



Dr. Allen Robinson
Academic Professional
School of Electrical and
Computer Engineering

Introduction to Electronics

An introduction to electronic components and a study of circuits containing such devices.

TECH



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Academic Professional
School of Electrical and
Computer Engineering

Half-Wave Rectifiers

Introduce diode half-wave rectifiers

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Previous Lessons

- Introduced methods of solving circuits containing resistors, diodes, and dc sources.
- Modeled diodes as ideal and as an ideal diode in series with a battery to model the forward voltage drop.

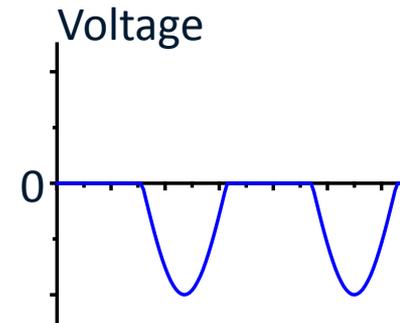
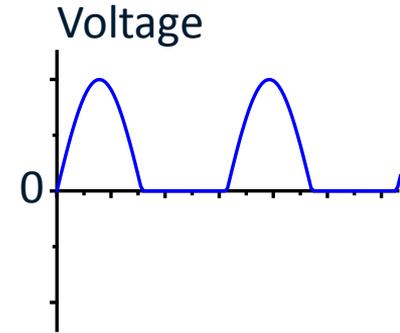
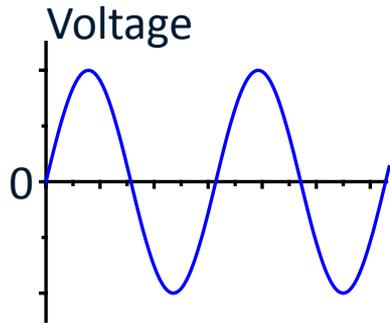
Lesson Objectives

- Introduce half-wave rectifiers
- Examine their behavior for sinusoidal inputs
- Analyze a diode rectifier circuit

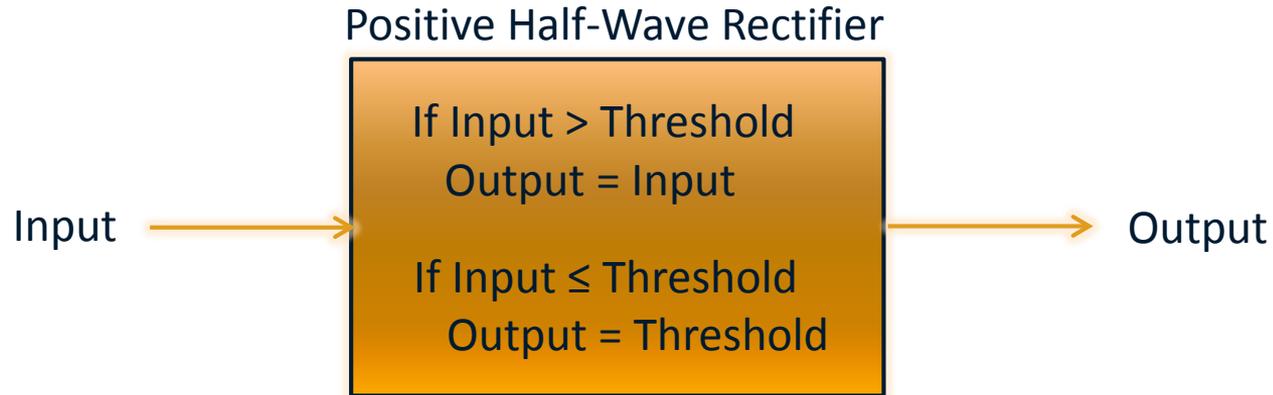
Rectifier

- A non-linear device that modifies an input voltage such that the output voltage is greater than or less than a threshold value

