

Rangkaian Dioda

Elektronika

(TKE 4012)

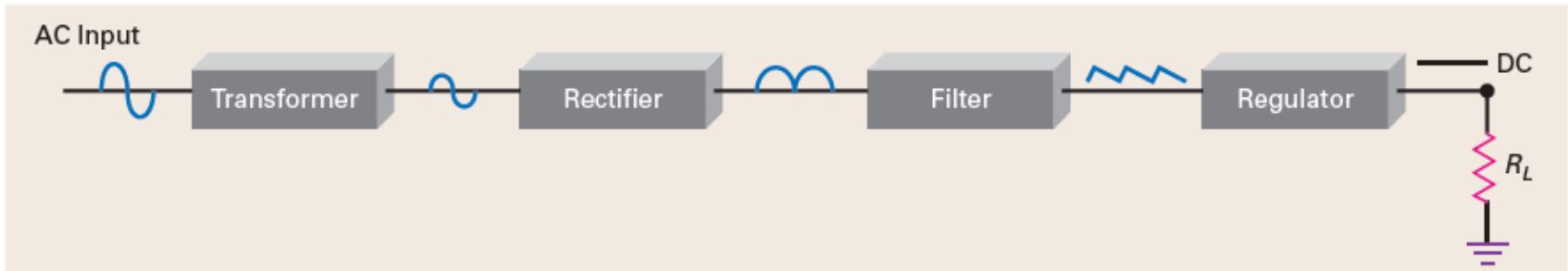
Eka Maulana

maulana.lecture.ub.ac.id

Pokok Bahasan

- Penyearah Setengah Gelombang
- Penyearah Gelombang Penuh
- Penyearah Jembatan
- Choke & Capacitor-input Filter
- Rangkaian Clipper
- Rangkaian Clamper
- Pengganda Tegangan

Pre: Power Supply

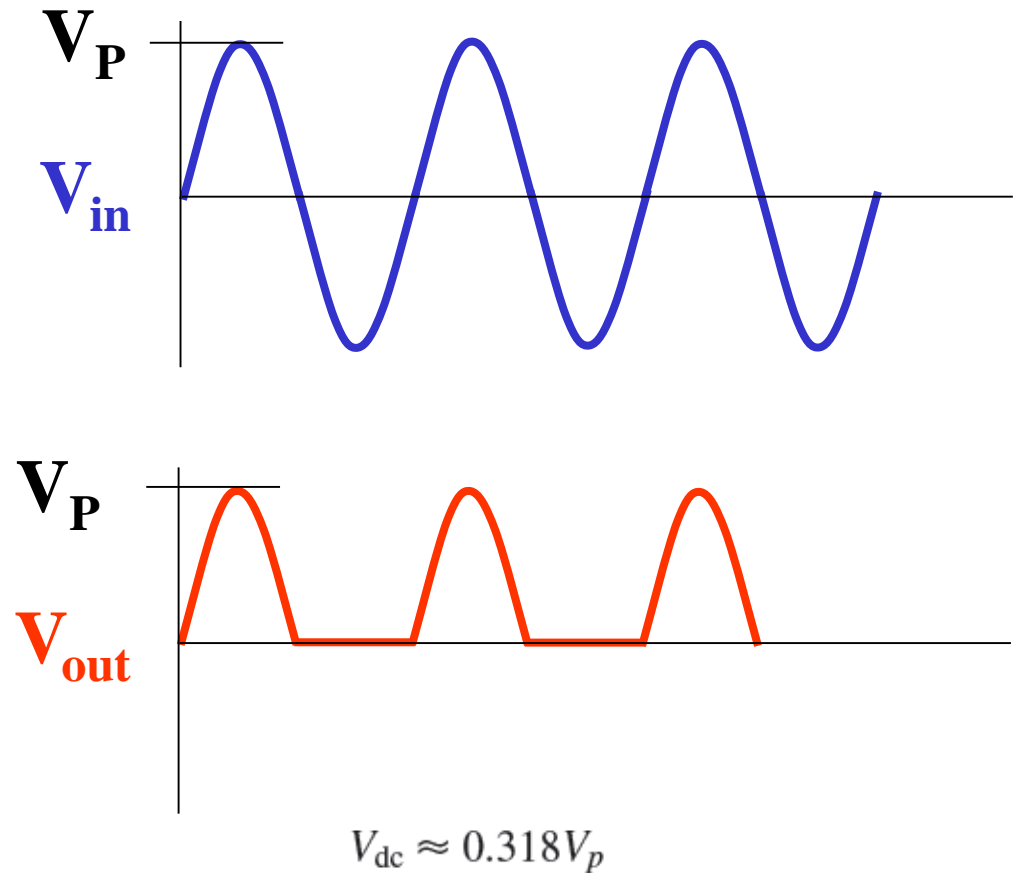
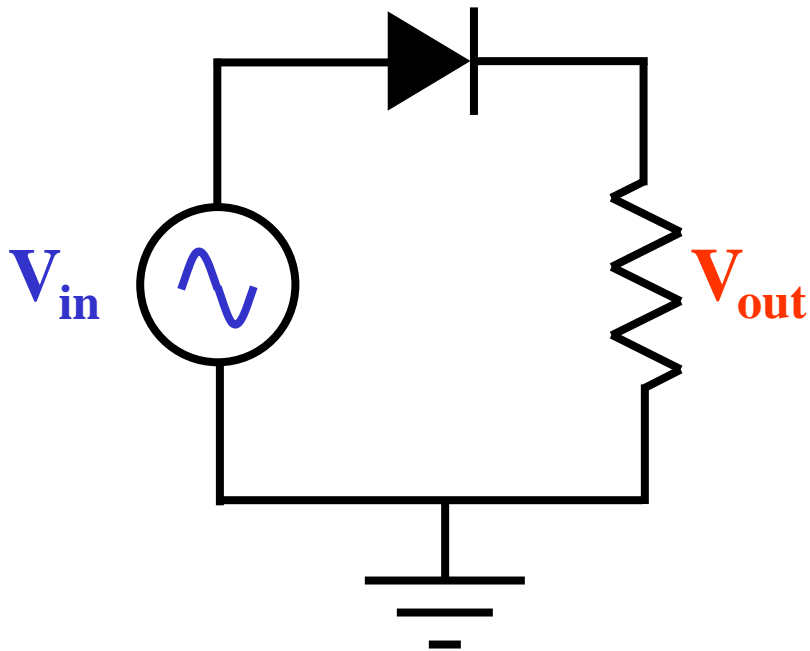


