EE 311: Electrical Machines and Power Electronics Laboratory
LAB REPORT - 5

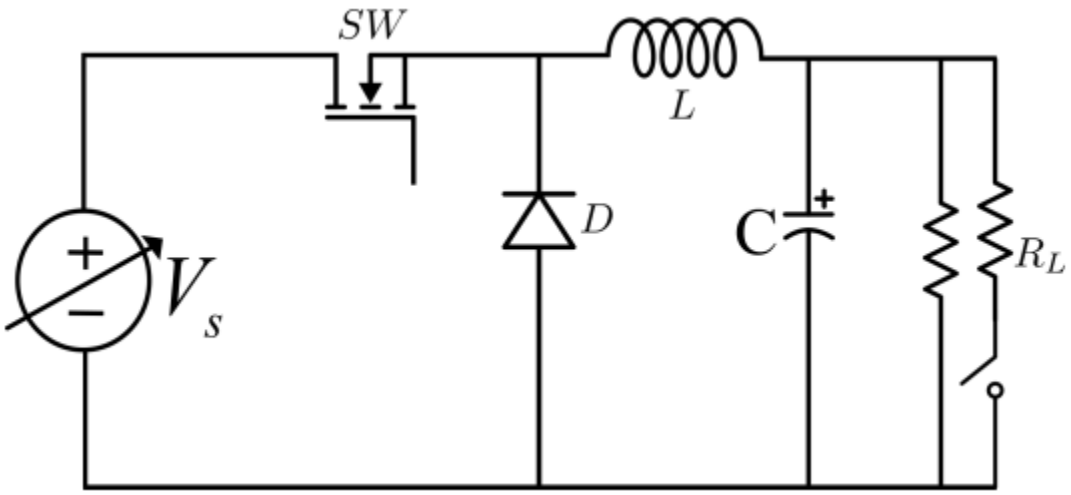
EXPERIMENT 5 : Dynamic analysis of a Buck Converter.

Aim - The buck converter is used to step down the input dc voltage to the desired output voltage. The duty cycle of the switch (MOSFET) can be varied to change the output voltage. Dynamics obtained during the load change, line voltage change and duty cycle change can be observed in the experiment.

Specifications of the Buck converter will be:

V_{in} = 15V
V_{out} = 7.5V
I_{avg} = 1A
F_{sw} = 30kHz

Circuit Diagram / Experimental Setup :



Procedure / Steps:

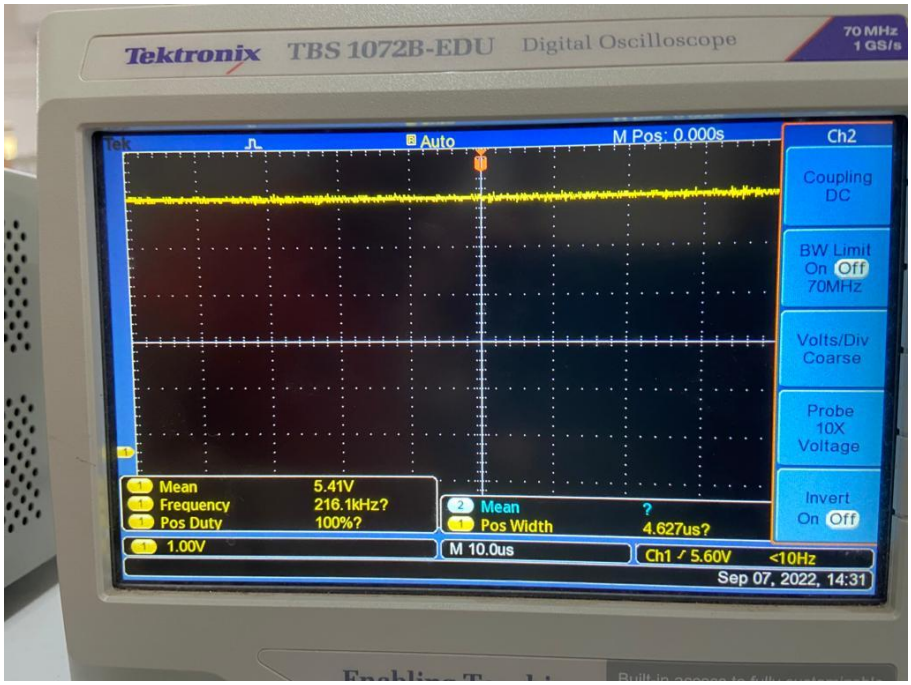
1. Connect the components according to the circuit diagram.
2. Apply the gate pulses using the TL494 PWM generator designed earlier. The PWM generator is set in emitter follower mode with push pull configuration
3. Create a load change and observe the transient in the buck converter using an oscilloscope.
4. Create an input voltage change and observe the transient in the buck converter using an oscilloscope.
5. Suddenly vary the duty cycle and observe the change in output voltage.
6. Take all the snapshots of the specified tasks.

