DC Güç Kaynağı

1) Transformatör
2) Doğrultucu
3) Filtre
4) Voltaj Regülatörü

GÜÇ KAYNAĞI BLOK DİAGRAMI

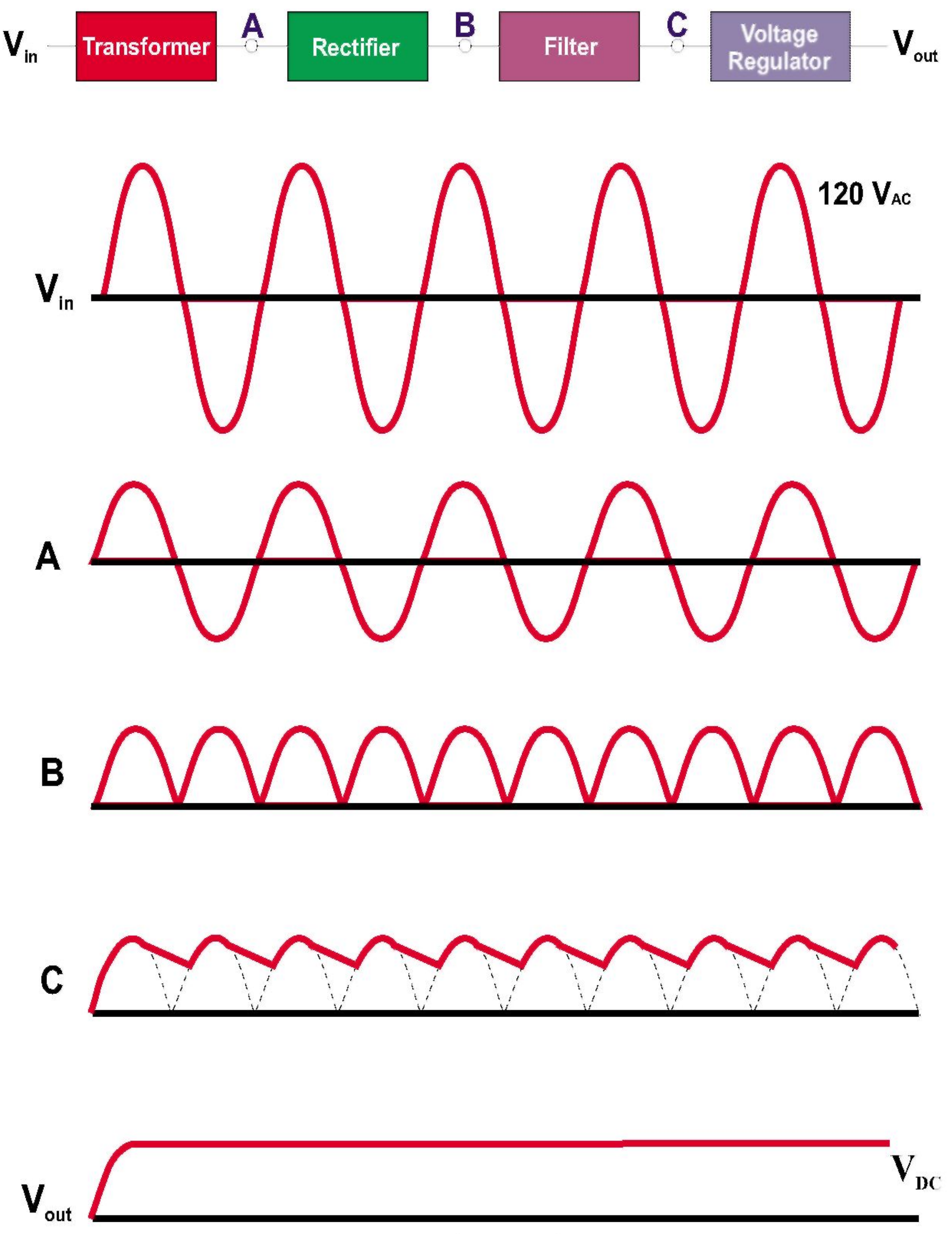


Figure 1

Transformatör

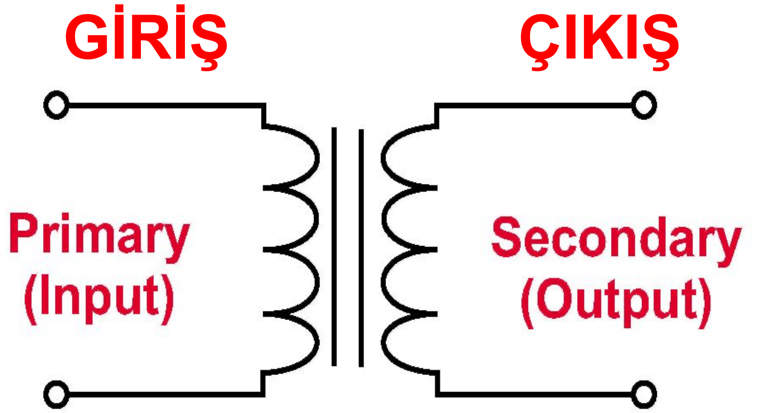


Figure 2

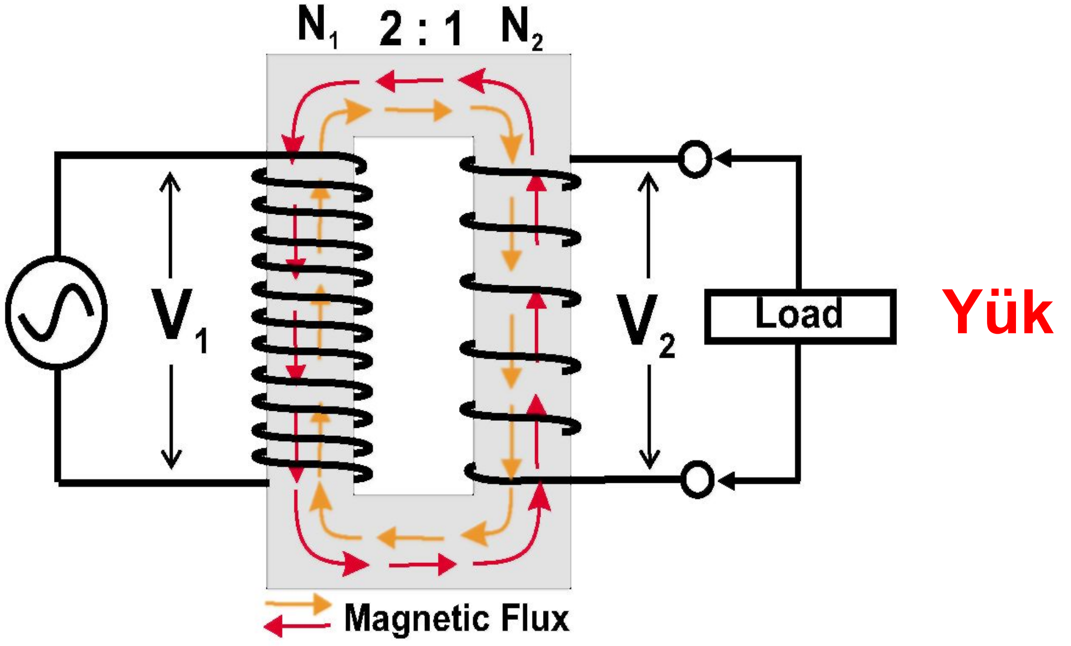
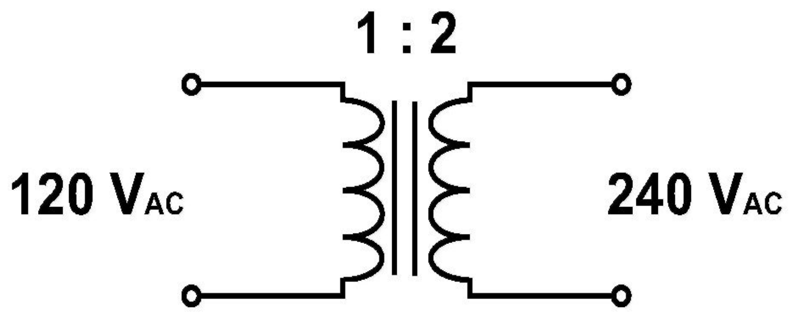


Figure 3

Transformatör Çeşitleri

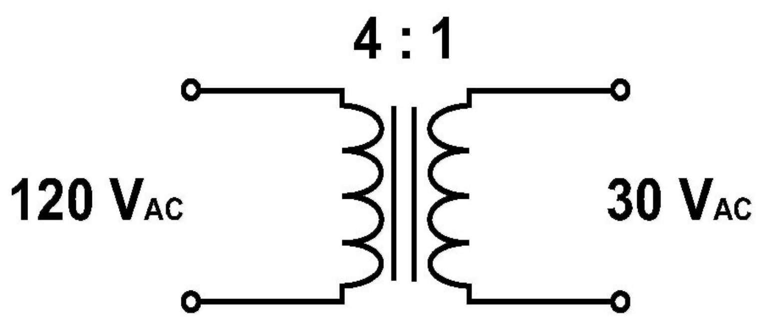
Yükseltici

Step Up



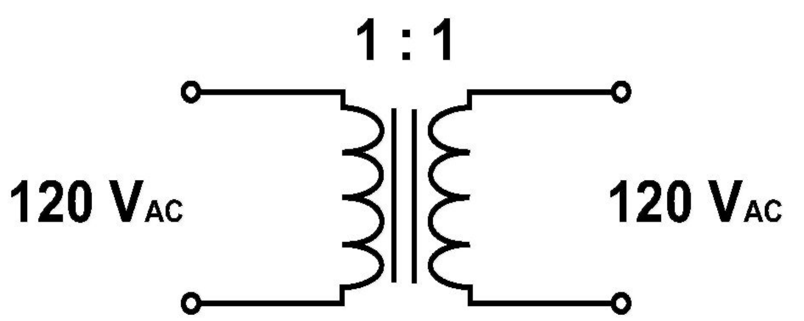
Alçaltıcı

Step Down



İzole

Isolation



Sekondary (Çıkış) Voltaj Hesabı

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

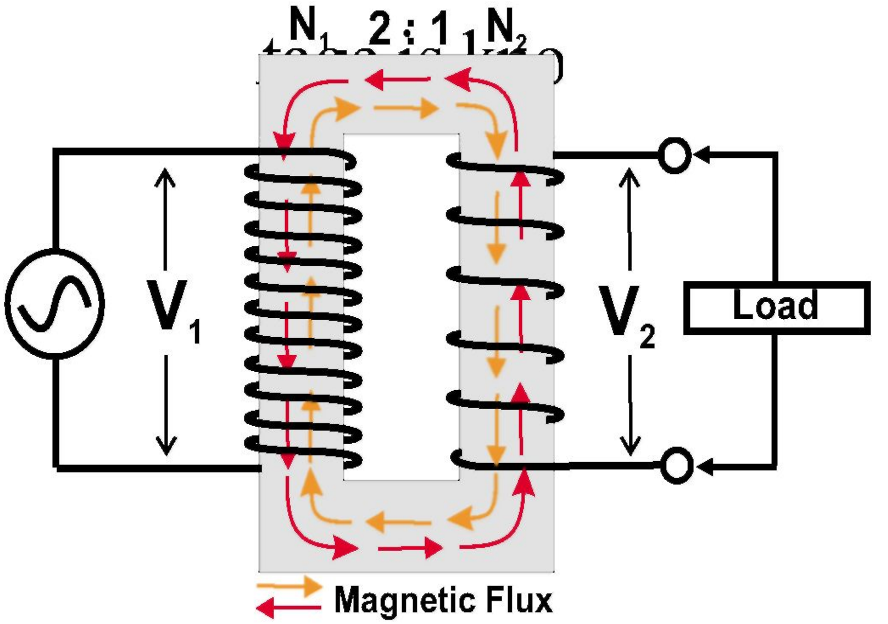


Figure 4

Sekondary Akım Hesabı

$$P_2 = P_1$$

$$V_2 I_2 = V_1 I_1$$

$$I_2 = \frac{V_1}{V_2} I_1$$

$$\frac{I_1}{I_2} = \frac{V_2}{V_1}$$

$$I_2 = \frac{N_2}{N_1} I_1$$

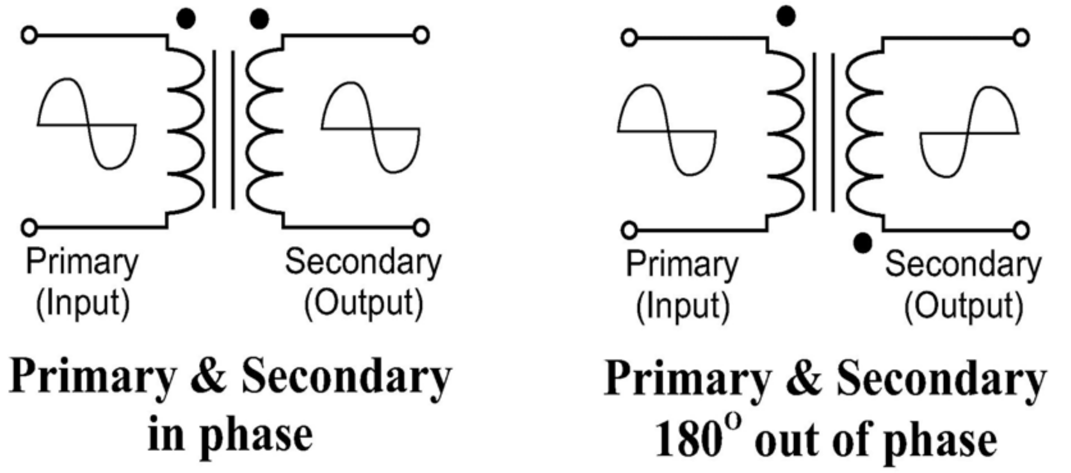


Figure 5

<u>Doğrultucu Devre Çeşitleri</u>

1) ***Yarım Dalga Doğrultucu***
2) ***Tam Dalga Doğrultucu***
3) ***Köprü Doğrultucu***

