Fall | 2011

Experiment 7

Diode Clipping and Clamping Circuits

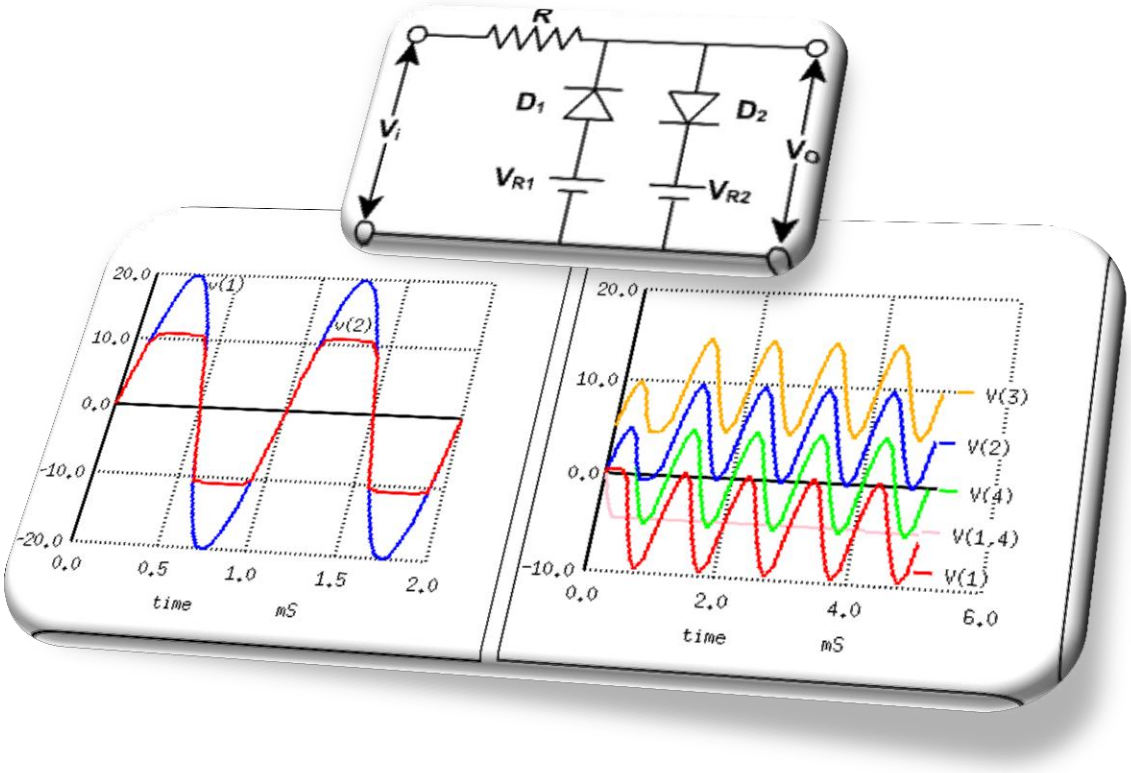

Table of Contents

I. OBJECTIVES

In this experiment you will:

- Investigate the diode clipping circuits, their characteristics and applications
- Investigate the diode clamping circuits, their characteristics and applications

II. MATERIAL AND PROCEDURE

Procedure

A. DIODE CLIPPING AND CLAMPING CIRCUITS

A1. ONE DIODE CLIPPING CIRCUIT

Connect the circuit of Fig. A-1. Apply a 2 V peak-to-peak, 1 KHz sinusoidal voltage, V_{IN}, and carefully measure V_{OUT}, comparing it with V_{IN}. Increase the amplitude of the input from 1 V to 10 V in steps of 1 V and repeat the measurements.

