
Electronics Technology

Fundamentals

Kapittel 18

Grunnleggende diodekoplinger

Basic Diode Circuits

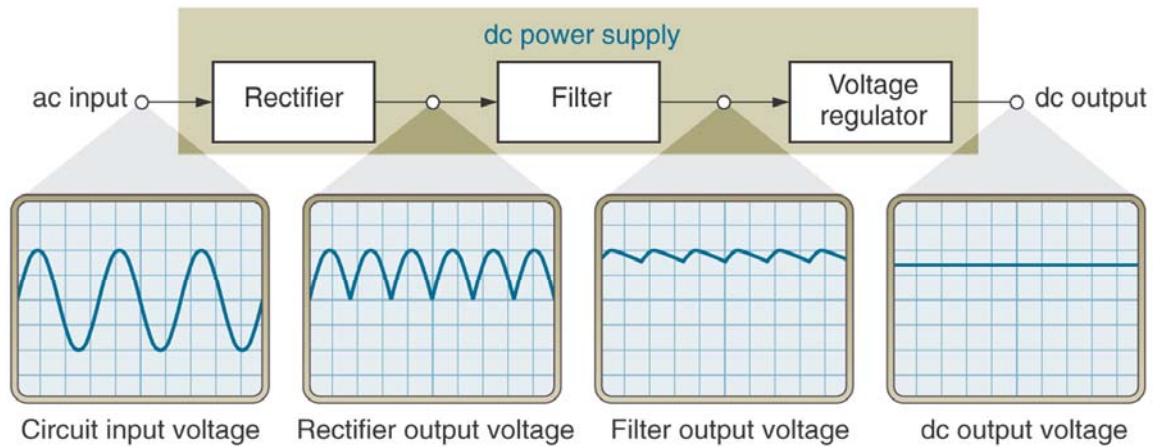
Revidert versjon 13 feb. 2007 T.Lindem

18.1 Likerettere

- **Likeretter** – en diodekrets som omformer en AC til pulserende DC
- **Filter** – en krets som reduserer variasjonene i spenningen ut fra en likeretter
- **Voltage Regulator** – **Spenningsregulator** – krets som opprettholder konstant spenninga ut (spenningen holdes konstant selv om belastningen endres)

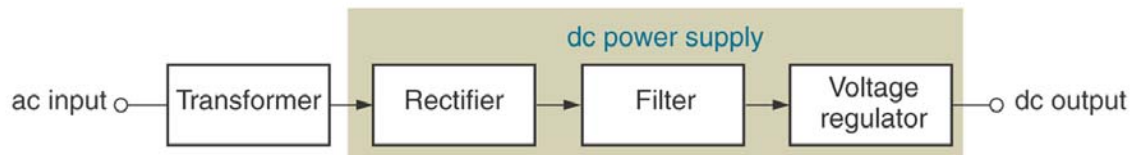
18.1 Halvbølge likeretter

■ Likerettere (fortsatt)



Basic power supply block diagram and waveforms

(a)

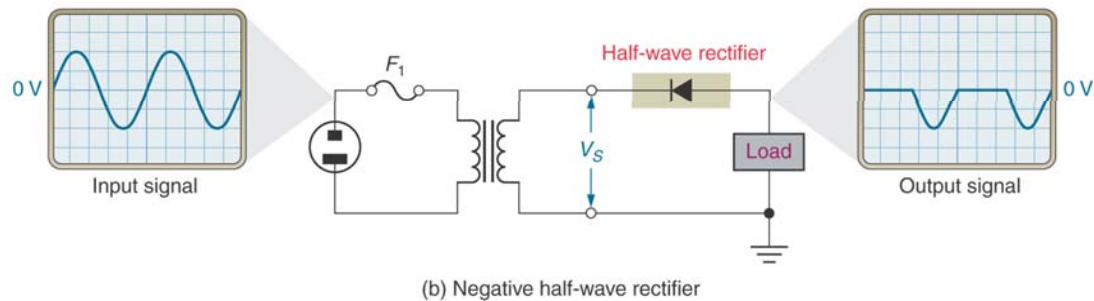
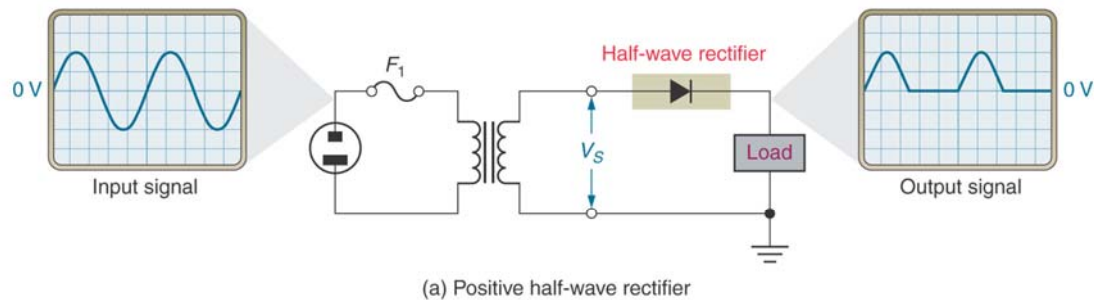


