EET-200L v15.1

Power Supplies

Half-Wave Rectifier

Use your oscilloscope to take screenshots in all places where a space is provided to graph the waveform. Your screenshot should include your name/initials and relevant measurements. Post your screenshots as a reply to the Topic for this lab exercise.

PROJECT 65

Name: ______________________________ Date: ____________

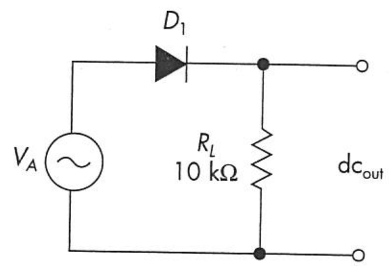


FIGURE 65-1

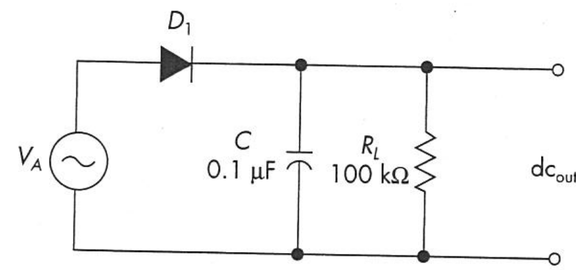


FIGURE 65-2

PROJECT PURPOSE The purpose of this project is to demonstrate the action of a simple half-wave rectifier and the effects of capacitor filtering.

PARTS NEEDED

- ☐ DMM
- ☐ Oscilloscope
- ☐ CIS
- ☐ Function generator or audio oscillator
- ☐ Diode: Silicon, 1-amp rating
- ☐ Resistors
  - 10 kΩ
  - 100 kΩ
- ☐ Capacitors
  - 0.1 μF
  - 1.0 μF

SPECIAL NOTE:

The following formulas will be helpful for drawing proper conclusions about the results of your work:

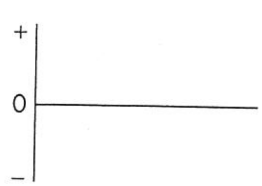
Input V_{rms} $= 0.707 \times V_{pk}$ Effective ac

Output V_{dc} $= 0.318 \times V_{pk}$ Average dc out

PROCEDURE

1. Connect the initial circuit as shown in Figure 65-1.
2. Set the function generator (sine-wave mode) or audio oscillator to a frequency of 100 Hz and V_A to 3 V_{rms}. Sketch two complete cycles of the input waveform in the "Observation" section.

OBSERVATION Waveform:



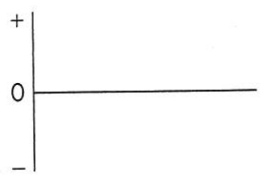
3. Measure the dc voltage output across R_L (dc_{out}).

OBSERVATION dc_{out} = ______________________ V.

CONCLUSION The dc output voltage should be approximately what percentage of the rms input voltage? Approximately __________ %. Since the average voltage value over one ac alternation is $0.637 \times V_p$ and the effective value is $0.707 \times V_{pk}$, then V_{dc} must be about __________ tenths of V_{rms}, because 0.637 is about __________ tenths of 0.707. Since the diode can conduct only half the time with ac applied, the average dc_{out} for the half-cycle the diode *does not* conduct is ________ V.

4. Connect the oscilloscope across R_L. Sketch the waveform for two complete cycles in the "Observation" section. Indicate the maximum and minimum voltage levels.

OBSERVATION Waveform:



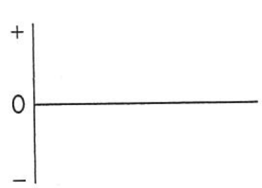
CONCLUSION For the half-cycle the diode does conduct, the peak V_{out} should be about __________ times V_{rms} (neglecting the small diode voltage drop). The end result is that the average dc_{out} over the *entire cycle* of ac input is about ________ times V_{rms} (again, neglecting the diode voltage drop).

5. Connect a 0.1-μF filter capacitor in parallel with a new value of R_L, as shown in Figure 65-2.

6. Set the function generator (sine-wave mode) to a frequency of 100 Hz and an amplitude of 3 V_{rms}. Sketch two complete cycles of the input waveform. Measure and record the ac input voltage (ac_{in}).

OBSERVATION ac_{in} = ______________________ V.

