Power Electronics Laboratory (EE3P004)

EXPERIMENT-4

To study the working of Step Up/Down Chopper

Shorya Sharma
19EE01017

AIM OF THE EXPERIMENT:

To study the working of Step Up/Down Chopper.

APPARATUS REQUIRED:

Sl. No.	Apparatus Required	Specification	Quantity
01	Module (Chopper)	3-Phase Step Up/Step Down, 30V, 2A	1No
02	Digital StorageOscilloscope (TDS 2014C)	4 Channel, 100 MHz, 2Gs/s	1No
03	Voltage Probe (TPP0201)	200 MHz, 10 MΩ/<12pF, 10x	01No
03	Rectifier Unit	230V/ 0-230V, 5A	1 No
04	Resistance Load		1 No
05	Patch Chord		15 Nos

Theory:

A chopper is a static device which is used to obtain a variable dc voltage from a constant dc voltage source. A chopper is also known as dc-to-dc converter. The MOSFET converter offers greater efficiency, faster response, lower maintenance, smaller size and smooth control. Choppers are widely used in trolly cars, battery operated vehicles, traction motor control, control of large number of dc motors, etc. Theyare also used in regenerative braking of dc motors to return energy back to supply and also as dc voltage regulators.

Choppers are of two types

- Step-down choppers
- Step-up choppers.

Instep-down choppers, the output voltage will be less than the input voltage whereas in step up choppers output voltage will be more than the input voltage

$$V_{dc} = \frac{Ton}{Ton+Toff}$$

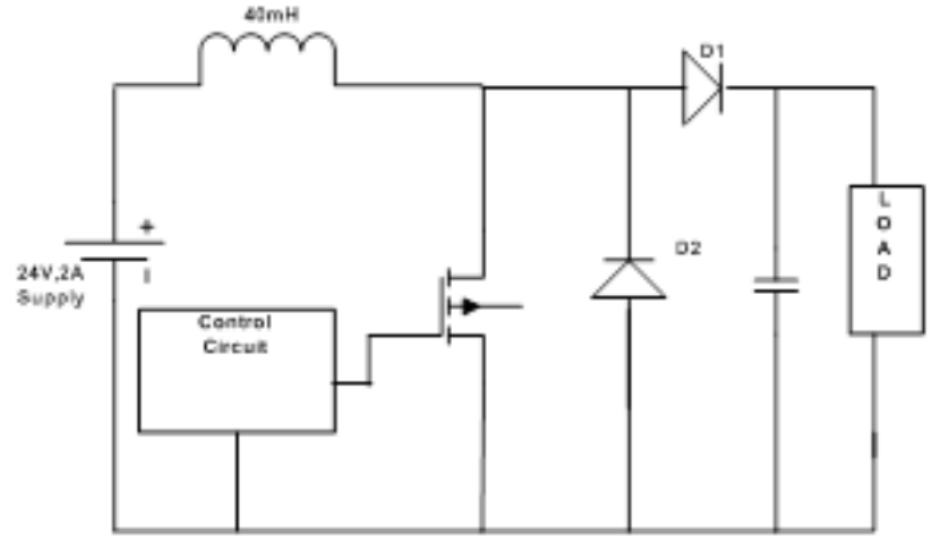
Precaution

I/P and O/P wave form must not be seen through DSO using the present voltage probe (TPP0201) at a time.

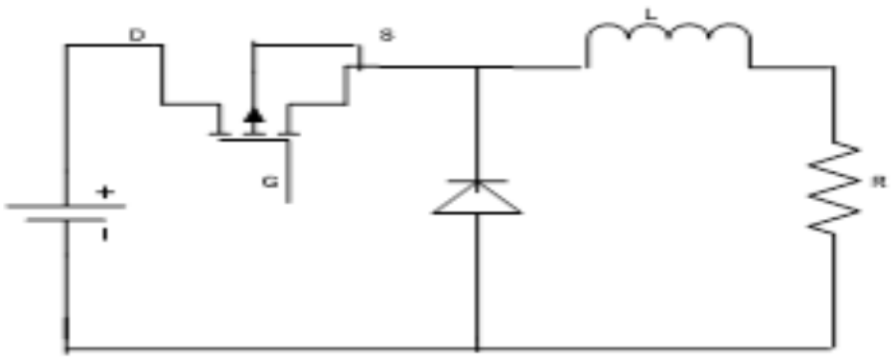
Procedure

- Switch ON the mains by control circuit and observe the output by carrying duty cycle and frequency.
- Connect the driver output to the gate and source of Power MOSFET.
- Make the step up chopper (Step down chopper) power circuit as per shown in the figure.
- Connect the DC input voltage from the regulated supply (0-30V/2A) to the input terminal apply small voltage (10V).
- Connect the R –Load of 1K/25W provided in the unit.
- Switch on the AC input in series with the DC input.
- Apply driver output pulse to power MOSFET and observe across and also observe the Ton and Toff by varying the duty cycle of potentiometer.
- Change the frequency and repeat the experiment.
- Same procedure will be followed for step down chopper.

CIRCUIT DIAGRAM:



Step Up Chopper



(Step Down Chopper)

(L = 40 mH, C = 220 µF, R = 1000 Ω)

OBSERVATION:

1. **Boost converter (Step up)**

Frequency = 300 Hz

Sl. No	V_{dc}	V_L	T_{ON}	T_{off}	Duty Cycle
1	10	11.86	0.667	2.665	20
2	10	13.58	1.010	2.321	30
3	10	15.57	1.329	2.001	40
4	10	18.36	1.669	1.666	50

2. **Boost converter (Step down)**

Frequency = 300 Hz

Sl. No	V_{dc}	V_L	T_{ON}	T_{off}	Duty Cycle
1	12	2.365	0.658	2.670	20
2	12	3.43	1.012	2.322	30
3	12	4.32	1.340	1.994	40
4	12	5.037	1.678	1.658	50

DISCUSSION

Q. What is the output voltage of boost converter if it is operated without a load? Give brief explanation.

Initially during the ON time the current flows the same and charges the inductor as it happens with load. But when load is removed the capacitor keeps its voltage, and it doesn't discharge now because there is no load resistance. During the OFF time the current flows to the output as before and charges the capacitor, so the output voltage is rising. And with each switching cycle it will be rising and rising - without being able to discharge. Therefore, without load, the output will tend to infinite ideally. But we know capacitor since it is not discharging it will become fault at some time.

Q. Physically explain how the boost convertor experiences boost in its input voltage?

The working principle that drives the boost converter is the tendency of an inductor to resist changes in current (dI/dt) by either increasing or decreasing the energy stored in the inductor magnetic field. So in a boost converter, the output voltage is always higher than the input voltage.

- When the switch is closed, current flows through the inductor in the clockwise direction and the inductor stores some energy by generating a magnetic field. Polarity of the left side of the inductor is positive.
- When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously created will be reduced in energy to maintain the current towards the load. Thus the polarity will be reversed (meaning the left side of the inductor will become negative). As a result, two sources will be in series causing a higher voltage to charge the capacitor through the diode *D.*

Vout = Vin/(1-D)

CONCLUSION

In this experiment we have successfully learnt the working of DC-DC converters of two types namely boost and buck. We also calculated their duty cycle and output voltage and also found the factor by which voltage is increasing or decreasing in each of them.