SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF MECHATRONICS

19MCB302 – INDUSTRIAL ELECTRONCIS & APPLICATION

III YEAR V SEM

UNIT 3 – DC TO DC CONVERTER

TOPIC – Step Up Chopper

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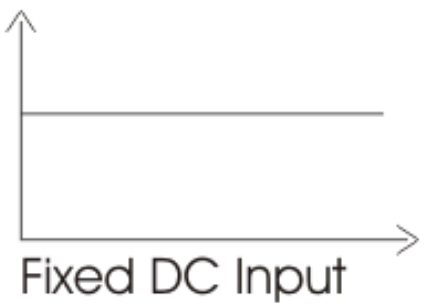
APPLICATION

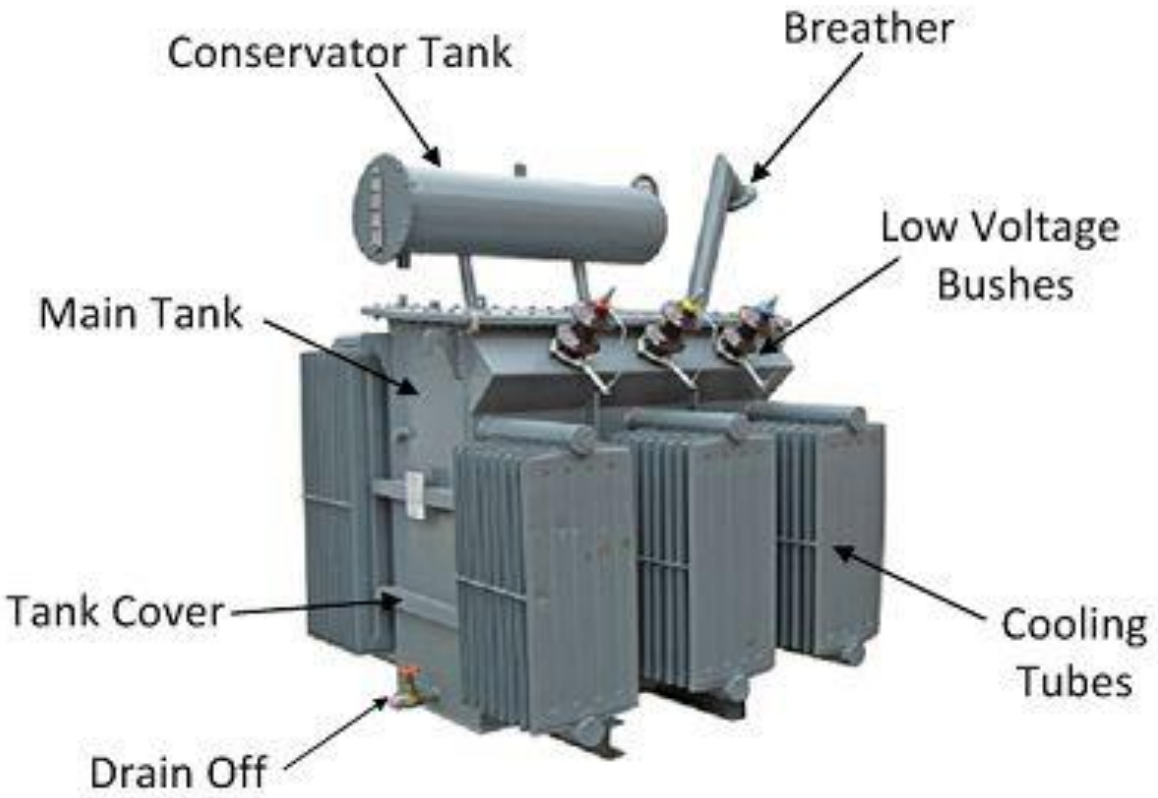
Intro-Chopper

The DC **Choppers** convert the input DC voltage into fixed or variable DC output. Hence DC **chopper** is also called as dc to dc converter.



Chopper

Chopper can increase or decrease the DC voltage level at its opposite side. So, chopper serves the same purpose in DC circuit transfers in case of ac circuit. So it is also known as DC transformer.



