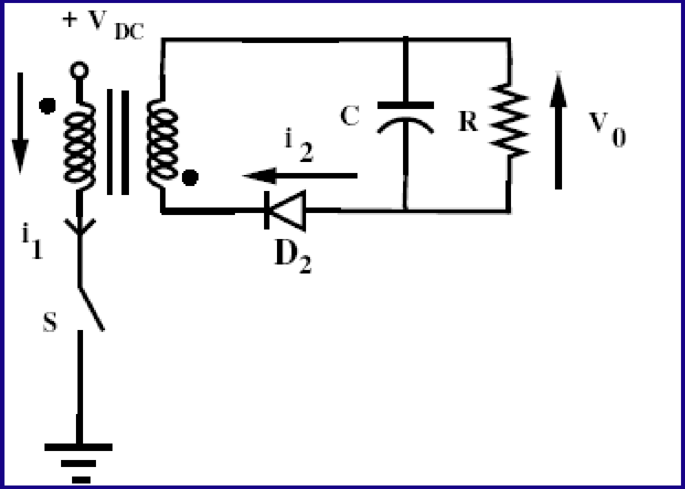
Review

1. Flyback converter :

$\Rightarrow$ Energy is stored in $\underline{\underline{L_m}}$ & it is transfered to o/p

$\Rightarrow$ Isolated Buck – Boost control

$$V_0 = V_{dc}\left(\frac{N_2}{N_1}\right)\frac{D}{(1-D)}$$



$\Rightarrow$ Operated in discontinuous mode (flux reseting)

$\Rightarrow$ Generally airgap is provided during the fabrication of transformer

$\Rightarrow$ Multiple o/p's are possible

$\Rightarrow$ Closed loop operation is a must

Forward Converter

With non-ideal transformer

$\Rightarrow \mu_r \neq \infty$, R $\rightarrow$ finite

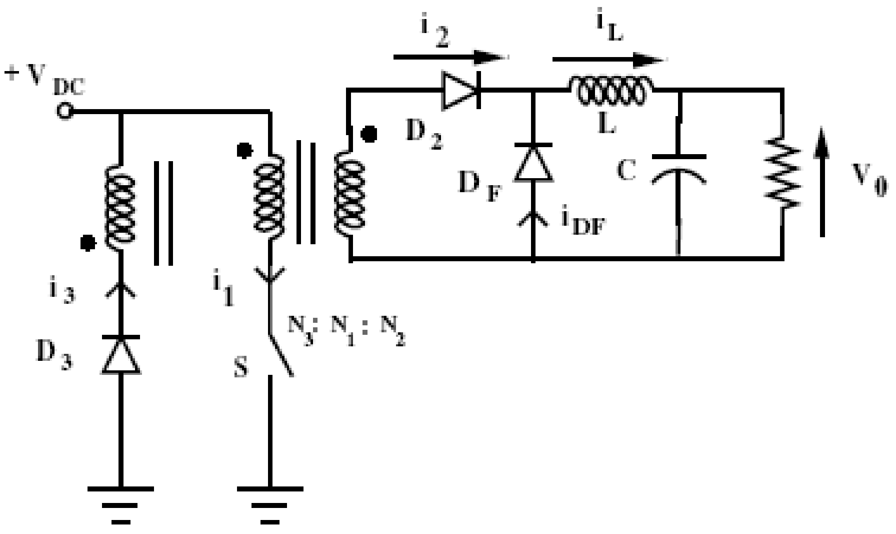
$\therefore$ magnetising current is finite.

$\Rightarrow$ when $i_2 = 0$, $i_1 \neq 0$

$\Rightarrow$ magnetising current should be continuous

$\Rightarrow$ calls for a seperate winding

$\Rightarrow$ should provide a path for the magnetising 'I'(similar to fly-back connection)



Close 'S'

