INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

Department of Electronics & Electrical Engineering

EE102: Basic Electronics Laboratory

Expt.No. 5: Power Supply Circuits

Objectives:

1. To study a full-wave rectifier made using a center tapped transformer.
2. To study a regulated power supply made using a Zener diode.

Materials Required:

1. Equipment: Breadboard, Function Generator, Oscilloscope
2. Components: Transformer (One, 230V to 12–0–12V), 1N4007 Diode (Two, V_D = 0.7V), Zener Diode (One, V_Z = 6.2V), 220Ω (One), 560Ω (One), 1kΩ (One), 100µF (One)

Precautions and Guidelines:

1. In order to avoid electric shock, switch on the mains supply to the transformer only after you have made all other connections. While making any changes in the circuit, switch off the mains supply to the transformer.
2. Connect the capacitor with the correct polarity. The capacitor being of electrolytic-type, is polarized, and will be damaged if connected with incorrect polarity. Similarly, confirm the polarity of the diodes before connecting.
3. Use "line" as the source of triggering in the oscilloscope. Put the oscilloscope in CHOP mode.
4. Never ever ground the probes of CRO while measuring the voltage cross transformer as it may get damaged due to shot-circuit. Adjust the dc level of CRO prior to connecting the probes to the circuit.

Part A: Unregulated Power Supply – Full Wave Rectifier (FWR)

1. Set up the circuit as shown in Fig.1 without the capacitor C. The transformer TX has rating of 230V to 12-0-12V, 1A and R_L = 1kΩ. Connect the transformer primary to the mains and switch on the mains.
2. Display the secondary voltages V_{AG} and V_{BG} (V_{AG} to Channel 1, V_{BG} to Channel 2) on the oscilloscope. Make sure that both the "probe grounds" are connected to the circuit ground.
3. Sketch the waveforms overlapping, with the same time and amplitude axes. They should be 180^0 out of phase.
4. Display and sketch the full-wave rectified output V_0 across R_L. Measure and record the peak voltages in both the halves.
5. Now connect C = 100µF as shown in Fig.1. Sketch V_0 and measure V_r (peak-to-peak ripple voltage). Set the oscilloscope channel to AC coupling and increase vertical sensitivity (decrease V/div) while measuring V_r.
6. Remove diode D2. The circuit is now a half wave rectifier (HWR) with a capacitor filter. Compare V_r values for the FWR and the HWR and record the values in Table 1.

