2.17 Determine output of P1V in each diode

Using IDEAL DIODE

\[ V_{in} \]

\[ 0 - T \frac{T}{2} t \]

\[ -10V \]

Since I is in the same direction as IDZ,

IDZ is ON

\[ V_A \] is equal to \[ N_C = 10 \sin \omega t \]

\[ 0 \text{ Volts} \]

positive

since the left side R's

are equal, \( \frac{1}{2} V \) is across each one.

\[ V_0 = 10 \frac{T}{2} \sin \omega t / 10 \text{ V} \frac{T}{2} \]

I leaves + side of \( V_i \) and travels THROUGH THE R's and IN THE SAME DIRECTION OF A FORWARD-BIASED (ON) D1. THE CURRENT

is IN THE OPPOSITE DIRECTION OF ID FOR DZ \( \Rightarrow \) MAKING DZ OFF.

\[ V_0 = V_i / 2 \]

\[ V_0 = -\frac{V_i}{2} \sin \omega t \text{ for } T/2 \text{ to } T \]

(Sign of \( V_i \) same as \( V_0 \) as \( V_0 \))
2.17 (cont.) \( V_{dc} = (0.636)(5V) = 3.18V \)

\( PIV = \text{max voltage across } R \),

which is 5 V

\[ V_{im} = 10V. \]

\[ V_{om} = \frac{10}{2} V. \]
2.8 **Clippers** - Cuts away a portion of an input signal.

**EX- HALF-WAVE RECTIFIER**

![Waveform diagram](image)

**Adding a DC supply can change output greatly**

![Circuit diagram](image)

**Figure 2.69**

\[
\begin{align*}
V_i & \rightarrow +V - \text{VD}=0V +R \text{V}_0 \rightarrow \\
V_i & \rightarrow +V - \text{VD}=0V +R \text{V}_0 \\
\end{align*}
\]

\[
\frac{2V=0}{V_D+IDR-V_i+V=0} \quad \text{since} \quad V_D=0, \text{ideal}
\]

\[
\frac{V_i-V=ID}{R}
\]

As long as **ID**, the diode is on.

When \( V_i=V \), \( ID=0 \)

When \( V_i<V \), \( ID=0 \)
EX 2.18

For $V_{in}$ positive, diode conducts, where $V_{in} = V_i + 5V$

If we redraw CKT:

This means $V_{in} = 0$ when $V_i = -5V$ when $V_i > -5V$ diode conducts

For $V_i < -5V$, diode is open, $I = 0A$, $V_o = 0$

OR

$\Sigma V = 0 \quad -5V + V_D + IR - V_i = 0$

$V_D + IR = V_i + 5V = IR = V_o$

$I = 0A$ when $|V_i + 5V| \leq 0$

When $|V_i + 5V| > 0$, $I = 0A$

1. Draw waveform
2. Shift X-axis $-5V$ volts
3. Output is above the X-axis
**SERIES**

1. \( E = V = 0 \)  
   Assume ideal diode, \( V_D = 0 \)

\[-5V + V_D + IR - V_i = 0\]

\[IR = V_o = V_i + 5V\]

2. **DRAW** \( V_i \)

3. **DIODE OFF WHEN** \( I = 0 \)
   \[V_i + 5V = 0\]
   \[V_i = -5V\]
   **DRAW** \( V_x\) **AXIS** \(-5V\)

---

**PARALLEL**

(\( \text{DIODE / LOAD} \))  
**LOAD ON OUTPUT**

\[E = V = 0\]

1. **DIODE CONDUCTS** \( \Rightarrow \) **SHORT** \( V_o = 0\)

2. **DIODE OPEN** \( V_o = I(\text{LOAD})\)
   \( = V_i \) (\( \text{LOAD = OPEN} \))

For diode conducting: \( IR + V_D - V_i = 0\)

\[IR = V_i - V_o = V_i\]  
\(\text{when} \ I > 0 \) diode conducts

\(\Rightarrow \) \( V_i > 0\)

\(\Rightarrow \) **DIODE OPEN** \( V_o = V_i\)

\(\Rightarrow \) **Load** \( V_i \) is **NEGATIVE**

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**EX 2.19**

\( V_i \)

\(-10\)

\[t\]

---

\( V_i \)

\[0\]

\[t\]

\( V_0\)
EX 2.20

1. Draw $I_D$ for one direction of diode.

2. $E_V = 0$ counter-clockwise direction.

\[ V_i - 4V + V_D + I_D R = 0 \]

$\text{Ideal Diode}$

\[ I_D R = 4V - V_i - V_D \]

3. $I_D$ positive when $4V - V_i > 0$ or $4V > V_i$.

