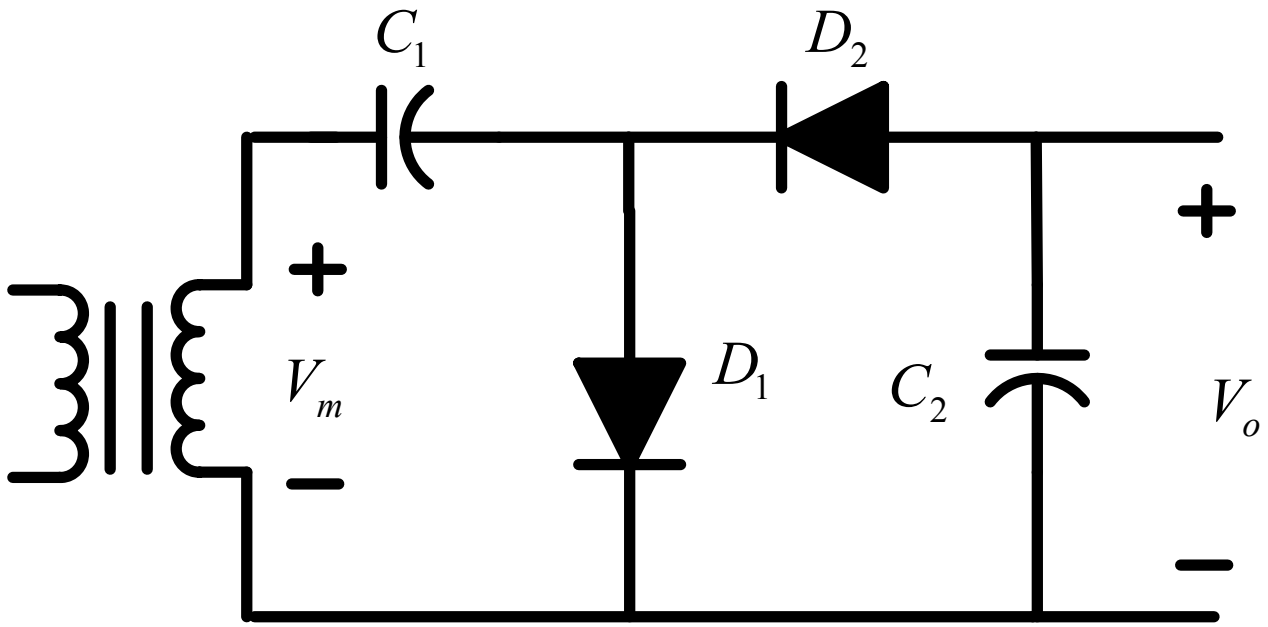
Bab 4 Rangkaian Aplikasi Dioda

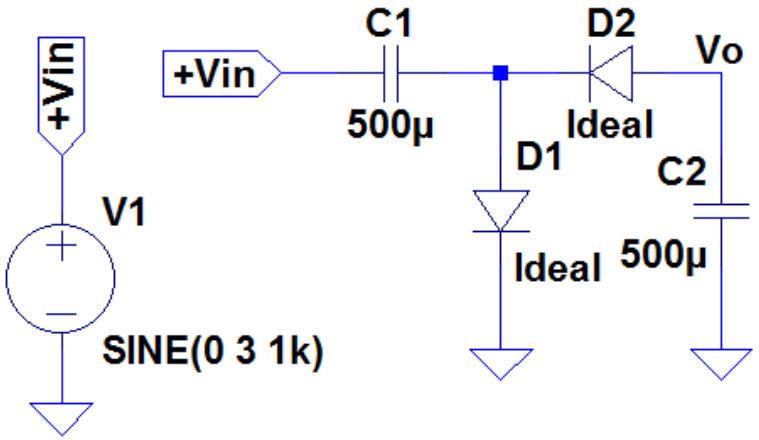
Memahami karakteristik dioda dan mampu menganalisis rangkaian aplikasi dioda

