DC to DC Converter Tables

Diego Trapero

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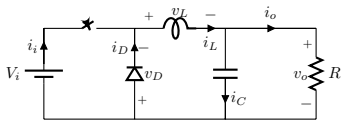
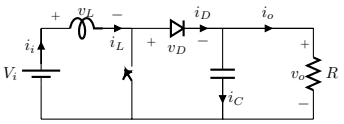
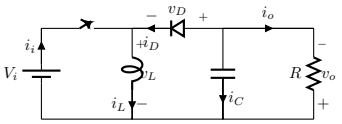
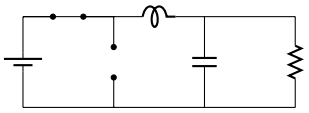
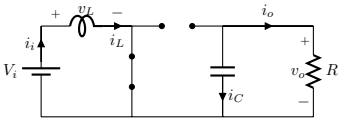
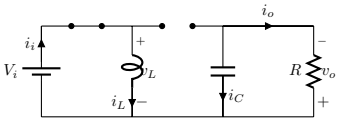
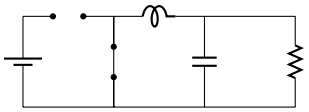
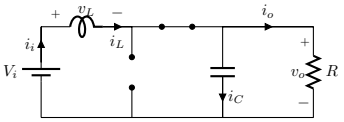
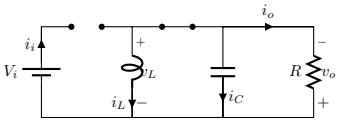
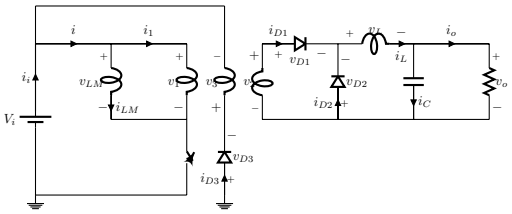
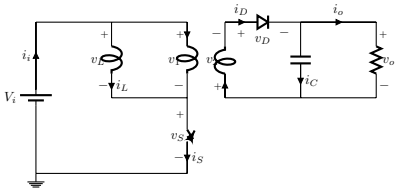
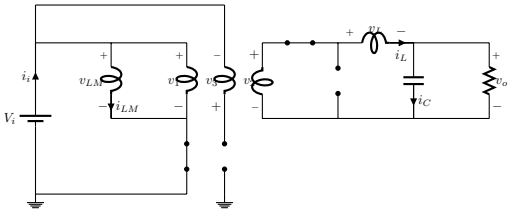
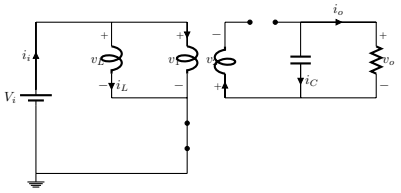
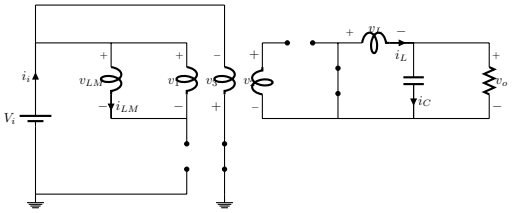
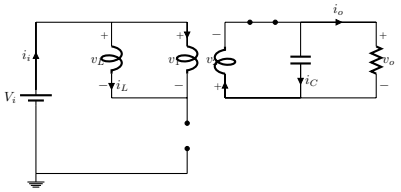
1 Non-Isolated DC to DC Converters

What	Buck	Boost	Buck-Boost
Circuit Diagram			
ON Circuit			
OFF Circuit			
V_o CCM	$V_o = DV_i$	$V_o = \frac{1}{1-D}V_i$	$V_o = \frac{D}{1-D}V_i$
D CCM	$D = \frac{V_o}{V_i}$	$D = 1 - \frac{V_i}{V_o}$	
V_o DCM		$V_o = V_i \frac{1+\sqrt{1+\frac{4D^2}{k}}}{2}$	$V_o = \frac{D}{\sqrt{k}}V_i$
D DCM	$D = \frac{V_o}{V_i}\sqrt{\frac{k}{1-\frac{V_o}{V_i}}}$		
v_L	**ON:** $v_L = V_i - V_o$ **OFF:** $v_L = -V_o$ **Waveform:**		

