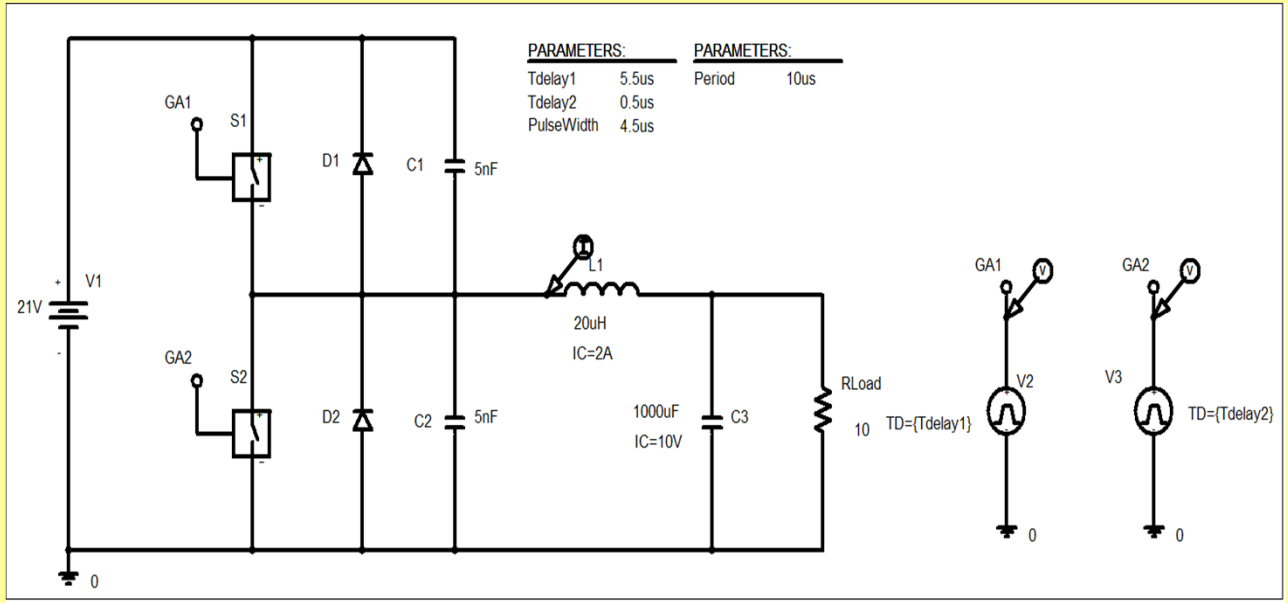
$$v_{C^+} + v_{C^-} = V_{in}$$

$$C\frac{d}{dt}v_{C^+} + C\frac{d}{dt}v_{C^-} = 0$$

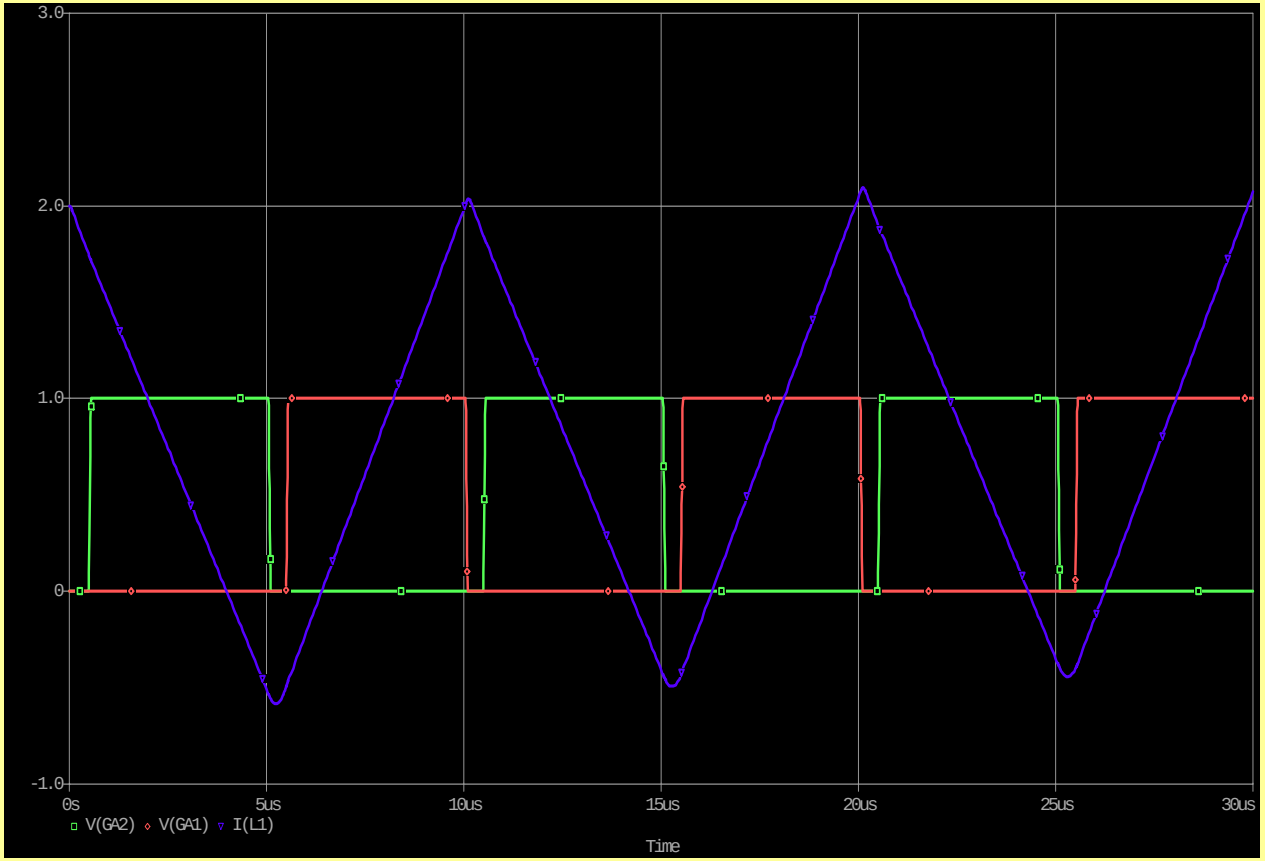
$$i_{C^+} + i_{C^-} = 0 \qquad \Rightarrow \qquad i_{C^+} = -i_{C^-}$$