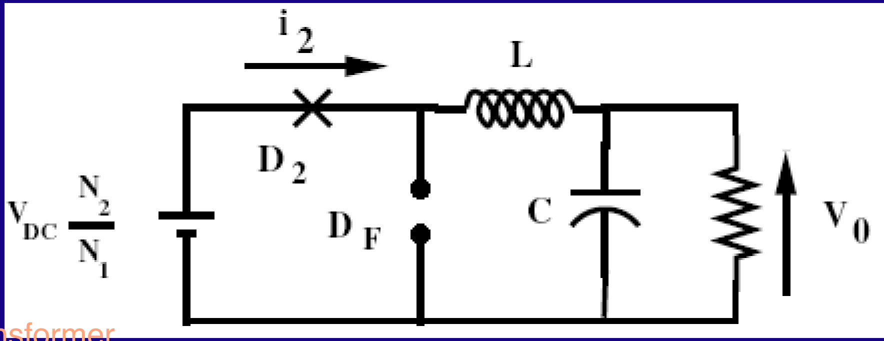
$i_1 = i_2' + i_m$

$i_m \rightarrow$ magnetising current

'V' applied to $L_m = V_{DC}$

$\therefore i_m \uparrow$ linearly with time.

as it is in direct contact with VDC in the equivalent model of transformer

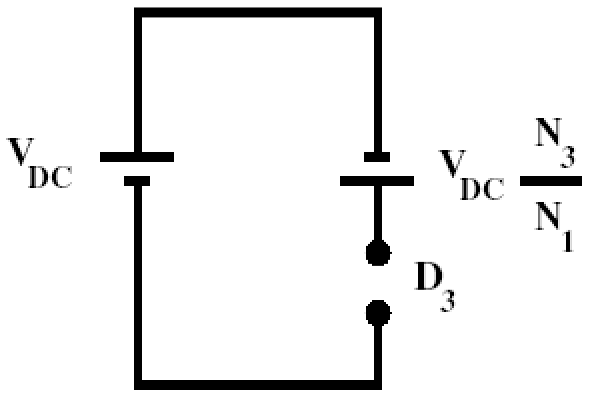


'V' induced in N_2 supplies current to load (i_2 can leave the dot)

'V' across $D_F = V_{DC}\frac{N_2}{N_1}$

Right direction for i_3 is to leave the dot.

$\Rightarrow$ not possible due to D_3



OR: – 'V' induced in $N_3 = V_{DC}\frac{N_3}{N_1}$ with '•' as +ve.

$\therefore$ 'V' across $D_3 = -V_{DC}\left(1+\frac{N_3}{N_1}\right)$

Open 'S'

$i_1 = 0 \qquad \therefore i_2 = 0$

i_m & i_L should be continuous $\therefore$ i_L flows through D_F.

'V' across D_2 = 'V' induced in N_2

$\Rightarrow \dfrac{d\phi}{dt}$ is -ve $\quad\therefore$ all '•' are -ve

$\Rightarrow D_3$ starts conducting providing a path for i_m

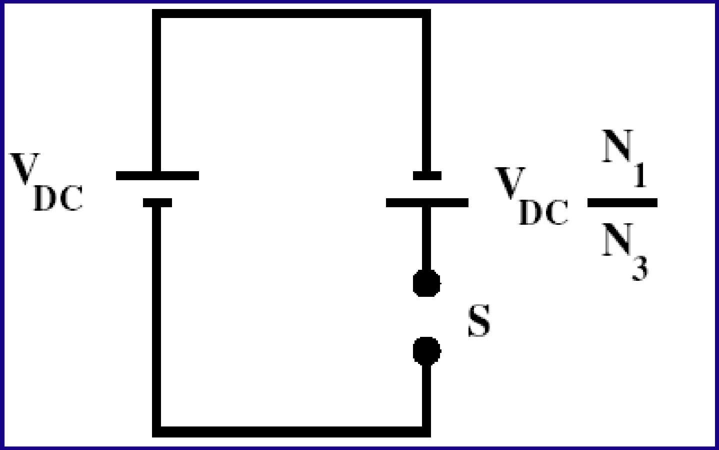
Peak value of $i_m = I_m = \dfrac{V_{DC}}{L_m} DT$

Peak value in $N_3 = I_m \dfrac{N_1}{N_3}$

'V' applied to $N_3 = V_{DC}$ (with '•' as -ve)

$\therefore$ Induced 'V' in $N_1 = V_{DC} \dfrac{N_1}{N_3}$

$\therefore$ 'V' across 'S' = $V_{DC}\left(1 + \dfrac{N_1}{N_3}\right)$



$\Rightarrow$ 'V' induced in $N_2 = V_{DC}\dfrac{N_2}{N_3}$ (with '$\bullet$' as -ve)

