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NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Charging Infrastructure

Lecture-32

Revisiting Isolated DC-DC Converters-III

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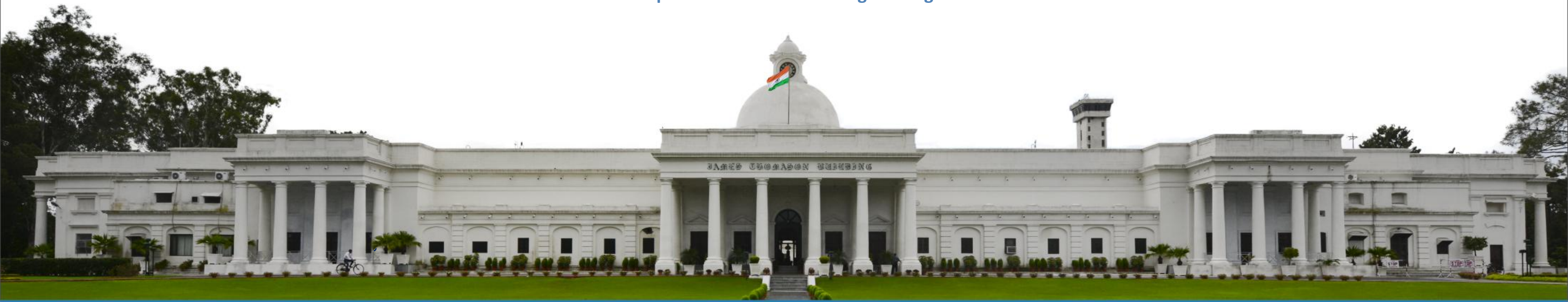
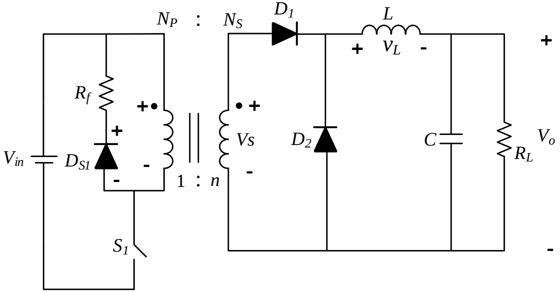
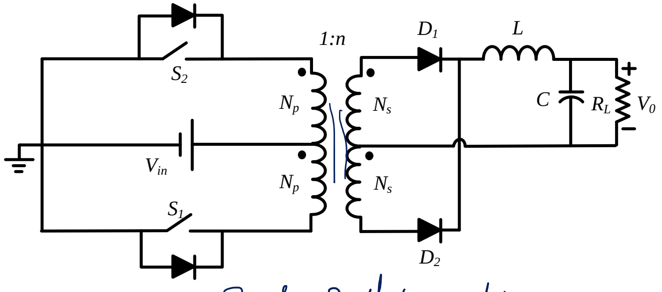