Purpose	Provides proper secondary ac voltage and ac ground isolation	Changes ac input to pulsating dc	Smooths out dc pulses	Provides a constant output voltage under varying loads and ac input voltage
Types	Step-up, step-down, isolation (1:1)	Half-wave, full-wave, full-wave bridge	Choke-input, capacitor-input	Discrete components, integrated circuit (IC)

$$V_{\text{rms}} = 0.707V_p$$

Penyearah Setengah Gelombang

Ideal: $V_{P(in)} = V_{P(out)}$



Penyearah Setengah Gelombang (Half Wave Rectifier)

- Output nilai DC adalah nilai rata-rata (*average*).

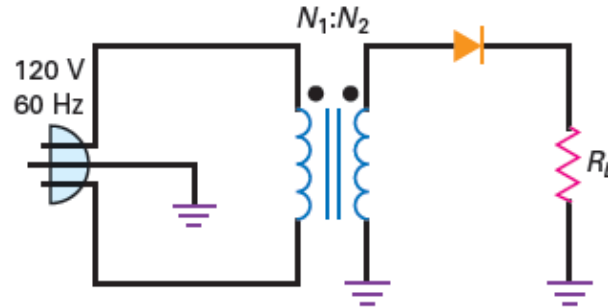
$$V_{dc} = V_P / \pi$$

$$f_{out} = f_{in}$$

- Menggunakan pendekatan kedua:

$$V_{P(out)} = V_{P(in)} - 0.7 \text{ V}$$

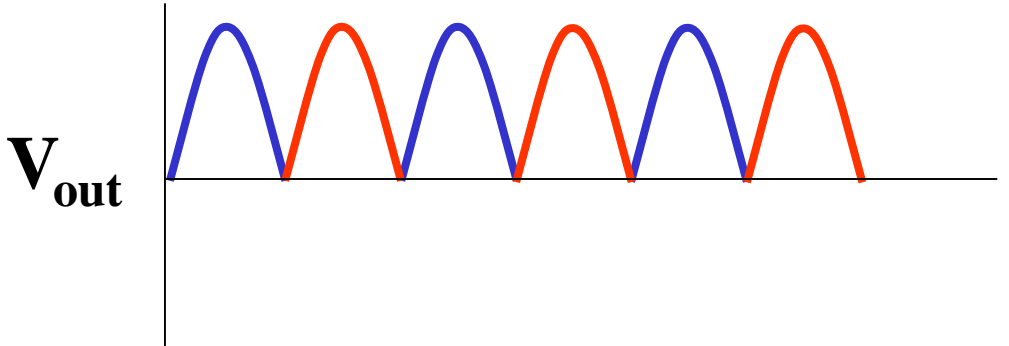
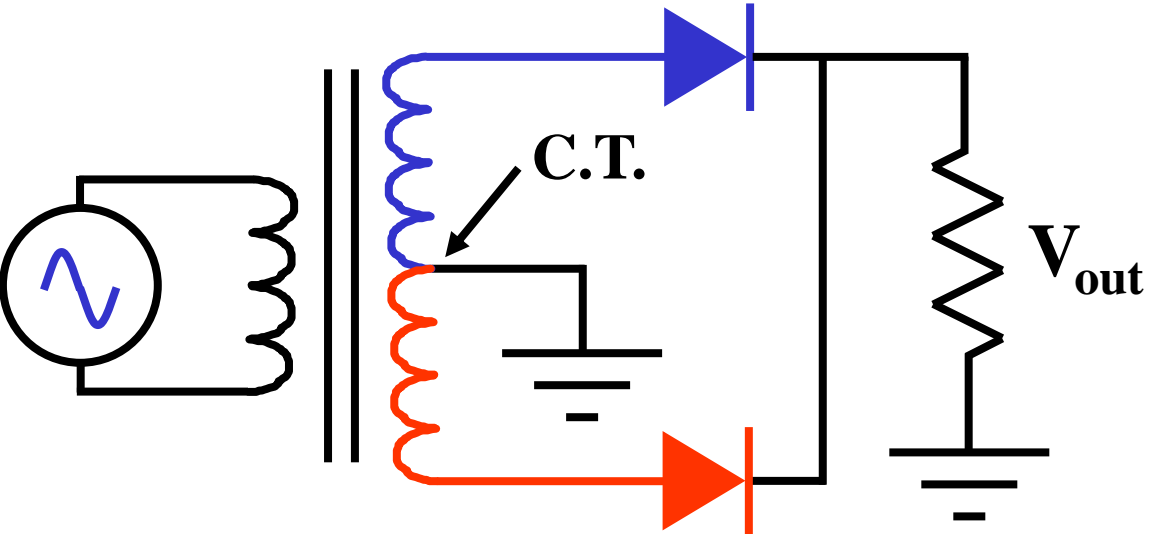
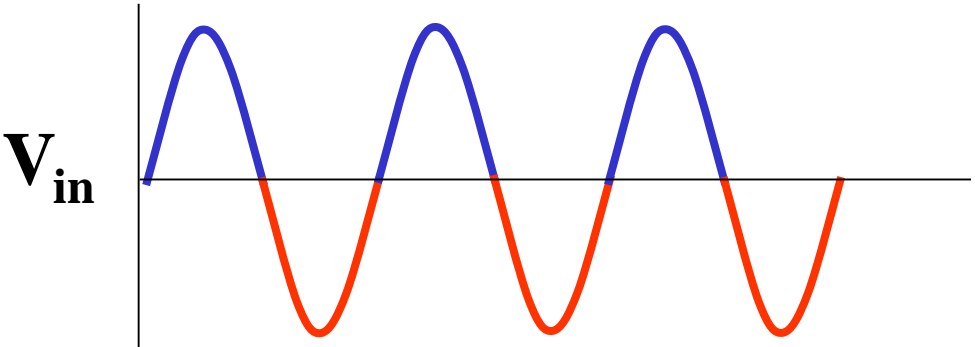
Transformer review



$$\frac{N_1}{N_2} = \frac{V_1}{V_2}$$

- When the turns ratio (N_1/N_2) is greater than 1, the primary voltage is stepped down.
- When the turns ratio is less than 1, the primary voltage is stepped up.
- Dotted ends have the same instantaneous phase.
- Full-wave rectifiers require a winding with a center tap.