$$i_{C^+} = -i_{C^-} = \frac{\hat{I}_L}{2}$$

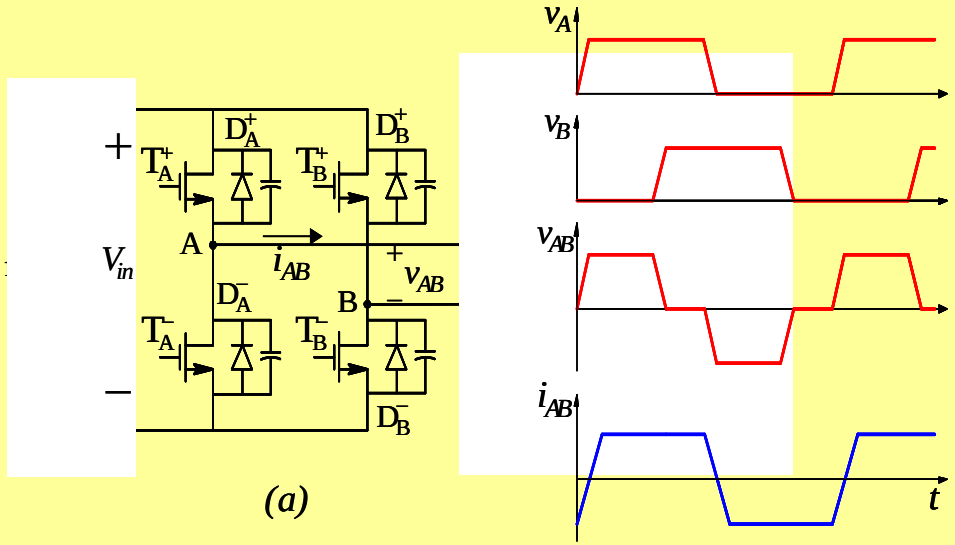
PSpice Modeling:



Simulation Results



Phase-Shift Modulated (PSM) DC-DC Converter



Summary

Soft-Switching in DC-DC Converters