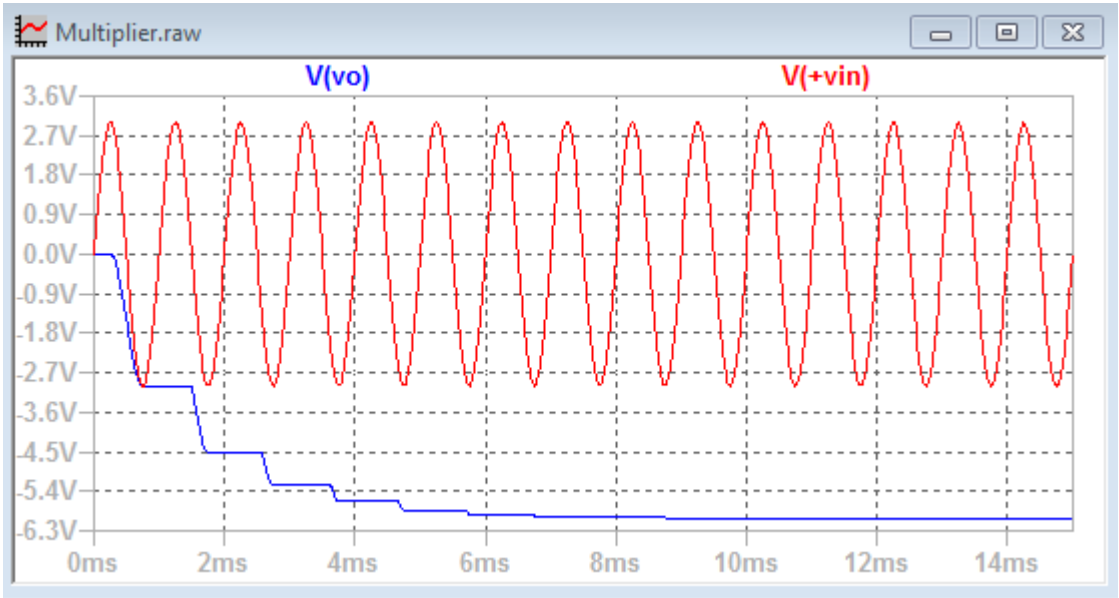
1. Multiplier
2. Gerbang logika dasar
3. Zener

Rangkaian *Multiplier*

- Rangkaian ini diterapkan pada trafo dengan tegangan puncak yang rendah dimana dapat dinaikkan output tegangan puncak menjadi dua, tiga, empat atau lebih tegangan puncak penyearahnya.