Yarım Dalga Doğrultucu

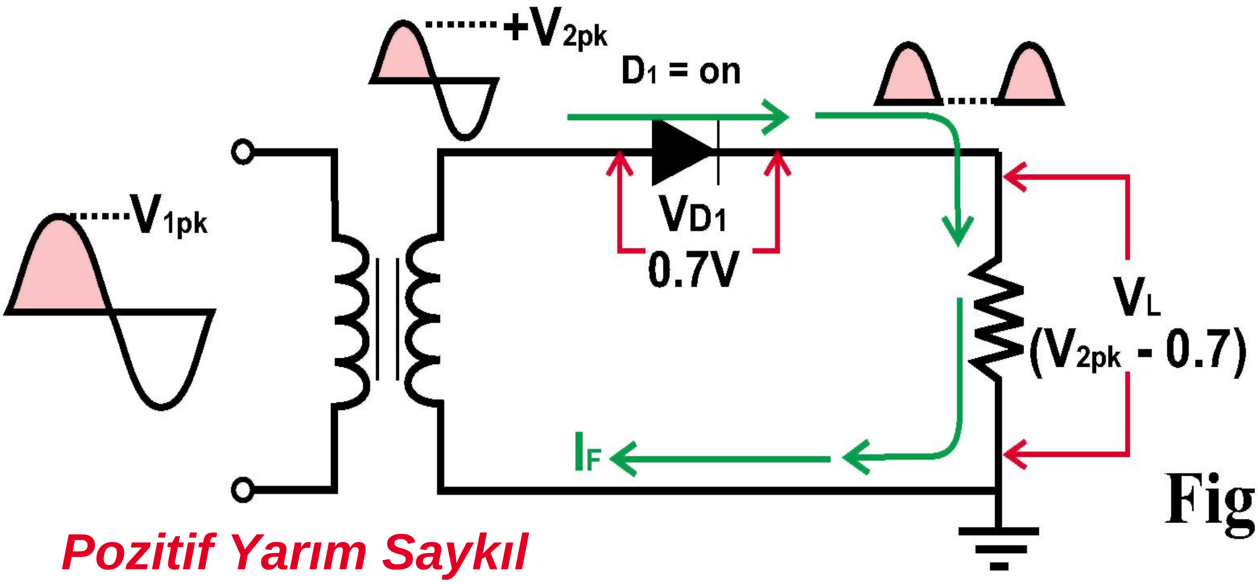


Figure 6

Pozitif Yarım Saykıl

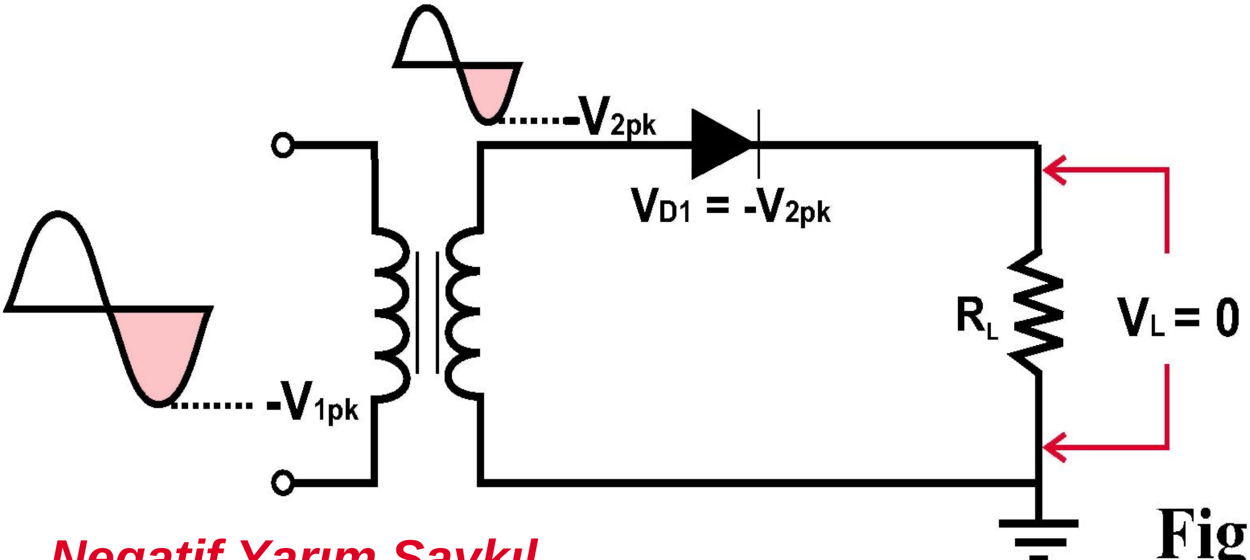


Figure 7

Negatif Yarım Saykıl

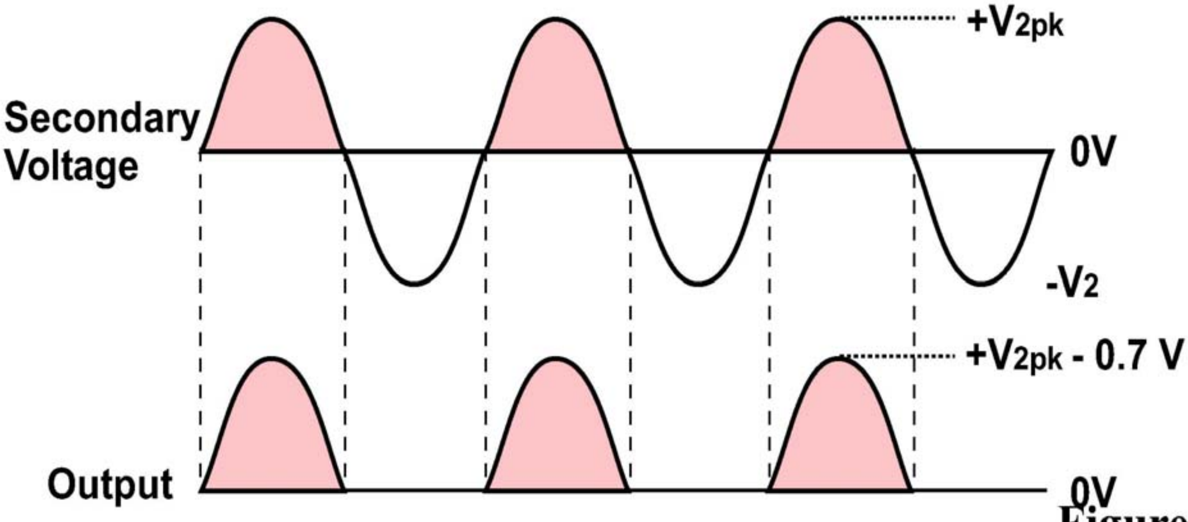


Figure 8

Negatif Yarım Dalga Doğrultma

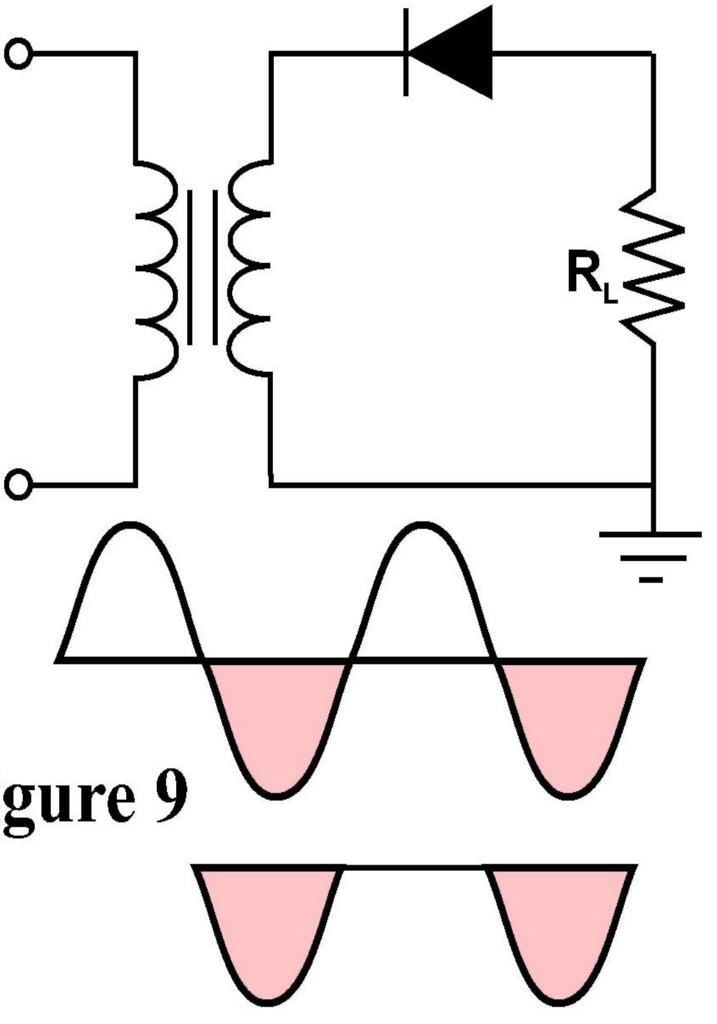


Figure 9

$$V_{L(pk)} = V_{2(pk)} - V_F$$

or

$$V_{L(pk)} = V_{2(pk)} - 0.7\ V$$

$$V_{2(pk)} = \frac{N_2}{N_1} V_{1(pk)}$$

$$V_{pk} = \frac{V_{rms}}{0.707}$$

$$I_{L(pk)} = \frac{V_{L(pk)}}{R_L}$$

Yarım Dalga Doğrultmaç Devrede Averaj Yükleme Voltajı & Akım

$$\boxed{V_{ave} = \frac{V_{L(pk)}}{\pi}} \qquad \boxed{V_{ave} = 0.318 V_{L(pk)}}$$

Unutmayın: ***Yukarıdaki bu formüller sadece yarım dalga doğrultumuş devre içindir.***

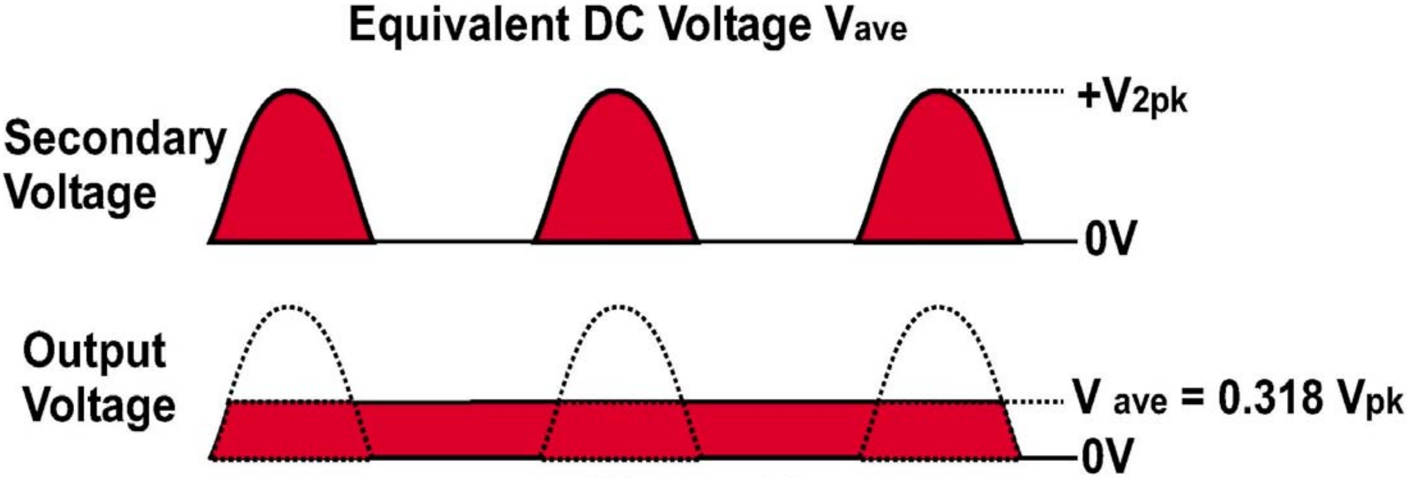


Figure 10

Iave değeri iki şekilde hesaplanabilir:

1) Ohm kanunu kullanarak

$$\boxed{I_{ave} = \frac{V_{ave}}{R_L}}$$

2) Ipk yı Iave değerine dönüştürerek

$$\boxed{I_{ave} = \frac{I_{pk}}{\pi}} \qquad \boxed{I_{ave} = 0.318 I_{pk}} \qquad \boxed{PIV = V_{2(pk)}}$$

Tam Dalga Doğrultma

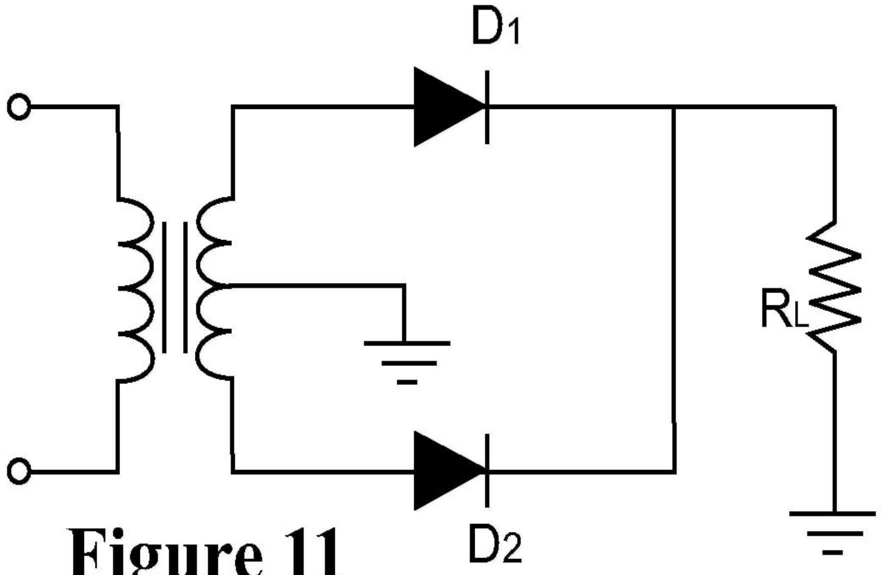
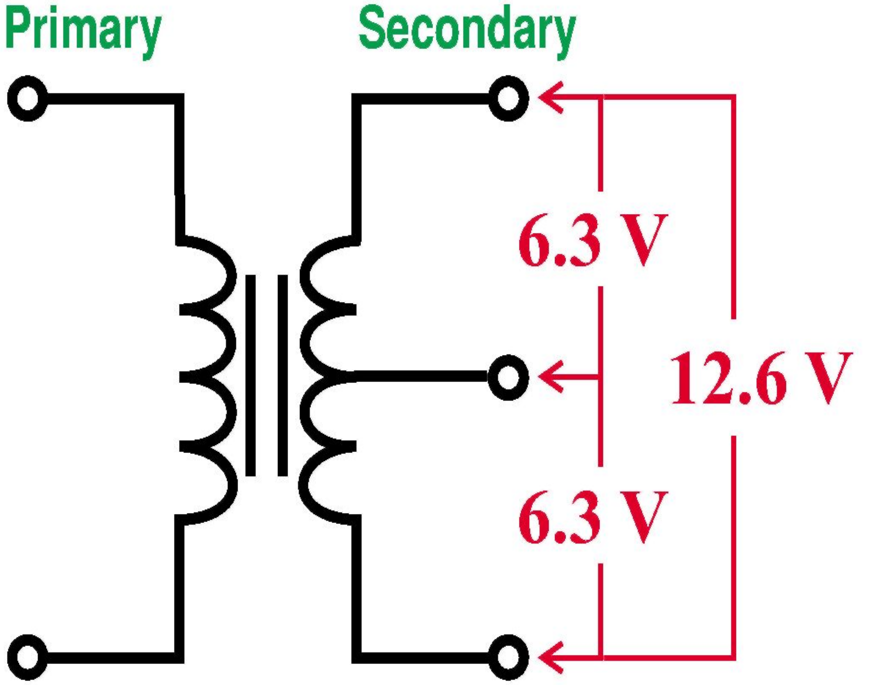


