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ENGINEERING SOFTWARE AND APPLICATIONS

LABORATORY REPORT

TITLE	FULL WAVE AND HALF WAVE RECTIFIER.
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1.0 Introduction

Circuit that converts alternating current (AC) into direct current (DC) are known as rectifiers.

Full wave rectifier:

Direct current (DC) is produced from alternating current (AC) via an electronic circuit known as a full-wave rectifier. While a half-wave rectifier only uses half of the AC input waveform, a full-wave rectifier uses both halves of the waveform. Popular full-wave rectifier types include the bridge rectifier and the centre-tap rectifier. In a centre-tap rectifier, a transformer with two diodes and a secondary winding tapped in the middle is used. To help create a smoother DC output, each diode conducts in turn during the positive and negative half-cycles of the AC input. A bridge rectifier, on the other hand, which is made up of four diodes arranged in a bridge configuration, does not require the use of a centre-tapped transformer. In this arrangement, the positive half-cycle is used by two diodes and the negative half-cycle is used by the remaining two. Complete-wave rectifiers produce a continuous and more stable DC output, making them suitable for applications like electronic devices and various power systems that require a steady and ripple-free power supply.

Half wave rectifier:

An electronic circuit known as a half-wave rectifier uses only half of the AC input waveform to convert alternating current (AC) to direct current (DC). The fundamental component of this device is a semiconductor diode, which only allows current to flow in one direction. This allows the positive half-cycles of the AC signal to pass through while obstructing the negative half-cycles. The diode conducts during the positive half-cycle, allowing current to flow through the circuit and providing a positive voltage to the load. But the diode stops the current during the negative half-cycle, so there is no output. Therefore, the output of a half-wave rectifier consists of discontinuous pulses that represent the only positive peaks of the input wave. Compared to full-wave rectifiers, half-wave rectifiers are simpler and less expensive, but they also produce a DC output with a lot more ripple and are less efficient. As such, they are used in situations where cost and simplicity are more important than the requirement for a steady and uninterrupted DC output.

