AUSTRALIAN NATIONAL UNIVERSITY
School of Engineering

ENGN1218 – Introduction to Electronics

HALB #4: Full-Wave Rectifier Implementation

Aims

In this lab you will implement a full-wave rectifier circuit on a proto-board demonstrating its performance.

1. Implement and solder a bridge rectifier circuit on a proto-board, demonstrating its performance
2. A formal report should be prepared and submitted later for the work on the full-wave rectifier design. Thus it would be a good idea to take some photos of the assembled circuit for inclusion in the report.

Preliminary Work

1. Read Lecture notes on a full-wave rectifier circuit
2. Q1) Predict the full-wave rectifier output voltage *Vout(p)* using the *Vsec(p)=12 √2* for the circuit shown in Figure 1 and fill in Table 1. Note that there are two diodes involved in each power cycle.
3. Q2) Predict *Vout(DC), Vr(pp)* for the circuit shown in Figure 2 by using the predicted output voltage *Vout(p)* from Q1). Fill them in Table 2 accordingly.

Lab Task

1. Complete Procedures implementing a full-wave rectifier on a prototyping board using an IC regulator (78L12) and attach a LED diode at the output load to indicate the presence of the regulated output voltage.

Post-Lab Task

1. Download PSPICE schematic: *full_rectifier_v1.0* from Wattle
2. Perform PSPICE simulation using the measured *Vsec(p)* value from the lab
3. Report writing: Compare theoretical analysis, simulation and actual measurements and submit the report on due date. Refer to the template report: *Rectifier_Report Preparation.doc* on wattle

Safety Notes

1. **Dangerous**: **Electrolytic capacitor** wrongly inserted in the circuit. The capacitor can explode if it is inserted in the circuit with reverse polarity, which can cause serious damage to eyes***. You must get Rectifier Circuit checked by the tutor before turning it on, and you should also wear a safety goggle***.

2. **Dangerous**: **Incorrect grounding in bridge rectifier circuit** (Figure 3-4 in the lab manual). This can result in short circuiting & burning/explosion of the transformer. You must get Rectifier Circuit checked by the tutor before turning it on.

Procedures

Materials Needed:

Resistors: Two 2.2kΩ resistors
One 12V (rms) AC transformer with fused line cord
Four diodes 1N4001
One 100uF capacitor
One 0.01uF capacitor
One 78L12 regulator
One proto-board

Task 1: Full-wave rectifier output

1. The output of the transformer in the lab is called a secondary terminal (our model has two outputs with 12V (rms)) and will be used to test a rectifier circuit. Please refer to appendix for the relationship between the rms-voltage and peak voltages. The primary terminal is connected to 240V (rms) with a fuse. Measure the peak voltage $Vsec(p)$ from the transformer output using the oscilloscope and fill in the Table 1.

2. Using a proto-board, construct a full-wave bridge rectifier by laying out four diodes and a load resistor. The ground symbol is not necessarily connected to Earth. Solder the parts on the protoboard (copper side) then use wires or excessive leads to connect the parts. Trim excessive leads after soldering.

   Caution: when you cut the excessive leads, they can fly in unpredictable directions at high speed and may hit someone in the eye. It is thus a good idea to wear safety glasses and pointing the cutting direction downwards when trimming wires.

3. Check your circuit carefully before applying power. The short-circuit checking functionality in a multi-meter can be useful to check the connections and any accidental short connection. Measure the rectifier output peak voltage Vout(p) and the output frequency in Table 1.

   Note: the oscilloscope should not be used to view both the secondary voltage (Vsec) and the output voltage (Vout) in the Figure 1 at the same time as the ground terminals of the probes are internally connected together.

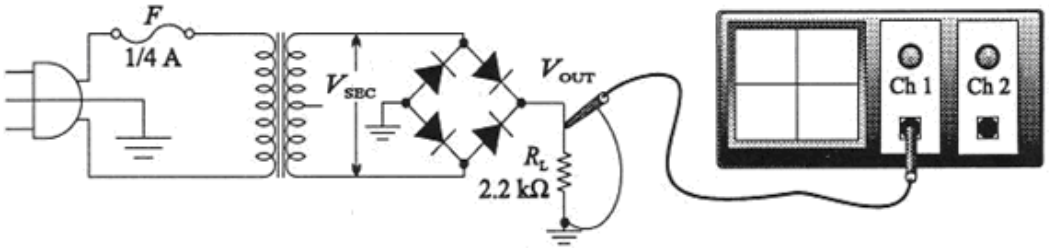

Figure 1. Measuring the rectifier output voltage

Table 1 Full-wave rectifier

Vsec (p) [V]		***R_L*** [Ω]		***Vout (p)*** [V]		***Frequency***
Predicted	Measured	Predicted	Measured	Predicted	Measured	Measured
$12\sqrt{2}$		2.2K				

Task 2: Full-wave rectifier with a smoothing capacitor

4. Connect and solder the 100uF (electrolytic) capacitor in parallel with the load resistor as shown in Figure 2. Measure *Vout(DC), Vr(pp)* the peak-to-peak ripple voltage, and the ripple frequency by using the oscilloscope. Fill Table 2 with measured values.