Application –

Chopper

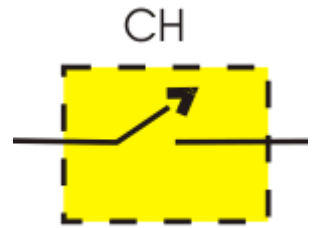
Devices used in Chopper

Low power application: GTO, IGBT, Power BJT, Power MOSFET etc.

High power application: Thyristor or SCR.

These devices are represented as a switch in a dotted box for simplicity. When it is closed current can flow in the direction of arrow only.

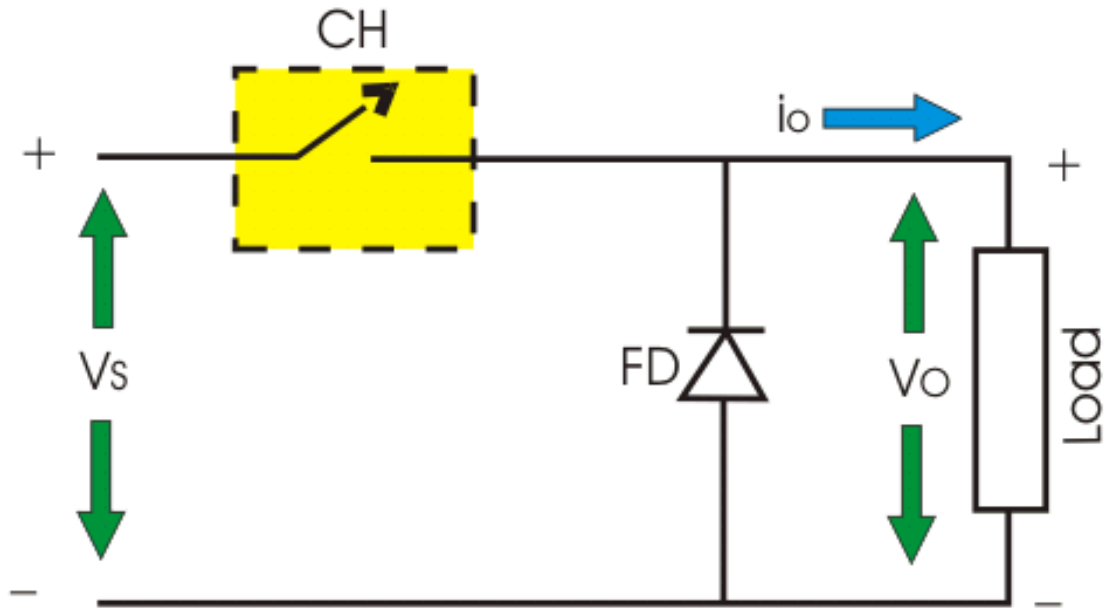
chopper switch



Chopper

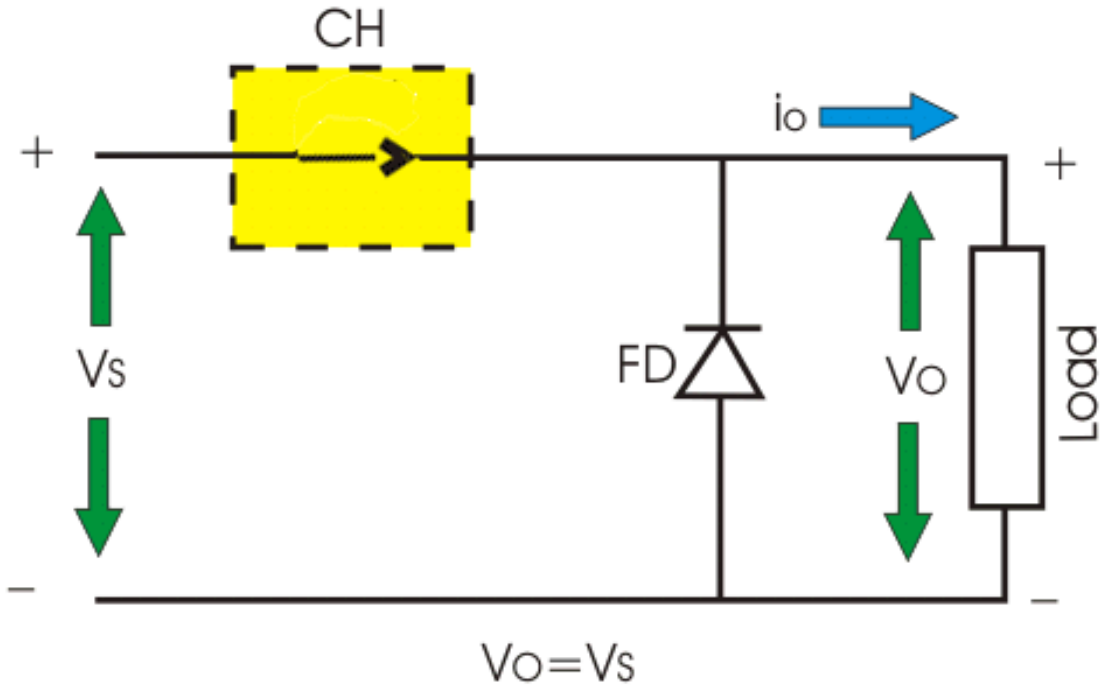
1) Step down Chopper :

