Experiment 6

Capacitor Filter Circuit

1- Objects of the Experiment

- Representing the ripple voltage on the load voltage.
- Determining the ripple voltage as a function of the charging capacitor and the load resistor.

2- Principles

Another example of a full-wave rectifier circuit appears in Figure 1. This circuit is a **bridge rectifier**, which still provides electrical isolation between the input alternating current powerline and the rectifier output, but does not require a center-tapped secondary winding (as the case of Figure 1 in Experiment 3). However, it does use four diodes, compared to only two in the previous experiment.

During the positive half of the input voltage cycle, v_s is positive, D_3 and D_2 are forward biased, D_1 and D_4 are reverse biased, and the direction of the current (solid line arrows) is as shown in Figure 1. During the negative half-cycle of the input voltage, v_s is negative, and D_1 and D_4 are forward biased, D_3 and D_2 are reverse biased. The direction of the current (dashed line arrows), shown in Figure 1, produces the same output voltage polarity as before. Because two diodes are in series in the conduction path, the magnitude of v_o is two diode drops less than the magnitude of v_s:

$$v_0 = |v_s| - 2V_\gamma \quad (\mathit{for}\ |v_s| \geq 2V_\gamma) \qquad \text{(Equation 1)}$$

3- Equipments

1 resistor 100Ω / 2W	577 32
1 resistor 1kΩ / 2W	577 44
1 resistor 10kΩ / 0.5W	577 56
1 electrolytic capacitor 10μF / 35V	578 37

1 Electrolytic capacitor 47μF / 35V	578 38
1 Electrolytic capacitor 100μF / 16V	578 39
4 Si-diode 1N4007	578 51
1 Two-oscilloscope	
1 multimeter	
1 Power supply unit	726 88
1 Plug-in board 297X300	72650
1 Measuring cable BNC/4mm	575 24
1 Set of bridging plugs 19mm	501 48
1 Set of connecting leads	501 532

4- Setup

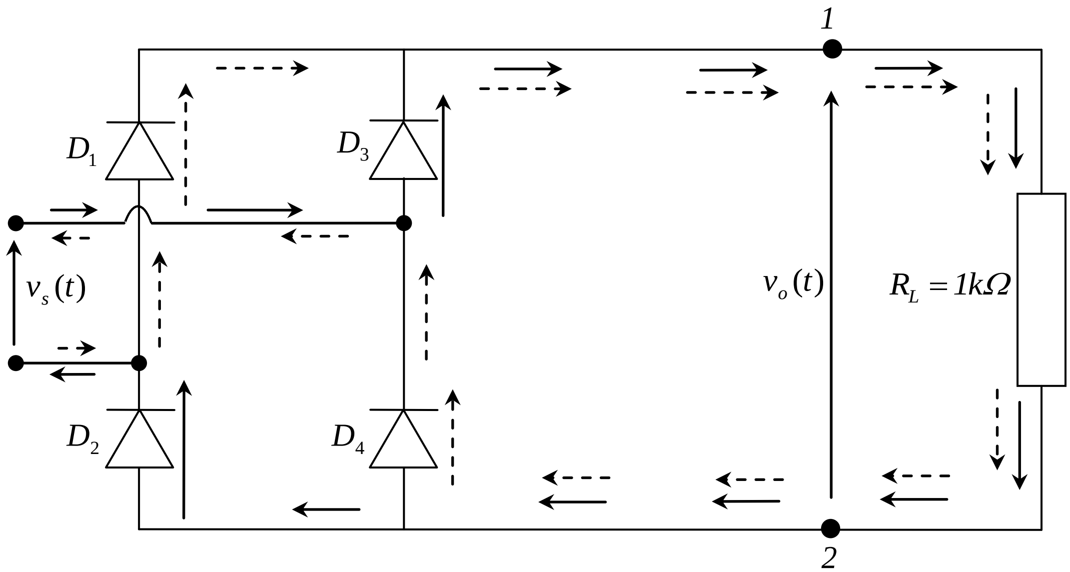

Figure 1. A full-wave bridge rectifier. The circuit showing the current direction (solid line arrows) for a positive input cycle, and the current direction (dashed line arrows) for a negative input cycle.