Basic power supply with a transformer input

(b)

18.1 Halvbølge likeretter

- Halvbølge likeretter – en diode er plassert i serie mellom en transformator og lasten (mottakerkretsen).
 - Positiv halvbølge likeretter – leverer en serie positive pulser
 - Negativ halvbølge likeretter – leverer en serie negative pulser



18.1 Halvbølge likeretter

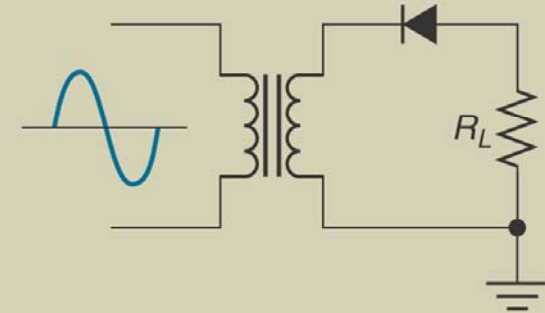
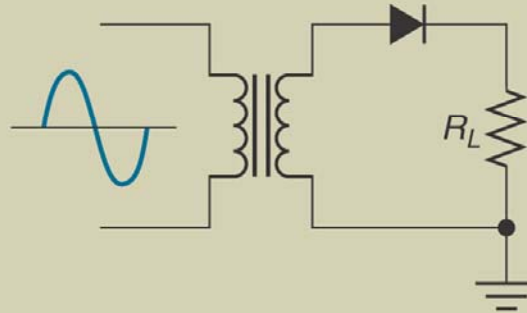
Half-Wave Rectifiers

Rectifier type:

Positive half-wave

Negative half-wave

Schematic diagram:



Circuit recognition:

The diode points toward the load (R_L).

The diode points toward the source.

When the diode conducts:

During the *positive* half-cycle of the input (V_S).

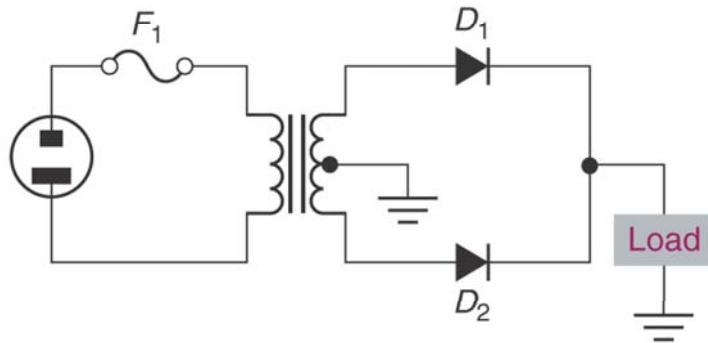
During the *negative* half-cycle of the input (V_S).

Resulting output waveform:



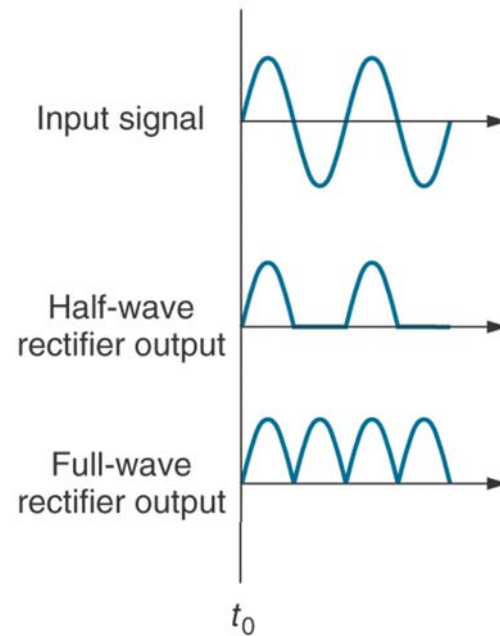
18.2 Helbølge likeretter

- Helbølge likeretter – består av to dioder som er forbundet til en sentertappet transformator



A full-wave rectifier

(a)

