Power Factor Correction Circuits (PFC)

- Basic Principle with single-phase input

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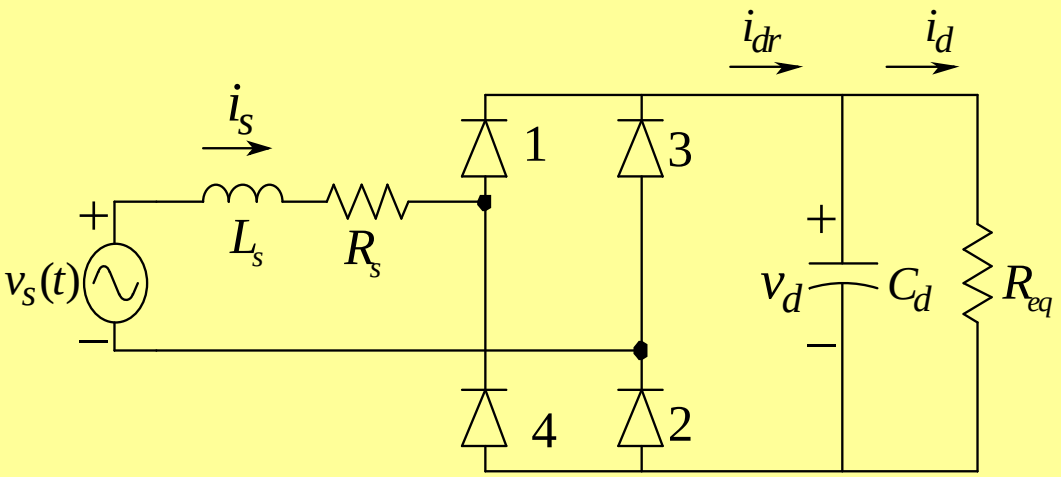
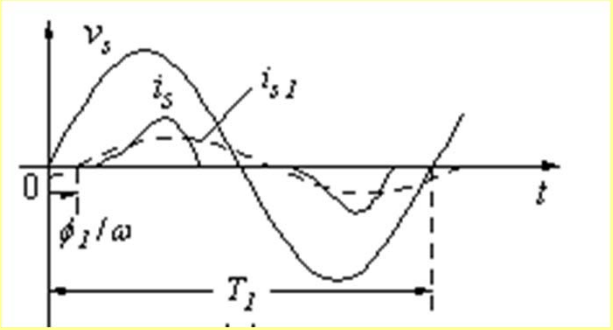
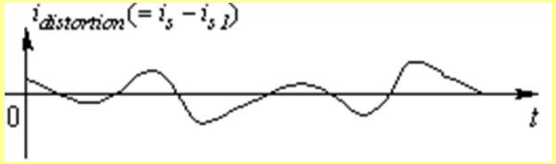
Diode Rectifier Circuit:







