

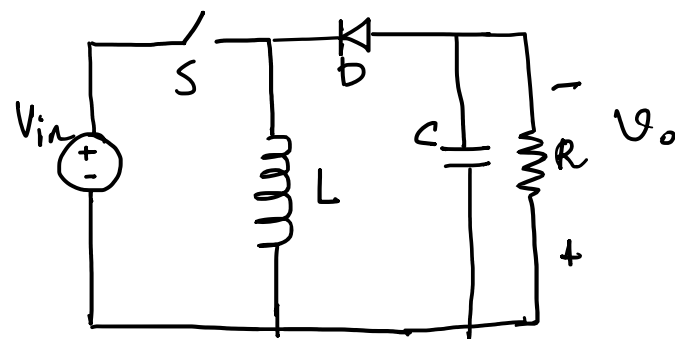
Switched Mode Power Conversion

Semester II Academic Year 2025-26

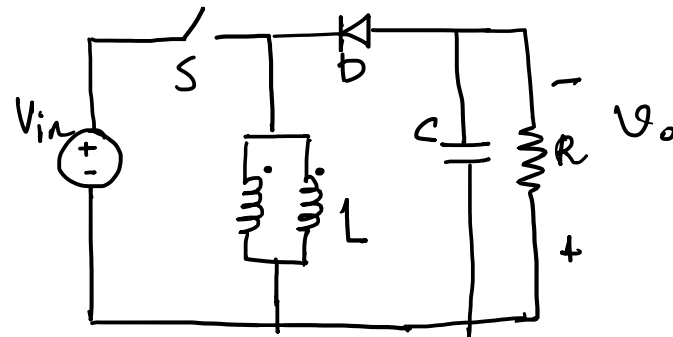
Lecture 27

27th March 2026

Buck Boost

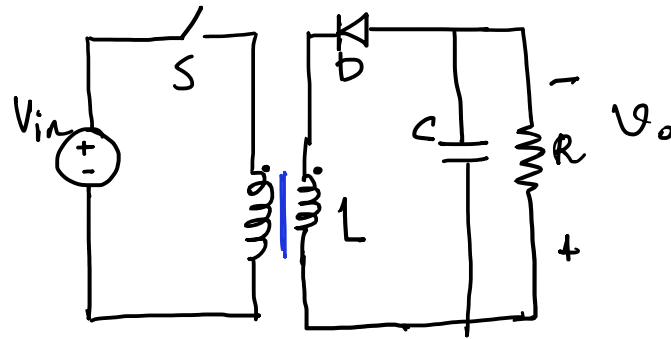


Buck Boost



L-Coupled inductor

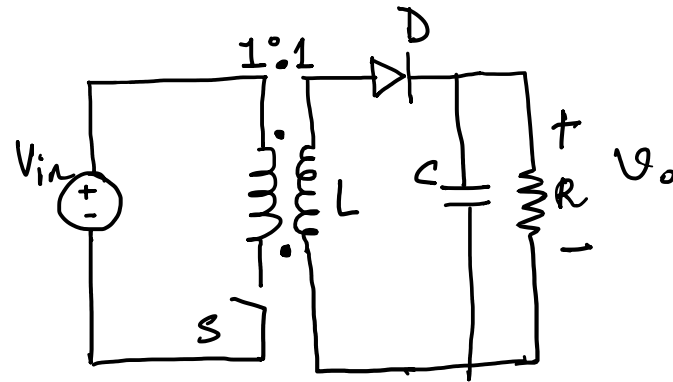
Buck Boost



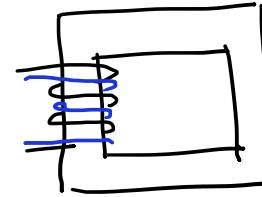
L -Coupled inductor

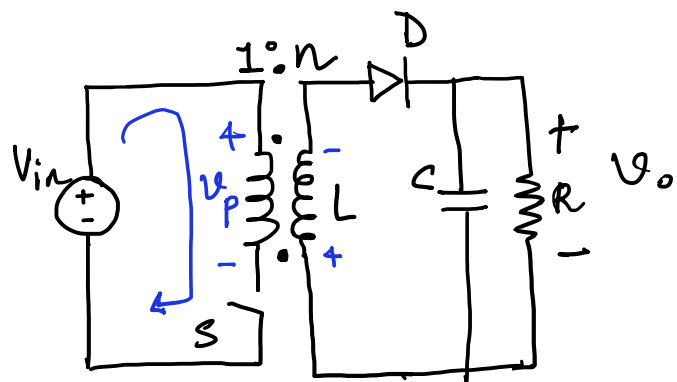
ϕ discontinuous X

Buck Boost



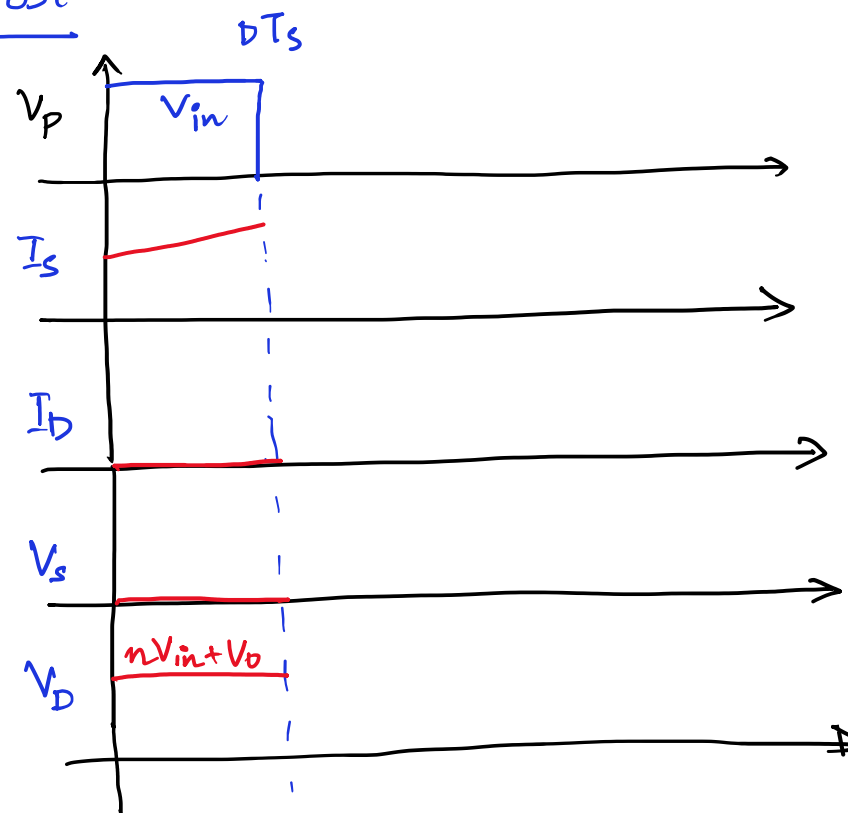
L-Coupled inductor



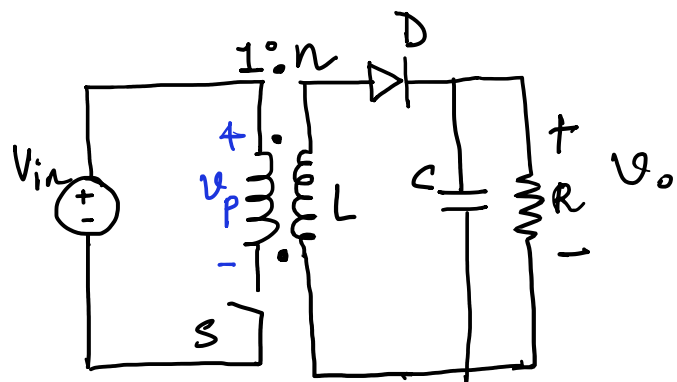


[Flyback Converter]

Buck Boost

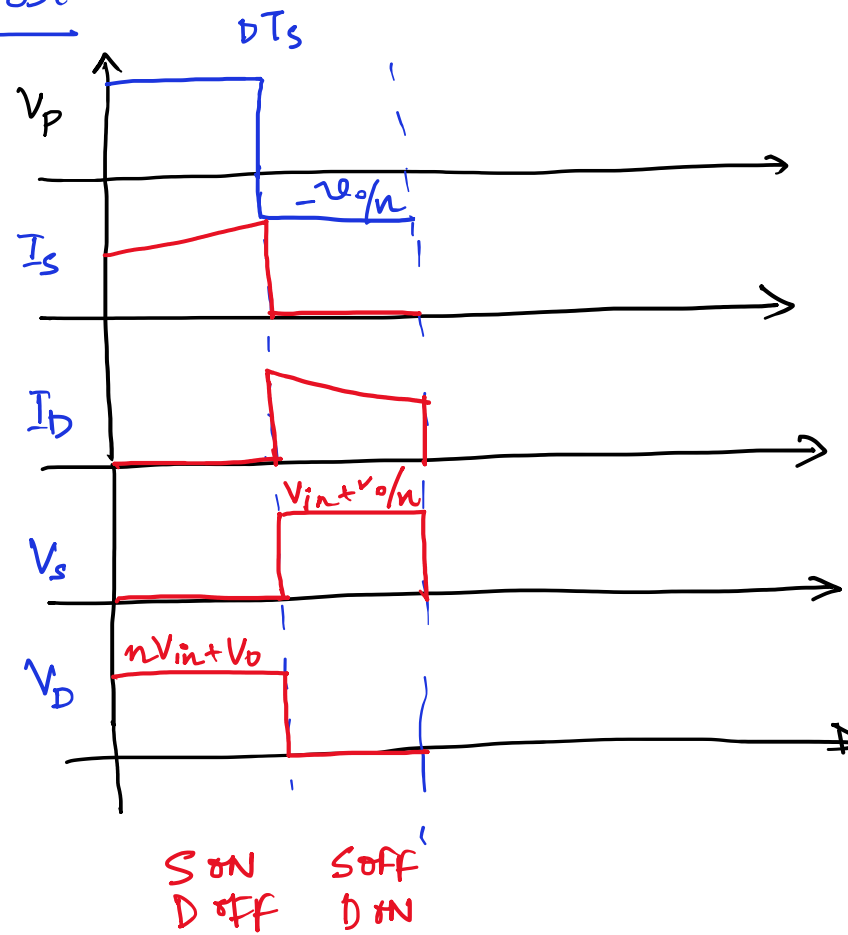


S on
D off

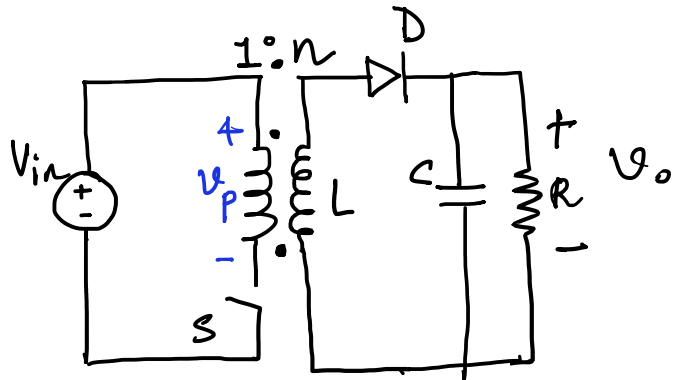


[Flyback Converter]

Buck Boost



Buck Boost

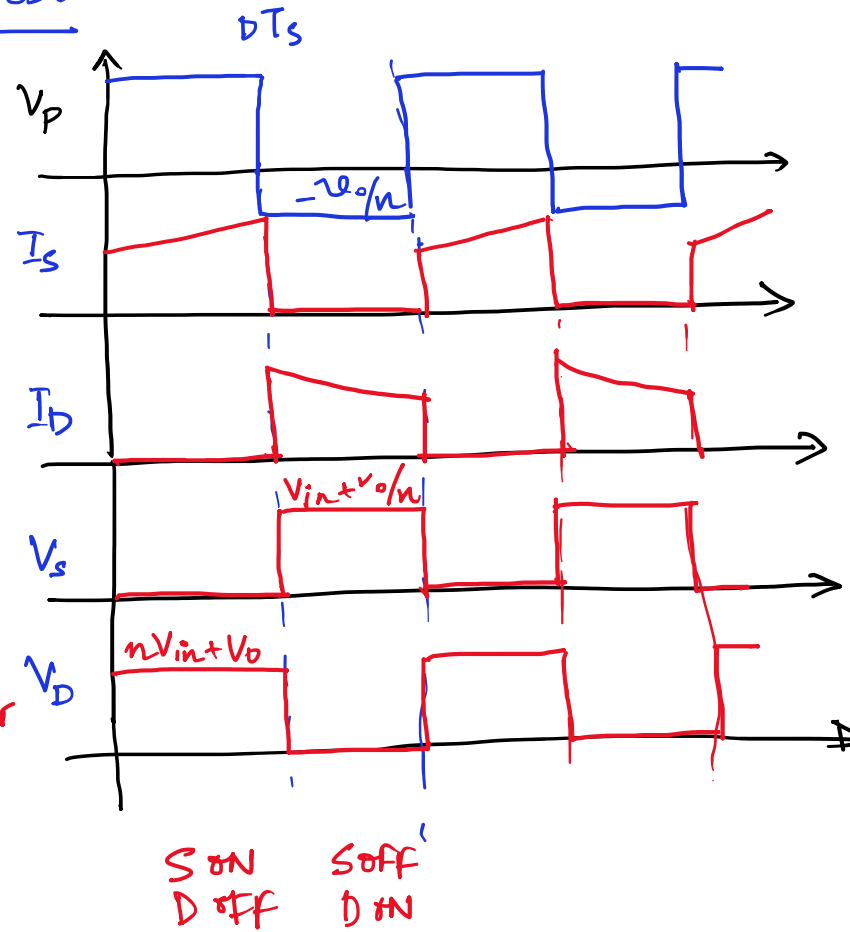
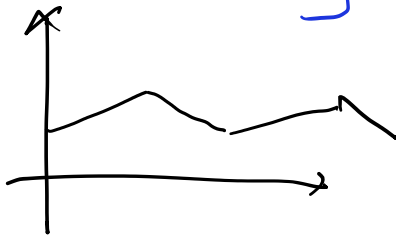


[Flyback Converter]