2.0 Design and flow of Routines

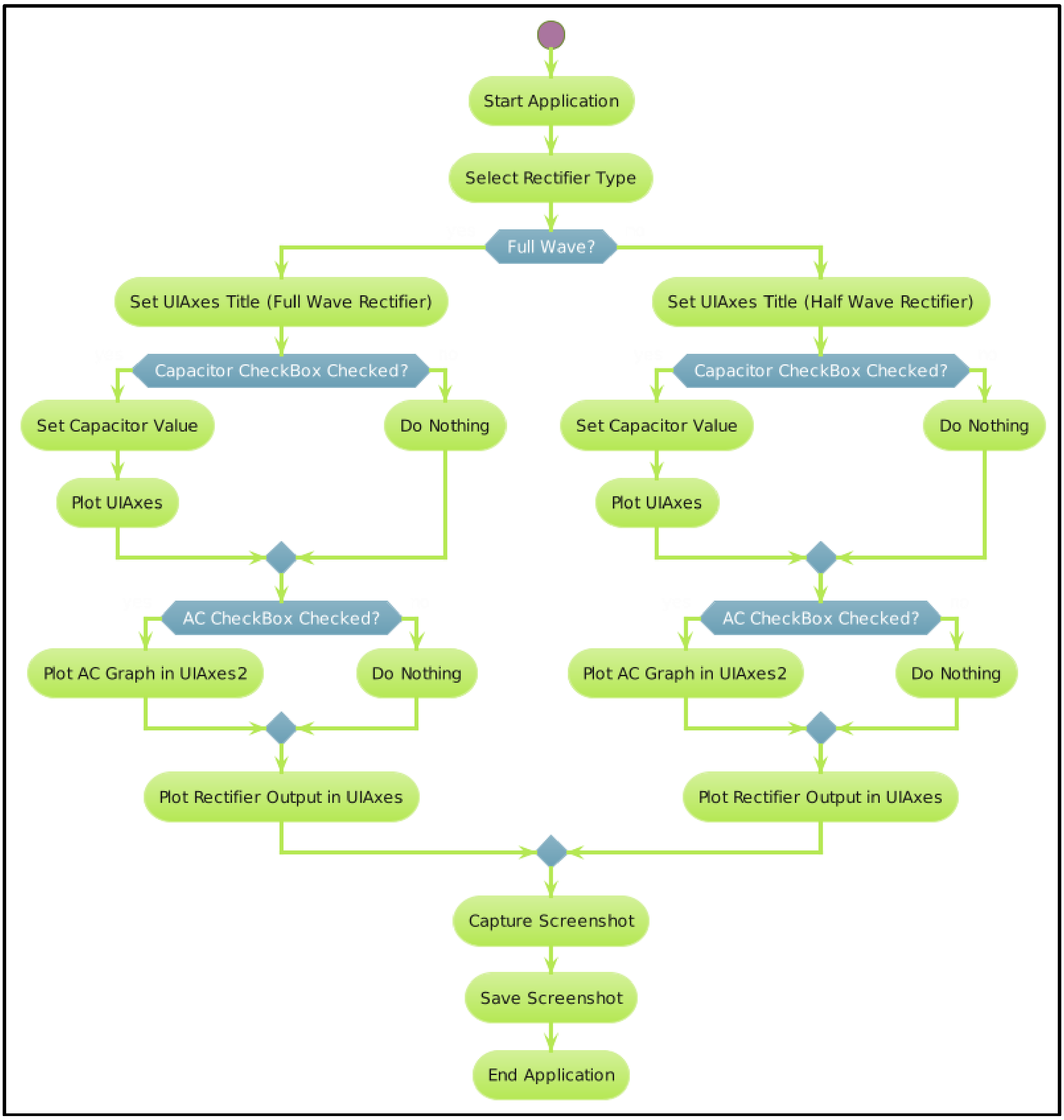

Figure 1- Flowchart

An illustration of the process for taking a screenshot of a full-wave rectifier circuit can be found in the image. The user chooses the kind of screenshot they wish to take at the start of the flowchart. The flowchart then asks if the user wants to add a capacitor to the circuit if they choose to use a full-wave rectifier. The flowchart will ask the user to enter the value of the capacitor if they so choose. The flowchart plots the full-wave rectifier circuit's output in the UlAxes plot window after the capacitor value has been entered.

The flowchart just plots the full-wave rectifier circuit's output in the UlAxes plot window if the user chooses not to include a capacitor in the circuit.

The flowchart then determines whether the user wishes to have an AC graph in the screenshot. If the user selects, the flowchart will show the AC graph of the input signal in the UlAxes2 plot window. If the user chooses not to include an AC graph, the flowchart skips this step.

Finally, the flowchart takes a screenshot, which is saved to the user's computer.

A more detailed explanation of each step in the flowchart can be found below:

Open the programme: The user opens the screenshot application.

Choose the Type of Rectifier: The rectifier circuit type (full-wave or half-wave) that the user wants to take a screenshot of is selected.

The flowchart verifies whether the user has chosen a circuit with a full-wave rectifier. The flowchart moves on to the following step if the user completed it.

Is the CheckBox for Capacitors checked? The capacitor checkbox in the screenshot application is checked or not based on the flowchart. The flowchart moves on to the following stage if it is. The flowchart moves on to step 6 if it isn't.

Set Capacitor Value: The user uses the screenshot application to input the capacitor's value.

Do Nothing: If the capacitor checkbox in the screenshot application is not checked, the flowchart will bypass this step.

Plot UlAxes: In the UlAxes plot window, the flowchart displays the output of the full-wave rectifier circuit.

Is the AC CheckBox set to ON? The flowchart determines whether the screenshot application's AC checkbox is checked. The flowchart moves on to the following stage if it is. The flowchart moves on to step 10 if it isn't.

Plot the AC in UlAxes2: The flowchart places the input signal's AC graph in the UlAxes2 plot window.

Do Nothing: If the AC checkbox in the screenshot application is not checked, the flowchart bypasses this step.

Plot Rectifier Output in UIAxes: The flowchart uses the UIAxes plot window to plot the full-wave rectifier circuit's output.

Take Screenshot: The flowchart takes a screenshot of the UIAxes and UIAxes2 plot windows.

Save Screenshot: Save Screenshot: The flowchart saves the screenshot to the user's computer.

Final Programme: The flowchart puts an end to the snapshot application.

