BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

REPORT ON

STEP DOWN CHOPPER SIMULATION USING MULTISIM

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MARKS:

THEORY

- Chopper is a power electronic converter which converts fixed DC input voltage to variable DC output voltage.
- They consist of semiconductor devices such as BJT, power transistors, IGBTs, power MOSFETS and thyristors (working as a switch), input DC power supply, elements (R,L,C) and output load.
- APPLICATIONS:
  - →DC Drives
  - →Subway cars
  - →Battery driven vehicles
  - →SMPS
- TYPES OF CHOPPERS:
  1. AC LINK CHOPPER

→Costly, bulky, less-efficient

→Transformer provides isolation between load and source

  2. DC CHOPPER

- It is a static device (switch) used to obtain variable DC voltage from a source of constant DC voltage.
- It is DC equivalent of an AC transformer.
- ADVANTAGES:

→saves power

→greater efficiency

→faster response

→lower maintenance

→small size, smooth control

- Solid-state choppers are widely used in
  →trolley cars
  →battery-operated vehicles
  →traction-motor control
  →control of large number of DC motors from a common DC bus
  →control of induction motors, marine hoists, forklift trucks, mine haulers
- DC CHOPPERS CLASSIFICATION:
  Based on input output voltage levels:
  →Step Down Chopper / Buck Converter
  Output voltage < Input voltage
  →Step Up Chopper / Boost Chopper
  Output voltage > Input voltage
- STEP-DOWN CHOPPER WORKING
  →The average output voltage across the load is controlled by varying on-period and off-period (or duty cycle) of the switch.
  →A commutation circuitry is required for SCR based chopper circuit.
  →Therefore, in general, gate-commutation based choppers have replaced the SCR based choppers.
  →However, for high voltage and high-current applications, SCR based choppers are used.
  →The power-diode (D_F) operates in freewheeling mode to provide a path to load-current when switch (S) is OFF.
  →The smoothing inductor filters out the ripples in the load current.
  →Switch S is kept conducting for period T_{on} and is blocked for period T_{off}.

→During the period T_{on}, when the chopper is on, the supply terminals are connected to the load, terminals.

→During the interval T_{off}, when the chopper is off, load current flows through the freewheeling diode D_F.

→Hence load terminals are short circuited by D_F and load voltage is zero during T_{off}.

→In this manner, a chopped DC voltage is produced at the load terminals.

→The average load-voltage E_o is given by

$$E_o = E_{dc}(T_{on} / T_{on} + T_{off})$$

T_{on} = on-time of the chopper

T_{off} = off-time of the chopper

$T = T_{on} + T_{off}$ = chopping period

→If $\alpha = T_{on} / T$ be the duty cycle

$$E_o = E_{dc} (T_{on} /T)$$

$$E_o = E_{dc} . \alpha$$

→Thus, the load voltage can be controlled by varying the duty cycle of the chopper.

$$E_o = E_{dc} (T_{on} /T)$$

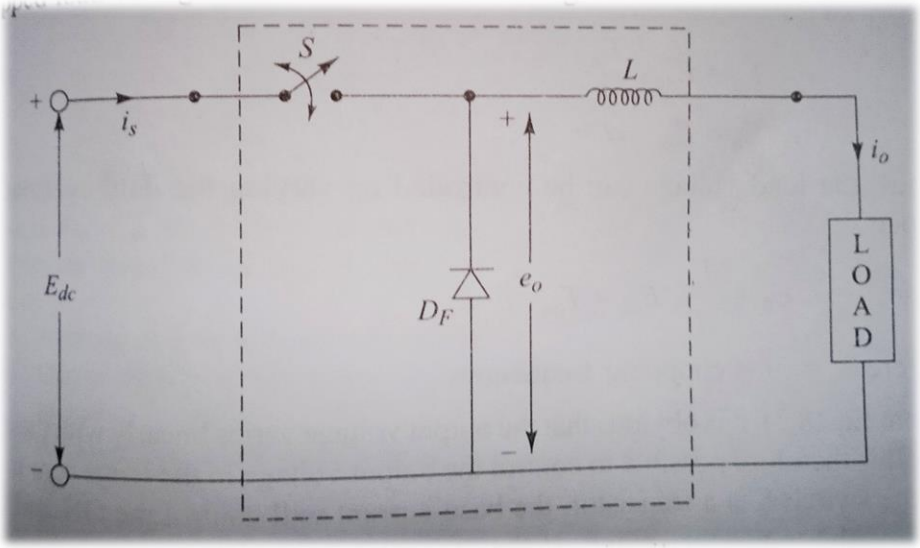
$$E_o = E_{dc} .T_{on} .f$$

f = chopping frequency

→The output voltage varies linearly with the duty cycle.

