

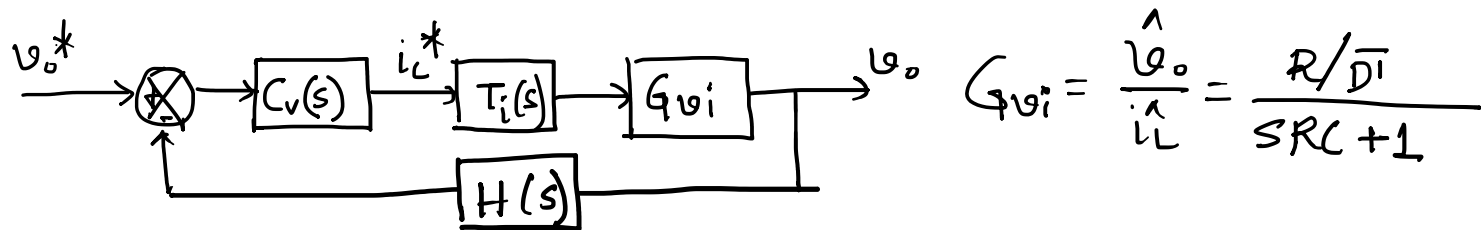
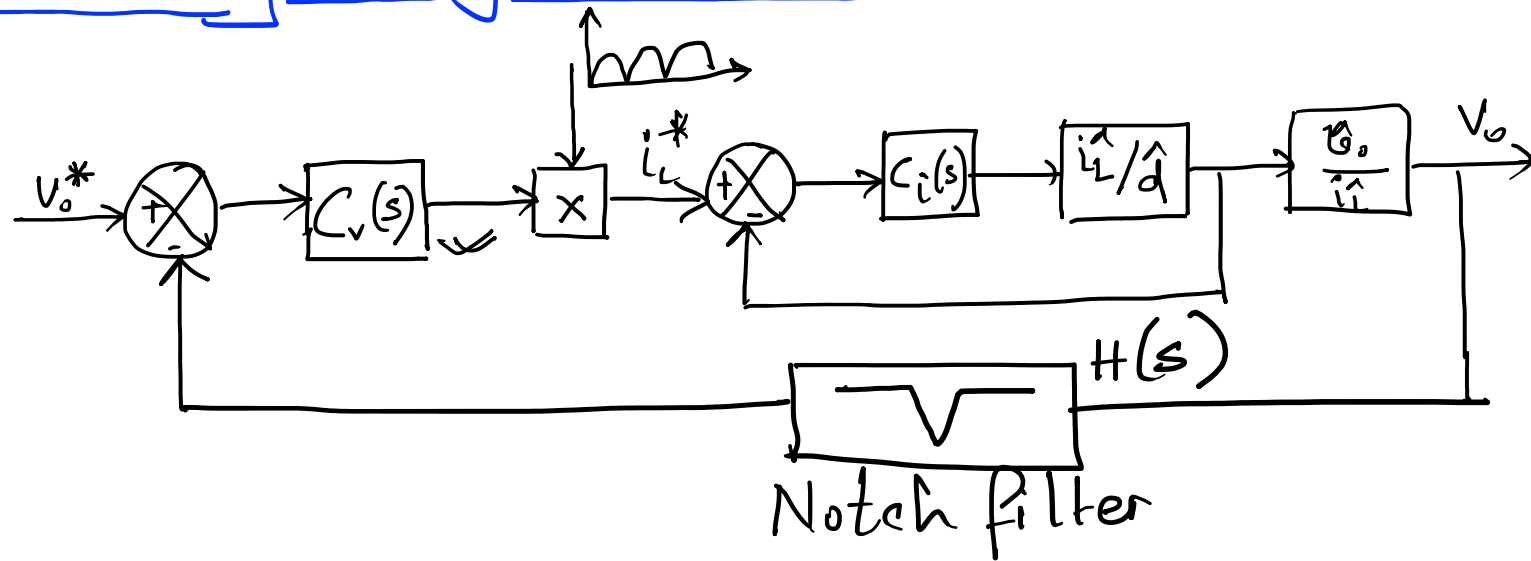
Switched Mode Power Conversion