$\therefore$ 'V' rating of $D_2 = V_{DC}\dfrac{N_2}{N_3}$

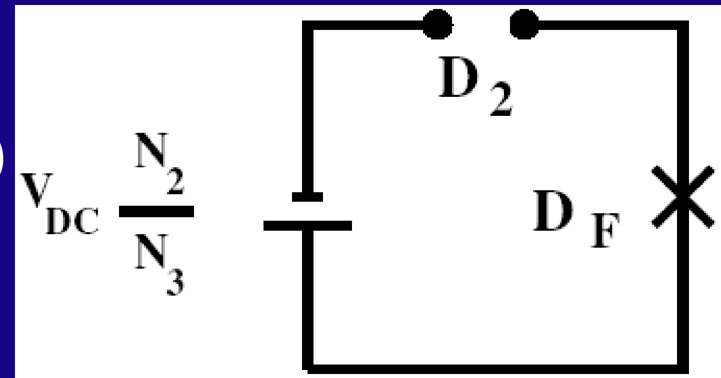
What is the value of $N_3 = ?$

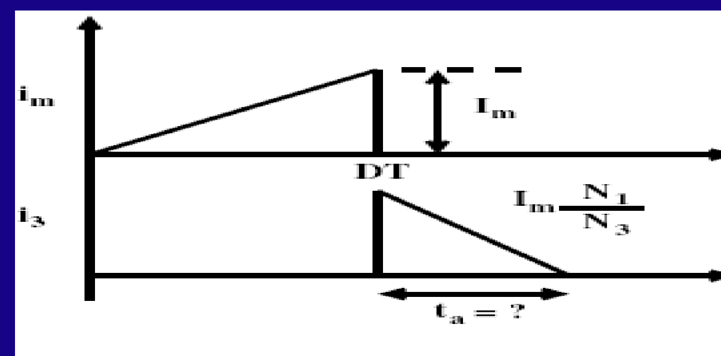
$$\uparrow d\phi = \frac{V_{DC}DT}{N_1}$$

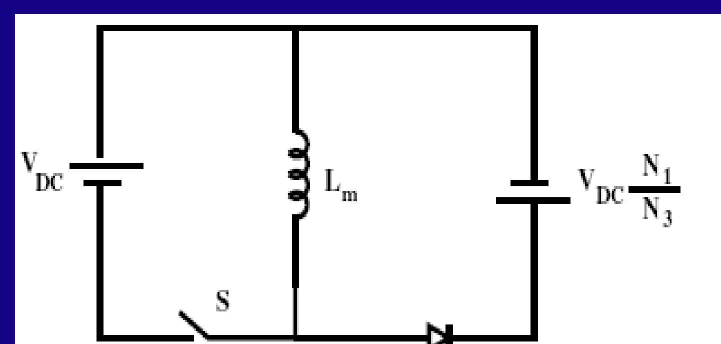
$$\downarrow d\phi = \frac{V_{DC}}{N_3}t_a$$

