IIT ROORKEE

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

NPTEL ONLINE CERTIFICATION COURSE

Charging Infrastructure

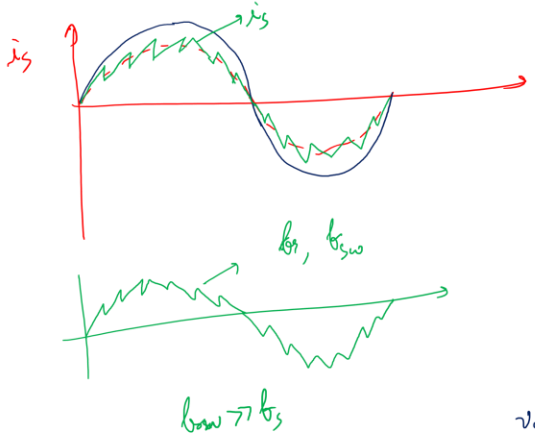
Lecture-17

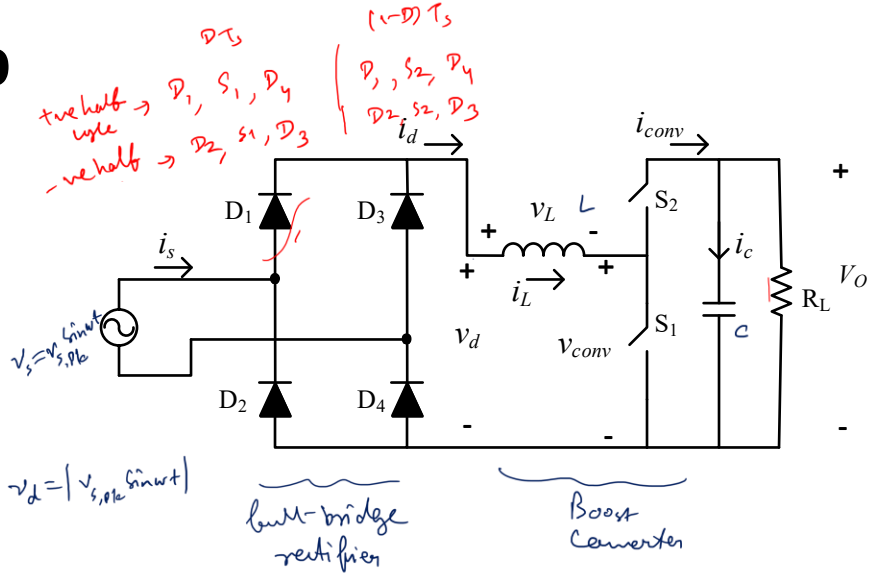
Bridgeless PFC Converter

Dr. Apurv Kumar Yadav

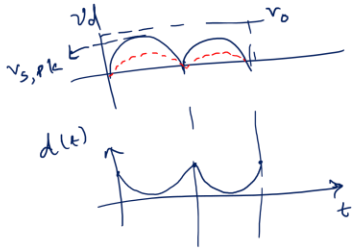
Department of Electrical Engineering

Recap

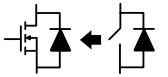




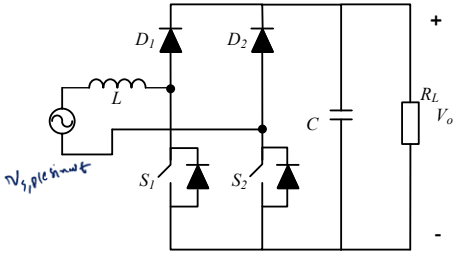
- higher component count
- 3 devices in conduction



