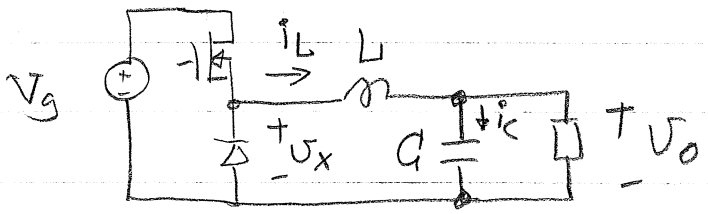
- AVERAGE MODEL
- STEADY STATE

} BUCK BOOST

- Transformer
  - IDEAL
  - PERFECT

- TRANSFORMER BASED CONVERTERS

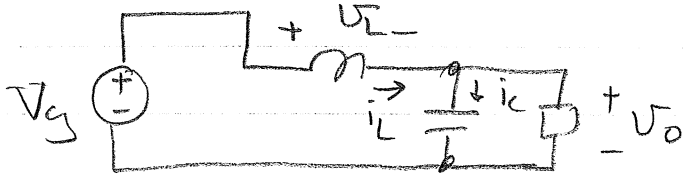
} Forward Flyback



CAPITAL LETTER => CONSTANT (DC)
SMALL LETTERS → DYNAMIC

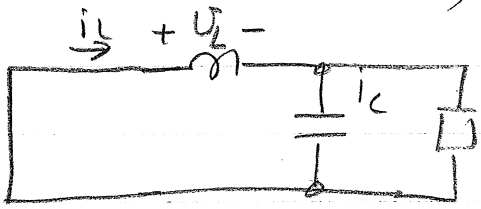
How will $v_x(t)$ look like ?

Q_1 = ON

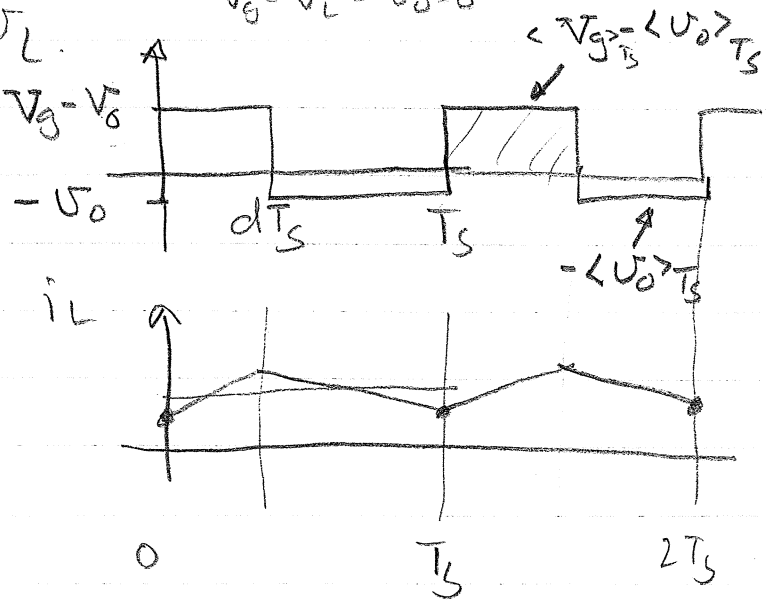


$V_g - v_L - v_o = 0$

D = ON (Q = OFF)



$-v_L - v_o = 0$



$$\langle v_L \rangle_{T_s} = L \frac{d\langle i_L \rangle_{T_s}}{dt}$$

$$\langle v_L \rangle_{T_s} = \frac{1}{T_s} \int_0^{T_s} v_L \, dt$$

$$\langle v_L \rangle_{T_s} = \frac{1}{T_s} \int_0^{T_{sd}} \langle v_g \rangle_{T_s} - \langle v_o \rangle_{T_s} \, dt$$

$$+ \frac{1}{T_s} \int_{T_{sd}}^{T_s} 0 - \langle v_o \rangle_{T_s} \, dt$$

$$\langle v_L \rangle_{T_S} = \langle v_g \rangle_{T_S} d - \langle v_o \rangle_{T_S} d$$

$$- \langle v_o \rangle_{T_S} (1-d)$$

$$- \langle v_o \rangle_{T_S} + \langle v_o \rangle_{T_S} d$$

$$\langle v_L \rangle_{T_S} = \langle v_g \rangle_{T_S} d - \langle v_o \rangle_{T_S}$$