equating above equation,

$$t_a = \frac{N_3}{N_1}DT$$







For core flux to become zero,

$t_a < (1-D)T$

$\therefore$ D must be limited to D_{max} such that

$$\frac{N_3}{N_1} D_{max} T = (1 - D_{max})T$$

$$\Rightarrow D_{max} = \frac{1}{2} \quad \text{if } N_3 = N_1$$

<u>If $N_3 = N_1$, $D > 0.5$</u> :–

i_m will not become zero , because

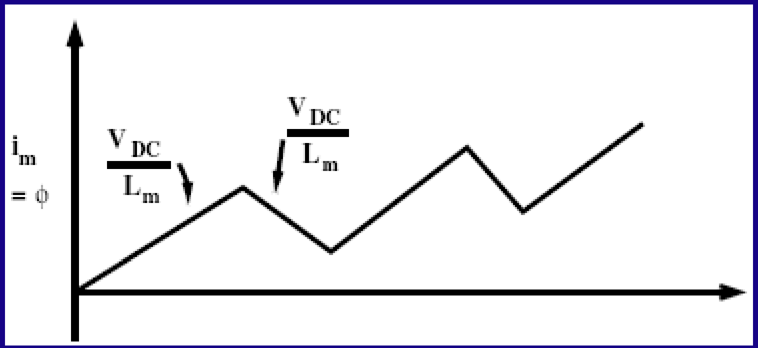
$+V_{DC}$ is applied for 'DT' &

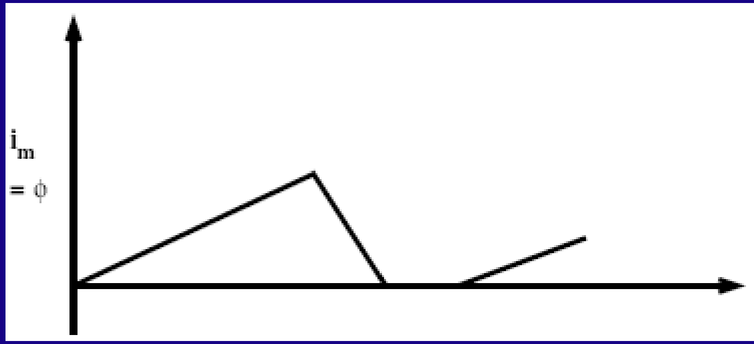
$-V_{DC}$ is applied for (1-D)T

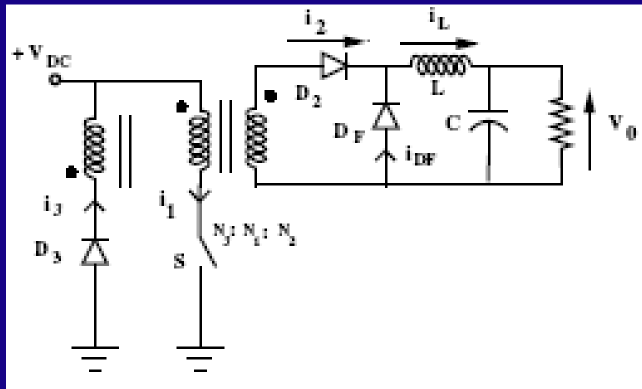
$\Rightarrow$ slope is the same

$\rightarrow$ core will saturate

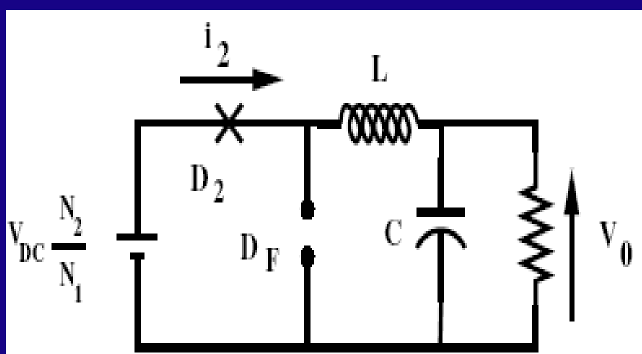
$\rightarrow \therefore$ For D < 0.5 , discontinuous (flux) conduction



