AC Circuit Examples

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Phase Shift Circuits

(a) Time-domain waveforms

\[ v_a = v_{in}(t) \]

\[ v_{out1} = v_{out1}(t) \]

\[ v_{out2} = v_{out2}(t) \]

Input

Lags input by \( \Delta t_2 \)

Leads input by \( \Delta t_1 \)
Power Supply Circuit

The diagram shows the components of a power supply circuit:

1. **Transformer**
2. **Rectifier**
3. **Filter**
4. **Voltage regulator**

The process starts with an ac input at $v_s(t)$, which is transformed by the transformer. The output is then rectified, filtered, and regulated to produce a dc output $V_{out}$. The waveforms illustrate the changes from ac to dc output.
Ideal Transformer

\[
\frac{v_2}{v_1} = \frac{N_2}{N_1} \quad \quad \quad \quad \quad \frac{i_2}{i_1} = \frac{N_1}{N_2}
\]
Half-Wave Rectifier

\[ v_{in}(t) \]

\[ v_{out}(t) \]

\[ v_{out}(t) \text{ with } V_F = 0 \]

\[ v_{out}(t) \text{ with } V_F = 0.7 \text{ V} \]
Current flow during first half of cycle

Current flow during second half of cycle
Smoothing RC Filter

(a) Bridge rectifier with filter

(b) Filtered output

Ripple voltage $v_r$

Capacitor charging up
Capacitor discharging

With filter
Without filter

$T_{rect}$
Complete Power Supply

Transformer

Rectifier

$V_{s1} = \left( \frac{N_2}{N_1} \right) V_s$

$\nu_{s1}(t) = V_{s1} \cos \omega t$

$(V_{s1} - 1.4)$

$\nu_{s2}(t)$

$C$

$R_s$

$i_z$

$R_L$

$\nu_{out}(t)$

Zener diode $V_z$

RC filter and voltage regulator