Figure 11



Example of a 12.6 VAC
Centre-Tapped Transformer

Figure 12

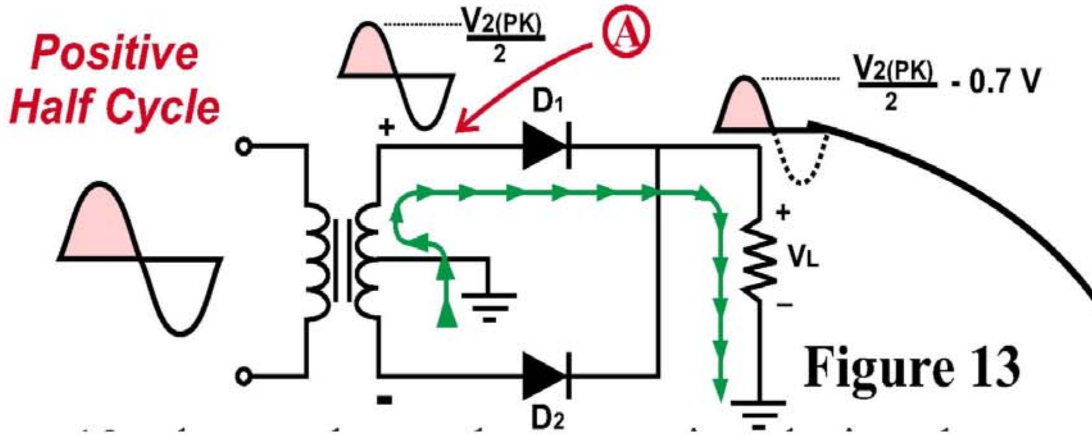
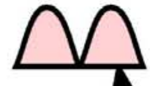


Figure 13

Yükleme Voltajı ve Akım Hesabı

$$\boxed{V_{L(pk)} = \frac{V_{2(pk)}}{2} - 0.7\ V}$$

$$\boxed{V_{ave} = \frac{2V_{L(pk)}}{\pi}} \qquad \boxed{V_{ave} = 0.636\ V_{L(pk)}}$$



Average DC Voltage V_{ave} for a Full Wave Rectifier

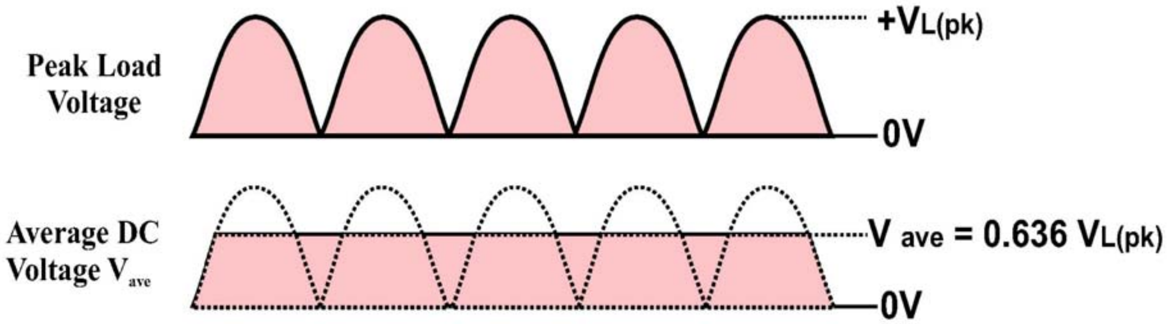


Figure 16

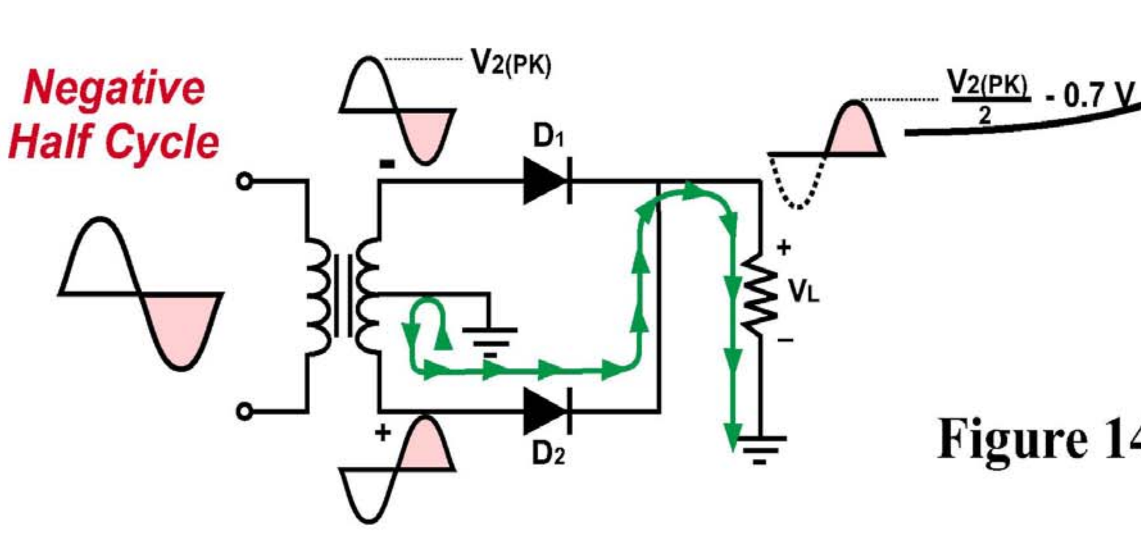


Figure 14

Negative Full Wave Rectifiers

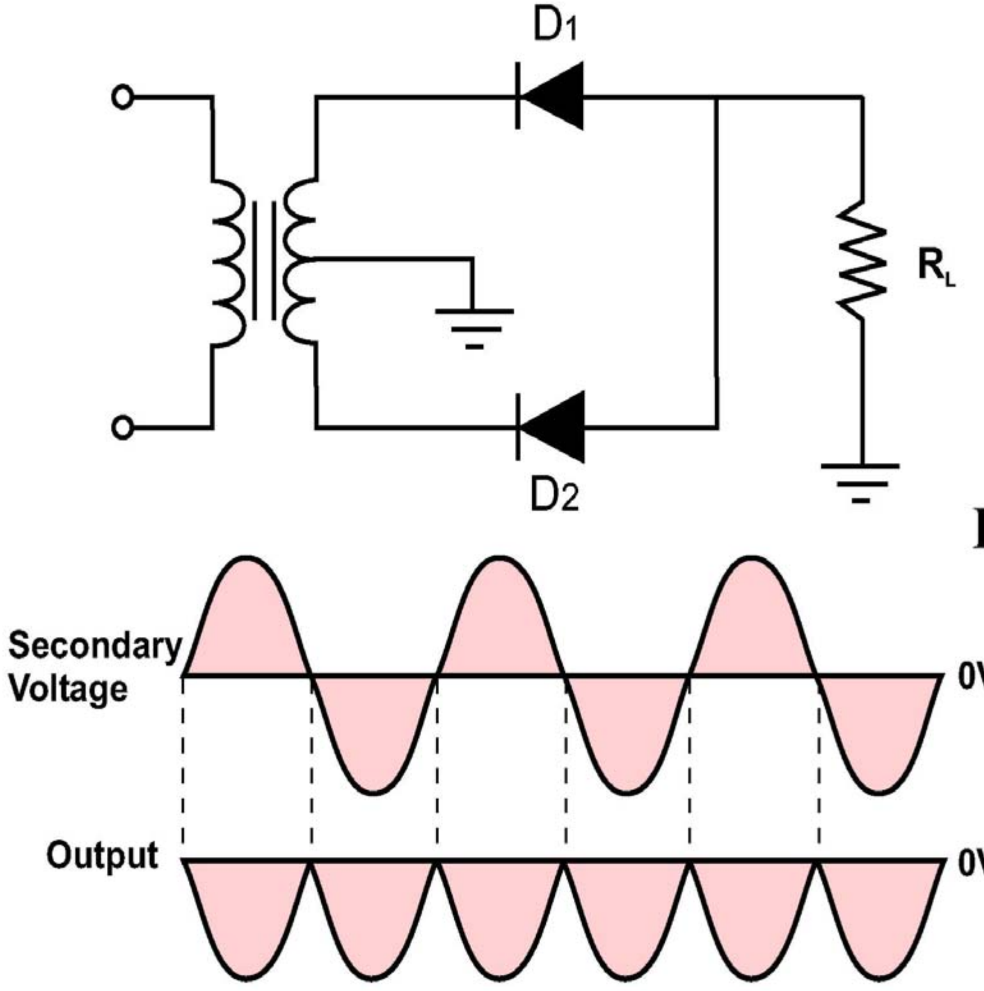
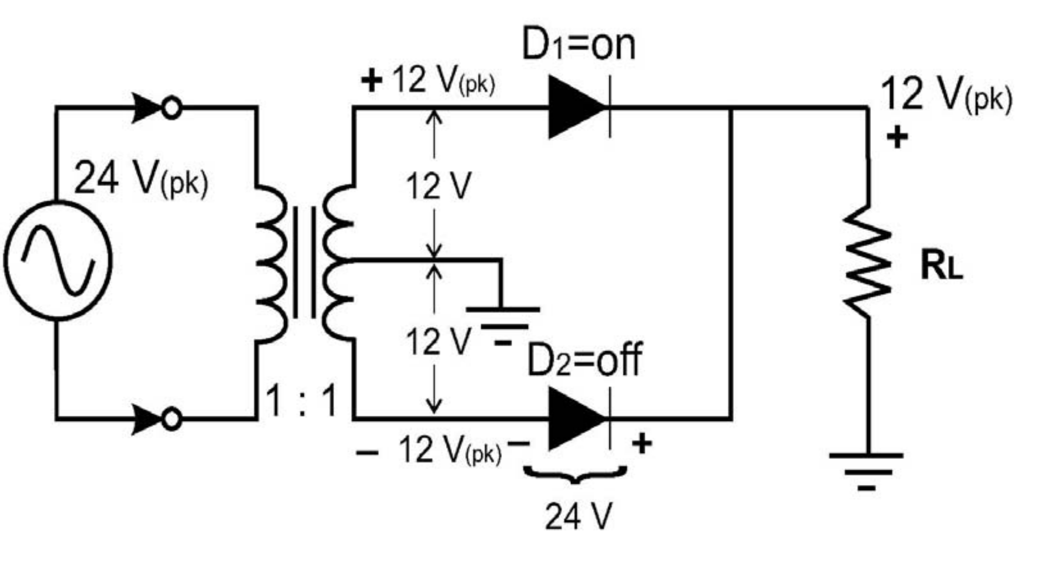


