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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EET501 / POWER ELECTRONICS AND DRIVES

V SEM EEE

UNIT 2 –DC CONVERTERS

2 . STEP UP – DC DC CONVERTER

Dr. C. UDHAYA SHANKAR

ASP/EEE, SNSCE

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2. Step-Up DC Converter

DC Fixed Voltage  **DC Output Voltage (Step up)**

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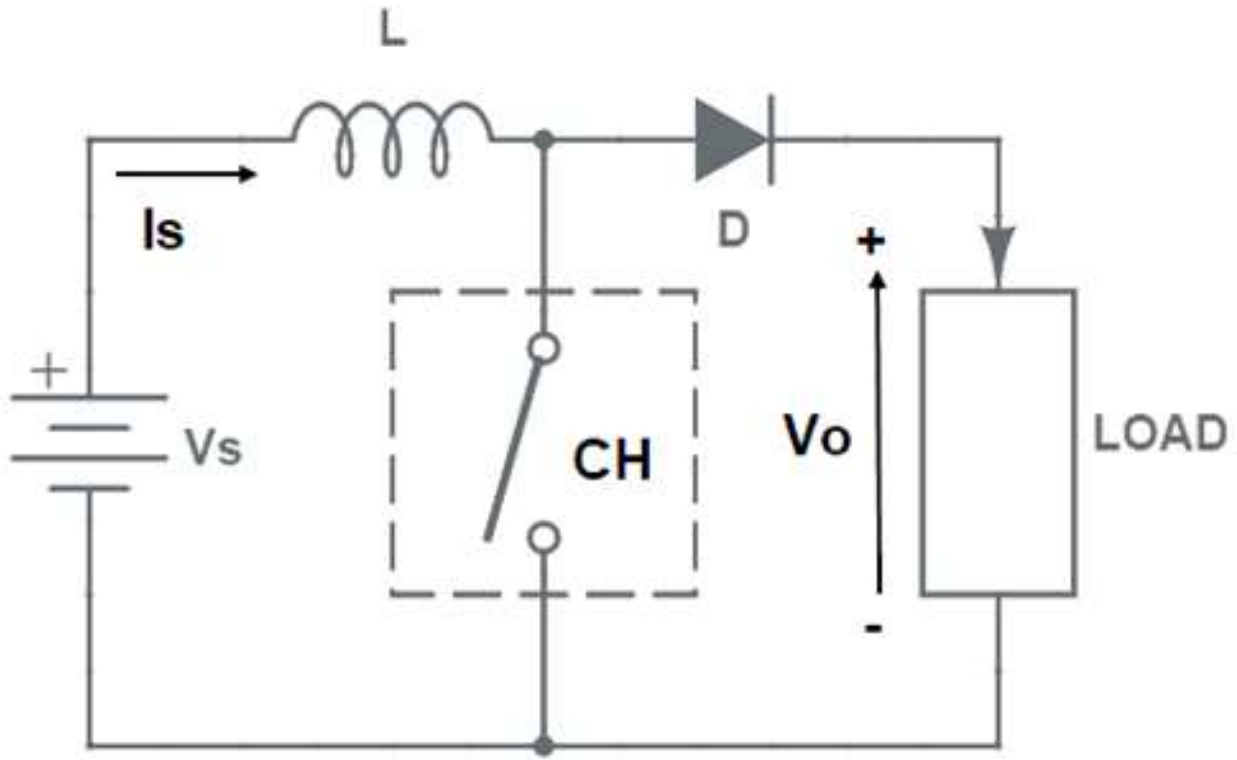
Step Up Chopper or Boost converter which increases the input DC voltage to a specified DC output voltage. A typical Boost converter is shown below.