Semester II Academic Year 2025-26

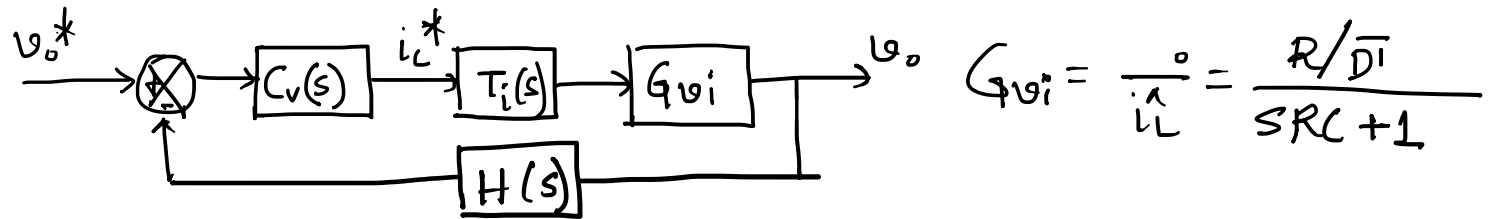
Lecture 19

10th March 2026

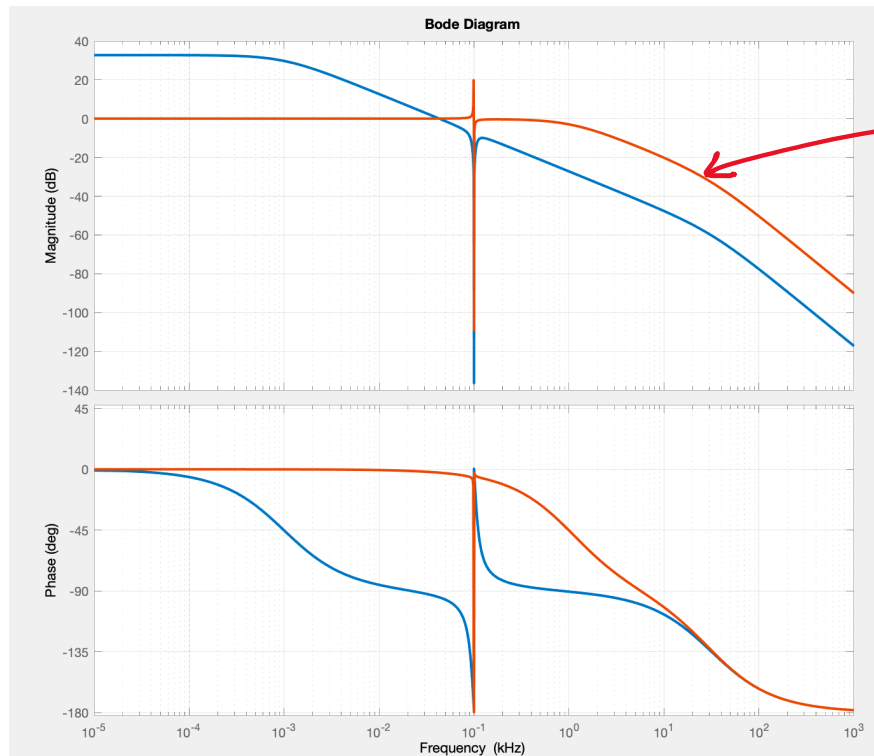
Improving voltage controller bandwidth



Improving voltage controller bandwidth



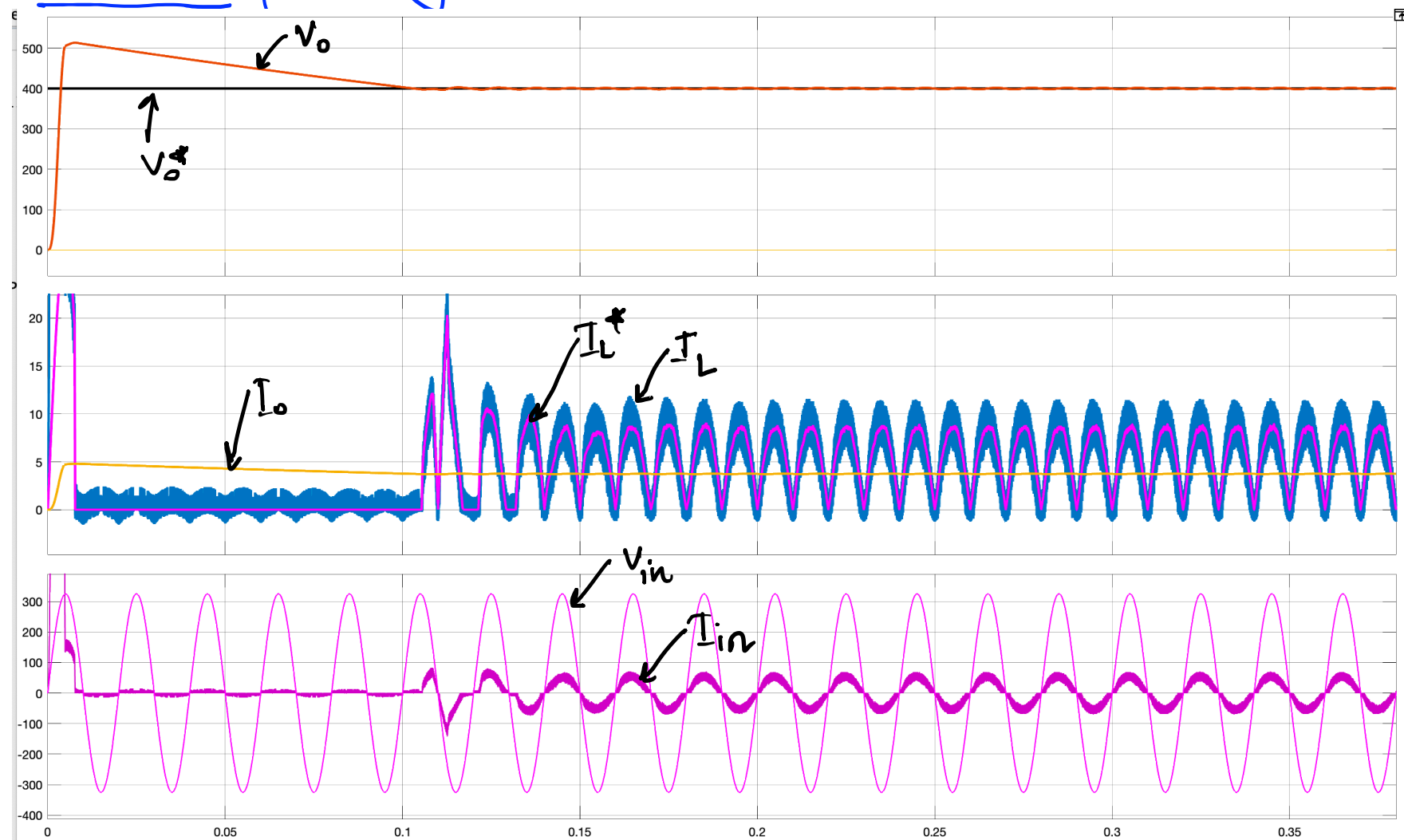
$$G_{vi} = \frac{v_o}{i_L} = \frac{R/\bar{D}^*}{sRC + 1}$$