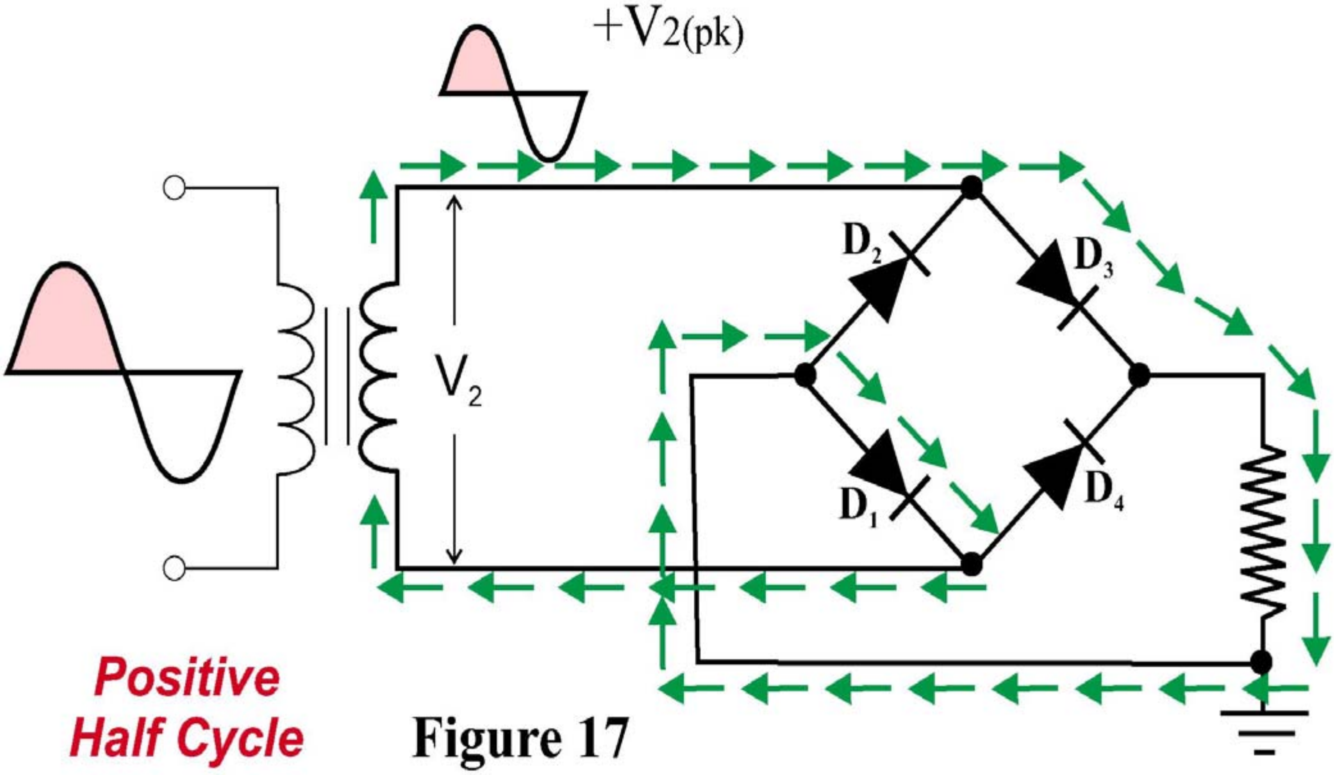
Figure 15

$$\boxed{PIV = V_{2(pk)} - 0.7\ V}$$

PIV using the Ideal Diode

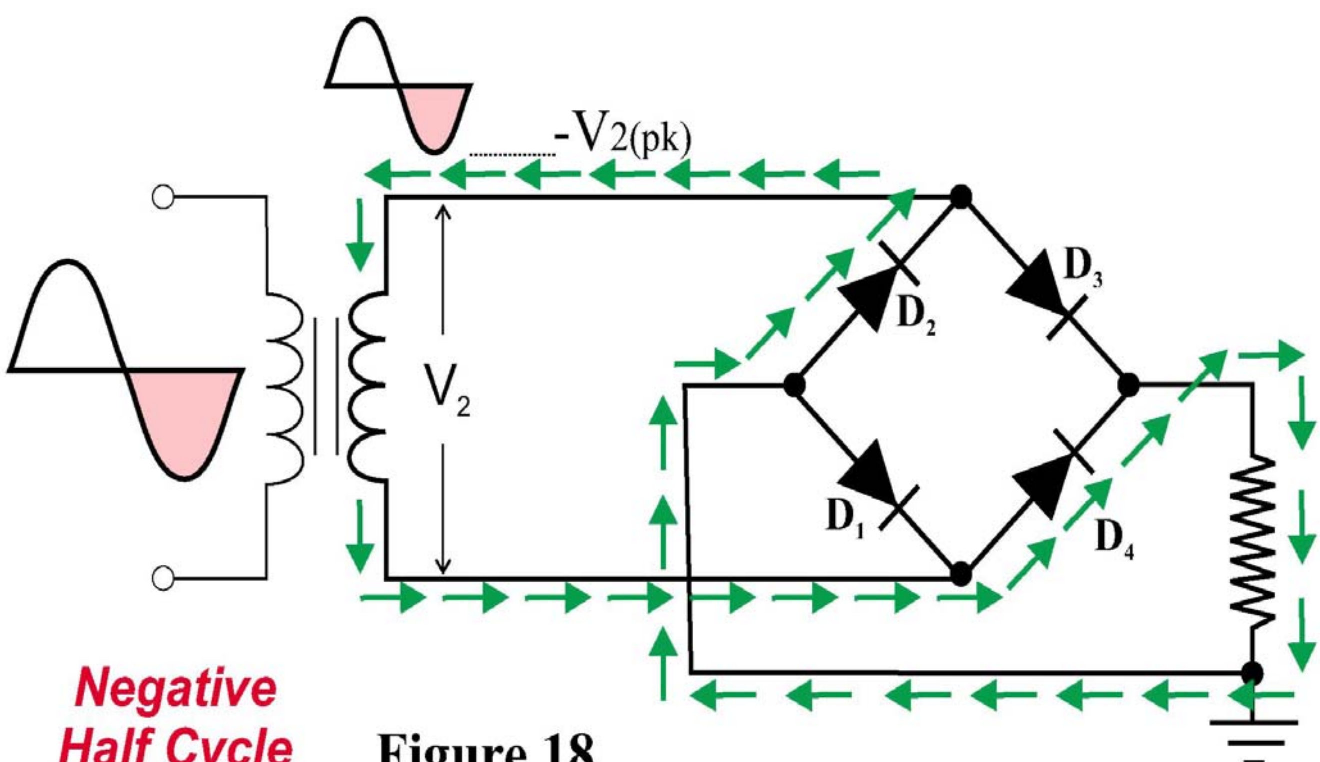
Figure 16





Positive Half Cycle

Figure 17



Negative Half Cycle

Figure 18

$$\boxed{V_{L(pk)} = V_{2\,(pk)} - 1.4\ V}$$

Figure 19

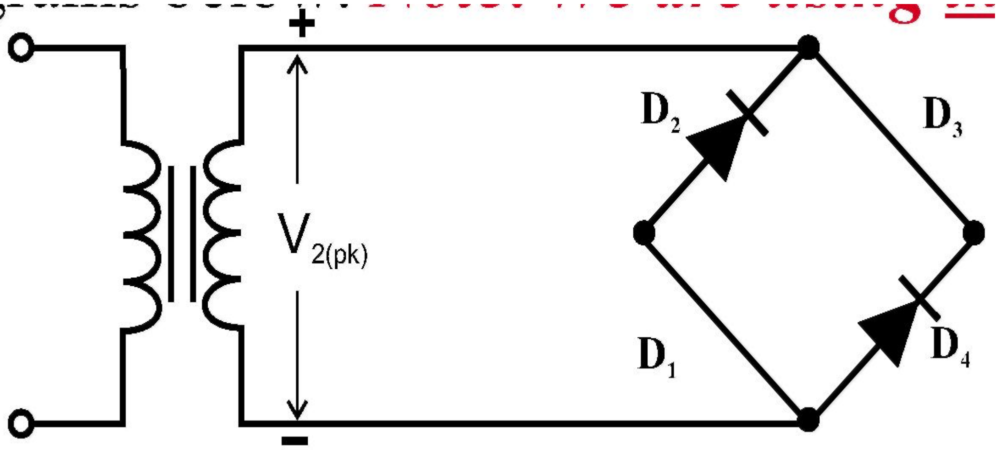
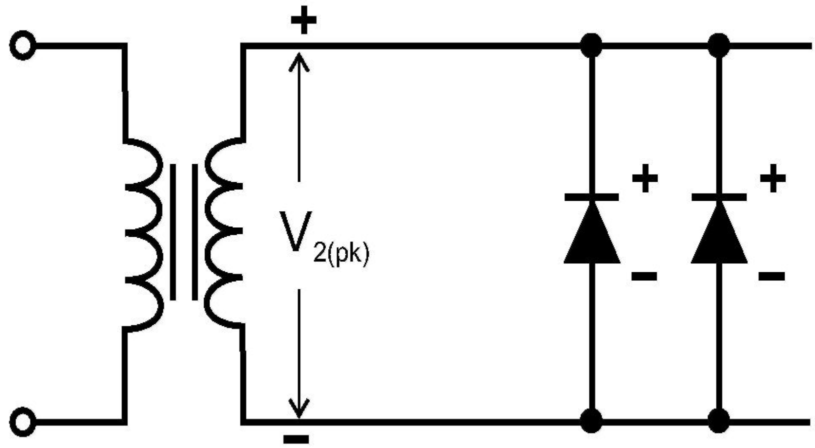
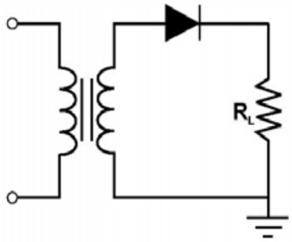
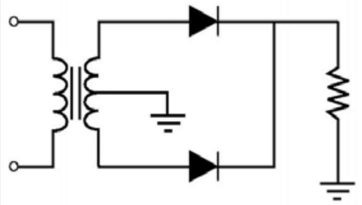
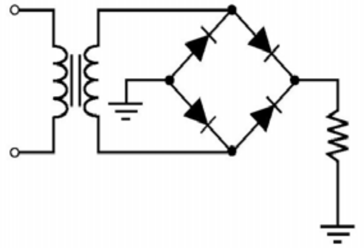
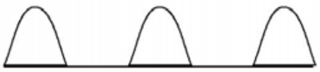
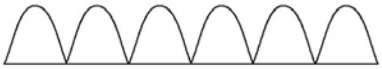
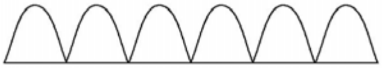


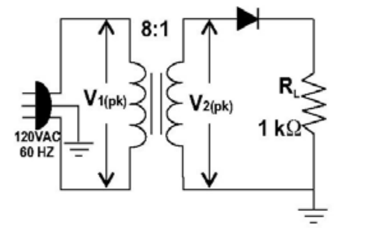
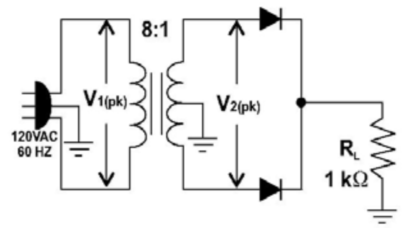
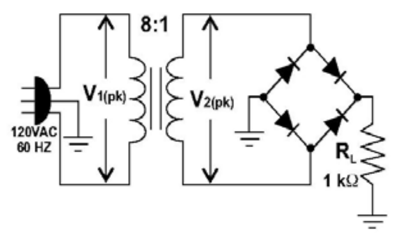
Figure 20

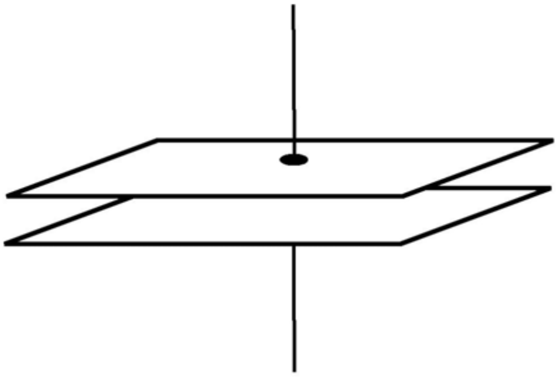


$$\boxed{PIV = V_{2\,(pk)}}$$ *Ideal Diode*

$$\boxed{PIV = V_{2\,(pk)} - 0.7V}$$ *Practical Diode*

	Half Wave	Full Wave	Bridge
Schematic Diagram			
Waveform			
Peak Load Voltage $V_{L(pk)}$	$V_{2(pk)} - 0.7V$	$\frac{V_{2(pk)}}{2} - 0.7V$	$V_{2(pk)} - 1.4V$
DC Load Voltage	$\frac{V_{L(pk)}}{}$ or $0.318\ V_{L(pk)}$	$\frac{2V_{L(pk)}}{}$ or $0.636\ V_{L(pk)}$	$\frac{2V_{L(pk)}}{}$ or $0.636\ V_{L(pk)}$
DC Load Current	$\frac{V_{ave}}{R_L}$	$\frac{V_{ave}}{R_L}$	$\frac{V_{ave}}{R_L}$
PIV	Equal to $V_{2(pk)}$	$V_{2(pk)} - 0.7V$	$V_{2(pk)} - 0.7V$
Frequency	$f_{out} = f_{in} = 60$ Hz	$f_{out} = 2f_{in} = 120$ Hz	$f_{out} = 2f_{in} = 120$ Hz

Half Wave	Full Wave	Bridge
		
① Find $V_{1(pk)} = \frac{120\ V}{.707} = 169.73\ V_p$ ② Find $V_{2(pk)} = \frac{N_2}{N_1} V_{1(pk)}$ $= \frac{1}{8} 169.73\ V_{pk}$ $= 21.21\ V_{pk}$	① Find $V_{1(pk)}$ = Same = $169.73\ V_p$ ② Find $V_{2(pk)}$ = Same = $21.21\ V_{pk}$	① Find $V_{1(pk)}$ = Same = $169.73\ V_p$ ② Find $V_{2(pk)}$ = Same = $21.21\ V_{pk}$
③ Find the Peak Load Voltage $V_{L(pk)} = V_{2(pk)} - 0.7V$ $= 21.21\ V_{pk} - 0.7\ V$ $\boxed{V_{L(pk)} = 20.51\ V_{pk}}$	③ Find the Peak Load Voltage $V_{L(pk)} = \frac{V_{2(pk)}}{2} - 0.7V$ $= \frac{21.21\ V_{pk}}{2} - 0.7\ V$ $= 10.6\ V_{pk} - 0.7\ V$ $\boxed{V_{L(pk)} = 9.9\ V_{pk}}$	③ Find the Peak Load Voltage $V_{L(pk)} = V_{2(pk)} - 1.4\ V$ $= 21.21\ V_{pk} - 1.4\ V$ $\boxed{V_{L(pk)} = 19.81\ V_{pk}}$
④ Find the DC Load Voltage V_{ave} or $V_{DC} = V_{L(pk)}(.318)$ $= 20.51\ V_{pk}(.318)$ $\boxed{V_{ave} = 6.52\ V}$	④ Find the DC Load Voltage V_{ave} or $V_{DC} = V_{L(pk)}(.636)$ $= 9.9\ V_{pk}(.636)$ $\boxed{V_{ave} = 6.3\ V}$	④ Find the DC Load Voltage V_{ave} or $V_{DC} = V_{L(pk)}(.636)$ $= 19.81\ V_{pk}(.636)$ $\boxed{V_{ave} = 12.6\ V}$
⑤ Find the DC Load Current $I_{ave} = \frac{V_{ave}}{R_L}$ $= \frac{6.52\ V}{1\ k\Omega}$ $\boxed{I_{ave} = 6.52\ mA}$	⑤ Find the DC Load Current $I_{ave} = \frac{V_{ave}}{R_L}$ $= \frac{6.3\ V}{1\ k\Omega}$ $\boxed{I_{ave} = 6.3\ mA}$	⑤ Find the DC Load Current $I_{ave} = \frac{V_{ave}}{R_L}$ $= \frac{12.6\ V}{1\ k\Omega}$ $\boxed{I_{ave} = 12.6\ mA}$
⑥ Find the Peak Inverse Voltage Equal to $V_{2(pk)}$ $\boxed{PIV = 21.21\ V}$	⑥ Find the Peak Inverse Voltage $= V_{2(pk)} - 0.7V$ $21.21\ V_{pk} - 0.7V$ $\boxed{PIV = 20.51\ V}$	⑥ Find the Peak Inverse Voltage $= V_{2(pk)} - 0.7\ V$ $21.21\ V_{pk} - 0.7\ V$ $\boxed{PIV = 20.51\ V}$
⑦ Find the Output Frequency $f_{out} = f_{in}$ $\boxed{f_{out} = 60\ Hz}$	⑦ Find the Output Frequency $f_{out} = 2f_{in}$ $\boxed{f_{out} = 120\ Hz}$	⑦ Find the Output Frequency $f_{out} = 2f_{in}$ $\boxed{f_{out} = 120\ Hz}$