Observations:

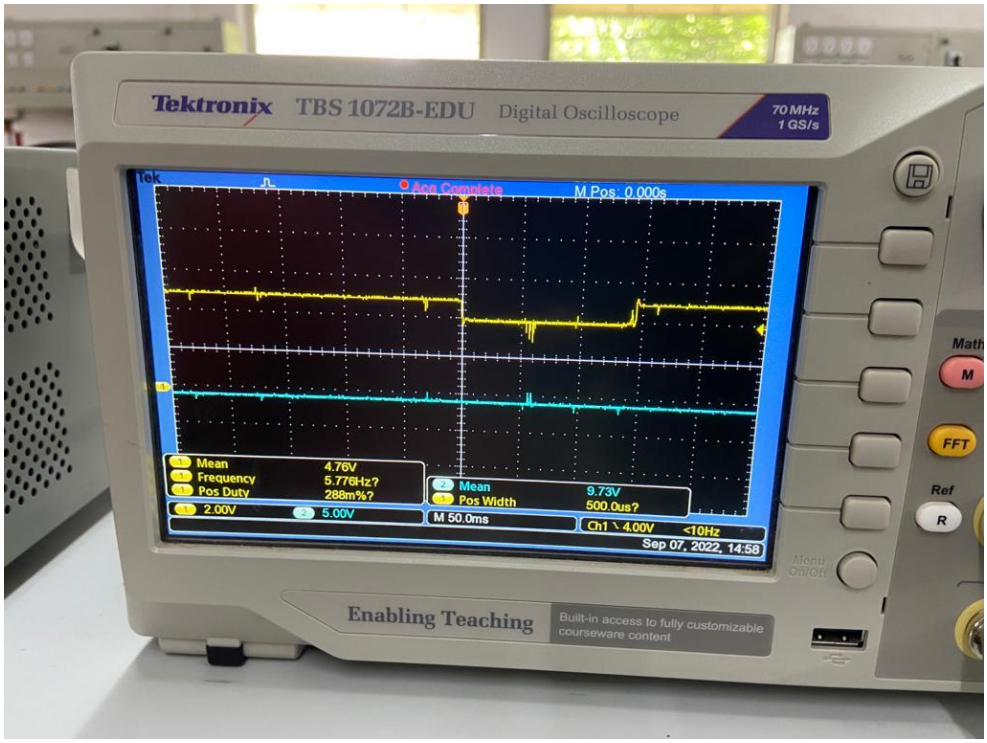
1. We saw that this buck converter will not act as a ideal buck converter, whereas it will not give the constant output voltage,if you dont change the input voltage and duty cycle.
2. It will depend on the resistor load of the circuit and it take some time to settle down and reach to its desired output.
3. The circuit will not be spontaneous for change in the voltage when change in the input voltage and duty cycle, It will take some time.

Data recorded & measured:

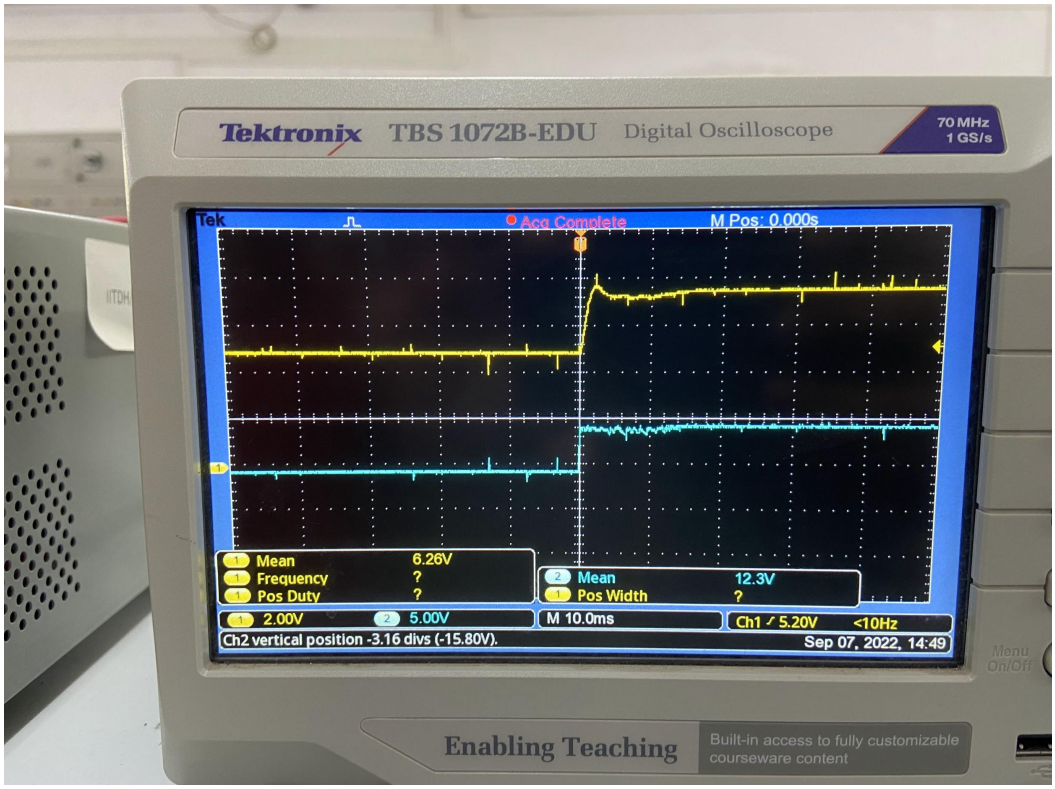
1. Output of the buck converter:



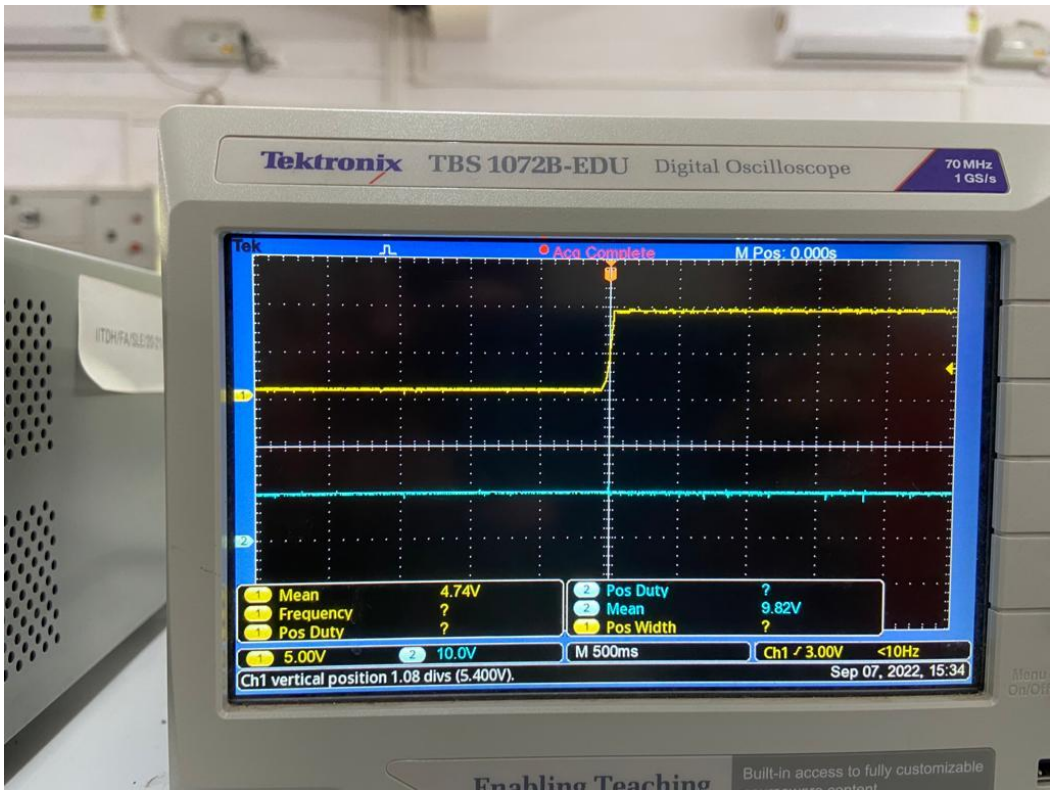
2. Output voltage for Load Change :