Step down chopper as Buck converted is used to reduce the i/p voltage level at the output side



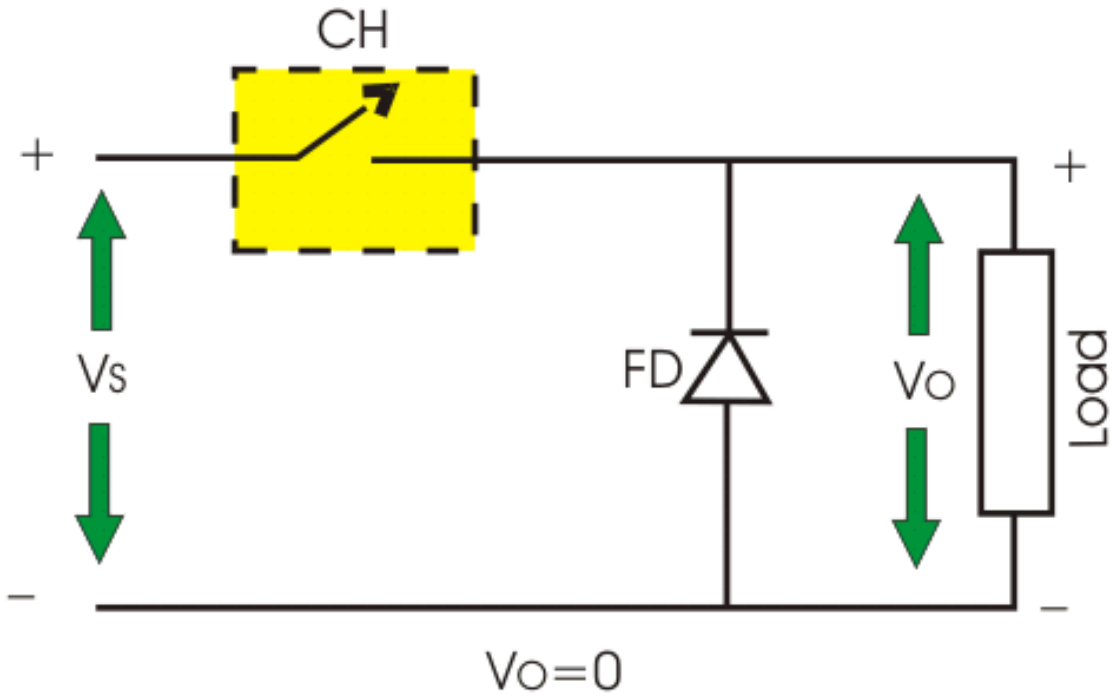
Chopper

When CH is turned ON, Vs directly appears across the load as shown in figure. So Vo = VS.