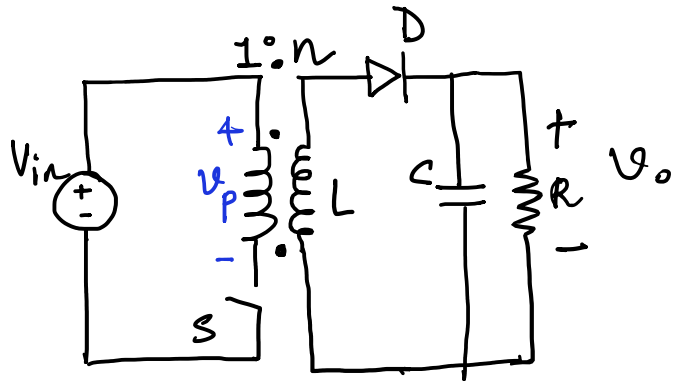
CCM mode

Flux is maintained
Energy stored in core

Inductance
not
transformer



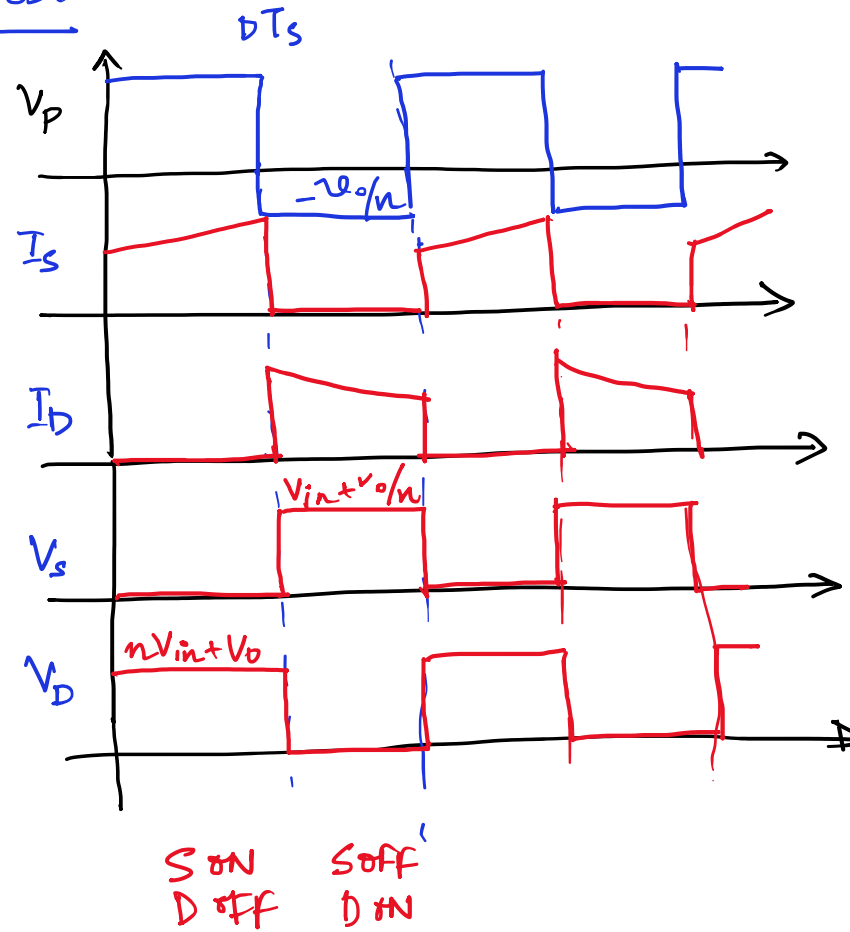
Buck Boost



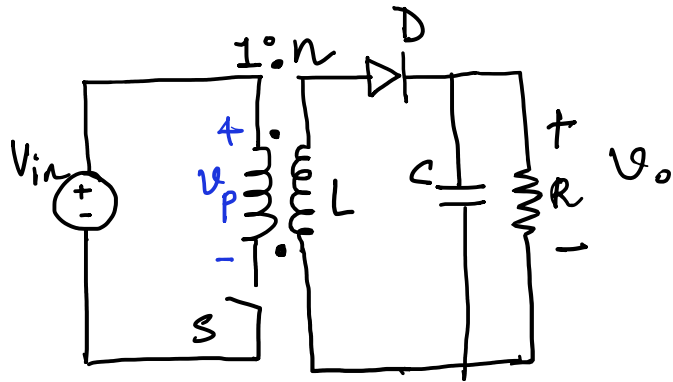
[Flyback Converter]

$$\langle v_L \rangle = V_{in} D - \frac{V_o}{n} (1-D) = 0$$

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



Buck Boost

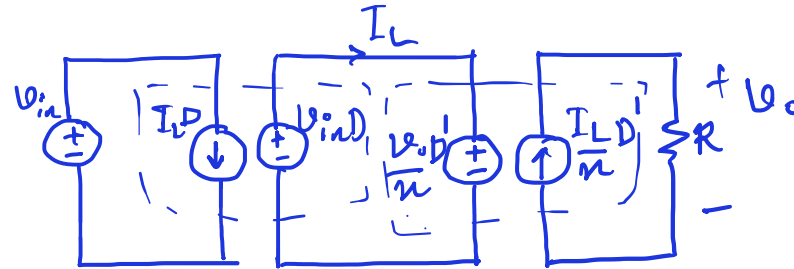


[Flyback Converter]

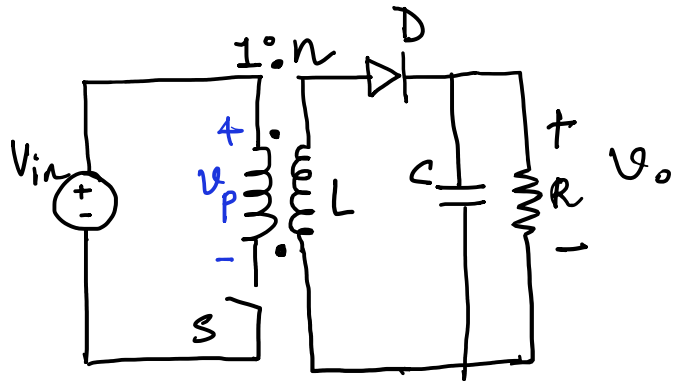
$$\langle v_L \rangle = V_{in} D - \frac{V_o}{n} (1-D) = 0$$

$$\begin{aligned} \langle I_C \rangle &= -\left(\frac{V_o}{R}\right) D + \left(\frac{I_L}{n} - \frac{V_o}{R}\right) D' \\ &= \frac{I_L}{n} D' - \frac{V_o}{R} = 0 \end{aligned}$$

$$\langle I_{in} \rangle = I_L D$$



Buck Boost

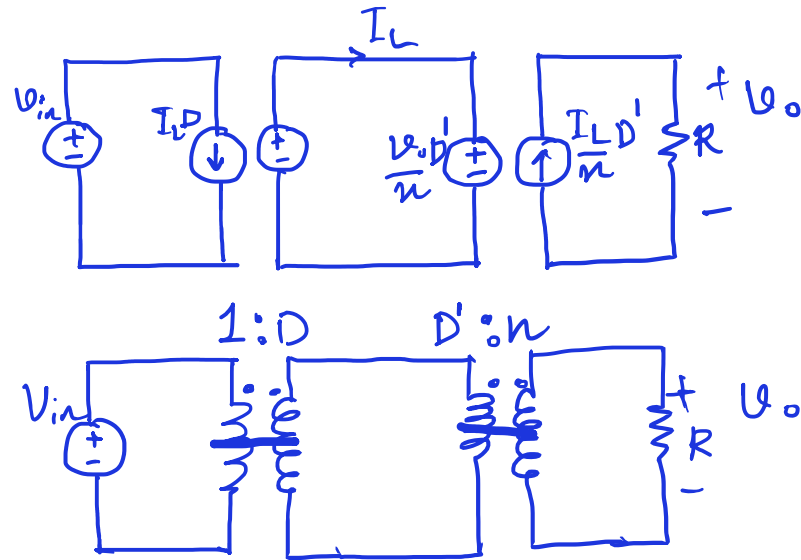


[Flyback Converter]

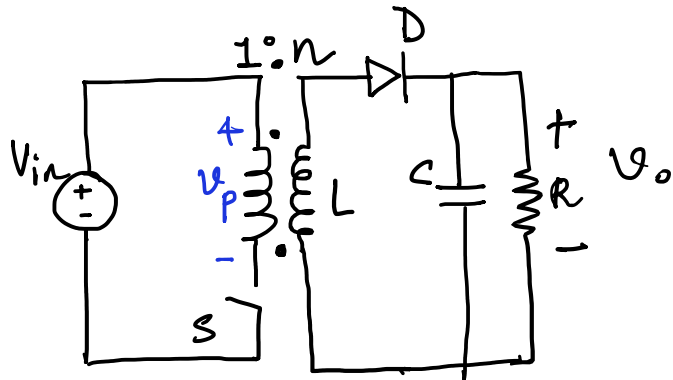
$$\langle v_L \rangle = V_{in} D - \frac{V_o}{n} (1-D) = 0$$

$$\begin{aligned} \langle I_c \rangle &= -\left(\frac{V_o}{R}\right) D + \left(\frac{I_L}{n} - \frac{V_o}{R}\right) D' \\ &= \frac{I_L}{n} D' - \frac{V_o}{R} = 0 \end{aligned}$$

$$\langle I_{in} \rangle = I_L D$$



Buck Boost



[Flyback Converter]

$$\langle v_L \rangle = V_{in} D - \frac{V_o}{n} (1-D) = 0 \quad \checkmark$$

$$\begin{aligned} \langle I_C \rangle &= -\left(\frac{V_o}{R}\right) D + \left(\frac{I_L}{n} - \frac{V_o}{R}\right) D' \\ &= \frac{I_L}{n} D' - \frac{V_o}{R} = 0 \quad \checkmark \end{aligned}$$

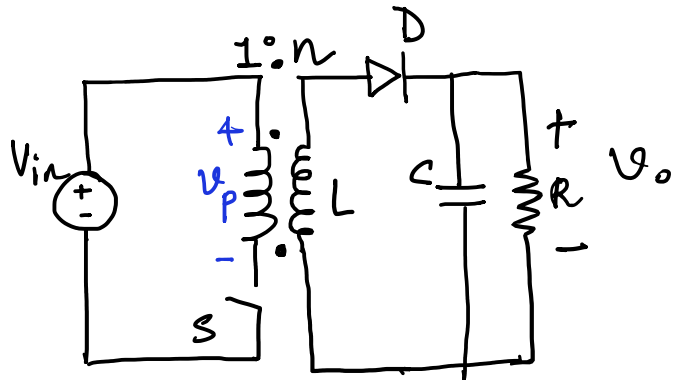
$$\langle I_{in} \rangle = I_L D$$

$$\bar{v}_L + \hat{v}_L = (\bar{v}_{in} + \hat{v}_{in})(\bar{D} + \hat{d}) - \frac{(\bar{v}_o + \hat{v}_o)(\bar{D}' - \hat{d})}{n}$$

$$\therefore \hat{v}_L = \bar{v}_{in} \hat{d} + \bar{D} \hat{v}_{in} + \frac{\bar{v}_o}{n} \hat{d} - \bar{D}' \frac{\hat{v}_o}{n}$$

$$\Rightarrow \boxed{L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + \left(\bar{v}_{in} + \frac{\bar{v}_o}{n}\right) \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o}$$

Buck Boost



[Flyback Converter]

$$\langle v_L \rangle = V_{in} D - \frac{V_o}{n} (1-D) = 0$$

$$\begin{aligned} \langle I_C \rangle &= -\left(\frac{V_o}{R}\right) D + \left(\frac{I_L}{n} - \frac{V_o}{R}\right) D' \\ &= \frac{I_L}{n} D' - \frac{V_o}{R} = 0 \end{aligned}$$

$$\langle I_{in} \rangle = I_L D$$

$$\bar{v}_L + \hat{v}_L = (\bar{v}_{in} + \hat{v}_{in})(\bar{D} + \hat{d}) - \frac{(\bar{v}_o + \hat{v}_o)(\bar{D}' - \hat{d})}{n}$$

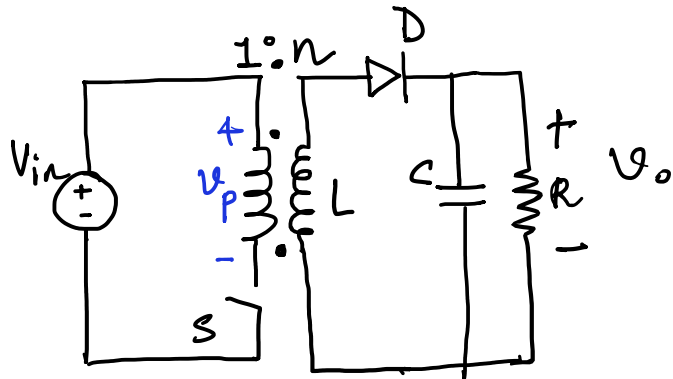
$$\therefore \hat{v}_L = \bar{v}_{in} \hat{d} + \bar{D} \hat{v}_{in} + \frac{\bar{v}_o}{n} \hat{d} - \bar{D}' \frac{\hat{v}_o}{n}$$

$$\Rightarrow L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + \left(\bar{v}_{in} + \frac{\bar{v}_o}{n}\right) \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

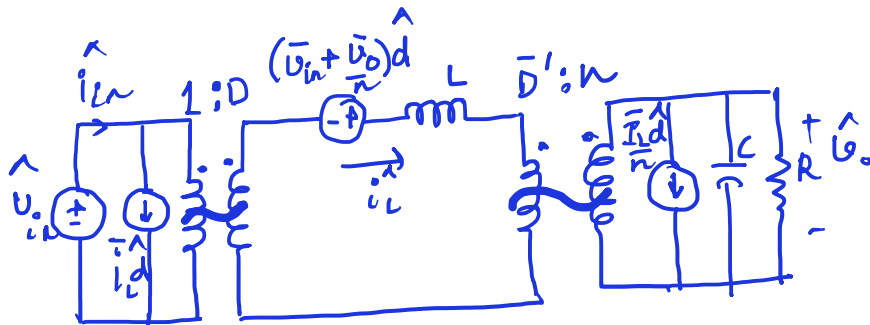
$$C \frac{d\hat{v}_C}{dt} = \bar{D}' \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R} \quad \checkmark$$

$$\hat{i}_{in} = \hat{i}_L \bar{D} + i_L \hat{d} \quad \checkmark$$

Buck Boost



[Flyback Converter]



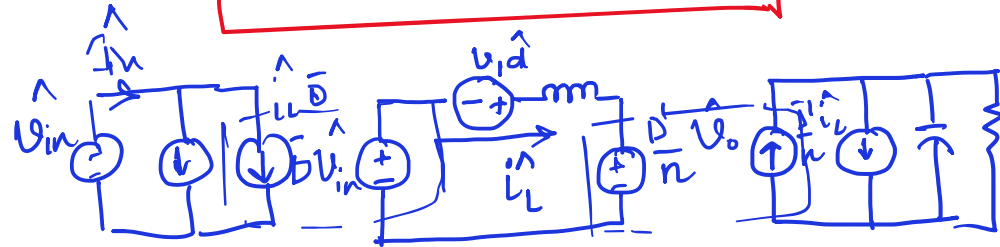
$$\bar{v}_L + \hat{v}_L = (\bar{v}_{in} + \hat{v}_{in})(\bar{D} + \hat{d}) - \frac{(\bar{v}_o + \hat{v}_o)(\bar{D} - \hat{d})}{n}$$

$$\therefore \hat{v}_L = \bar{v}_{in} \hat{d} + \bar{D} \hat{v}_{in} + \frac{\bar{v}_o}{n} \hat{d} - \bar{D} \frac{\hat{v}_o}{n}$$

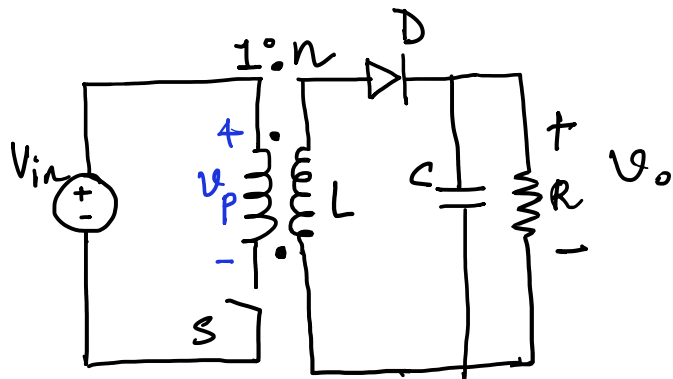
$$\Rightarrow L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + (\bar{v}_{in} + \frac{\bar{v}_o}{n}) \hat{d} - \frac{\bar{D}}{n} \hat{v}_o$$

$$C \frac{d\hat{v}_C}{dt} = \bar{D} \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

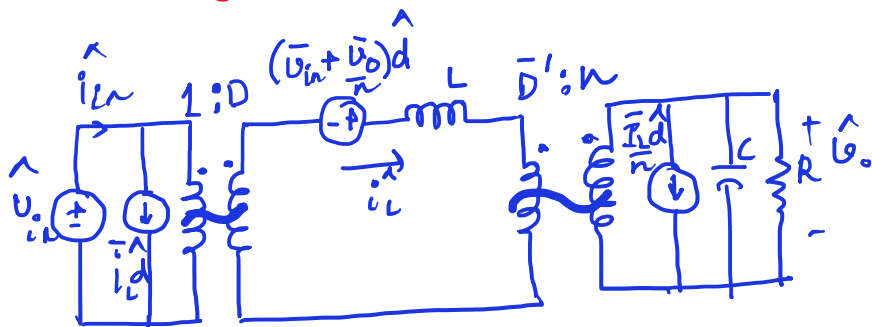
$$\hat{i}_{in} = \hat{i}_L \bar{D} + \bar{I}_L \hat{d}$$



Flyback Converter



[Flyback Converter]