$V_0 \to V_i$ when $V_i < 4V$, diode on

$V_0 = 4V$

when $V_i > 4V$

$I_D$ negative => Diode is "open"

$V_0 = V_i$

EX 2.21

Use $V_D (V_K) = 0.7V$ for EX 2.20

$E_V = 0$ $I_D R = 4V - V_i - 0.7V = 3.3V - V_i$

$I_D$ pos when $3.3V - V_i > 0$

\[ 3.3V > V_i \Rightarrow V_i < 3.3V \]
2.9 Changer - uses a capacitor to DC-shift a waveform.

\[ T = RC \Rightarrow \text{Discharge Time for } C \]

C is connected directly from input to output

\[ R \parallel \text{output} \]

\[ V_{in} - \longrightarrow R \longrightarrow \text{Vin} \]

\[ \text{Output} \]

1. Begin when \( I_D > 0 \), diode on

C will charge instantaneously

\[ V_i = V_c \quad \text{and} \quad I = 0 \]

2. When diode off, \( V_c = V_{i,\text{MAX}} \)

\[ V_i = \frac{V_{i,\text{MAX}} + V_i}{T} \quad V_o = \frac{T}{R} \quad V_i = \frac{T}{R} \]

\[ \text{or} \]

\[ V_o = V_i \text{ shifted by } -V_{i,\text{MAX}} \]

3. On the next period of the waveform, \( V_o \) is shifted by \( -V_{i,\text{MAX}} \)

\[ V_{c} = -N \quad ; \quad V_o = 0 \]
\[ F = 1000 \text{Hz} \quad T = \frac{1}{F} = 10^5 \times 10^{-6} = 0.15 \text{sec} \quad T = \frac{1}{F} = 0.0015 \text{sec} \]

**Diode ID** \[ \rightarrow CCW, \text{ MEANS} \]

**Since diode ID Flows into the top of Vi**, this means \[ \frac{1 - \sqrt{1}}{1 + \sqrt{1}} \]

\[ V_{\text{max}} \text{ looks like} \Rightarrow \]

\[ V_{\text{max}} = \frac{1 - \sqrt{1}}{1 + \sqrt{1}} \text{ which is the negative part of the input signal} (t) \]

\[ +V_i -5V +V_c = 0 \]

\[ V_c = 5V -V_i \quad \text{since} \quad V_{\text{lin}} = -20V \]

\[ V_c = 5V -(-20V) = 25V \]

**Final CI**

\[ V_i -25V \quad + \quad V_c = V_o \quad \Rightarrow \quad V_i -25V \quad - \quad V_c \]

**When diode is off**

\[ V_o = V_i + 25V \]

**When diode is conducting**

\[ V_o = 5V \]

\[ t_1 \quad t_2 \quad t_3 \quad t_4 \]

\[ 10V \quad -20V \]

\[ t \]

\[ 5V \quad -10V \quad (0+25V) \]

\[ t_1 \quad t_2 \quad t_3 \quad t_4 \]

\[ 0V \quad 0V \quad 0V \quad 0V \quad \text{off} \]

\[ t \]
EX 2.23

When diode is ON:

\[ V_c = V_i + 0.7V \]

\[ V_c = V_i + 0.7V \]

Since \( V_i \) goes into \(+\) side of \( V_i \), this means negative portion of curve.

\[ V_i = \frac{V_c - V_D}{2} \]

\[ V_i = \frac{V_c - V_D}{2} \]

\[ V_c = -V_i + 5V - 0.7V \]

\[ V_c = -V_i + 5V - 0.7V \]

\[ V_c = V_i \]

\[ V_c = V_i \]

\[ V_c = \left[V_i_{\text{max}}(t_1-t_2)\right] + 4.3V = -(20) + 4.3V = 24.3V \]

\[ V_c = \left[V_i_{\text{max}}(t_1-t_2)\right] + 4.3V = -(20) + 4.3V = 24.3V \]

When diode is conducting:

\[ V_o = 5V - 0.7V \]

\[ V_o = 4.3V \]

\[ V_o = 4.3V \]

\[ V_o = 4.3V \]

\[ V_o = 4.3V \]

\[ V_o = 4.3V \]

\[ V_o = 4.3V \]
\[ V = 0 \text{ ccw} \quad V_c + V_i + 10 + V_D = 0 \]
\[ V_c = -10 - V_i - V_D \quad \Rightarrow V_{c_{\text{max}}} = V_{i_{\text{max}}} = -20 \text{V} \]

Let diode be ideal, then \( C \) charges to \( V_c = -10 - (-20) = 10 \text{V} \)

\[ V_i \rightarrow V_c \rightarrow 10 \text{V} \rightarrow 0 \]

\[ R \leftarrow \frac{50}{\text{Circuit looks like}} \]

\[ V_o \text{ is } [N_c + 10] \Rightarrow \text{shifts } V_i \text{ up by } +10 \text{V} \]
2.10 NETWORK WITH AC + DC SOURCE

USE SUPERPOSITION

1. \( V_D = 0.7V \), 10V
2. \( V \) = 3,10V \( V_R + I_D \times R \) = 0
3. \( V_D + I_D \times 2k \times R = 10 \)
4. \( I_D = 9.3V \)
5. \( I_D = \frac{26mV}{4.65mA} \)
6. \( R_D = 5.59 \Omega \)
7. \( V_D = 9.3V \)
8. \( V_D = 1.99V \)
9. \( V_D = 0.01V = 10mV = V_D \)
Combine DC + AC

\[ V_{RQ} = \left. V_R \right|_t = 9.3 \, V \quad V_R = V_{RQ} + V_{RAC} \]

\[ V_{RQ} = 0.7 \, V \quad V_{DP} = 0.01 \, V \]

GRAPHING

\[ \text{with diode shorted} \]
\[ I_D = \frac{10 \, V}{2k}\Omega = 5 \, mA \]

\[ \text{with diode open} \]
\[ V_D = 10 \, V \]

\[ \text{draw load line} \]

DC ± AC peak
\[ I_{DP+} = \frac{10 + 2}{2k}\Omega = 6 \, mA \]
\[ I_{DP-} = 4 \, mA \]