i_L	**Mean value:** $\bar{i_L} = \cancel{\bar{i_C}} + I_o$ $\bar{i_L} = \frac{V_o}{R}$ **Ripple:** $\Delta i_L = \frac{(V_i - V_o)DT}{L}$ $\Delta i_L = \frac{V_o(1-D)T}{L}$ **Waveform:**		
i_o	$I_o = \frac{V_o}{R} = \frac{P_o}{V_o} = \sqrt{\frac{P_o}{R}}$	$I_o = \frac{V_o}{R} = \frac{P_o}{V_o} = \sqrt{\frac{P_o}{R}}$	$I_o = \frac{V_o}{R} = \frac{P_o}{V_o} = \sqrt{\frac{P_o}{R}}$
v_S	**ON:** $v_S = 0$ **OFF:** $v_S = V_i - 0 = V_i$		
i_S	**ON:** $i_S = i_L$ **OFF:** $i_S = 0$		

v_D	**ON:** $v_D = 0 - V_i = -V_i$ **OFF:** $v_D = 0$		
i_D	**ON:** $i_D = 0$ **OFF:** $i_S = i_L$		
i_C	$i_C(t) = i_L(t) - I_o$ $I_1 = +\frac{1}{2}\Delta i_L$ $I_2 = -\frac{1}{2}\Delta i_L$ **Waveform:**		

2 Isolated DC to DC Converters

What	Forward	Flyback
Circuit Diagram		
ON Circuit		
OFF Circuit		
v_o CCM	$V_o = \frac{N_2}{N_1} D V_i$	$V_o = \frac{N_2}{N_1} \frac{D}{1-D} V_i$
D CCM	$D = \frac{V_o}{V_i} \frac{N_1}{N_2}$	
v_L	**ON:** $v_L = v_2 - V_o$ $v_L = \frac{N_2}{N_1} v_1 - V_o$ $v_L = \frac{N_2}{N_1} V_i - V_o$ **OFF:** $v_L = -V_o$ **Waveform:**	**ON:** $v_L = V_i$ **OFF:** $v_L = v_1$ $v_L = \frac{N_1}{N_2} v_2$ $v_L = -\frac{N_1}{N_2} V_o$ **Waveform:**

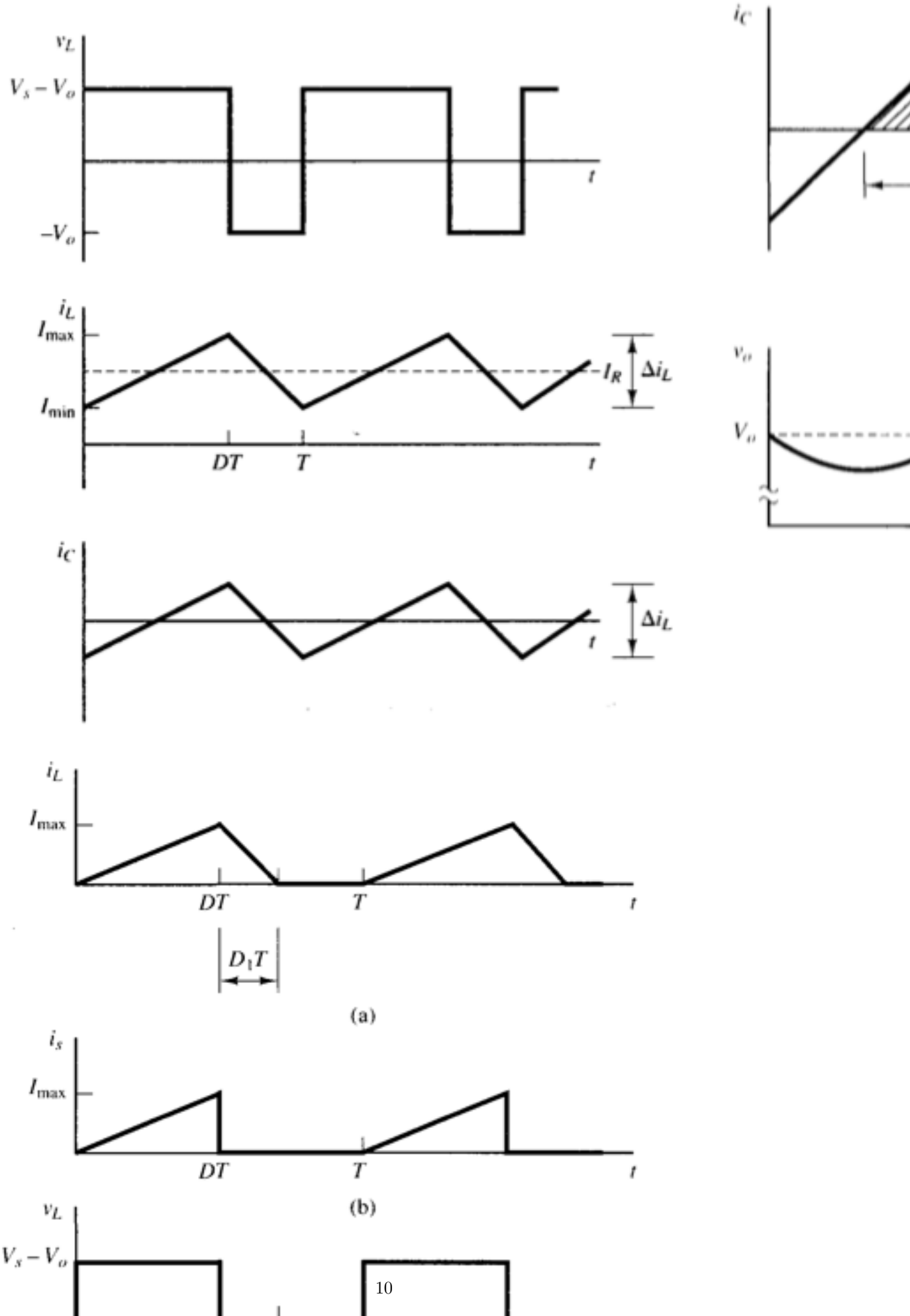
i_L		
v_{LM}		No
v_3	**ON:** $$v_3 = \frac{N_3}{N_1} v_1$$ $$v_3 = \frac{N_3}{N_1} V_i$$ **OFF:** $$v_3 = -V_i$$ **Waveform:**	No
v_S		