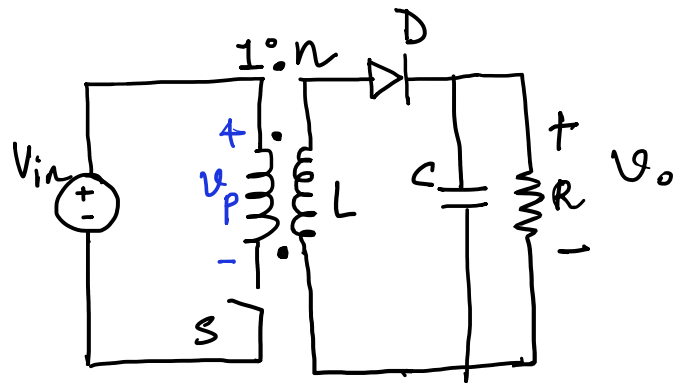
$$\bar{v}_L + \hat{v}_L = (\bar{v}_{in} + \hat{v}_{in})(\bar{D} + \hat{d}) - \frac{(\bar{v}_o + \hat{v}_o)(\bar{D}' - \hat{d})}{n}$$

$$\text{o.o. } \hat{v}_L = \bar{v}_{in} \hat{d} + \bar{D} \hat{v}_{in} + \frac{\bar{v}_o}{n} \hat{d} - \bar{D}' \frac{\hat{v}_o}{n}$$

$$\Rightarrow L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + (\bar{v}_{in} + \frac{\bar{v}_o}{n}) \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

$$C \frac{d\hat{v}_C}{dt} = \bar{D}' \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

$$\hat{i}_{in} = \hat{i}_L \bar{D} + \bar{i}_L \hat{d}$$



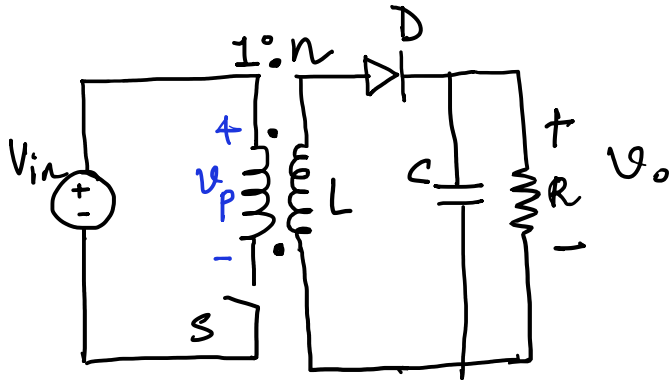
Flyback Converter [Transfer fn.]

$$C \frac{d\hat{v}_c}{dt} = \bar{D} \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

$$\left(\frac{sCR+1}{R} \right) \hat{v}_o(s) = \frac{\bar{D}}{n} \hat{i}_L(s) - \frac{\bar{I}_L}{n} \hat{d}$$

$$\hat{i}_L(s) = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \hat{v}_o(s) + \frac{\bar{I}_L}{\bar{D}'} \hat{d}$$

Flyback Converter [Transfer fun.]



$$C \frac{dv_c}{dt} = \bar{D} \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

$$\hat{i}_L(s) = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \hat{v}_o(s) + \frac{\bar{I}_L}{\bar{D}'} \hat{d}$$

$$L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + \underbrace{(\bar{v}_{in} + \frac{\bar{v}_o}{n})}_{\bar{v}_1} \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

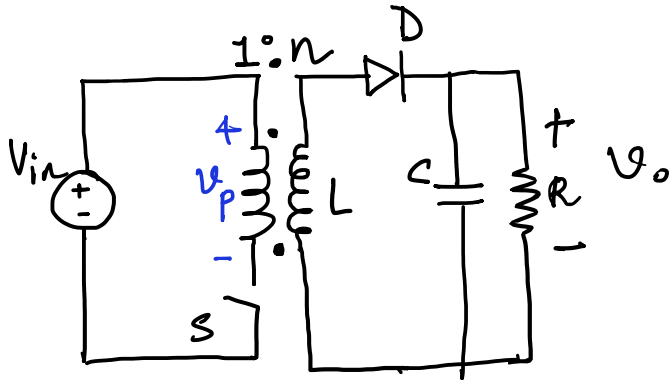
$$sL \hat{i}_L(s) = \bar{D} \hat{v}_{in}(s) + \bar{v}_1 \hat{d}(s) - \frac{\bar{D}'}{n} \hat{v}_o(s)$$

$$\Rightarrow \frac{s n L (sCR+1)}{\bar{D}' R} \hat{v}_o + \frac{s L \bar{I}_L}{\bar{D}'} \hat{d} = \bar{D} \hat{v}_{in} + \bar{v}_1 \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

$$\Rightarrow \hat{v}_o \left[\frac{s^2 n^2 L C R + s n^2 L + \bar{D}'^2 R}{n \bar{D}' R} \right] = \bar{D} \hat{v}_{in} + \left(\frac{\bar{v}_1 \bar{D}' - s L \bar{I}_L}{\bar{D}'} \right) \hat{d}$$

$$\Rightarrow \hat{v}_o(s) = \frac{n \bar{D} \bar{D}' R}{s^2 n^2 L C R + s n^2 L + \bar{D}'^2 R} \hat{v}_{in} + \frac{n R (\bar{v}_1 \bar{D}' - s L \bar{I}_L)}{s^2 n^2 L C R + s n^2 L + \bar{D}'^2 R} \hat{d}$$

Flyback Converter [Transfer fun.]



$$C \frac{dv_c}{dt} = \bar{D} \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

$$\hat{i}_L(s) = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \hat{v}_o(s) + \frac{\bar{I}_L}{\bar{D}'} \hat{d}$$

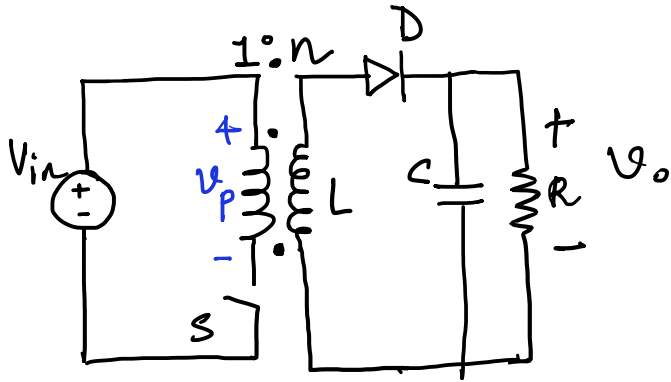
$$L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + \underbrace{(\bar{v}_{in} + \frac{\bar{v}_o}{n})}_{\bar{v}_i} \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

$$\begin{aligned} \bar{I}_L \bar{D}' &= \bar{I}_o \\ \Rightarrow \bar{I}_L &= \frac{\bar{v}_o}{R \bar{D}'} = \frac{n \bar{D} \bar{v}_{in}}{R \bar{D}'^2} \end{aligned} \quad \hat{v}_o(s) = \frac{n \bar{D} \bar{D}' R}{s^2 n^2 LC R + s n^2 L + \bar{D}'^2 R} \hat{v}_{in} + \frac{n R (\bar{v}_i \bar{D}' - s L \bar{I}_L)}{s^2 n^2 LC R + s n^2 L + \bar{D}'^2 R} \hat{d}$$

$$\frac{\hat{v}_o}{\hat{v}_{in}} = \frac{n \bar{D}}{\bar{D}'} \frac{1}{s^2 \frac{n^2 LC}{\bar{D}'^2} + s \frac{n^2 L}{\bar{D}'^2 R} + 1}$$

$$\frac{\hat{v}_o}{\hat{d}} = \frac{n (\bar{v}_{in} + \frac{\bar{v}_o}{n})}{\bar{D}'} \frac{1 - s \frac{L \bar{I}_L}{\bar{D}' (\bar{v}_{in} + \frac{\bar{v}_o}{n})}}{s^2 \frac{n^2 LC}{\bar{D}'^2} + s \frac{n^2 L}{\bar{D}'^2 R} + 1}$$

Flyback Converter [Transfer fun.]



$$C \frac{dv_c}{dt} = \bar{D} \frac{\hat{i}_L}{n} - \frac{\bar{I}_L}{n} \hat{d} - \frac{\hat{v}_o}{R}$$

$$\hat{i}_L(s) = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \hat{v}_o(s) + \frac{\bar{I}_L}{\bar{D}'} \hat{d}$$

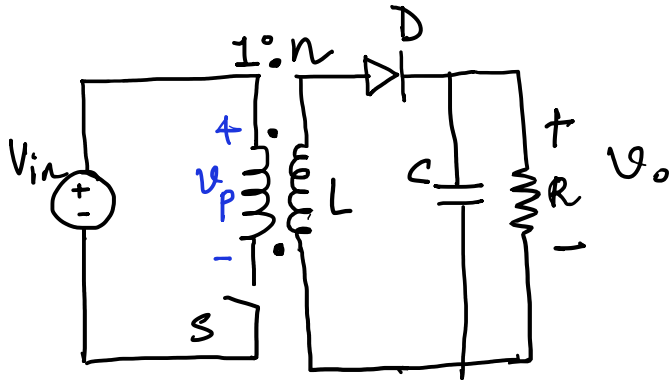
$$L \frac{d\hat{i}_L}{dt} = \bar{D} \hat{v}_{in} + \underbrace{\left(\bar{v}_{in} + \frac{\bar{v}_o}{n} \right)}_{\bar{v}_i} \hat{d} - \frac{\bar{D}'}{n} \hat{v}_o$$

$$\begin{aligned} \bar{I}_L \bar{D}' &= \bar{I}_o \\ \Rightarrow \bar{I}_L &= \frac{\bar{v}_o}{R \bar{D}'} = \frac{n \bar{D} \bar{v}_{in}}{R \bar{D}'^2} \end{aligned} \quad \hat{v}_o(s) = \frac{n \bar{D} \bar{D}' R}{s^2 n^2 LC R + s n^2 L + \bar{D}'^2 R} \hat{v}_{in} + \frac{n R (\bar{v}_i \bar{D}' - s L \bar{I}_L)}{s^2 n^2 LC R + s n^2 L + \bar{D}'^2 R} \hat{d}$$

$$\frac{\hat{v}_o}{\hat{v}_{in}} = \frac{n \bar{D}}{\bar{D}'} \frac{1}{s^2 \frac{n^2 LC}{\bar{D}'^2} + s \frac{n^2 L}{\bar{D}'^2 R} + 1}$$

$$\frac{\hat{v}_o}{\hat{d}} = \frac{n \bar{v}_{in}}{\bar{D}'^2} \frac{1 - s \frac{n L \bar{D}}{R \bar{D}'^2}}{s^2 \frac{n^2 LC}{\bar{D}'^2} + s \frac{n^2 L}{\bar{D}'^2 R} + 1}$$

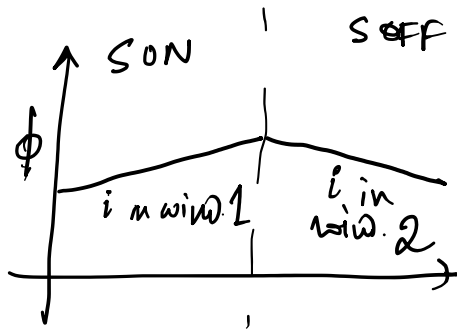
Flyback Converter [Transfer fcn.]



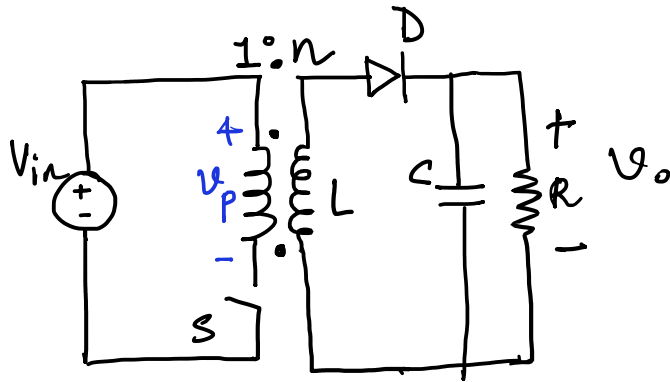
$$\hat{i}_L(s) = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \hat{v}_o(s) + \frac{\bar{I}_L}{\bar{D}'} \hat{d}$$

$$\frac{\hat{v}_o}{\hat{d}} = \frac{n \bar{V}_{in}}{\bar{D}'^2} \frac{1 - s \frac{nL\bar{D}}{R\bar{D}'^2}}{s^2 \frac{n^2LC}{\bar{D}'^2} + s \frac{n^2L}{\bar{D}'^2 R} + 1}$$

$$\hat{i}_L = \frac{n}{\bar{D}'} \left(\frac{sCR+1}{R} \right) \frac{n \bar{V}_{in}}{\bar{D}'^2} \frac{\left(1 - s \frac{nL\bar{D}}{R\bar{D}'^2} \right)}{s^2 \frac{n^2LC}{\bar{D}'^2} + s \frac{n^2L}{\bar{D}'^2 R} + 1} \hat{d} + \frac{n\bar{D}}{R\bar{D}'^3} \bar{V}_{in} \hat{d}$$



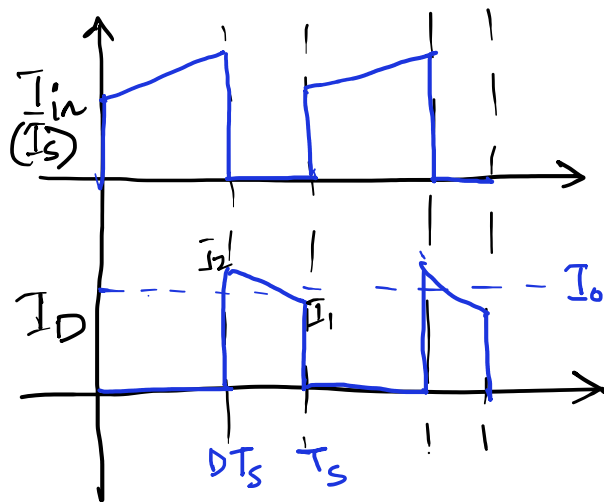
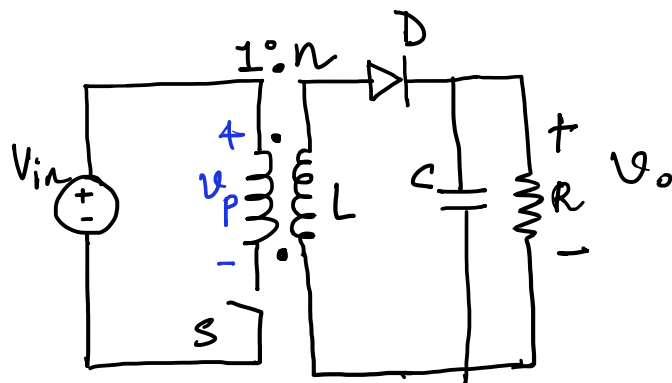
$$\frac{\hat{i}_L}{\hat{d}} = \frac{n^2 \bar{V}_{in} \left(1 + \frac{\bar{D}}{n} \right)}{R(1-\bar{D})^3} \frac{1 + sC \frac{R}{1 + \bar{D}/n}}{s^2 \frac{n^2LC}{\bar{D}'^2} + s \frac{n^2L}{\bar{D}'^2 R} + 1}$$



Flyback Converter

Specifications:

$$\begin{aligned}
 V_{in} &= 325\text{V} & V_o &= 12\text{V} & P &= 10\text{W} \\
 f_{sw} &= 20\text{kHz} & V_{\text{ripple}} &= 0.1\text{V} \\
 I_{\text{ripple}} &= 20\% \text{ of rated current.}
 \end{aligned}$$