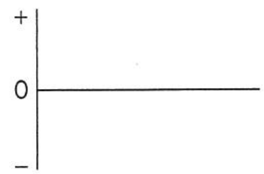
Waveform:



7. Measure and record the dc voltage output across R_L (dc_{out}). Sketch two complete ac cycles of the oscilloscope waveform found across R_L.

OBSERVATION dc_{out} = ______________________ V.

Waveform:



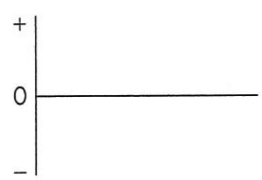
CONCLUSION Is the dc output voltage higher or lower than the effective ac input voltage? ________. This can be explained by the fact that the filter capacitor charges to the ____________ ______________________ value of the input voltage, rather than the average or effective values. Since the charge path for the capacitor is through the low resistance of the forward-conducting diode, the capacitor has time to charge to the __________ ______________________ value of the input voltage. But when the input voltage begins to decrease from its ____________________ value, the capacitor begins to ____________________ slowly through the load resistor, R_L. Before the capacitor can discharge completely, the next cycle of ac will reach a point where it is higher than the voltage remaining on the capacitor. The diode thus begins to conduct again and charge the capacitor to the __________________ voltage value again.

8. Replace the 0.1-µF filter capacitor with a 1.0-µF capacitor.

9. Record the dc_{out} and sketch two complete ac cycles of the oscilloscope waveform found across R_L.

OBSERVATION dc_{out} = ______________________ V.

Waveform:



CONCLUSION Is dc_{out} higher or lower with the 1.0-µF filter capacitor? __________________. This is because the *RC* discharge time with the 1.0-µF filter capacitor is much __________________ than with the 0.1-µF capacitor. The larger the value of filter capacitor, the (*higher, lower*) ____________________ the amount of discharge during each nonconducting half-cycle for the diode. This means the average dc output voltage (*increases, decreases*) __________________ with increasing values of filter capacitance.

Power Supplies
Bridge Rectifier

PROJECT **66**

Name: ______________________ Date: ____________

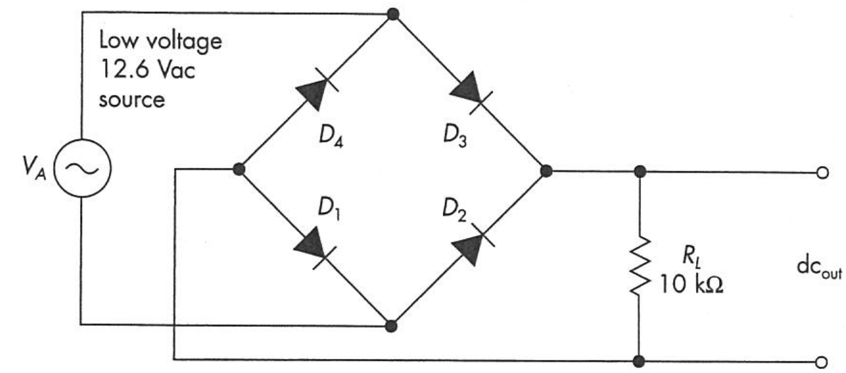


FIGURE 66-1

NOTE:
ONLY MEASURE THE OUTPUT VOLTAGE OF THESE CIRCUITS. DO NOT CONNECT YOUR SCOPE PROBE TO MEASURE THE 12.6 VAC INPUT. You cannot measure the input and output voltages of this full-wave bridge rectifier simultaneously with the probes we have in the lab. You will cause a short to ground, possibly damaging a diode and/or the 12.6VAC output.