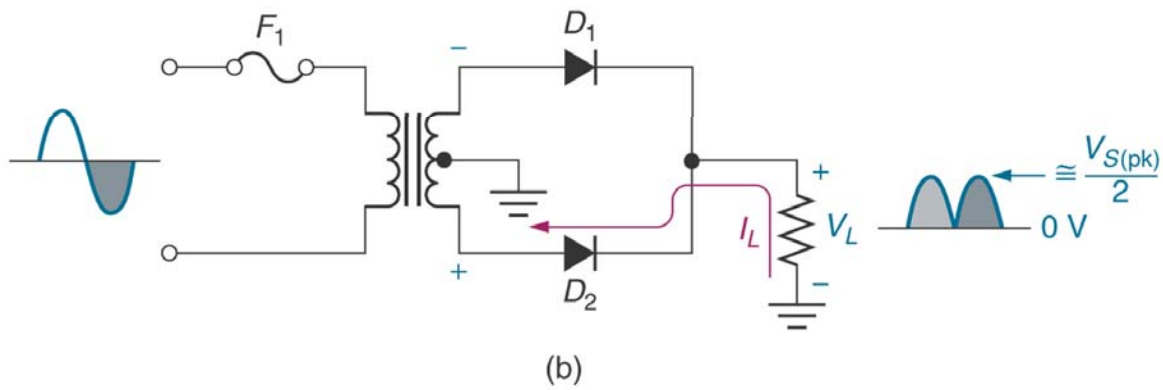
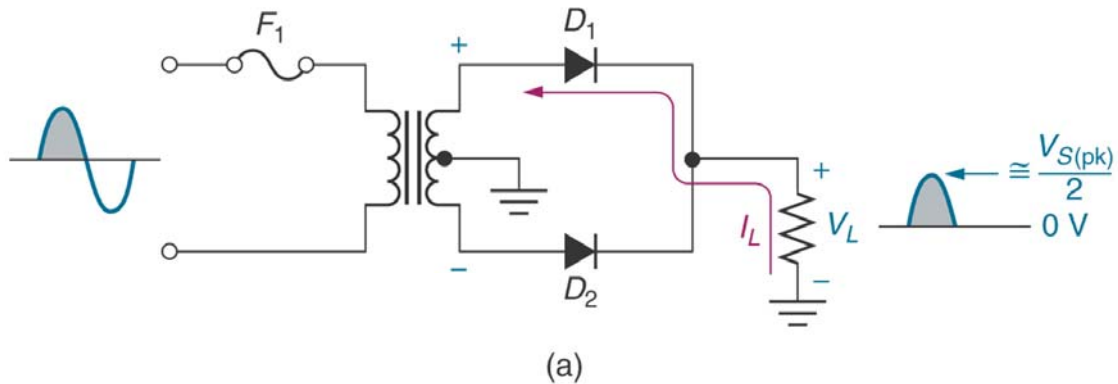


Typical rectifier waveforms

(b)