v_D		
i_S		
i_D		

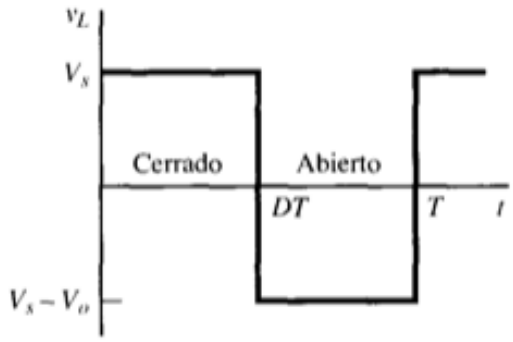
3 Waveforms

From *Electrónica de Potencia*, Daniel W. Hart.

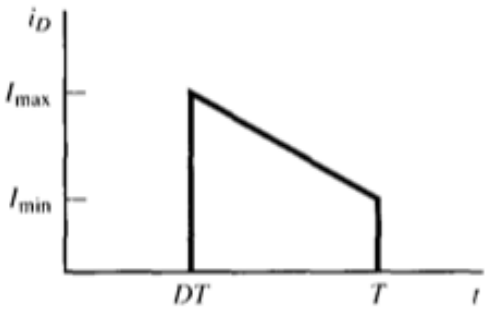
3.1 Buck


v_L
$V_s - V_o$
$-V_o$
t
i_L
I_{max}
I_{min}
I_R
Δi_L
DT
T
t
i_C
Δi_L
t
i_L
I_{max}
DT
T
t
D_1T
(a)
i_s
I_{max}
DT
T
t
(b)
v_L
$V_s - V_o$
i_C
v_o
V_o

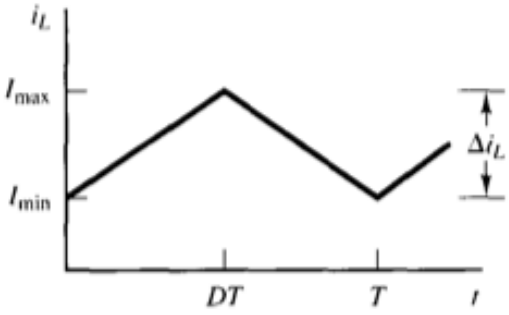
3.2 Boost



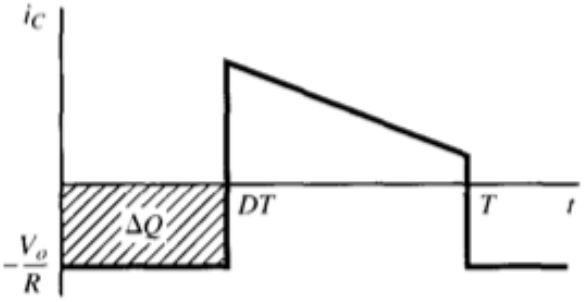
(a)



