DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EE502 / POWER ELECTRONICS AND DRIVES

V SEM EEE

UNIT 2 –DC CONVERTERS

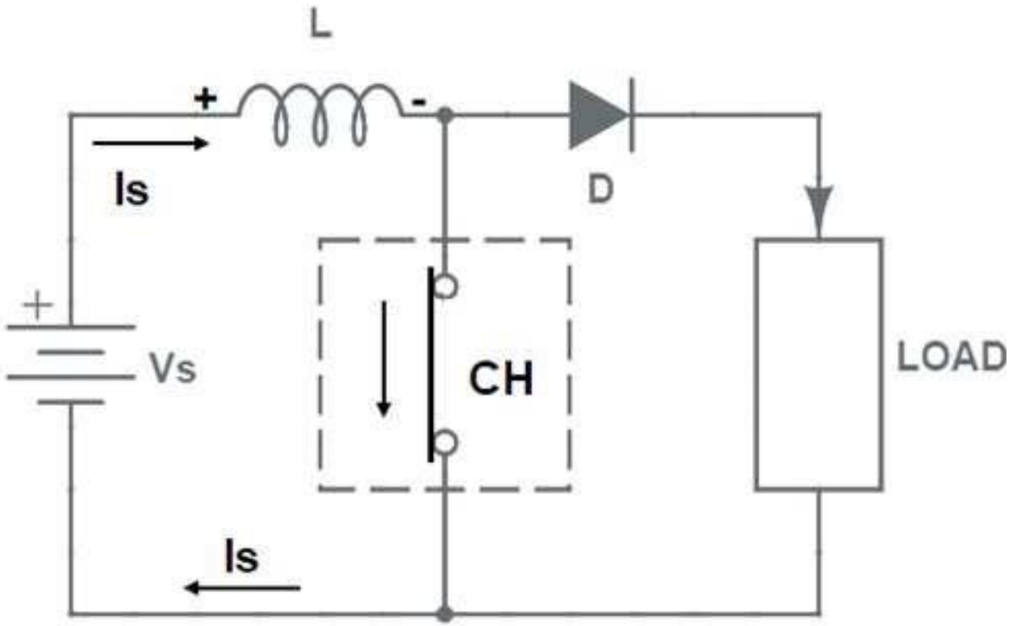
2 . STEP UP – DC DC CONVERTER

2. Step-Up DC Converter

DC Fixed Voltage → DC Output Voltage (Step up)

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.

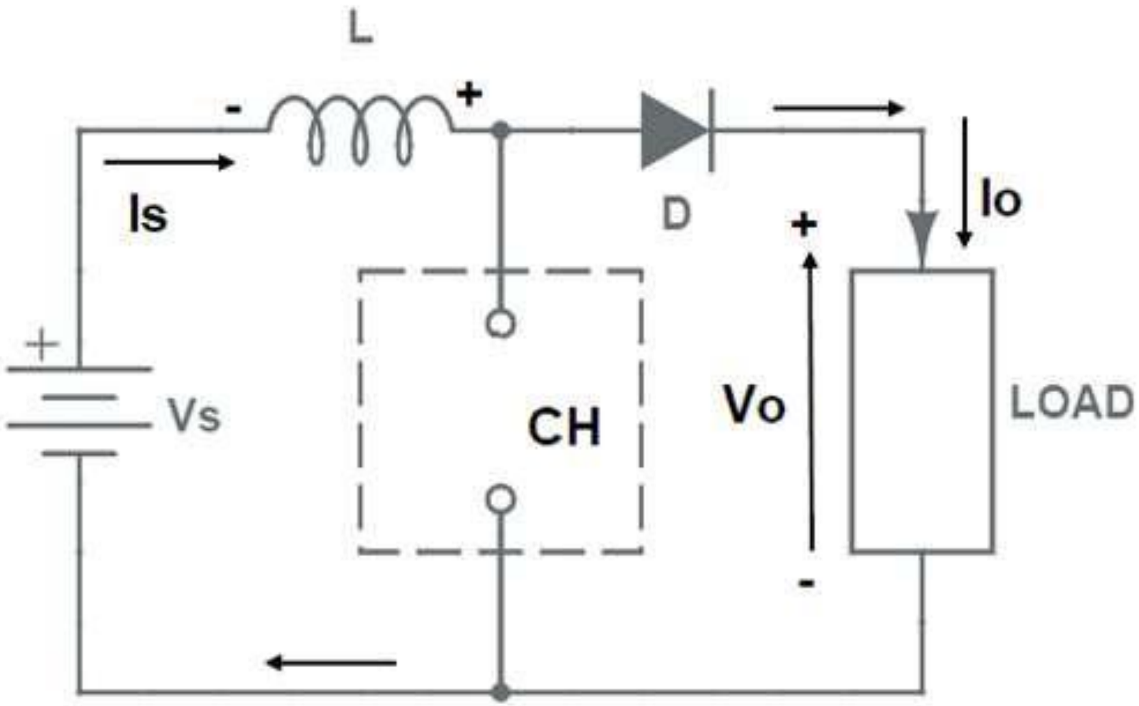
Switch ON Period (mode I): When chopper (CH) is switched ON, the current will flow through the closed path formed by supply source Vs, inductor L and chopper CH.



