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Coimbatore-35
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EET301 / POWER ELECTRONICS AND DRIVES

V SEM EEE

UNIT 2 –DC CONVERTER

STEP DOWN - DC DC CONVERTER

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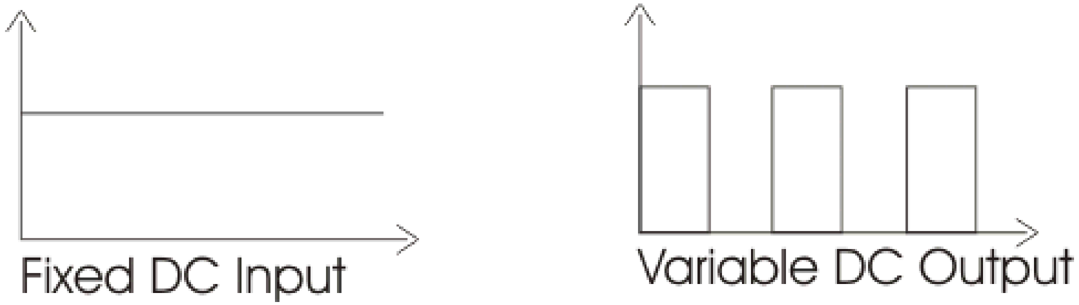
APPLICATION

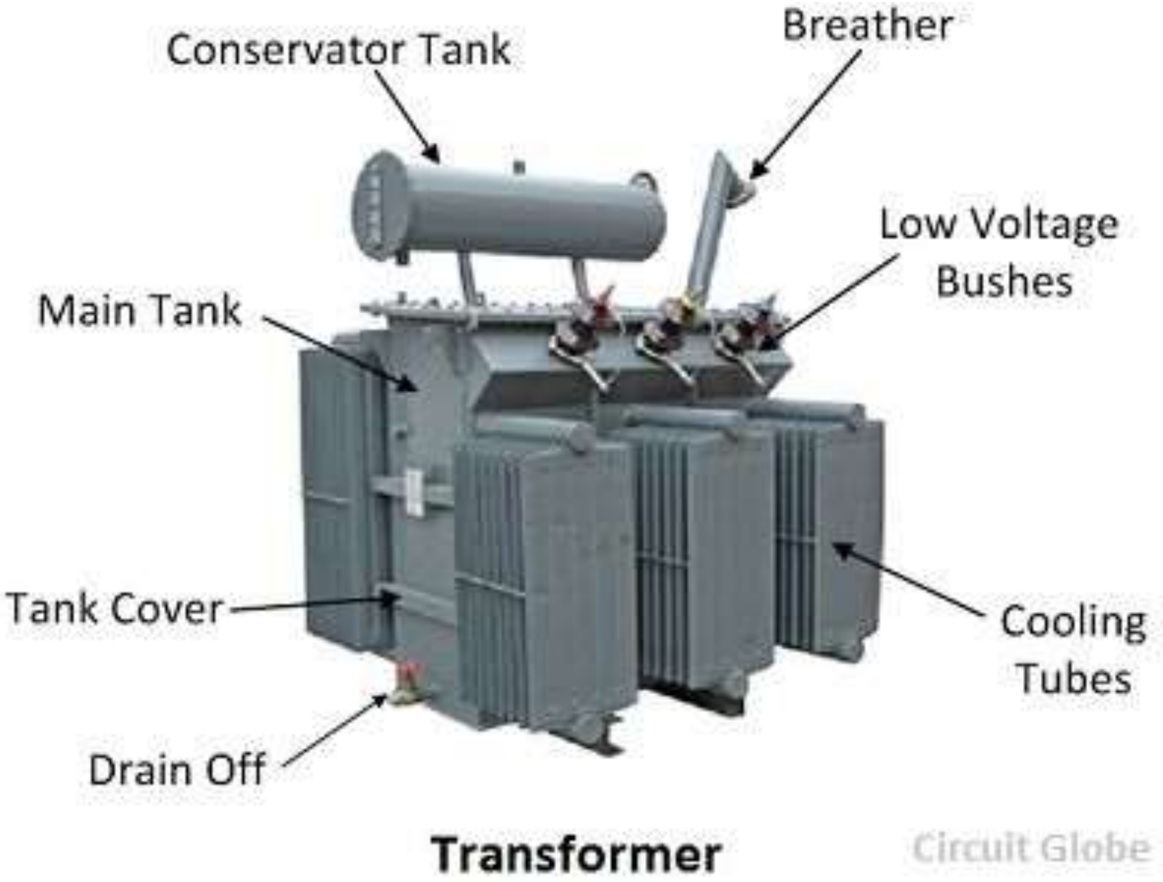
Chopper or DC-DC Converter

The DC **Choppers** convert the fixed input DC voltage into variable DC output voltage. 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.



