EE-464 STATIC POWER CONVERSION-II

Midterm Recitation

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Ex. Mohan 10-3

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In a regulated flyback converter with 1:1 turns ratio, Vo=12V, Vd=12-24V, Pload is 60W, and the switching frequency is 200 kHz.

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In a regulated flyback converter with 1:1 turns ratio, V_o=12V, V_d=12-24V, P_{load} is 60W, and the switching frequency is 200 kHz.

Calculate the maximum value of the magnetizing inductance L_m that can be used if the converter is always required to operate in a complete demagnetization (i.e. discontinuous conduction mode).

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1:1 ratio means same as a buck-boost converter

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Refer to Mohan Section 7.5.2

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$$I_{oB} = \frac{T_s V_o}{2L}(1 - D)^2 \qquad (7\text{-}47)$$

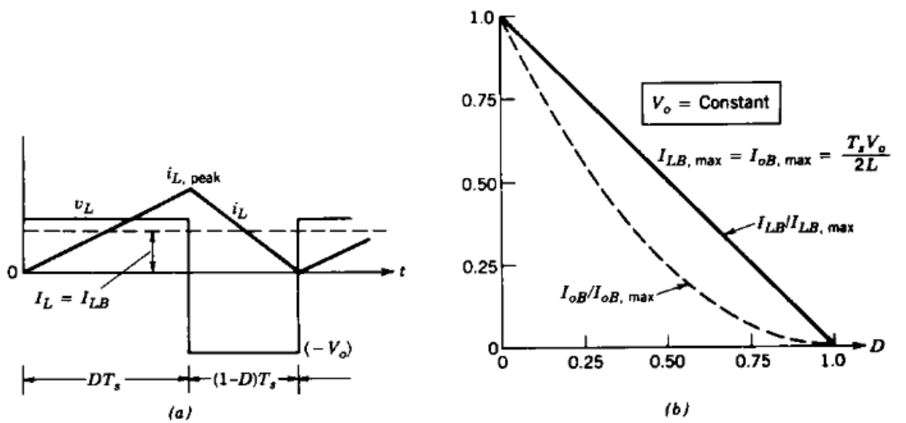

Figure 7-20 Buck–boost converter: boundary of continuous–discontinuous conduction.

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$$L_m = \frac{12(1-0.5)^2}{200 10^3 2\, 5} = 1.5\mu H$$

Ex. Mohan 10-5

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A switch-mode supply with the following specs are designed:

V_d=48 V ± 10%,

V_o=5V,

f_s=100kHz,

P_{load}=15-50W

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A forward converter is operating in continuous conduction mode with the demagnetizing winding ($N_3 = N_1$). Assume ideal components (except transformer magnetization)

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a) Calculate N2/N1 if the turns ratio is desired to be as small as possible.

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b) Calculate the minimum value of filter inductance.

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$$\frac{V_o}{V_{dmin}} = \frac{5}{43.2} = \frac{N_2}{N_1}0.5 \rightarrow \frac{N_2}{N_1} = 0.232$$

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$D = 0.408$ **Condition satisfied**

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$$V_{dmin} = 43.2 \rightarrow D = 0.5 \rightarrow L_{min} = 4.18\mu H$$

$$V_{dmax} = 52.8 \rightarrow D = 0.408 \rightarrow L_{min} = 4.93\mu H$$

Therefore $L_{min} = 4.93\mu H \approx 5\mu H$ **should be used**

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Solution available in the textbook

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A forward converter of Fig. 7-5a has the following parameters:

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- V_s=48V
- R= 10 Ohm
- L_x = 0.4 mH, L_m = 5 mH
- C=100 uF
- f = 35 kHz
- N1/N2= 1.5, N1/N3=1
- D=0.4

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a) Determine the output voltage, the maximum and minimum currents in Lx, and the output voltage ripple.

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b) Determine the peak curren in the transformer primary winding. Verify that the magnetizinf current is reset to zero during each switching period.