DYNAMIC EQUATION

SINCE $\langle v_L \rangle_{T_S} = L \frac{d\langle i_L \rangle}{dt}$

$$L \frac{d\langle i_L \rangle_{T_S}}{dt} = \langle v_g \rangle_{T_S} d - \langle v_o \rangle_{T_S}$$

IN STEADY STATE

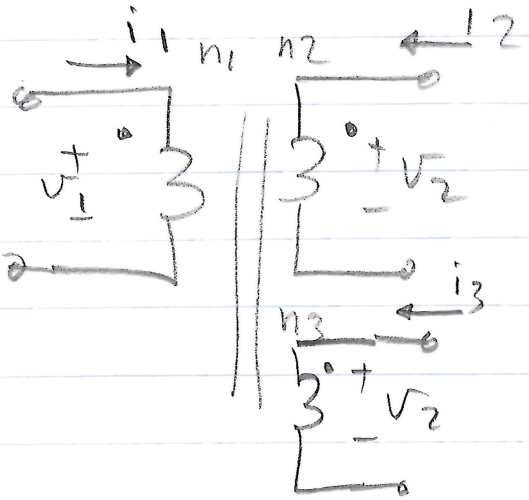
WHAT HAPPENS WHEN

$\frac{d\langle i \rangle}{dt} = ?$

$$0 = V_g D - V_o$$

$$\boxed{V_o = V_g D}$$

TRANSFORMER



$$\frac{v_1}{n_1} = \frac{v_2}{n_2} = \frac{v_3}{n_3} \quad \ldots$$

$$i_1 n_1 + i_2 n_2 + i_3 n_3 \ldots = 0$$

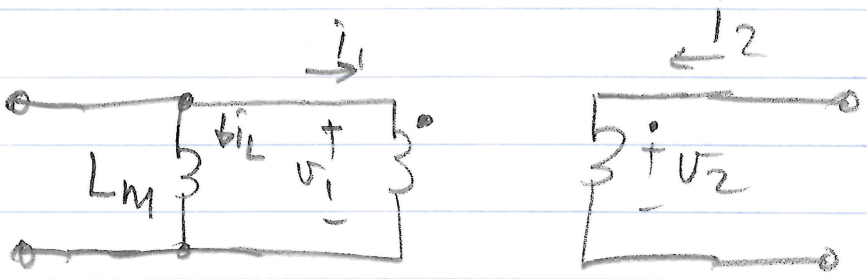
WHY DO YOU THINK IT IS NAMED IDEAL?