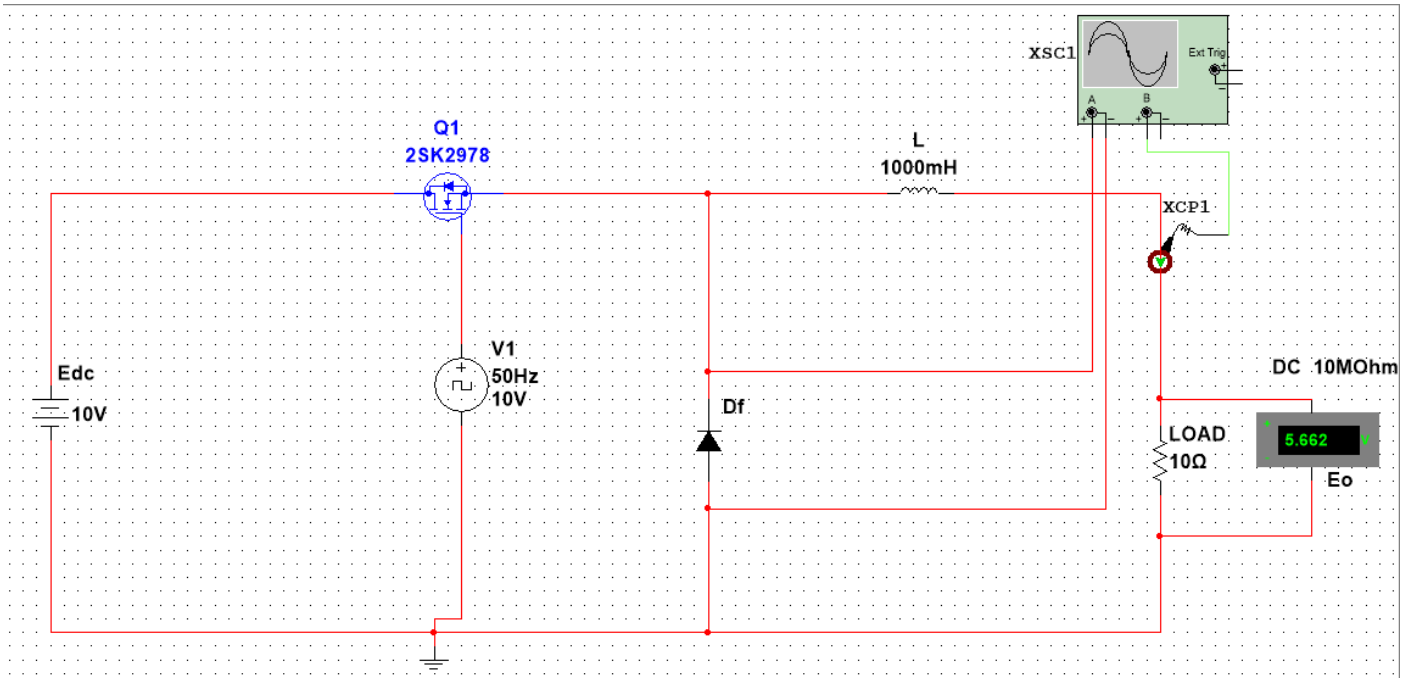
→It is therefore possible to control the output voltage in the range zero to E_{dc}.

CIRCUIT

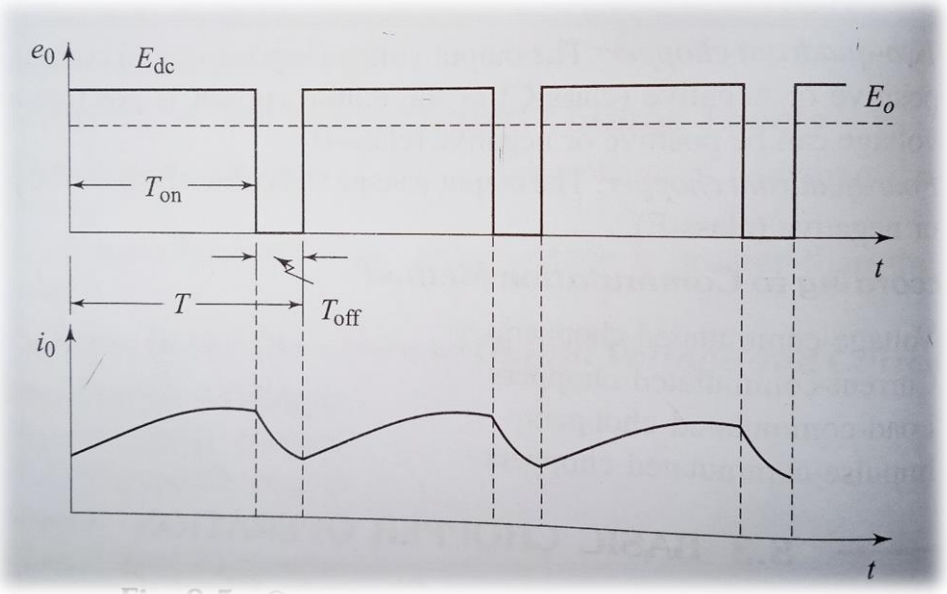


COMPONENTS USED IN MULTISIM:

1. DC power supply
2. N channel power MOSFET
3. Clock Voltage Source
4. Diode
5. Inductor (1000mH)
6. Resistor (Load) (10Ω)
7. Voltmeter (to measure stepped down voltage)
8. Oscilloscope
9. Current clamp (to observe current waveform)
10. Ground



OUTPUT VOLTAGE AND CURRENT WAVEFORMS



SIMULATED WAVEFORMS