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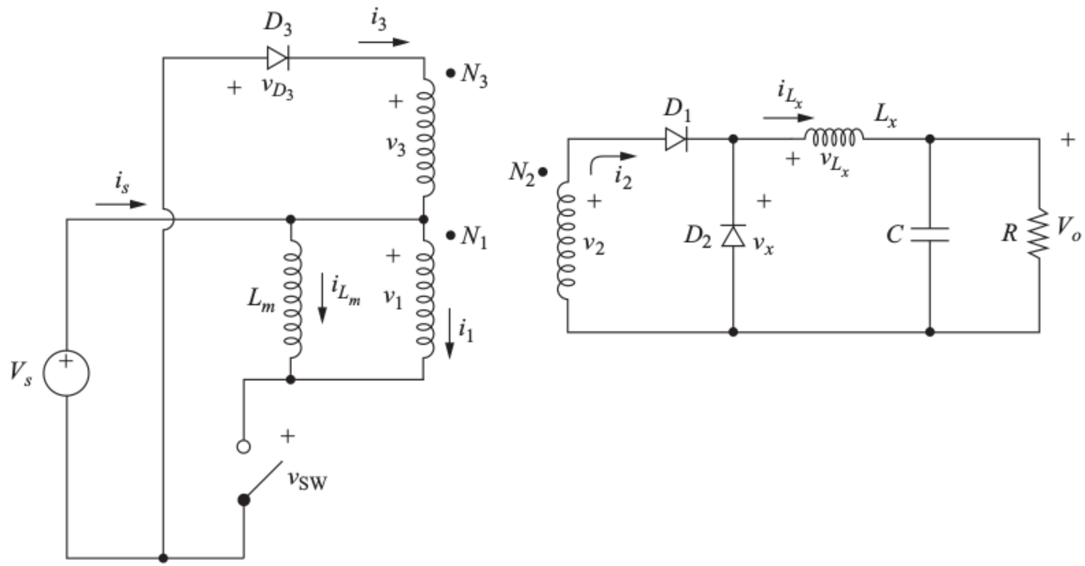

D_3
i_3
$+ \ v_{D_3}$
N_3
$+$
v_3
i_s
N_1
$+$
L_m
i_{L_m}
v_1
i_1
V_s
$+$
v_{SW}
D_1
i_{L_x}
L_x
N_2
i_2
$+$
v_2
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D_2
v_x
C
R
V_o
$+$

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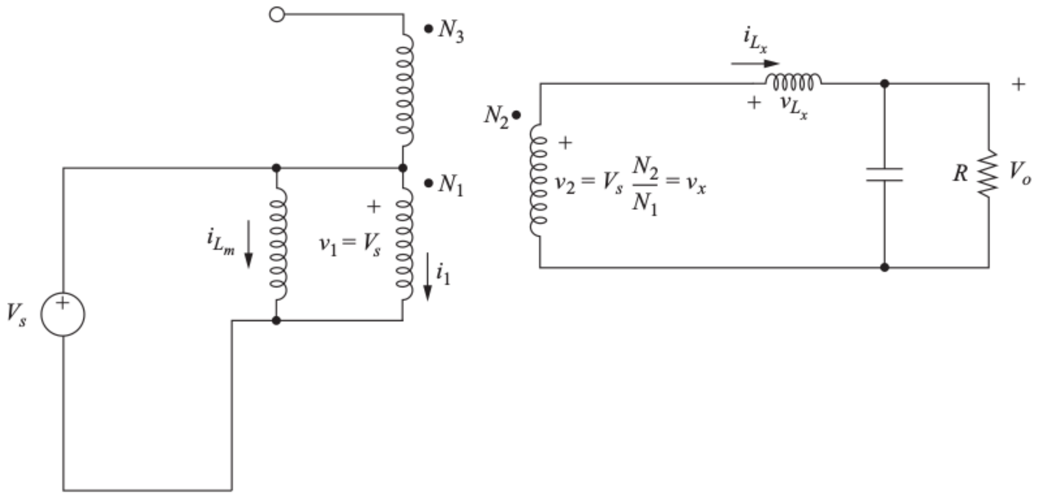

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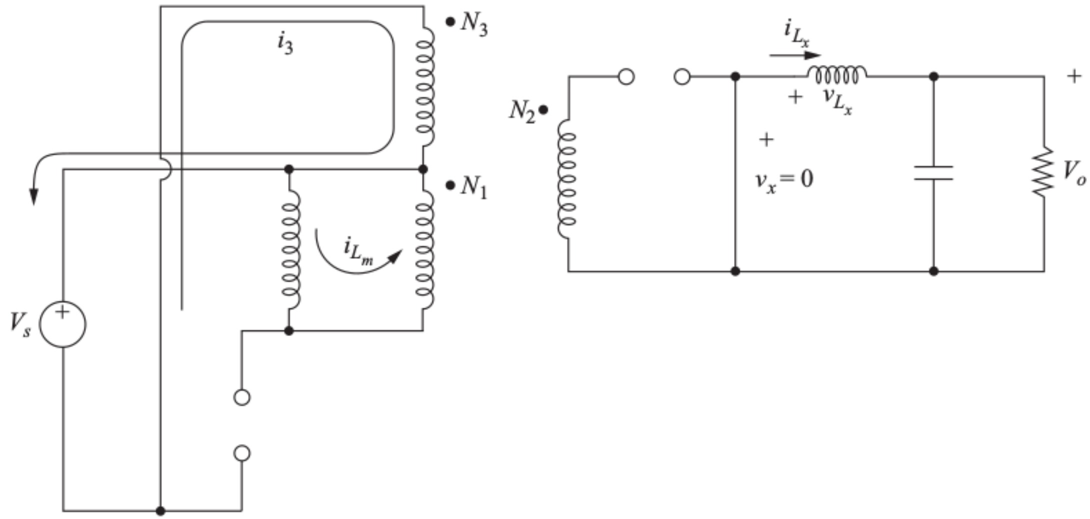

