EE230: Analog Circuits Lab
Lab No.3

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1 Full Wave Rectifiers

1.1 Centre Tapped Full-Wave Rectifier

1.1.1 Aim of the experiment

Verifying the functioning of the centre tapped full-wave rectifier using a transformer and diodes.

1.1.2 Design

Designed the circuit using 1N4007 diodes, R=22kohm

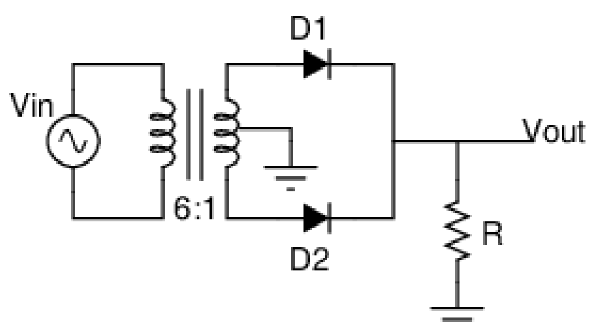

Figure 1: Circuit Diagram

1.1.3 Simulation results

DSO graphs of results

Figure 2: Inverting Amplifier

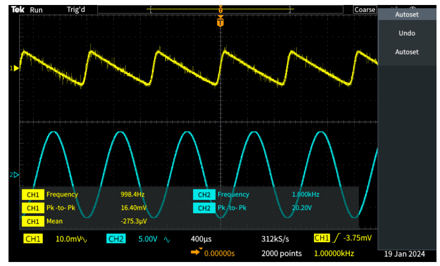

Figure 3: Maximum and Minimum of output

1.1.4 Experimental results

The output voltage is rectified to be constantly positive, and is flat instead of sinusoidal when input voltage is close to zero.

1.1.5 Conclusion and Inference

There is a drop of around 0.7V due to forward-biased diode drop. Current flows only through forward based diode resulting in constant positive output.

1.1.6 Experiment completion status

Complete.

1.2 Full-Wave Precision Rectifier

1.2.1 Aim of the experiment

Verifying the functioning of the full-wave precision rectifier using a a half-wave rectified circuit and inverting summer circuit.

1.2.2 Design

Designed the circuit using 1N4007 diodes and IC 741 OpAmp

$$V_o = -\frac{10k}{10k}V_{in} + -\frac{10k}{5k}V_{half_wave} \tag{1}$$

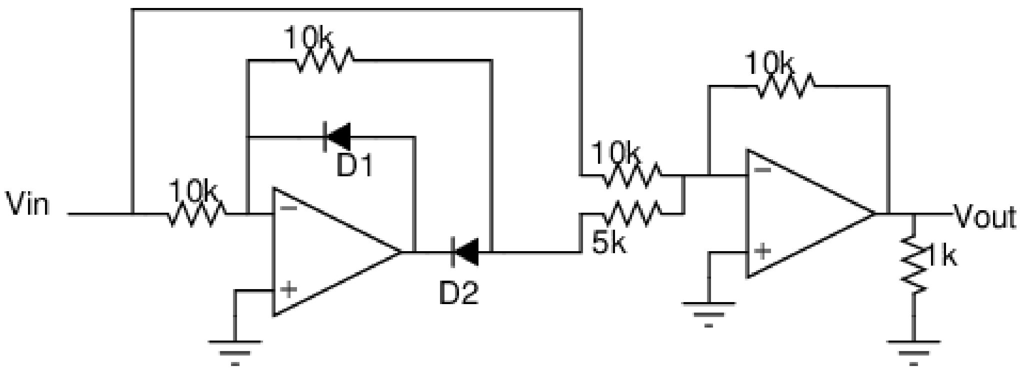

Figure 4: Circuit Diagram

1.2.3 Simulation results

DSO graphs of results

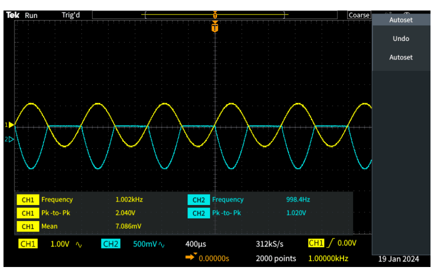

Figure 5: Half Wave Rectifier

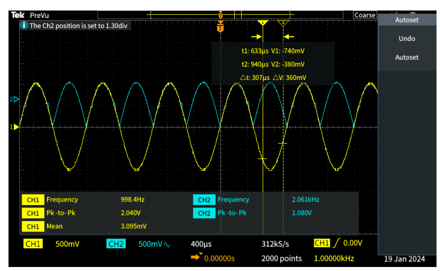

Figure 6: Full Wave Rectifier

1.2.4 Experimental results

The output voltage is rectified to be constantly positive, with no voltage drop compared to input voltage.

1.2.5 Conclusion and Inference

The correction due to OpAmp based circuit ensures no diode drop in half-wave rectifier, and the Inverting Summer takes a ratio of input and output such that output has equivalent amplitude and is always positive.

1.2.6 Experiment completion status

Complete.

2 Multivibrators

2.1 Astable Multivibrator

2.1.1 Aim of the experiment

Constructing and verifying the working of an astable multivibrator.

2.1.2 Design

Designed the circuit using OpAmp 741 and Zener Diodes (4.7V).

$$Timeconstant = RC \tag{2}$$

$$V_{TH} = V_{out} * \frac{R_1}{R_1 + R_2} = 6.875V \tag{3}$$

$$V_{TL} = -V_{out} * \frac{R_1}{R_1 + R_2} = -6.875V \tag{4}$$

$$Chargingtime : e^{t/RC} = 1 - \frac{6.875}{15} \tag{5}$$

2.1.3 Simulation results

DSO graphs of results

2.1.4 Experimental results

The output waves have frequencies 726Hz and 713Hz.