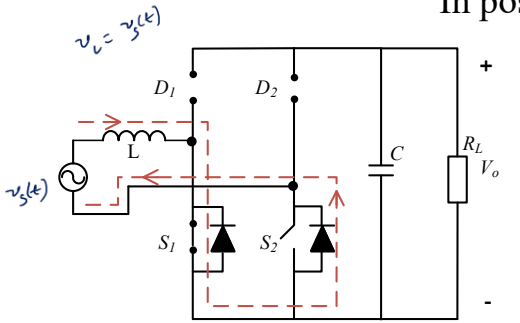
Bridgeless PFC



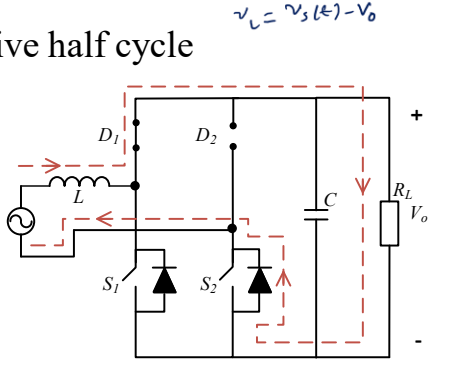
4 devices



In positive half cycle

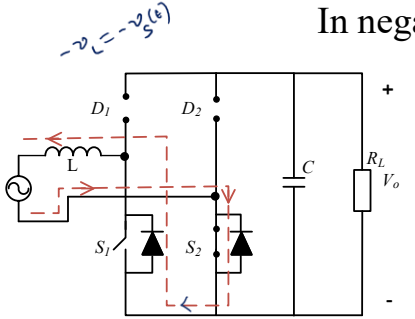


during "DT_s" duration

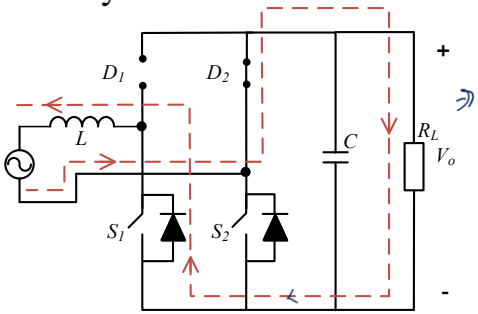


during "$(1\text{-}D)T_s$" duration

In negative half cycle



during "DT_s" duration



during "$(1\text{-}D)T_s$" duration

$T_s = 1/f_s$

$f_s \gg f_{line}$ (line frequency)

$\Rightarrow -v_L = v_o - v_s(t)$

$\Rightarrow v_L = v_s(t) - v_o$

Bridgeless PFC

+ve half cycle

DT_s

$v_L = v_s$

$(1-D)T_s$

$v_L = v_s - v_o$

+ve half cycle

DT_s

$\Rightarrow v_L = v_s$

$(1-D)T_s$

$v_L = v_s - v_o$

DT_s

$\Rightarrow v_L = |v_s|$

$(1-D)T_s$

$v_L = |v_s| - v_o$

$\Rightarrow d(t) = 1 - \frac{|v_{s,pk} \sin \omega t|}{v_o}$

$\Rightarrow d_{s_1}(t) = d(t), \quad v_s > 0$

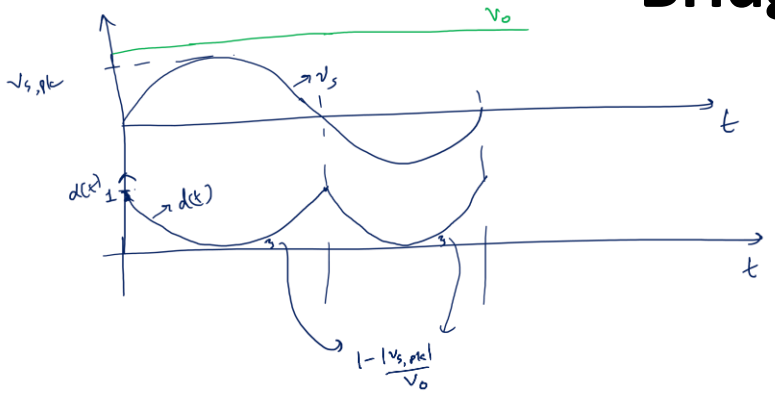
$= 0, \quad v_s < 0$

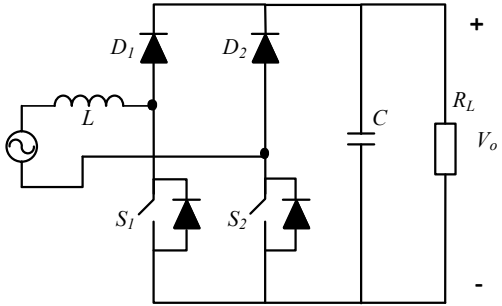
$\Rightarrow d_{s_2}(t) = 0, \quad v_s > 0$