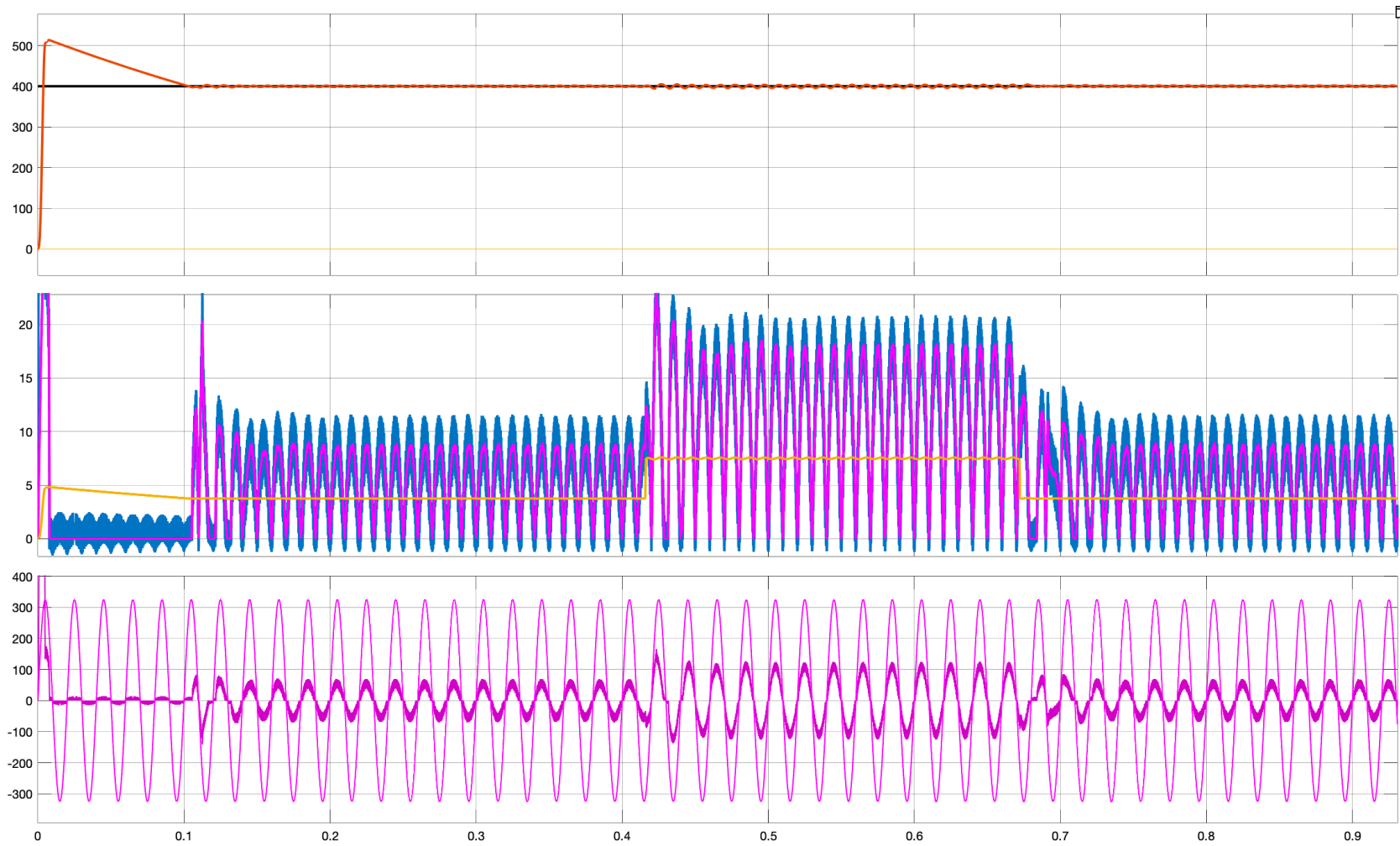
Closed loop transfer function of the compensated system