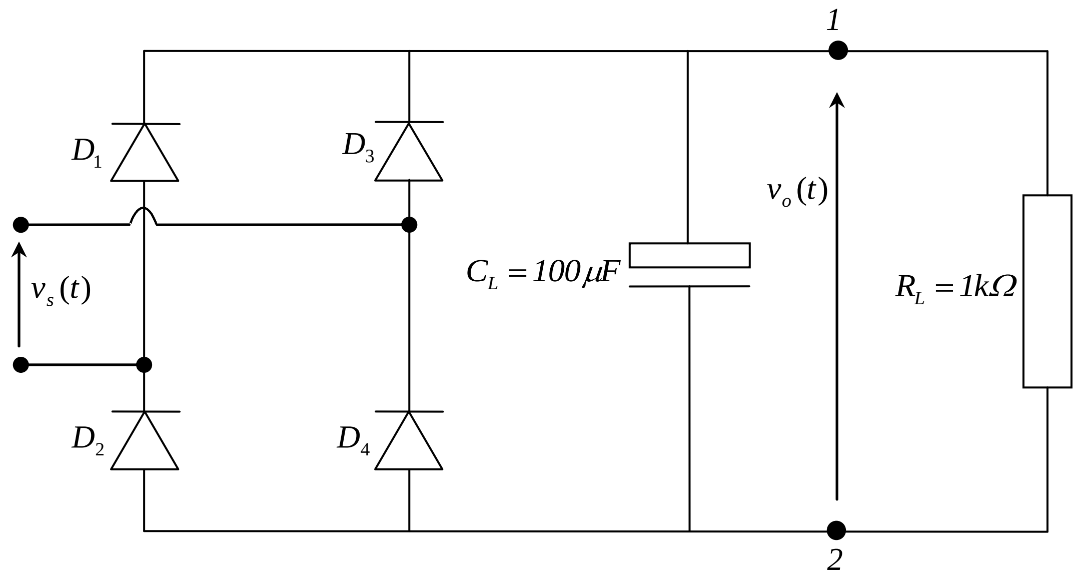

Figure 2. A full-wave bridge rectifier with an RC filter

5- Carrying out the experiment

5-1- Representing the ripple voltage on the load voltage

- Assemble the circuit as shown in Figure 1 and apply an AC voltage of $V_s = 12V$, $f = 60Hz$.
- Use channel 1 of the oscilloscope to measure the voltage $v_o(t)$ across the load resistor.
- Transfer the graph into a sheet of graph paper. Each axis should be labeled and appropriate units indicated.

The voltage $v_o(t)$ across the load resistor is a pulsating DC voltage, which is made up from a DC and an AC voltage component. The AC voltage component, which is superpositioned onto the DC voltage is designated the ripple voltage.

- Determine the peak-to-peak value of the ripple voltage from the graph ($V_{r\,pp}$ =??)

I5-2- Determining the ripple voltage as a function of the charging capacitor and the load resistor

- Measure the value of V_M (amplitude of $v_o(t)$) and the peak-to-peak value of the ripple voltage $V_{r\,pp}$ for the combination of charging capacitor and load resistor as given in Table 1. Enter the values in Line 1 of Table 1.

Table 1.

		$R_L = 1k\Omega$			$C_L = 100\mu F$	
		$C_L = 10\mu F$	$C_L = 47\mu F$	$C_L = 100\mu F$	$R_L = 100\Omega$	$R_L = 10k\Omega$
1	$V_{rpp}(V)$					
	V_M (V)					
2	$V_{rpp}(V)$ (Eq. 2)					
3	*Percent error (%)*					

- Describe the ripple voltage dependence on the charging capacitor.
- Describe the ripple voltage dependence on the load resistor.

- The peak-to-peak value of the ripple voltage can be calculated **approximately** using the expression below:

$$V_{rpp} = \frac{V_M}{2\,f\,RC} \qquad \text{(Equation 2)}$$

- Calculate the ripple voltages for the values given in Table1 and enter your results into Line 2 in the table
- Calculate the percent errors for the values given in Table 1 and enter your results into Line 3 in the table.

6- Conclusion

Make a general conclusion about the experiments and the results obtained.