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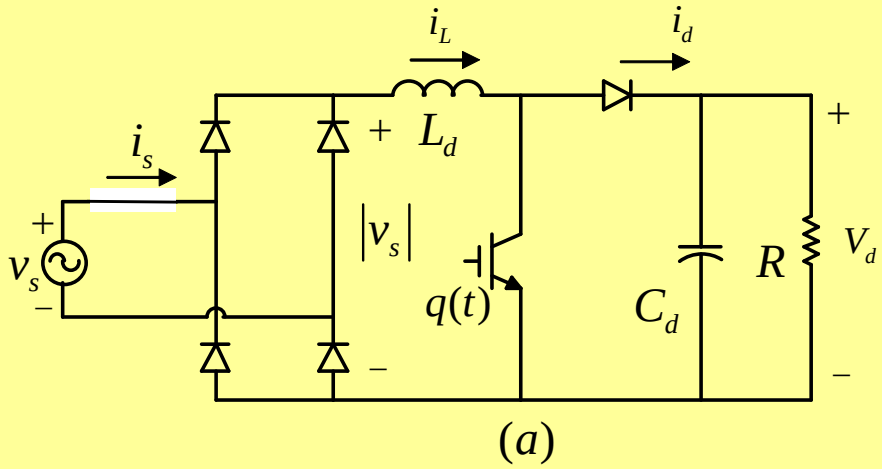
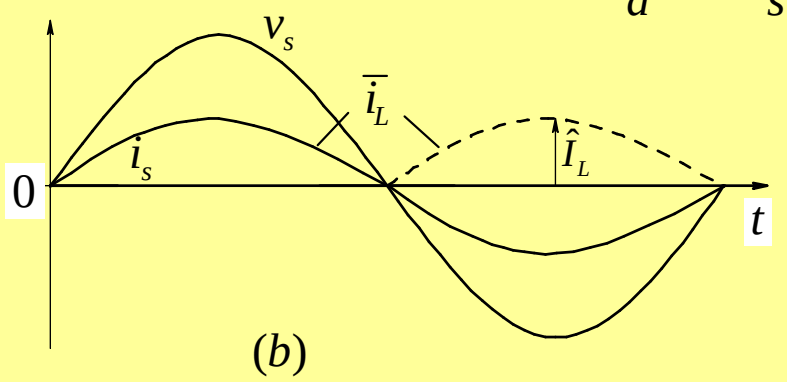
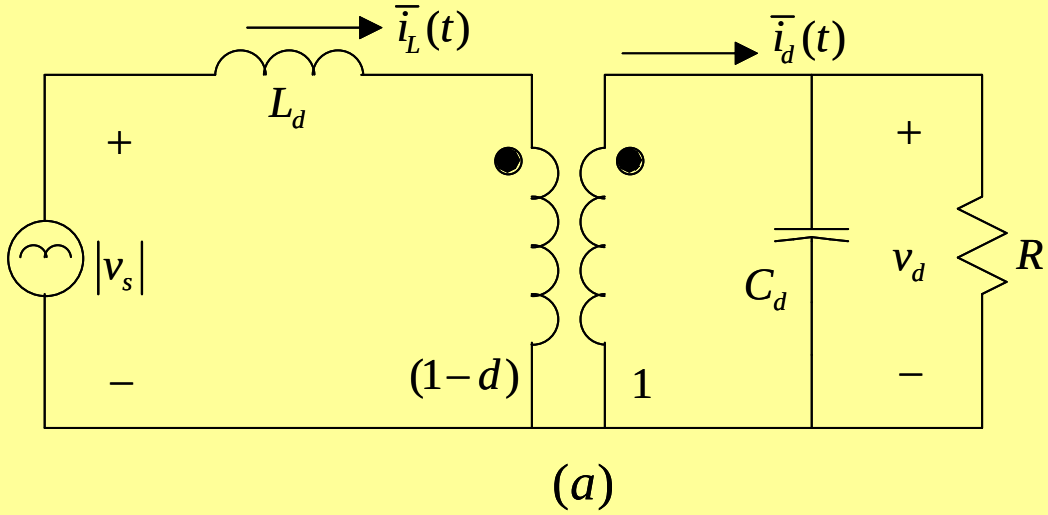
Implementation of PFC

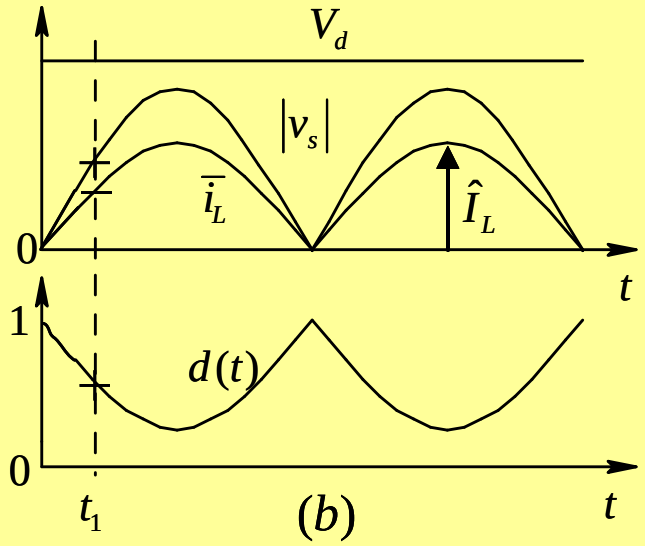
- Use a boost dc-dc converter to shape the rectified current