Chopper

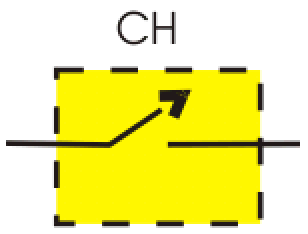
Devices used in Chopper

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

High power application: Thyristor or SCR.

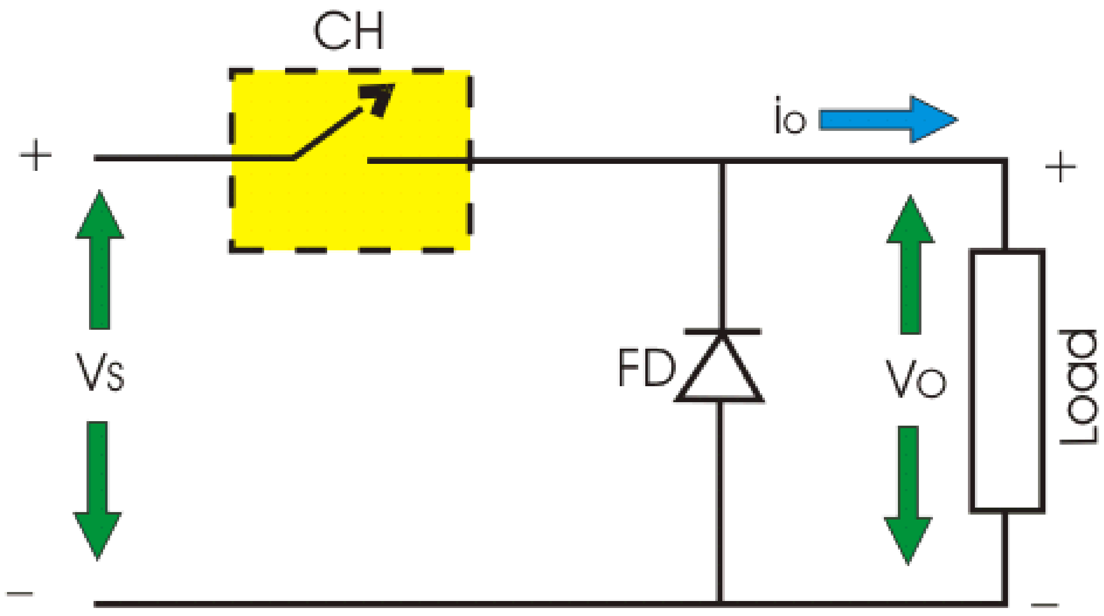
These devices are represented as a switch in a dotted box for simplicity. When it is closed current can flow in the direction of arrow only.