$$C_v = \frac{23(s + 6.28)}{s}$$

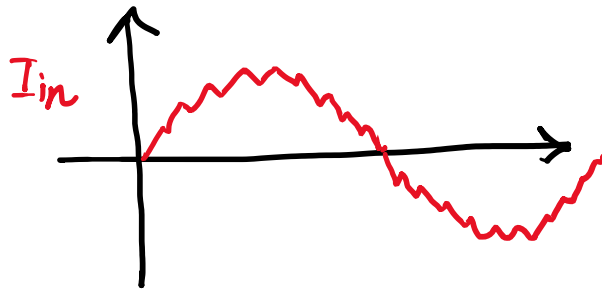
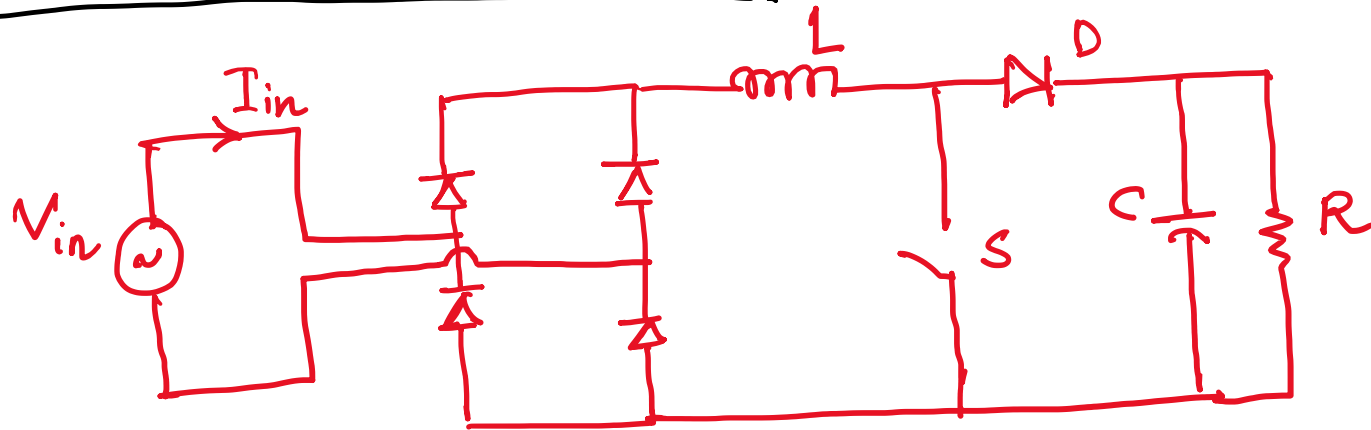
Improving voltage controller bandwidth