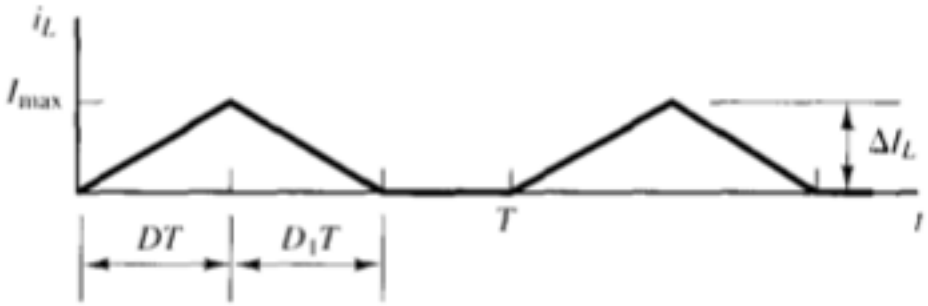
(c)



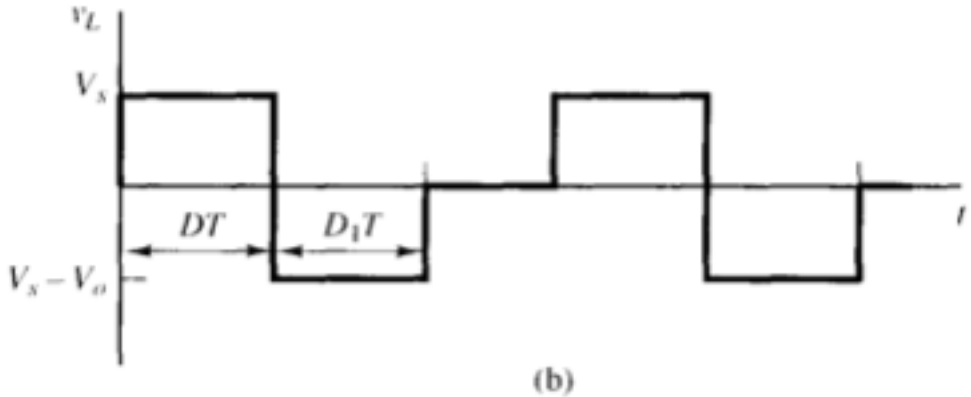
(b)



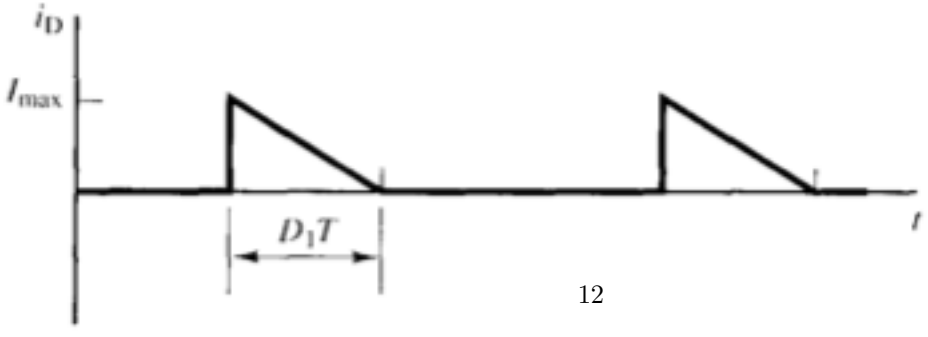
(d)