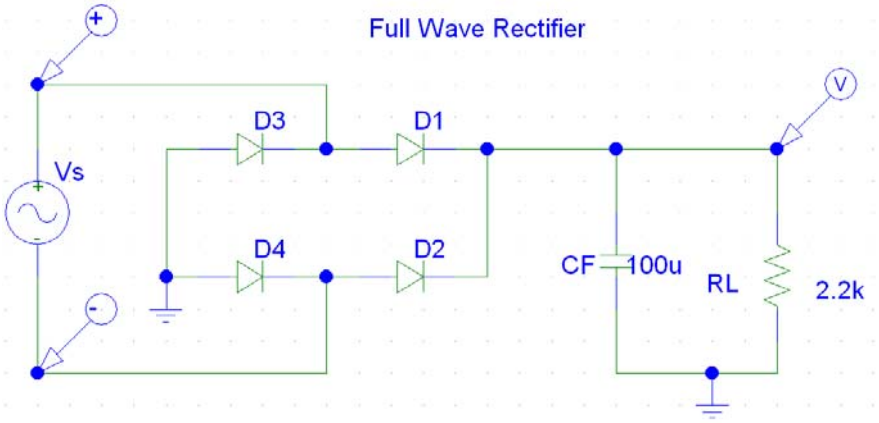

Figure 2. A Full wave rectifier with a capacitor.

Table 2 Full-wave rectifier with a smoothing capacitor

Vout (DC) [V]		***Vr(pp)*** [V]		Ripple Frequency
Predicted	Measured	Predicted	Measured	Measured

5. (Pspice Simulation) Perform Pspice simulation for your report preparation. In your report, compare and discuss the simulation results and measurements from the hardware experiment. Simulate an open diode (or a faulty diode) in the bridge by removing one diode from the circuit. Investigate the effect of the load resistor on the ripple voltage by connecting a second *2.2 K-ohm* resistor in parallel with R_L in Figure 3. Observe the effects on the ripple voltage and ripple frequency.

Task 3: Full-wave rectifier with a regulator

6. Add the circuit with a 78L12 regulator to provide +12V regulated output voltage as shown in Figure 3. It is a three terminal regulator and 'L' means small power option which can deliver over 100mA with '12' for 12V output. If you need more output current such as 1.0A then you need to use 7812 regulator. Disconnect (or cut off) the resistor from the circuit in Figure 2, and then add 74L12 regulator with additional 0.01uF capacitor (this is used for the regulator to operate properly). In the output load side, connect one resistor in series with a LED to indicate the presence of power. (To increase the brightness of the LED, you can use smaller series resistance) Measure the output voltage and ripple and compare them with the circuit without the regulator.

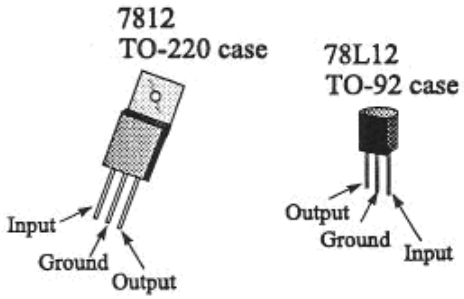

Figure 3. Regulator 78L12 will be used in the lab.

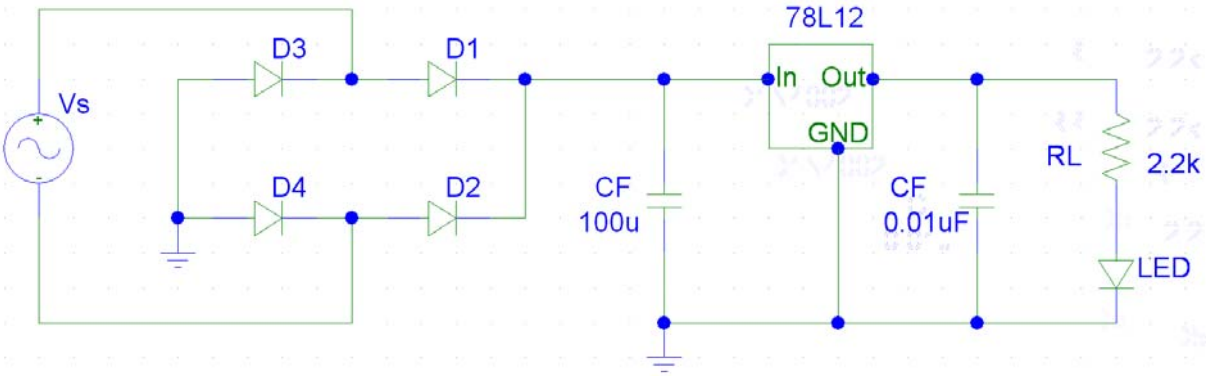

Figure 4. Schematic diagram with the regulator and LED at the output

7. Show your working circuit to your tutor for marking.
8. Turn off the power and clean up the table.