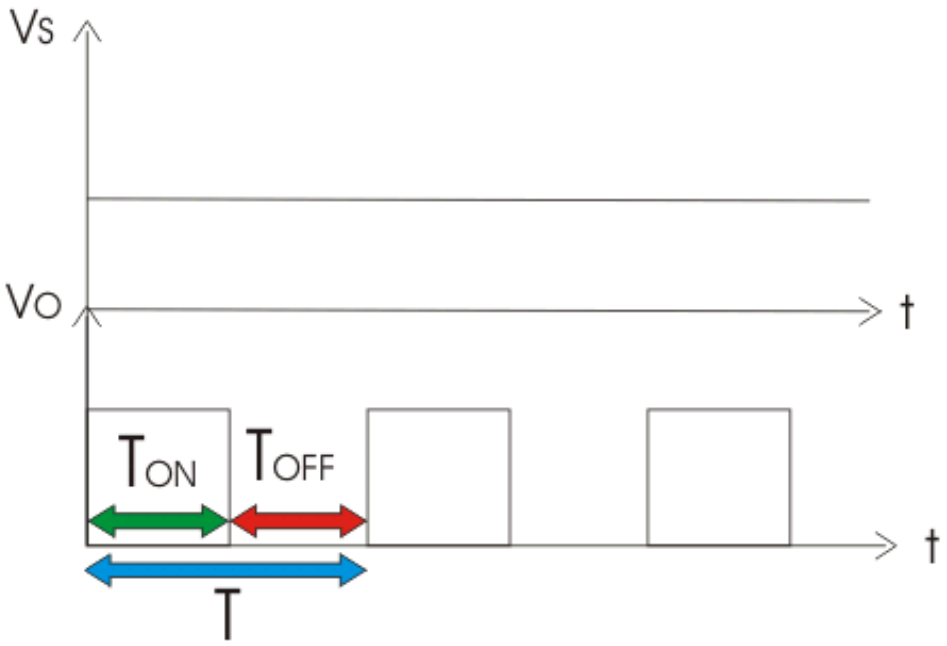
Chopper

When CH is turned off, Vs is disconnected from the load. So output voltage Vo = 0.



Chopper

The voltage waveform of step down chopper is shown below:



TON → It is the interval in which chopper is in ON state.

TOFF → It is the interval in which chopper is in OFF state.

VS → Source or input voltage.

Vo → Output or load voltage.

T → Chopping period = TON + TOFF

Chopper

During ON time of Chopper

$$V_s = V_L + V_o \Rightarrow V_L = V_s - V_o \Rightarrow L\frac{di}{dt} = V_s - V_o \Rightarrow L\frac{\Delta I}{T_{ON}} = V_s - V_o$$

Therefore, peak to peak load current,

$$\Delta I = \frac{V_s - V_o}{L} T_{ON} \cdots\cdots\cdots (i)$$

Chopper

During OFF Time of Chopper

If inductance value of L is very large, so load current will be continuous in nature. When CH is OFF inductor reverses its polarity and discharges. This current freewheels through diode FD.

$$Therefore,\ L\frac{di}{dt} = V_o$$

$$L\frac{\Delta I}{T_{OFF}} = V_o \Rightarrow \Delta I = V_o\frac{T_{OFF}}{L} \cdots\cdots\cdots (ii)$$

By equating (i) and (ii)