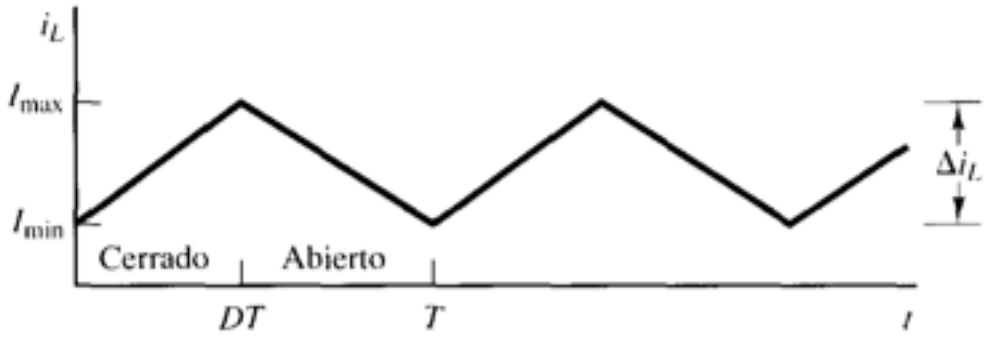
(a)



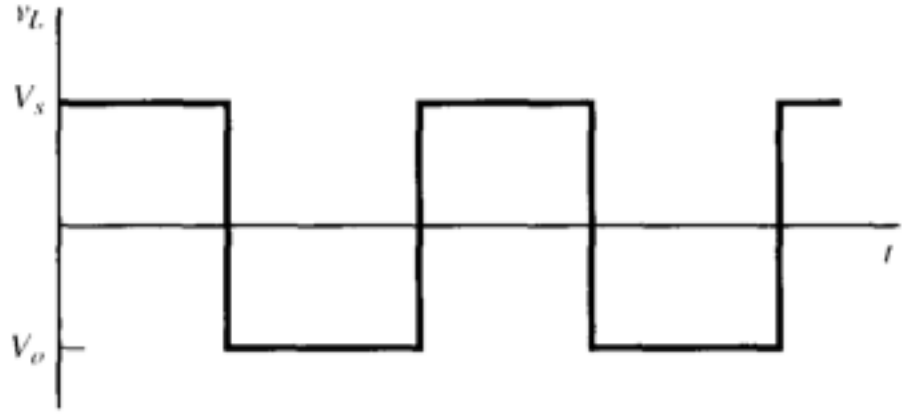
(b)



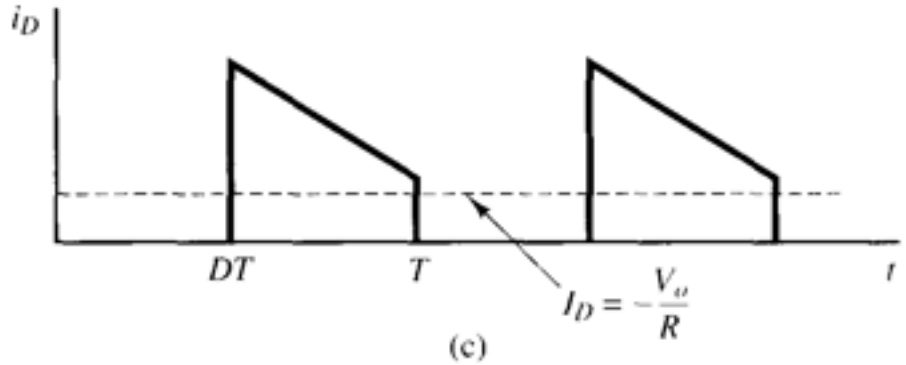
3.3 Buck-Boost


i_L
I_{max}
I_{min}
Δi_L
Cerrado
Abierto
DT
T
t

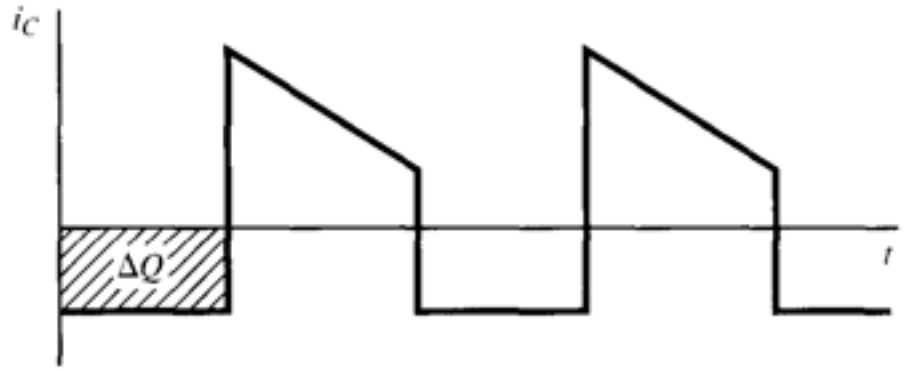
(a)


v_L
V_s
V_o
t

(b)