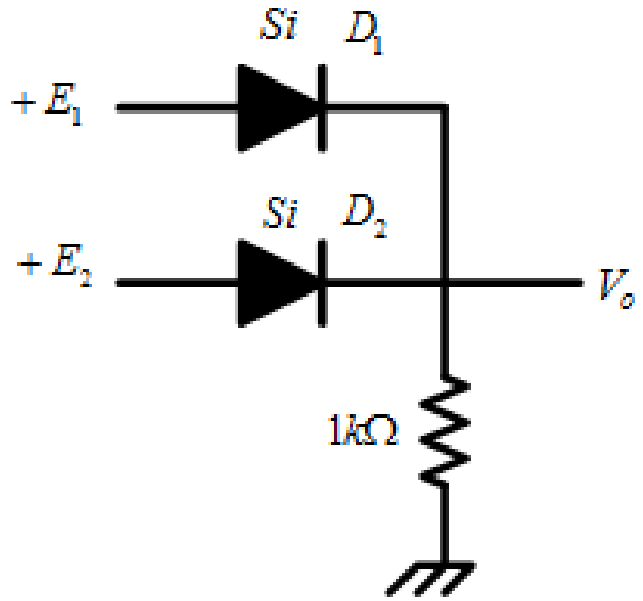



+Vin
V1
SINE(0 3 1k)
+Vin
C1
500µ
D1
Ideal
D2
Ideal
Vo
C2
500µ

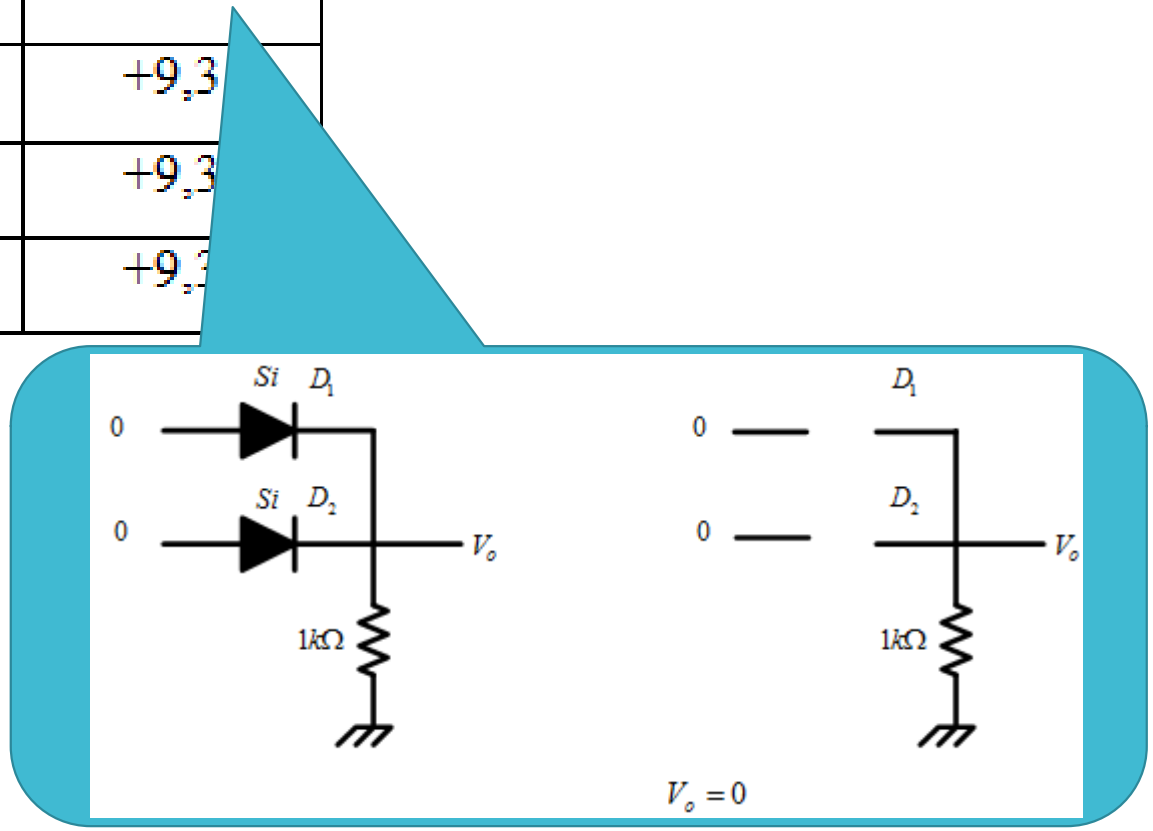

Multiplier.raw
V(vo)
V(+vin)
3.6V
2.7V
1.8V
0.9V
0.0V
-0.9V
-1.8V
-2.7V
-3.6V
-4.5V
-5.4V
-6.3V
0ms
2ms
4ms
6ms
8ms
10ms
12ms
14ms