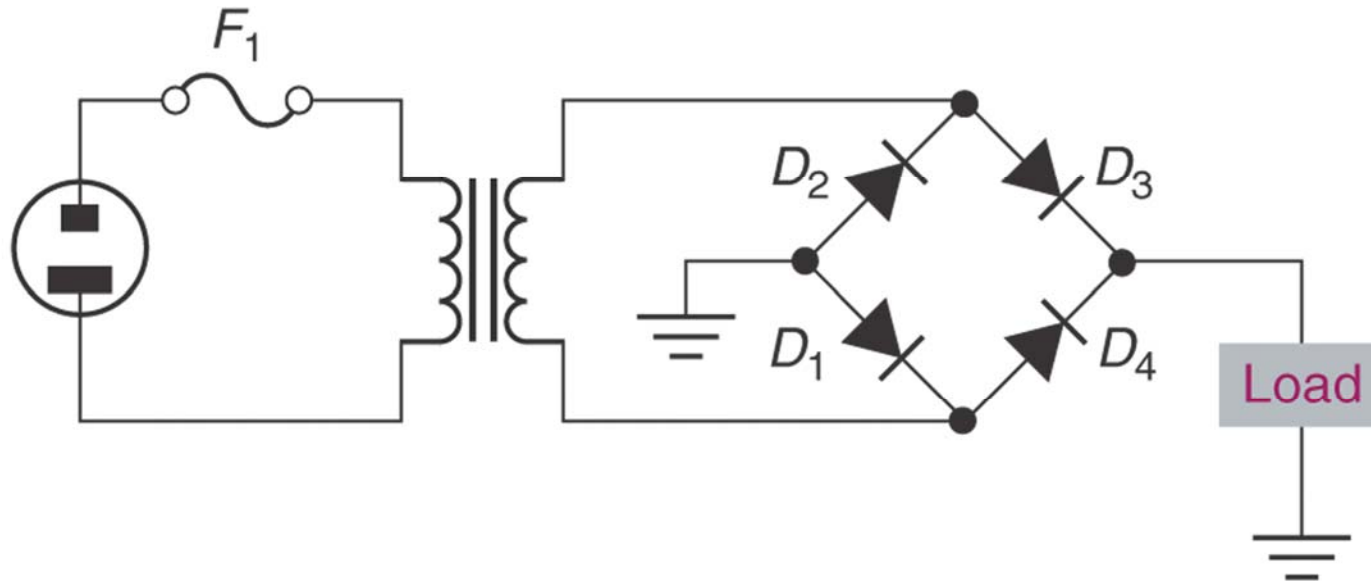
18.2 “Full-Wave” - Helbølge likeretter

■ Basic Circuit Operation



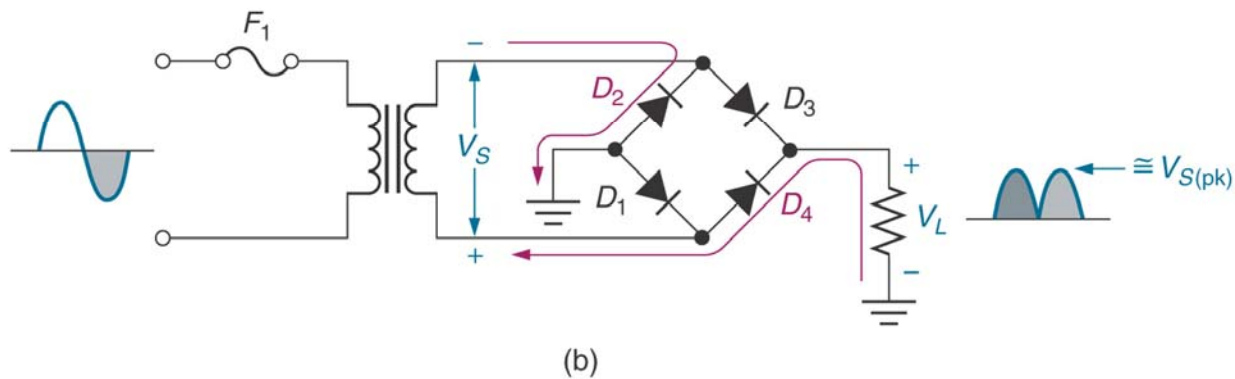
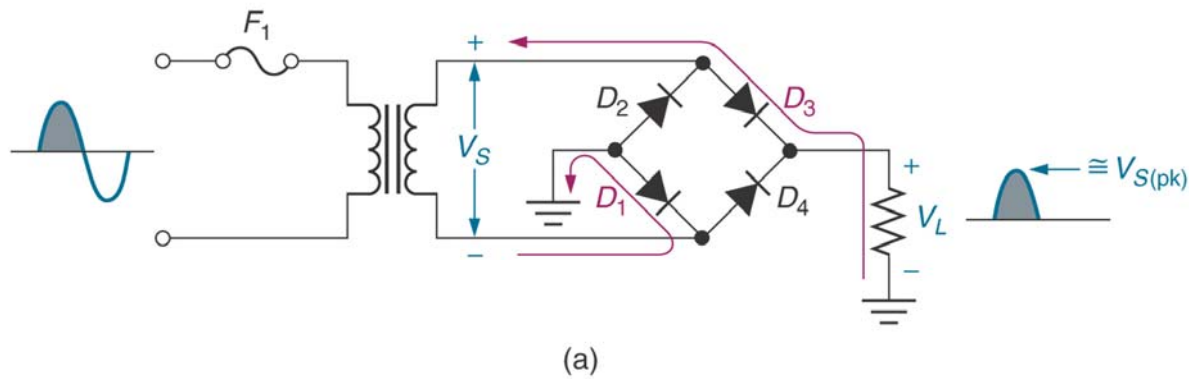
18.3 “Full-Wave” - Helbølge likeretter

- Helbølge likeretter – den mest benyttede likeretter
 - Trenger ikke sentertappet transformator