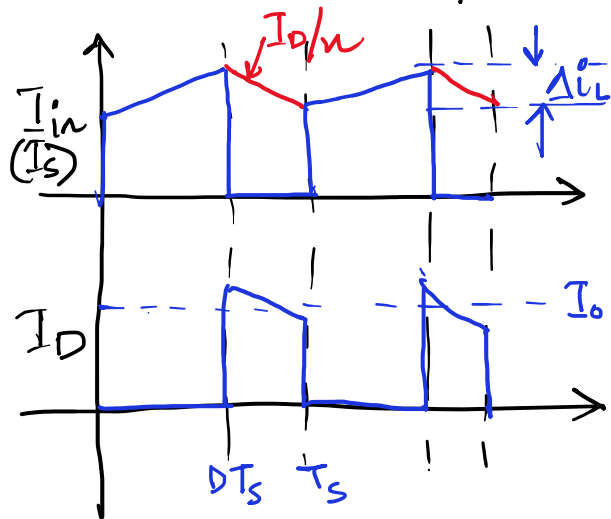
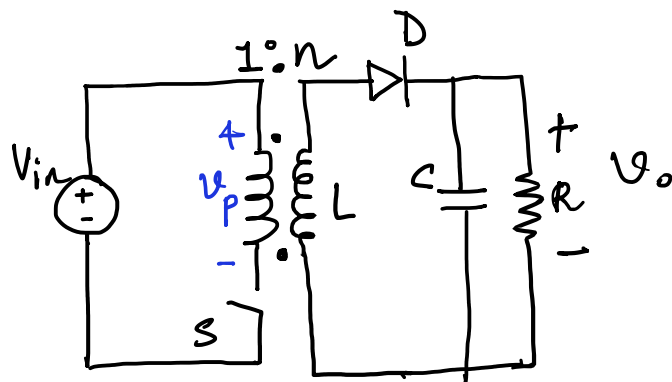


$$V_{in} I_{in} = V_o I_o$$

$$\Rightarrow \frac{I_o}{I_{in}} = \frac{V_{in}}{V_o} = \frac{1-D}{nD}$$

Flyback Converter

Specifications: $V_{in} = 325V$ $V_o = 12V$ $P = 10W$
 $f_{sw} = 20kHz$ $V_{ripple} = 0.1V$
 $I_{ripple} = 20\%$ of rated current.



$$V_{in} I_{in} = V_o I_o$$

$$\Rightarrow \frac{I_o}{I_{in}} = \frac{V_{in}}{V_o} = \frac{1-D}{nD}$$

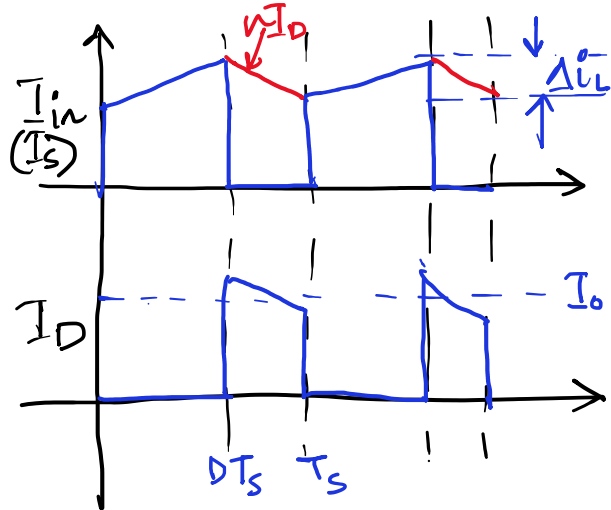
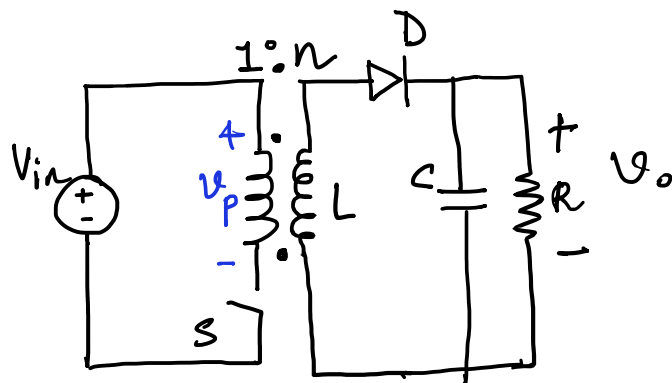
Flyback Converter

Specifications: $V_{in} = 325V$ $V_o = 12V$ $P = 10W$
 $f_{sw} = 20kHz$ $V_{ripple} = 0.1V$
 $I_{ripple} = 20\%$ of rated current.

$$L \frac{\Delta i_L}{DT_s} = V_{in}$$

$$\Rightarrow L = \frac{V_{in} DT_s}{\Delta i_L} = 0.658H$$

$$C = \frac{P DT_s}{\Delta V V_o} = 208\mu F$$



$$V_{in} I_{in} = V_o I_o$$

$$\Rightarrow \frac{I_o}{I_{in}} = \frac{V_{in}}{V_o} = \frac{1-D}{nD}$$

Flyback Converter

Specifications: $V_{in} = 325V$ $V_o = 12V$ $P = 10W$
 $f_{sw} = 20kHz$ $V_{ripple} = 0.1V$
 $I_{ripple} = 20\%$ of rated current.

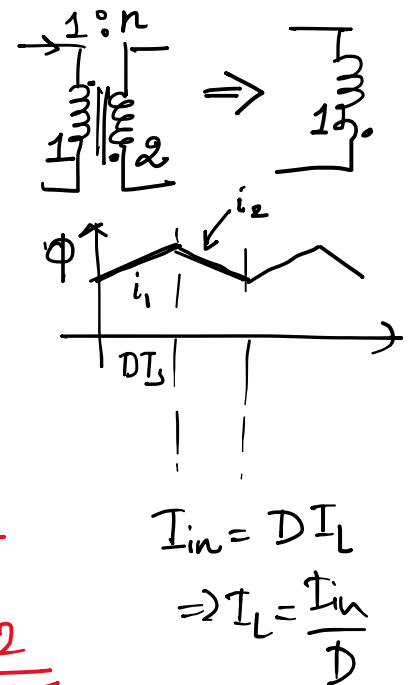
$$L \frac{\Delta i_L}{DT_s} = V_{in}$$

$$\Rightarrow L = \frac{V_{in} DT_s}{\Delta i_L} = 0.658H$$

$$C = \frac{P DT_s}{\Delta V V_o} = 208\mu F$$

$$D = 0.5 \quad \therefore V_o = \frac{n V_{in} D}{1-D}$$

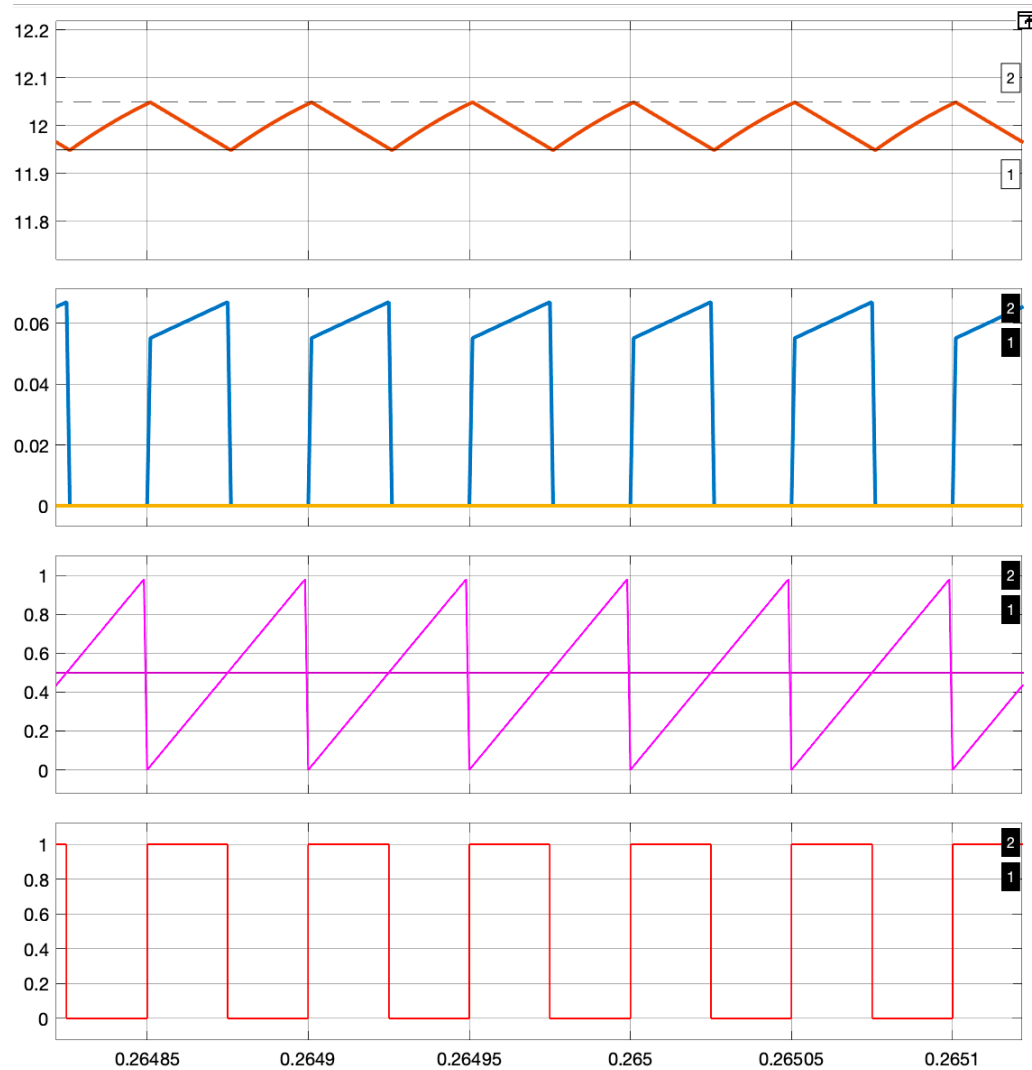
$$\Rightarrow n = \frac{V_o}{V_{in}} = \frac{12}{325}$$



$$I_{in} = D I_L$$

$$\Rightarrow I_L = \frac{I_{in}}{D}$$

Flyback Converter



Trace Selection

Channel 1

Cursor Measurements

Settings

- ☒ Screen cursors
 - ☒ Horizontal ☐ Vertical
- ☐ Waveform cursors

1 | Channel 1

2 | Channel 1

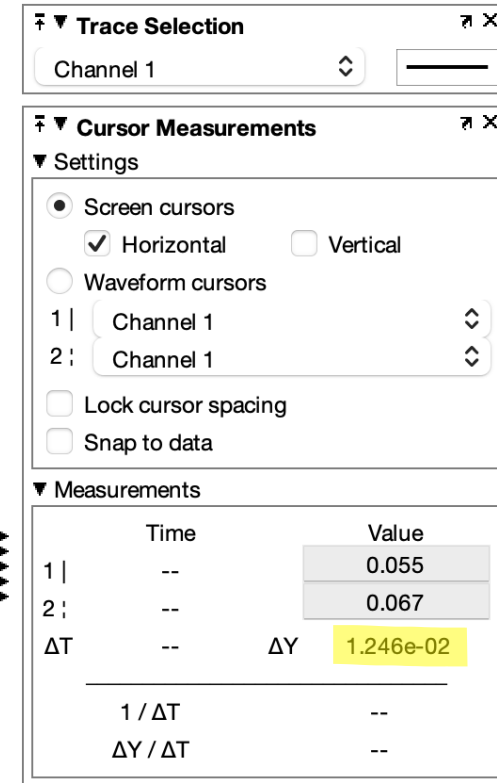
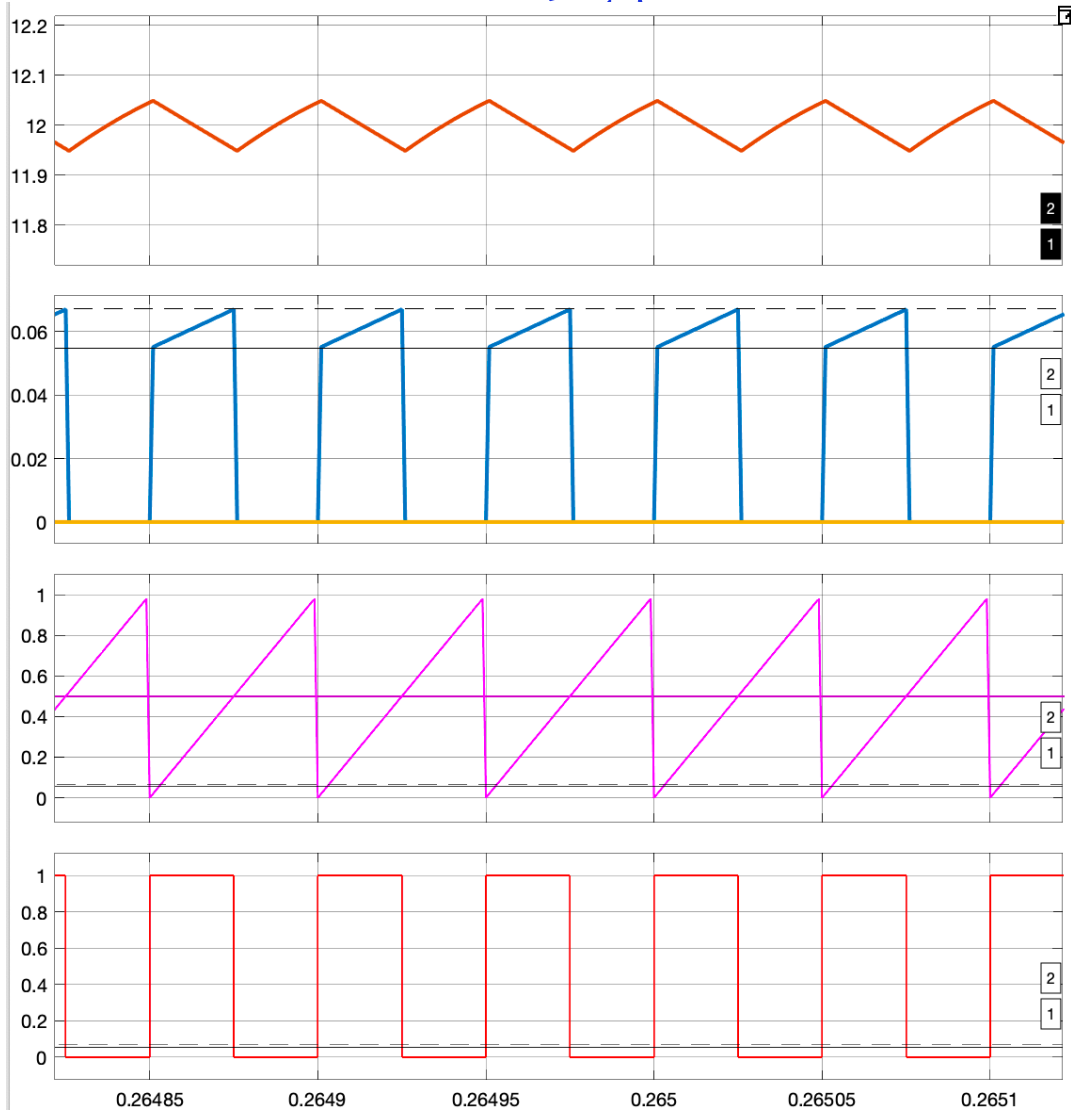
☐ Lock cursor spacing

☐ Snap to data

Measurements

	Time	Value
1	--	11.949
2	--	12.049
ΔT	--	ΔY 9.947e-02
$1 / \Delta T$		--
$\Delta Y / \Delta T$		--