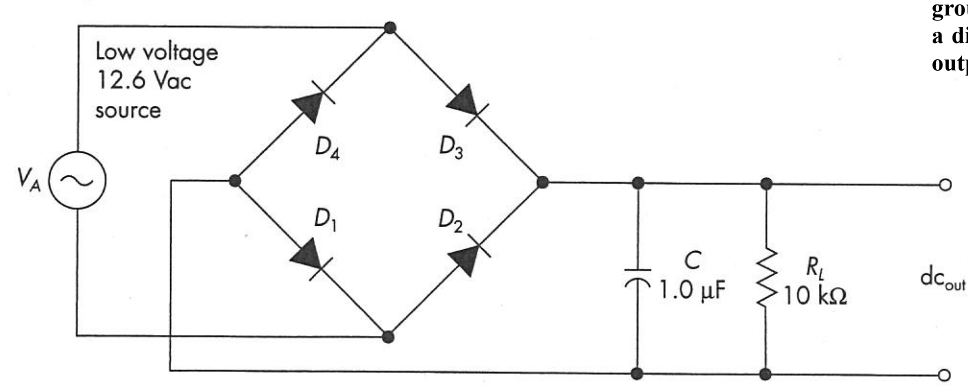


FIGURE 66-2

PROJECT PURPOSE In this project you will study the action of a bridge rectifier and demonstrate the effects of capacitor filtering.

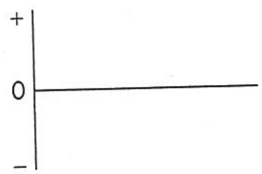
PARTS NEEDED

- ☐ DMM
- ☐ Oscilloscope
- ☐ CIS
- ☐ Function generator or audio oscillator
- ☐ Diodes: Silicon, 1-amp rating (4)
- ☐ Resistor 10 kΩ
- ☐ Capacitor 1.0 μF
- ☐ Transformer (12.6 V with center-tapped secondary) or, a 12.6 Vac source

PROCEDURE

1. Connect the initial circuit as shown in Figure 66-1.
2. Apply 12.6 Vac to the circuit. Measure the dc voltage output across R_L (dc_{out}).
3. Sketch the secondary waveform. Indicate the maximum and minimum voltage levels. Measure the secondary voltage.

OBSERVATION Waveform:



ac_{sec} = ______________________ V_{rms}.

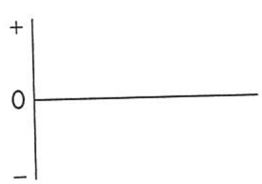
4. Measure the dc voltage output across R_L (dc_{out}).

OBSERVATION dc_{out} = ______________________ V.

CONCLUSION Current (*flows, does not flow*) ______________ through R_L on both alternations of each ac input cycle. This means the bridge rectifier is a (*half-wave, full-wave*) ______________ rectifier. According to theory, if there were no diode voltage drops, the average dc output of the bridge circuit without filtering should be __________ × V_{rms} of the applied ac. Does your measured value of dc_{out} for this step agree reasonably with theory? ________. How do you account for most of the difference, if any? ____
____
____.

5. Connect the oscilloscope across R_L. Sketch the waveform for two complete cycles in the "Observation" section. Indicate the maximum and minimum voltage levels.

OBSERVATION Waveform:



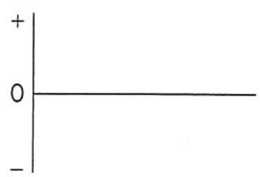
CONCLUSION The frequency of the waveform across the output resistor is (*one-half, equal to, double*) ______________________________ the secondary frequency.

6. Connect the 1.0-μF filter capacitor across R_L as shown in Figure 66-2.
7. Measure and record the ac voltage at the secondary (ac_{sec}) and the dc voltage output across R_L (dc_{out}). Sketch two complete ac cycles of the oscilloscope waveform found across R_L.

OBSERVATION ac_{sec} = ______________________________ V_{rms}.

dc_{out} = ______________________________ V_{rms}.

Waveform:



CONCLUSION What is the highest voltage output we could get from this circuit with a secondary voltage of 7 V_{rms} and no load current? About __________ V. What is the value of load current according to our measured value of V_{out}? __________ mA. The filter capacitor causes the dc level of V_{out} to be (*higher, lower*) ______________________________ than if it were not in the circuit. This filter capacitor has (*more, less*) ____________________ time to discharge between charging pulses in a bridge circuit than in a half-wave rectifier circuit. The reason for this answer is that the bridge rectifier has ____________________ charging pulses for each complete cycle of the ac input waveform. The capacitor in a bridge rectifier will not discharge to as low a value of voltage between charging pulses as in a half-wave rectifier. When compared to a half-wave rectifier, the average voltage output of a bridge rectifier will be (*higher, lower*) ______________________________ and remain closer to (*peak, effective, average*) ______________________________ of the secondary voltage than for a half-wave rectifier having the same R_L and filter capacitor.