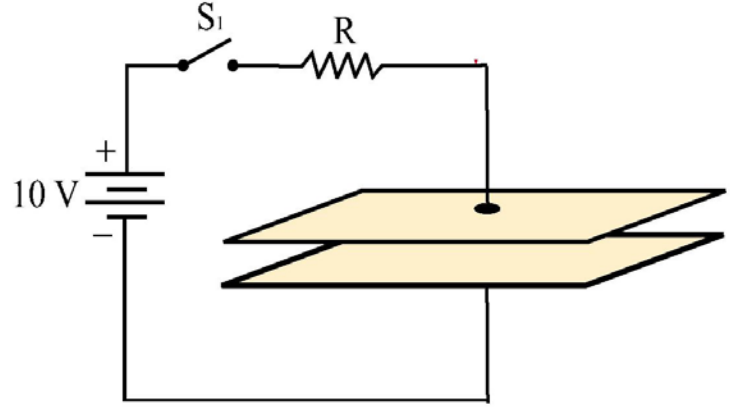


fig 1

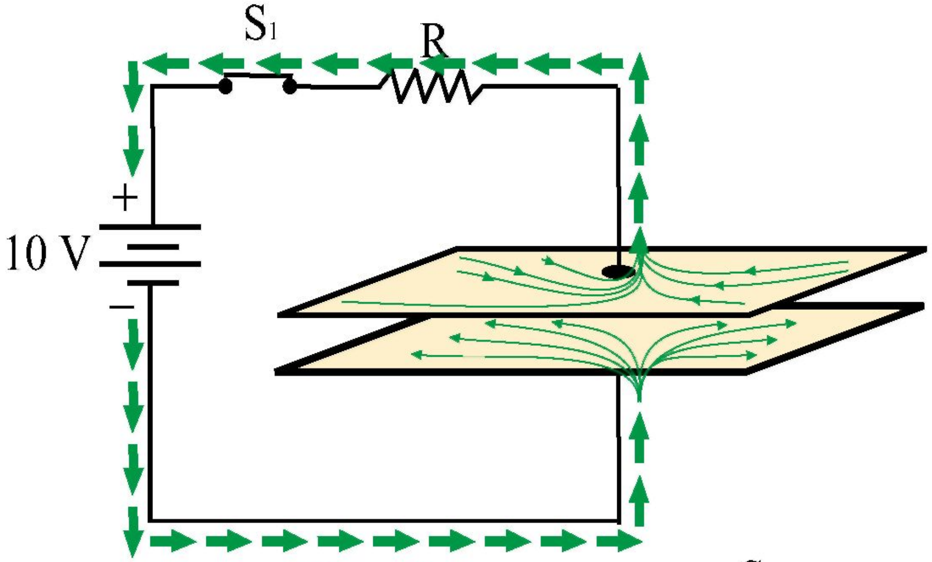
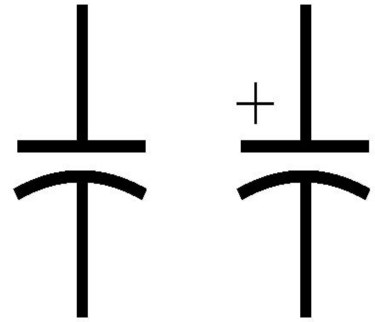


fig 2



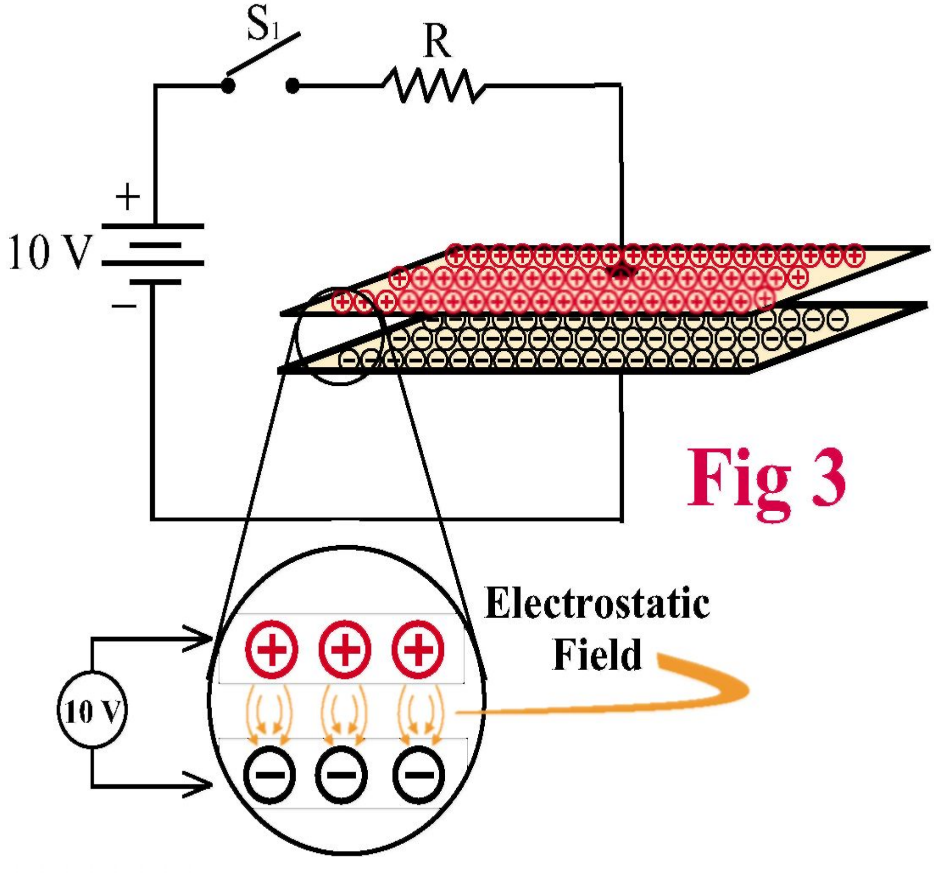
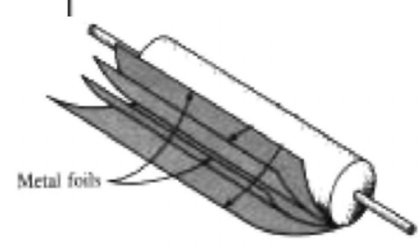


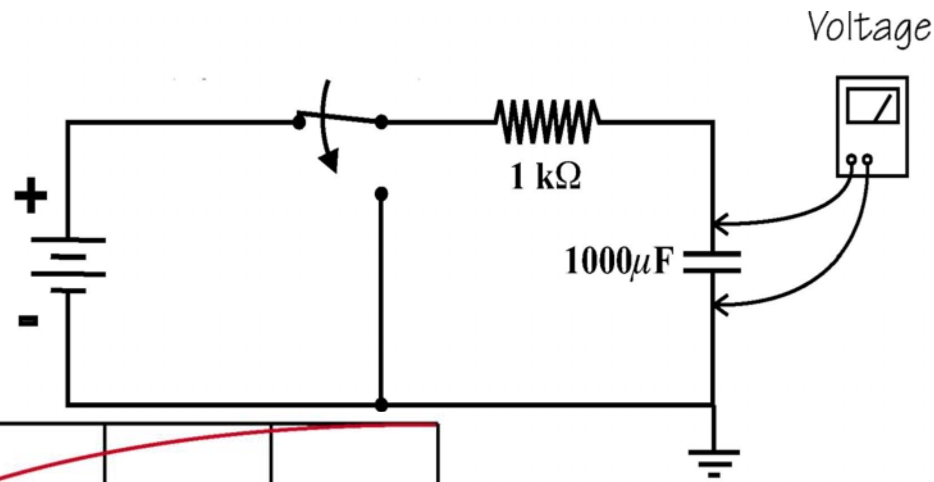
Fig 3

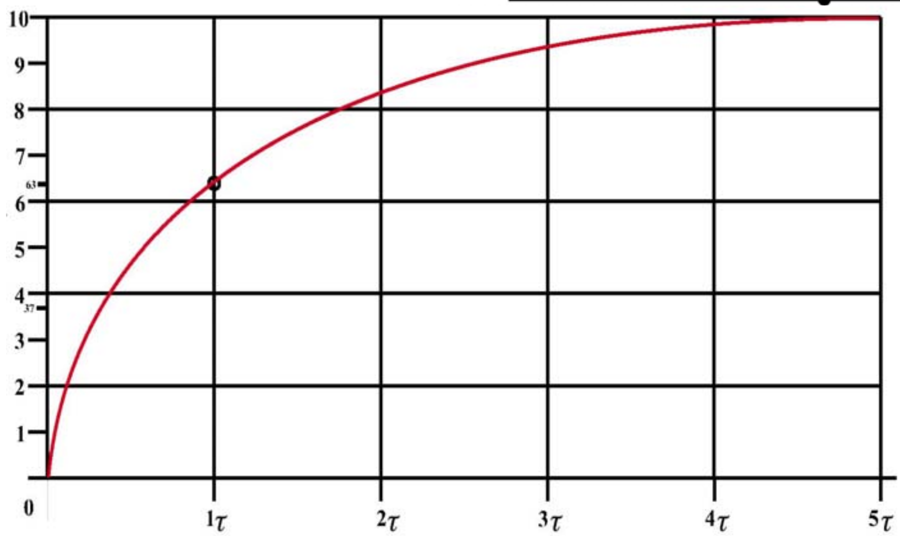
Radial Leads

Axial Leads



Yükleme (Charge)

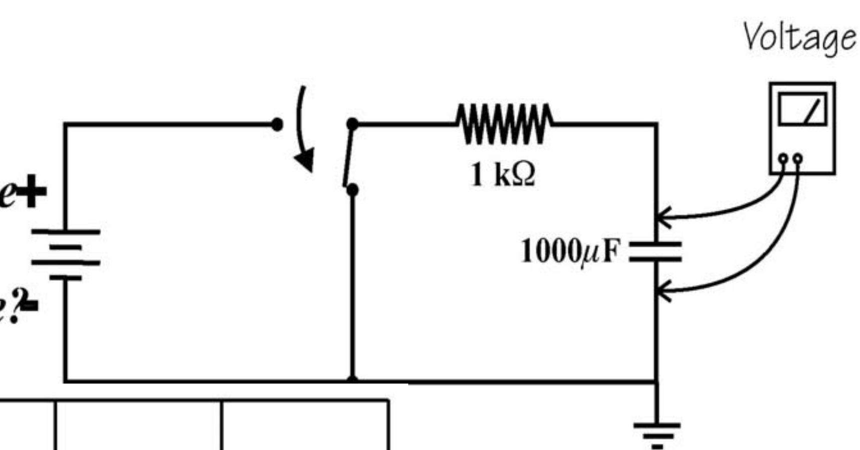




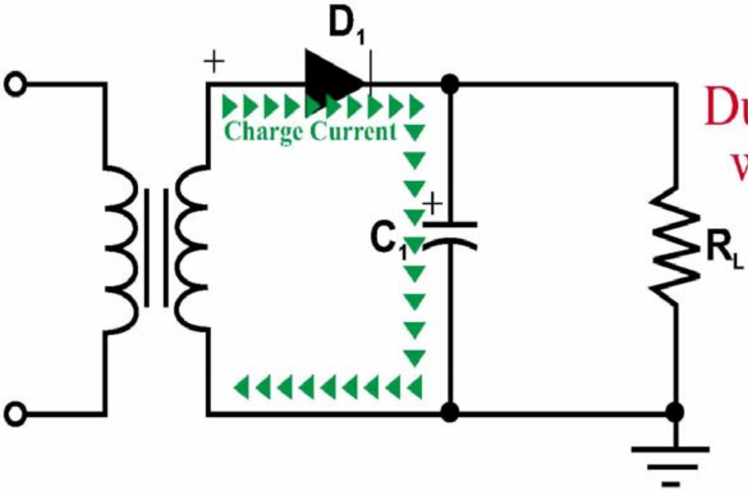
Capacitor Charging Time Constant

Boşaltma (Discharge)

How long does it take the capacitor to completely discharge?

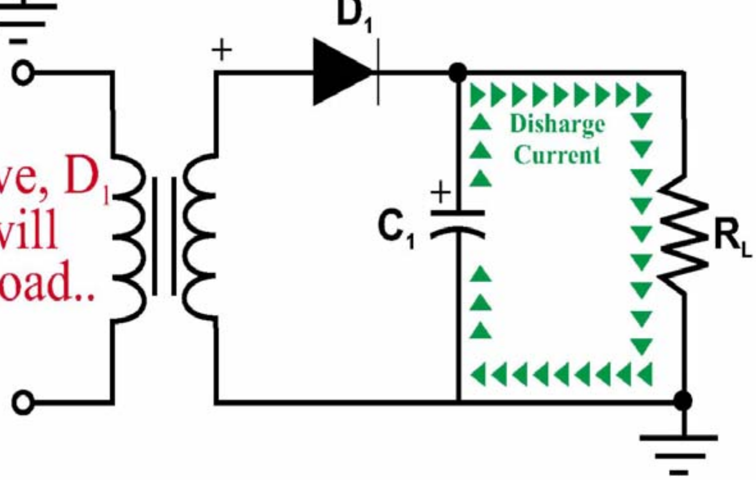


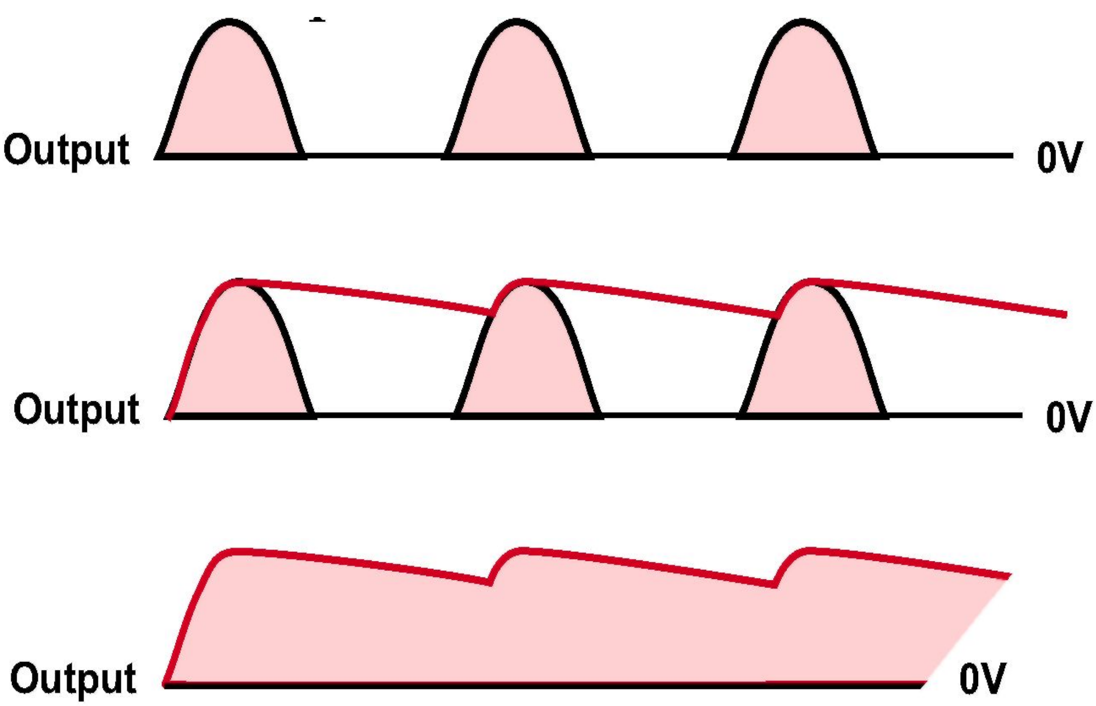
Capacitor Discharging Time Constant



During the positive half cycle, D_1 will conduct, and the capacitor charges rapidly.