3.0 Format and style of Routines

```
%Fullwave rectifier
if strcmp(app.DropDown.Value, "Full Wave");
    %app.FullWaveRectifierCheckBox.Value ==1
    app.UIAxes.Title.String = "Full Wave Rectifier";
    if app.CapacitorCheckBox.Value == 1
    c = 1e-4;
    assignin("base","Capacitor2", c);
    Vr1 = app.VoltageEditField.Value/(2*(app.FrequencyEditField.Value*1000*c));
    app.VoltageripplepeaktopeakvalueEditField.Value = Vr1;
    else
        c1 = 0;
        assignin("base","Capacitor2", c1);
    end

    if app.ACCheckBox.Value == 1
        assignin("base","Voltage2",app.VoltageEditField.Value);
        assignin("base","Frequency2",app.FrequencyEditField.Value);
        full2 = sim("Full_wave_rectifier");
        plot(app.UIAxes2,full2.fullwave_input.Time,full2.fullwave_input.Data);

    end
        assignin("base","Voltage2",app.VoltageEditField.Value);
        assignin("base","Frequency2",app.FrequencyEditField.Value);
        full1 = sim("Full_wave_rectifier");
        plot(app.UIAxes,full1.fullwave_output.Time,full1.fullwave_output.Data);
```

```
%Half wave rectifier
else

    app.UIAxes.Title.String = "Half Wave Rectifier";
    if app.CapacitorCheckBox.Value == 1
        c3 = 1e-4;
        assignin("base","Capacitor1", c3);
        Vr2 = app.VoltageEditField.Value/(app.FrequencyEditField.Value*1000*c3);
        app.VoltageripplepeaktopeakvalueEditField.Value = Vr2;
    else
        c4 = 0;
        assignin("base","Capacitor1", c4);
    end

    if app.ACCheckBox.Value == 1
        assignin("base","Voltage1",app.VoltageEditField.Value);
        assignin("base","Frequency2",app.FrequencyEditField.Value);
        half2 = sim("Half_wave_rectifier");
        plot(app.UIAxes2,half2.halfwave_input.Time,half2.halfwave_input.Data);

    end
        assignin("base","Voltage1",app.VoltageEditField.Value);
        assignin("base","Frequency1",app.FrequencyEditField.Value);
        half1 = sim("Half_wave_rectifier");
        plot(app.UIAxes,half1.halfwave_output.Time,half1.halfwave_output.Data);


end
```

Figure 2- Code for Start Button.

A function named full 1 that mimics a full-wave rectifier is displayed in the code. The voltage and frequency of the AC signal are two inputs used by the function. The rectified DC signal's voltage ripple peak-to-peak value is then computed.

To use the function, first create full2 MATLAB object, which is a representation of the full-wave rectifier circuit. Voltage and frequency are the two characteristics of the full2 object. The input voltage and frequency values are assigned to these properties, respectively.

Next, the full1 function simulates the full2 object.. The rectifier circuit's output voltage is computed in this simulation. After that, a graph is created using the output voltage.

In addition, two EditField objects, a CheckBox object, and a DropDown object are included in the code shown in the screenshot. The user can choose which kind of rectifier to simulate by using the DropDown object. The rectifier circuit's capacitor can be turned on or off by the user via the CheckBox object. The user can enter the AC signal's voltage and frequency using the EditField objects.

The full1 function is called in order to simulate the rectifier circuit and update the graph whenever the user modifies the value of any of these objects.

Half2 is a MATLAB function that mimics a half-wave rectifier. The voltage and frequency of the AC signal are the two inputs used by the function. The rectified DC signal's voltage ripple peak-to-peak value is then computed.

To use the function, first create the half1 MATLAB object, which is a representation of the half-wave rectifier circuit. Voltage and frequency are the two characteristics of the half1 object. The input voltage and frequency values are assigned to these properties, respectively.

The half2 function then simulates the half1 object. The rectifier circuit's output voltage is computed in this simulation. After that, a graph is created using the output voltage.

In addition, two EditField objects, a CheckBox object, and a DropDown object are included in the code shown in the screenshot. The user can choose which kind of rectifier to simulate by using the DropDown object. The rectifier circuit's capacitor can be turned on or off by the user via the CheckBox object. The user can enter the AC signal's voltage and frequency using the EditField objects.