$V_d > \hat{V}_s$







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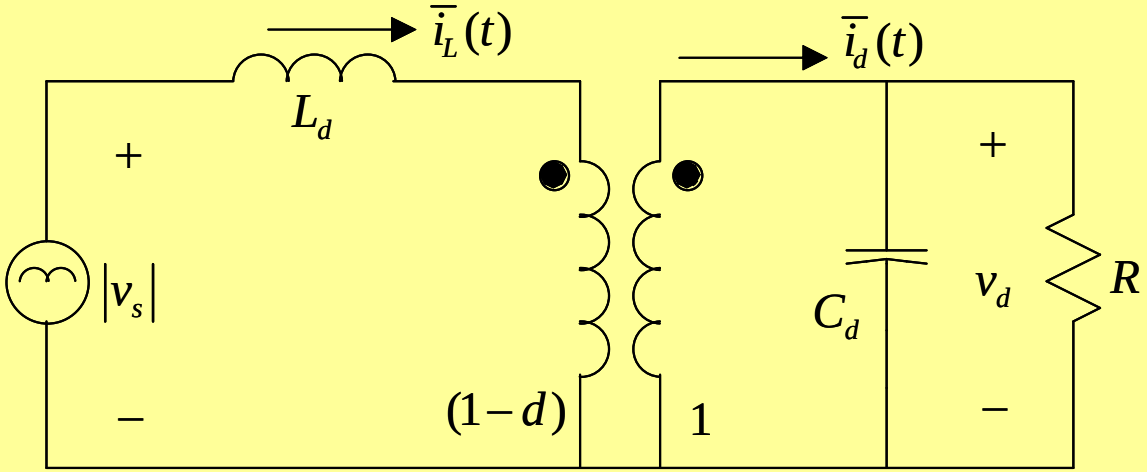
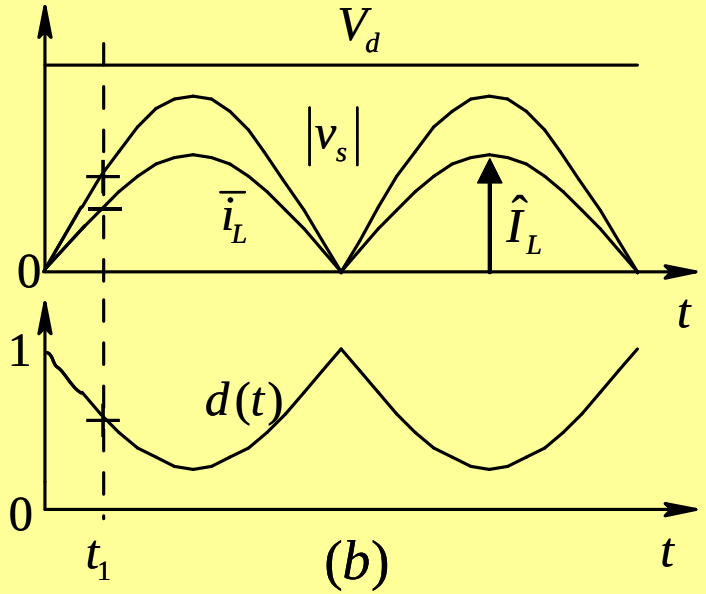


(a)