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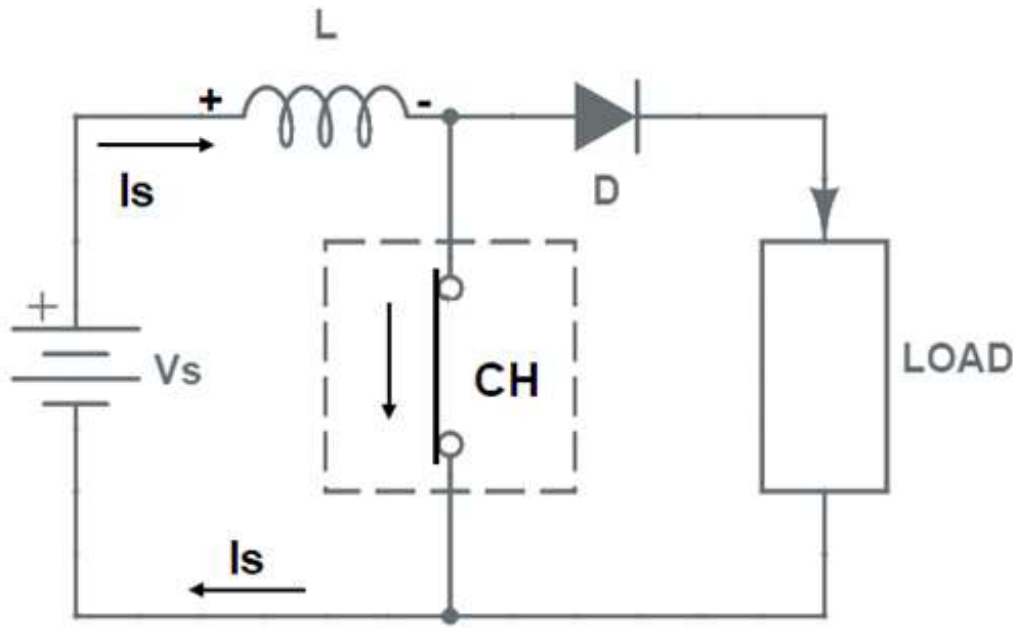
Switch ON Period (mode I): When chopper (CH) is switched ON, the current will flow through the closed path formed by supply source Vs, inductor L and chopper CH.



Also, during the TON period, energy is stored in the inductor L. This energy storage in L is essential to boost the load output voltage above the source voltage. Therefore, a large value of L is essential in a step-up chopper.

During this period, no current will flow through the load. Only source current ‘is’ will flow and the value of load current ‘io’ will be ZERO during the ON period.

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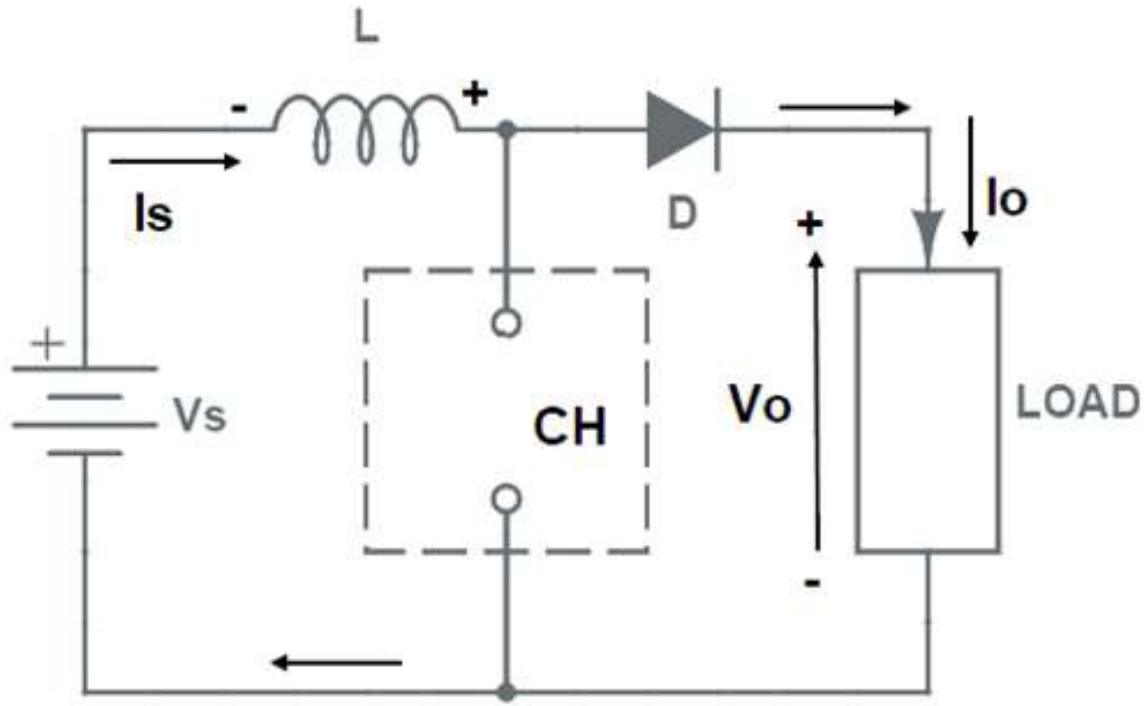
Switch OFF period (mode II): When the chopper CH is switched OFF, the current through the L can not die instantaneously rather it decays exponentially. Due to this behavior of L, it will force the current through the diode D and load for the entire time period TOFF. This is shown in figure below.