Penyearah Gelombang Penuh



Penyearah Gelombang Penuh

(Full Wave Rectifier)

- Output nilai DC adalah nilai rata-rata (*average*).

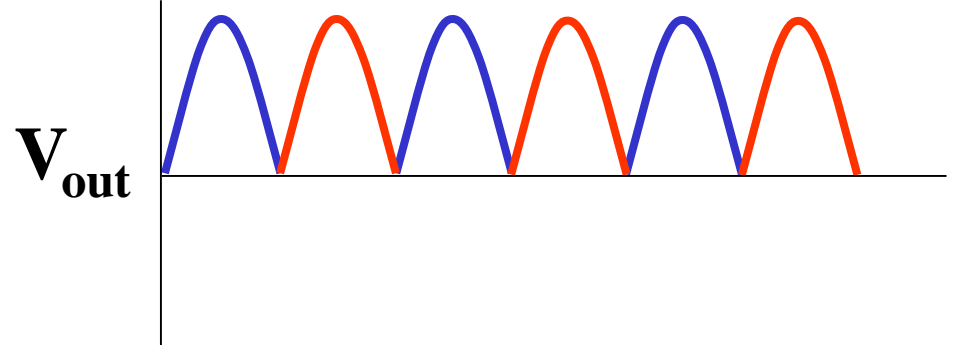
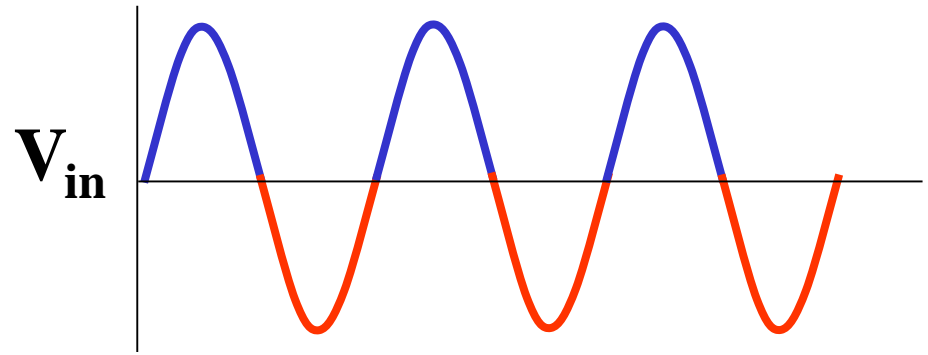
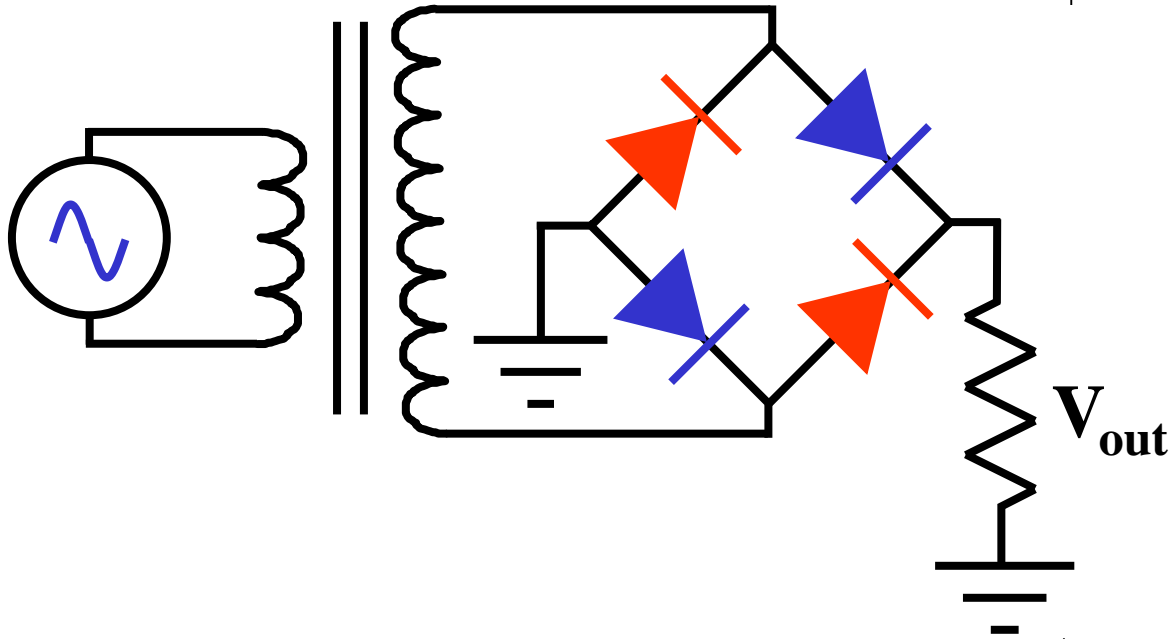
$$V_{dc} = 2V_P/\pi$$

$$f_{out} = 2f_{in}$$

- Input pada masing-masing dioda adalah setengah dari tegangan sekunder.
- Menggunakan pendekatan kedua:

$$V_{P(out)} = V_{P(in)} - 0.7 \text{ V}$$

Penyearah Jembatan (Bridge)