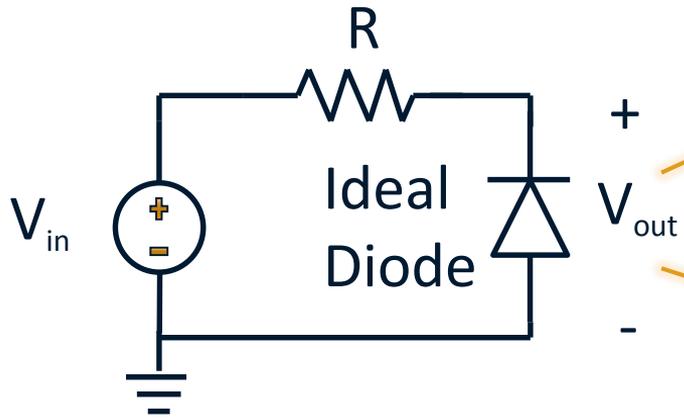
Sinusoidal Input Voltages



Half-Wave Rectifier



Diode Rectifier Circuit

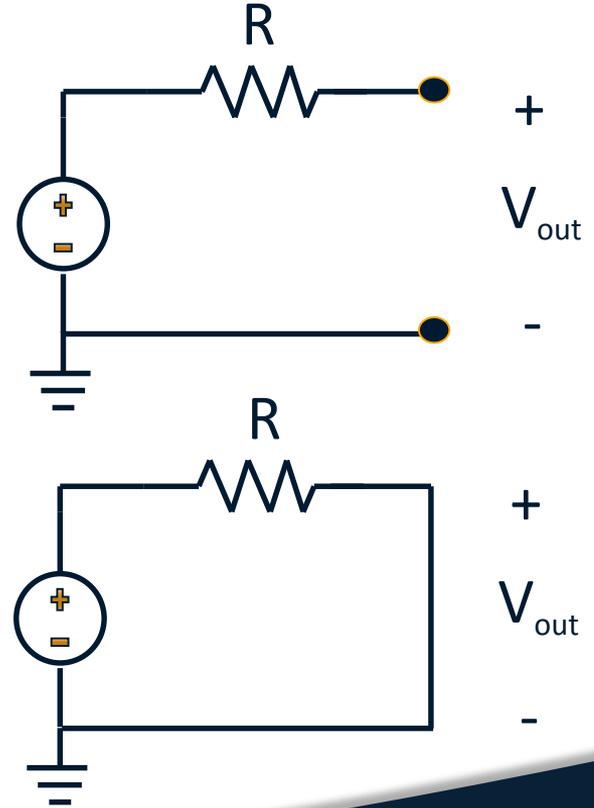


V_{in}
positive

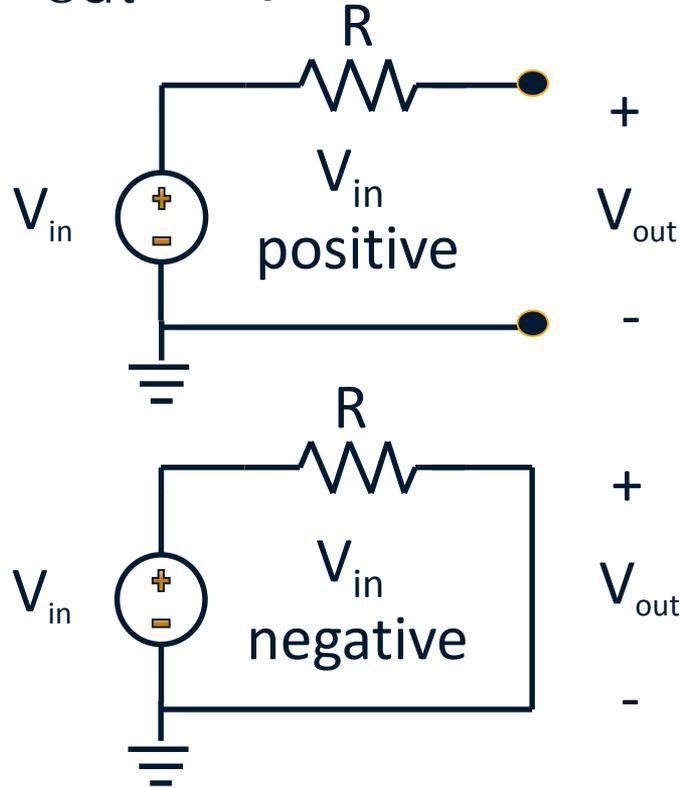
V_{in}

V_{in}
negative

V_{in}

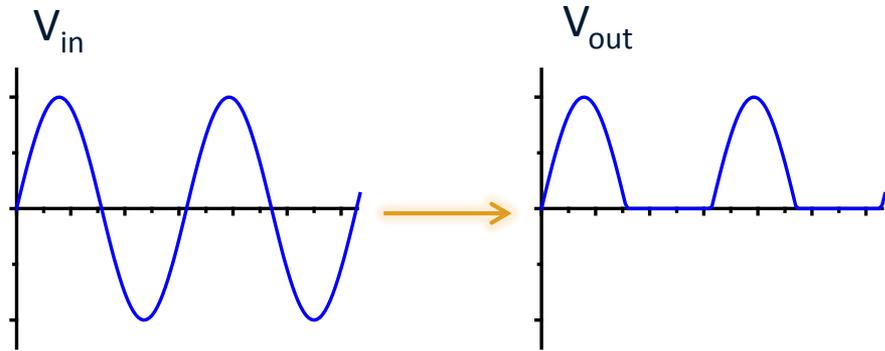


V_{out} Equations



