Step_Down_Chopper -- Overview

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STEP-DOWN CHOPPER (DC-DC CONVERTER)

Objective:

After performing this lab exercise, learner will be able to:

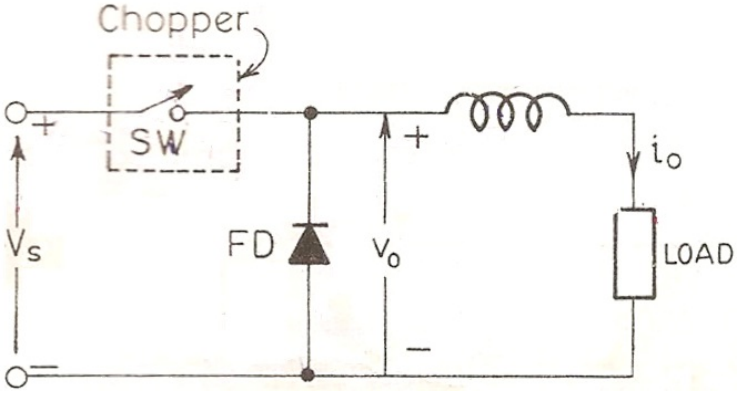
- Understand the working of DC-DC converter.
- Understand and design single-phase Step Down Chopper.
- Analyze and interpret results.
- Learn the role of Power Electronics in utility related applications, e.g. UPS, SMPS etc.
- Work with digital oscilloscope to debug circuit and analyze signals.

Equipment:

To carry out this experiment, you will need:

- Single Phase DC-DC converter Kit
- SCR firing circuit kit, 1-phase, 230V, 5A
- Patch chords
- Load (100 ohm / 2A)
- Digital Oscilloscope (TBS1000B-EDU from Tektronix)

Circuit Diagram:



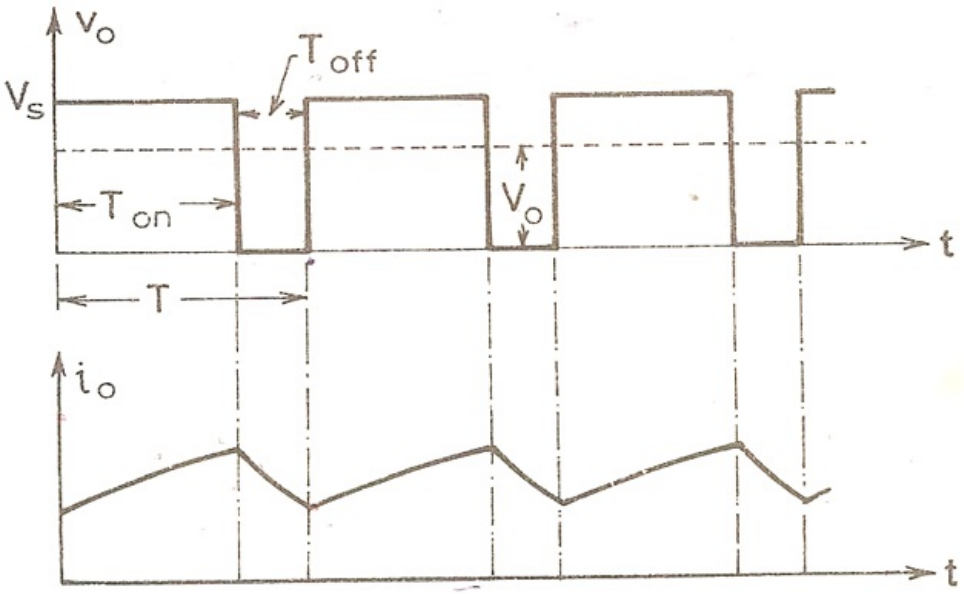
Theory:

- A chopper is a high speed ON/OFF switch. It connects source to load and disconnect the load from the source at very fast speed. Hence a chopped output voltage is obtained from a constant DC supply.
- During the period T_on, chopper is ON and load voltage is equal to source voltage Vs.