$$Vo = Vs + L(di/dt)$$

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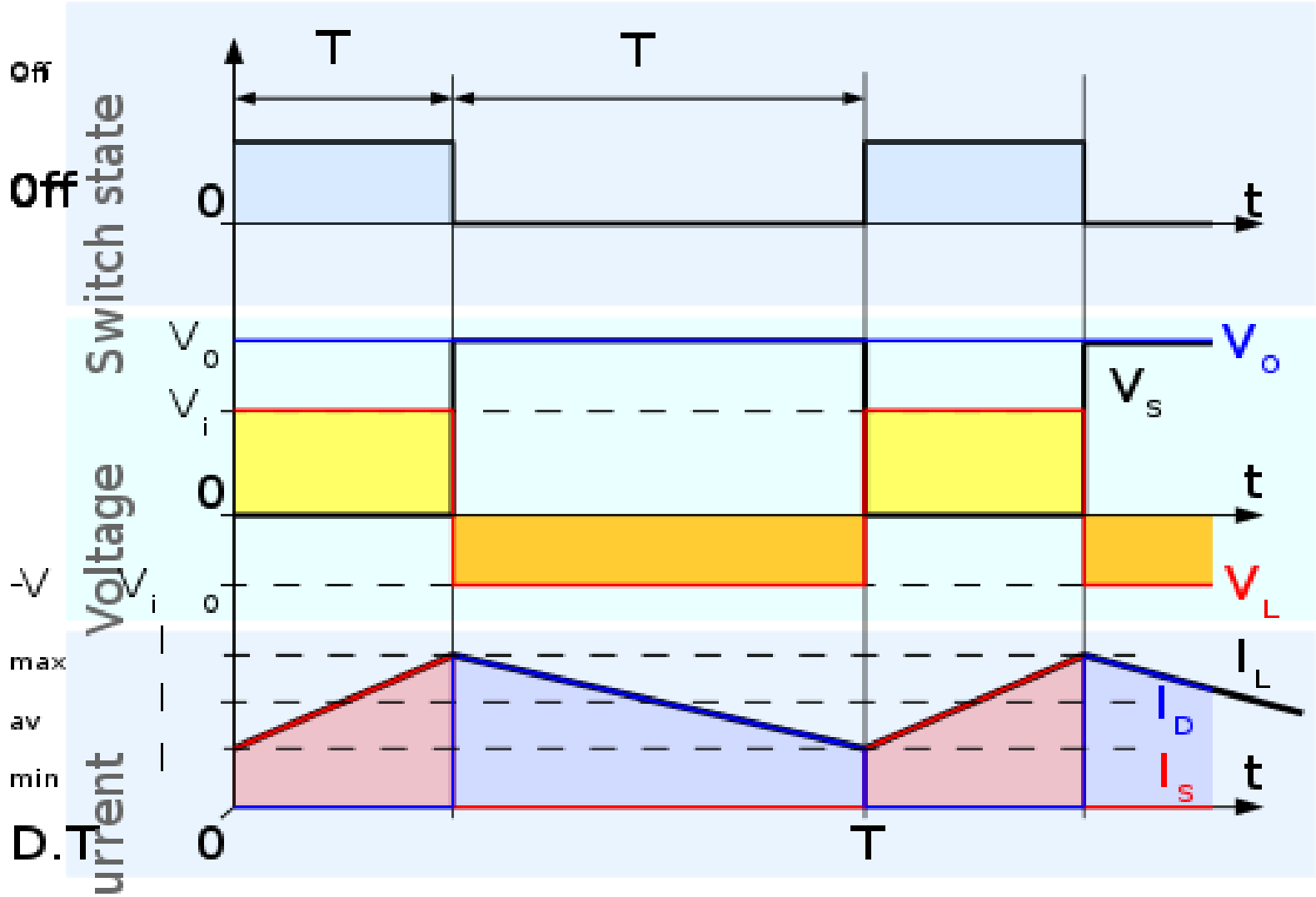
Output Waveform