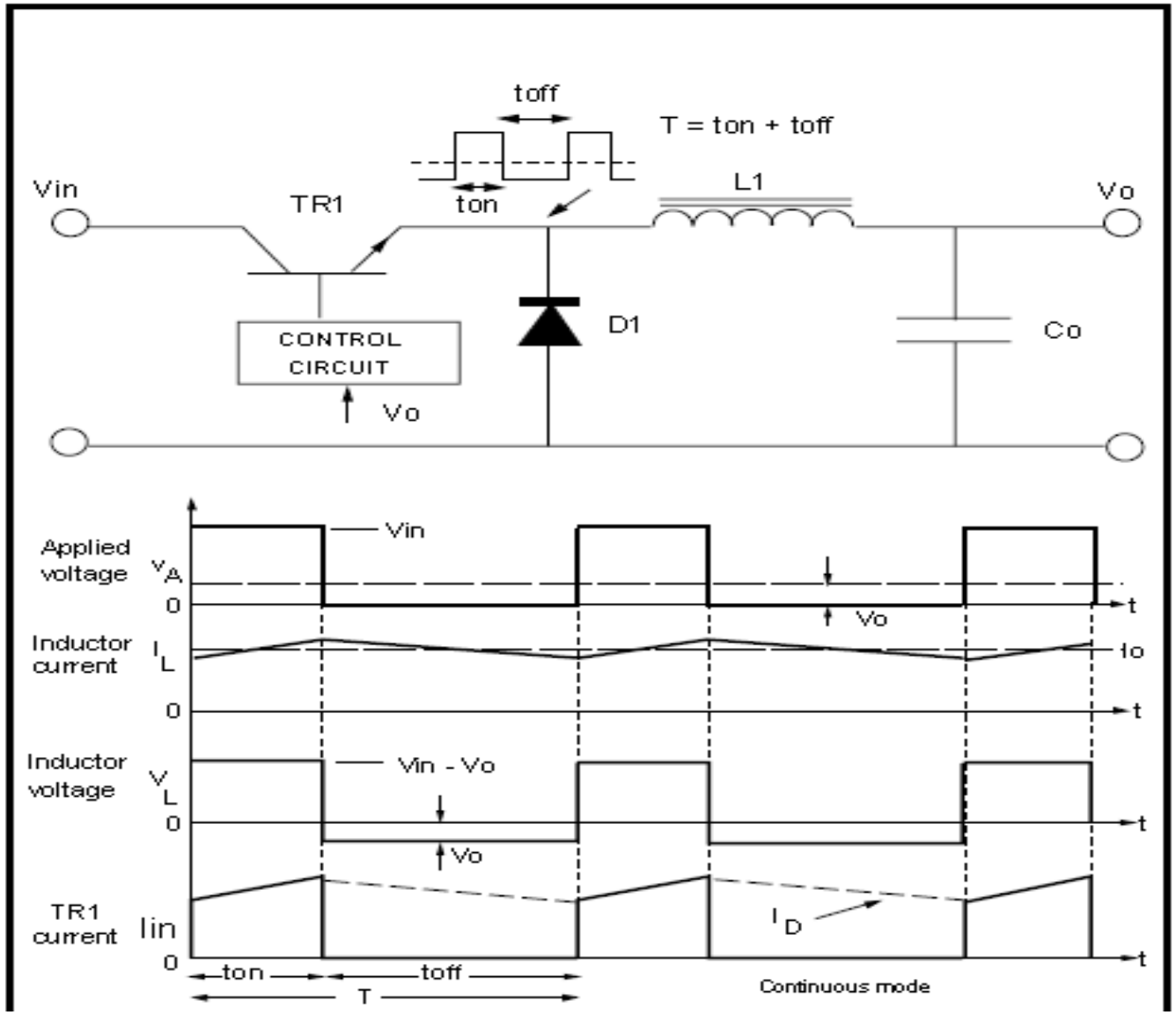
$$\frac{V_s - V_o}{L}T_{ON} = \frac{V_o}{L}T_{OFF}$$

$$\frac{V_s - V_o}{V_o} = \frac{T_{OFF}}{T_{ON}}$$

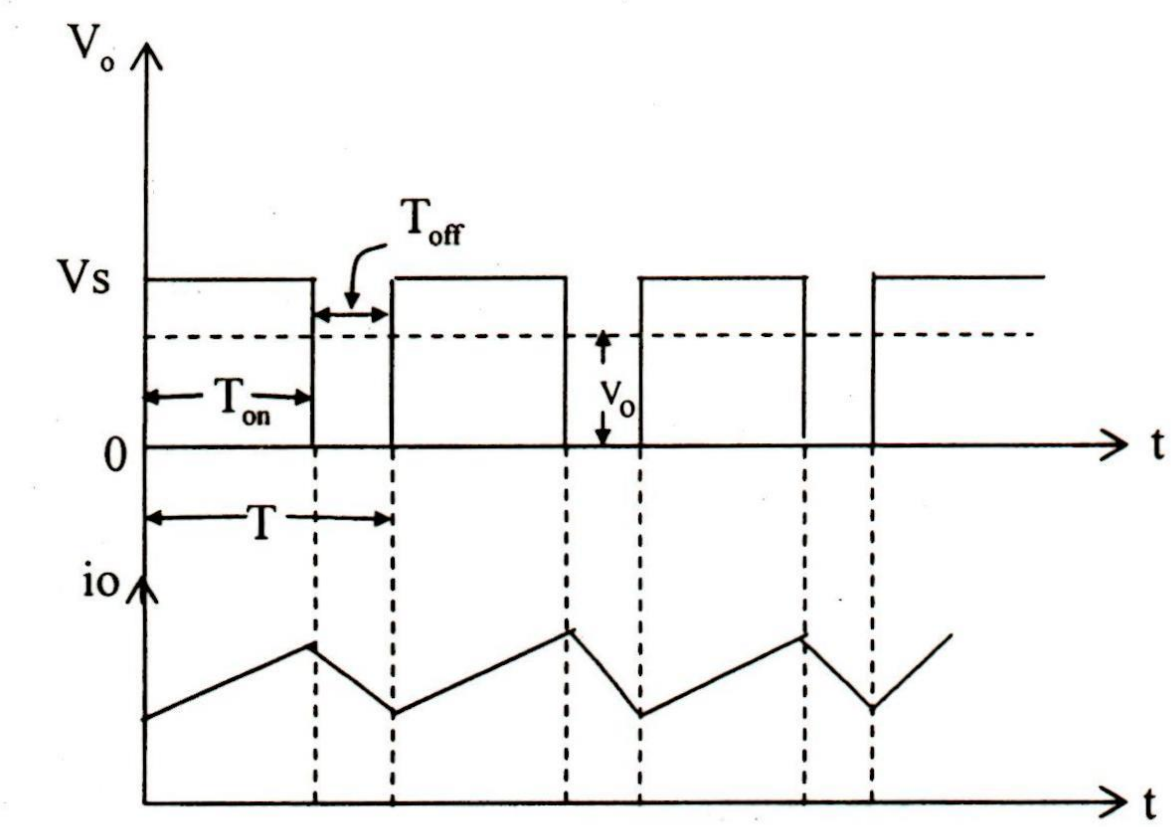
$$\frac{V_s}{V_o} = \frac{T_{ON} - T_{OFF}}{T_{ON}}$$