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.

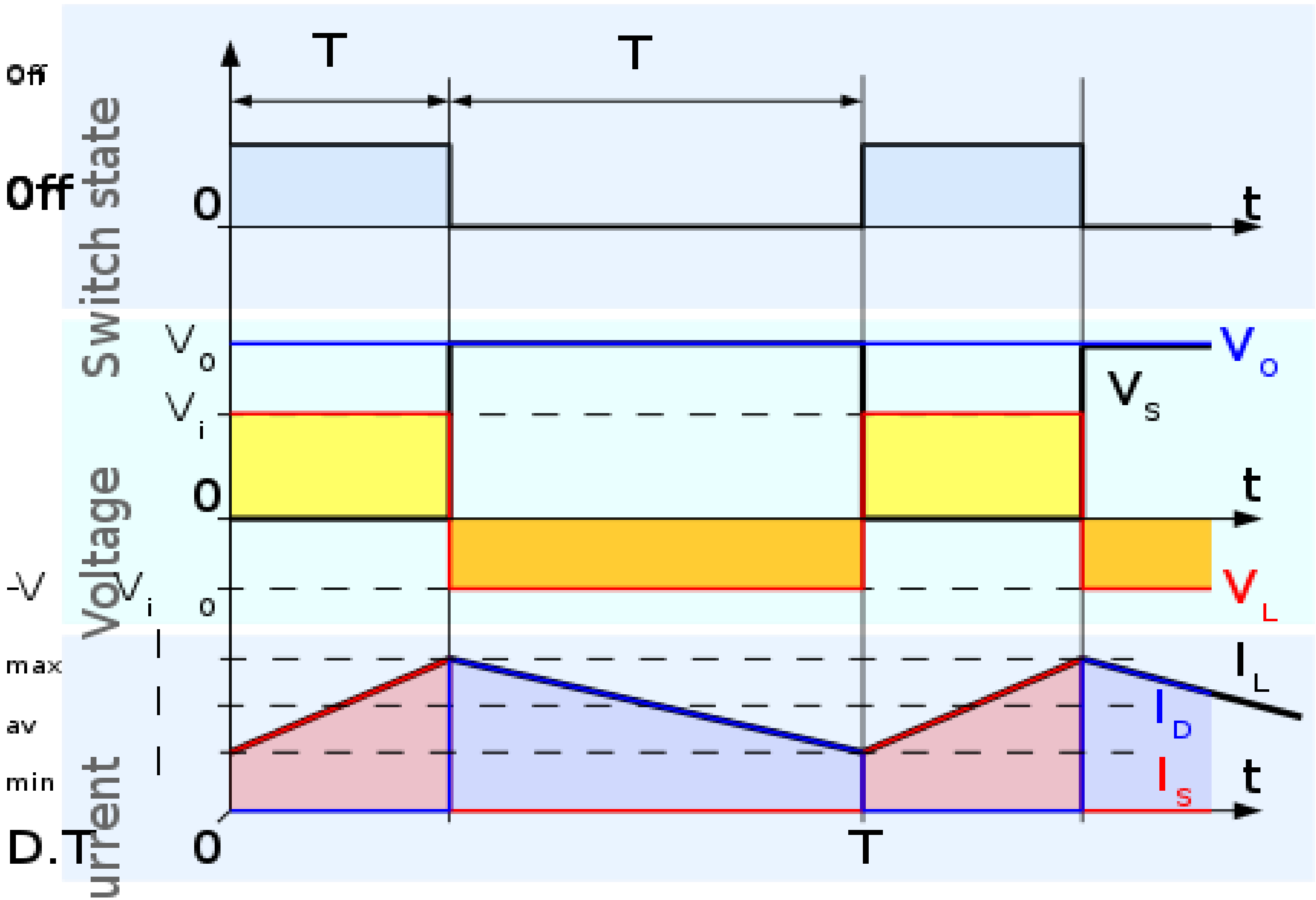
During this period, no current will flow through the load. Only source current 'is' will flow and the value of load current 'io' will be ZERO during the ON period.

