Winter Semester (2018-2019) / 3rd Grade

Experiment No: 5

Full-Wave Bridge Rectifier (FWBR)

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Objective

1- Plotting input and output waveforms of a full-wave bridge rectifier.

2- Finding ripple factor of a full-wave rectifier.

Components

Name	Specifications
Diode 1N4001 (Si)	PIV : 50 V Forward current: 1 A
Resistors	1 kΩ, 500 Ω, 100 Ω

Equipment

Name	Specifications
Bread board / Circuit Panel	
AC Power Supply Or Step-down Transformer	0-30 V 220V to 12 V
Digital Ammeter	200 mA
Digital Voltmeter	30 V
Connecting Wires	

Circuit operation

As shown in Fig. 1, the FWBR circuit is composed of four diodes connected in a bridge with no need for a center-tap transformer. Diodes D_1 and D_2 conduct the current during the positive half-cycles of the voltage, whereas diode D_3 and D_4 become conducting during the negative half cycles.

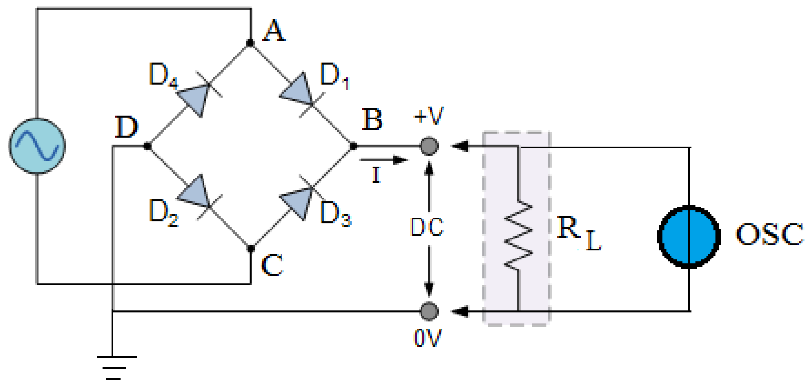

Fig. 1. Full-wave bridge rectifier circuit.

During the positive half-cycle of the input voltage (0 - π), diodes D_1 and D_2 are forward biased and diodes D_3 and D_4 are reverse biased. Therefore, on point B, the positive-half cycle presents, and the current will pass through resistor R_L and diode D_2 to point C. It is seen in Fig. 3 that the positive-half cycle is less than the input voltage by V_b. When the input wave changes to the negative half (π - 2π), diodes D_3 and D_4 are forward biased and diodes D_1 and D_2 become then reverse biased. This part of the input wave will present as a positive cycle on the load. The current path starts from point A through diode D_4, resistor R_L and diode D_3 to point C. Because the area under the curve of the full-wave rectifier signal is twice that of the half-wave rectifier, the average or DC value of the full-wave rectified signal, Vdc, is twice that of the half-wave rectifier.

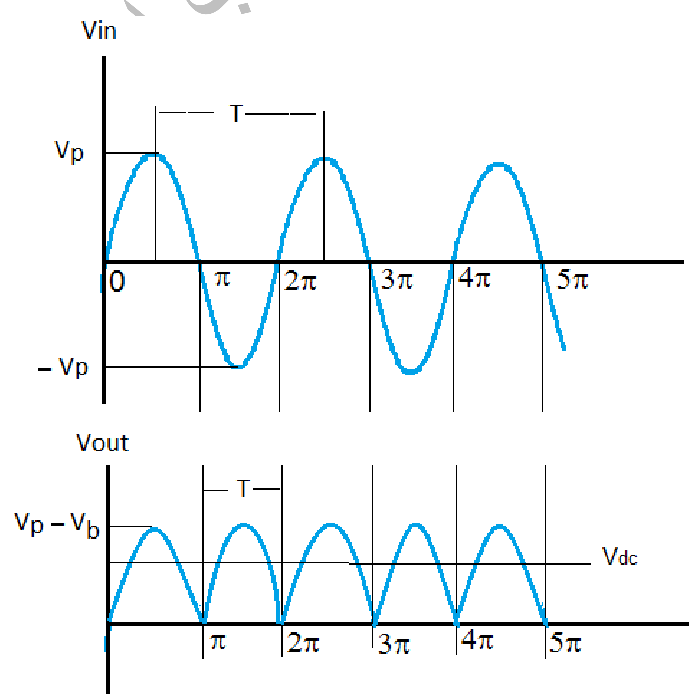

Fig. 3. Full-wave bridge rectifier waveforms

The DC voltage at the output is given by

$$V_{dc} = \frac{2(V_P - V_b)}{\pi}$$

where V_b is the built-in voltage. Also, the DC current passing through R_L can be calculated by

$$I_{dc} = \frac{V_{dc}}{R_L}$$

$$= \frac{2(V_P - V_b)}{\pi R_L}$$

When the output voltage is measured by a voltmeter, the root-mean-square voltage must satisfy

$$V_{rms} = \frac{V_P}{\sqrt{2}}$$

In FWBR, the frequency of the rectified output seen on the load R_L is twice the input frequency f_{in}, that is

$$f_{out} = 2f_{in}$$

The ripple factor (R.F.), which is defined as the ratio of V_{rms} value of the ripple voltage to the absolute value of the DC component of the output voltage, can be given by

$$R.F. = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1} \qquad (1)$$

$$= \sqrt{\left(\frac{V_p/\sqrt{2}}{2V_p/\pi}\right)^2 - 1}$$

$$= \sqrt{\left(\frac{/\pi}{V_p/\sqrt{2}}\right)^2 - 1}$$

$$= 0.48$$

If one uses a voltmeter, the ripple factor is then given by

$$R.F. = \frac{V_{ac}}{V_{dc}} \qquad (2)$$

Peak Inverse Voltage

If one of the diodes is reverse biased, the peak voltage across that diode will be approximately equal to V_P. Thus the cathode of D_1 will be at V_P as well as that of D_2. By applying a reverse bias, the total voltage across both diodes is $2V_P$. Therefore, the maximum reverse voltage will be twice the peak load voltage, $PIV = 2V_P$.

Procedure

1- Connect the circuit diagram shown in Fig. 2. Consider point **D** as ground.
2- Connect CH1 of the oscilloscope between point **A** and **C**, and CH2 to the load.
3- Measure V_{out} by a voltmeter.
4- Plot the AC input voltage of the rectifier and measure its frequency.
5- Plot the DC output voltage of the rectifier.
6- Change the load to **0.5** kΩ and repeat steps 3 through 5.
7- Change the load to **100** Ω and repeat steps 3 through 5.

Calculations

1- Calculate ripple factor using Eq. 1. And Eq. 2.
2- Arrange a table including all the measured parameters according to R_L.

Discussion

1- Compare among the values of **R.F**.
2- Discuss your results stating the error sources.