$$Therefore,\ V_o = \frac{T_{ON}}{T}V_s = DV_s$$

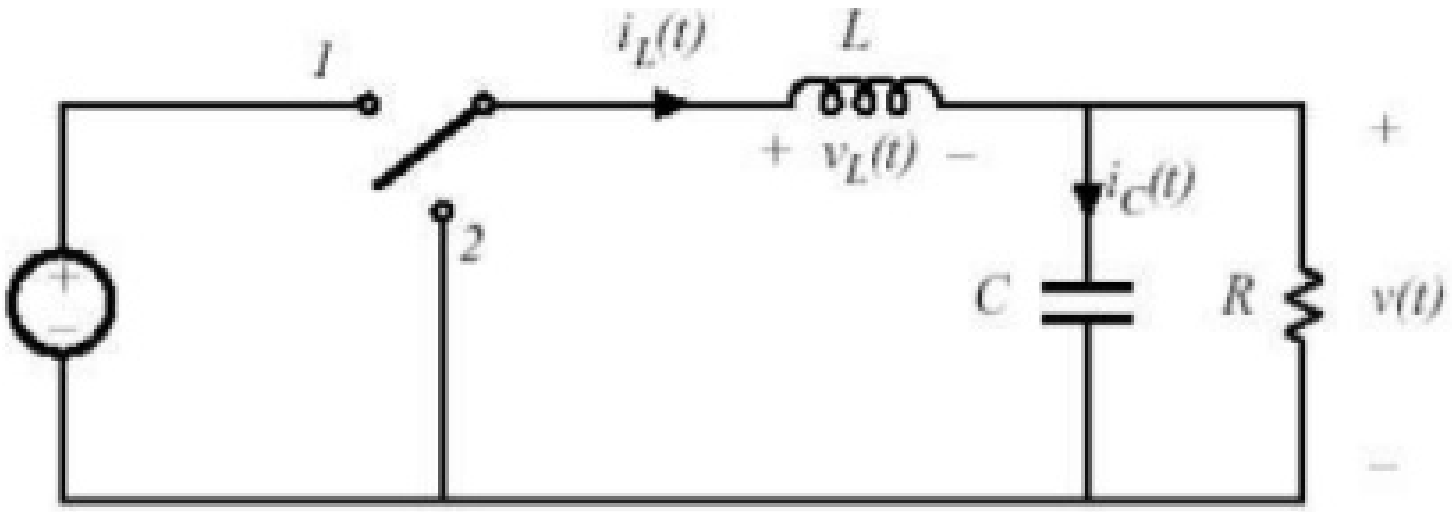
DC Fixed Voltage → **DC Output Voltage (Step up)**


toff
T = ton + toff
Vin
TR1
ton
L1
Vo
D1
Co
CONTROL
CIRCUIT
Vo
Applied
voltage
V_A
Vin
0
t
Vo
Inductor
current
I_L
Io
0
t
Inductor
voltage
V_L
Vin - Vo
0
t
Vo
TR1
current
Iin
I_D
0
t
ton
toff
T
Continuous mode