$$v_1 = \frac{n_1}{n_2} v_2$$

10 10 1

$$i_1 \frac{n_1}{n_2} = -i_2$$

1·10 −10

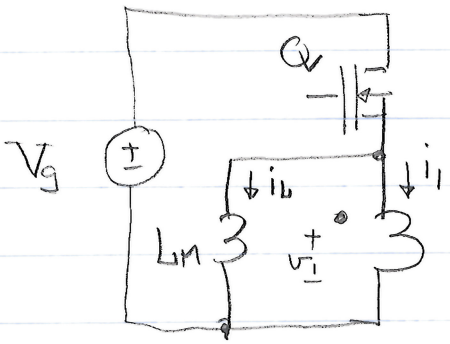


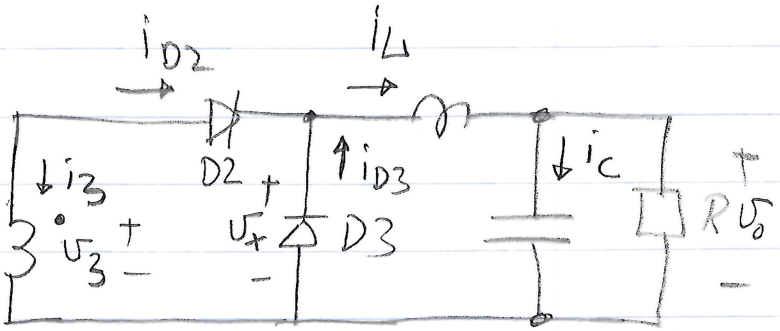
PERFECT TRANSFORMER

v_1 and v_2 NOW MUST HAVE AVERAGE VOLTAGES EQUAL TO ZERO

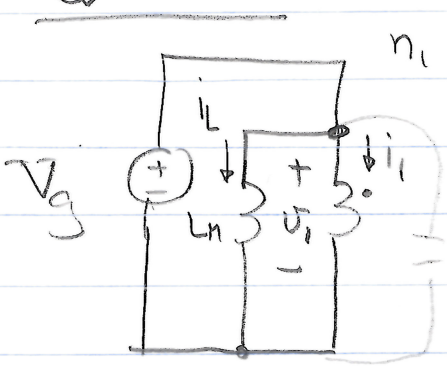
TRANSFORMER BASED CONVERTER

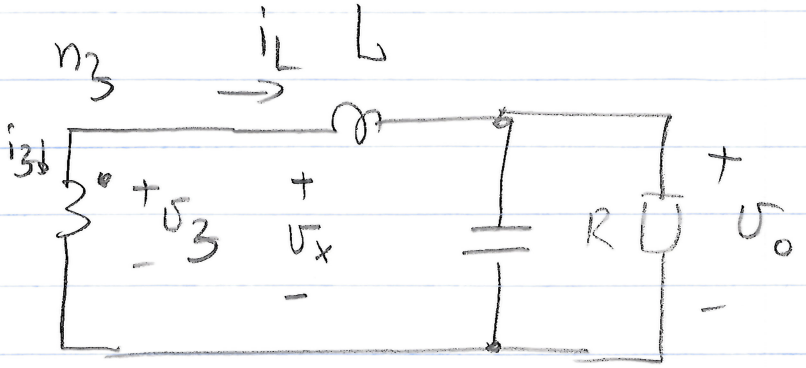
FORWARD.

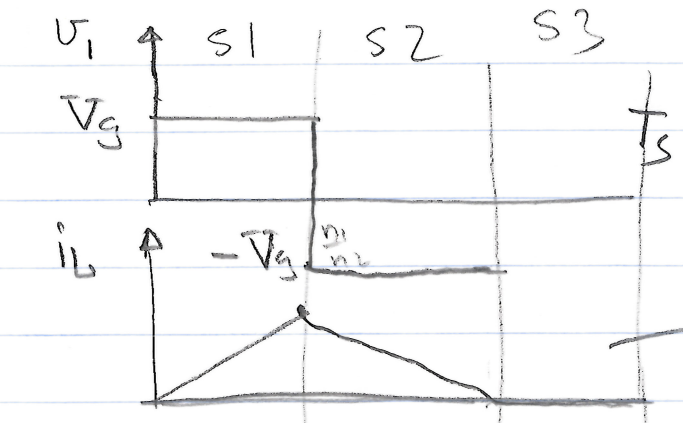




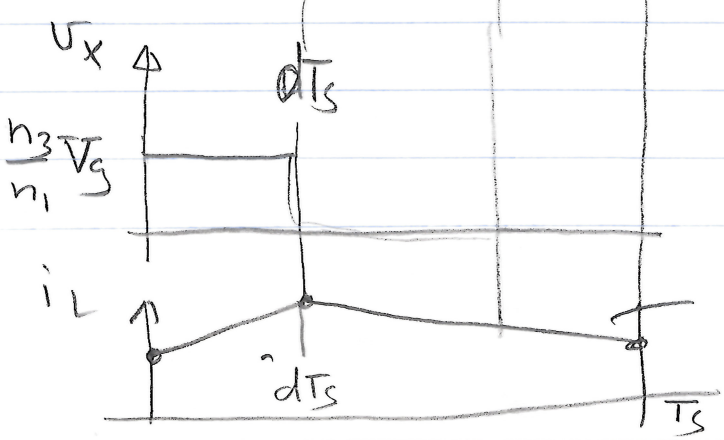
Q=ON







DCM !