The half2 function is called in order to simulate the rectifier circuit and update the graph whenever the user modifies the value of any of these objects.

```
if app.CapacitorCheckBox.Value == 1
    app.VoltageripplepeaktopeakvalueEditField.Visible = 'on';
    app.VoltageripplepeaktopeakvalueEditFieldLabel.Visible = 'on';
else
    app.VoltageripplepeaktopeakvalueEditField.Visible = 'off';
    app.VoltageripplepeaktopeakvalueEditFieldLabel.Visible = 'off';
end
```

Figure 3-Code for Capacitor Checkbox

The full-wave rectifier circuit is represented by MATLAB object full1. Three characteristics of the full1 object are its voltage, frequency, and capacitance. The input voltage, frequency, and capacitance values are assigned to these properties, in that order.

The full2 function then simulates the full1 object. The rectifier circuit's output voltage is computed in this simulation. The capacitor then filters the output voltage to eliminate ripple voltage. Next, a graph is created using the filtered output voltage.

Three EditField objects, a CheckBox object, and a DropDown object are also included in the code. The user can choose which kind of rectifier to simulate by using the DropDown object.

The rectifier circuit's capacitor can be turned on or off by the user via the CheckBox object. The user can enter the AC signal's voltage, frequency, and capacitance using the EditField objects.

The full2 function is called in order to simulate the rectifier circuit and update the graph whenever the user modifies the value of any of these objects.

```
 if app.ACCheckBox.Value == 1
    app.UIAxes2.Visible = 'on';
    set(app.UIAxes2.Children, 'Visible', 'on');
else
    app.UIAxes2.Visible = 'off';
    set(app.UIAxes2.Children, 'Visible', 'off');
end
```

Figure 4- Code for AC Checkbox

This function is typically used to show or hide a GUI element based on the value of a checkbox. For example, you could use this function to show or hide a chart when the user checks or uncheck a checkbox.

```
% Capture the UIAxes component
screenshot = getframe(app.UIFigure);

% Convert to image data
imageData = screenshot.cdata;

% Generate a timestamp for the filename
timestamp = datestr(now, 'yyyymmdd_HHMMSS');

% Create a unique filename with the timestamp
filename = ['screenshot_' timestamp '.png'];

% Save the image
imwrite(imageData, filename);

% Display a message indicating the screenshot was saved
msg = ['Screenshot saved as ' filename];
disp(msg);
```

Figure 5- Code for Screenshot Button

Half2 is a MATLAB function that mimics a capacitor-equipped half-wave rectifier. The voltage, frequency, and capacitance of the AC signal are the three inputs used by the function. The rectified DC signal's voltage ripple peak-to-peak value is then computed.
To use the function, first create the half1 MATLAB object, which is a representation of the half-wave rectifier circuit. Three characteristics of the half1 object are its voltage, frequency, and capacitance. The input voltage, frequency, and capacitance values are assigned to these properties, in that order.
The half2 function then simulates the half1 object. The rectifier circuit's output voltage is computed in this simulation. The capacitor then filters the output voltage to eliminate ripple voltage. Next, a graph is created using the filtered output voltage.
Three EditField objects, a CheckBox object, and a DropDown object are also included in the code shown in the screenshot. The user can choose which kind of rectifier to simulate by using the DropDown object. The rectifier circuit's capacitor can be turned on or off by the user via the CheckBox object. The user can enter the AC signal's voltage, frequency, and capacitance using the EditField objects.
The half2 function is called in order to simulate the rectifier circuit and update the graph whenever the user modifies the value of any of these objects.

