Half-Wave_Rectifier -- Overview

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OBJECTIVES

After performing this lab experiment learner will be able to:

- Understand rectification property of the diode
- Learn effective use of Op-amp in precision rectification
- Measure MAXIMUM and MINIMUM amplitude of the captured signal using inbuilt functions of the scope

EQUIPMENT

To carry out this experiment, you will need:

- TBS1KB - Digital Oscilloscope from Tektronix
- Voltage probe (provided with oscilloscope) / BNC cables
- Breadboard and connecting wires
- Simple circuit components – Resistor / capacitors

CIRCUIT DIAGRAM

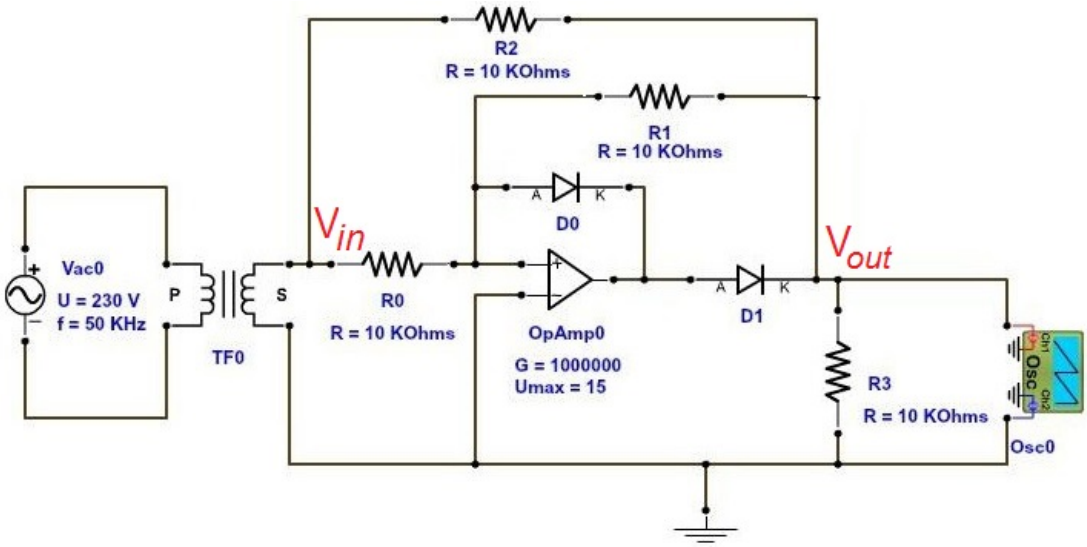


Figure 1. shows the circuit of precision rctifier. On positive voltage swings diode conducts and voltage is developed across the resistor. During negative voltage swings, the diode does not conduct.

THEORY

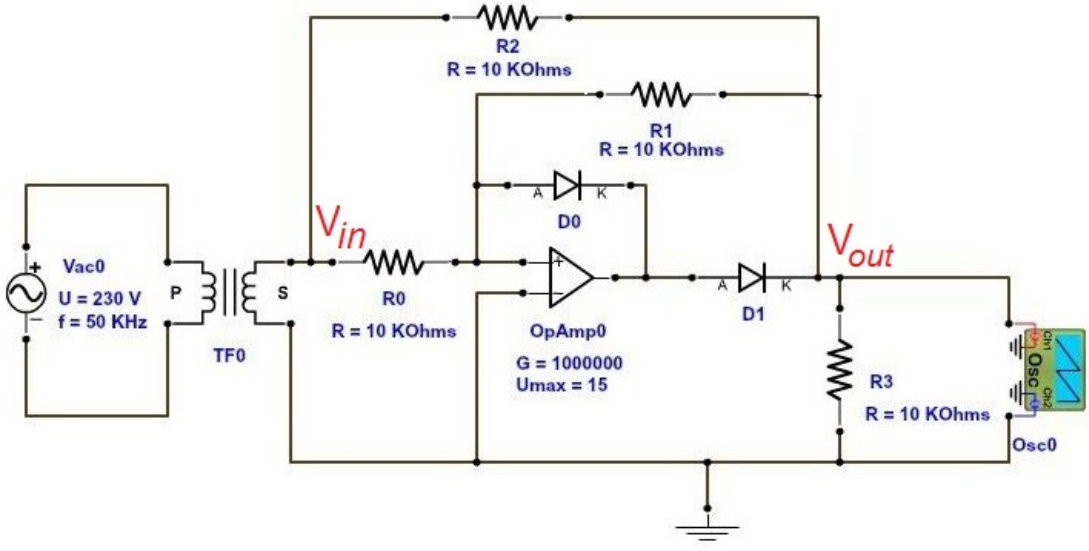
- Precision rectifier also known as super diode, is configured with operational amplifier to behave like an ideal diode and rectifer.
- The actual threshold of precision rectifier is very close to zero, but not exactly zero, instead it equals the actual threshold of the diode to gain of the operational amplifier, which results in accurate results.
- The basic idea behind the superdiode is to use the high-gain of an op-amp to mask the finite turn-on voltage and other nonlinearities of the diode. This is done by placing it in the negative feedback path as shown in circuit.
- Any positive voltage at the op-amp terminal is now sufficient to turn on the diode, and the negative feedback regulates the current through the load resistor to maintain an output voltage equal to the input voltage for these positive input voltages.
- For positive signals the circuit is a unity-gain buffer. For negative signals, the output goes negative, and the diode turns off. Because of the high open-loop gain of the op-amp, the circuit operates as a perfect switch for even very small voltages.

Half-Wave_Rectifier -- Procedures

Step 1

SOURCE SETUP

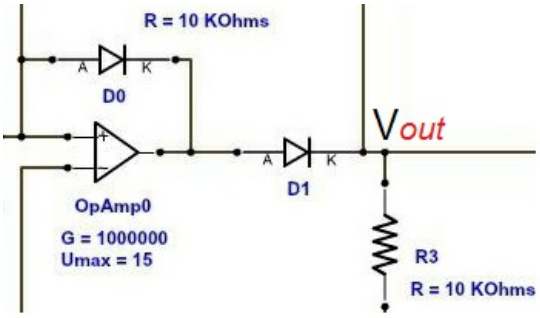
- Connect the connections as per the circuit diagram.



Step 2

MEASUREMENT / SCOPE SETUP

- Power ON the oscilloscope
- Connect the Channel 1 probe of the oscilloscope to V_{in} and Channel 2 to V_{out}



- Acquire the signal(s) from circuit on oscilloscope

Step 3

- Do the Autoset on the scope to efficiently capture and view the signal
- If AUTOSET feature is not enabled, then manually set the horizontal and vertical scale, and trigger condition to view 3-4 cycles of waveform without any clipping.

Step 4

Measurement Configuration

- Add Maximum and Minimum measurements on both the Channels

Step 5

Verify the rectified output from the circuit if it matches the expectation.