18.3 “Full-Wave” - Helbølge likeretter

- Circuit Operation – conduction alternates between two diode pairs



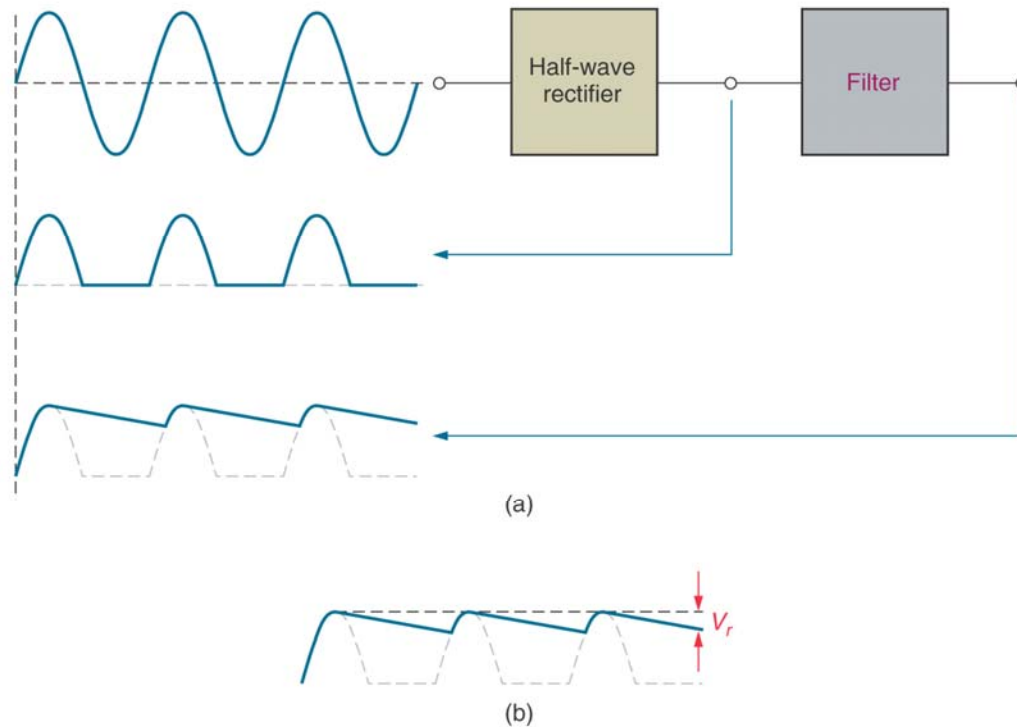
18.3 “Full-Wave” - Helbølge likeretter

Rectifiers: A Comparison

Rectifier type:	Half-wave	Full-wave	Bridge
Schematic diagram:			
Typical output waveform:			
Peak load voltage:	$V_{S(pk)} - 0.7 \text{ V}$	$\frac{V_{S(pk)}}{2} - 0.7 \text{ V}$	$V_{S(pk)} - 1.4 \text{ V}$
dc load voltage (V_{ave}):	$\frac{V_{L(pk)}}{\pi}$	$\frac{2V_{L(pk)}}{\pi}$	$\frac{2V_{L(pk)}}{\pi}$
dc load current (I_{ave}):	$\frac{V_{ave}}{R_L}$	$\frac{V_{ave}}{R_L}$	$\frac{V_{ave}}{R_L}$
PIV:	Equal to $V_{S(pk)}$	$V_{S(pk)} - 0.7 \text{ V}$	$V_{S(pk)} - 0.7 \text{ V}$

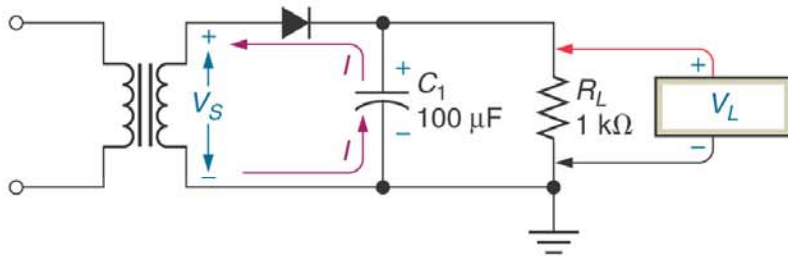
18.4 Likeretter med filter

- Power Supply Filter – en krets som reduserer variasjonene i DC spenningen ut fra likeretteren
 - Rippelspenning (V_R) – variasjonen i utgangs-spenningen (V_{PP})



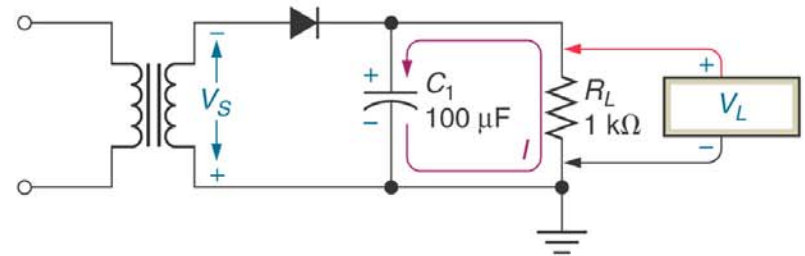
18.4 Likeretter med filter

- Basic Capacitive Filter – en kondensator er koplet i parallell med “lasten”



Charge circuit

(a)

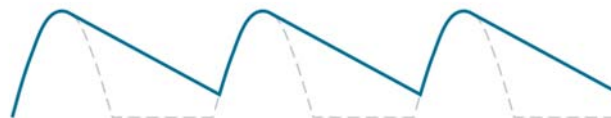


Discharge circuit

(b)