Analysis of Step Up Converter

Let us now analyse the **Boost converter** in steady state operation for Mode II using KVL.

$$\therefore V_{in} = V_L + V_o$$

$$\therefore V_L = L\frac{di_L}{dt} = V_{in} - V_o$$

$$\frac{di_L}{dt} = \frac{\Delta i_L}{\Delta t} = \frac{\Delta i_L}{(1-D)T} = \frac{V_{in} - V_o}{L}$$

Since the switch is open for a time

$T_{OFF} = T - T_{ON} = T - DT = (1-D)T$

we can say that

$\Delta t = (1-D)T$

.

$$(\Delta i_L)_{open} = \left(\frac{V_{in} - V_o}{L}\right)(1-D)T$$

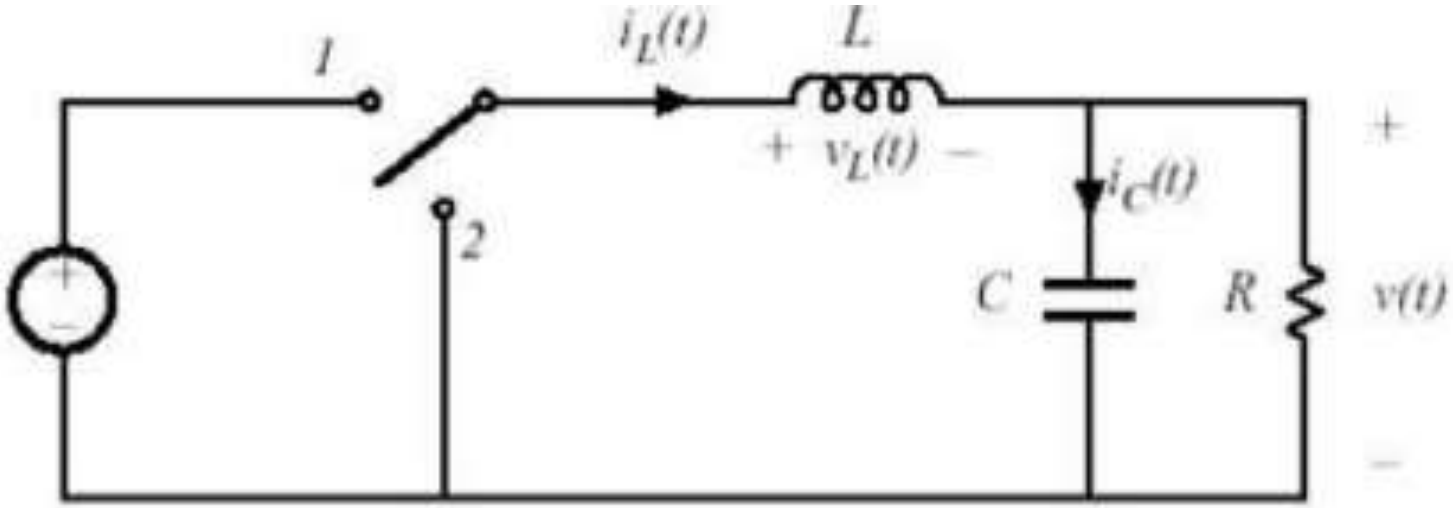
It is already established that the net change of the inductor current over any one complete cycle is zero.