- During interval T_off, copper is OFF, load current flows through freewheeling diode. As a result load terminal are short circuited by FD and load voltage is therefore zero during T_off.
- In this manner a chopped dc voltage is produced at the load terminals. During T_on, load current rises, whereas during T_off, load current decays.
- The average load voltage of the chopper can be given by:

$$V_0 = \frac{T_{ON}}{T_{ON} + T_{OFF}} V_s = \alpha V_s$$ Where α is the duty cycle

- The ideal waveform of the experimental setup is shown in Figure below:



Step_Down_Chopper -- Procedures

Step 1

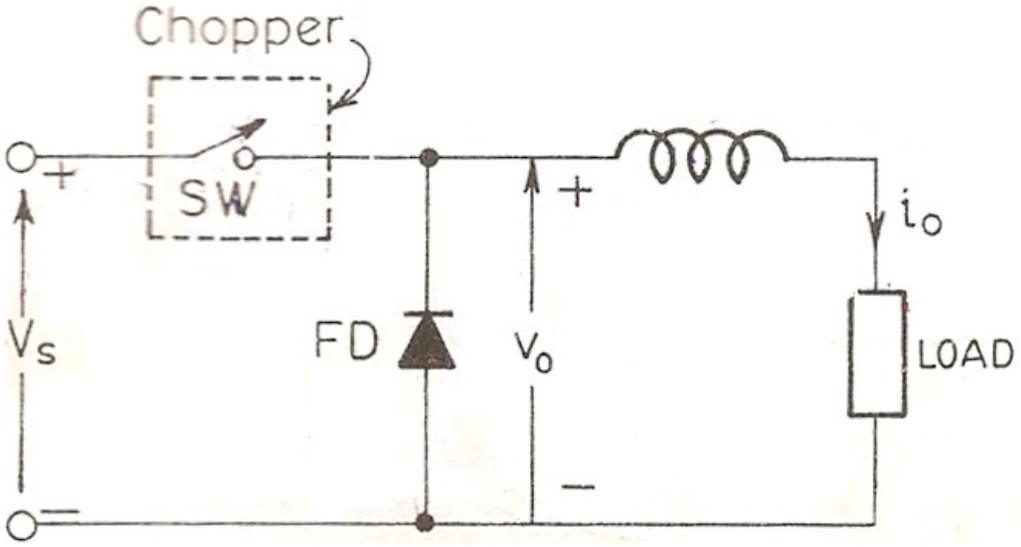
Precautions:

- A main switch should be included in whole circuit, so that in case of any emergency main supply can be disconnected from the circuit.
- Check all the connection before switching ON the power supply.
- Apply low voltages or low power to check the proper functionality of circuits.
- Load should be remained connected to the experimental setup for discharging the energy stored in the inductor or capacitor present in the circuit, if any.
- Don’t touch live wires.

Step 2

Circuit Setup:

Build the circuit as shown below:



Step 3

Probe across load resistance (V_0)

Step 4

Keep the multiplication factor of the CRO's probe at the maximum position (10X or 100X - whichever is available)

Step 5

Switch on the experimental kit and firing circuit kit.

Step 6

Set the duty cycle (duty ratio) to 0.1 (10%) and capture output waveforms on oscilloscope

Step 7

Measure the RMS value of the output and take screenshot of output waveform.

Step 8

Now change the duty cycle to 0.2 (20%).

Step 9

Measure the RMS value of the output and take screenshot of output waveform.

Step 10

Continue Step # 8 for different values of duty cycle like 30%, 40%... till 90%.

Step 11

Open Question:

- What is the relationship of RMS value of output with the duty cycle?
- What happens to RMS value of the output when duty cycle is increased from 10% to 90%?

Step 12

Switch off the power supply and disconnect from the power source.