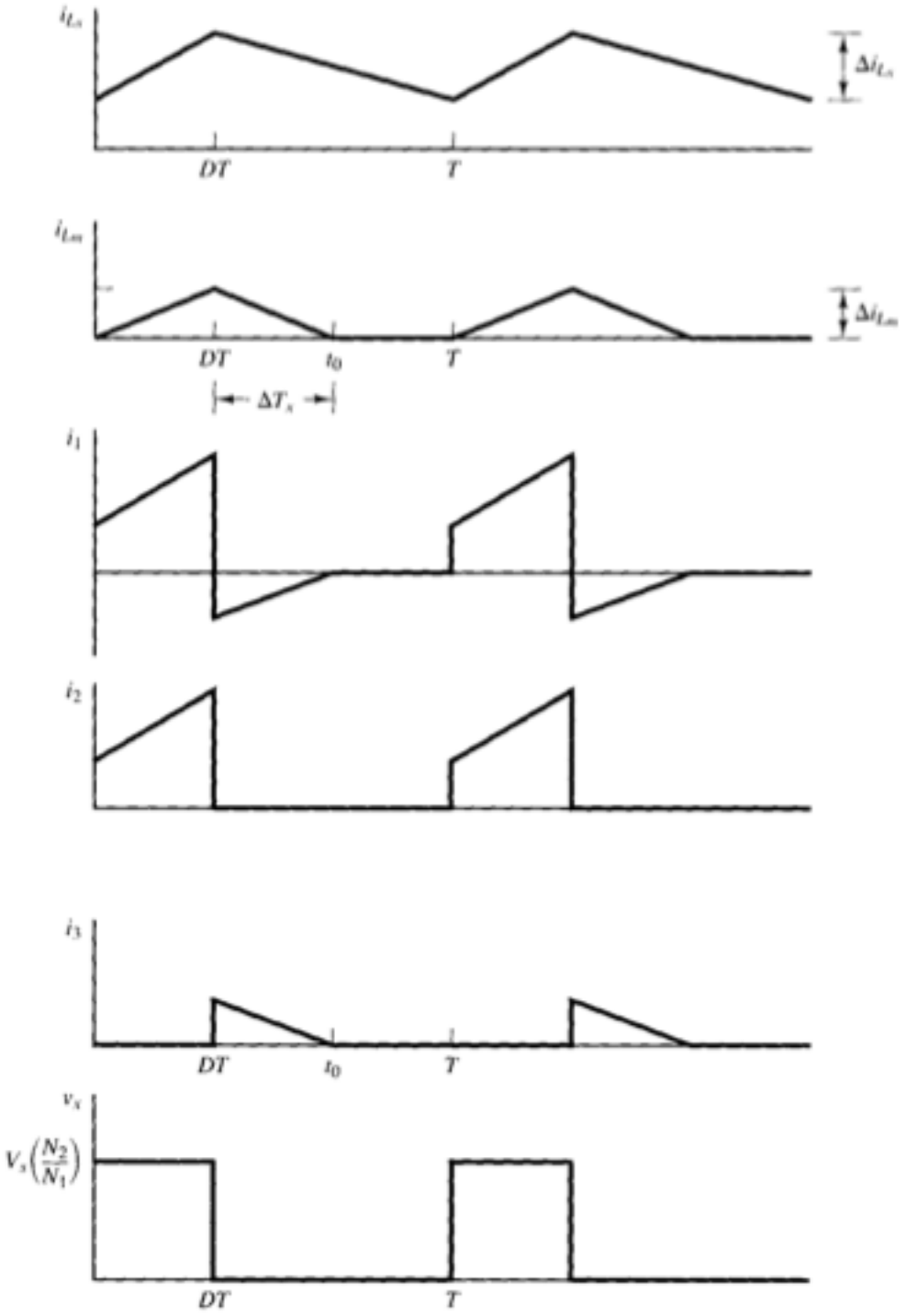

i_D
DT
T
t
$I_D = -\frac{V_o}{R}$

(c)

