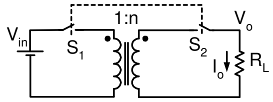
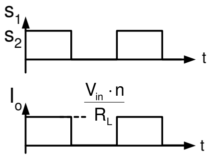
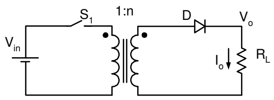
Isolated Converters
Forward and Flyback

- DC current via transformer
- Forward
  - Voltage transfer function
  - Magnetizing inductance
  - Transformer reset
- Coupled inductors
- Flyback
  - Voltage transfer function
  - Multiple outputs

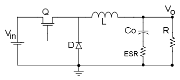
DC current via transformer

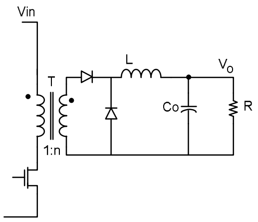


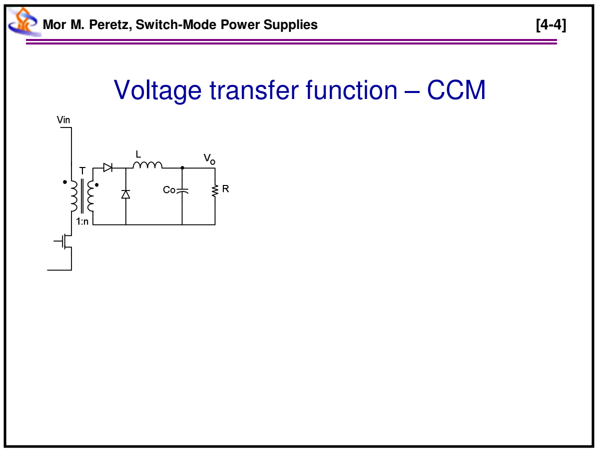




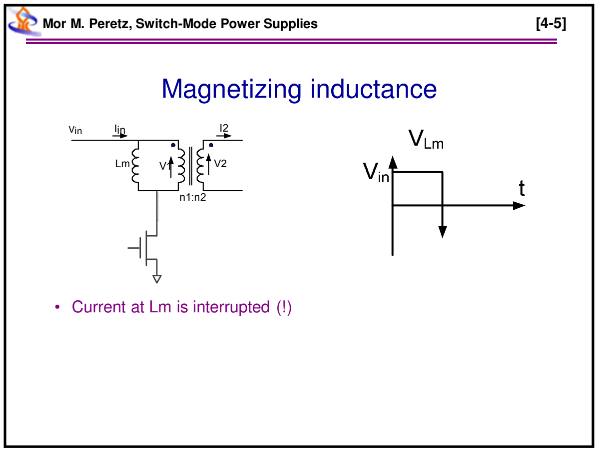
Forward converter
(buck derived)





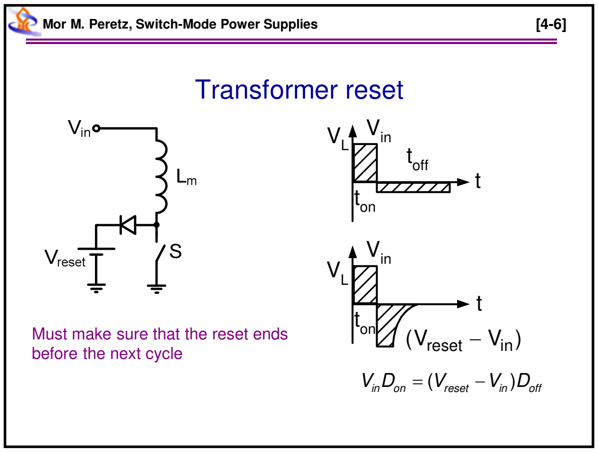


Voltage transfer function – CCM



Magnetizing inductance

- Current at Lm is interrupted (!)

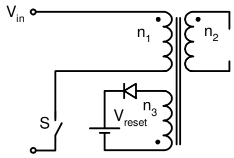


Transformer reset

Must make sure that the reset ends before the next cycle

$$V_{in}D_{on} = (V_{reset} - V_{in})D_{off}$$

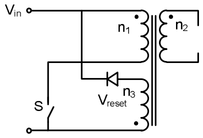
Reset winding
Auxiliary source



Requirement for reset:

$$D_{off}\frac{V_{reset}}{n_3} \ge \frac{V_{in}}{n_1} D_{on}$$

Reset winding
Same source



Requirement for reset:

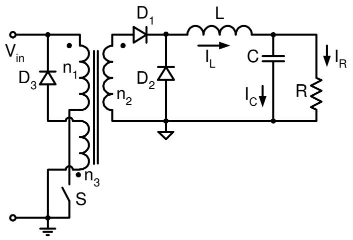
$$D_{off}\frac{V_{in}}{n_3} \ge \frac{V_{in}}{n_1} D_{on}$$

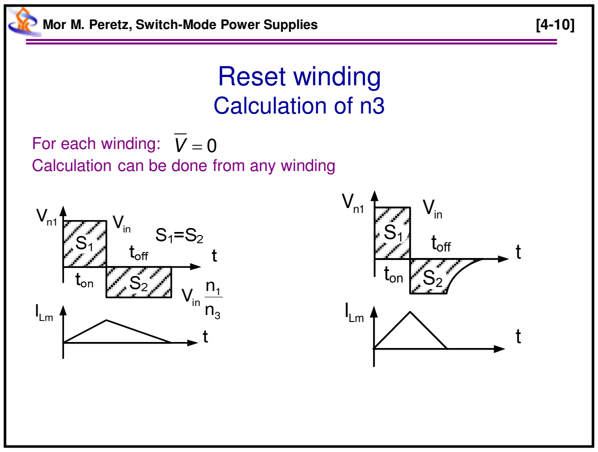
$$\frac{n_1}{n_3} \ge \frac{D_{on}}{D_{off}}$$