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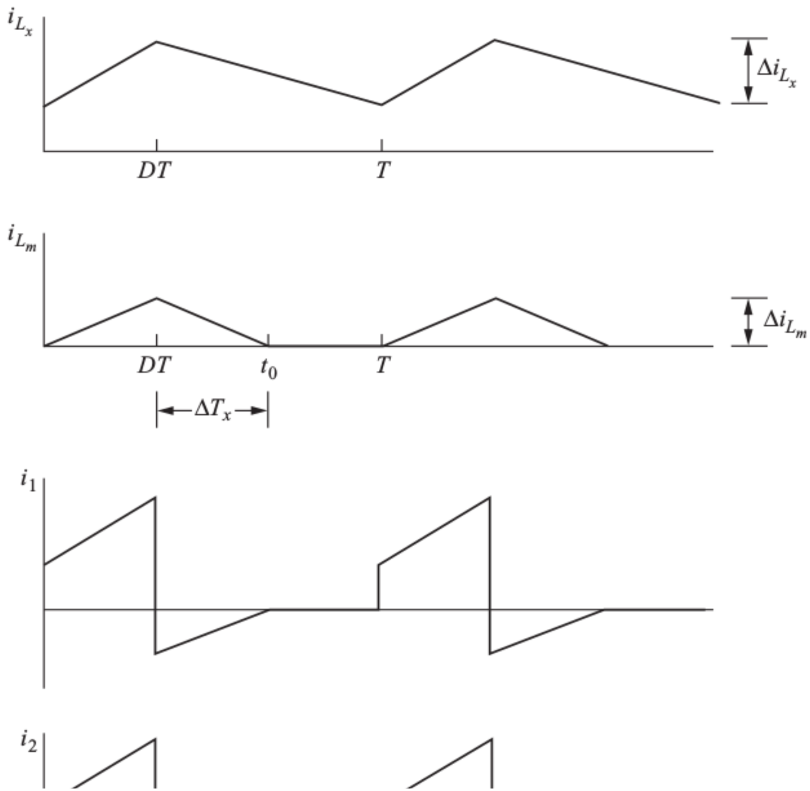

Ex. W.Hart 8.9

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Design a bipolar PWM single phase inverter that will produce 75 Vrms, 60 Hz output from a 150 Vdc supply.

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Design a bipolar PWM single phase inverter that will produce 75 Vrms, 60 Hz output from a 150 Vdc supply.

Rload=12 Ohm, Lload=60mH. Select the switching frequency such that the current THD is less than 10 %.

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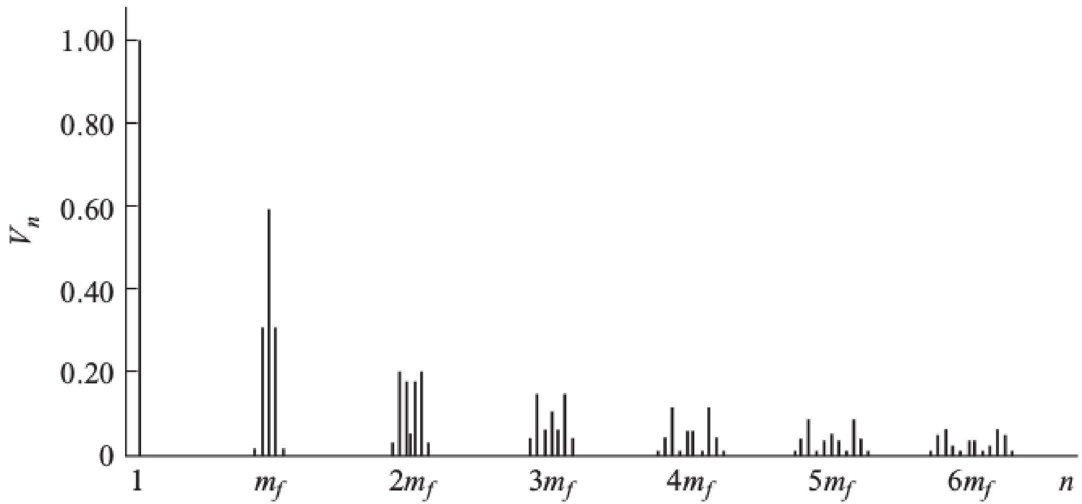

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Table 8-3 Normalized Fourier Coefficients V_n/V_{dc} for Bipolar PWM

	m_a=1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
$n=1$	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10
$n=m_f$	0.60	0.71	0.82	0.92	1.01	1.08	1.15	1.20	1.24	1.27
$n=mf\pm2$	0.32	0.27	0.22	0.17	0.13	0.09	0.06	0.03	0.02	0.00

Solution available in the textbook and also in the YouTube Channel

You can download this presentation from:
keysan.me/ee464