C_F constant

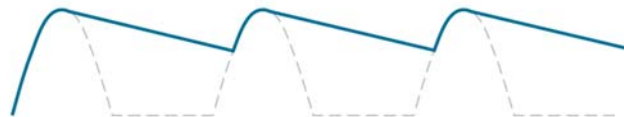
$R_L = 500 \Omega$



R_L constant

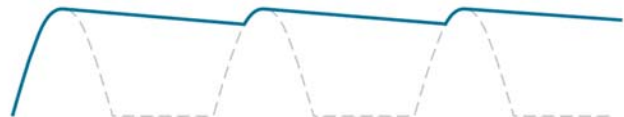
$C_F = 150 \mu\text{F}$

$R_L = 1 \text{ k}\Omega$



$C_F = 300 \mu\text{F}$

$R_L = 1.5 \text{ k}\Omega$

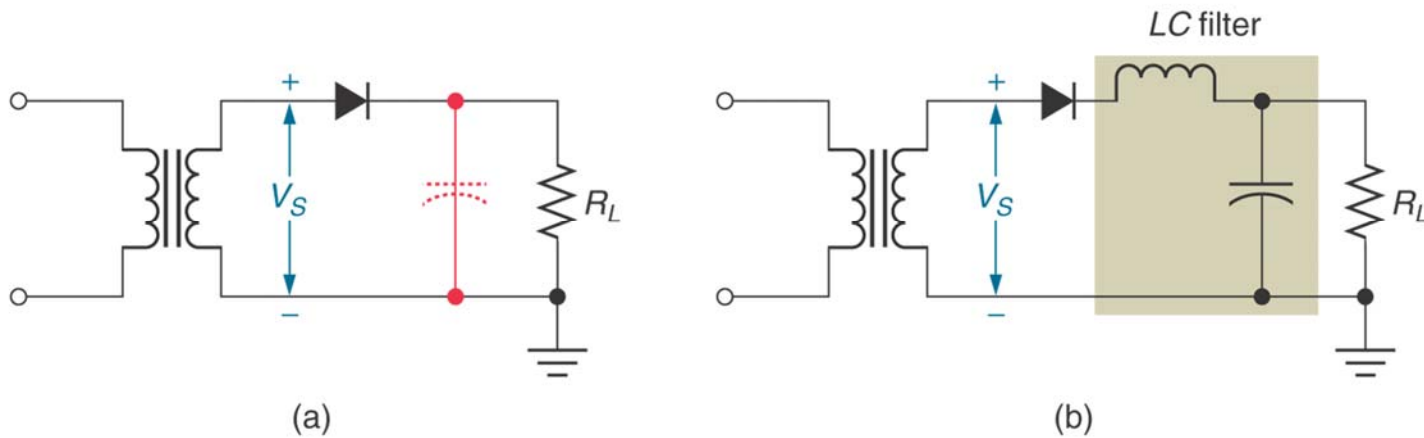


$C_F = 470 \mu\text{F}$

18.4 Likeretter med filter

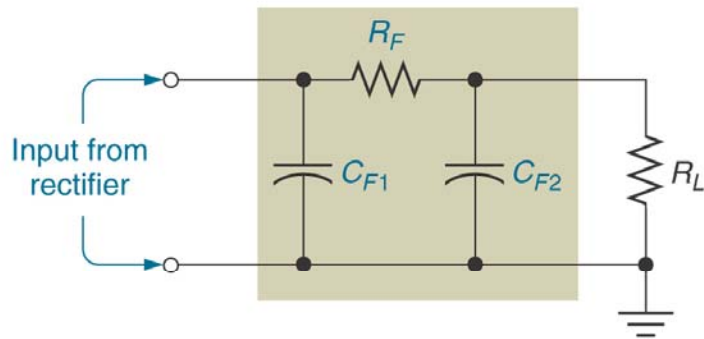
■ Surge Current

- At the first instant when a power supply is turned on, the discharged capacitor acts as a short circuit
- Rectifier current limited by:
 - Winding resistance of the transformer secondary
 - Bulk resistance of the diode
- Surge current can be limited by using *LC* / *RC* filter

