Lab 12 Rectifier Circuits

Name _____ **Section** _____

PURPOSE

To construct and examine a half wave and a full wave bridge rectifier.
To measure and compare the output of these rectifiers.
To add a filter capacitor to both of these rectifiers and to re-measure and compare the output of these rectifiers with the filters added.

EQUIPMENT

LAB SUPPLIED PARTS

Oscilloscope
DMM
Test Leads
BNC to Clip Leads

PARTS KIT PARTS

1- Transformer (centre Tapped 12.6 V @ 1 Amp rated)
5- 1N400X diodes
2 - 470 mF Capacitor
2- 1 k resistor

DISCUSSION

The Unfiltered Rectifier

The purpose for rectifier circuits is to convert an AC source to DC level. That is, all current flows in one direction only through a load, positive or negative with respect to common (0V).

This DC level is an average of the peak load voltage (V_{peak}) over 360° and can be expressed as a constant

$(0.318)V_{L(peak)}$ - (half-wave rectification)
$(0.636)V_{L(peak)}$ - (full-wave rectification)

The frequency of the output waveform is directly related to the DC level and can be expressed as

$f_{OUT} = f_{IN}$ (half-wave rectification)
$f_{OUT} = 2f_{IN}$ (full-wave rectification)

PROCEDURE - The Half Wave Rectifier

1) Construct the circuit shown in Figure 1. ***Keep this circuit on your breadboard. You will add a filter capacitor to it later in the Lab.***

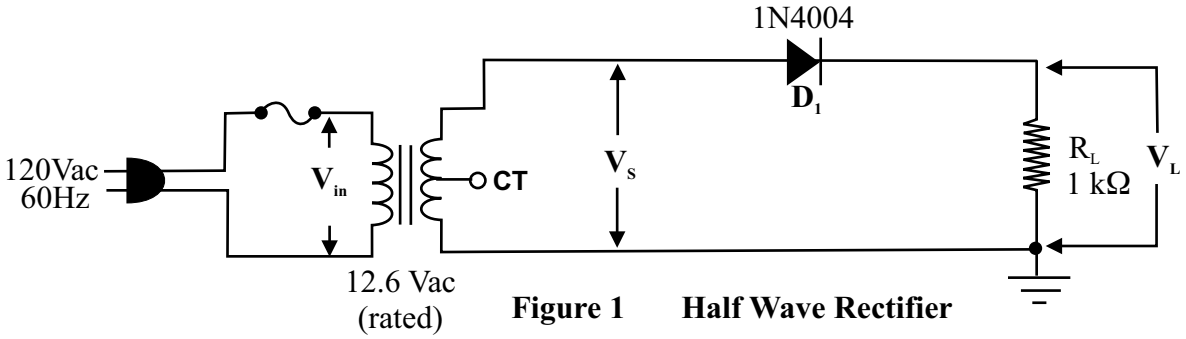


Figure 1 Half Wave Rectifier

The Half Wave Rectifier

2) Use the **DMM** to measure and record the following values.

- The full ac secondary voltage of the transformer. $V_{S\,ac}$ = _____

- The average dc level across the load resistor. V_L = _____

3) Use the **OSCILLOSCOPE** to measure and record the following values.
Sketch each waveform on the on the respective grids to the right.

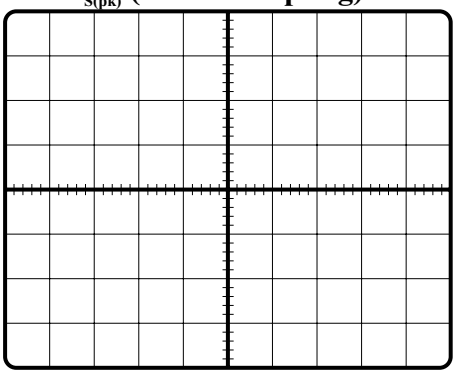
- The peak secondary voltage of the transformer. $V_{S(pk)}$ = _____

- The frequency of secondary voltage. f_{IN} = _____

- The peak output voltage across the load resistor. $V_{L(pk)}$ = _____

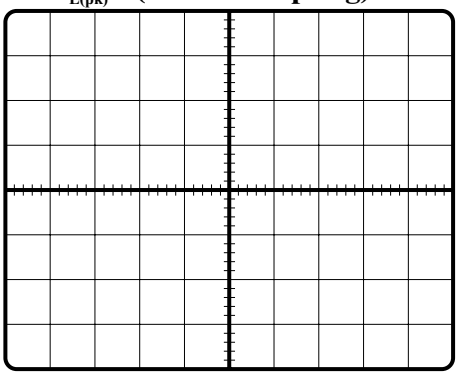
- The frequency of the load voltage. f_{OUT} = _____

$V_{S(pk)}$ (Use ac coupling)



Volts/Div: _____ **Time/Div:** _____

$V_{L(pk)}$ - (Use dc coupling)