4.0 Results and Analysis

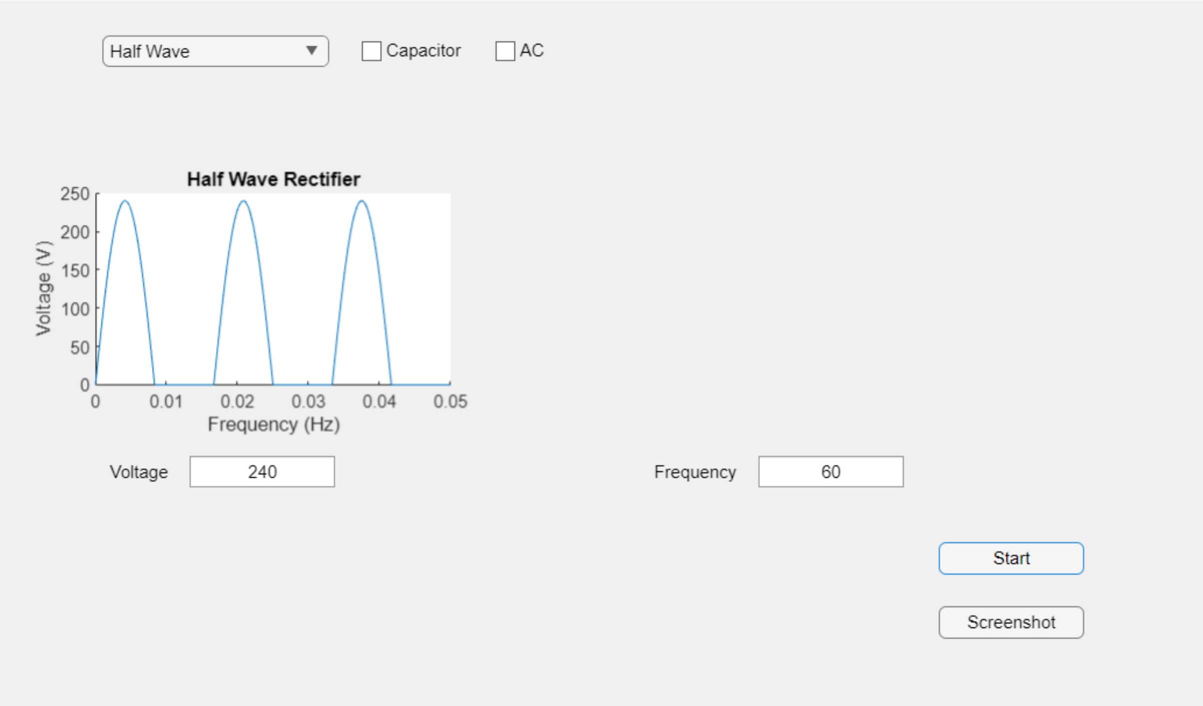

Figure 6- Half wave rectifier without capacitor.

The picture shows how half wave rectifier looks like in the graph when the program is run and for the voltage and frequency value are 240V and 60Hz.

Figure 7- Half wave rectifier with capacitor

The half wave rectifier in the picture is depicted with the capacitor in the graph at 240V and 60Hz voltage and frequency values, respectively, when the programme is operating.

