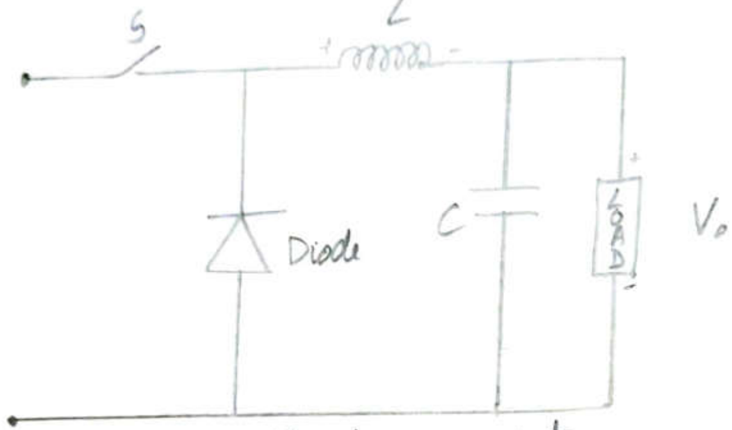
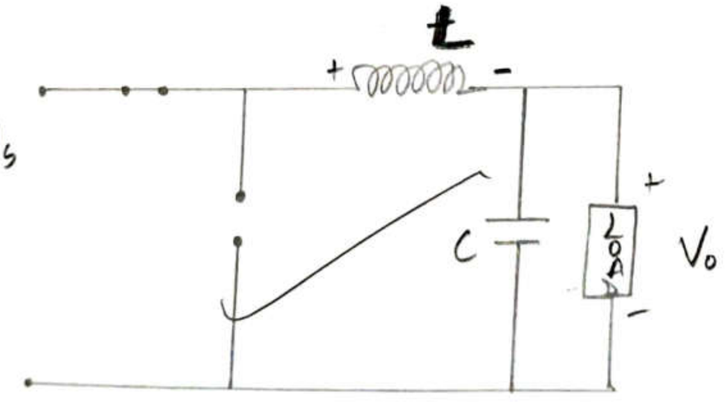
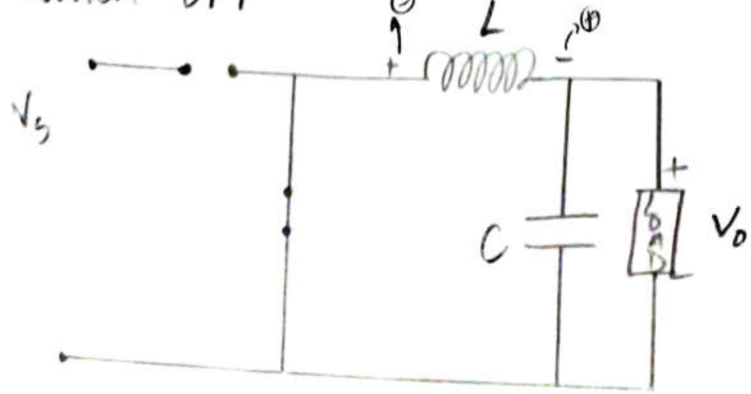



Buck converter

(i) Switch ON




(ii) Switch OFF



TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem Ist

Roll No. Date

EXPERIMENT 9

Objective - Study of DC-DC Buck converter with R load and observed effect of duty ratio on converter output voltage.

Apparatus Required - DC-DC Buck converter, trainer kit, two channel DSO, connection leads.

