Diodes
Diode V-I Relationship

\[ i_D(t) = I_{dss} \left( e^{-v_D(t)/V_{th}} - 1 \right) \]
Diode V-I Relationship

If $v_D(t) > 0$ the diode is **forward biased**.
If $v_D(t) < 0$ the diode is **reverse biased**.
If $v_D(t) = 0$ the diode is **zero biased**.
Graphical Diode Circuit Analysis

Forward Bias

\[ v_s(t) = i_D(t)R + v_D(t) \]

Reverse Bias

\[ v_s(t) = i_D(t)R + v_D(t) \]
The Ideal Diode

In some designs we can ignore the small forward bias voltage of 0.6-0.7 volts and approximate the diode as **ideal**. Then the diode is always in one of two possible states; the voltage $v_D(t)$ is zero (forward bias), or the current $i_D(t)$ is zero (reverse bias).
The Half-Wave Rectifier

\[ v_s(t) \rightarrow \rightarrow R \rightarrow v_o(t) \]
Zener Diodes

Zener diodes are designed to “break down” at a specific reverse bias voltage (4 V in this illustration).
Graphical Diode Circuit Analysis

Reverse Bias

\[ v_s(t) = i_D(t)R + v_D(t) \]

![Diode Circuit Diagram]