Power Electronics Fundamentals - AC to DC Power - Rectifiers

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Overview

The National Instruments Power Electronics Fundamentals series is designed to provide an overview of power electronics concepts used in research and taught throughout worldwide institutions.

Using advanced simulation models and analyses used in industry, but wrapped in an intuitive, pedagogical environment Multisim enables students to characterize power circuits concepts before the laboratory.

The power capabilities of Multisim means that students have access to the same technology that they will use for research and industry to prototype power electronics circuit designs. However in learning power electronics in a simulated environment optimized for education, students have the ability to experiment safely before the laboratory.

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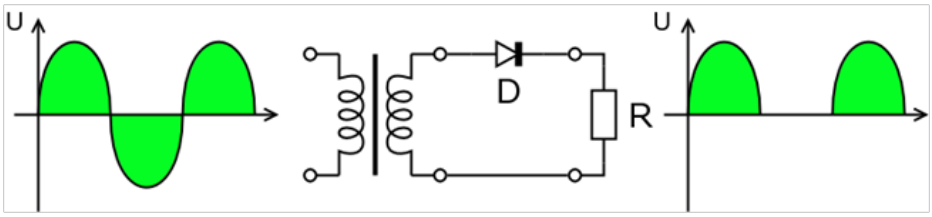
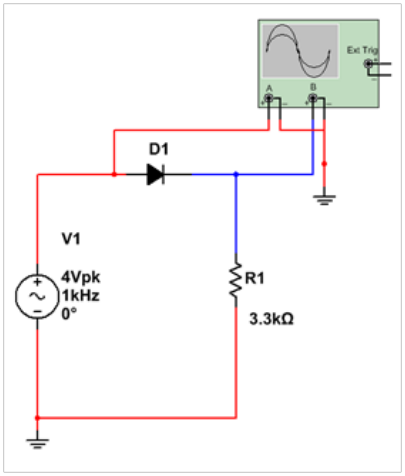
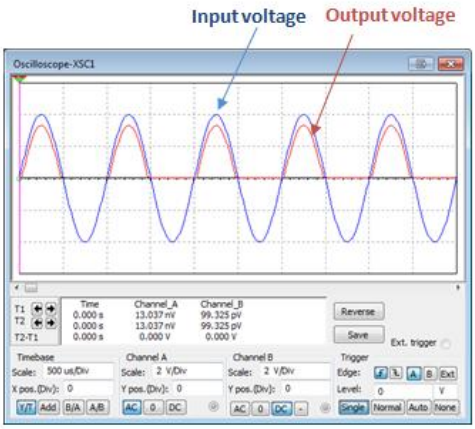
Rectification systems are primarily designed for converting sinusoidal AC input signals into a DC voltage signals. They are most commonly used in domestic power supplies and power transmission systems. Single wave rectification can be achieved by using either a half wave or full wave rectification circuit.

1. Half Wave Rectifier

Half-wave rectification systems utilise a single diode, removing half of the sinusoidal source. This produces a single directional signal with a pulsating characteristic.



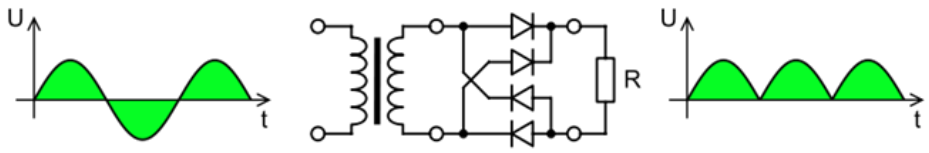


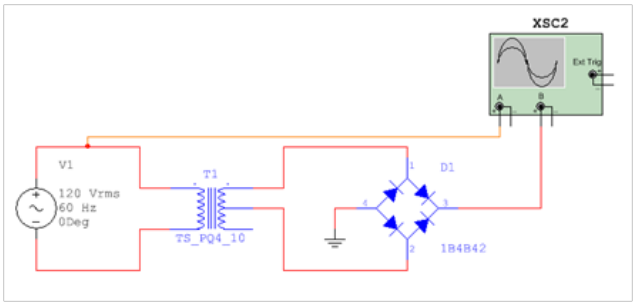


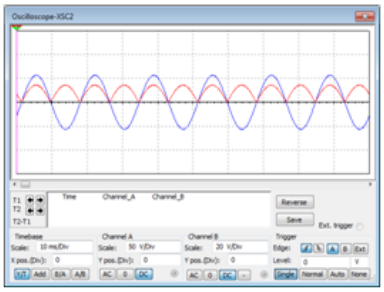
As a result of the heavy pulsating nature of the signal, more filtering is required to eliminate any harmonies from the AC source and provide a constant DC signal. The efficiency of the half wave rectifier is also limited because only half the sinusoidal waveform is being converted to the DC signal. Losing this half of the signal can be comparable to losing energy..

2. Full Wave Rectifier

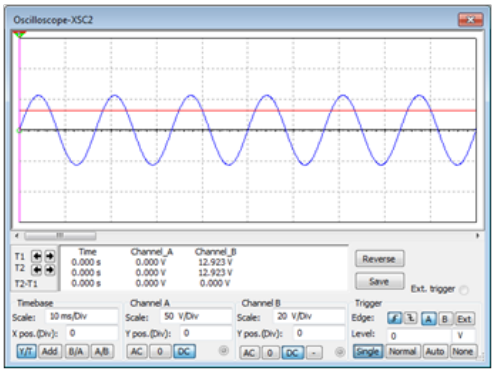
Full-wave (full bridge) rectifiers construct a bridge of diodes to convert the whole of the input voltage to one of constant polarity. This is more efficient than the half wave rectifier as it allows both the positive and negative components of the input voltage to be utilised in building the DC voltage.







Once the signal has a single polarity we can apply a simple filter to provide a DC voltage source. This filter applies a smoothing effect allowing the DC output to be maintained.



3. Tutorial Questions

Why is it important to select an appropriate capacitor value? What is the effect of using a larger or a smaller capacitor?

The bridge circuit above provides us with a positive DC voltage, using NI Multisim identify how this can be modified to develop a negative DC voltage level?