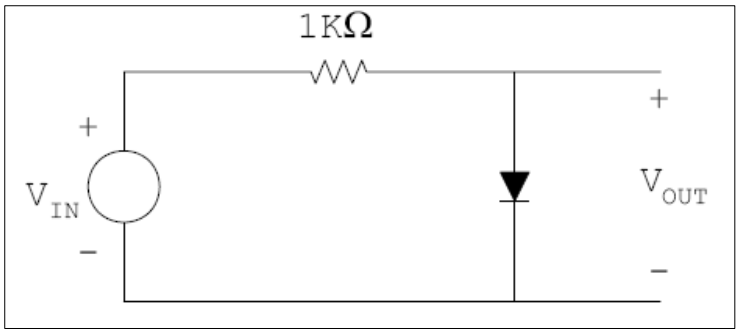

Figure A-1: Clipping Circuit with one diode

Exercise • Refer to in-lab 7 exercise A-1

A2. ZENER DIODES CLIPPING CIRCUIT

Connect the circuit of Fig A-2. Apply a 2 V peak-to-peak, 1 KHz sinusoidal voltage, V_{IN}, and measure VOUT. Increase the amplitude of the input from 1 V to 10 V in steps of 1 V, and repeat the measurements.

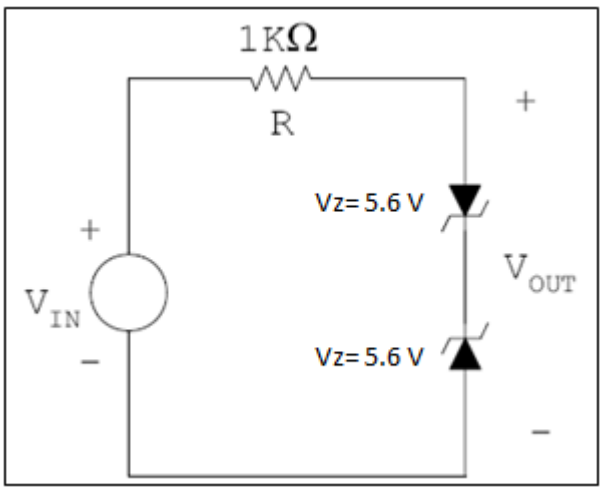

Figure A-2: Clipping circuit with two zener diodes

- When does clipping start?
- Is the clipped waveform perfectly symmetrical?

Exercise • Refer to in-lab 7 exercise A-2

A3. CLAMPPING CIRCUIT APPLICATION 1

Connect the circuit of Fig. A-3 with C = 0.1 µF. Apply a 10 KHz, 2 V peak-to-peak sinusoidal voltage and observe the V_{OUT} waveform. What is the relationship between the input and output waveforms. Verify by measuring the DC voltage across the capacitor.

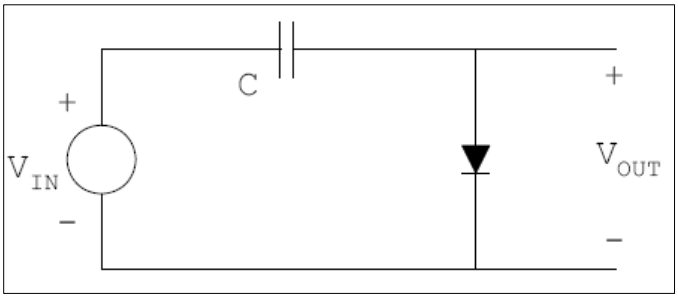

Figure A-3: Clapping circuit

- Repeat with the diode reversed.
- Repeat using a 2 V peak-to-peak, 10 KHz square wave.

Exercise • Refer to in-lab 7 exercise A-3

A4. CLAMPPING CIRCUIT APPLICATION 2

Connect a 10 KΩ resistor in parallel with the diode in Fig. A-3, and measure the DC shift of V_{OUT}.

Repeat with a 1 KΩ resistor. Explain the effect of the load resistor on the DC shift.

Exercise • Refer to in-lab 7 exercise A-4

A5. CLAMPPING CIRCUIT APPLICATION 3

Connect the circuit of Fig. A-4 with C = 0.1 µF and R = 10 KΩ. Apply a 10 V peak-to-peak, 1 KHz sinusoidal input. Observe V_{OUT}, first without the diode then with the diode.

- What is the effect of the diode on V_{OUT}? Why?