(b)

$$\frac{V_d}{|v_s|} = \frac{1}{1-d(t)}$$

$$1-d(t) = \frac{\hat{V}_s\left|\sin(\omega t)\right|}{V_d}$$

$$d(t) = 1-\frac{\hat{V}_s\left|\sin(\omega t)\right|}{V_d}$$

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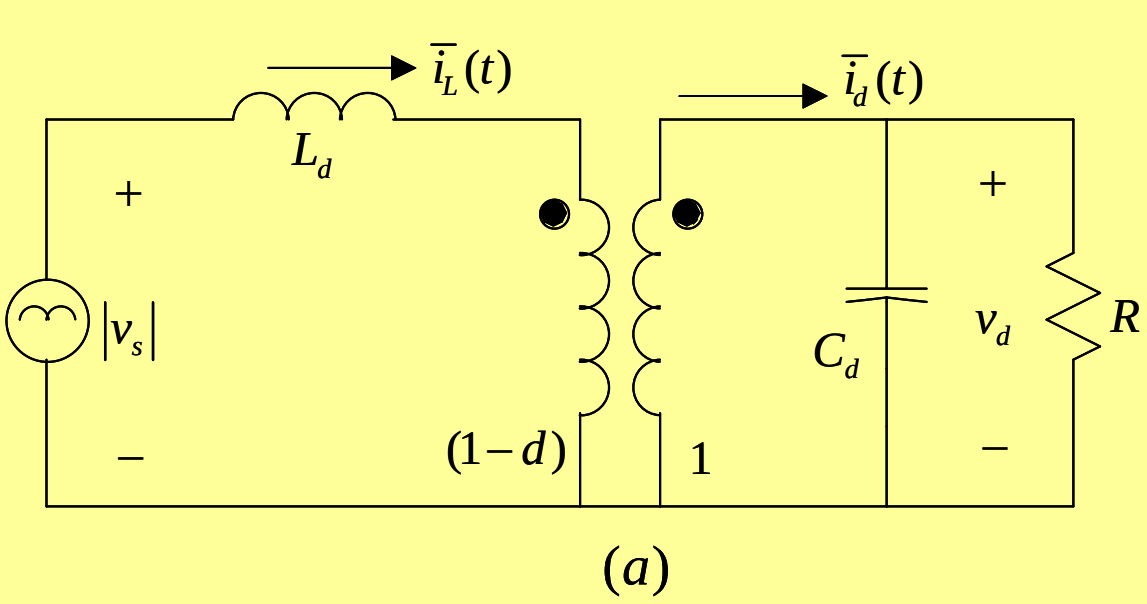
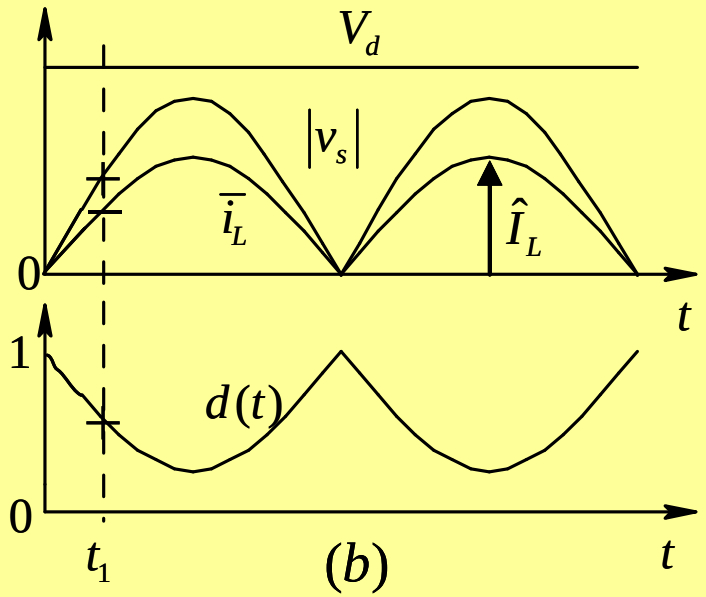