Flyback Converter



$$P = 10W$$

$$V_{in} = 325V$$

$$I_{in} = \frac{P}{V_{in}}$$

$$D I_L = I_{in}$$

$$\Rightarrow I_L = \frac{P}{V_{in} D}$$

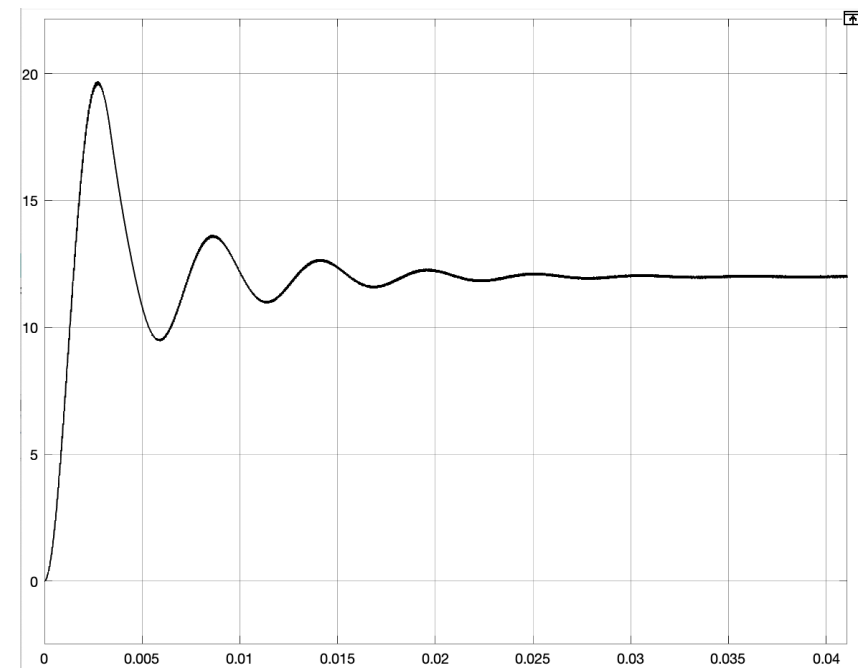
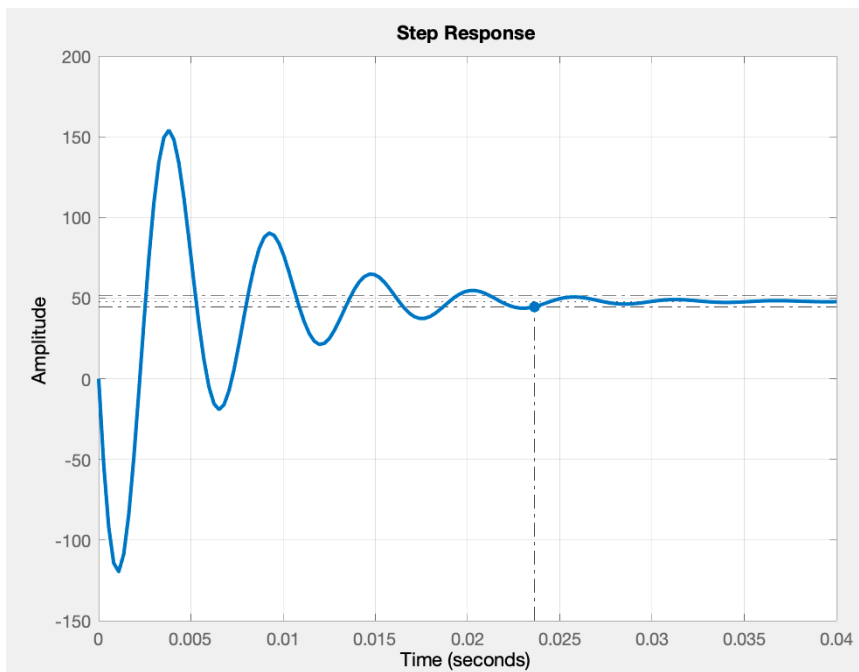
$$= 0.06A$$

$$\Delta i_L = 0.2 \times 0.06$$

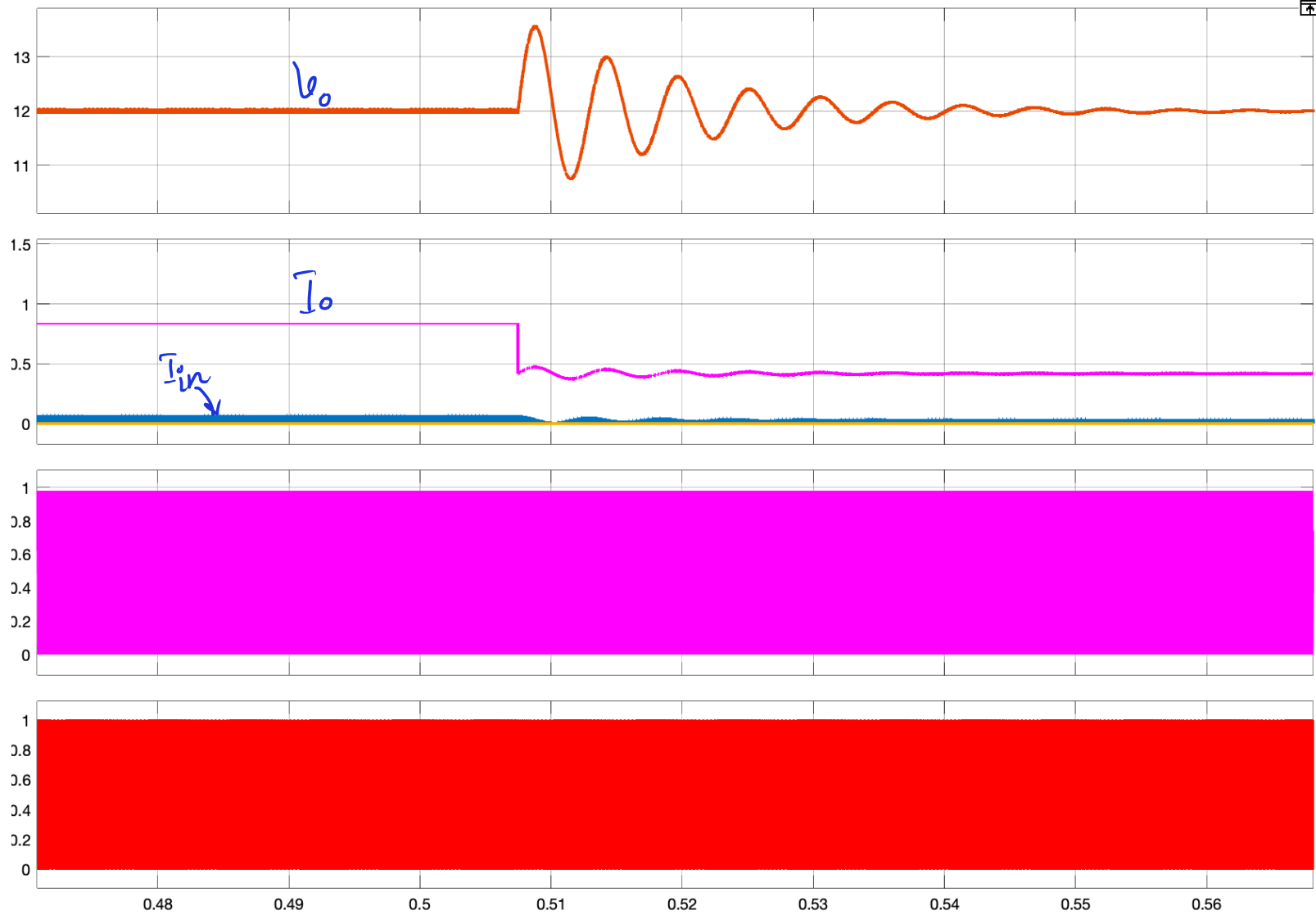
$$= \underline{\underline{0.012A}}$$

Flyback Converter

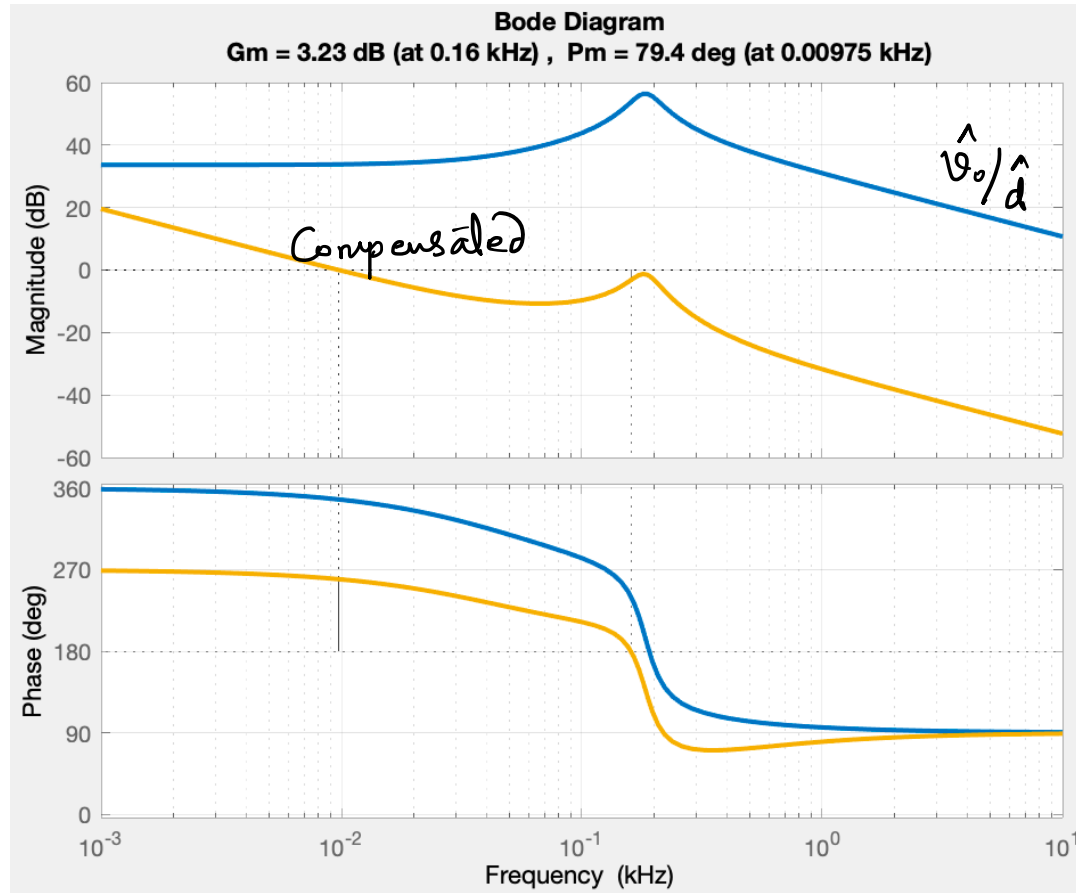
$$\frac{\hat{v}_o}{\hat{d}} = \frac{n \bar{V}_{in}}{\bar{D}'^2} \frac{1 - s \frac{nL\bar{D}}{R\bar{D}'^2}}{s^2 \frac{n^2LC}{\bar{D}'^2} + s \frac{n^2L}{\bar{D}'^2 R} + 1}$$



Flyback Converter [Dynamic Response - Open loop]



Flyback Converter [Voltage Control]



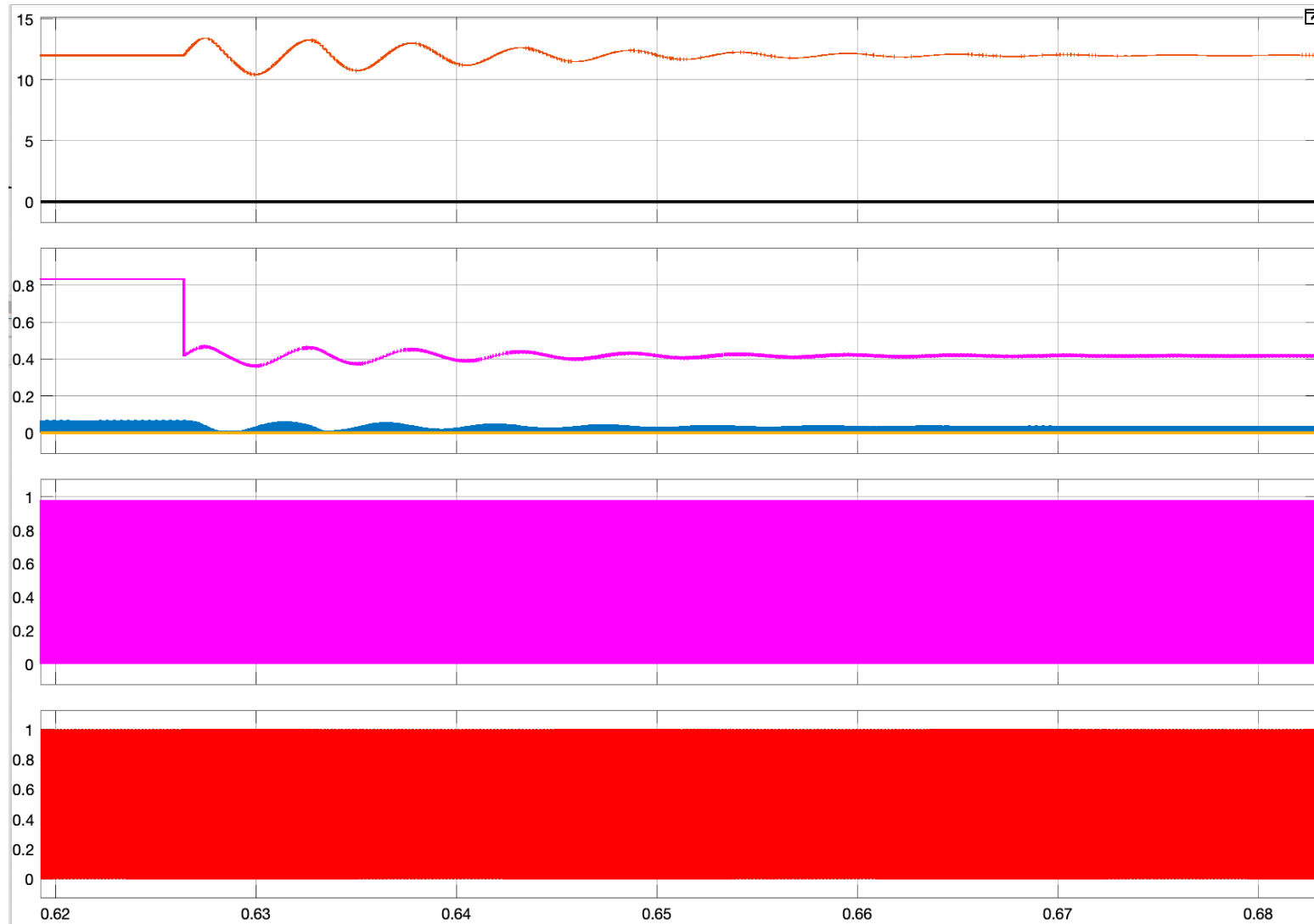
$$c(s) = \frac{7 \times 10^{-4} (s + 1780)}{s}$$

$$BW \approx 10 \text{ Hz}$$

$$PM \approx 80^\circ$$

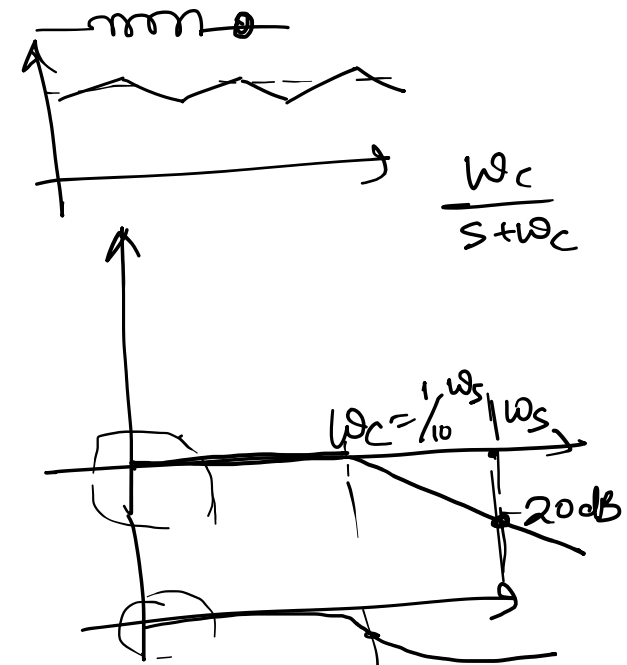
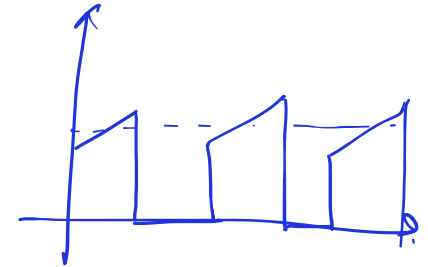
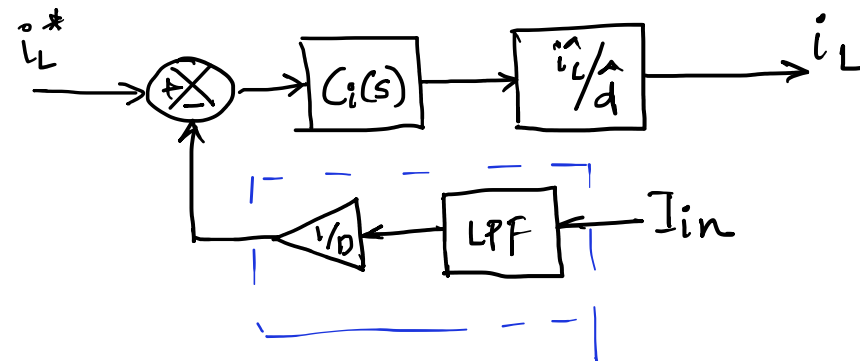
RHP zero $\Rightarrow$ Low BW

