①

2102026

Experiment Name: To design and implement a Half-wave Rectifier circuit.

Apparatues: Function generator, CRO, Regulated Power Supply, resistor, diode, connecting wires.

Vlab Specifications Taken:

Half-wave circuit design has been implemented on the virtual breadboard using following specifications:

Power Supply : +10V and -10V

Function generator : selected wave with following specifications:

Frequency = 1KHz

Amplitude = 5V

Duty cycle = 50%.

Resistor R_1 = 10.36 K

Theory: The conversion of AC into DC is called rectification. Electronic devices can convert AC power into DC power with high efficiency.

During the positive half cycle, the diode is forward biased and it conducts and hence a current flow through the load resistor.

During the negative half cycle, the diode is reverse biased and it is equivalent to an open circuit, hence the current through the load resistance is zero. Thus the diode conducts only for one half cycle and results in half wave rectification.

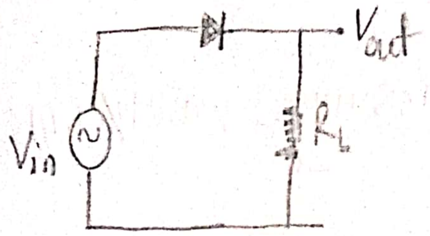
The input voltage: $V_{in} = V_p \sin \omega t, \ 0 \leq t \leq T$

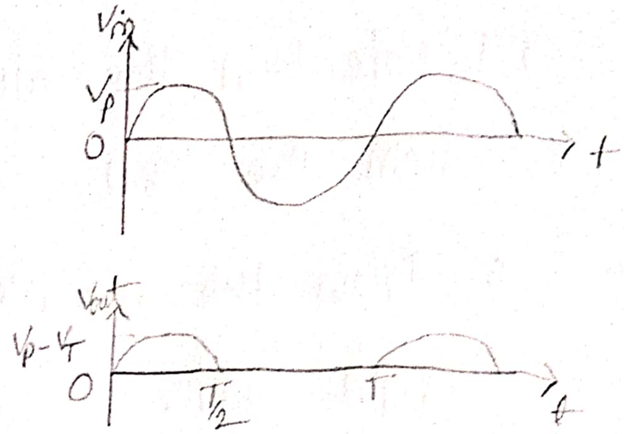
The output voltage : $V_{out} = V_{pl} \sin \omega t, \ 0 \leq t \leq T$

where, $V_{pl} = V_p - V_T$

and V_T is cut-in voltage of the diode.

Circuit Diagram :





The avarage (dc) value of half-wave rectified sine wave is represented by :

$$V_{av} = V_{dc} = \frac{1}{T}\left[\int_0^{T/2} V_{ps} \sin \omega t \, . \, d(\omega t) + \int_{T/2}^{T} 0 \, . \, d(\omega t)\right]$$

$$= \frac{V_{pe}}{\pi}$$

RMS voltage at the load resistance —

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T V_{pI}^2 \sin^2 \omega t \, . \, d(\omega t)} = \frac{V_{p1}}{2}$$

Procedure :

1. Connect the circuit as shown in the circuit diagram.
2. Give the input as specified.

3. Switch on the power supply.

4. Note down the value of AC and DC voltages from the CRO

5. Draw the ~~me~~ necessary waveforms on the graph sheet.

Observations :

1. Observe the output waveform from CRO.
2. Measure the value of AC and DC voltages of the output waveform from the CRO.
3. Calculate the value .

Vlab Observations Obtained :

1. Output waveform frequency = 1 KHz
2. Output voltage, $V_{P1} = 1.91 V$
3. $V_{rms} = V_{P1}/2 = 0.955 V$
4. $V_{dc} = V_{P1}/\cancel{\theta} V_{Pi} = 0.608 V$

Calculations :

1. Ripple Factor :

Ripple factor is defined as the ratio of effective value of AC componet to the va average DC value. Ripple factor (r),

$$r = \sqrt{\left[\frac{V_{pl}/2}{V_{pl}/\pi}\right]^2 - 1} = 1.21$$

Experimentally,

$$r = \sqrt{\left(V_{rms}/V_{dc}\right)^2 - 1} = \sqrt{(0.955/0.608)^2 - 1} = 1.211$$

2. Efficiency :

we know, the efficiency of half-wave rectifier is 40.6%.

Experimentally,

$$\eta = \frac{\text{dc output power}}{\text{ac output power}} \times 100\% = \frac{P_{dc}}{P_{ac}} \times 100\%.$$

$$= \frac{\cancel{P}\ V_{dc}^2/R_L}{V_{rms}^2/R_L} \times 100\% = \left(\frac{0.608}{0.955}\right)^2 \times 100\% = 40.53\%$$

Result :

The Half-wave Rectifier circuit design output waveforms have been studied and the required parameters are calculated.

Precautions :

1. Connections should be varified before clicking run button.
2. The resistance to be chosen should be in Kohm range.
3. Best performance is being obtained within 50Hz to 1MHz.

—0—