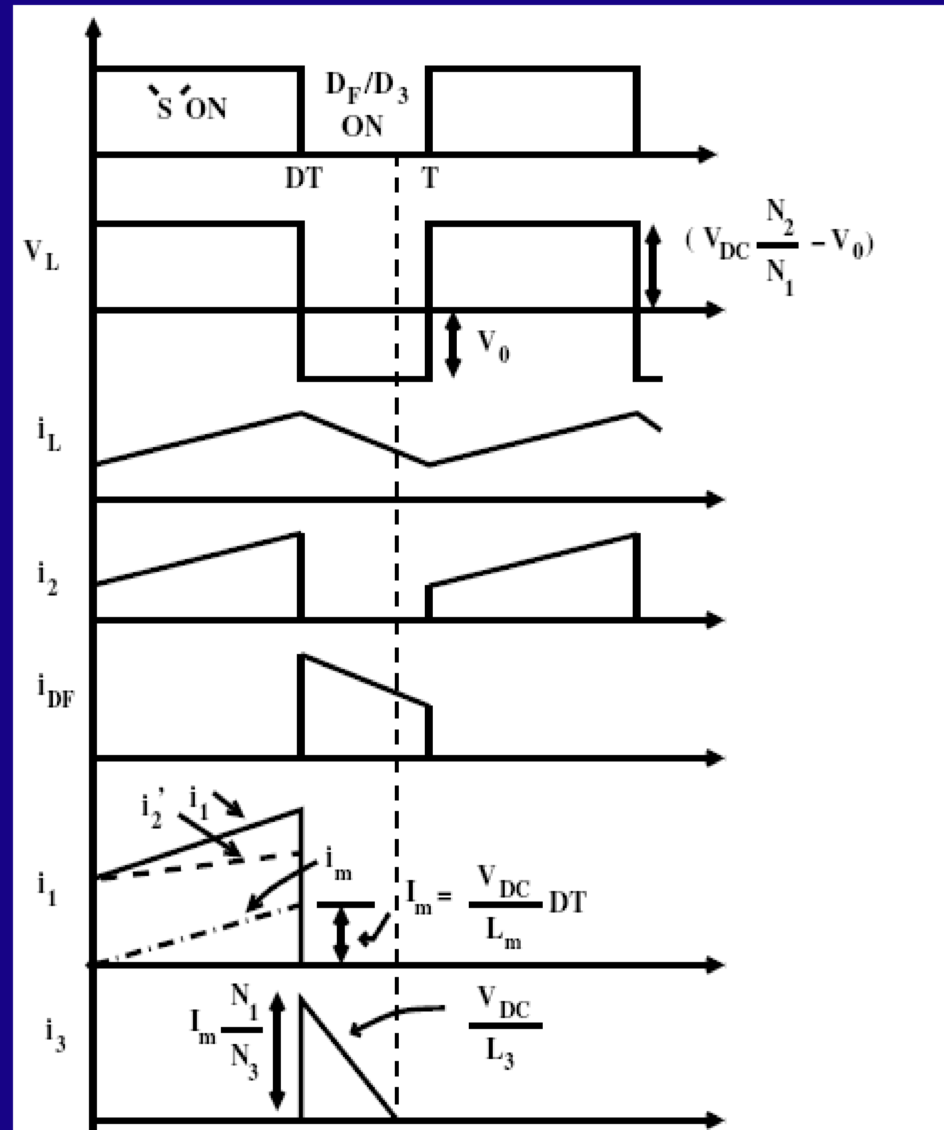




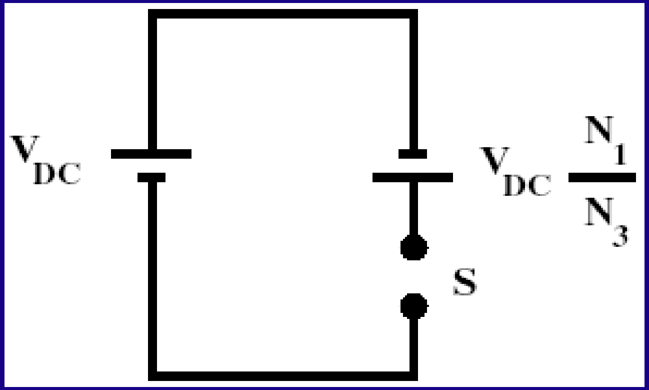
+V DC
i2
iL
D2
L
DF
iDF
C
V0
i3
D3
i1
S
N3 : N1 : N2