Flyback Converter [Voltage Control]

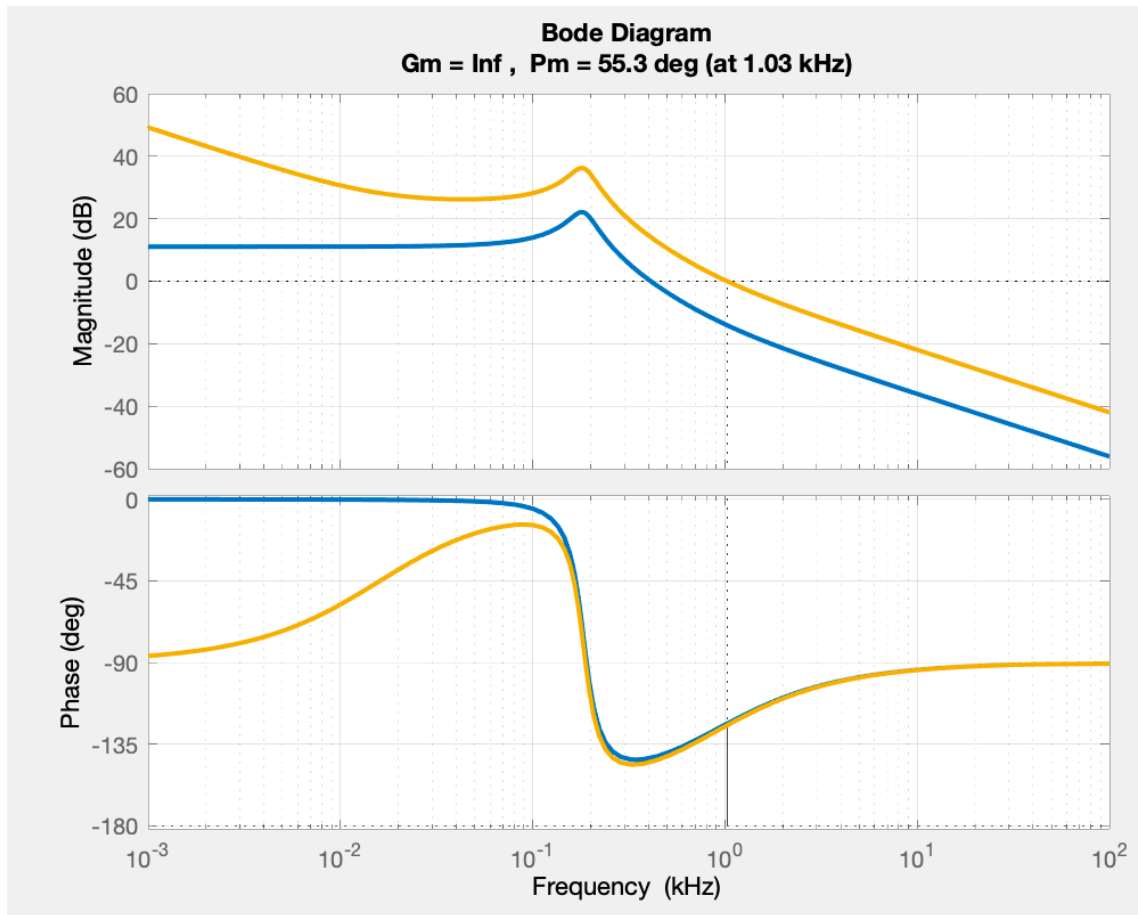


Slow Response!!

Flyback Converter [Current Control]

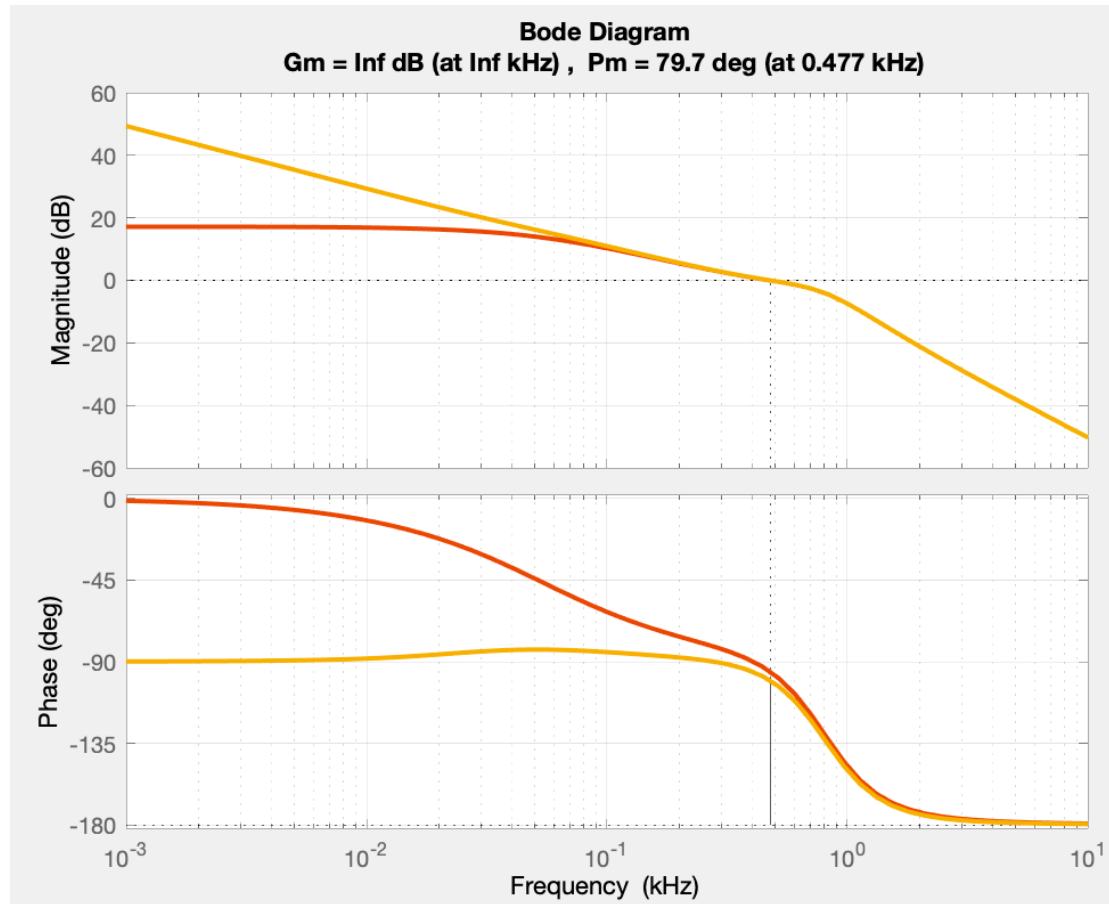


Flyback Converter [Current Control]



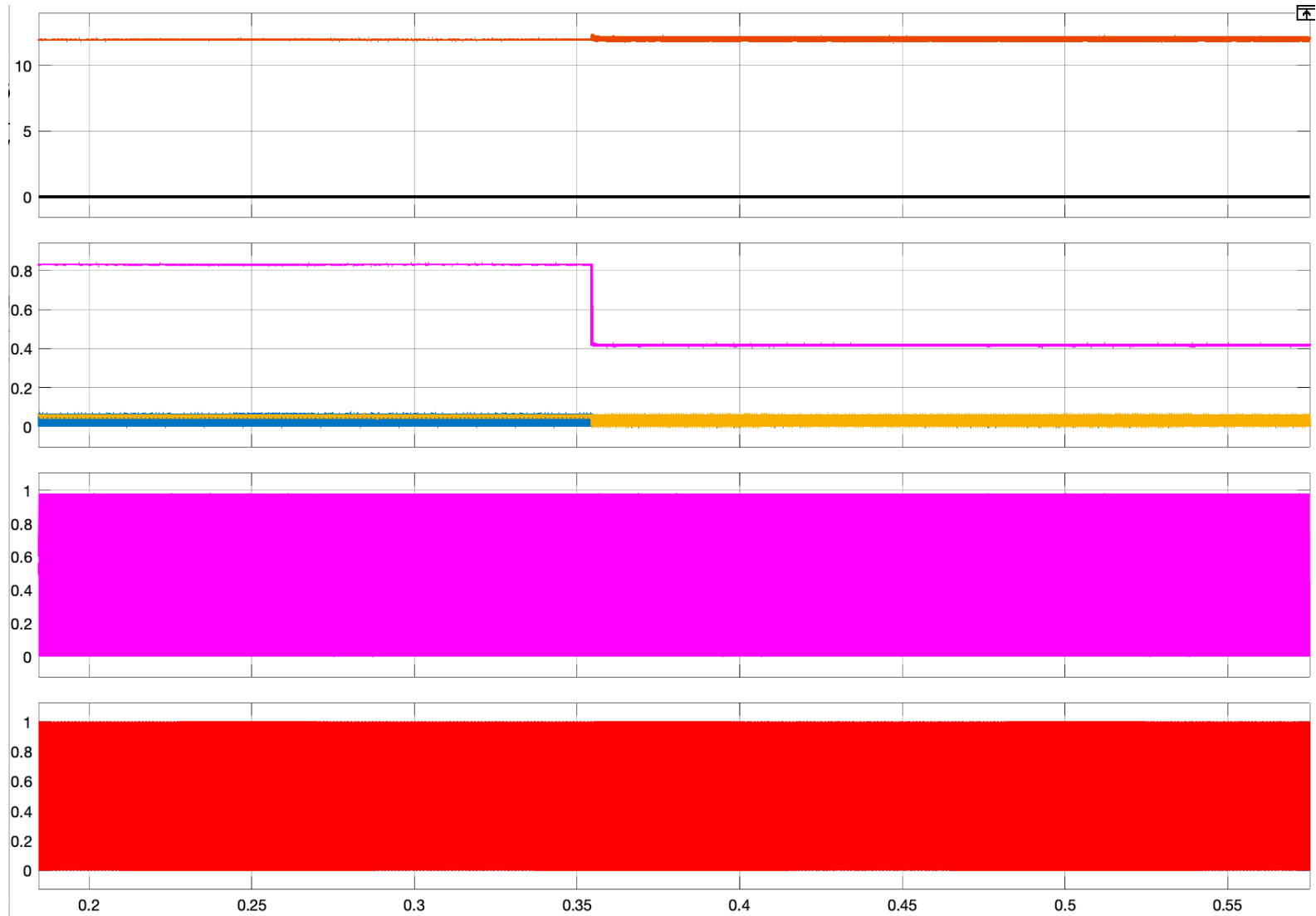
$$C_i(s) = \frac{5.07(s + 100)}{s}$$

Flyback Converter [Current Control]



$$C_v = \frac{s + 256}{s}$$

Flyback Converter [Current Control]

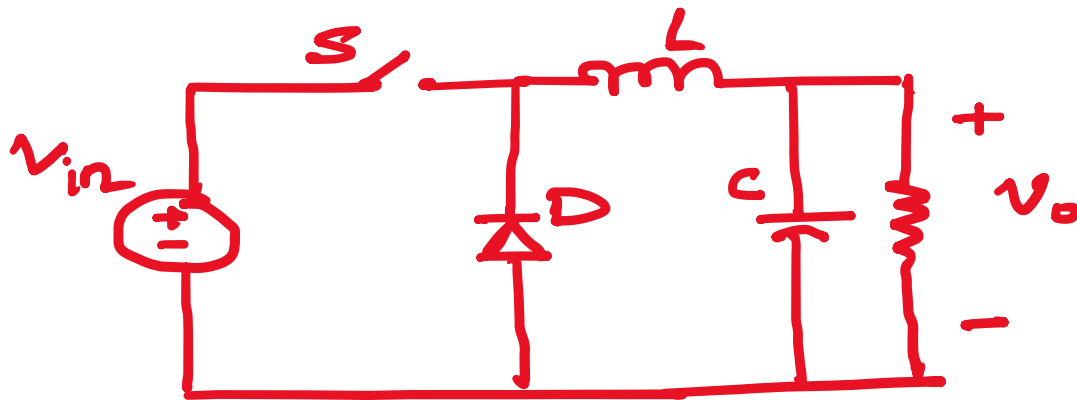


Current Programmed Control

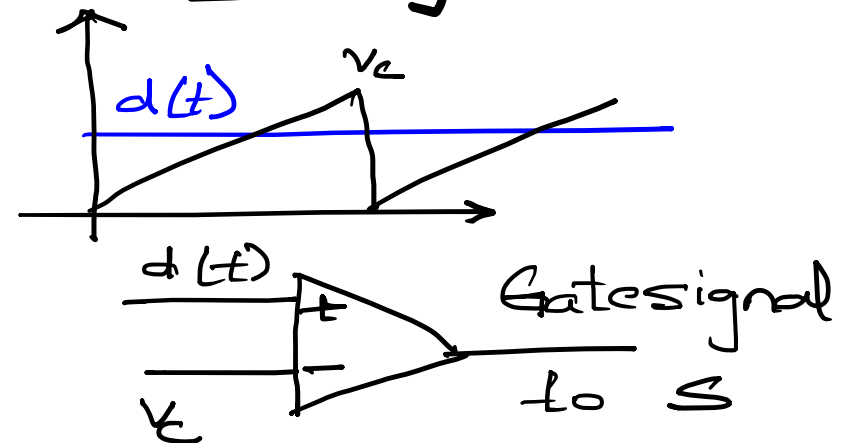
⇒ Control input signal is current

– Duty not being controlled directly

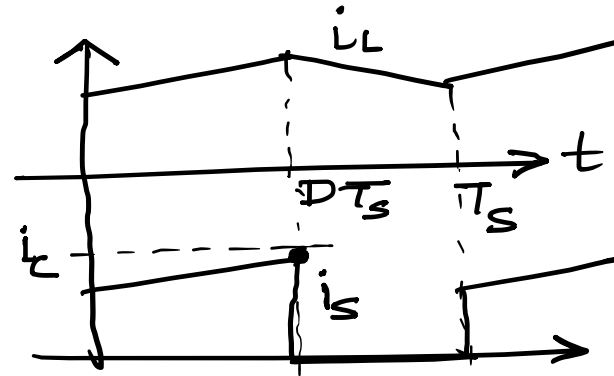
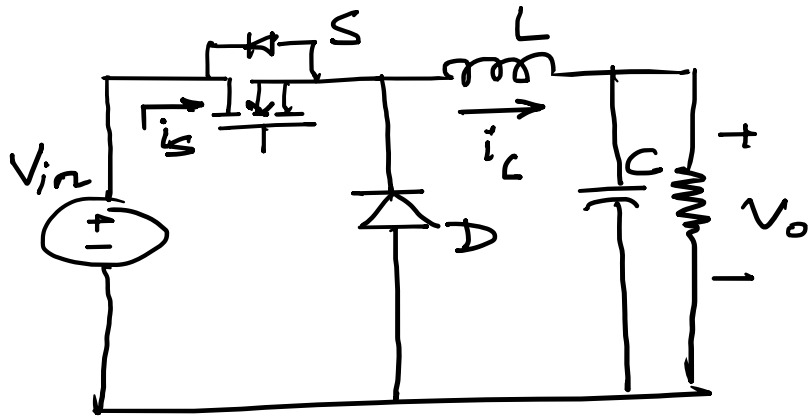
– Duty dependent on converter current (inductor/output/device)