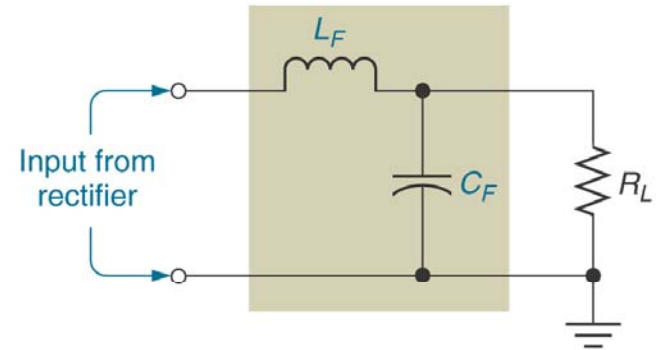


18.4 Filtered Rectifiers – P11

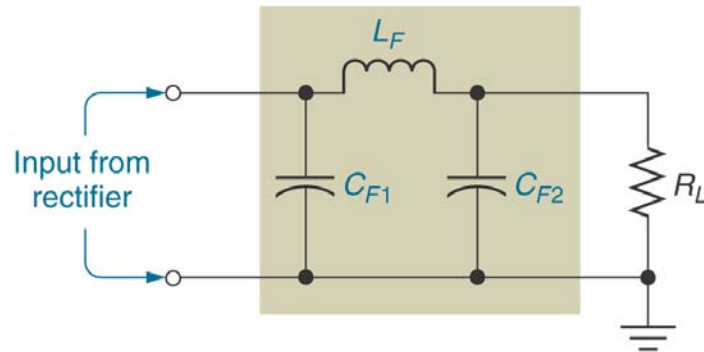
Other Filter Types



(a) $RC \pi$ filter



(b) LC filter

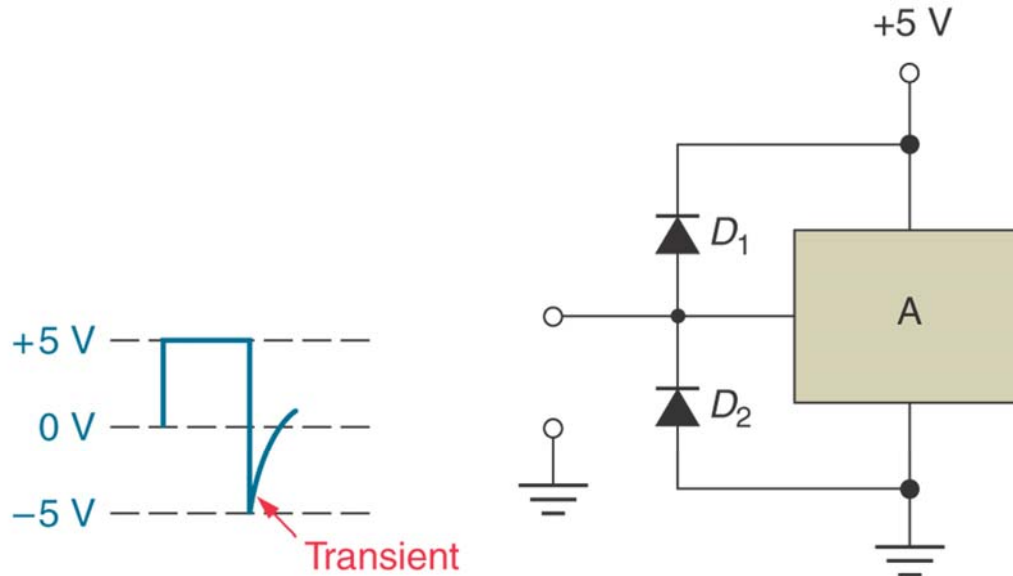


(c) $LC \pi$ filter

18.5 Klippere

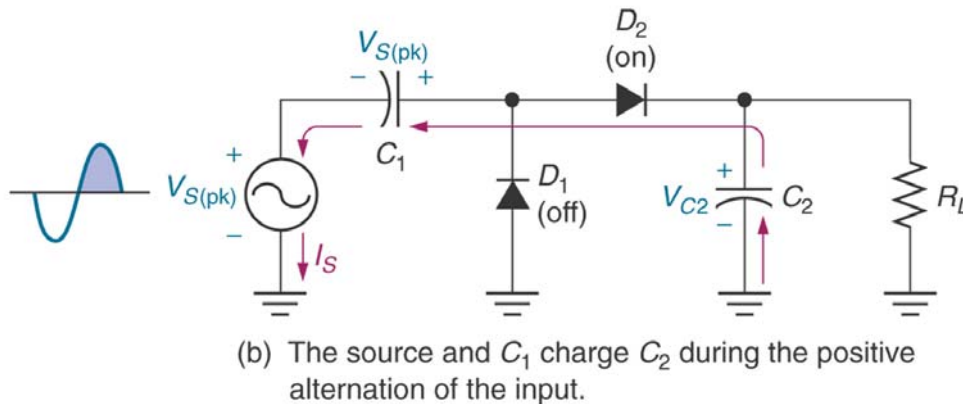
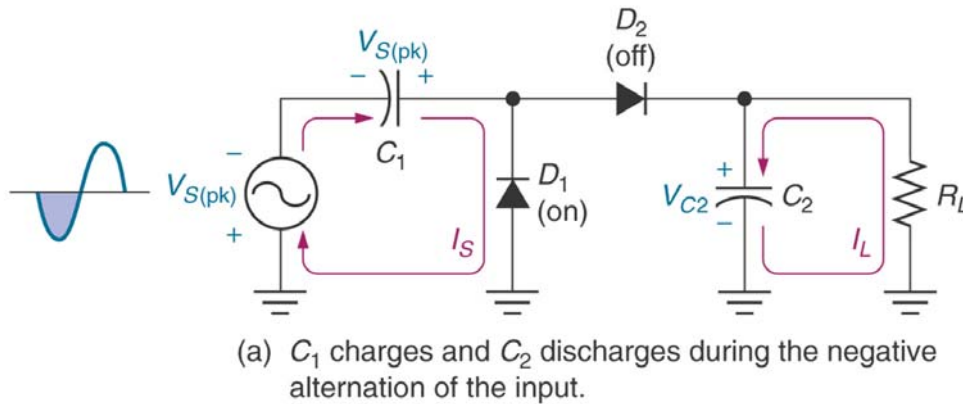
■ Transient beskyttelse

- Transient – en meget rask endring i enten strøm eller spenning – Kan ødelegge halvlederkomponenter. Forekommer ofte som elektrostatisk utladning når man berører komponenter. Har du klær av syntetisk materiale kan du fort “lades opp” til spenninger på over 1000 volt. Det er viktig at du er “jordet” når du behandler transistorer og integrerte kretser !
- Mange kretser må beskyttes mot overspenninger – til dette brukes diode“klippere” . Diode D_1 leder hvis input-signalet overstiger +5,7volt --- D_2 leder hvis input-signalet blir lavere enn - 0,7volt