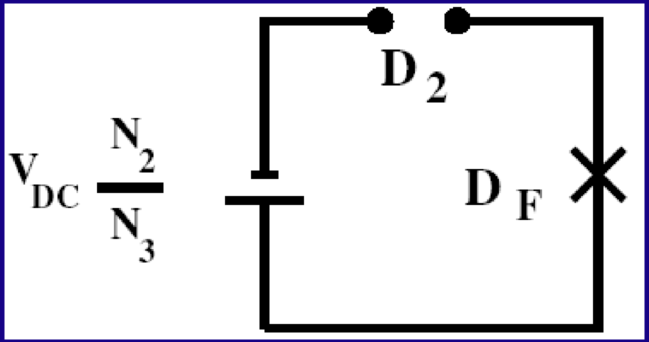


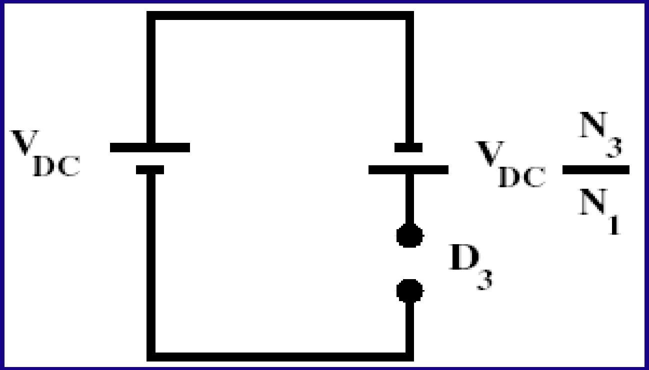
i2
L
D2
DF
C
V0
VDC N2/N1

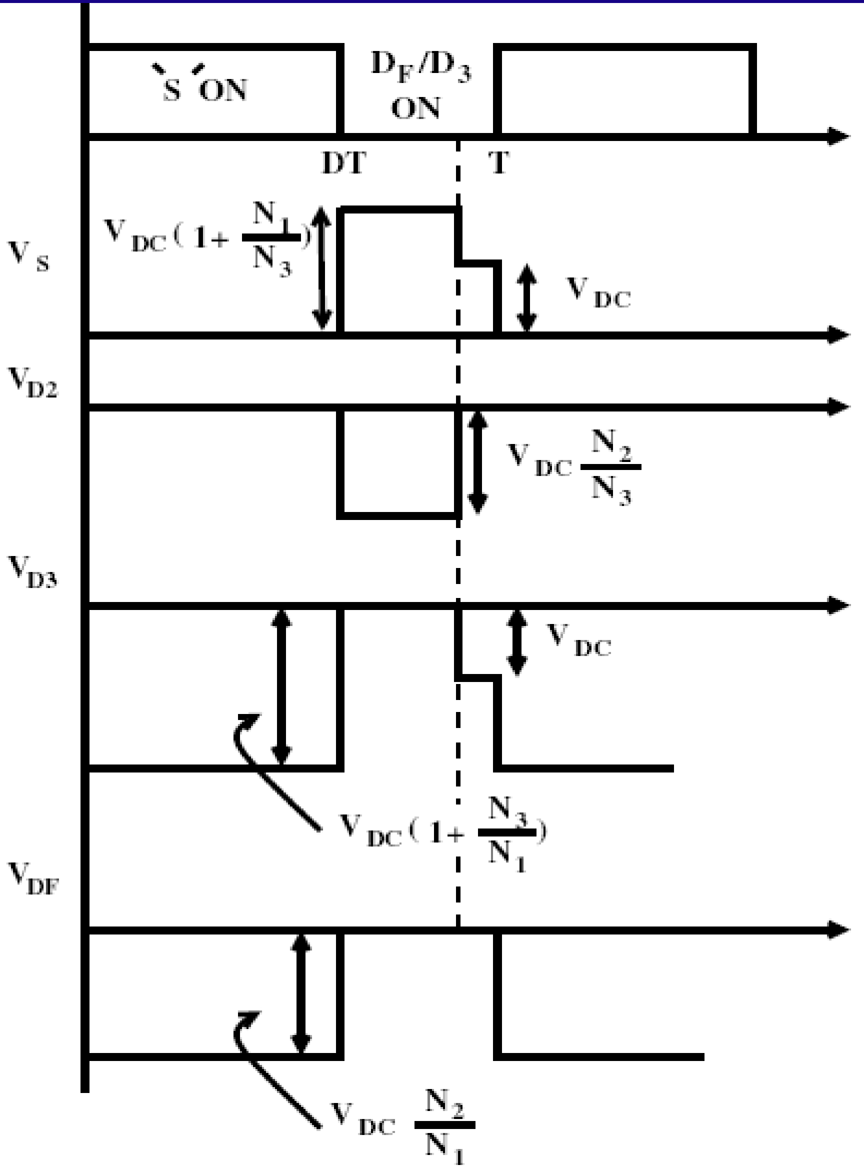


S ON
DF/D3 ON
DT
T
VL
(VDC N2/N1 − V0)
V0
iL
i2
iDF
i1
i2'
i1
im
Im = VDC/Lm DT
i3
Im N1/N3
VDC/L3