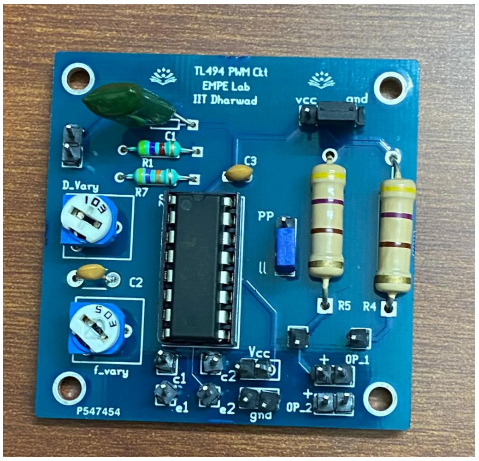
3. Output voltage change for input voltage :

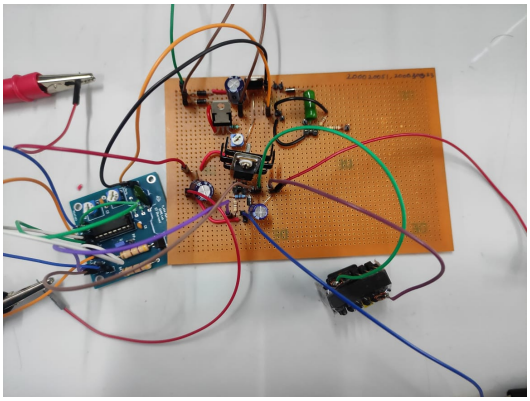


4. Output voltage change for change in duty cycle:



Soldered Board Snapshot:





ANALYSIS:

We first observed the output voltage after setting the input voltage to 15 V and the duty cycle to 0.5 and the switching frequency for the gate pulses from the TL494 chip to be 30 KHz, and we then measured the output voltage, and we got 7.40 V as the output voltage.

Then we gave a impulsive input of a resistive load, where we observed change in the output voltage, and the output voltage decreased after loading for some time and reached the desired output voltage.

Then we gave a impulse change of input voltage from 10 to 15 and found out the feedback is kind of overdamped and it took some time to reach the desired output voltage.

Then for change in duty cycle, the circuit response is faster than compared to the previous two cases.

ADDITIONAL RESULTS:

Our final goal is to give gate signals to the mosfet in a buck or boost voltage converter, so we use this **TL494 PWM** chip to provide the appropriate gate pulses, and the buck converter gives out the output voltage as per the set duty cycle.
The waveforms of the buck converter will look like:

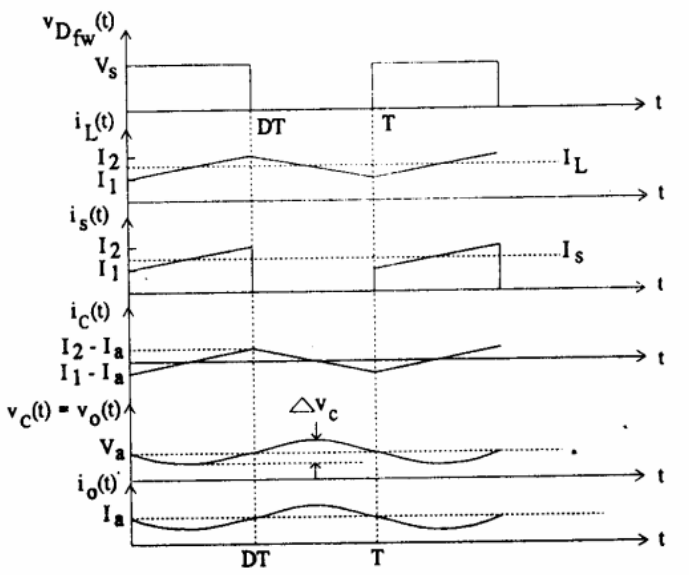


Fig. 3-6, Buck converter switching waveforms

INPUT DC-DC converters : Source