CCM !

n_1	n_3
1	$\frac{n_3}{n_1}$

$$\frac{v_1}{n_1} = \frac{v_2}{n_3}$$

$$v_2 = \frac{n_3}{n_1} v_1$$

$$v_3 = \frac{n_3}{n_1} V_g$$

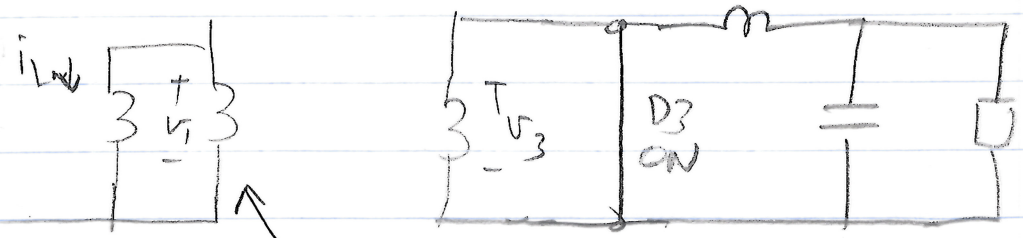
Q = OFF

WHAT HAPPENS NOW ?

v_1 decrease USE SMALL CAPACITOR

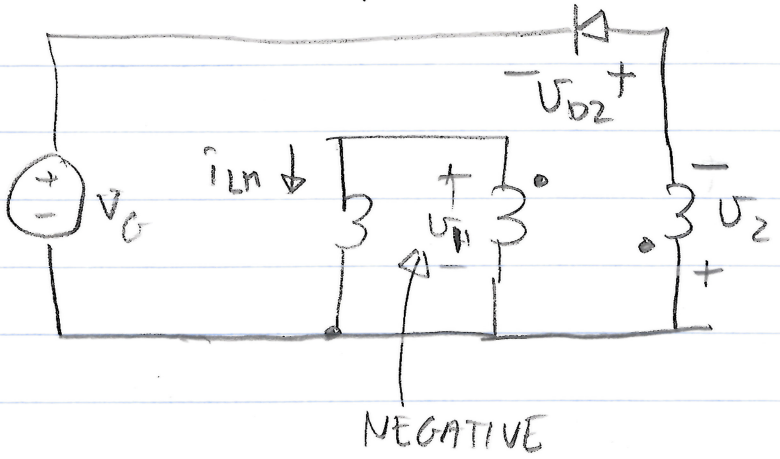
try to become negative.

BUT if v_x NEGATIVE D3 TURN ON

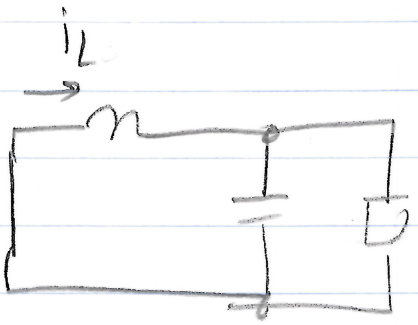


$v_1 = 0$ SO NO DEMAGNITISATION!