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.



$$V_o = V_s + L(di/dt)$$

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

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

.

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

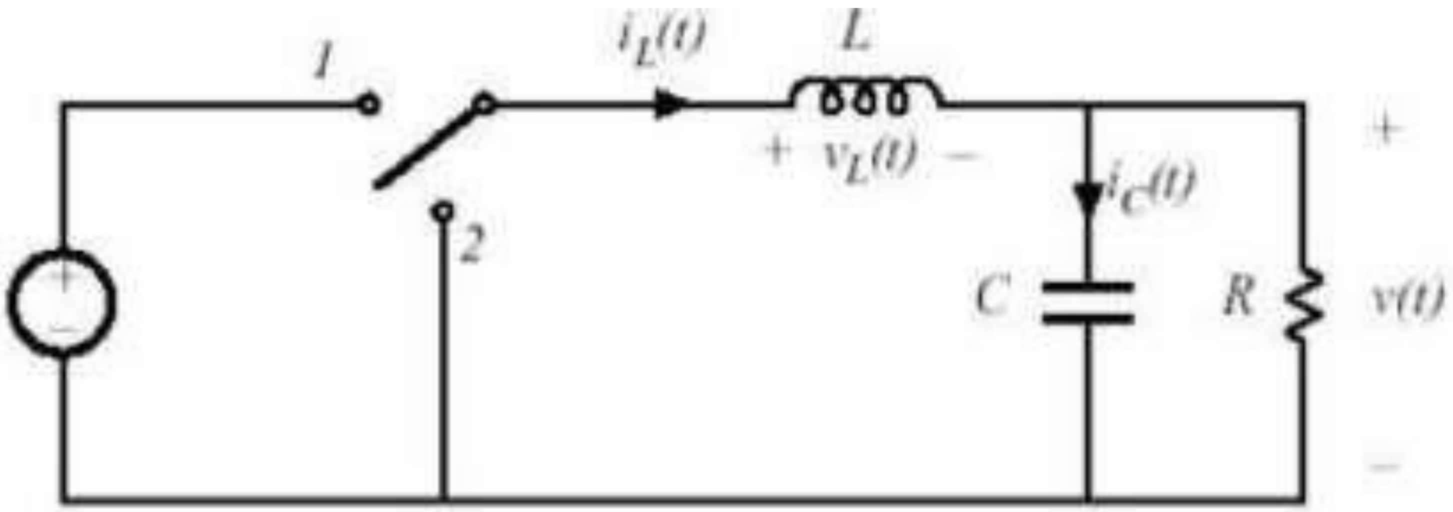
It is already established that the net change of the inductor current over any one complete cycle is zero.

