Laboratory Application Assignment

In this lab application assignment you will examine half-wave and full-wave rectifier circuits. In each circuit you will analyze the output voltage waveforms and values with and without a filter capacitor connected to the output.

Equipment: Obtain the following items from your instructor.

- Isolation transformer and Variac
- Transformer: 120-V primary, 25.2-V, 2-A secondary with center tap
- Two 1N4002 silicon diodes or equivalent
- 470-μF electrolytic capacitor
- 1 kΩ, ½-watt carbon-film resistor
- DMM and oscilloscope

Caution: In this lab you will be working with 120 Vac. For your safety, you will need to use an isolation transformer. Plug the isolation transformer into the 120-Vac outlet on your benchtop and in turn plug a Variac into the isolation transformer. Next, adjust the Variac for an output of 120 Vac. This is the voltage you will apply directly to the primary of the transformer.

Transformer Measurements

Connect the circuit in Fig. 27–37*a*. With exactly 120 Vac applied to the primary, measure and record the following rms values of secondary voltage. (Use your DMM.) Note that V_1 and V_2 each represent the voltage measured from one side of the transformer secondary to the center tap, whereas V_S represents the full secondary voltage.

V_1 = ________, V_2 = ________, V_S = ________

Are these voltages approximately 10% higher than the rated values? ____

If yes, explain why. ____

____

Use these measured values in all your calculations that follow.

Half-Wave Rectifier

Examine the half-wave rectifier in Fig. 27–37*a*. Calculate and record the following circuit values:

$V_{out(pk)}$ = ________, V_{dc} = ________, I_L = ________, I_D = ________, f_{out} = ________

Connect channel 1 of your oscilloscope to the top of the transformer secondary and channel 2 across the load resistor, R_L. Set the channel 2 input coupling switch to dc. Adjust the sec./div. control of the oscilloscope to view at least two complete cycles of secondary voltage. Draw the channels 1 and 2 waveforms on the scope graticule provided in Fig. 27–38. Label each waveform. From your displayed waveforms, what is

a. The peak output voltage across the load resistor, R_L?
$V_{out\ (pk)}$ = ________

Figure 27–37

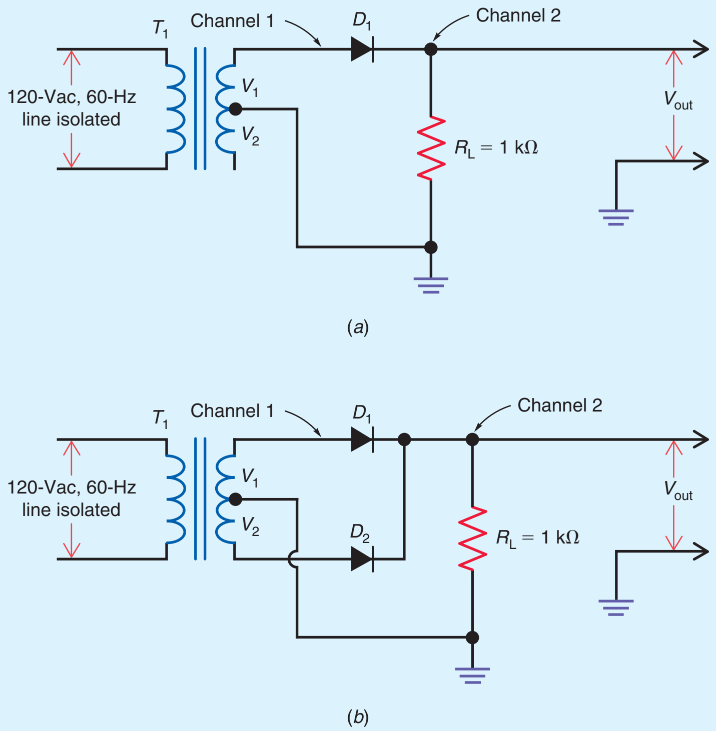
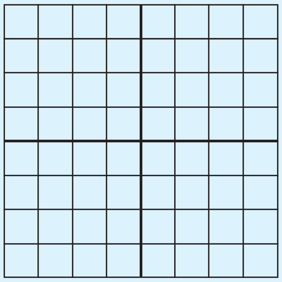


Figure 27–38



b. The period, T, and frequency, f, of the secondary voltage?
$T =$ ________, $f =$ ________
c. The period, T, and frequency, f, of the load voltage?
$T =$ ________, $f =$ ________

Next, measure and record the dc load voltage and current:
$V_{dc} =$ ________, $I_L =$ ________
Connect a 470-μF filter capacitor across R_L. (Observe polarity.)
Remeasure V_{dc} and I_L. $V_{dc} =$ __________, $I_L =$ ____________
Did the filter capacitor increase the dc load voltage? ________ If yes, why did this happen? ______________________________

____

Explain the waveform that is now displayed on channel 2 of your oscilloscope. ______________________________

____

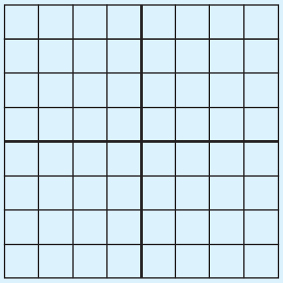
Change the channel 2 input coupling switch to ac, and reduce the volts/div. setting. Measure and record the peak-to-peak ripple voltage. $V_{ripple} =$ ________

Full-Wave Rectifier

Examine the full-wave rectifier in Fig. 27–37*b*. Calculate and record the following circuit values:
$V_{out(pk)} =$ ________, $V_{dc} =$ ________, $I_L =$ ________,
$I_D =$ ________, $f_{out} =$ __________

Construct the full-wave rectifier in Fig. 27–37*b*. Connect channel 1 of your oscilloscope to the top of the transformer secondary and channel 2 across the load resistor, R_L. Set the channel 2 input coupling switch to dc. Adjust the sec./div. control of the oscilloscope to view at least two complete cycles of secondary voltage. Draw the channels 1 and 2 waveforms on the scope graticule provided in Fig. 27–39. Label each waveform. From your displayed waveforms, what is

Figure 27–39



a. The peak output voltage across the load resistor, R_L?
$V_{out(pk)} =$ ________
b. The period, T, and frequency, f, of the secondary voltage?
$T =$ ________, $f =$ ________
c. The period, T, and frequency, f, of the load voltage?
$T =$ ________, $f =$ ________

Next, measure and record the following dc values:
$V_{dc} =$ ________, $I_L =$ ________, $I_{D_1} =$ ________,
$I_{D_2} =$ ______________
Connect a 470-μF filter capacitor across R_L. (Observe polarity.)
Remeasure V_{dc} and I_L. $V_{dc} =$ ________, $I_L =$ ________
Did the filter capacitor increase the dc load voltage? ________ If yes, why did this happen? ______________________________

____

Explain the waveform that is now displayed on channel 2 of your oscilloscope. ______________________________

____

Change the channel 2 input coupling switch to ac, and reduce the volts/div. setting. Measure and record the peak-to-peak ripple voltage. $V_{ripple} =$ ________ How does this value compare to what was measured in the half-wave rectifier? ______________