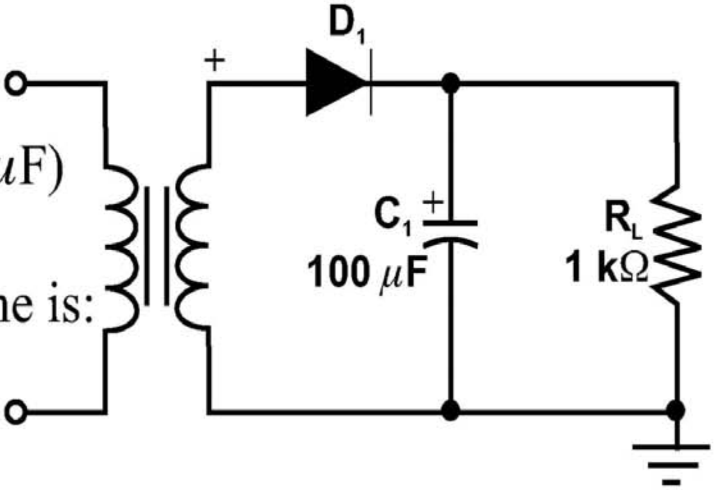
As the input starts to go negative, D_1 turns off, and the capacitor will slowly discharge through the load..





The Charging Time Constant

In the diagram, if D_1 has a forward resistance of 5Ω, then the RC time constant is:



$$\begin{aligned}\tau &= RC \\ &= (5\Omega)(100\,\mu F) \\ &= 500\,\mu s\end{aligned}$$

and the total capacitor charge time is:

$$\begin{aligned}T &= 5(RC) \\ &= 5(500\,\mu s) \\ &\boxed{= 2.5\ ms}\end{aligned}$$

Thus, the capacitor charges to the peak input voltage in 2.5 ms.

The Discharging Time Constant

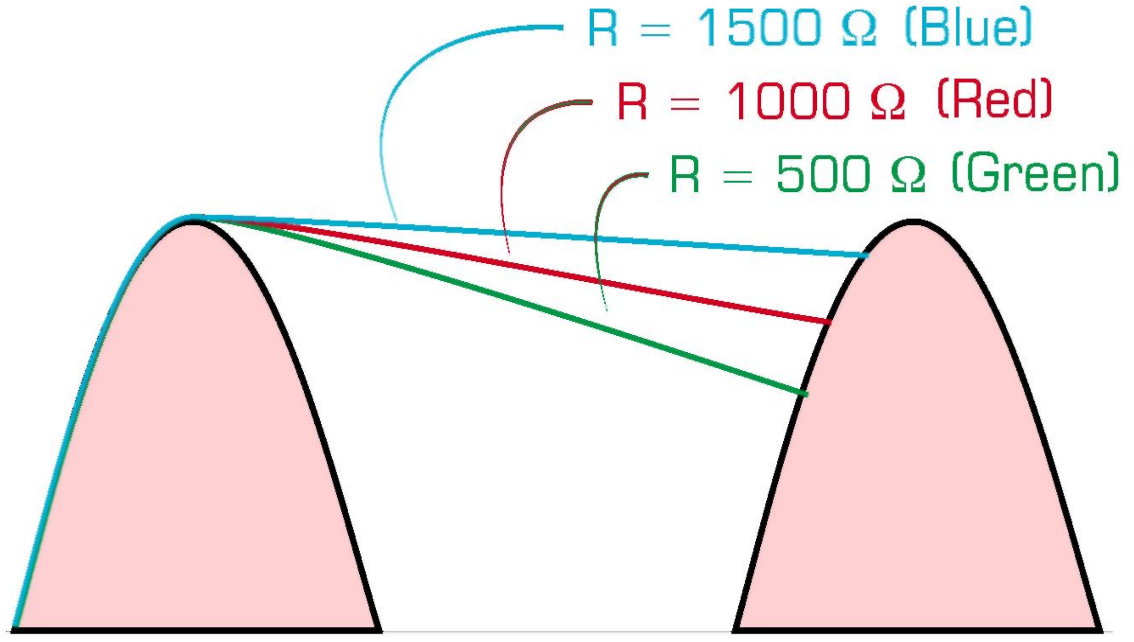
The discharging path is through the load resistor. The discharge time constant is:

$$\begin{aligned}\tau &= RC \\ &= (1k\Omega)(100\,\mu F) \\ &= 100\ ms\end{aligned}$$

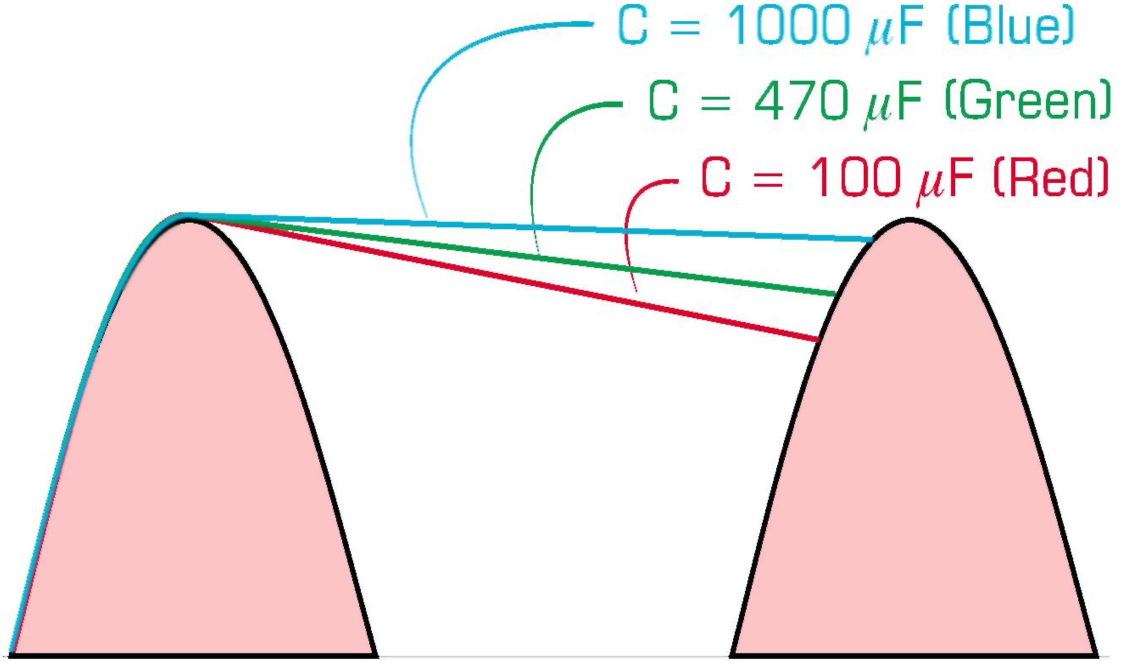
and the total capacitor charge time is:

$$\begin{aligned}T &= 5(RC) \\ &= 5(100\ ms) \\ &\boxed{= 500\ ms}\end{aligned}$$

Note that the capacitor charges completely is short time (2.5 ms) , but it takes 500 ms to discharge. The next charging cycle is provided by the rectifier long before the capacitor is discharged.



Capacitor is constant & R_L is varied

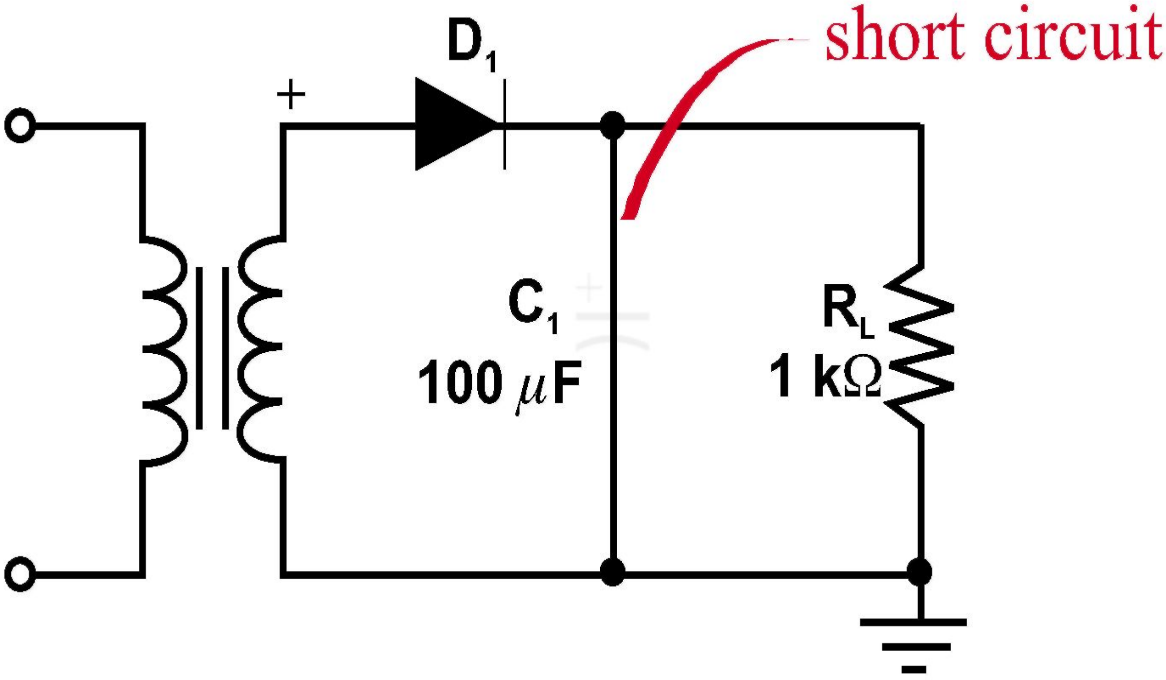


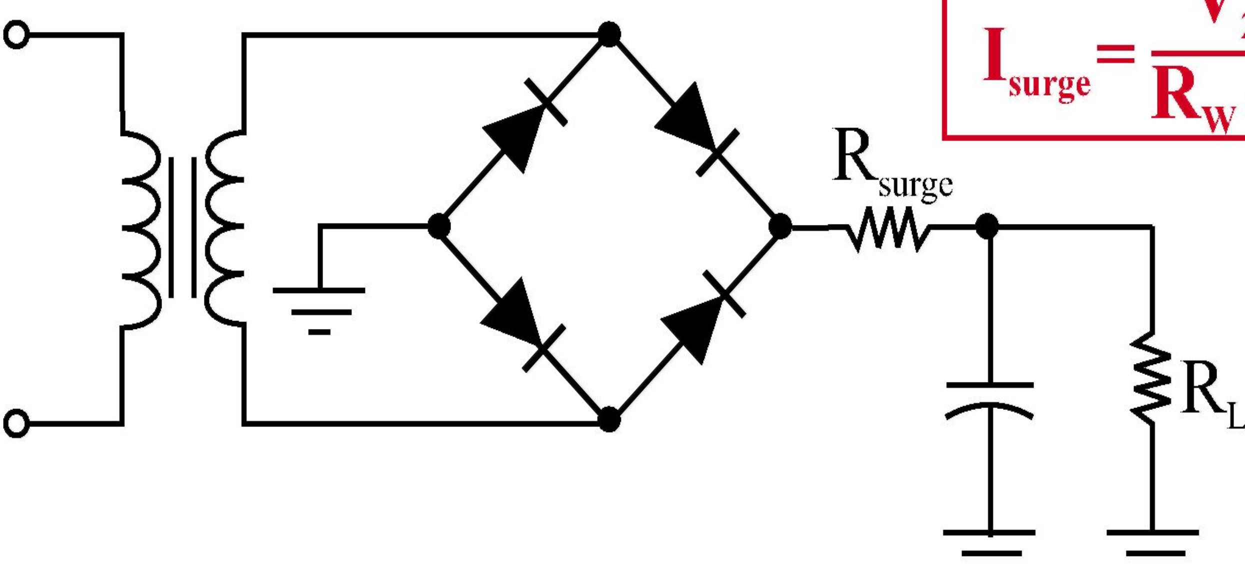
Resistance is constant & C is varied

Ripple faktörünü minimize edebiliriz:

- Kapasitansı (C)büyük bir kondansatör kullanarak
- Büyük bir R_L direnci kullanarak