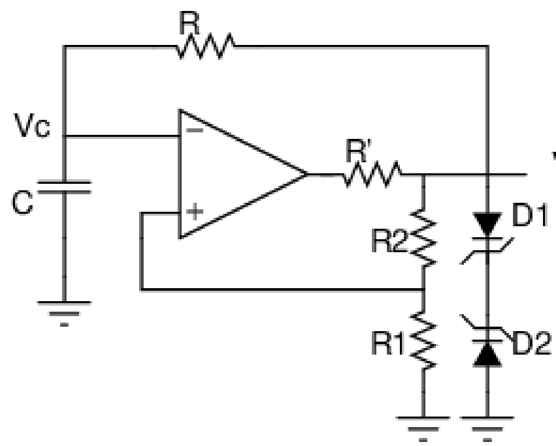

Figure 7: Circuit Diagram

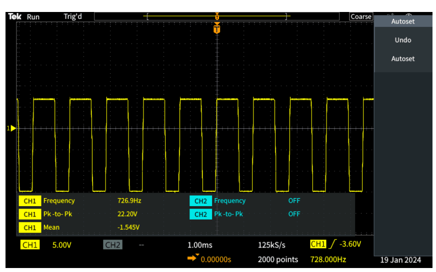

Figure 8: Astable multivibrator (without Zener diodes)

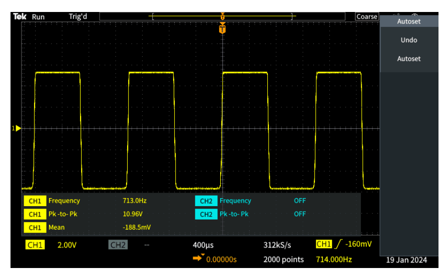

Figure 9: Astable multivibrator (with Zener diodes)

2.1.5 Conclusion and Inference

Output voltage keeps changing voltage every time Capacitor finishes charging/discharging to the value at positive terminal of OpAmp. The resistor R' functions to limit the current flowing out of the OpAmp into the diodes, and thus cannot be replaced with a short. The voltage at V_O1 is the maximum/minimum output voltage of OpAmp and at V_O is the total drop across both forward and reversed biased Zener diodes. Therefore, they are different.

2.1.6 Experiment completion status

Complete.

2.2 Monostable Multivibrator

2.2.1 Aim of the experiment

Constructing and verifying the working of a monostable multivibrator.

2.2.2 Design

Designed the circuit using OpAmp 741, Zener Diodes (4.7V) and 10uF electrolytic capacitor.

$$timeconstant = RC \tag{6}$$

$$t_{charge} = -\frac{R_2}{R_1} V_{in}(given|Vo| < 15V) \tag{7}$$

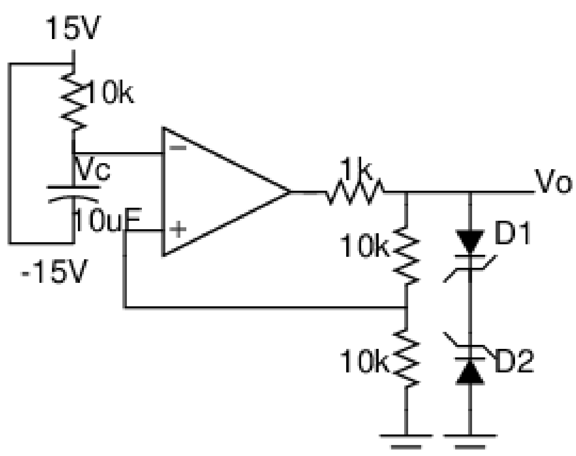

Figure 10: Circuit Diagram

2.2.3 Simulation results

DSO graphs of results

2.2.4 Experimental results

The output wave has a pulse width of 153ms.

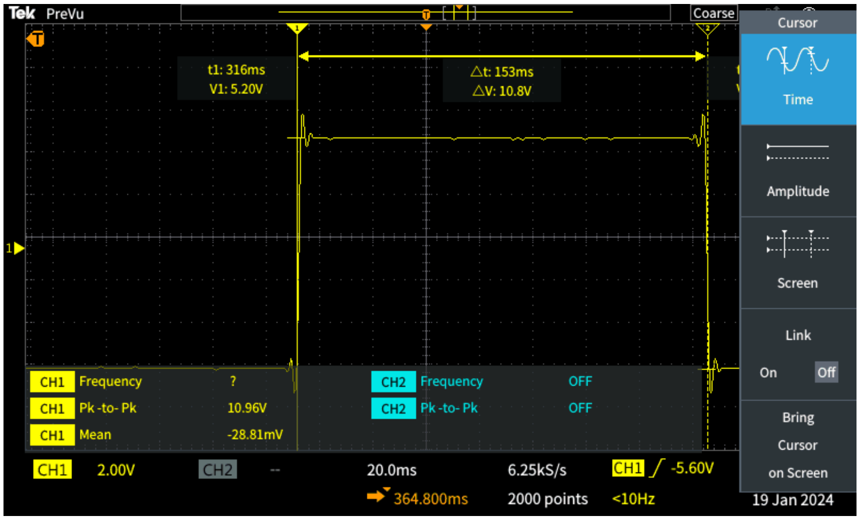

Figure 11: Monostable multivibrator

2.2.5 Conclusion and Inference

The capacitor is short circuited to discharge it nearly instantly. The circuit has 1 stable state, of value Vout = 5.4V

2.2.6 Experiment completion status

I assembled the circuit but couldn't complete it in class, but completed it during the weekend after assembling the circuit again, and using the instruments in Tinkerer's Laboratory.