chopper switch

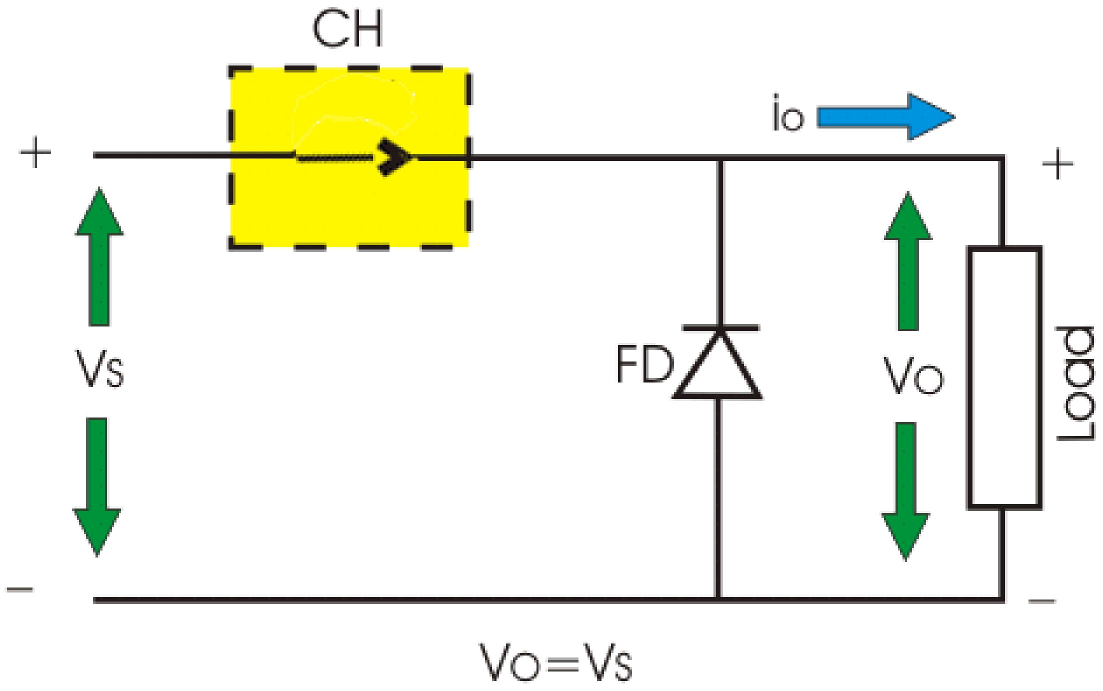


1. Step-Down DC Converter

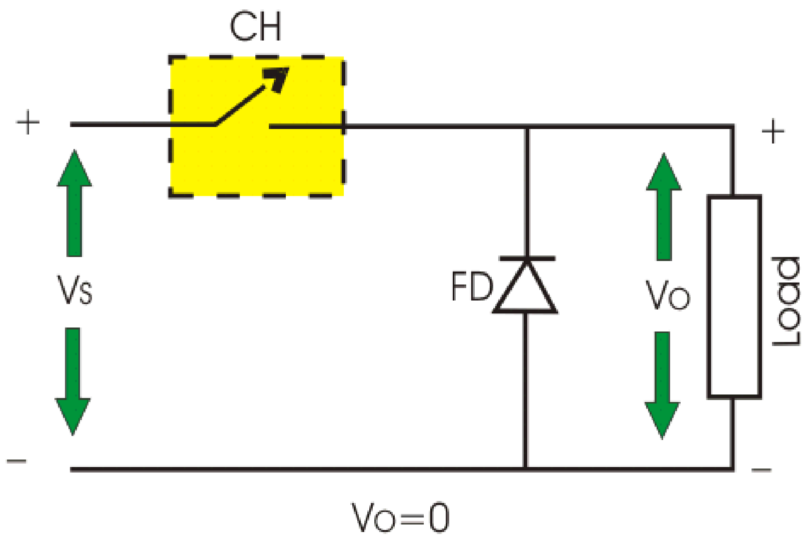
Step down DC converter or chopper or Buck converter is used to reduce the i/p voltage level at the output side

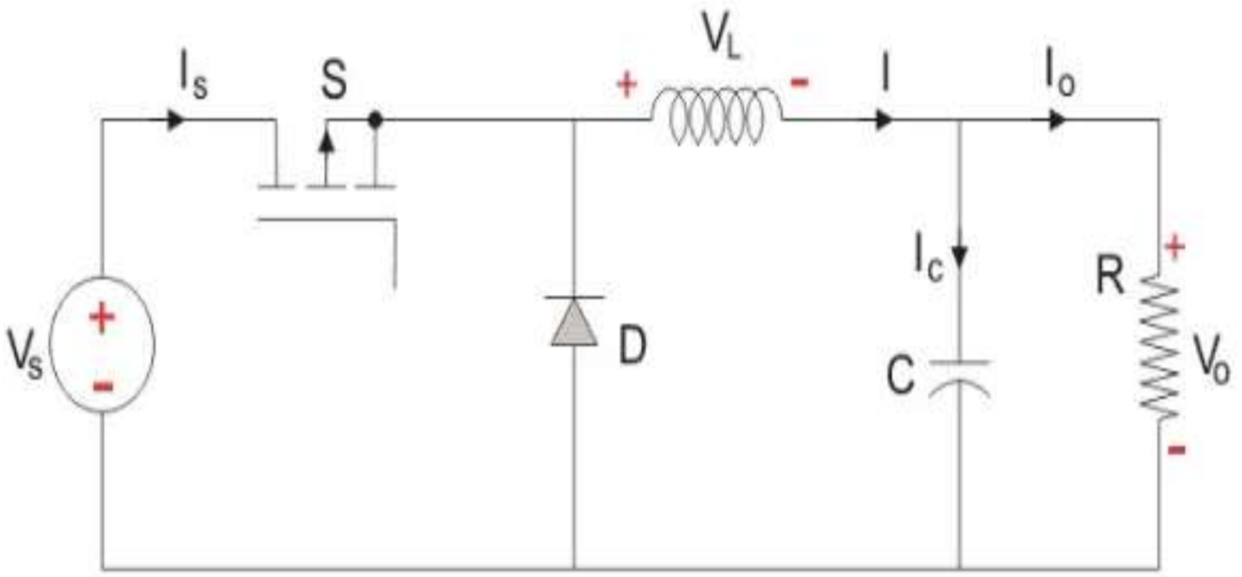


When CH is turned ON, Vs directly appears across the load as shown in figure. So Vo = VS.