Must make sure that the reset ends before the next cycle

For calculations use Don-max

Forward converter
Schematic with reset

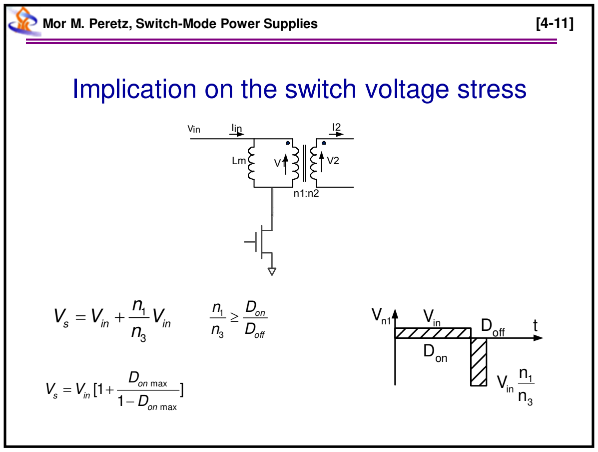




Reset winding
Calculation of n3

For each winding: $\overline{V} = 0$

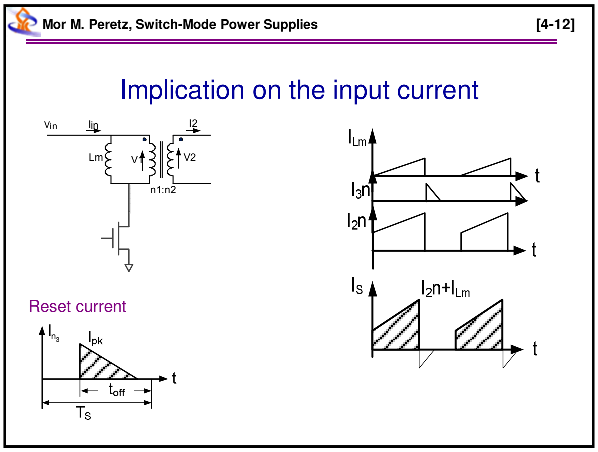
Calculation can be done from any winding



Implication on the switch voltage stress

$$V_s = V_{in} + \frac{n_1}{n_3}V_{in} \qquad \frac{n_1}{n_3} \geq \frac{D_{on}}{D_{off}}$$

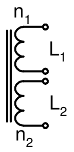
$$V_s = V_{in}\left[1 + \frac{D_{on\,\max}}{1 - D_{on\,\max}}\right]$$



Implication on the input current

Reset current

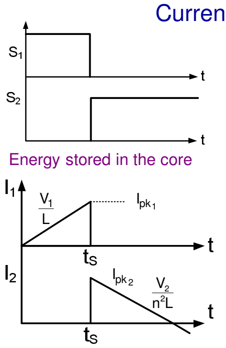
Coupled inductors

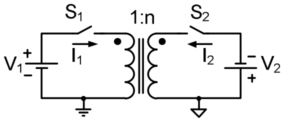


$$\frac{L_1}{L_2} = \left(\frac{n_1}{n_2}\right)^2$$

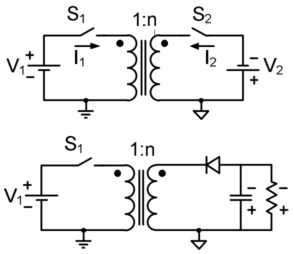
Coupled inductors

Current interruption



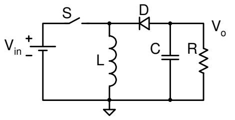


Replacing switch by a diode

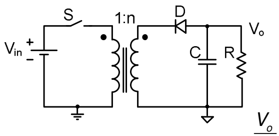


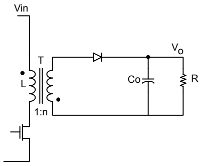
Flyback converter

buck-boost derived



$$\frac{V_o}{V_{in}} = -\frac{D}{1-D}$$





$$\frac{V_o}{V_{in}} = \frac{1}{n}\frac{D}{1-D}$$

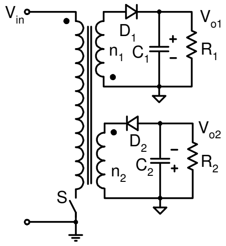
Voltage transfer function – CCM

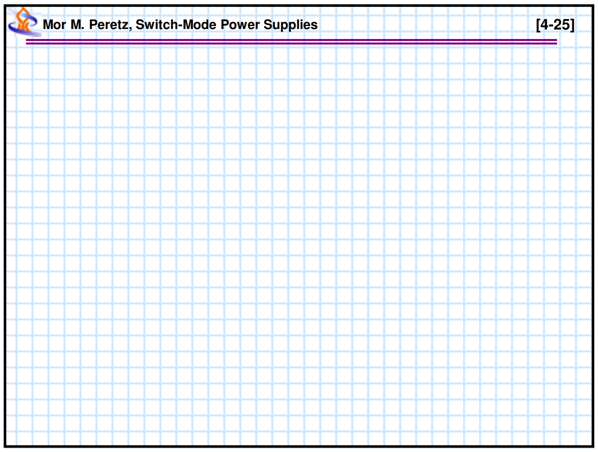
average voltage method

Voltage transfer function – CCM

ΔI method

Multiple outputs
Effect of coupling





Mor M. Peretz, Switch-Mode Power Supplies [4-25]