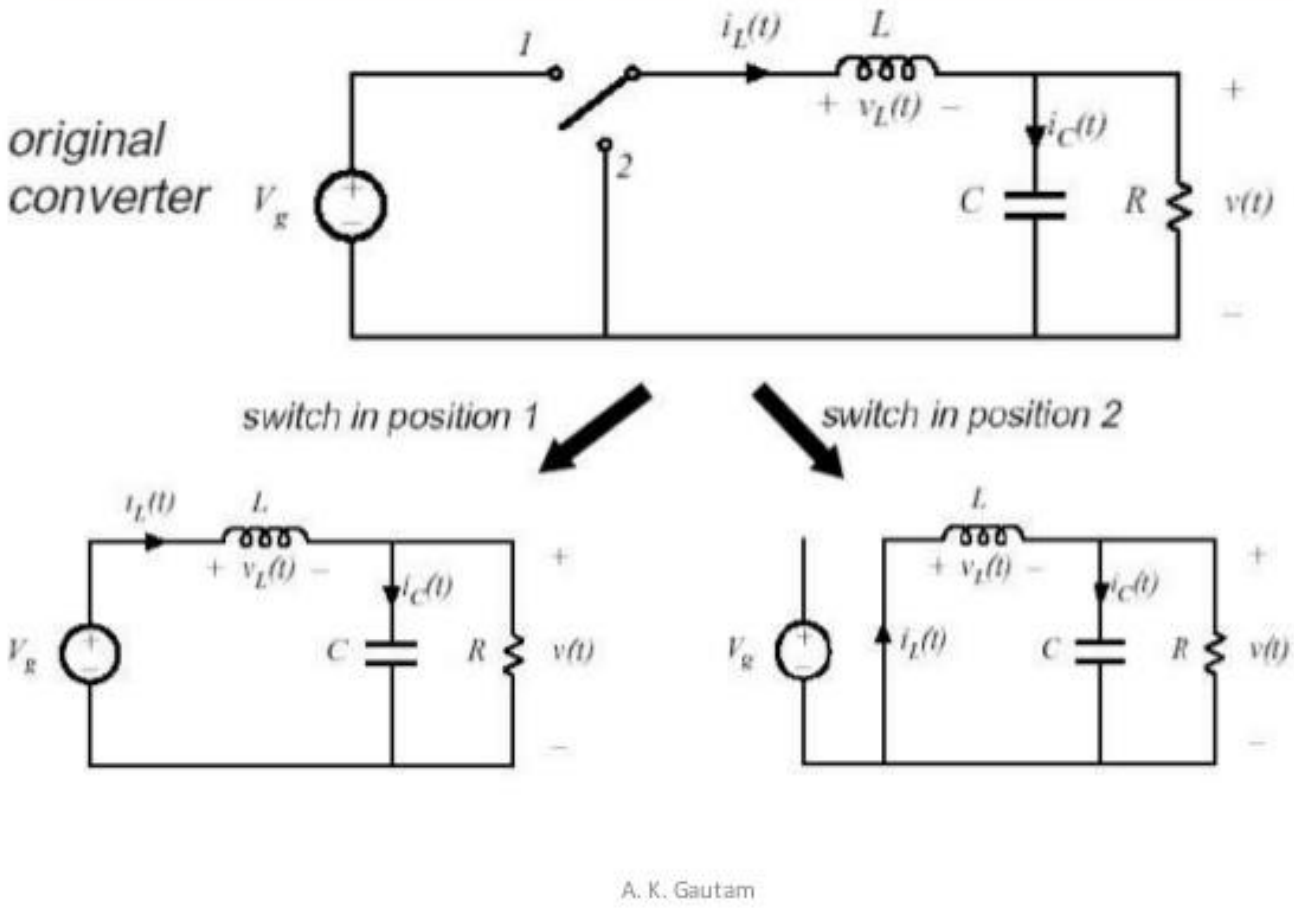
Output Waveform



Assessment - Draw the equivalent circuit for the Following.



Buck converter (Step-down converter)



A. K. Gautam

References

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4. https://www.youtube.com/watch?v=jx5I2FbiI8U