V DC
V DC N1/N3
S

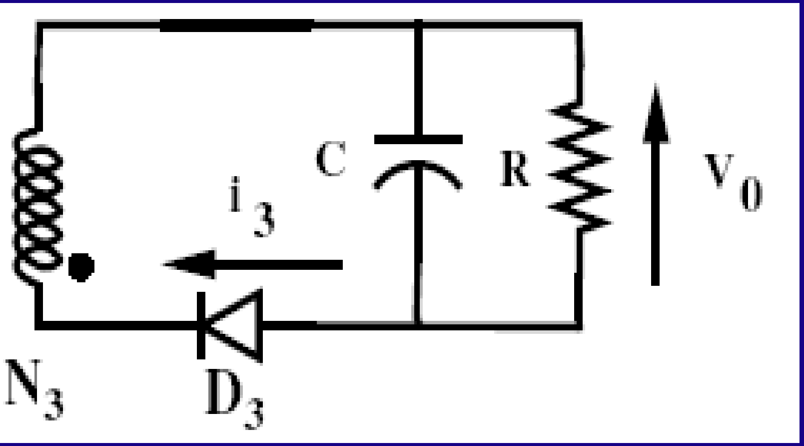

V DC N2/N3
D 2
D F


V DC
V DC N3/N1
D3


S ON
DF/D3 ON
DT
T
V S
V DC (1+ N1/N3)
V DC
V D2
V DC N2/N3
V D3
V DC
V DC (1+ N3/N1)
V DF
V DC N2/N1

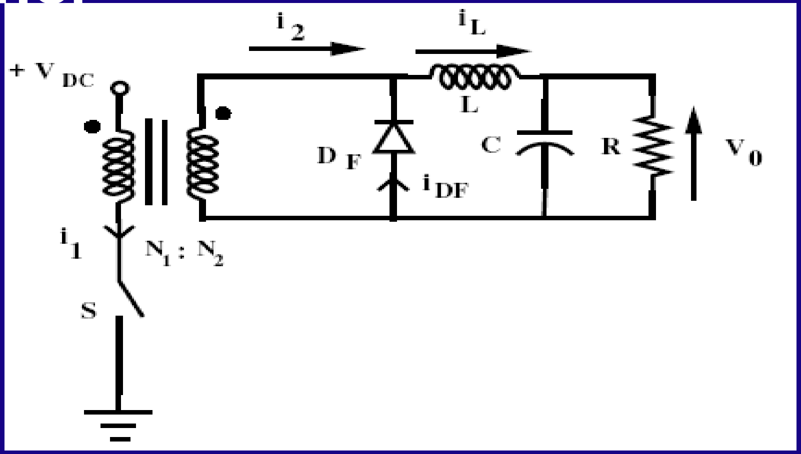
Special Cases:

$\Rightarrow$ Primary & tertiary winding form a flyback converter $(C \text{ \& } R \text{ are replaced by } V_{DC})$



$\Rightarrow$ No need to connect to V_{DC} instead connect to $C \| R$

OR : Using $2-$winding transformer



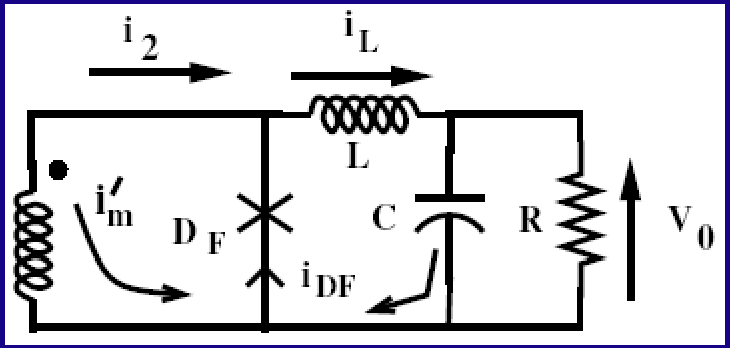
Close 'S'