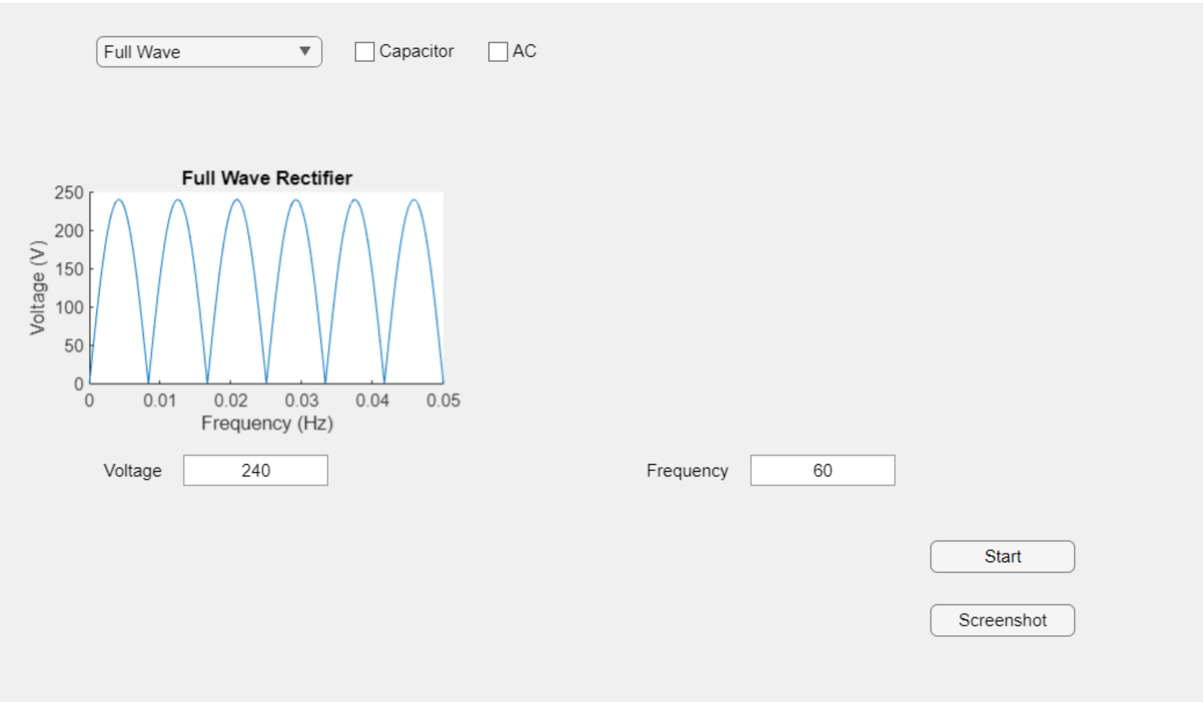

Figure 8- Full wave rectifier without capacitor

The picture shows how full wave rectifier looks like in the graph when the program is ran and for the voltage and frequency value are 240V and 60Hz.

Figure 9- Full wave rectifier with capacitor

The picture shows how full wave rectifier looks like with the capacitor in the graph when the program is run and for the voltage and frequency value are 240V and 60Hz.

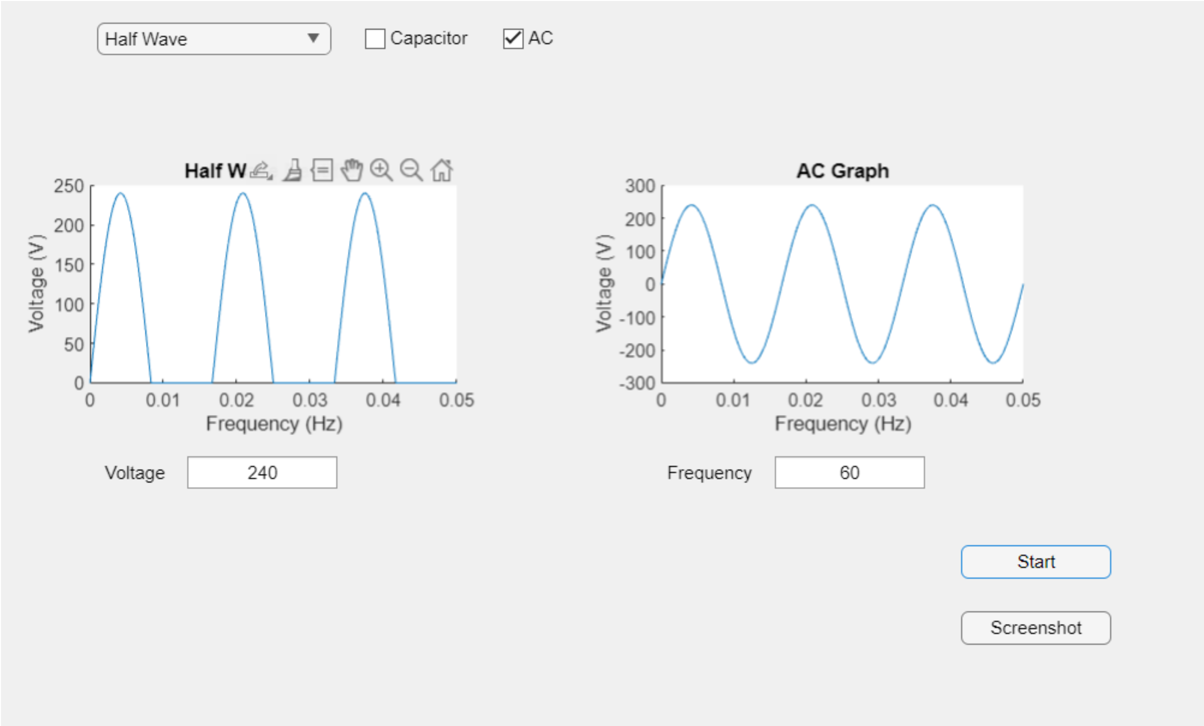

Figure 10- AC graph for half wave rectifier.

The picture shows how half wave rectifier looks like in the graph on the left and on the right that is how Input graph of AC looks like when the program is ran and for the voltage and frequency value are 240V and 60Hz.