Her ikisinide belirli limitlerde kullanarak



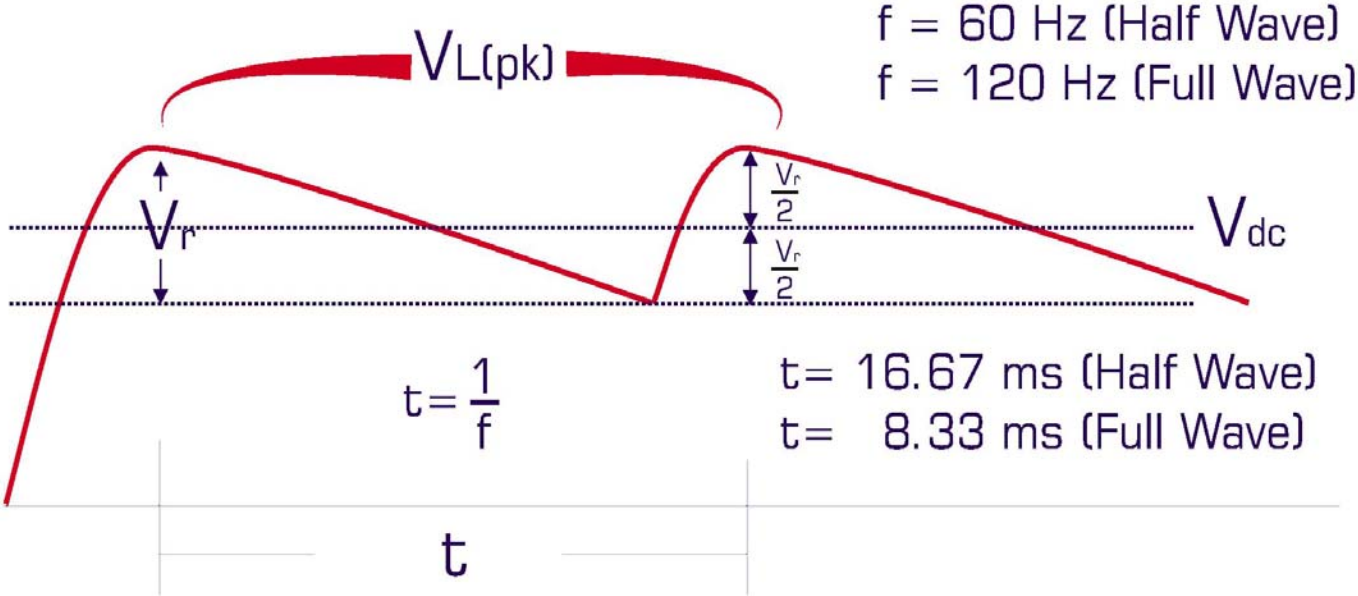


$$\boxed{I_{surge} = \frac{V_{2(pk)}}{R_W + R_B}}$$

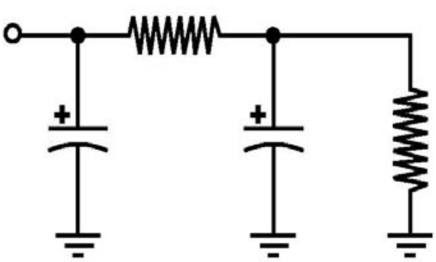
$$\boxed{C = \frac{I(t)}{\Delta V_C}}$$

$$\boxed{t = \frac{C(\Delta V_C)}{I}}$$

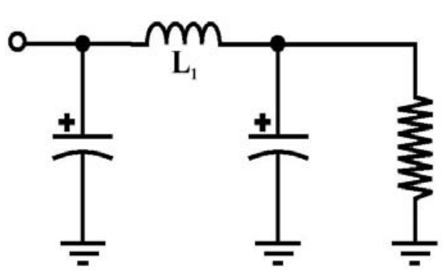
The Ripple Voltage



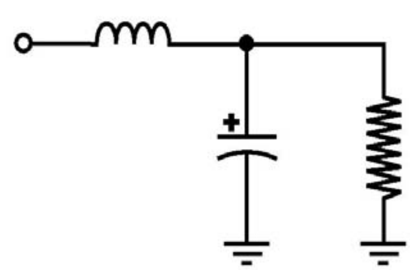
$$\boxed{V_r = \frac{I_L t}{C}} \qquad \boxed{V_r = \frac{I_L}{f\,C}} \qquad \boxed{V_{dc} = V_{pk} - \frac{V_r}{2}}$$



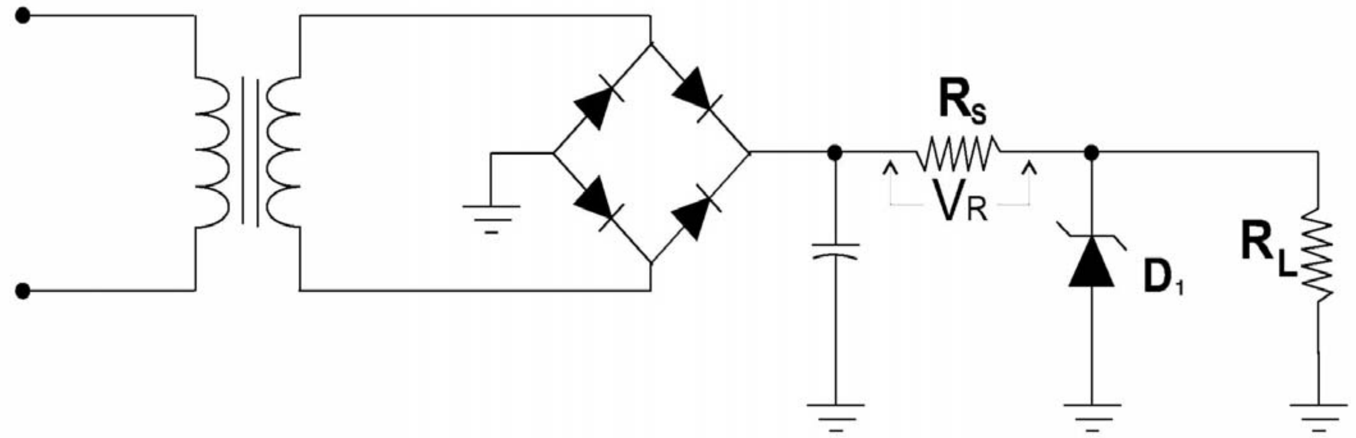
RC π filter

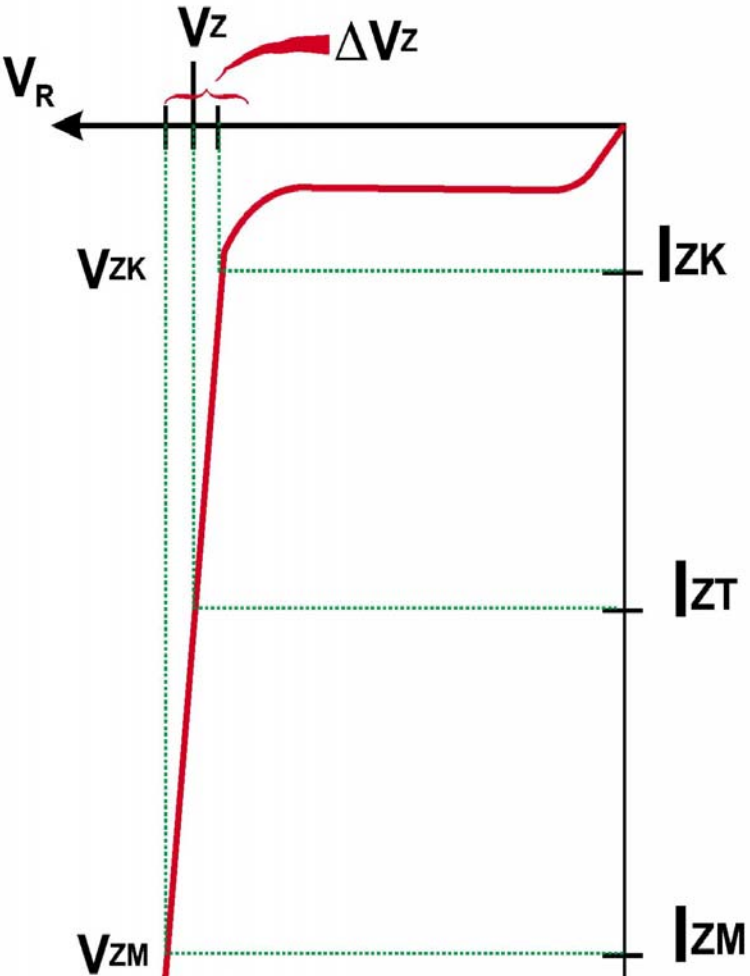


LC π filter



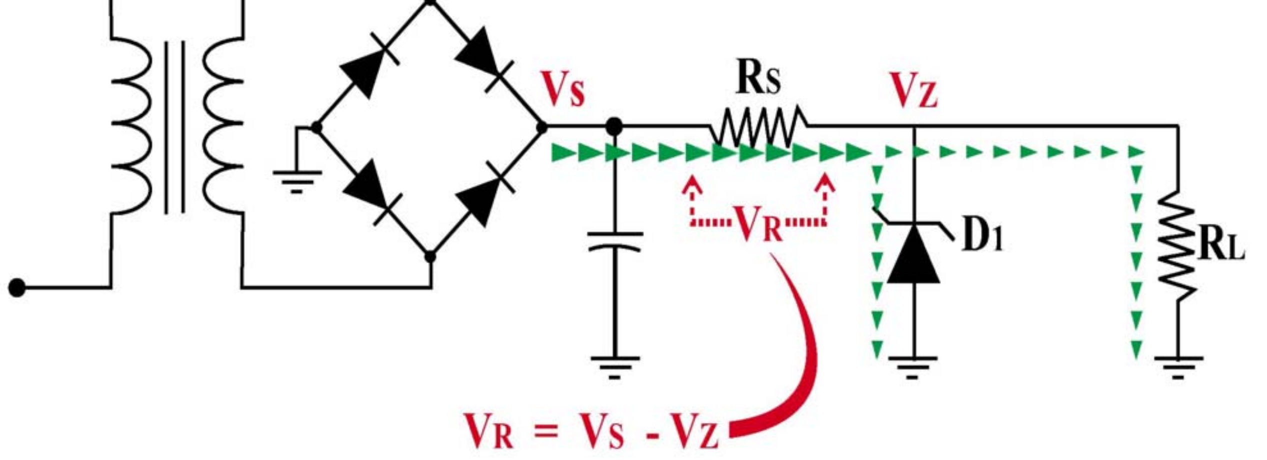
LC filter





$$\boxed{I_T = \frac{V_S - V_Z}{R_S}}$$

Figure 1



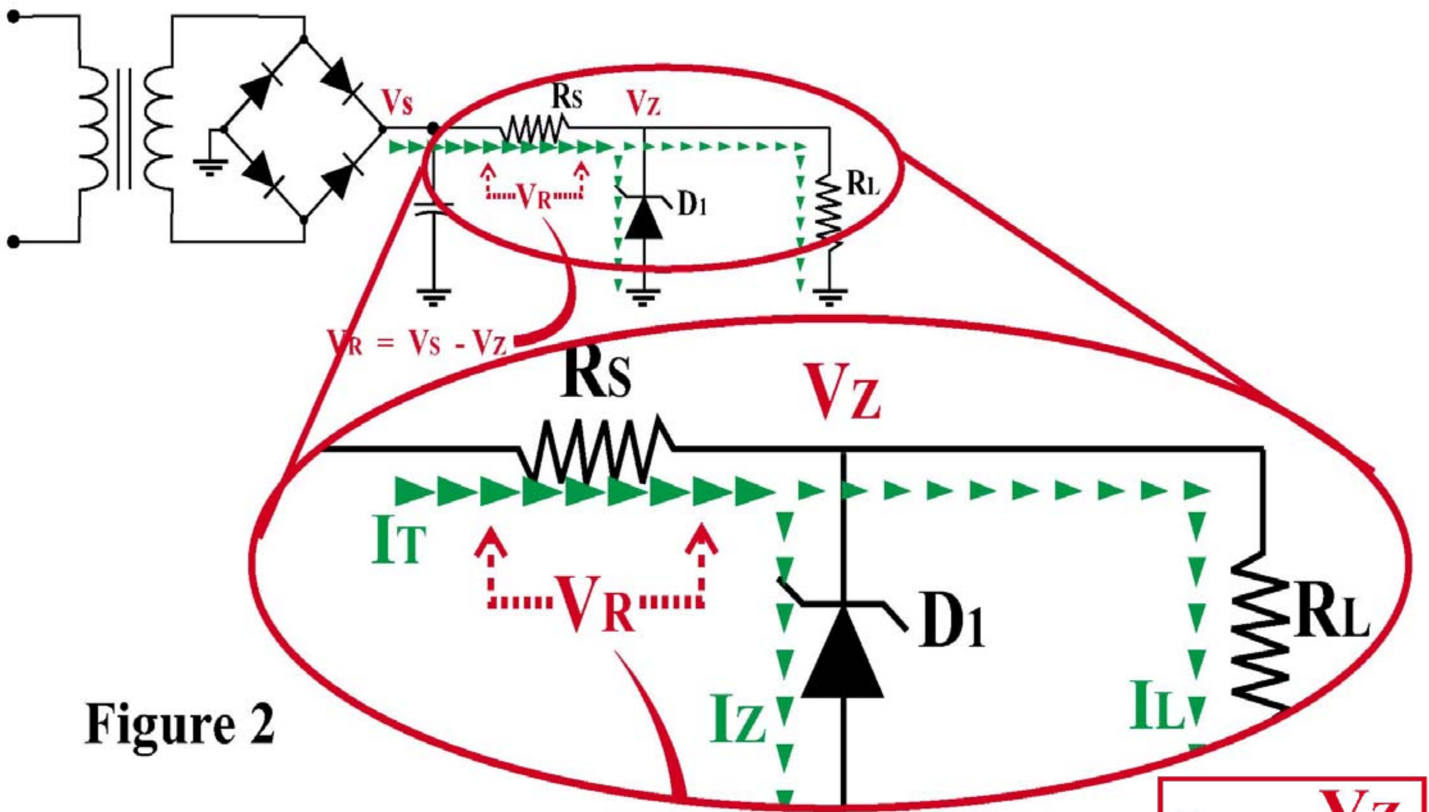


Figure 2

$$\boxed{I_Z = I_T - I_L}$$

$$\boxed{I_L = \frac{V_Z}{R_L}}$$

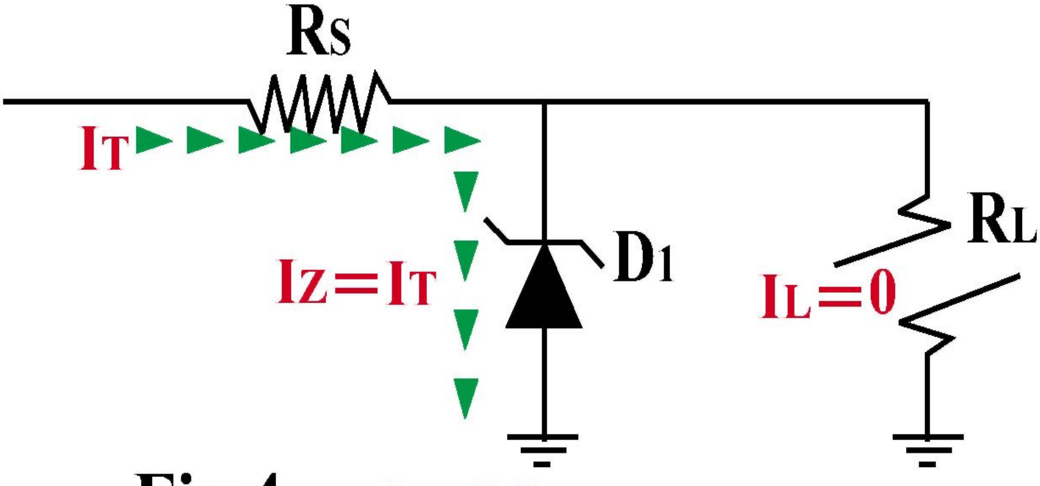
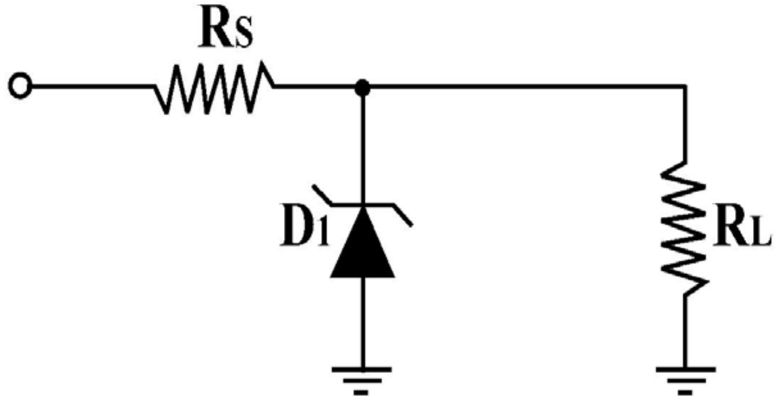