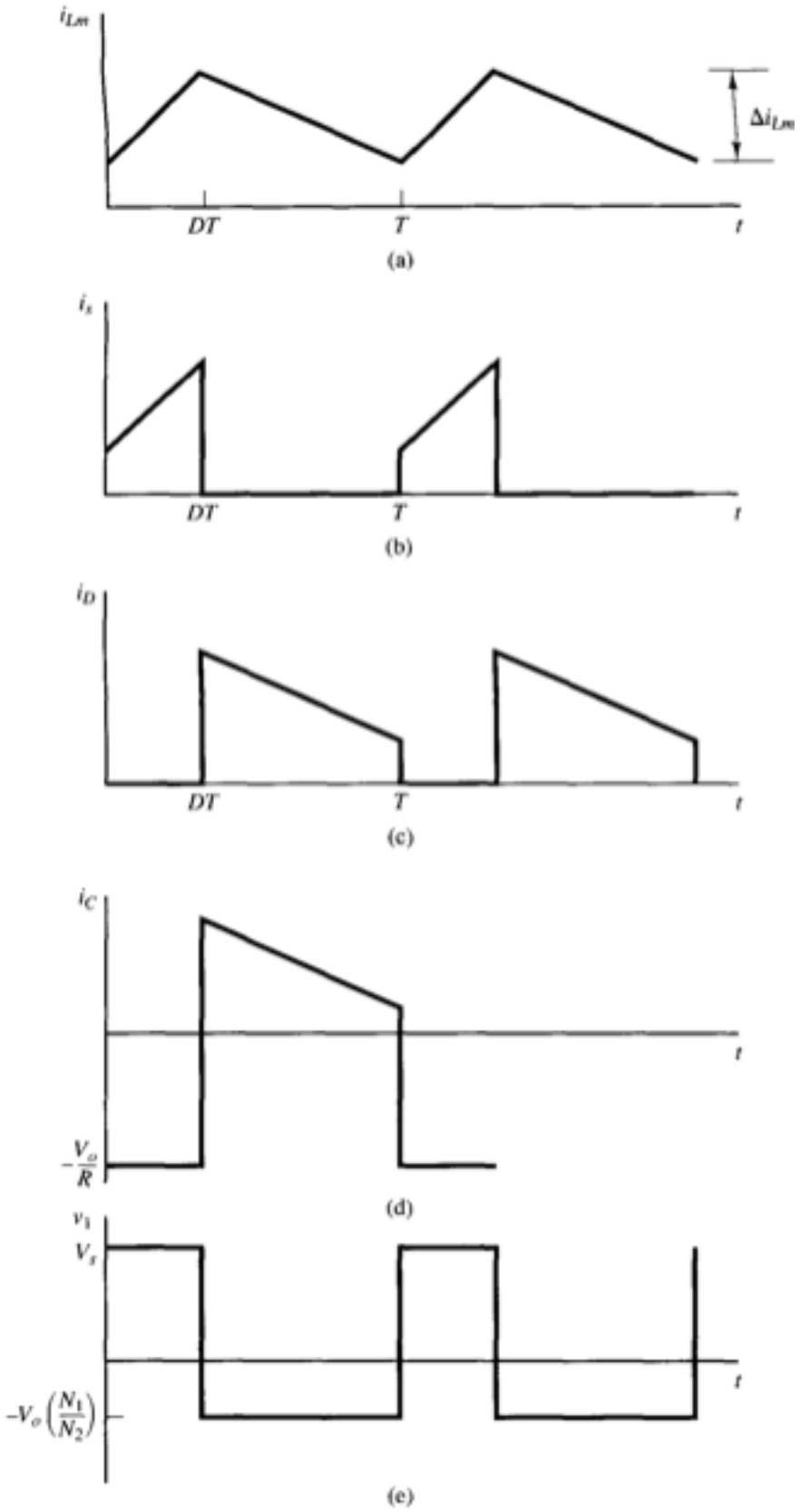

i_C
ΔQ
t

(d)

3.4 Forward


i_{L_s}
Δi_{L_s}
DT
T
i_{L_m}
Δi_{L_m}
DT
t_0
T
ΔT_s
i_1
i_2
i_3
DT
t_0
T
v_s
$V_s\left(\frac{N_2}{N_1}\right)$
DT
T

3.5 Flyback


i_{Lm}
Δi_{Lm}
DT
T
t
(a)
i_s
DT
T
t
(b)
i_D
DT
T
t
(c)
i_C
t
$-\frac{V_o}{R}$
(d)
v_1
V_s
t
$-V_o\left(\frac{N_1}{N_2}\right)$
(e)