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

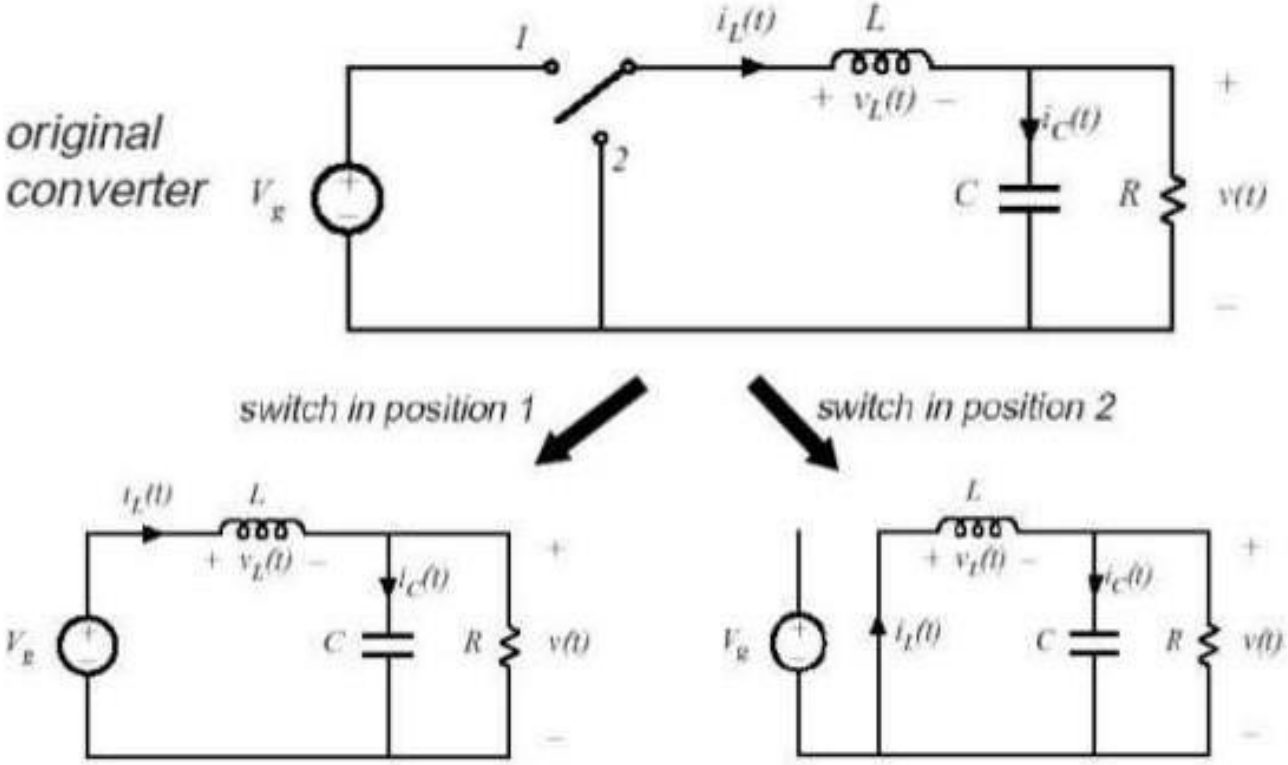
$$\left(\frac{V_{in} - V_o}{L}\right)(1-D)T + \left(\frac{-V_o}{L}\right)DT = 0$$

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

Assessment - Draw the equivalent circuit for the Following.



Buck converter (Step-down converter)



A. K. Gautam

References

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