Gerbang Dasar

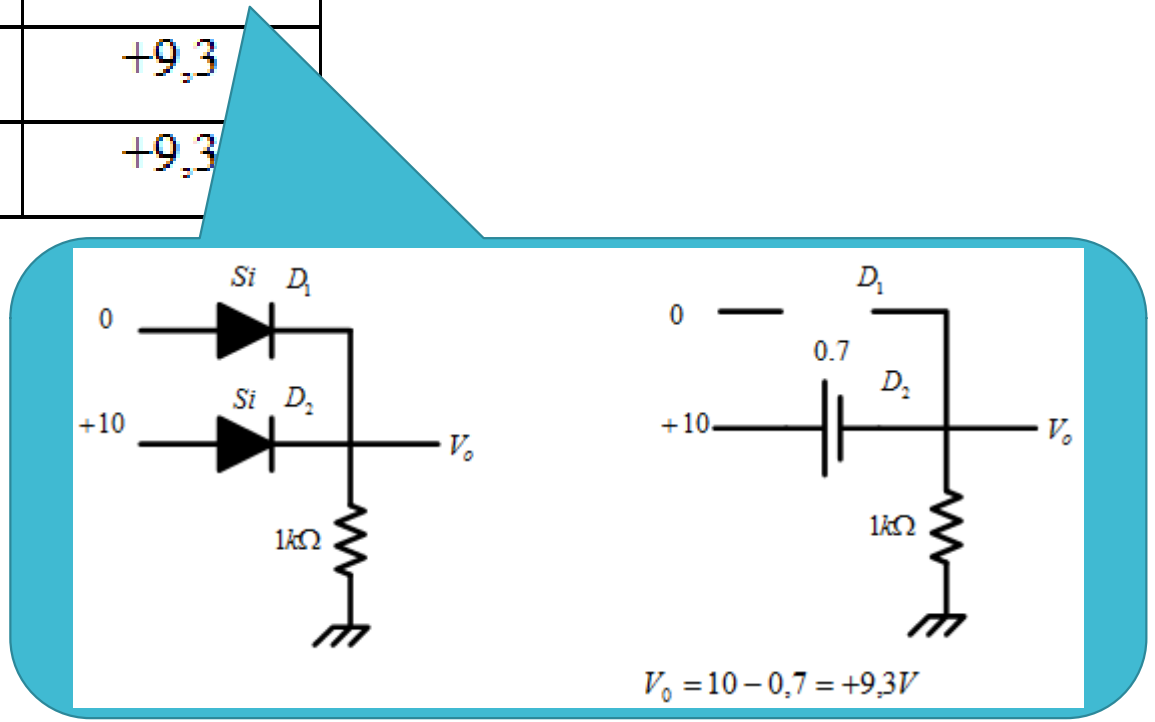
- Gerbang OR



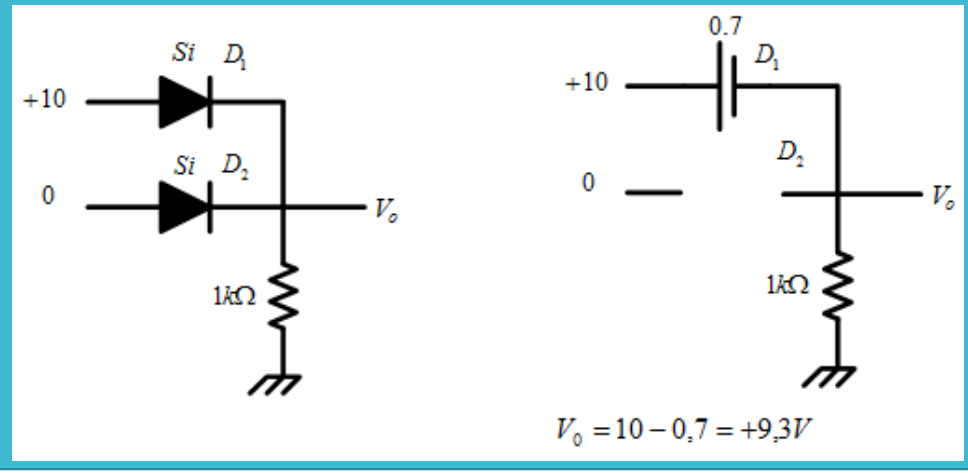
E_2	E_1	V_o
0	0	0
0	+10	+9,3
+10	0	+9,3
+10	+10	+9,3