$= d(t), \quad v_s < 0$

$\Rightarrow$ At any given instant, two devices are in conduction

Bridgeless PFC





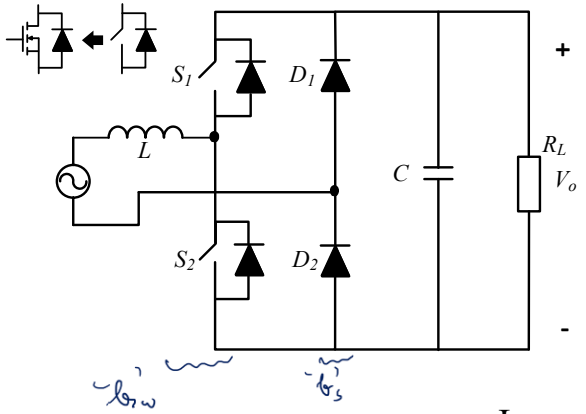
⇒ At any time instant, only 2 devices are in conduction

⇒ Only 4 devices need to be used

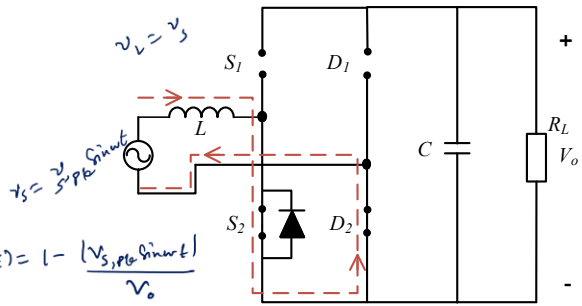
disadvantage

① Diodes need to switch at 'f_{sw}' ($f_{sw} \gg f_s$), thus fast recovery diode need to be used ⇒ higher losses associated with diode

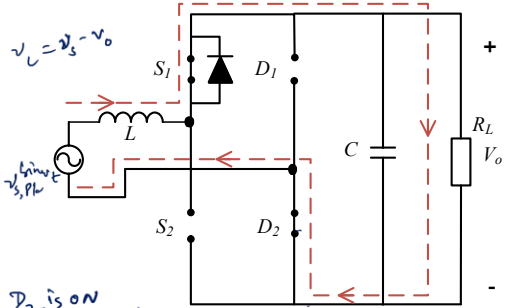
Totem pole PFC



In positive half cycle

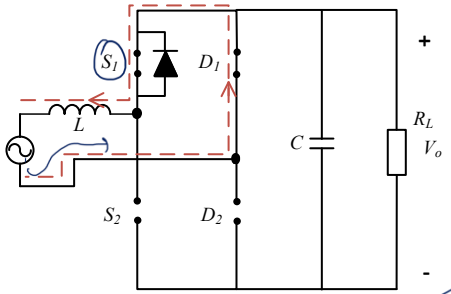


during "DT_s" duration

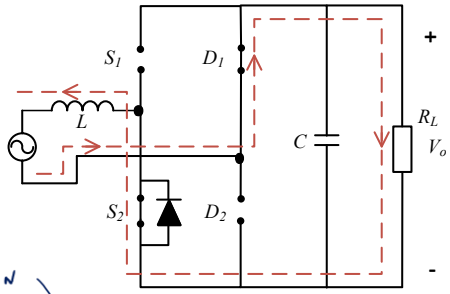


during "$(1\text{-}D)T_s$" duration

In negative half cycle



during "DT_s" duration



during "$(1\text{-}D)T_s$" duration

Totem pole PFC

→ It has two legs, where one of the legs one fast-switching leg, while the other one is slow switching leg.

In positive half cycle, (always D_2 is ON)

$$d_{s_1} = 1 - d(t)$$

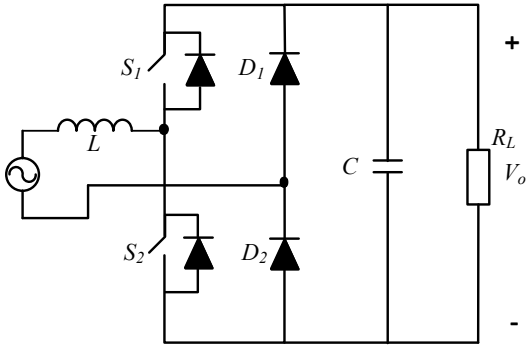
$$d_{s_2} = d(t)$$

In negative halfcycle, (always D_1 is ON)

$$d_{s_1} = d(t)$$

$$d_{s_2} = 1 - d(t)$$

$$d(t) = 1 - \frac{|V_{s,pk} \sin \omega t|}{V_o}$$



Thank You