 Duty Control



Current Programmed Control

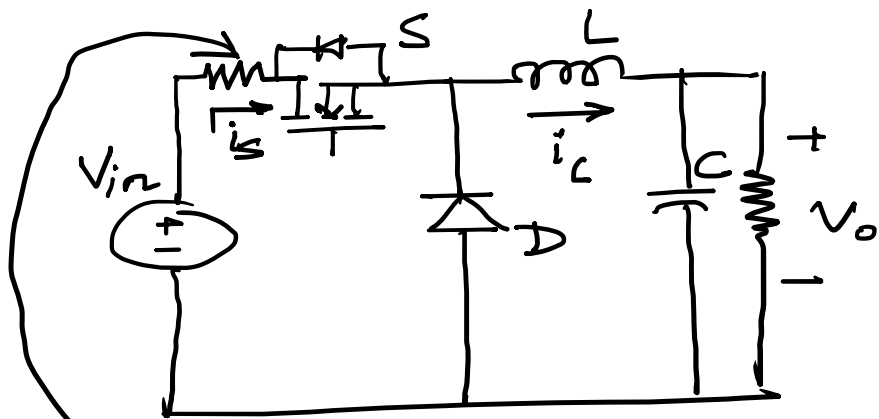


⇒ i_L → peak of inductor current = peak of switch current

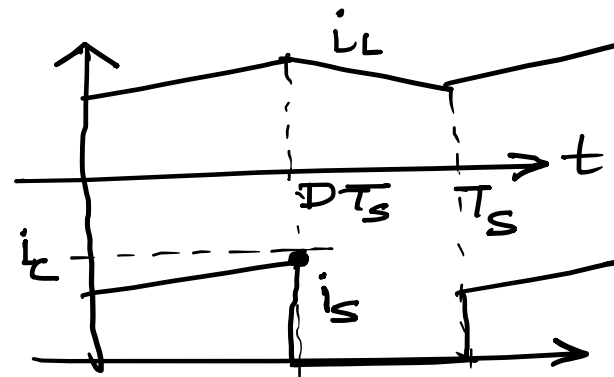
⇒ Current programmed control (CPC)

- logic to turn off the switch when switch current reaches peak
 - Switch S turns on at the start of a switching cycle
- } Duty

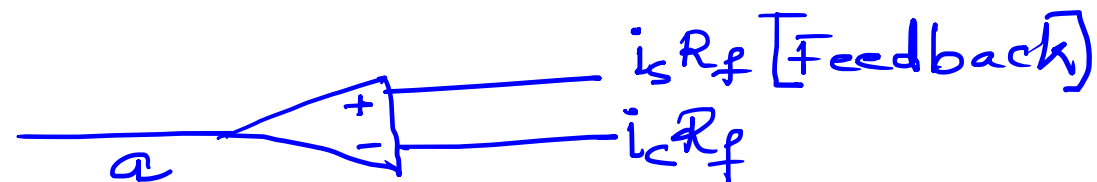
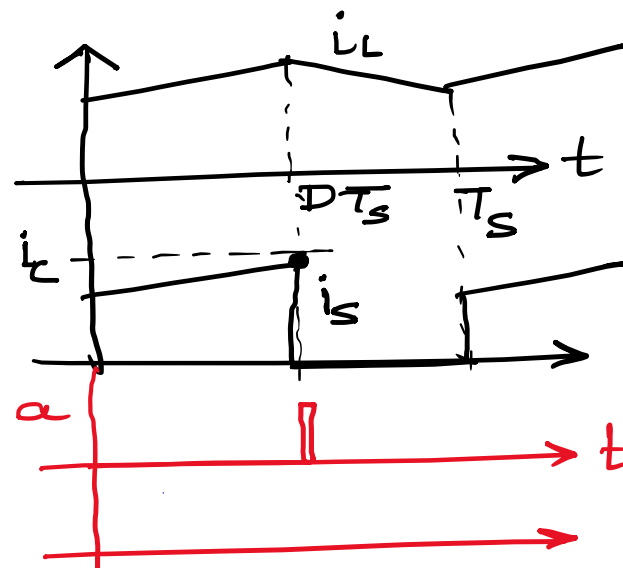
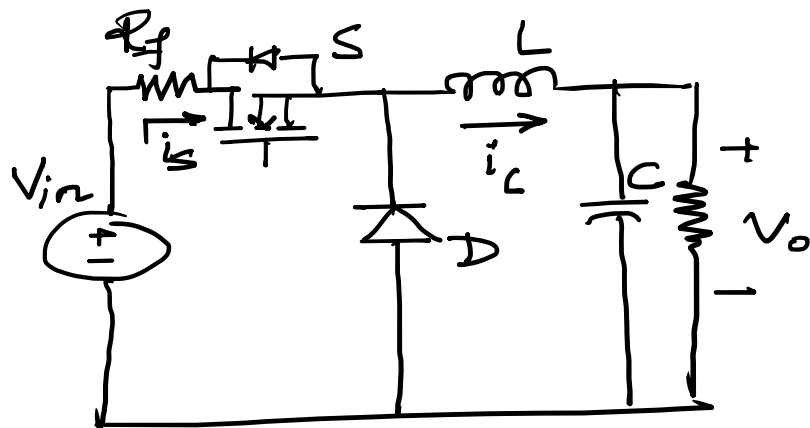
Current Programmed Control



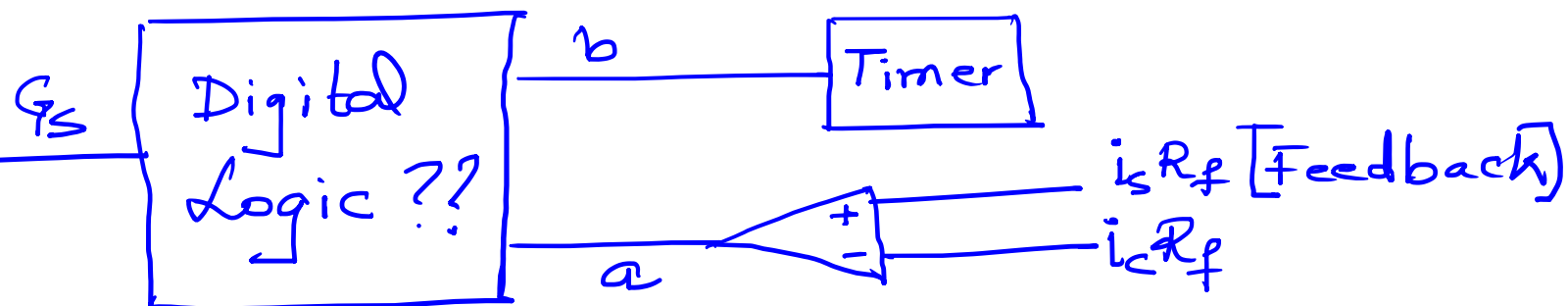
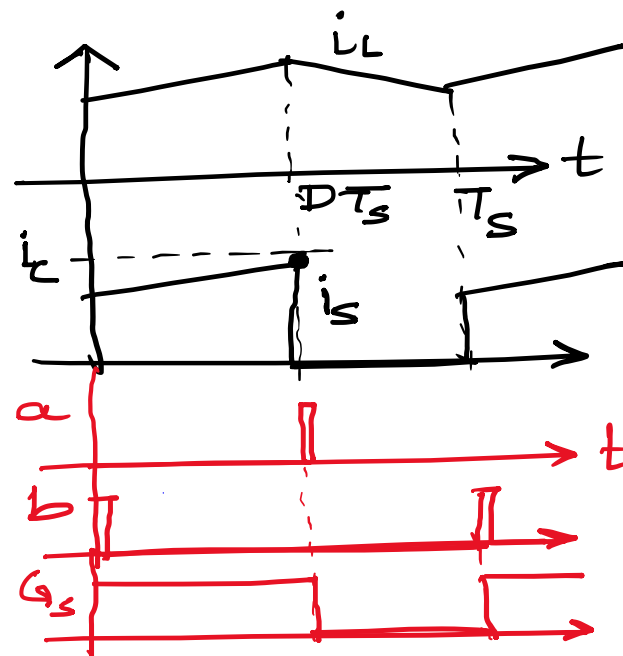
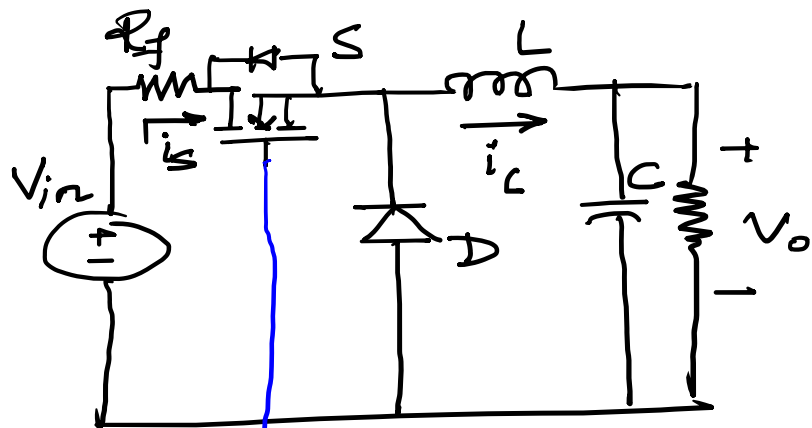
Current sense resistance R_f



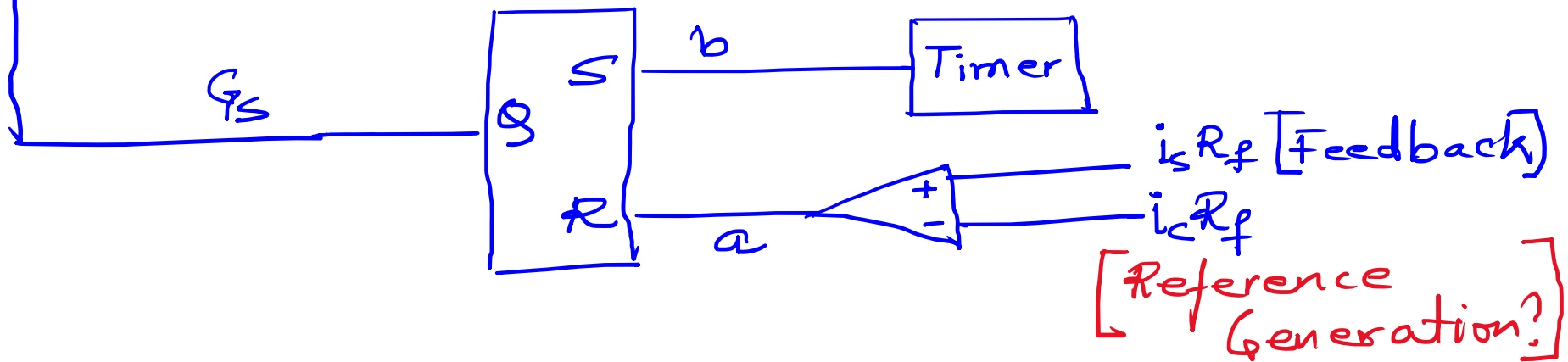
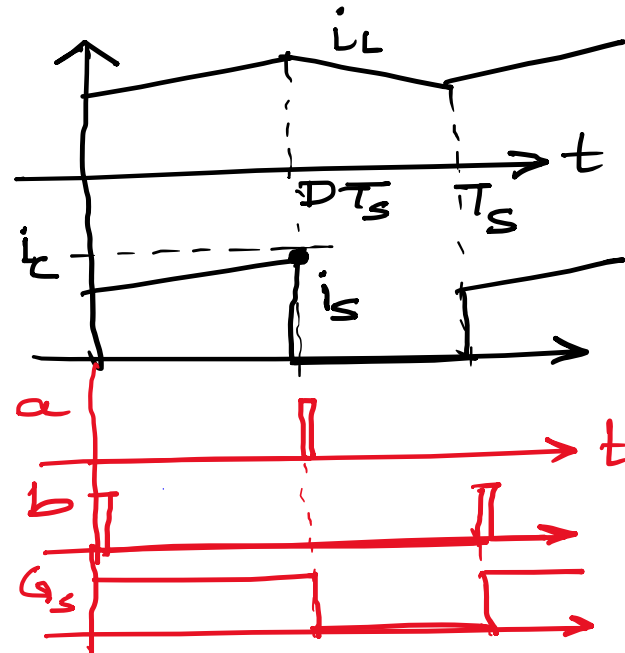
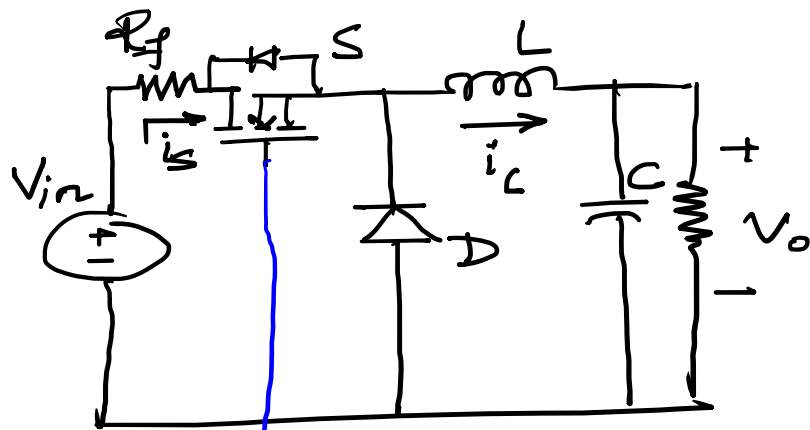
Current Programmed Control



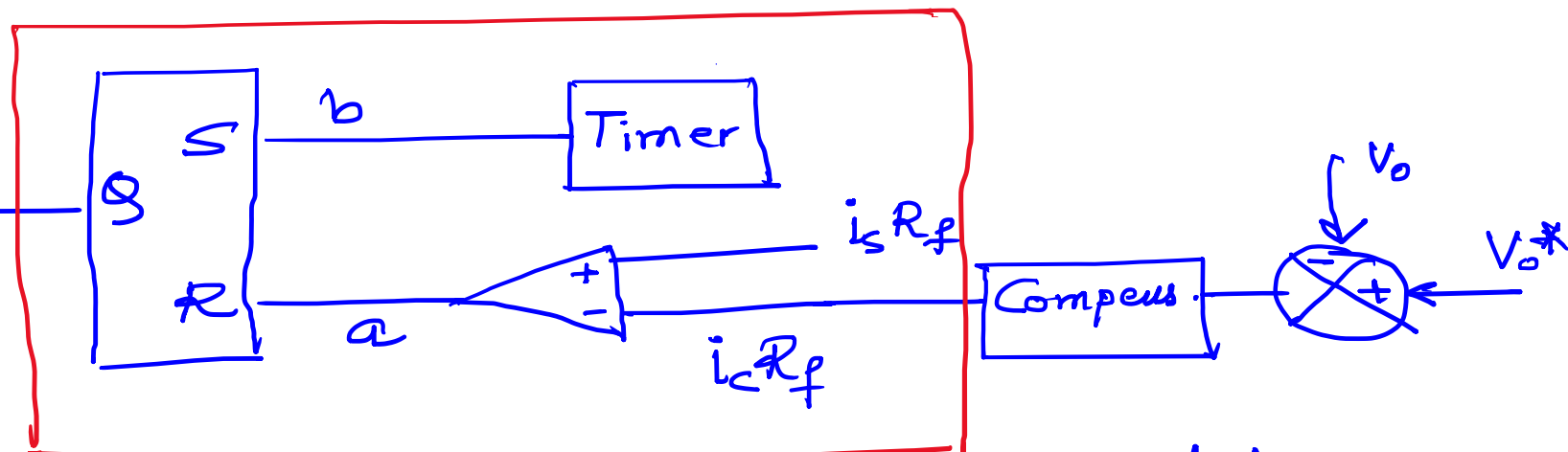
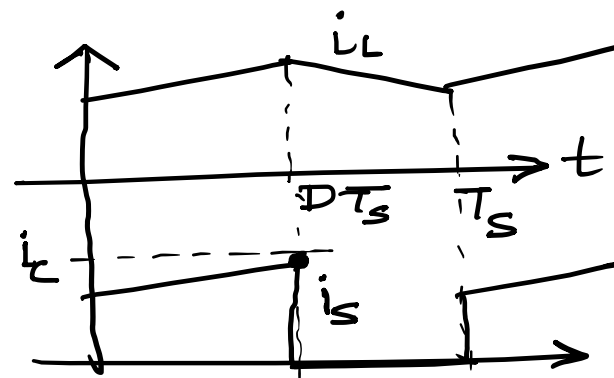
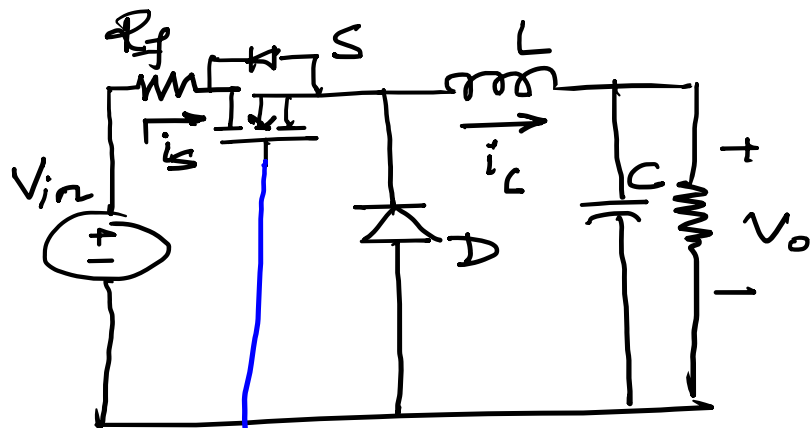
Current Programmed Control