Volts/Div: _____ **Time/Div:** _____

PROCEDURE - The Full Wave Bridge Rectifier

1) Construct the circuit shown in Figure 1. ***Keep this circuit on your breadboard. You will add a filtercapacitor to it later in the Lab.***

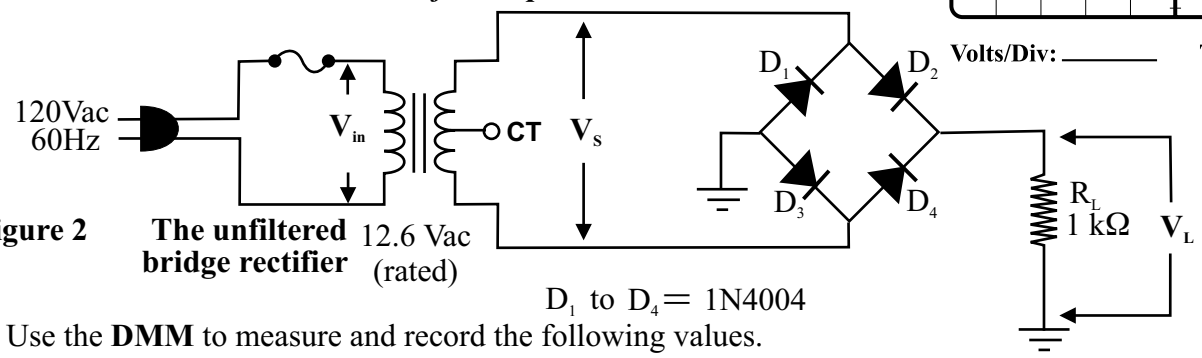


Figure 2 **The unfiltered bridge rectifier** 12.6 Vac (rated)

D_1 to D_4 = 1N4004

2) Use the **DMM** to measure and record the following values.

- The full ac secondary voltage of the transformer. $V_{S\,ac}$ = _____

- The average dc level across the load resistor. V_L = _____

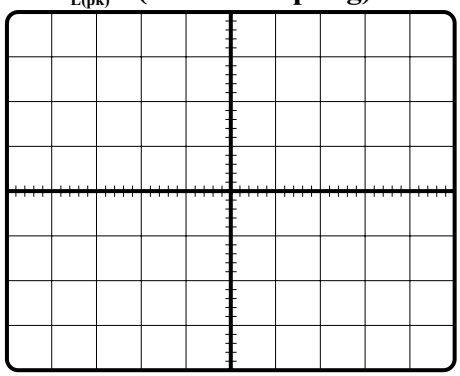
3) Use the **OSCILLOSCOPE** to measure and record the following values.

Sketch $V_{L(pk)}$ on the grid to the right.

- The peak output voltage across the load resistor. $V_{L(pk)}$ = _____

- The frequency of the load voltage. f_{OUT} = _____

$V_{L(pk)}$ - (Use dc coupling)



Volts/Div: _____ **Time/Div:** _____

Questions on the Unfiltered Rectifier

1) Comparing the two rectifier types, which has the highest dc level output?

_____

2) Comparing the output waveforms, which circuit has the highest output frequency?

_____

3) What happens when one of the diodes is removed from the bridge rectifier?

_____

4) What do you think would happen if one of the diodes in the bridge were to short? ***Do not try this with your circuit.***

_____

PART 2 - THE FILTERED RECTIFIER

DISCUSSION

The purpose of the filter capacitor is to reduce the amount of ripple voltage at the output of the rectifier circuit. The capacitor charges to approximately the peak voltage across the load $V_{L(pk)}$ and then discharges through the load as the rectified DC falls below V_{pk}.

As long as the discharge time for the capacitor is greater than the time between the peaks of the rectified dc, the load voltage can be found using the formula shown.

$$V_{dc} = V_{L(pk)} - (V_r/2)$$

PROCEDURE - The Half Wave Filtered Rectifier

1) Using your original half wave rectifier circuit, insert the filter capacitor as shown in Figure 3.. ***Be sure to observe the capacitor polarity.***