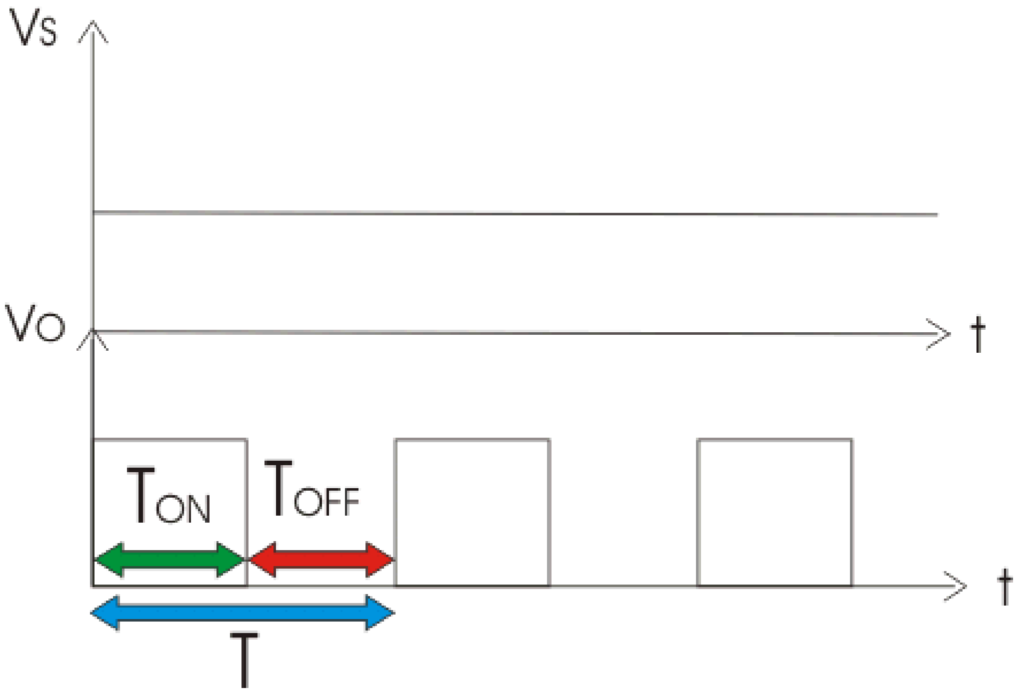


When CH is turned off, Vs is disconnected from the load. So output voltage Vo = 0.





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

Analysis of Step down 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,

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

Analysis of Step down 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)

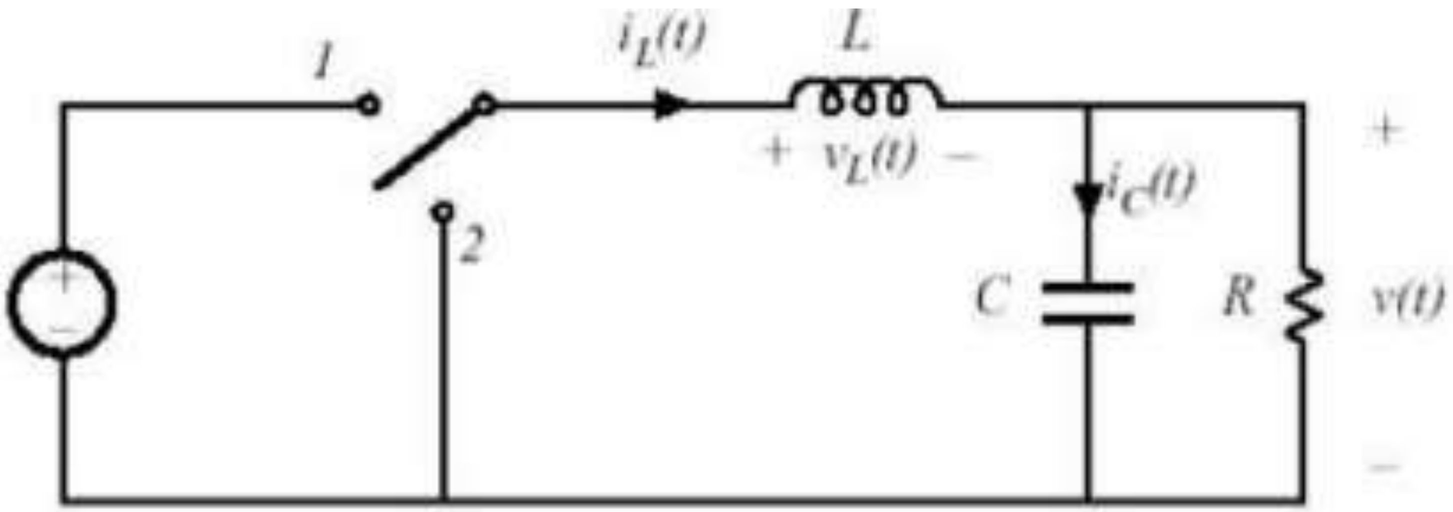
$$\frac{V_s - V_o}{L}T_{ON} = \frac{V_o}{L}T_{OFF}$$