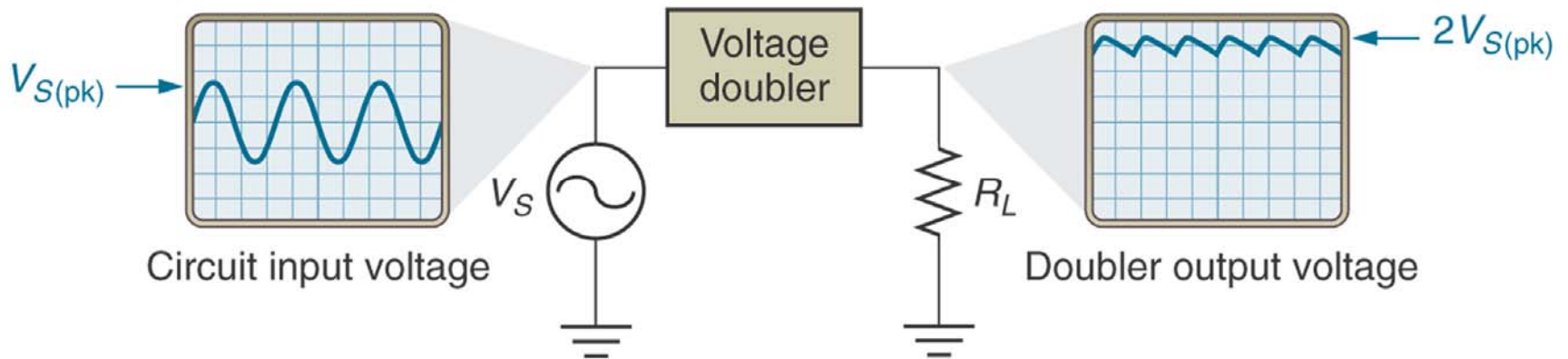
18.7 Spenningsdoblere (Voltage Multipliers)

■ Halvbølge “Voltage Doublers”



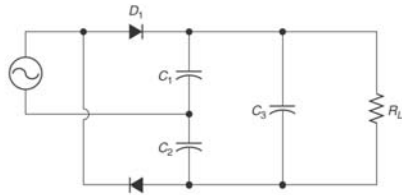
18.7 Voltage Multipliers – P3

- Half-Wave Voltage Doublers (Continued)

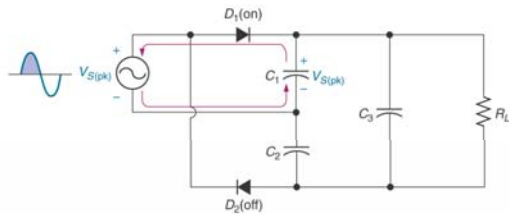


18.7 Voltage Multipliers – P4

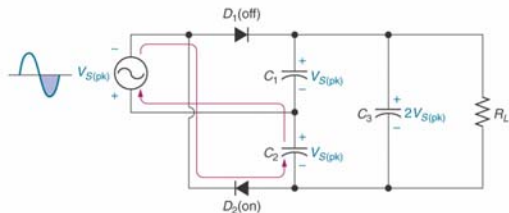
■ Helbølge spenningsdobler / tripler



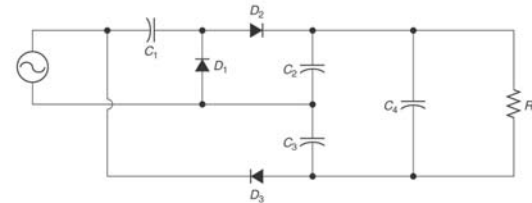
(a) A full-wave voltage doubler



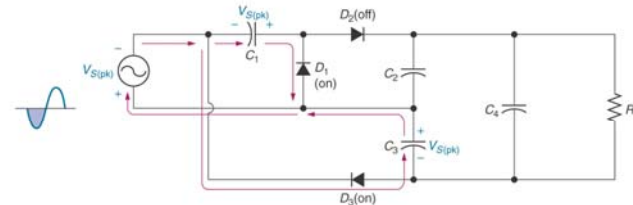
(b) C_1 is charged (via D_1) during the positive alternation of the input cycle.



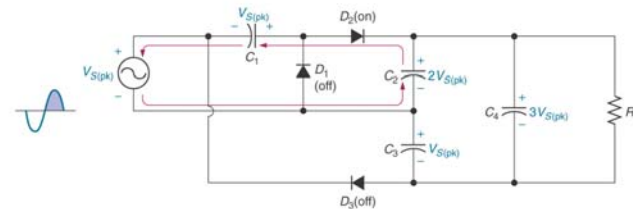
(c) C_2 is charged (via D_2) during the negative alternation of the input cycle.



(a) A voltage tripler



(b) C_1 and C_3 are charged during the negative alternation of the input cycle.



(c) C_2 is charged during the positive alternation of the input cycle.

18.7 Voltage Multipliers – P6

- Voltage Quadrupler

