Kathmandu University
Department of Electrical and Electronics Engineering
ANALOG ELECTRONICS LABORATORY WORK

EXPERIMENT 3: DC Power Supply Design

Objectives: To design a battery eliminator using a peak detector.

Materials and Equipment:
Resistor: 12K [1], 100K [1] Capacitor: 100uF 25V [1], 220uF 50V [1] Probe: [1]
Rectifier Diode: [4] Centre Tapped Transformer: 12-0-12 [1]

Theory:
When a capacitor is connected in series with a diode as shown in fig 2 (a), then the capacitor always gets charged up to the highest available peak. The capacitor remains at the peak unless it gets discharged.

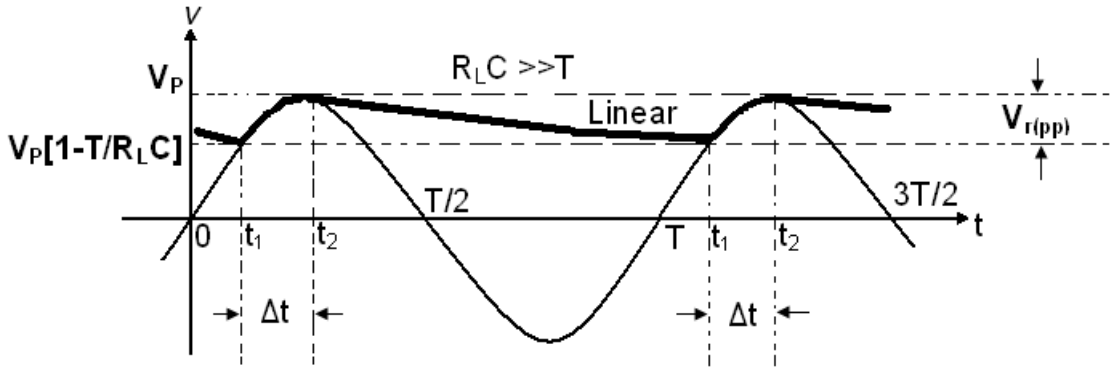

Fig 1

At the time t_2 the diode cuts off and the capacitor is discharged through the load. If $R_LC >> T$ then the discharge can be considered as linear. It reaches up to the voltage $V_P[1-T/R_LC]$ at the end of the discharge interval. Here discharge interval is ≈T. During time Δt the diode conducts and charges the capacitor up to the peak value (V_P).
For full wave rectifier, the diode conducts every after T/2 time interval whereas in case of half wave rectifier it conducts every after T time interval. Note that the conduction interval is Δt is same for both case of half wave and full wave rectifiers.
The load current can be approximately kept constant at $I_L=V_P / R_L$. The peak value of current that the diode must carry during Δt in half wave rectifier is given as

$$I_{D(Peak)} = I_L\left[1+2\pi\sqrt{\frac{2V_P}{V_{r(PP)}}}\right]$$

Conduction interval Δt is given as $\Delta t = \frac{1}{\omega}\sqrt{\frac{2T}{R_LC}}, \omega = 2\pi f$

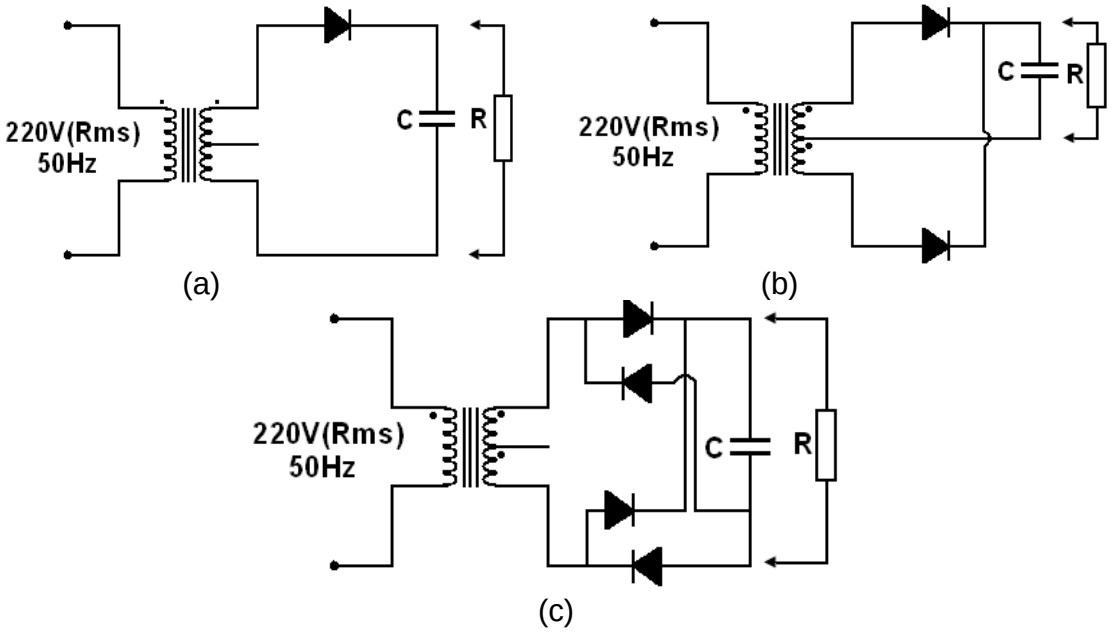

Fig 2: Peak detector circuit with loading
(a) Half Wave Rectifier (b) Full Wave Centre Tapped (c) Full Wave Bridge

Half Wave Rectifier (Peak Detector with Loading)

Procedure

1. Connect the circuit as shown in fig 2 (a).
2. See the peak detector output by using 100uF capacitor only.
3. Find the average output voltage.
4. Put 12K resistor across the capacitor.
5. Using AC mode of the oscilloscope find the peak to peak ripple voltage.
6. Find the ripple frequency and the conduction interval Δt.
7. Remove 12K resistor and place 100K resistor with same capacitor.
8. Find the conduction interval and peak to peak ripple voltage in AC mode.
9. Change the capacitor to 220uF.
10. Repeat procedure 4 to 8.
11. Remove the capacitor and see the output across 100K resistor in DC mode.

Full Wave Rectifier (Centre Tapped)

Procedure

1. Connect the circuit as shown in fig 2 (b).
2. See the peak detector output by using 100uF capacitor only.
3. Find the average output voltage.
4. Put 12K resistor across the capacitor.
5. Using AC mode of the oscilloscope find the peak to peak ripple voltage.
6. Find the ripple frequency and the conduction interval Δt.
7. Remove 12K resistor and place 100K resistor with same capacitor.
8. Find the conduction interval and peak to peak ripple voltage in AC mode.

9. Change the capacitor to 220uF.
10. Repeat procedure 4 to 8.
11. Remove the capacitor and see the output across 100K resistor in DC mode.

Full Wave Rectifier (Bridge)

Procedure

1. Connect the circuit as shown in fig 2 (c).
2. See the peak detector output by using 100uF capacitor only.
3. Find the average output voltage.
4. Put 12K resistor across the capacitor.
5. Using AC mode of the oscilloscope find the peak to peak ripple voltage.
6. Find the ripple frequency and the conduction interval Δt.
7. Remove the capacitor and see the output across 12K resistor in DC mode.