(a)



(b)

$$1-d(t)=\frac{\hat{V}_s\left|\sin(\omega t)\right|}{V_d} \qquad \bar{i}_L=\hat{I}_L\left|\sin(\omega t)\right|$$

$$\bar{i}_d=\left(1-d(t)\right)\bar{i}_L=\frac{\hat{V}_s\left|\sin(\omega t)\right|}{V_d}\hat{I}_L\left|\sin(\omega t)\right|=\frac{\hat{V}_s\hat{I}_L}{V_d}\left|\sin(\omega t)\right|^2$$

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$$\bar{i}_d = \frac{\hat{V}_s \hat{I}_L}{V_d} \left| \sin(\omega t) \right|^2$$

$$\bar{i}_d = \frac{\hat{V}_s \hat{I}_L}{V_d} \sin^2(\omega t) = \frac{\hat{V}_s \hat{I}_L}{V_d} \left(\frac{1}{2} - \frac{1}{2} \cos(2\omega t) \right)$$

$$\bar{i}_d = \underbrace{\frac{1}{2} \frac{\hat{V}_s}{V_d} \hat{I}_L}_{I_d} - \underbrace{\frac{1}{2} \frac{\hat{V}_s}{V_d} \hat{I}_L \cos 2\omega t}_{i_{d2}(t)}$$

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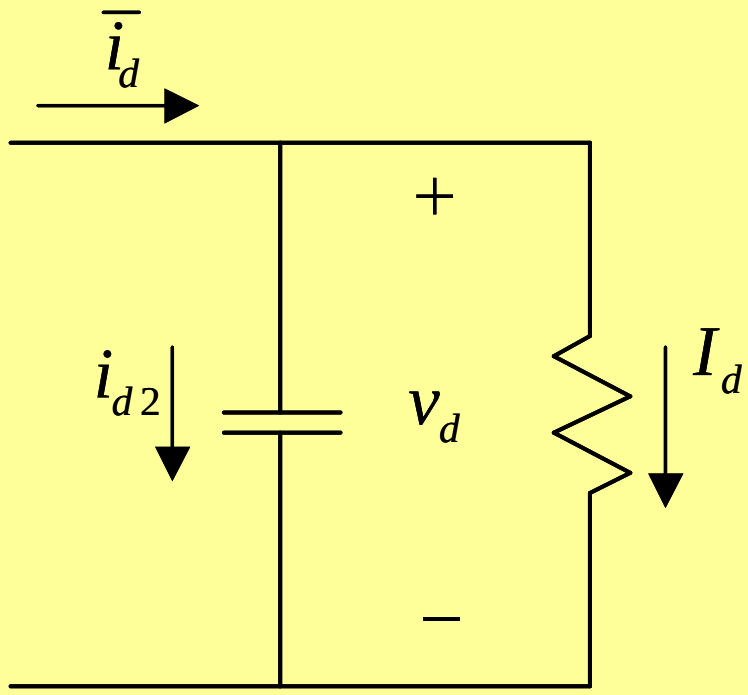
Calculation of $\hat{V}_{d2}$



$$\bar{i}_d = \underbrace{\frac{1}{2}\frac{\hat{V}_s}{V_d}\hat{I}_L}_{I_d} - \underbrace{\frac{1}{2}\frac{\hat{V}_s}{V_d}\hat{I}_L \cos 2\omega t}_{i_{d2}(t)}$$

$$\hat{I}_{d2} = \frac{1}{2}\frac{\hat{V}_s}{V_d}\hat{I}_L$$

$$\hat{V}_{d2} = \left(\frac{1}{2\omega C}\right)\hat{I}_{d2} = \frac{\hat{I}_L}{4\omega C}\frac{\hat{V}_s}{V_d}$$

