Step_Up_Chopper -- Overview

Dr. Ashish Shrivastava (Professor & HoD)
Vikas Singh Bhadoria (Asst. Professor)
Electrical Engineering Department
JRE Group of Institution, Gr.Noida (UP)

STEP-UP CHOPPER (DC-DC CONVERTER)

Objective:

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

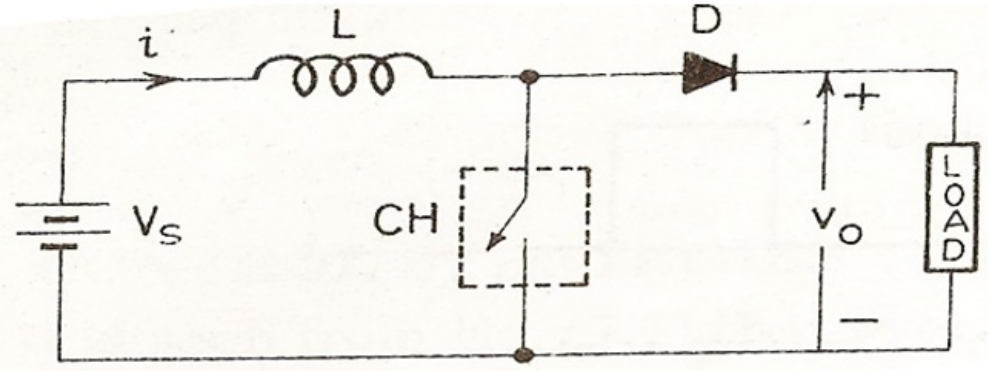
- Understand the working of DC-DC converter.
- Understand and design single-phase Step Up Chopper.
- Analyze and interpret results.
- Learn the role of Power Electronics in utility related applications, e.g. UPS, SMPS etc.
- Work with digital oscilloscope to debug circuit and analyze signals.

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
- Digital Oscilloscope (TBS1000B-EDU from Tektronix)

Circuit Diagram:



Theory:

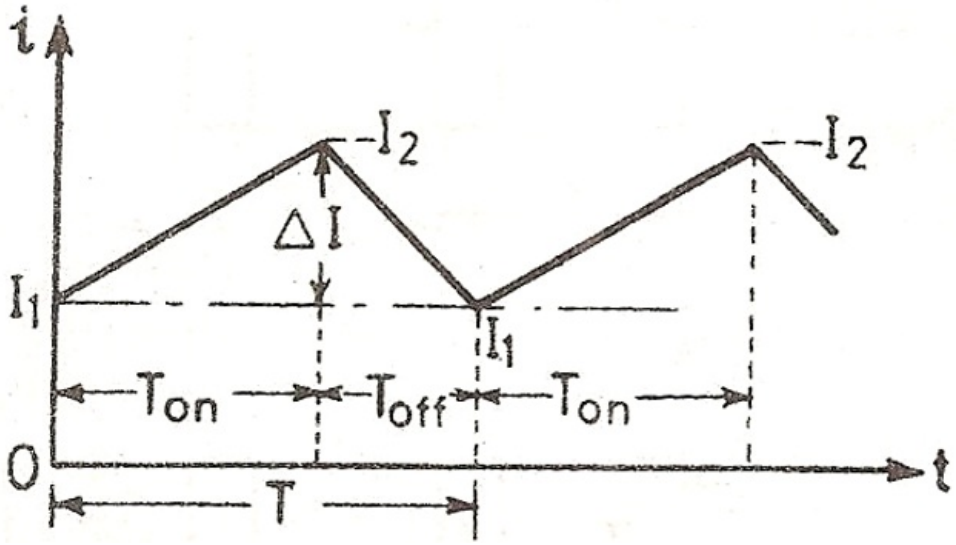
- A chopper is a high speed ON/OFF switch. It connects source to load and disconnect the load from the source at very fast speed. Hence a chopped output voltage is obtained from a constant DC supply.
- If in a chopper average output voltage Vo is greater than the input voltage Vs, then this type of chopper is called as step up

chopper.

- In this chopper, a large inductor is in series with with source voltage. When chopper CH is ON, the path is closed and inductor store energy during this period.
- When CH is OFF, as the inductor current cannot die down instantaneously, this current is forced to flow through the diode and load for time T_off.
- As the current tends to decrease, polarity of the induced EMF in L is reversed. As a result voltage across the load, given by Vo = Vs + L (di/dt), exceeds the source voltage Vs. In this manner, circuit acts as a step up the chopper.
- The average load voltage of the chopper can be given by:

$$V_0 = \frac{T}{T_{OFF}} V_s = \frac{1}{1-\alpha} V_s$$ Where α is the duty cycle

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



Step_Up_Chopper -- Procedures

Step 1

Precautions:

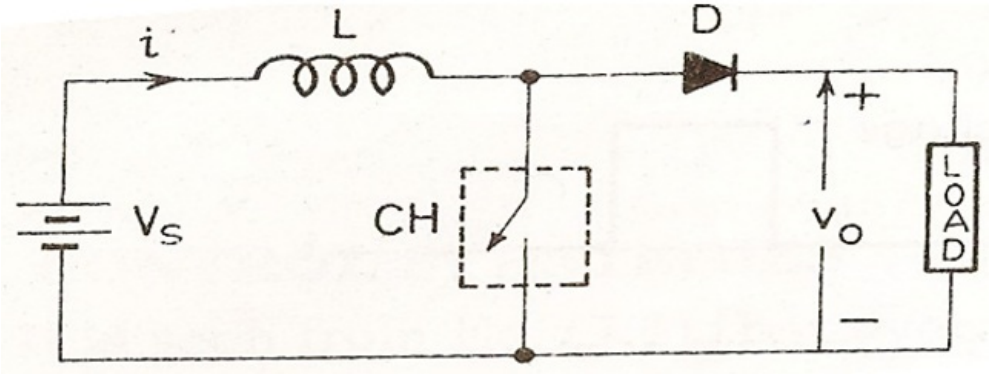
- A main switch should be included in whole circuit, so that in case of any emergency main supply can be disconnected from the circuit.
- Check all the connection before switching ON the power supply.
- Apply low voltages or low power to check the proper functionality of circuits.
- Load should be remained 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 waveform 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 would be the expected output voltage (Vo) in terms of Vs for duty cycle of 50%? Verify the actual value against expected.

Step 12

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