Recap





Push-Pull converter

→ forward converter with demagnetizing winding

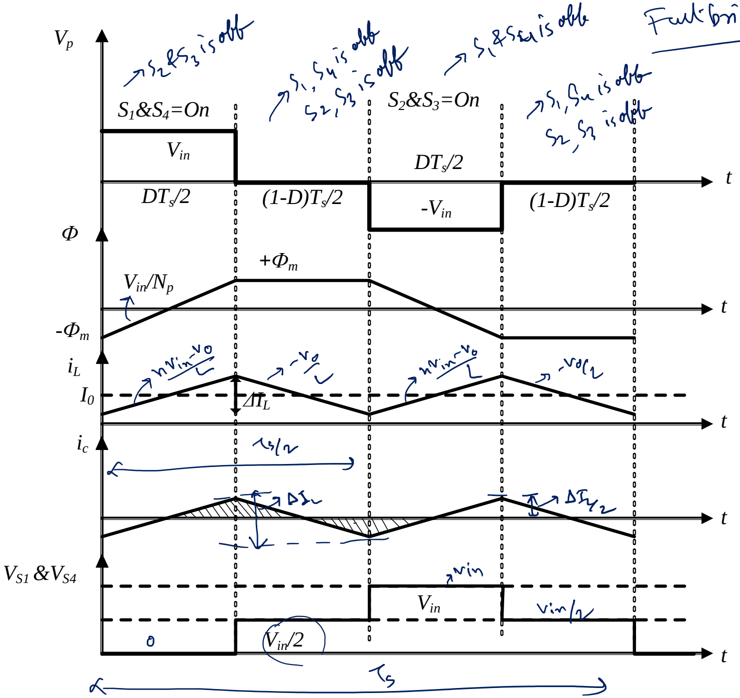
→ dual switch forward converter

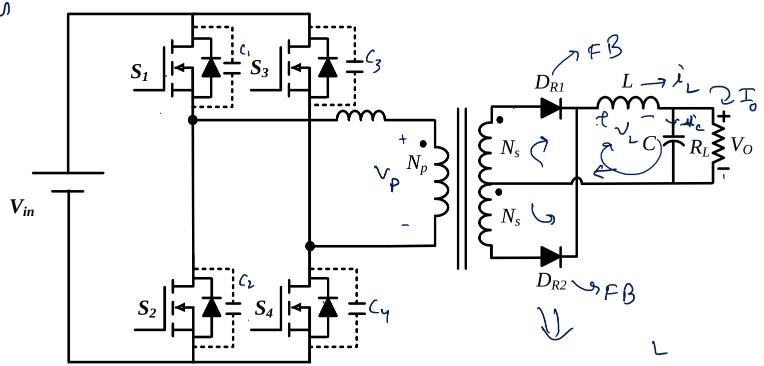
0 to B_{max}

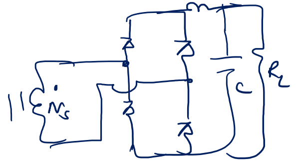
$-B_{max}$ to $+B_{max}$

$\vec{A}$rea of core gets reduced by half

Full-bridge based isolated DC-DC Converter







$\frac{N_s}{N_p} = n$

$\frac{DT_s}{2}$ period,

$v_L = nV_{in} - V_o$

$\frac{(1-D)T_s}{2}$ period,

$v_L = -V_o$

$\frac{DT_s}{2}$ period

$v_L = nV_{in} - V_o$

$\frac{(1-D)T_s}{2}$ period

$v_L = -V_o$

⇒ the L&C has to be sized for $2f_{sw}$

$$\Rightarrow (nV_{in} - V_o)\frac{DT_s}{2} + (-V_o)\frac{(1-D)T_s}{2} = 0$$

$$\Rightarrow V_o = nV_{in}D$$

Source: Power Electronics: Essentials & Applications by L Umanand

Sizing of 'C'

$$C\cdot\Delta V_o = \Delta Q = \frac{1}{2}\times\frac{\Delta I_L}{2}\times\frac{T_s}{4}$$

$$f_{sw}=\frac{1}{T_s}$$

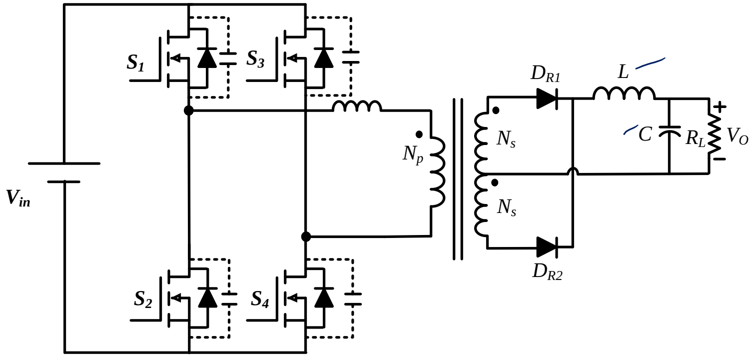
$$\Rightarrow C_{cri} = \frac{\Delta I_L}{8(2f_{sw})\cdot\Delta V_o}$$

$$C > C_{cri}$$

$\Delta V_o \to$ specification

$f_{sw} \to$ designer choice

$\Delta I_L \to$ 5 to 10% of I_o



Sizing of 'L'

$$|-v_o| = L\frac{\Delta i_L}{\left(\frac{(1-D)T_s}{2}\right)}$$

$$\left(\frac{(1-D)T_s}{2} \to v_L = -v_o\right)$$

$$\Rightarrow L = \frac{v_o(1-D)}{2f_{sw}\,\Delta i_L}$$

$$\Rightarrow L = \frac{nV_{in}D(1-D)}{2f_{sw}\cdot\Delta i_L}$$

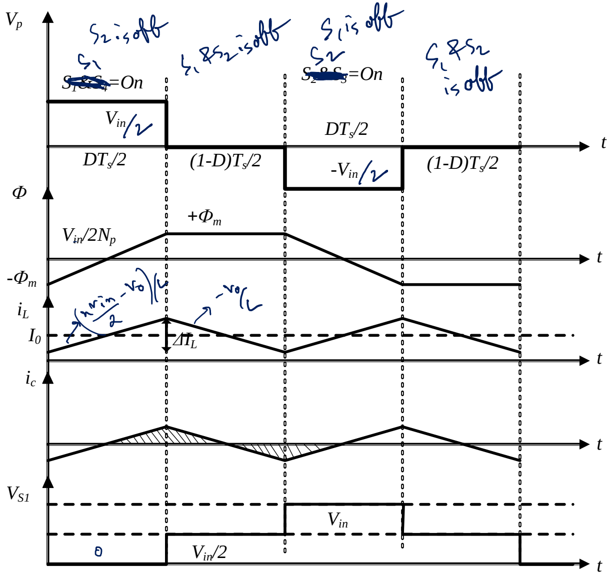
specification

depends on output voltage & 'n'

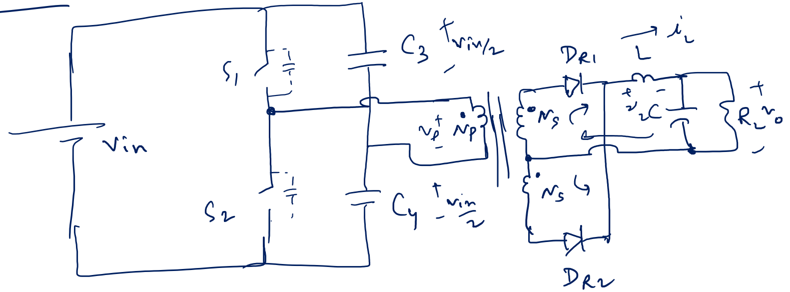
designer choice

designer choice

5 to 10% of I_o



half-bridge Converter



$$\frac{N_s}{N_p} = n$$

$\frac{DT_s}{2}$ period

$$v_p = V_{in} - \frac{V_{in}}{2}$$

$$v_p = \frac{V_{in}}{2}$$

$$v_L = \frac{nV_{in}}{2} - V_0$$

$\frac{(1-D)T_s}{2}$ period

$$v_L = -V_0$$

volt-sec balance on 'L'

$$\Rightarrow V_0 = \frac{nV_{in}}{2} D$$

$$\left(\frac{nV_{in}}{2} - V_0\right)\frac{DT_s}{2} + (-V_0)\frac{(1-D)T_s}{2} = 0$$

Source: Power Electronics: Essentials & Applications by L Umanand

Thank You