Bridge rectifier

- Output nilai DC adalah nilai rata-rata (*average*).

$$V_{dc} = 2V_P/\pi$$

$$f_{out} = 2f_{in}$$

- Menggunakan pendekatan kedua:

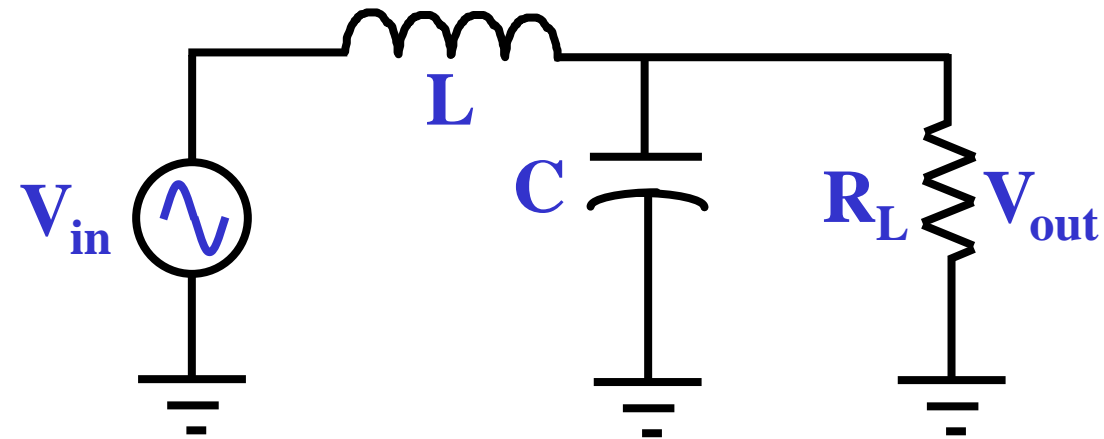
$$V_{P(out)} = V_{P(in)} - 1.4 \text{ V}$$

Ringkasan – Dioda Penyearah

	Half-wave	Full-wave	Bridge
Number of diodes	1	2	4
Rectifier input	$V_{p(2)}$	$0.5V_{p(2)}$	$V_{p(2)}$
Peak output (ideal)	$V_{p(2)}$	$0.5V_{p(2)}$	$V_{p(2)}$
Peak output (2d)	$V_{p(2)} - 0.7 \text{ V}$	$0.5V_{p(2)} - 0.7 \text{ V}$	$V_{p(2)} - 1.4 \text{ V}$
DC output	$V_{p(\text{out})}/\pi$	$2V_{p(\text{out})}/\pi$	$2V_{p(\text{out})}/\pi$
Ripple frequency	f_{in}	$2f_{\text{in}}$	$2f_{\text{in}}$

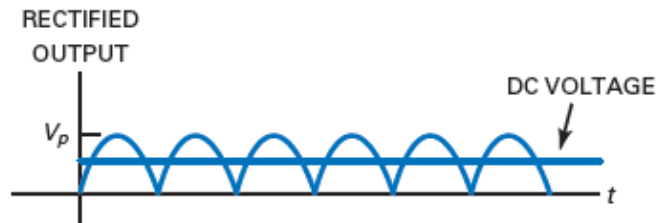
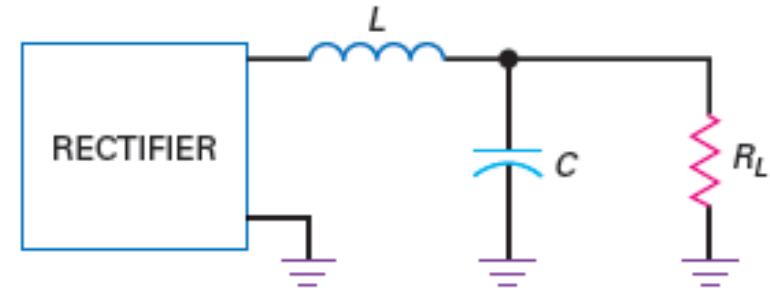
* $V_{p(2)}$ = peak secondary voltage; $V_{p(\text{out})}$ = peak output voltage.

The choke-input filter

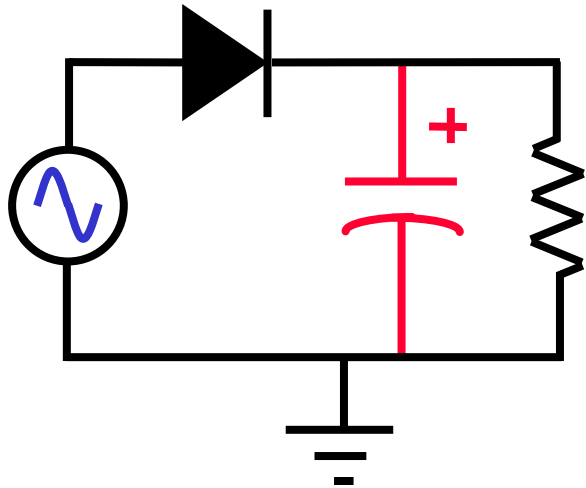


When $X_L \gg X_C$:

$$V_{out} \approx \frac{X_C}{X_L} V_{in}$$



The capacitor-input filter



peak-to-peak ripple voltage

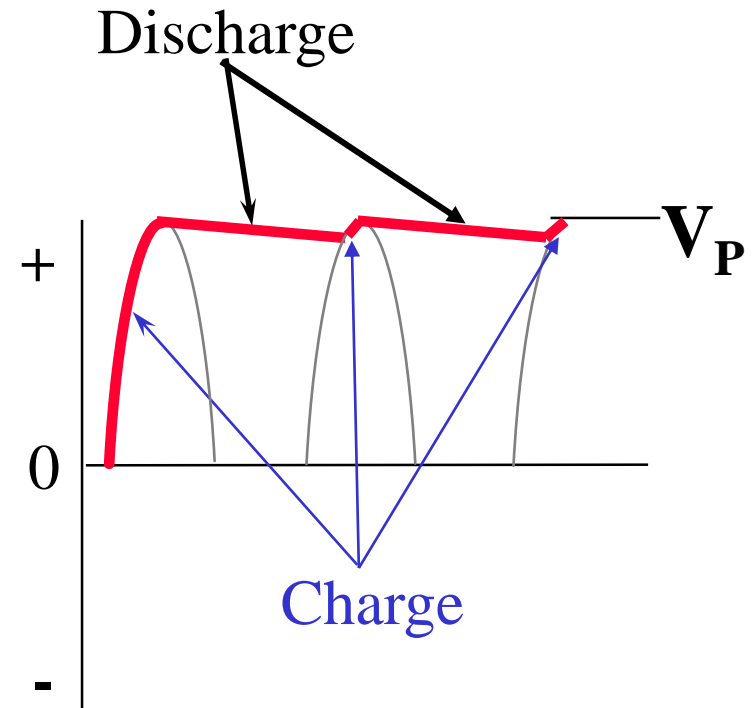
$$V_R = \frac{I}{fC}$$

where V_R = peak-to-peak ripple voltage

I = dc load current

f = ripple frequency

C = capacitance



Dc output voltage drops when load current increases

- Ac line regulation can have an effect
- Bulk resistance of rectifiers causes a voltage drop
- Resistance of transformer windings causes a voltage drop
- Ac ripple increases and average dc decreases

Diode ratings

- Half-wave rectifier with capacitor-input filter:

$$PIV = 2V_P \quad I_{\text{diode}} = I_{\text{dc}}$$

- Full-wave rectifier with capacitor-input filter:

$$PIV = V_P \quad I_{\text{diode}} = I_{\text{dc}}$$

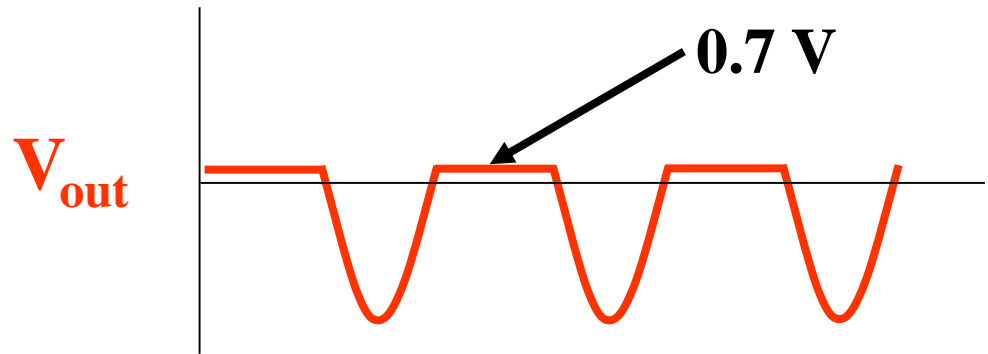
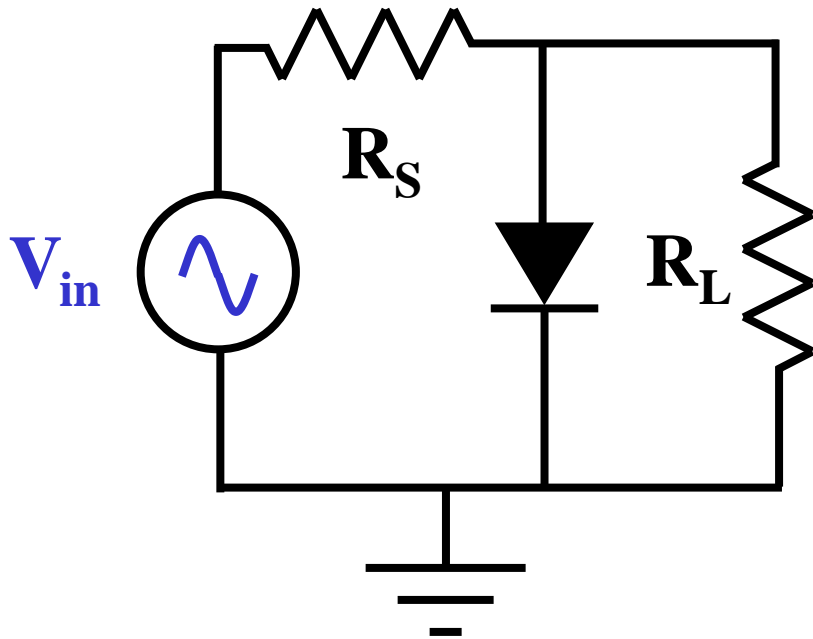
- Bridge rectifier with capacitor-input filter:

$$PIV = V_P \quad I_{\text{diode}} = 0.5I_{\text{dc}}$$

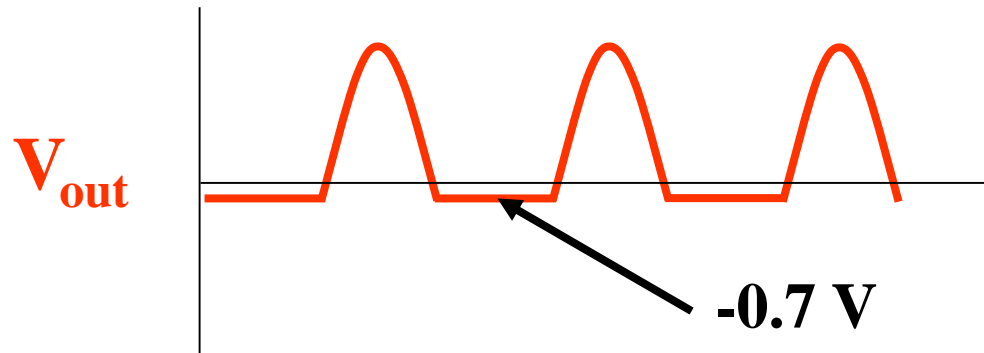
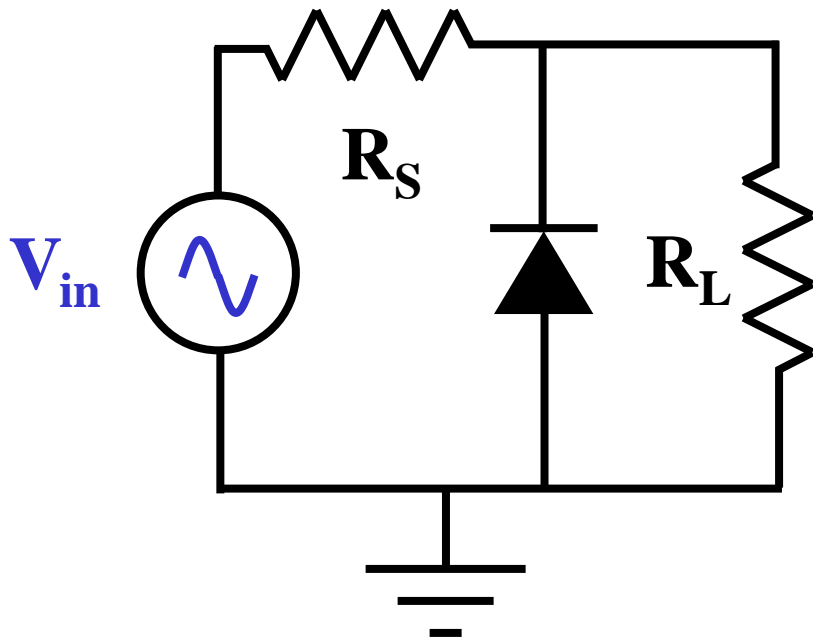
Bridge supply troubleshooting

- **No output - - blown fuse, two or more diodes open, load shorted**
- **Low output/extra ripple - - bad filter, open diode, shorted winding, overload**
- **Full-wave signal at output - - open filter capacitor**
- **Half-wave ripple frequency - - open diode**