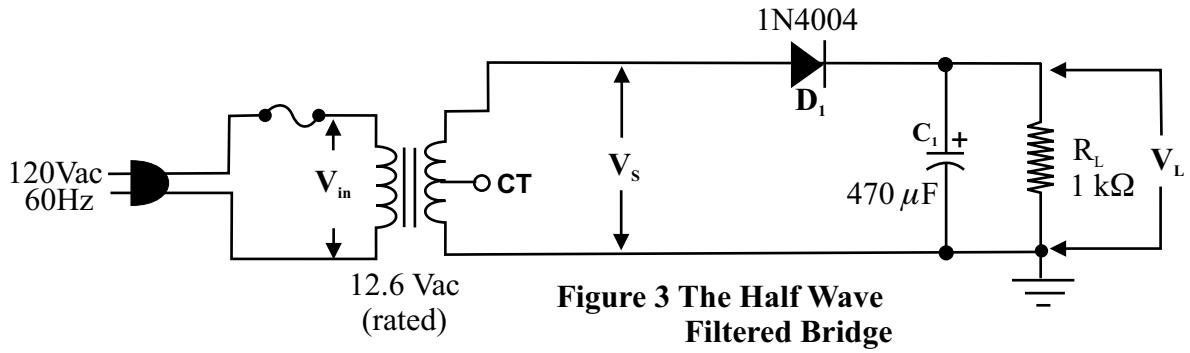


Figure 3 The Half Wave Filtered Bridge

The Half Wave Filtered Rectifier

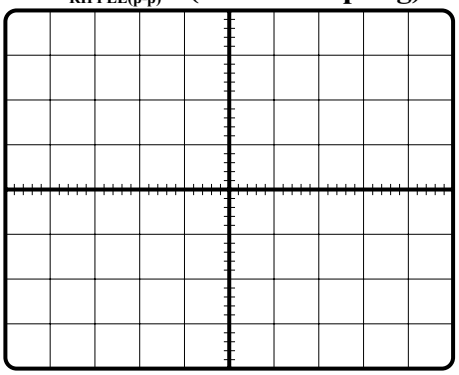
2) Use the **DMM** to measure and record the following values.

- The average dc level across the load resistor. V_L = _____

3) Use the **OSCILLOSCOPE** to measure and record the following values.
Sketch the ripple voltage on the grid to the right.

- The peak output voltage across the load resistor. $V_{L(pk)}$ = _____
- The peak-to-peak ac ripple voltage across the load. $V_{r(p-p)}$ = _____
- The frequency of the ripple voltage. f_{RIPPLE} = _____

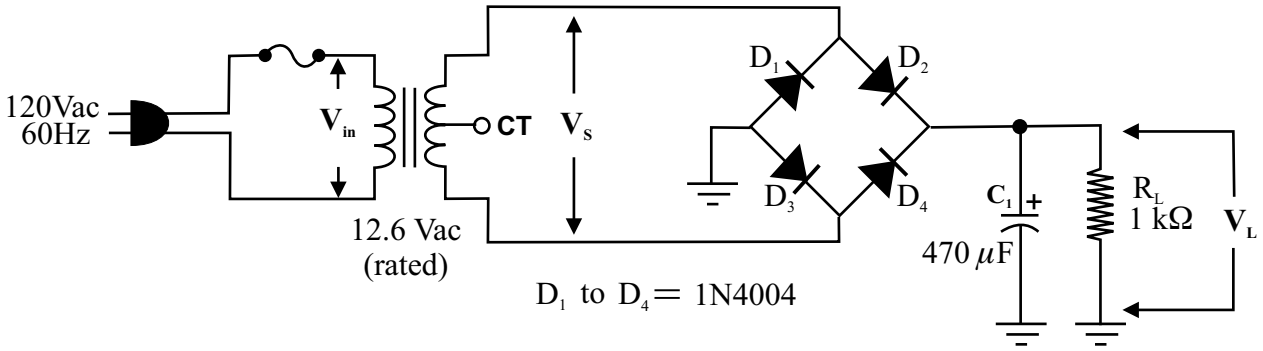
$V_{RIPPLE(p-p)}$ - (Use ac coupling)



Volts/Div: _____ **Time/Div:** _____

PROCEDURE - The Full Wave Bridge Rectifier

1) Using your original half wave rectifier circuit, insert the filter capacitor as shown in Figure 3.. ***Be sure to observe the capacitor polarity.***



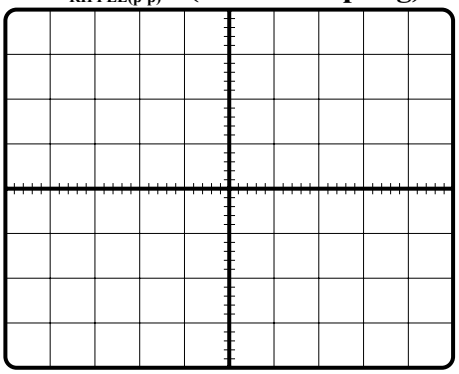
2) Use the **DMM** to measure and record the following values.

- The average dc level across the load resistor. V_L = _____

3) Use the **OSCILLOSCOPE** to measure and record the following values.
Sketch the ripple voltage on the grid to the right.

- The peak output voltage across the load resistor. $V_{L(pk)}$ = _____
- The peak-to-peak ac ripple voltage across the load. $V_{r(p-p)}$ = _____
- The frequency of the ripple voltage. f_{RIPPLE} = _____

$V_{RIPPLE(p-p)}$ - (Use ac coupling)



Volts/Div: _____ **Time/Div:** _____

Lab 12 Rectifier Circuits

Troubleshooting (Filtered Bridge Rectifier)

1) Remove **one** of the diodes from the bridge and measure the following values. Measure V_L with a DMM and V_r and f_{ripple} with the oscilloscope.

V_L = _____ $V_{r\,(p\text{-}p)}$ = _____ f_{ripple} _____

2) Why does the ripple voltage increase when a diode is removed from the filtered bridge circuit . Why does the frequency change to half of what it was before the diode was removed?

_____

_____

_____

_____