Theory -

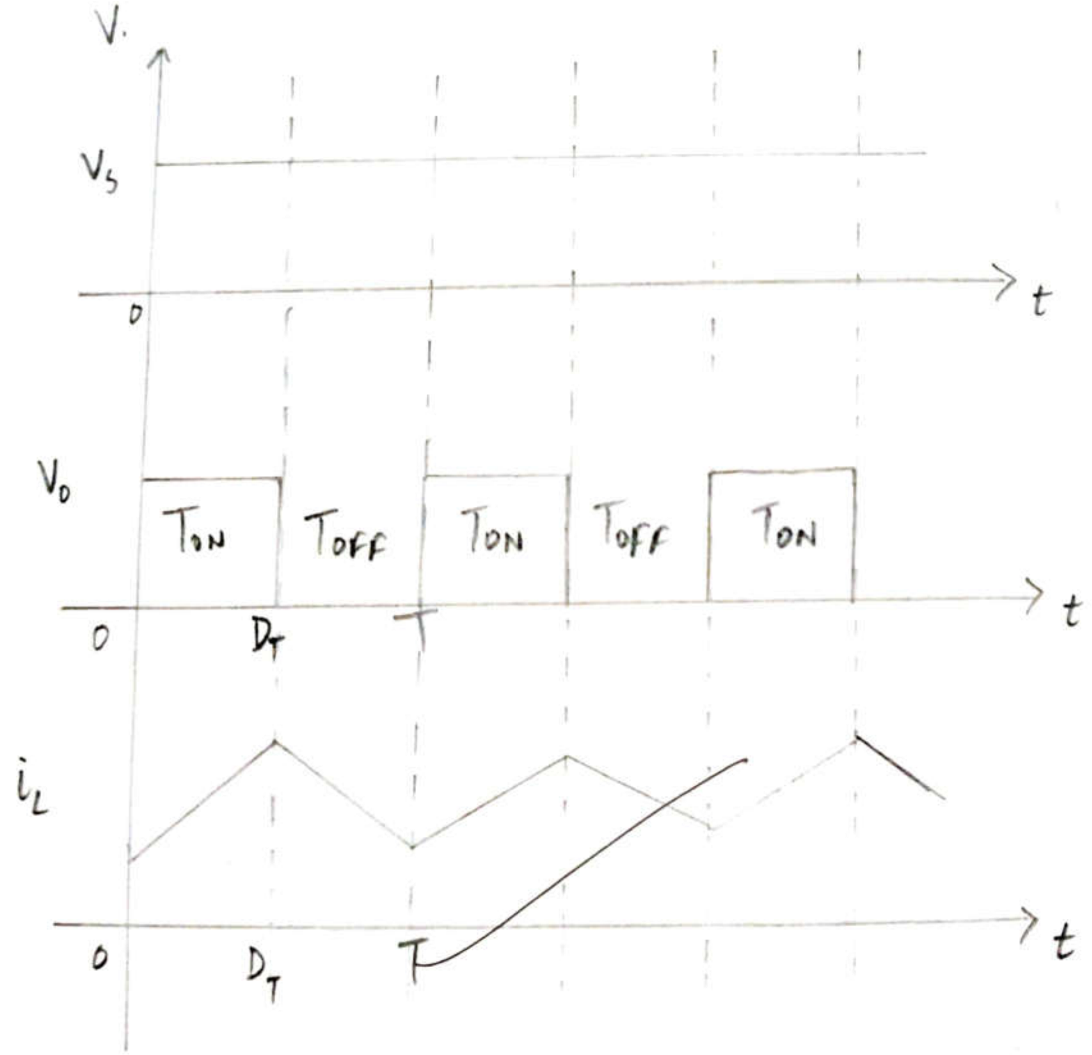
- Circuit description -

The three basic dc-dc converter use a pair of switches, usually one controlled (eg. MOSFET) and one uncontrolled (i.e, diode), to achieve unidirectional power flow from input to output. The converters also use one capacitor and one inductor to store and transfer energy from input to output. They also filter or smooth voltage and current.

The dc-dc converters can have two distinct modes of operation: Continuous conduction mode (CCM) and discontinuous conduction mode (DCM). In practice, a converter may operate in both modes, which have significantly diff. characteristics. Therefore, a converter and its control should be designed based on both modes of operation. However, for this course we only consider the dc-dc converters operated in CCM.

- Circuit operation -

When the switch is on for a time duration DT,




waveforms

# TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem $1^{st}$

Roll No. Date

the switch conducts the inductor current and the diode becomes reverse biased. This results in a +ve voltage $V_L = V_g - V_o$ across the inductor. This voltage causes ~~to~~ a linear increase in the inductor current $i_L$. When the switch is turned off, because of the inductive energy storage, $i_L$ continues to flow. This current now flows through the diode, and $V_L = -V_o$ for a time duration $(1-D)T$ until the switch is turned on again.

- Volt second Balance equation -

Voltage upto time $DT = V_s - V_o$
Voltage for time $(T - DT) = 0 - V_o = -V_o$

$$\frac{(V_s - V_o)}{\cancel{L}} D\cancel{T} = -\left(\frac{-V_o}{\cancel{L}}\right) \cancel{T}(1-D)$$

$$V_s D - V_o D = V_o - V_o D$$

$\boxed{V_o = V_s D}$ volt second balance eqn.

$V_o$ = output voltage
$V_s$ = input voltage
$D$ = Duty ratio / Duty cycle $= \frac{T_{ON}}{T} = \frac{T_{ON}}{T_{ON} + T_{OFF}}$

## Observation Table -

| Sr. No. | Input voltage ($V_s$) | Duty Ratio ($D$) | Output voltage ($V_o$) |
|---|---|---|---|
| 1. | 24V | 15% | 5.20V |
| 2. | 24V | 20% | 7.2 V |
| 3. | 24V | 30% | 10.4 V |
| 4. | 24V | 40% | 12.8V |
| 5. | 24V | 50% | 14.8V |
| 6. | 24V | 60% | 16 V |
| 7. | 24V | 70% | 17.2 V |
| 8. | 24V | 80% | 18.4V |
| 9. | 24V | 90% | 20.4V |
| 10. | 24V | 95% | 21.6V |

For $R_L = 36.6\ \Omega$

Frequency = 2 KHz.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

Result - We have studied and observed the DC-DC buck converter with R load and observed effect of duty ratio on converter output voltage.

Abreey 25/1/22