Precision Diodes

Diodes have $V_D = 0.7\,\text{V}$

If the input peak $V_{in} < 0.7\,\text{V}$, then the rectifier will NOT function.
Examples of Precision Diodes

Example 1.

\[ V_i \]
\[ \frac{V_i}{V_{in}} \]
\[ V_{in} \]
\[ V_{out} \]
\[ i = 0 \]

Diode is off

No negative feedback from Opamp

Opamp is like OC (Saturated)

\[ V_o = 0 \] directly

Or: \( i = 0 \) since it is from the Opamp

Inverting terminal

\[ V_o = iR = 0 \]
(2) $V_i$ goes positive:

*even if $V_i$ is a little bit $> 0$, the output terminal of Opamp*

\[ V_A = A(V_i - 0) \]

\[ V_A \text{ becomes large, easily } > 0.7V \]

\[ D \text{ turns on } \Rightarrow \text{ build negative feedback} \]

\[ \Rightarrow \text{ virtual short } \Rightarrow V_o = V_i \]

Disadvantage: when $V_i$ goes negative, Opamp is saturated

Switching is slow $\Rightarrow$ limit the frequency of operation
Example 2. Precision diode with gain

(1) When $V_i < 0$, Diode off
    Opamp is saturated $\Rightarrow V_o = 0$

(2) When $V_i > 0$, Diode on, virtual short

$\Rightarrow$ Non-inverting amplifier

$$V_o = (1 + \frac{R_2}{R_1}) V_i$$
$$\text{Slope} = \frac{R}{R + (R + r + R_0) < 1}$$

$V_i(t)$

$V_o(t)$
Example 3. (inverting topology, "fullwave rectifier")

1. $V_i > 0$, $D$ is off, no feedback

2. $V_i < 0$, $D$ is on, negative feedback, virtual ground

\[ V_o = \frac{R}{R+(R_1+R_2)} V_i \]

(ideal diode model)