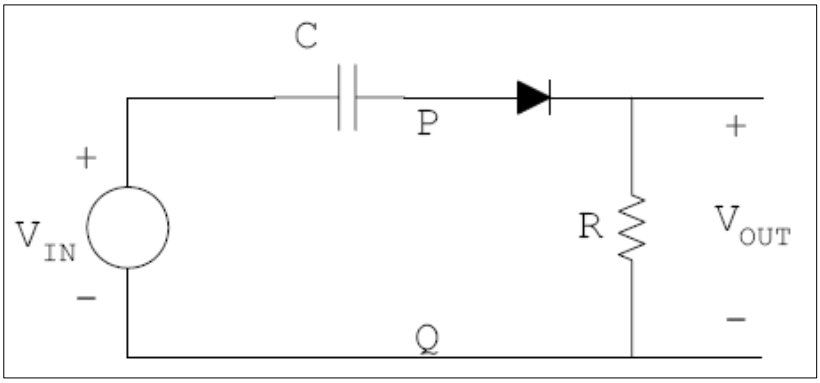

Figure A-4: Clapping Circuit

Connect a 1 KΩ resistor across PQ and observe V_{OUT}.

- What is the effect of this resistor?

Discussion on Part A

- Diodes may be used for overload protection of meters. A DC voltmeter consists of a resistance in series with a moving coil meter having a full-scale deflection of 1 mA and an internal resistance of 100 ohms, (see Fig. A-5). Assuming that the LED has an ideal characteristic with a 2 V offset, calculate R1 and R2 such that the current through the meter never exceeds 1.2 mA no matter how large an input voltage is applied. How would you protect the meter against reversal of polarity?

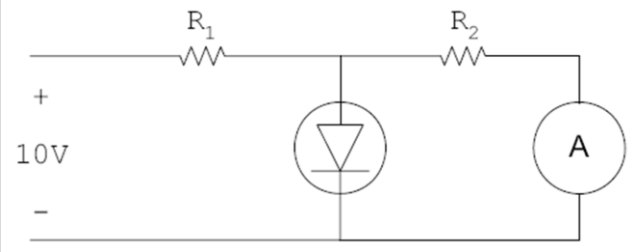

Figure A-5: Diode Application, meter protection

- A diode is sometimes connected across a relay coil to protect a switch from excessive voltage due to induced e.m.f. (see Fig. A-6). Explain the operation of the circuit. What is the maximum voltage across the switch upon opening? How does the diode affect the pick-up and release times of the relay?

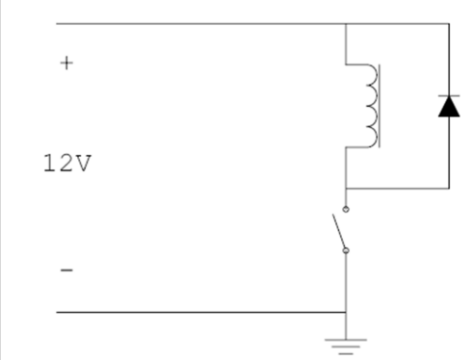

Figure A-6: : Diode Application, switch protection

Discussion on Part A

- Modify the circuit of Fig. A-2 so as to have symmetrical clipping, using a single Zener diode and a diode bridge.
- For effective clamping in Fig. A-3, what should be the relationship between the period of the applied waveform and the RC time constant?
- The circuit in Fig. A-7 illustrates a voltage multiplying rectifier circuit. Assuming ideal diodes, trace the peak charging voltage across the capacitors. Compare the voltages across AC, AD, BE and BF with the peak value of VIN.

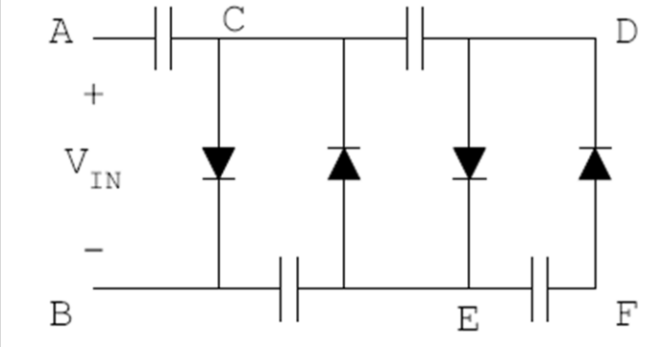

Figure A-7: Voltage Multiplier

III. OUTCOMES

By the end of Experiment VII, students:

- Are familiar with diode clipping circuits, their characteristics and applications
- Are familiar with diode clamping circuits, their characteristics and applications