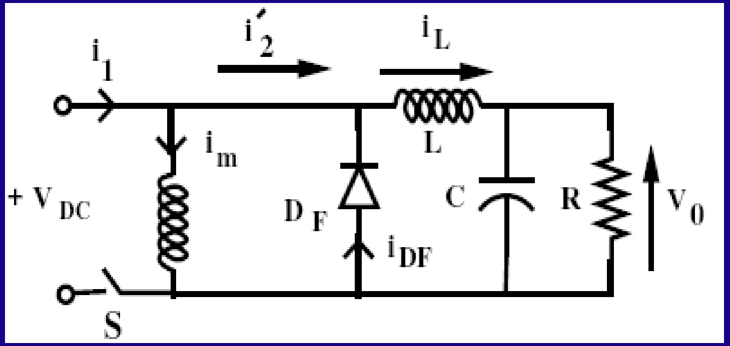
i_1 enters the dot

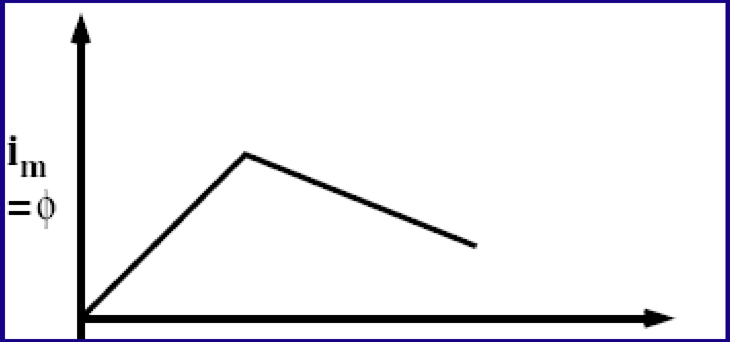
i_2 can leave the dot

$I_1 = I_m + I_2'$

Open 'S'







i_m & i_L should be continuous

For continuity of flux,

right direction

for 'i' in secondary

(when 'S' is opened)

is to enter the dot.

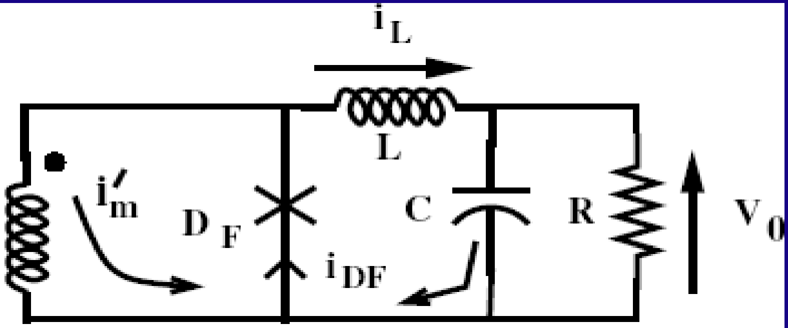
$\Rightarrow$ Possible.

$\Rightarrow$ 'i' in $D_F = i'_m + i_L$

$\Rightarrow$ But $\downarrow$ of $d\phi$ is very slow

as there is only internal resistance in path of IM

$\Rightarrow$ Next cycle core may saturate

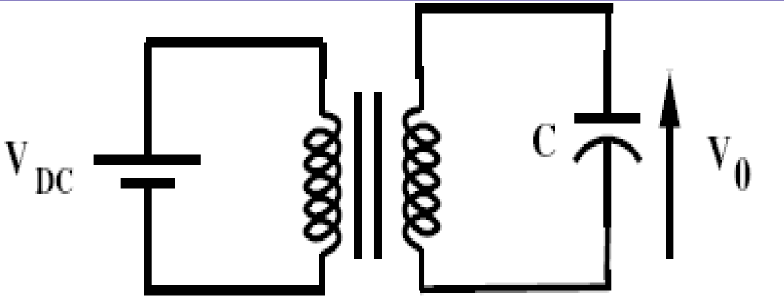


If L_f is not present

'V_0' appears directly

across secondary

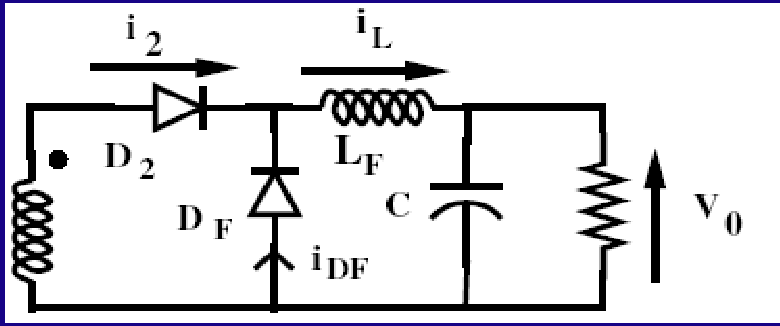
$\Rightarrow$ Affect the energy transfer



$\Rightarrow$ Do not allow 'V_0'

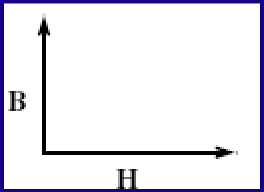
to appear across 'N_2'

$\Rightarrow$ Use 'L_F'



$\Rightarrow$ i_L must be continuous

$\Rightarrow$ Use $\underline{\underline{D_F}}$



$\Rightarrow$ Operation in the I^{st} quadrant only