Current Programmed Control



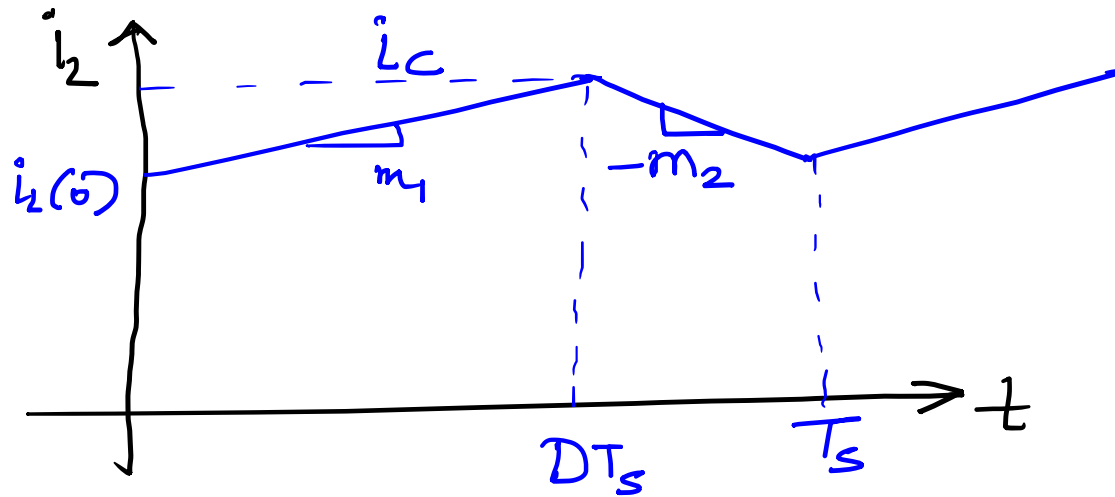
Current Programmed Control



CPM → Simple Implementation

Current Programmed Control

Oscillations



$$i_L(DT_s) = i_L(0) + m_1 d T_s = i_c$$

$$D = \frac{i_c - i_L(0)}{m_1}$$

$$i_L(T_s) = i_L(T_s) - m_2 d' T_s = i_L(0) + m_1 d T_s - m_2 d' T_s$$

In steady state,

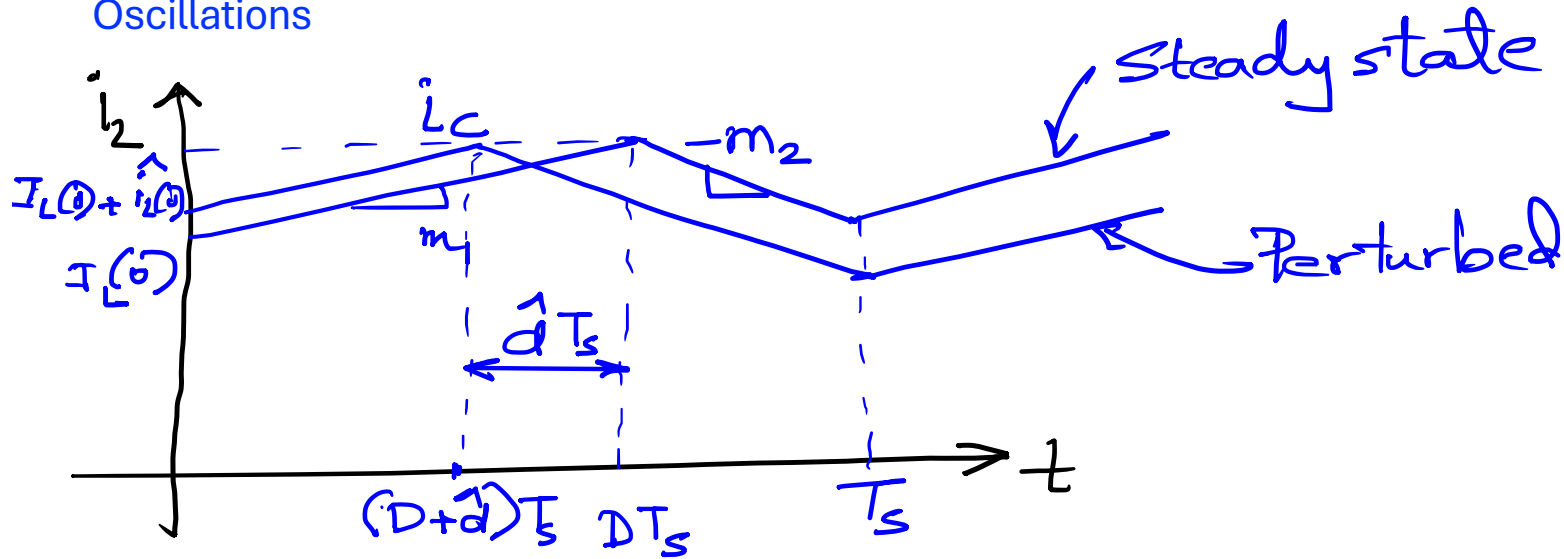
$$i_L(T_s) = i_L(0) \quad d = D \quad m_1 = M_1 \quad m_2 = M_2$$

$$\Rightarrow M_1 D - D' M_2 = 0$$

$$\Rightarrow \frac{M_2}{M_1} = \frac{D}{D'}$$

Current Programmed Control

Oscillations



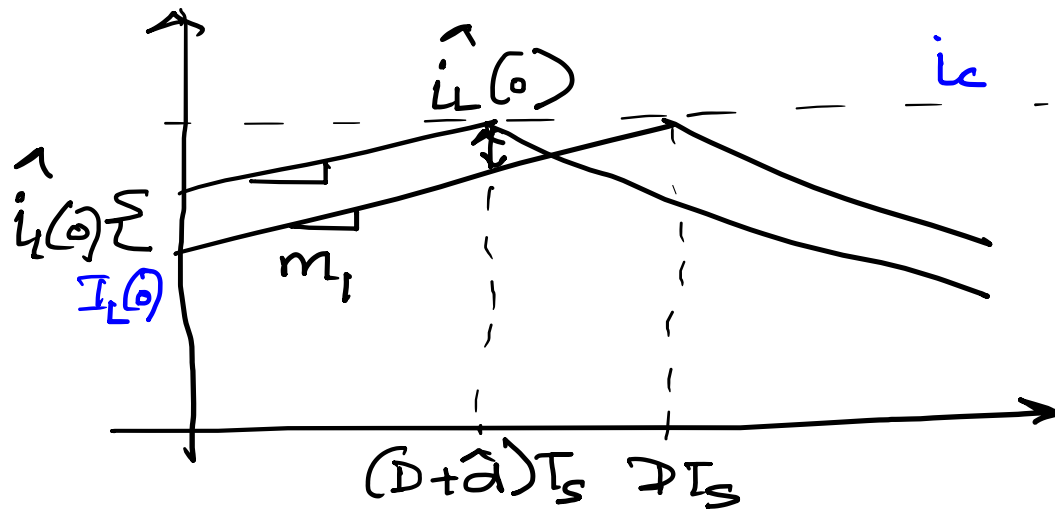
+ve perturbation
 $\hat{d}$ -ve
 -ve perturbation
 $\hat{d}$ +ve

$$\dot{i}_L(0) = I_L(0) + \hat{i}_L(0)$$

$$|\hat{i}_L(0)| \ll |I_L(0)|$$

Current Programmed Control

Oscillations



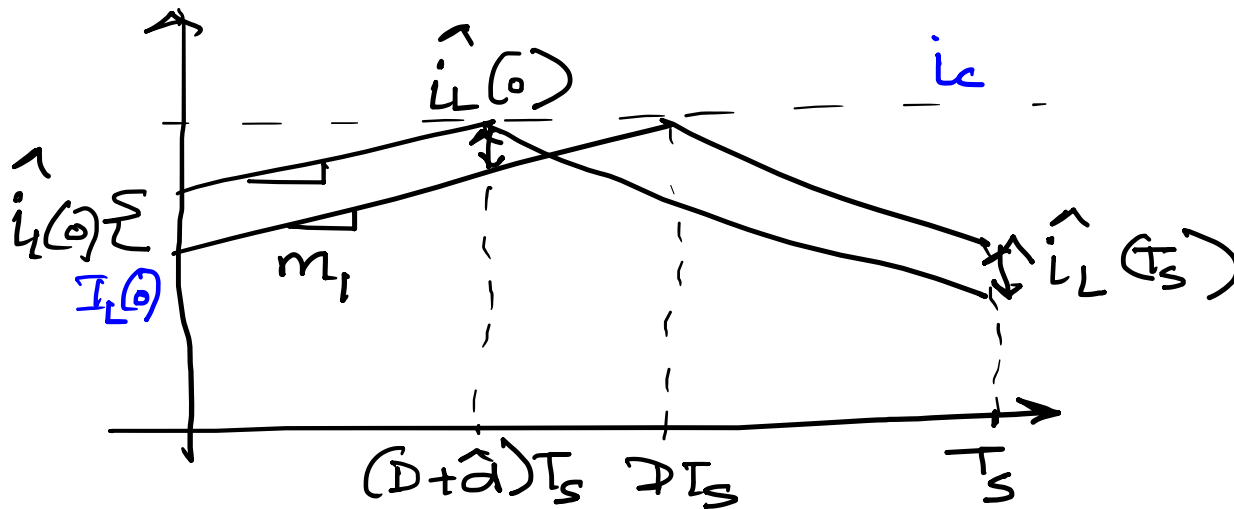
$$\hat{i}_c = I_L(0) + m_l D T_s$$

$$\hat{i}_c = I_L(0) + \hat{i}_L(0) + m_l (D + \hat{a}) T_s$$

$$\therefore \hat{i}_L(0) = -m_l \hat{a} T_s$$

Current Programmed Control

Oscillations



$$i_c = I_L(0) + m_1 D T_s$$

$$i_c = I_L(0) + \hat{i}_L(0) + m_1 (D + \hat{\alpha}) T_s$$

$$\therefore \hat{i}_L(0) = -m_1 \hat{\alpha} T_s$$

$$\hat{i}_L(T_s) = m_2 \hat{\alpha} T_s$$

$$\hat{i}_L(T_s) = \hat{i}_L(0) \left(\frac{-m_2}{m_1} \right)$$

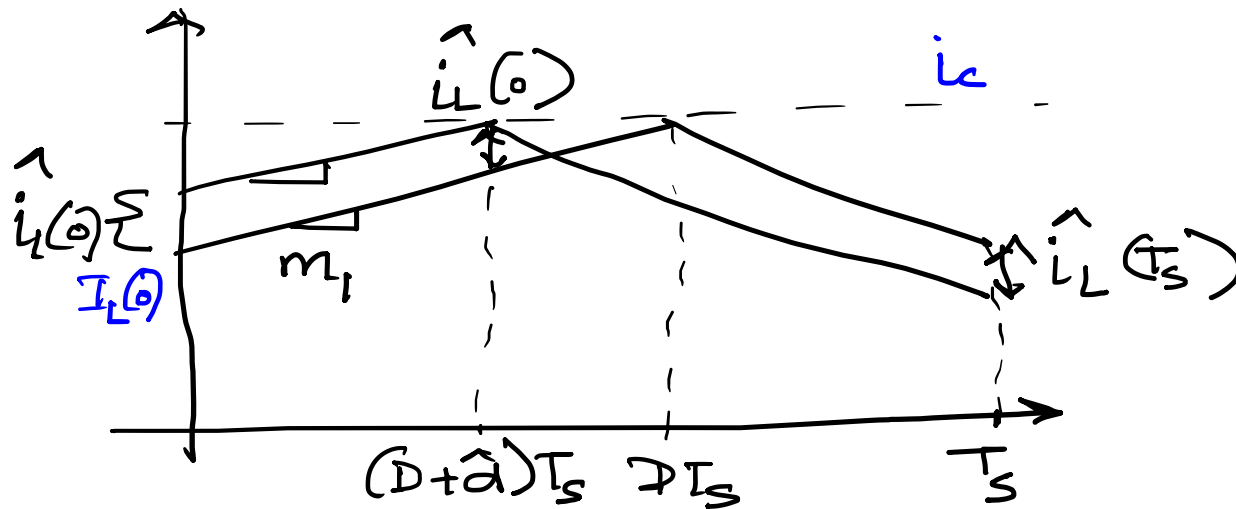
$$\Rightarrow \hat{i}_L(T_s) = \hat{i}_L(0) \left(-\frac{D}{D'} \right)$$

$$\hat{i}_L(2T_s) = \hat{i}_L(0) \left(-\frac{D}{D'} \right)^2$$

$$\therefore \hat{i}_L(nT_s) = \hat{i}_L(0) \left(-\frac{D}{D'} \right)^n$$

Current Programmed Control

Oscillations



$$\hat{i}_L(nT_s) = \hat{i}_L(0) \left(-\frac{D}{D'}\right)^n$$

$$\hat{i}_L(nT_s) = \begin{cases} 0 & \frac{D}{D'} < 1 \\ \infty & \frac{D}{D'} > 1 \end{cases}$$

$\therefore$ stable when

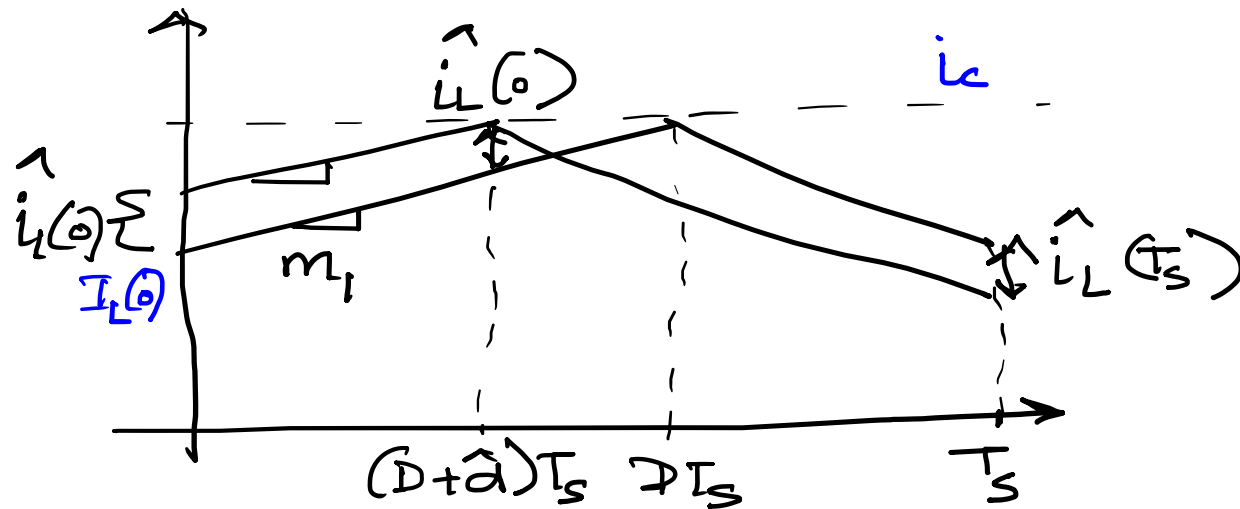
$$\frac{D}{D'} < 1$$

$$\Rightarrow D < 0.5$$

CPM suffers from oscillations for $D > 0.5$

Current Programmed Control

Oscillations



How reduce this oscillation
for $D > 0.5$ with CPM??