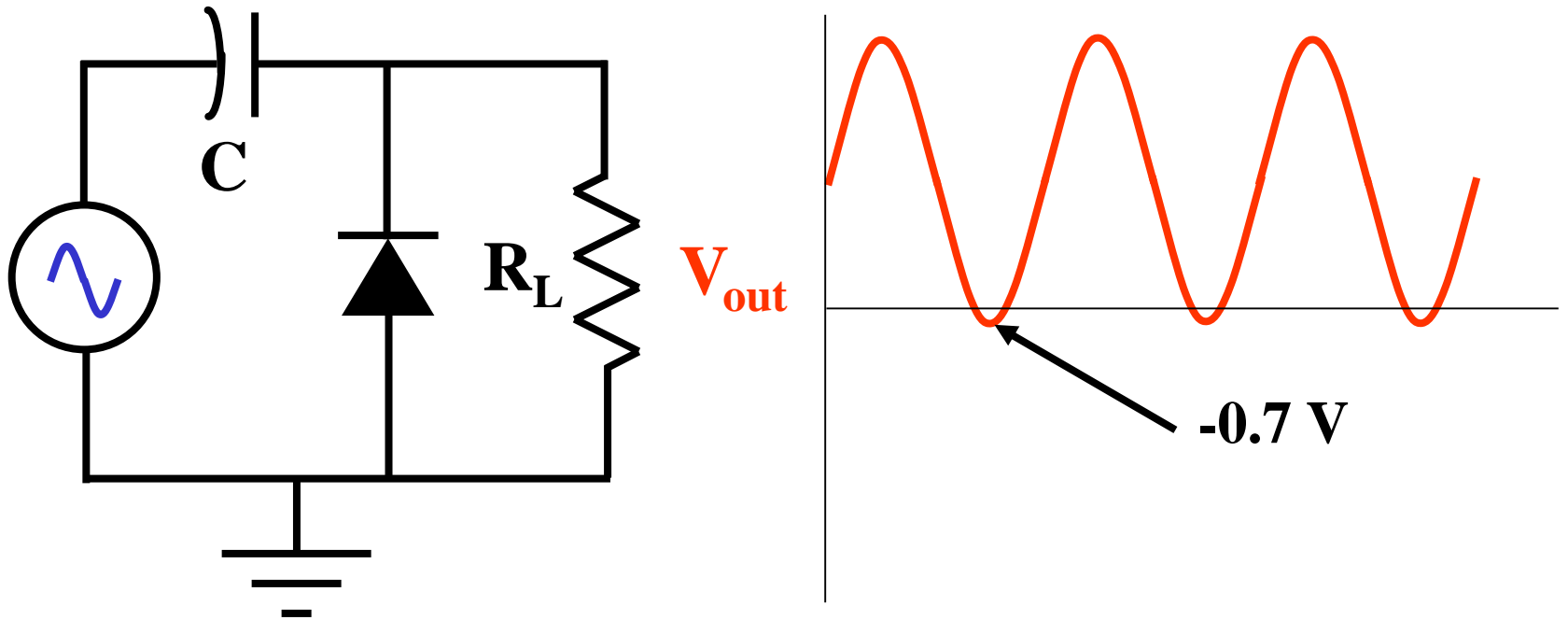
Positive clipper



Negative clipper

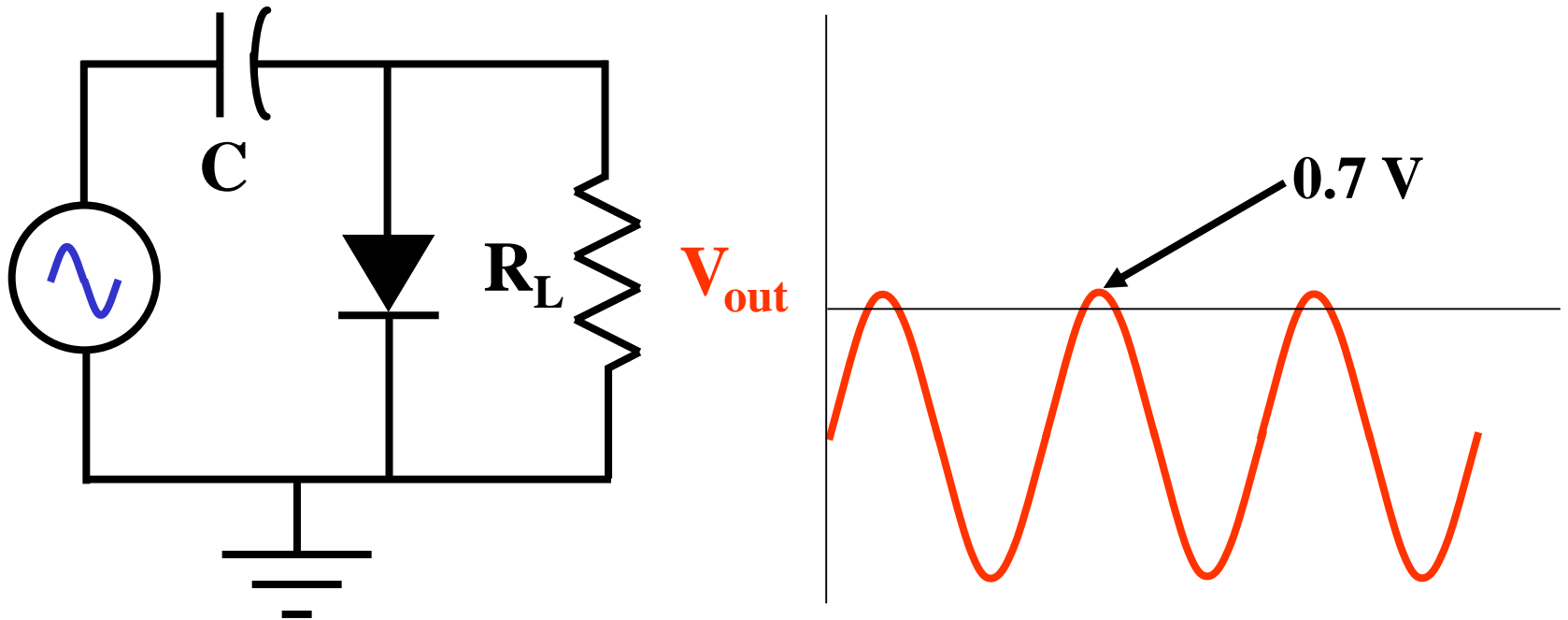


Positive clamper



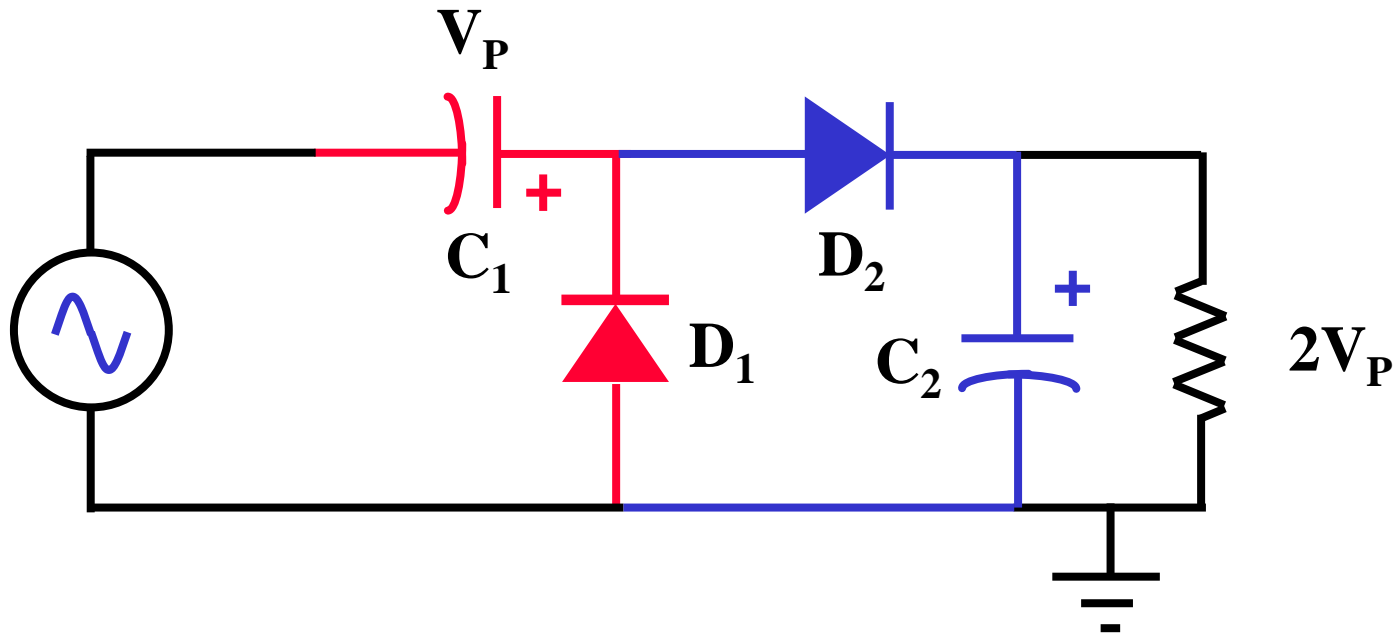
Stiff clamper: $R_L C > 100T$

Negative clamper

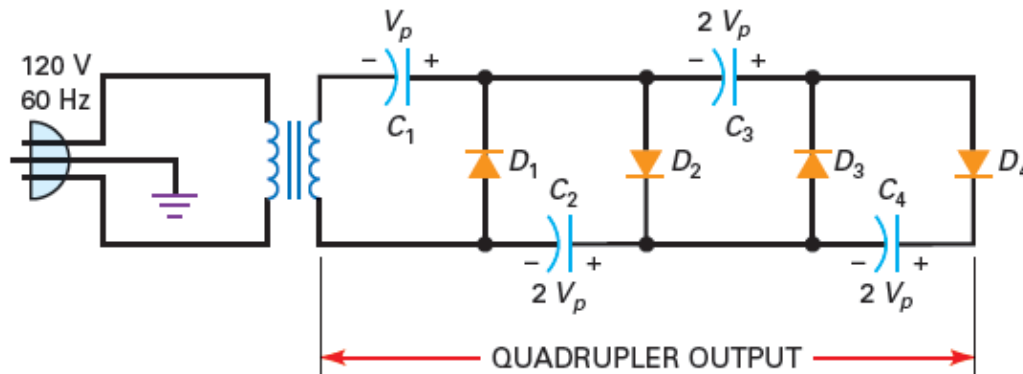
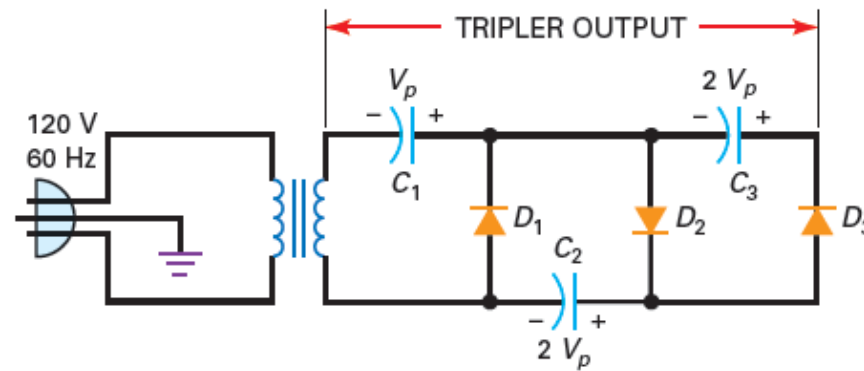