	FWR	HWR
V_r		

Table 1

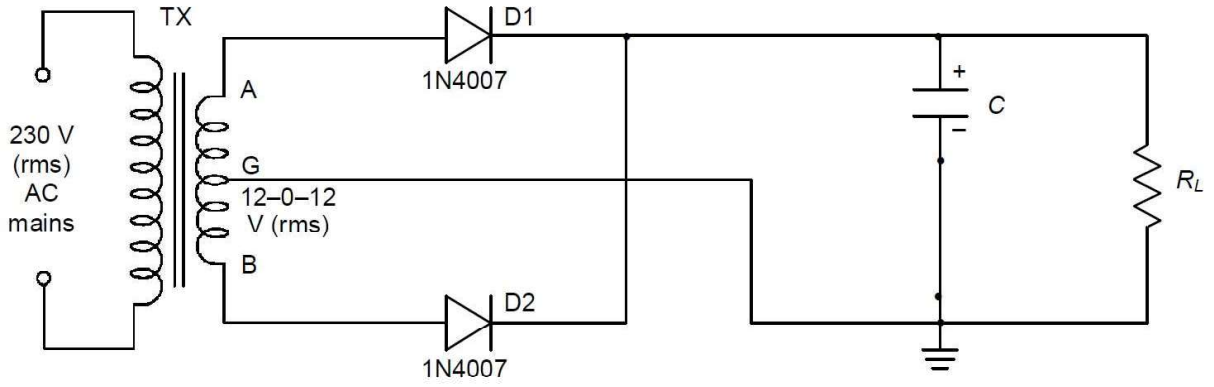

Fig.1

Part B: Regulated Power Supply – Zener Regulator

1. Connect a Zener diode D_Z with series resistance R = 560Ω as shown in Fig.2. The voltage across D_Z will now be the desired (regulated) output voltage V_{0R} which will supply current I_L to the external load R_L.
2. With R_L = ∞, use the oscilloscope to measure the maximum of the unregulated DC along with ripple, V_0(max) and the peak to peak ripple, V_r at point 1.
3. Similarly, obtain the maximum of the regulated DC along with ripple, V_{0R}(max) and the peak to peak ripple, V_{rR} at point 1'. You will find V_{rR} to be very small and may have to increase the oscilloscope sensitivity suitably.
4. Calculate $V_0(avg) = V_0(max) - ½V_r$ and $V_{0R}(avg) = V_{0R}(max) - ½V_{rR}$.
5. Compute I_R, I_Z, and I_L (all average values), and the power dissipations $P_Z = V_Z \times I_Z = V_{0R}(avg) \times I_Z(avg)$ and $P_R = V_R \times I_R$, (V_R = average voltage across R).
6. Compute the percent regulation

$$\%Reg = 100 \times (V_{0R}(avg, NoLoad) - V_{0R}(avg, Load)) / (V_{0R}(avg, NoLoad))$$

7. Repeat steps 2 to 6 for R_L = 1kΩ and 220Ω. Record the measured and calculated values in Table 2.

R_L	V_0(max)	V_r	V_{0R}(max)	V_{rR}	V_0(avg)	V_{0R}(avg)
R_L	I_R	I_L	I_Z	P_Z	P_R	%Reg

Table 2

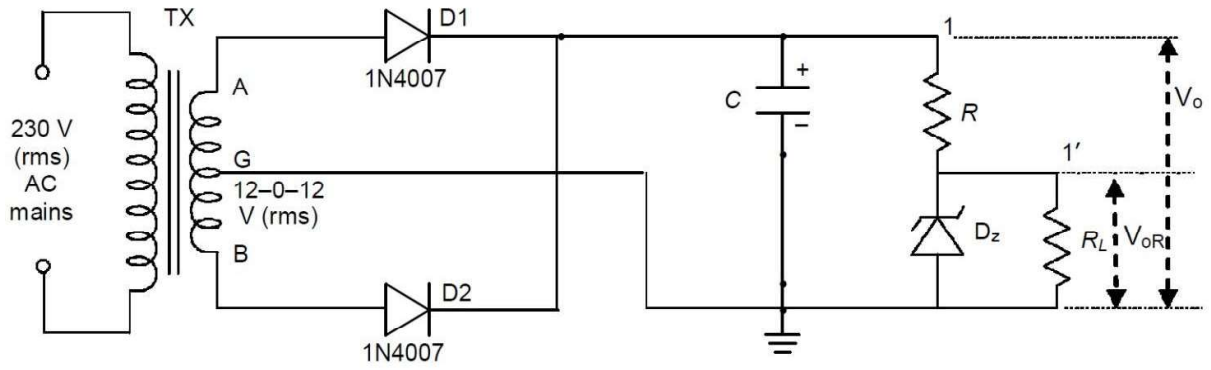

Fig.2

Part C: Lab Report

Prepare and submit a lab report as specified in the general instructions regarding the lab. Include the answers to the following questions in the report:

1. Are the peak voltages in both the halves equal in step 3 of Part A? Explain. What are the ripple frequencies in FWR and HWR in Part A?
2. Do you observe poor regulation for some I_L ? Why does it occur?
3. What is the maximum load current the Zener regulator (under test) can supply? It is given that I_Z (min) = 5mA and the maximum power dissipation in the Zener is ½W. How would you modify the circuit to provide an even higher I_L? What is this maximum value?
4. What are the wattage ratings of the resistances you will use in the modified circuit for the maximum I_L value obtained in Q.3? (Standard wattage ratings are ¼W, ½W, 1W, 2W, 5W etc.) Have you used the correct wattage resistances for the circuit under test?