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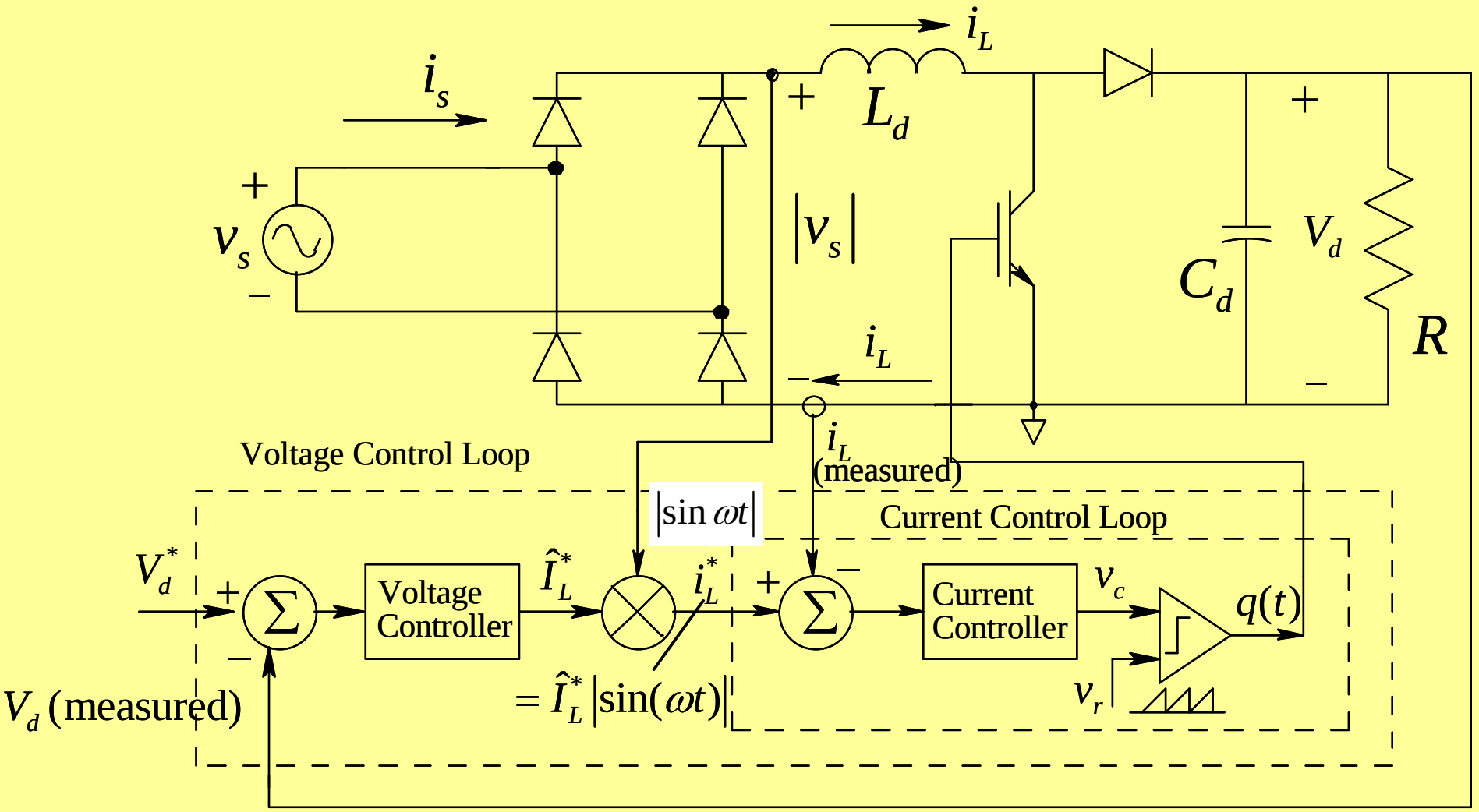
CONTROL OF PFC



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Summary

Power Factor Correction Circuits (PFC)

- Basic Principle with single-phase input

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