Fig 4

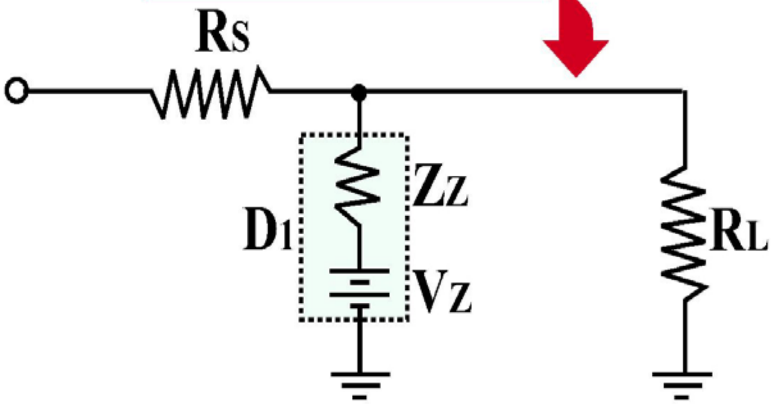
Load Open

$$\boxed{I_{L(max)} = I_T - I_{ZK}}$$

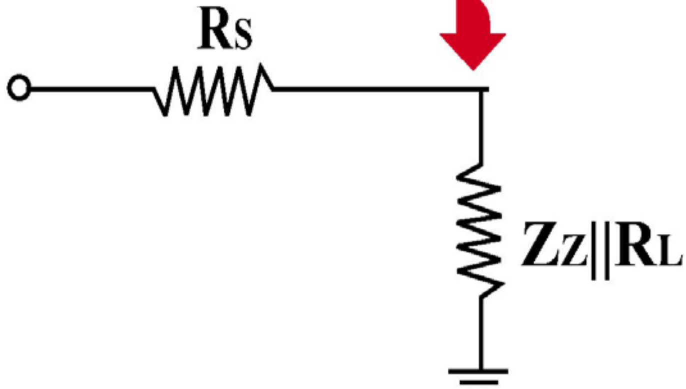
$$\boxed{R_{L(min)} = \frac{V_Z}{I_{L(max)}}}$$



This zener regulator is equivalent to



The varying ripple voltage sees this



This voltage divider circuit gives us this formula

$$\boxed{V_{r(out)} = \frac{(Z_Z \| R_L)}{(Z_Z \| R_L) + R_S} V_r}$$

Figure 6

Özet Olarak:

Transformatör, giriş gerilimini alçak çıkış gerilimine çevirir

Doğrultucu, çıkış ac gerilimini dc puls a çevirir (doğrultur).

Filtre, Doğrultulmuş dalgadaki değişimleri azaltır.

Zener Regülatör

İki çeşit davranışı vardır:

1) Çıkış voltajının ripple değerini filtreden daha iyi azaltır.
2) dc çıkış değerinin sabit bir değer almasını sağlar.

Güç Kaynağını Analiz Ederken İzlenmesi Gerekli Temel Kurallar

Vdc , Vr(out) , ve I_L değerlerini hesaplarken izlenecek prosedür.

1/ Secondary voltajın *rms* değerini hesapla.

2/ V_2(pk) değerini hesapla.

3/ Doğrultucu çıkışının V(pk) değerini hesapla.

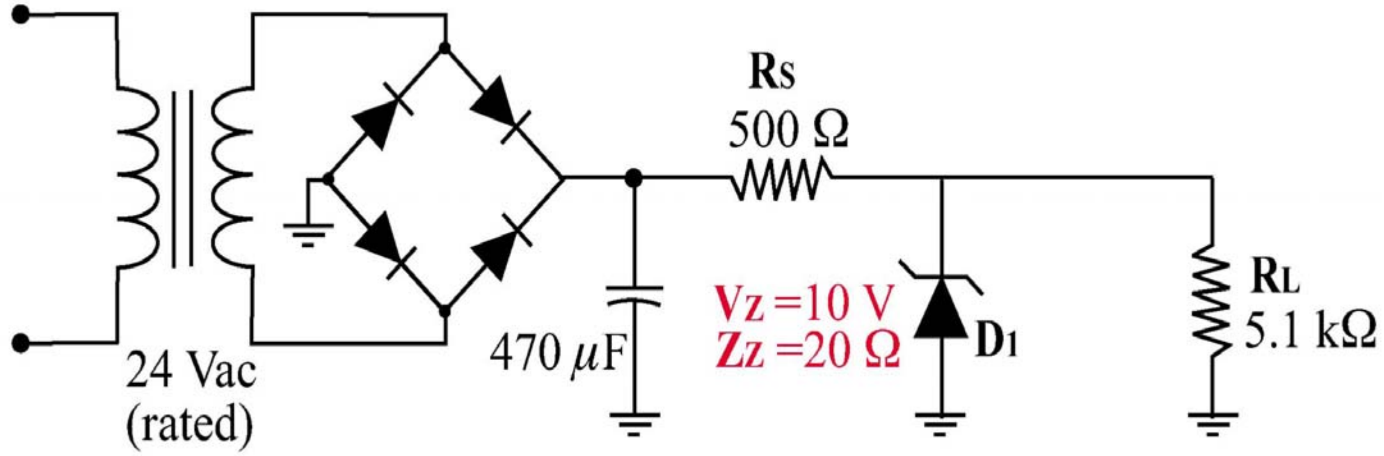
4/ Seri dirençten geçen toplam akımı hesapla. (Bu akıma Ir diyelim)

5/ Yukarıda hesaplanan Ir değerini kullanılan filtrenin ripple voltajını hesaplarken kullan.

6/ Çıkış Vdc değerini bul. (bu değer normal koşullarda zener diod un üretici firma tarafından tanımlanmış Vz değerine eşittir.)

7/ Üretici tarafından belirlenmiş Zz değerini kullanarak, yaklaşık Vr(out) ripple değerini hesapla.

8/ Vz veR_L değerlerini kullanrak, I_L çıkış (yükleme) akımını hesaplayın.



Örnek

Vdc, Vr(out) , ve I_l değerlerini hesaplayın

1/ Transformatörün secondary voltajının rms değerini bulun.

24 Vac transformatör secondary voltajının rms değeridir.

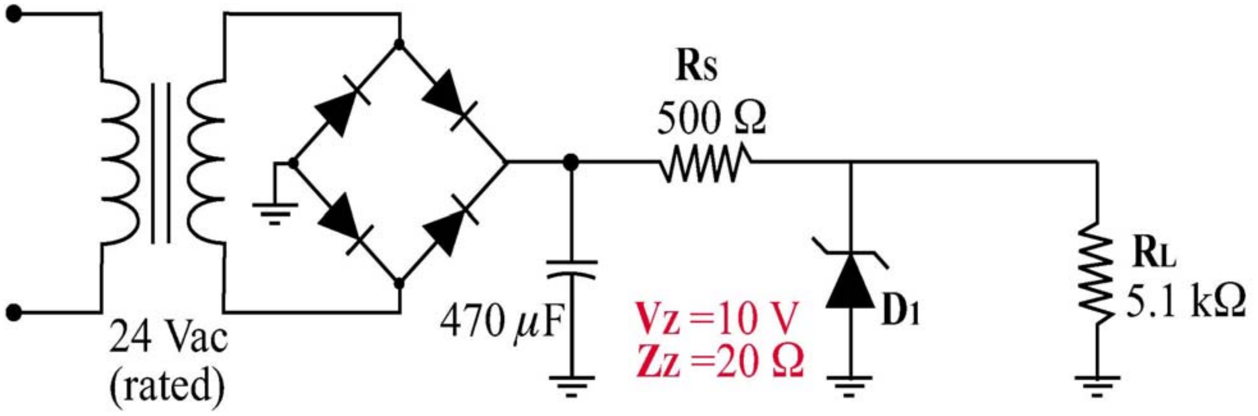
2/ V2(pk) değerini hesaplayın.

$$V_{2(pk)} = \frac{24\ V}{0.707} = 33.95\ V_{pk}$$

3/ Doğrultucu çıkışındaki V(pk) değerini hesaplayın.

$$\begin{aligned} V_{pk} &= V_{2(pk)} - 1.4\ V \\ &= 33.95\ V_{pk} - 1.4\ V \\ &= 32.55\ V_{pk} \end{aligned}$$

4/ Seri dirençten geçen akımı hesaplayın. Bu akıma I_R diyelim. Farzedelimki, step 3 de bulunan V_{pk} değerindc kaynak voltajı V_S dir.



$$I_R = \frac{V_S - V_Z}{R_S} = \frac{32.55\text{ V} - 10\text{ V}}{500} = 45.1\text{ mA}$$

5/ V_r "ripple voltaj" değerini step 4 de kullanılan filtrenin I_R değerini kullanarak hesaplayın.

Tam dalga doğrultmaç devresinde frekans (f) 120 Hz ve periyot ise (T) 8.33 ms dir.

$$V_r = \frac{I_{R(t)}}{C}$$

$$= \frac{45.1\text{ mA}\,(8.33\text{ ms})}{470\ \mu\text{F}}$$

$$= \frac{(45.1 \times 10^{-3})(8.33 \times 10^{-3})}{470 \times 10^{-6}}$$

$$= 0.799\ V_{p\text{-}p} \text{ or } 799\text{ mV}_{p\text{-}p}$$

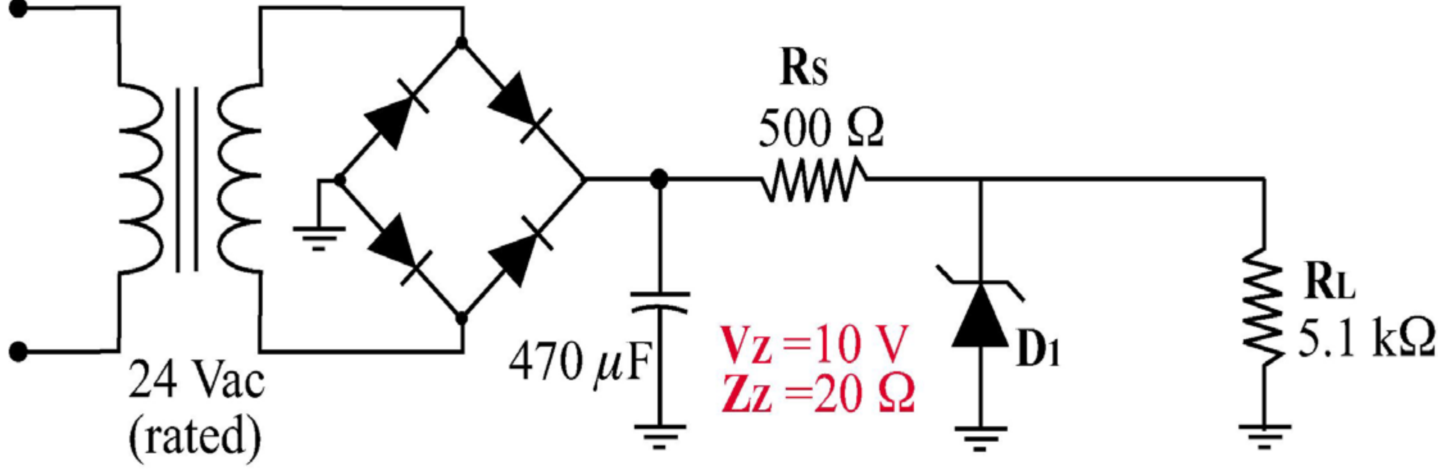
Or

$$V_r = \frac{I_R}{fC}$$

$$= \frac{45.1\text{ mA}}{120\text{ Hz}(470\ \mu\text{F})}$$

$$= \frac{(45.1 \times 10^{-3})}{(120)(470 \times 10^{-6})}$$

$$= 0.799\ V_{p\text{-}p} \text{ or } 799\text{ mV}_{p\text{-}p}$$



6/ Çıkış Vdc değerini bulun. (Bu değer normal koşullarda Zenerin kırılma değerine eşittir.)

$$\boxed{V_{dc} = V_Z = 10\ \text{V}}$$

7/ Önceden verilen Zz, değerini kullanarak çıkış gerilimini bulun

$$Z_Z = 20\ \Omega$$

$$V_{r(out)} = \frac{Z_Z \parallel R_L}{(Z_Z \parallel R_L) + R_S} V_r$$

$$= \frac{19.92\ \Omega}{19.92\ \Omega + 500\ \Omega}\ 799\ \text{mV}_{p\text{-}p}$$

$$\boxed{= 30.61\ \text{mV}_{p\text{-}p}}$$

8/ Vz veR_L, değerlerini kullanarak çıkış (yükleme) akımını bulun.

$$I_L = \frac{V_Z}{R_L}$$

$$= \frac{10\ \text{V}}{5.1\ \text{k}\Omega}$$

$$\boxed{= 1.96\ \text{mA}}$$