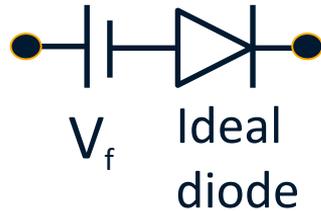
Positive Half-Wave Rectifier

$$V_{\text{out}} = \begin{cases} V_{\text{in}} & V_{\text{in}} > 0 \\ 0 & V_{\text{in}} \leq 0 \end{cases}$$

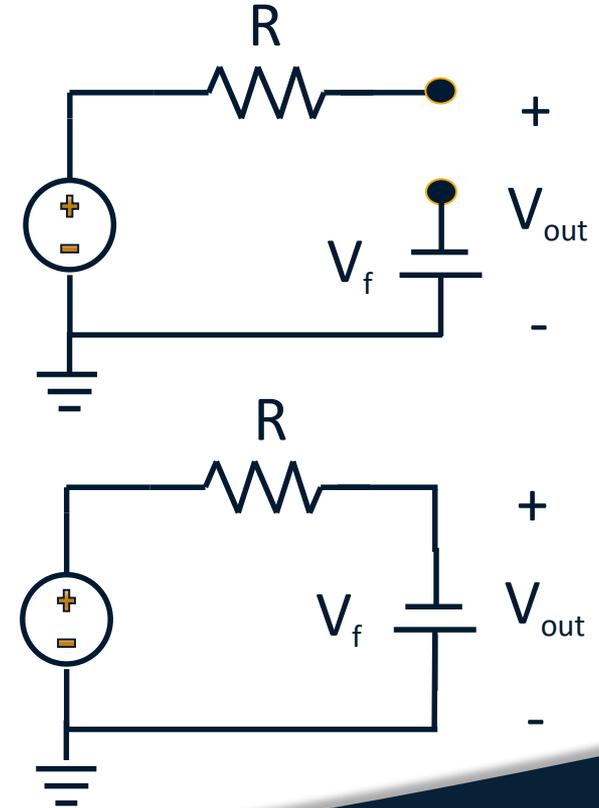
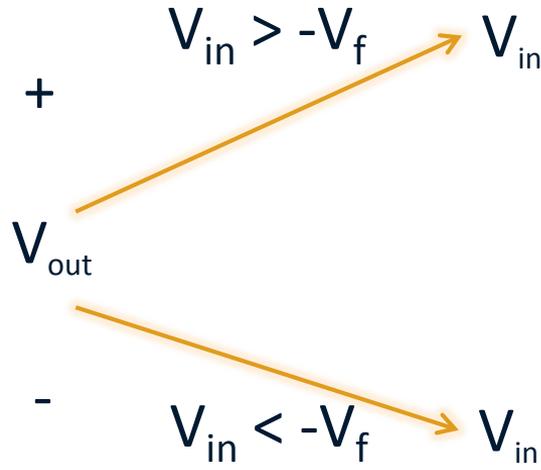
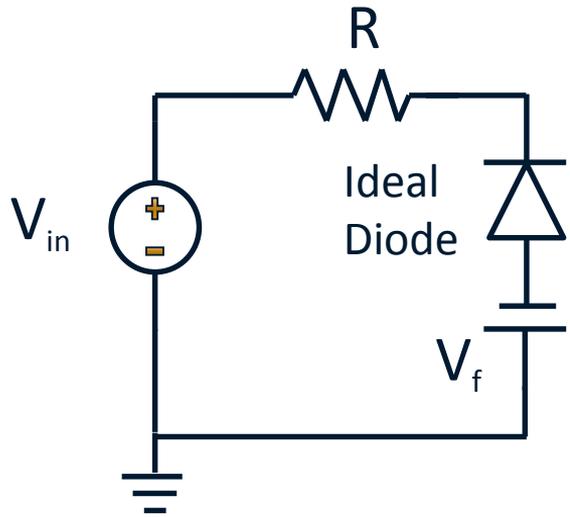