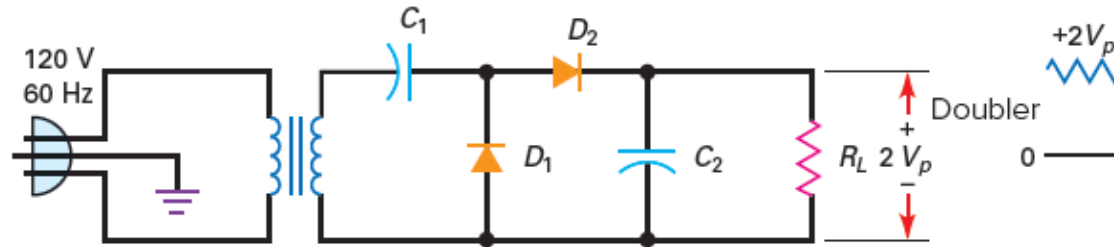


Stiff clamper: $R_L C > 100T$

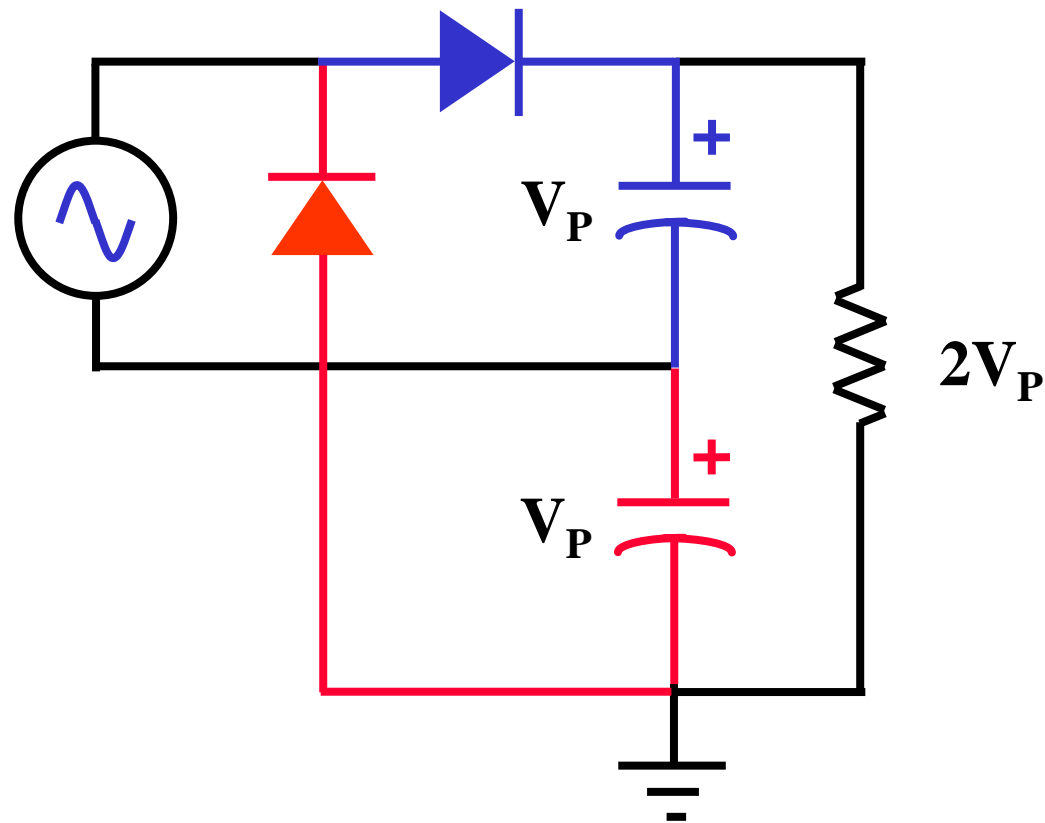
Half-wave voltage doubler



Multiplier tegangan output (beban Floating)



Full-wave voltage doubler



Persoalan:

Hitung V_{dc} dan V_R pada beban R_L masing-masing rangkaian