vinyl voltage controller bandwidth



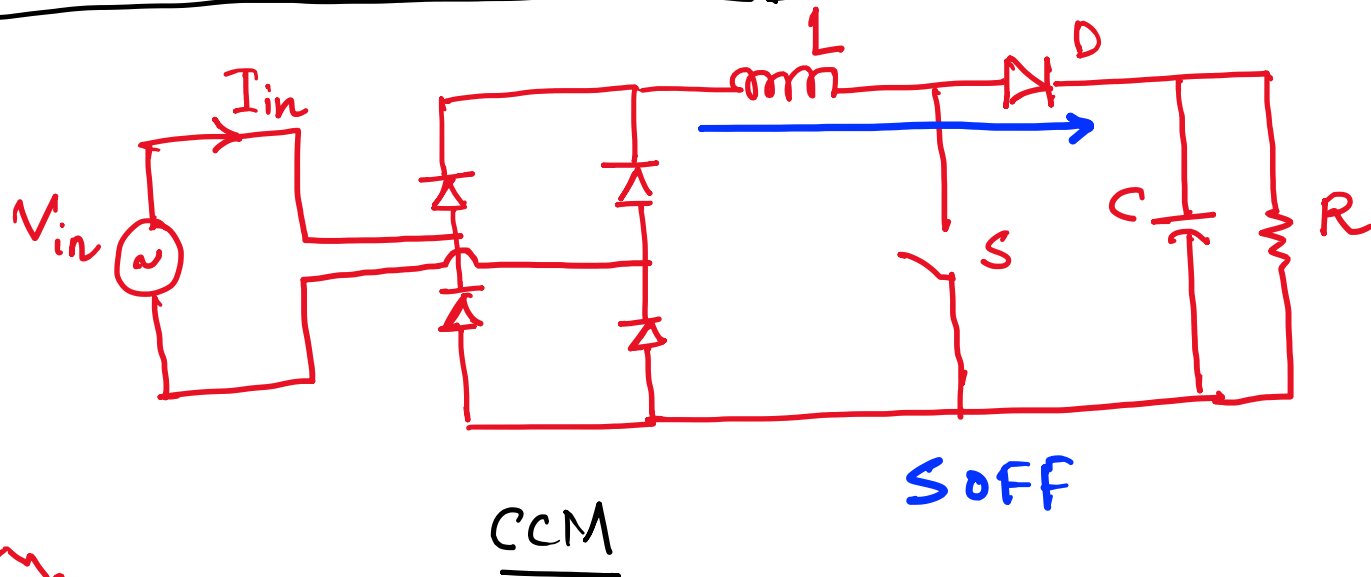
* Comparison of Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) of Boost PFC



CCM

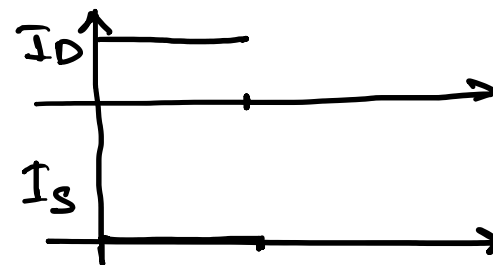
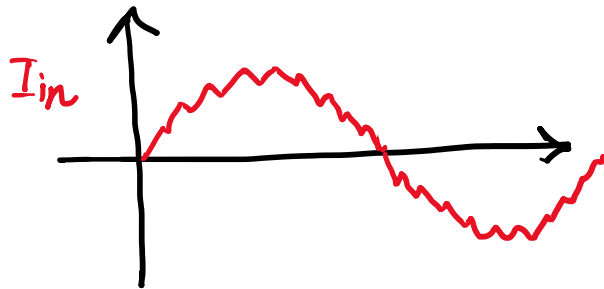
- Continuous current due to high value of L
- Low THD

* Comparison of Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) of Boost PFC