Non-Ideal Diode

- How does a non-ideal diode change the behavior of the circuit?
- Include the forward voltage drop V_f by modeling the diode as an ideal diode in series with a voltage source



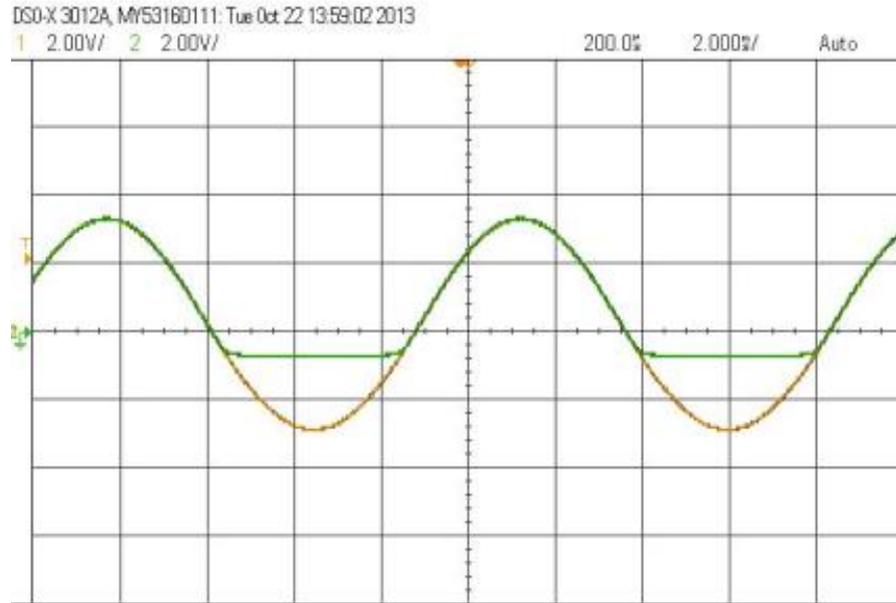
Non-Ideal Diode Circuit



Measured Output

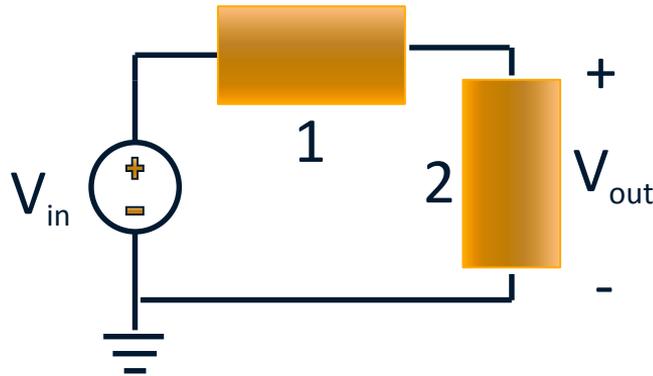
V_{in} and V_{out}

$$V_{out} = \begin{cases} V_{in} & V_{in} > -V_f \\ -V_f & V_{in} \leq -V_f \end{cases}$$



Other Possible Circuits

- Four different rectifiers can be constructed using a resistor and a diode.



Other Possible Circuits

- ⦿ Can you determine the equation for V_{out} in terms of V_{in} for each of the possible circuits assuming both ideal and non-ideal diodes?
- ⦿ How does the output of each circuit change if it is taken across element 1 rather than element 2?

Summary

- ⦿ Rectification
- ⦿ Half-Wave Rectifiers

Next Lesson

- Full-Wave Rectifiers