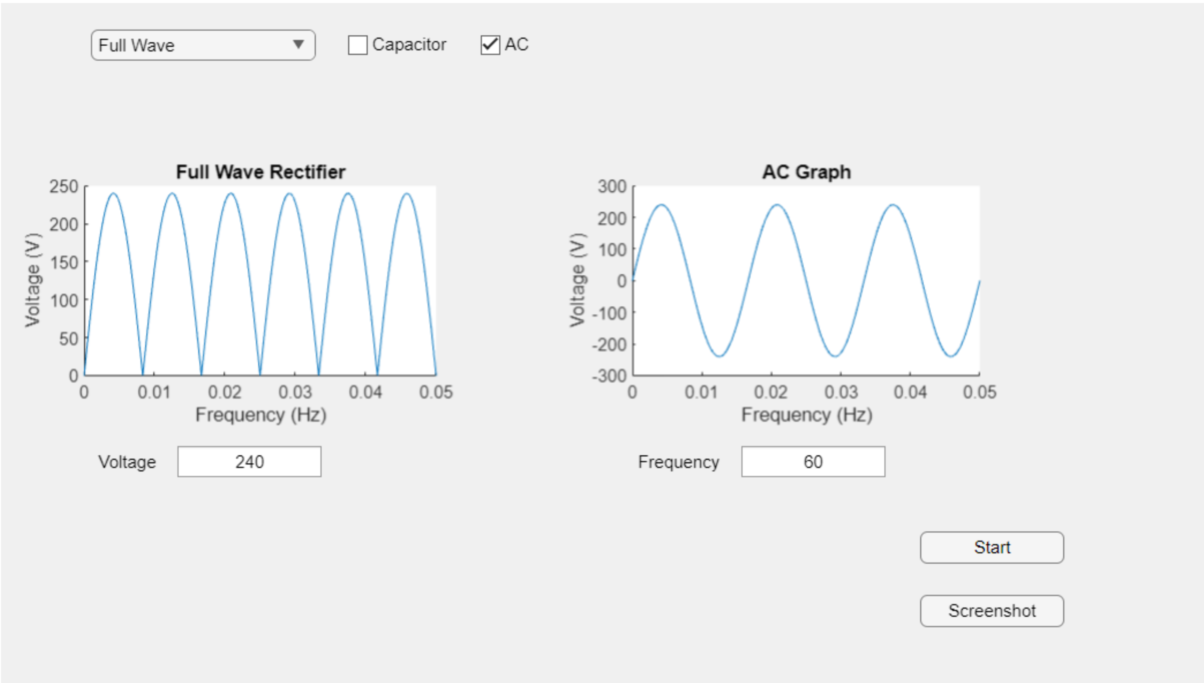

Figure 11- AC wave for full wave rectifier.

The picture shows how full wave rectifier looks like in the graph on the left and on the right that is how Input graph of AC looks like when the program is ran and for the voltage and frequency value are 240V and 60Hz.

5.0 Discussion

Understanding the working principles of full-wave and half-wave rectifiers was the goal of this report. Simulink was used to create circuits for both kinds of rectifiers in order to accomplish this goal. Variables that allowed users to enter specific values included parameters like voltage, frequency, and capacitance. Simulink runs the entire simulation process after the user enters the voltage and frequency parameters, producing graphs within the app designer interface. Furthermore, users can select whether or not to see capacitance on the graphs thanks to the addition of a capacitance option. Unless the full-wave rectifier box is checked, in which case the graph displays capacitance for the full-wave rectifier, if the capacitance box is selected, the default presentation shows capacitance for the half-wave rectifier.

6.0 Conclusion

In conclusion, this lab experiment gave us a deeper understanding of rectifier circuits and was an engaging, hands-on learning opportunity. Gaining knowledge about the operation of full-wave and half-wave rectifiers as well as the importance of capacitors in signal smoothing is a step towards a thorough comprehension of the fundamental concepts underlying the conversion of alternating current to direct current in electronic circuits.

7.0 Reference

- *Definition of Half-Wave Rectifier | Analog Devices*. (2022). Analog.com. https://www.analog.com/en/design-center/glossary/half-wave-rectifier.html

- Full-Wave Rectification and Half-Wave Rectification | Electronics Basics | ROHM. (n.d.). Www.rohm.com. https://www.rohm.com/electronics-basics/ac-dc/rectification

8.0 Appendix


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25 November 2023