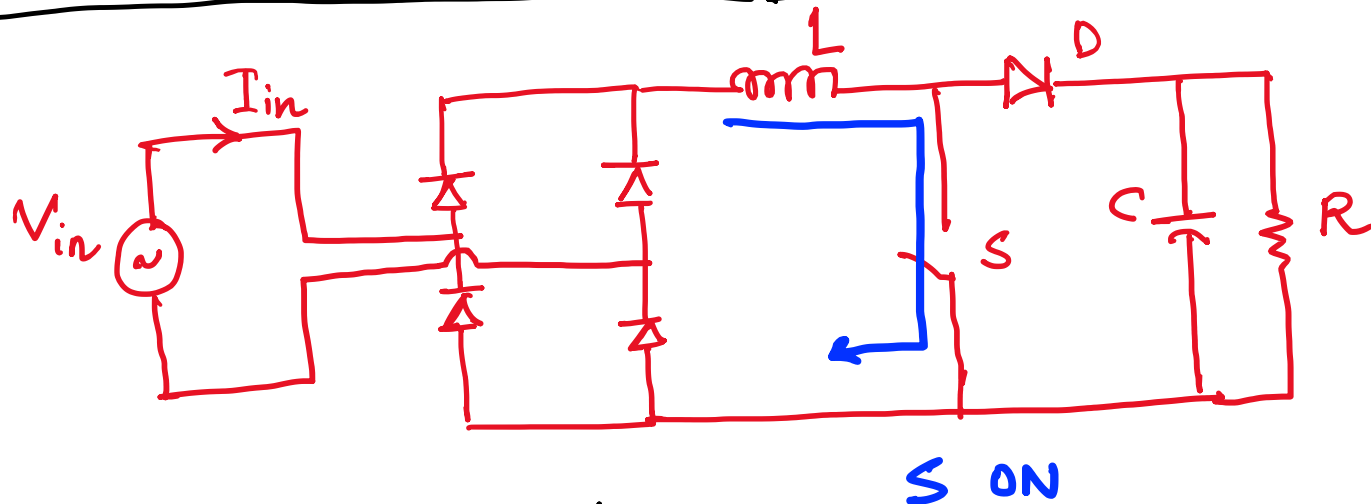


SOFF

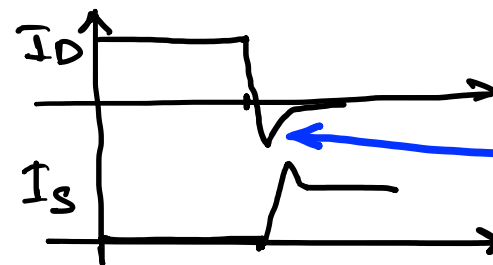
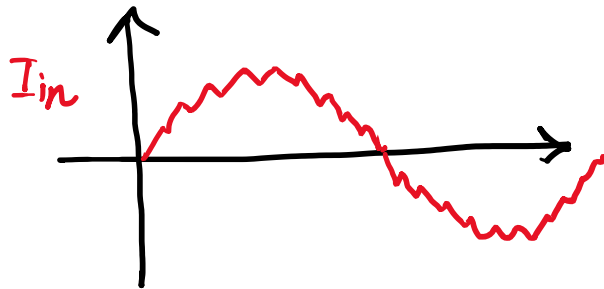
CCM



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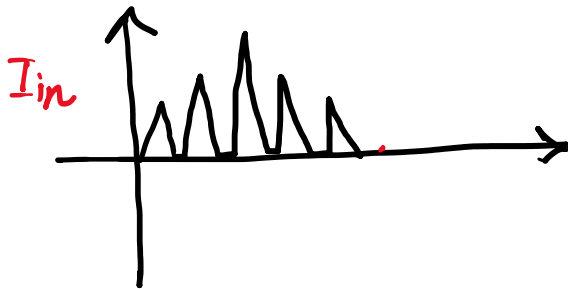
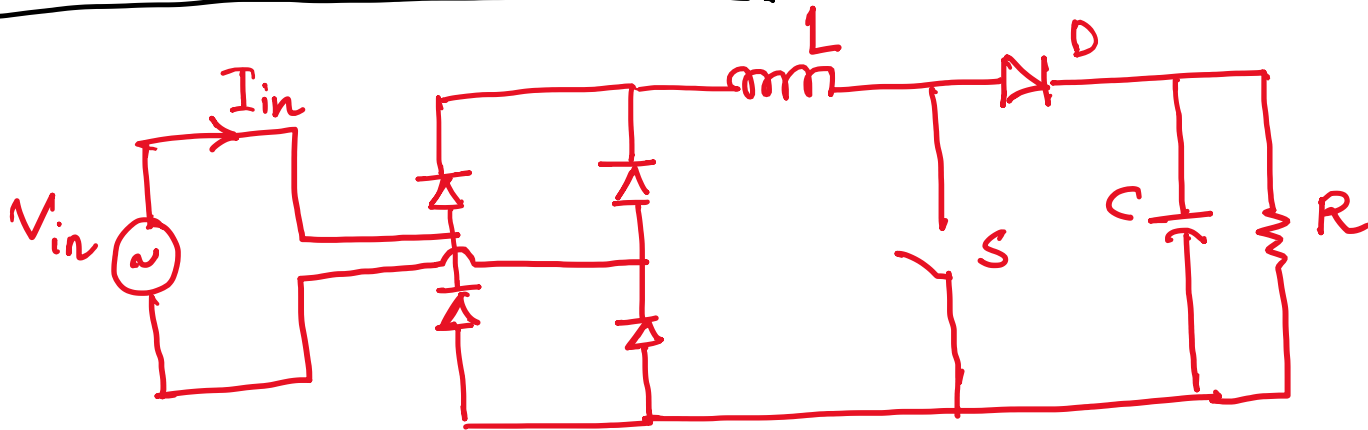


