INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

Department of Electronics & Electrical Engineering

EE102: Basic Electronics Laboratory

Expt.No. 4: Diode Circuits

Objectives:

1. To study half-wave rectifier circuits with and without capacitor filter.
2. To study the behaviour of clipping circuits.

Materials Required:

1. Equipment: Breadboard, Function Generator, Oscilloscope
2. Components: 1N4007 Diode (1, V_D = 0.7V), Zener Diode (1, V_Z = 3.9V), 56Ω (1), 1kΩ (1), 2.2kΩ (1), 4.7kΩ (1), 22μF (1)

Precautions and Guidelines:

1. 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.
2. Keep the ground terminals of oscilloscope probes and function generator outputs connected together throughout the experiment.
3. In an oscilloscope, for higher precision, increase vertical sensitivity (i.e. lower value of volt/div), especially while measuring small amplitude levels (e.g. ripple voltage). You may need to switch to ac coupling while doing so.

Pre-Lab Work:

1. Draw the expected waveforms at step 3 of Part A.
2. Draw the expected waveforms at step 2 of Part B.
3. Draw the expected waveforms at step 3 of Part C.

Part A: Half Wave Rectifier without Filter

1. Set the function generator to obtain a 10V peak-to-peak sine wave at 500 Hz frequency. Do not connect any circuit to the function generator. Ensure that the dc offset of the function generator is set to 0. Observe the function generator output on the oscilloscope and verify sine wave generation.
2. Set up the circuit as shown in Fig. 1(a) without the capacitor C, taking R_L = 2.2kΩ and the function generator connected at points F_1 & F_2.
3. Display V_i and V_o simultaneously on the oscilloscope on Channel 1 and Channel 2 respectively. Sketch V_i and V_o, one below the other with identical time and amplitude axes.

Part B: Half Wave Rectifier with Capacitor Filter

1. Connect a capacitor with C = 22μF in the circuit with correct polarity as shown in Fig. 1(a).

2. Display V_i and V_o simultaneously on the oscilloscope on Channel 1 and Channel 2 respectively. Sketch V_i and V_o, one below the other with identical time and amplitude axes.
3. Measure peak-to-peak ripple voltage on oscilloscope by enlarging Vo to the maximum extent. You may have to put the input coupling in ac mode while doing this measurement. See the guidelines given at the end. Repeat steps 2 and 3 for R_L = 1kΩ and 4.7kΩ. Comment on the output waveforms and ripple voltages.
4. Connect a 56Ω resistance in series with C of Fig. 1(a) as shown in Fig. 1(b). The points across this 56Ω resistor are marked as p and q. Display and sketch Vo and V_{56} (i.e. voltage across 56Ω between 'p' and 'q') one below the other with identical time axes. Mark the ground reference line.

Please note that: The resistance 56Ω is chosen small enough not to affect the overall performance of the circuit and at the same time to ensure an appreciable voltage across it. This voltage represents the current flowing through the capacitor.

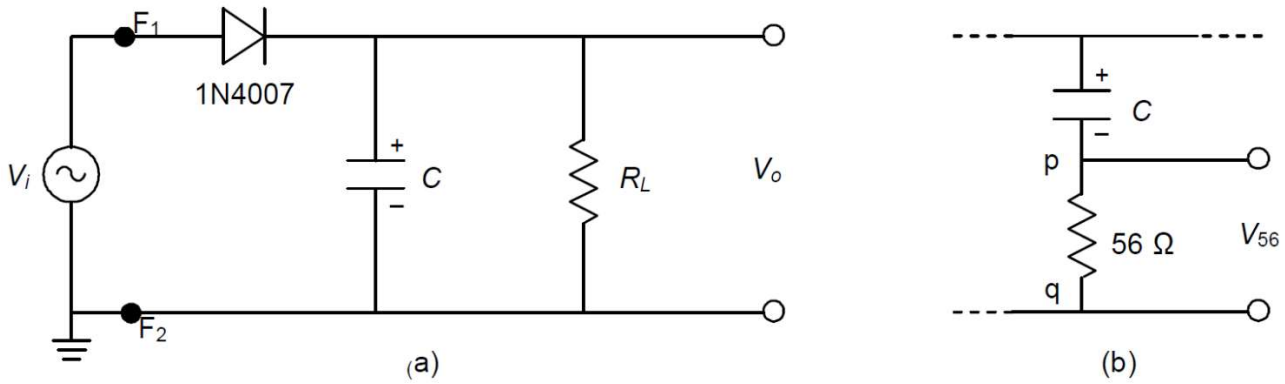

Fig.1

Part C: Clipping Circuit – Positive Clipper

1. Connect the circuit as shown in Fig. 2 with R = 2.2kΩ.
2. Set the function generator to get 20 V peak-to- peak sine wave at 500 Hz frequency. Observe the function generator output on the oscilloscope and verify sine wave generation. Connect the function generator output to the circuit as shown in Fig. 2.
3. Display V_i and V_o simultaneously on the oscilloscope on Channel 1 and Channel 2 respectively. Sketch V_i and V_o, one below the other with identical time and amplitude axes.
4. Set the oscilloscope in X-Y mode (V_i to Channel 2: X- input and V_o to Channel 1: Y-input) and sketch V_o versus V_i with equal x and y scales. Label the graph and ticks on the axes.

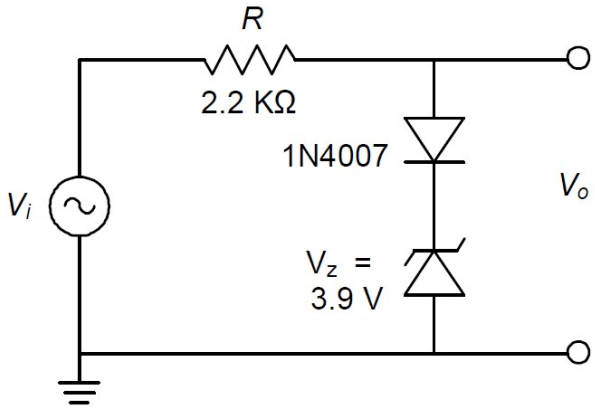

Fig. 2

Part D: 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. Why is the current through the capacitor $I_C(=V_{56}/56)$, negative for some portion of a cycle ? Estimate positive peak of the I_C (I_{surge}).
2. Draw circuit diagrams for: (a) –ve clipper (b) +ve and –ve clipper