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

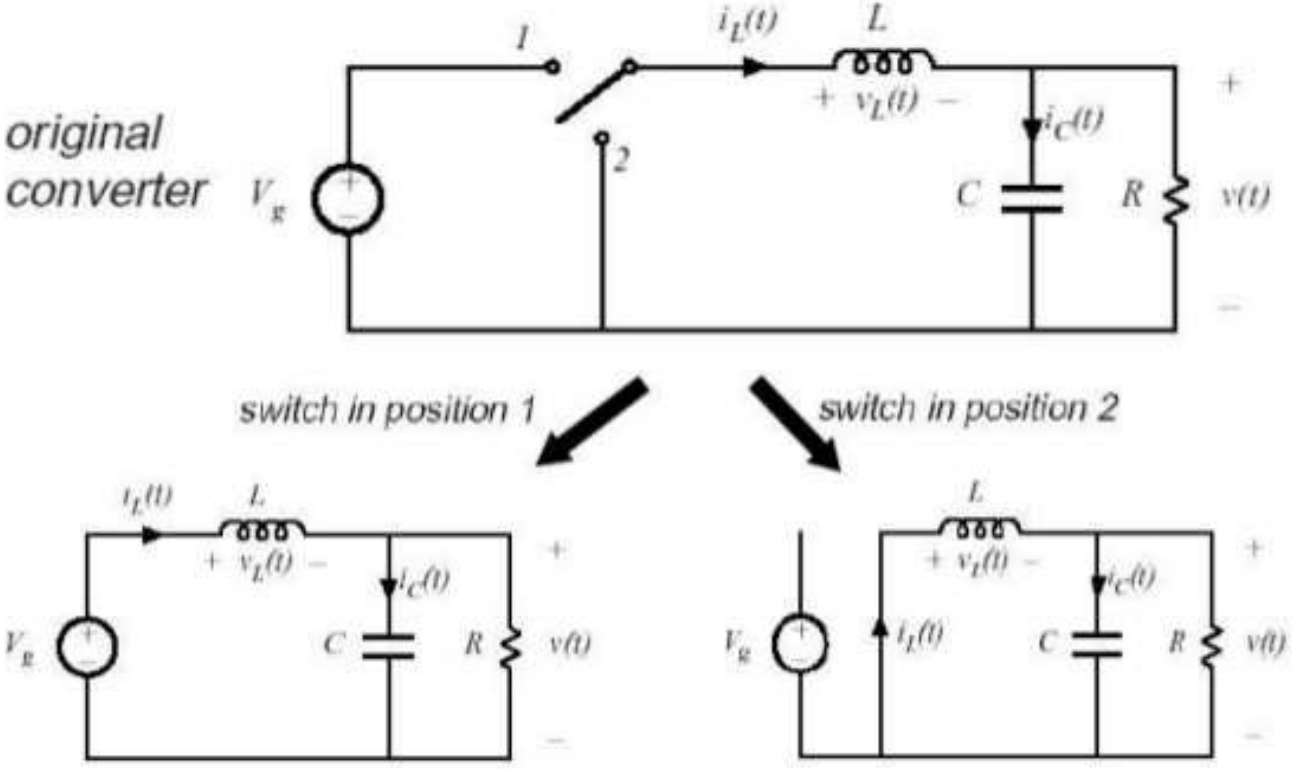
$$\frac{V_s}{V_o} = \frac{T_{ON} - T_{OFF}}{T_{ON}}$$

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

Assessment - Draw the equivalent circuit for the Following.



Buck converter (Step-down converter)



A. K. Gautam

References

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