CCM



Reverse Recovery
current
More switching
loss

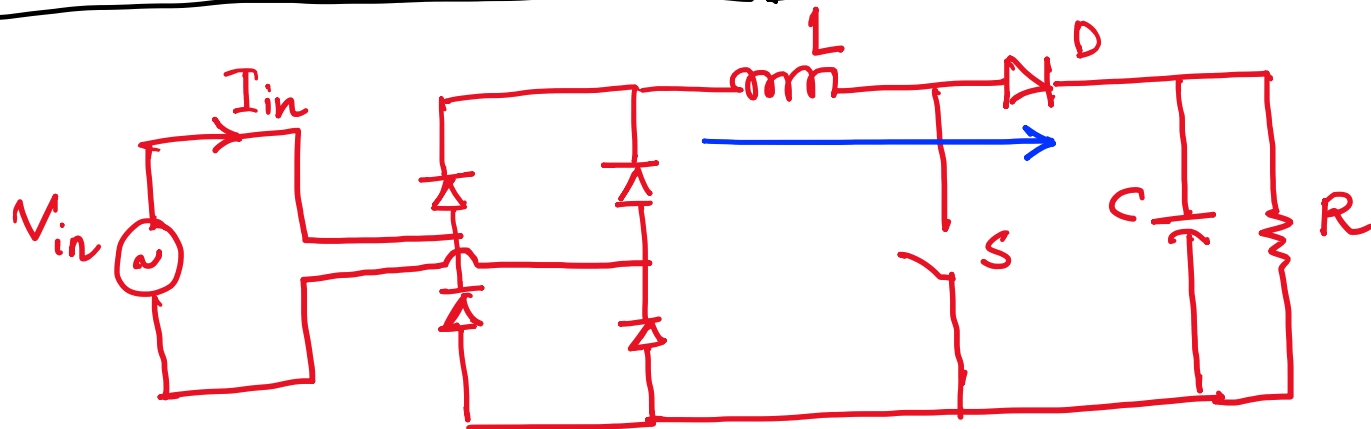
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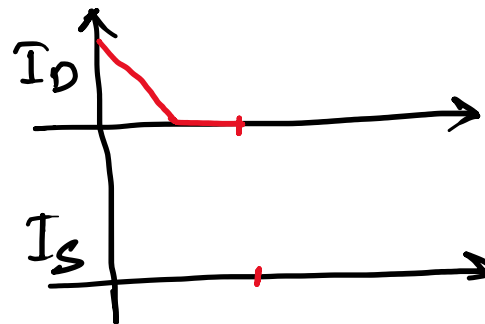
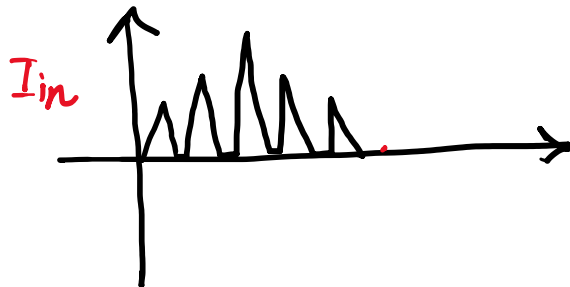
DCM

- Inductor size reduces
- THD deteriorates (C Filter)

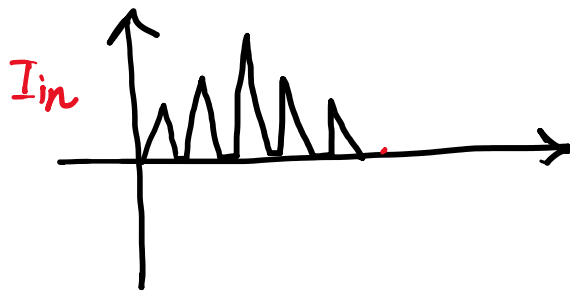
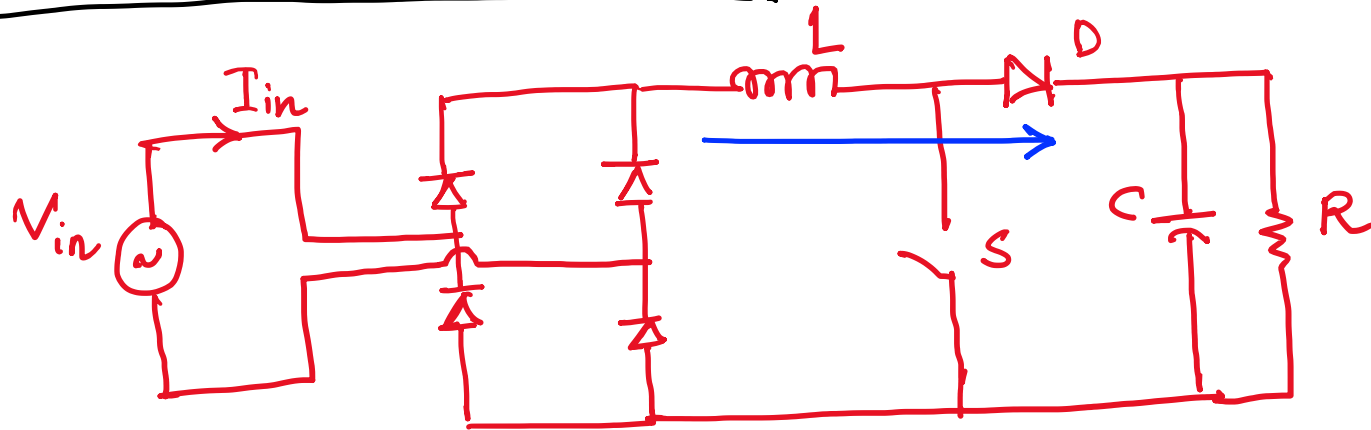
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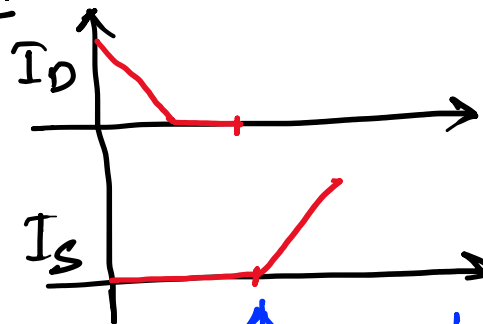
S-OFF