$$\therefore (\Delta i_L)_{closed} + (\Delta i_L)_{open} = 0$$

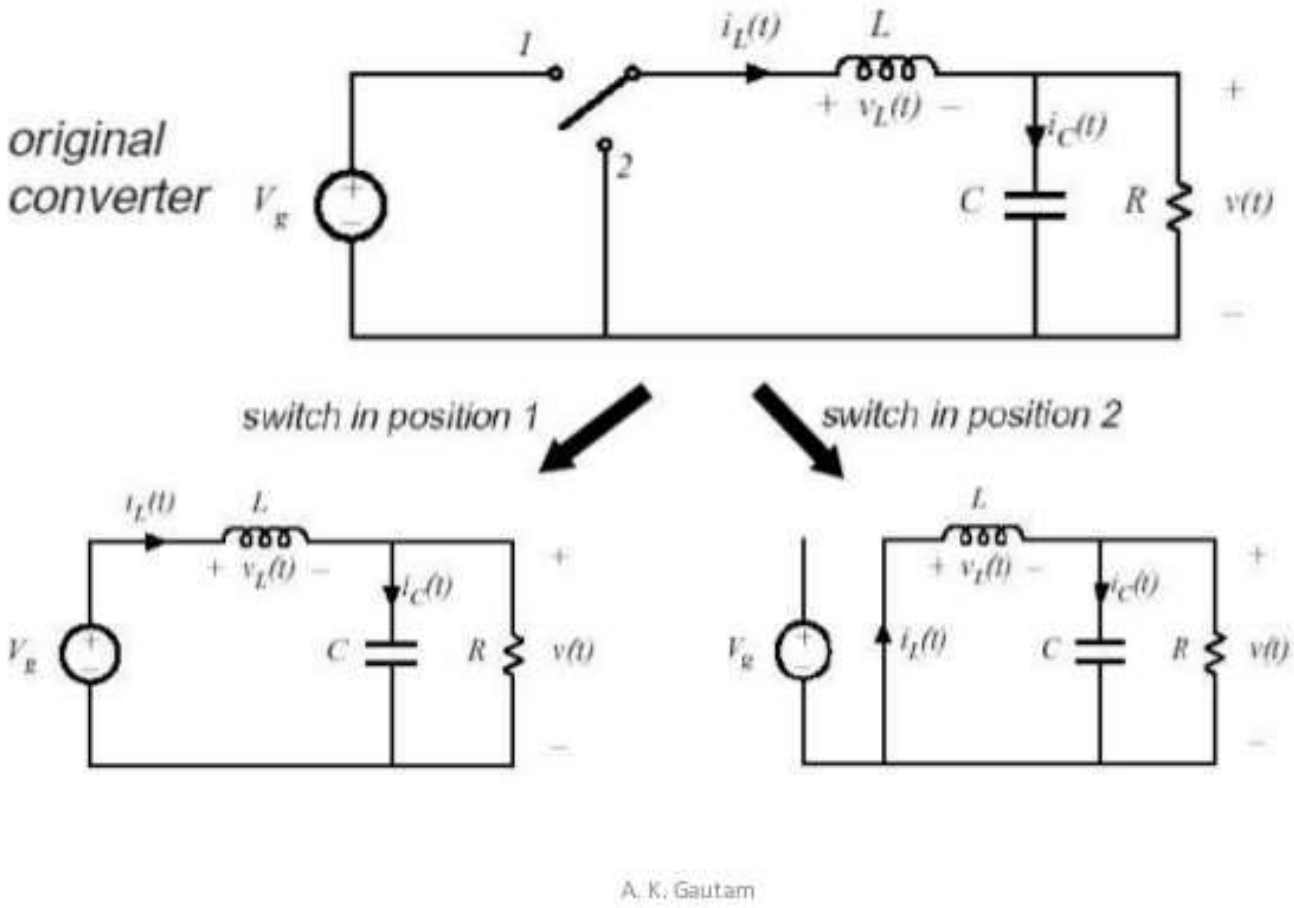
$$\left(\frac{V_{in} - V_o}{L}\right)(1-D)T + \left(\frac{-V_o}{L}\right)DT = 0$$

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

Assessment - Draw the equivalent circuit for the Following.



Buck converter (Step-down converter)



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