With D2



NEGATIVE



$$\frac{v_1}{n_1} = \frac{v_2}{n_2} \Rightarrow v_2 = \frac{n_2}{n_1} v_1$$

$$V_G + V_{D2} + v_2 = 0$$

$$V_{D2} = -V_G - \frac{n_2}{n_1} v_1 = 0 \Rightarrow$$

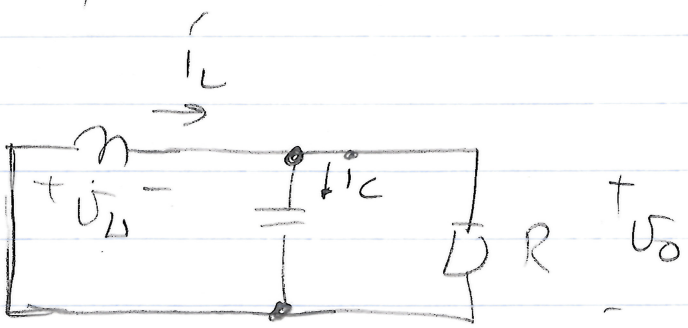
$$v_1 = -V_G \frac{n_1}{n_2}$$

$$n_1 = n_2$$

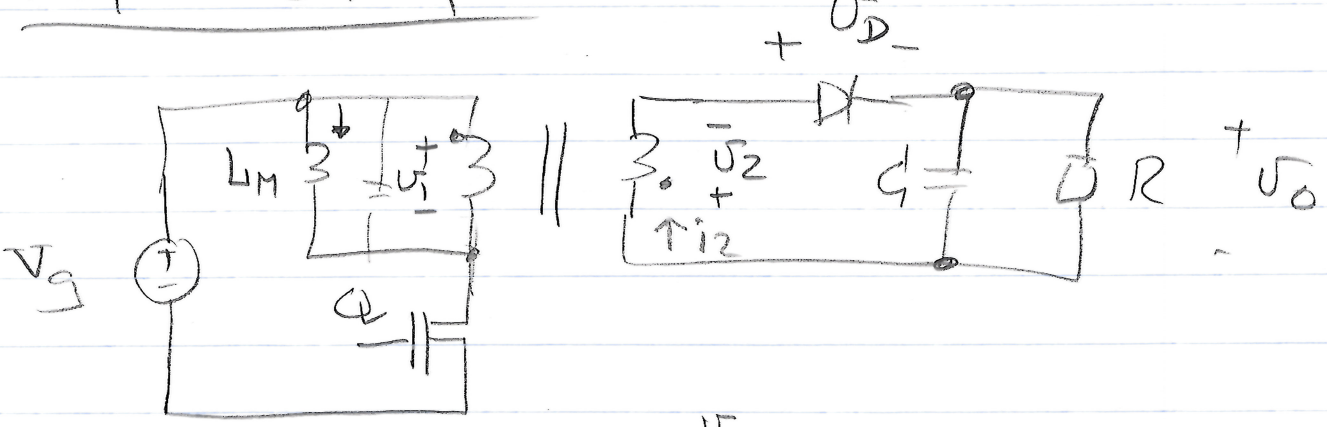
$$v_1 = -V_G$$

S3:

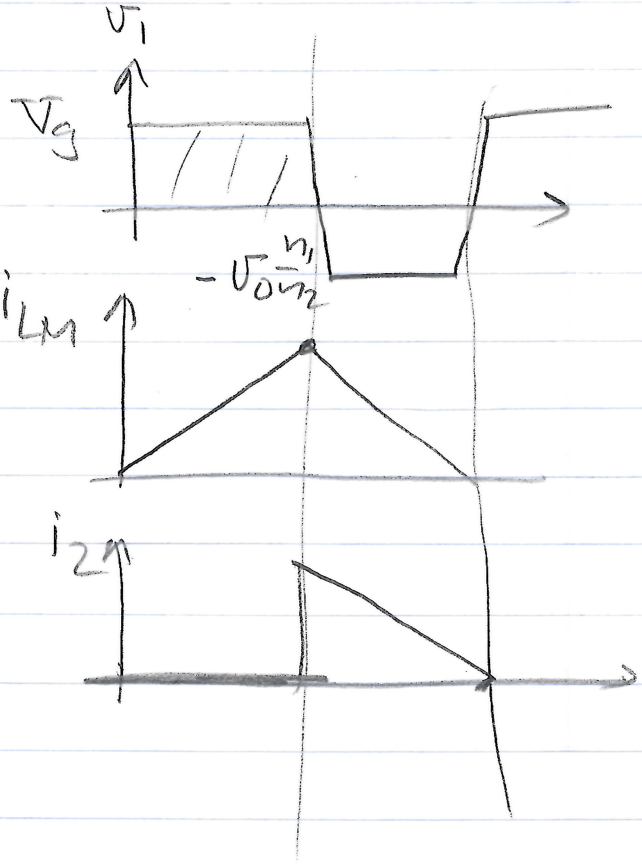
D2 = OFF , Q = OFF , D3 = ON



FLY BACK



Q = ON



$$\frac{v_1}{n_1} = \frac{v_2}{n_2}$$

$$\boxed{v_2 = v_1 \frac{n_2}{n_1}}$$

SEC:

$$-v_2 - v_D - v_o = 0$$

$$v_D = -v_2 - v_o$$

AT $v_D = 0$

$$v_2 = -v_o$$

$$\boxed{v_1 = \frac{n_1}{n_2}(-v_o)}$$

$$V_g \, d T_s = V_o \frac{n_1}{n_2}(1-D) T_s$$

$$V_o = \frac{n_2}{n_1} V_g \frac{D}{1-D}$$

$$V_o = n V_g \frac{D}{1-D}$$