* Comparison of Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) of Boost PFC



DCM

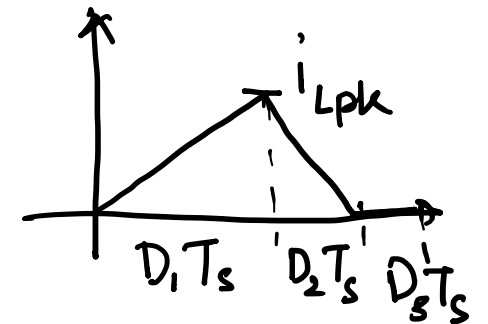
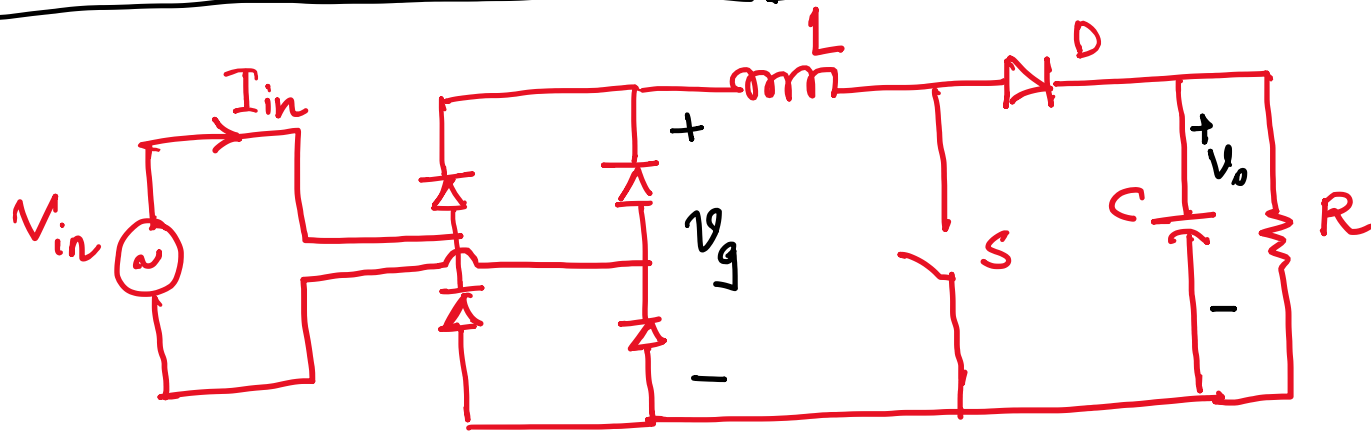


S-OFF

↖ ZCS turn ON

- Low switching loss
- Reduced inductor size

* Comparison of Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) of Boost PFC



DCM

$$v_g = V_m |\sin \omega t|$$

$$(V_o - v_g) D_2 T_s = v_g D_1 T_s$$

$$\Rightarrow D_2 = \frac{v_g}{V_o - v_g} D_1$$

$$\begin{aligned} i_{Lavg} &= \frac{1}{2} i_{Lpk} (D_1 + D_2) \\ &= \frac{V_m |\sin \omega t| D_1^2 T_s V_o}{2L [V_o - V_m |\sin \omega t|]} \end{aligned}$$

$$i_{Lpk} = \frac{V_m |\sin \omega t| D_1 T_s}{L}$$

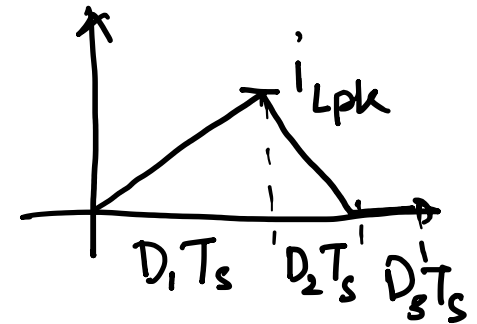
[Sine Envelope]

* Comparison of Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM) of Boost PFC

$$i_{Lavg} = \frac{V_m |\sin \omega t| D_1^2 T_s V_o}{2L [V_o - V_m |\sin \omega t|]}$$

$$\frac{i_{Lpk}}{i_{Lavg}} = \frac{2}{D_1} \left[1 - \frac{V_m}{V_o} |\sin \omega t| \right]$$

- High device current rating
- Application - low power PFC



$$i_{Lpk} = \frac{V_m |\sin \omega t| D_1 T_s}{L}$$

[Sine Envelope]

- * Constant duty control simplicity