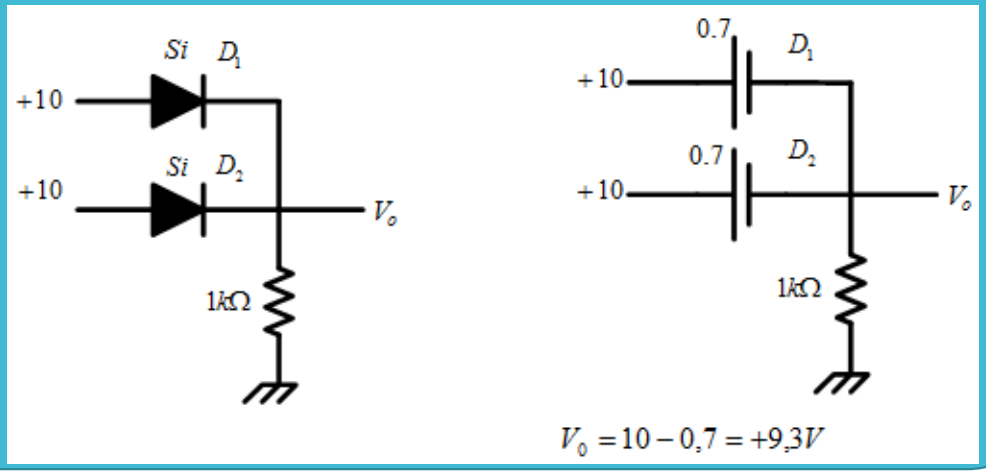
E_2	E_1	V_o
0	0	0
0	+10	+9,3
+10	0	+9,3
+10	+10	+9,3

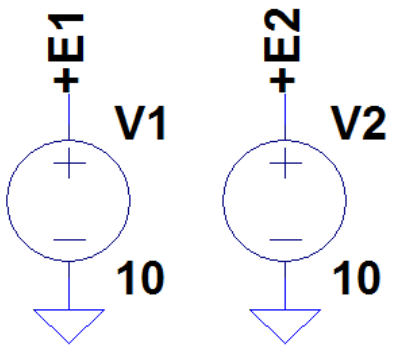


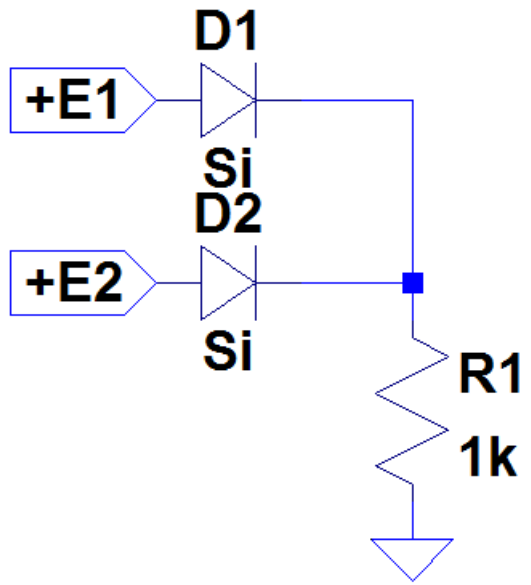
E_2	E_1	V_o
0	0	0
0	+10	+9,3
+10	0	+9,3
+10	+10	+9



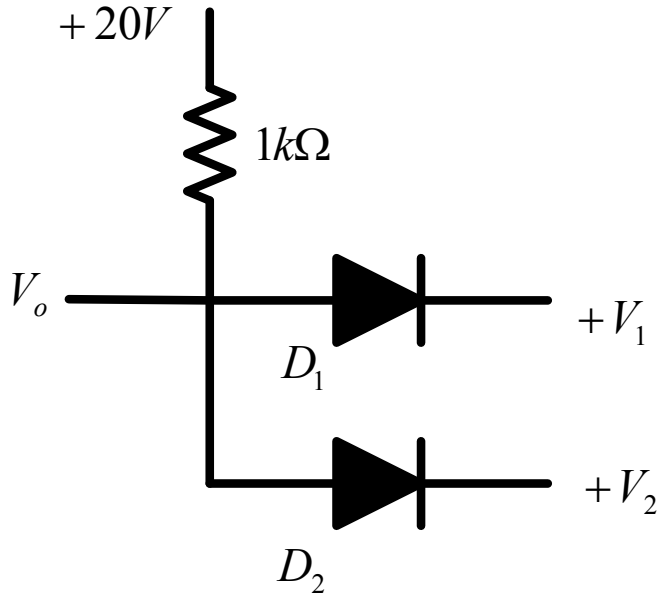
E_2	E_1	V_o
0	0	0
0	+10	+9,3
+10	0	+9,3
+10	+10	+9,3

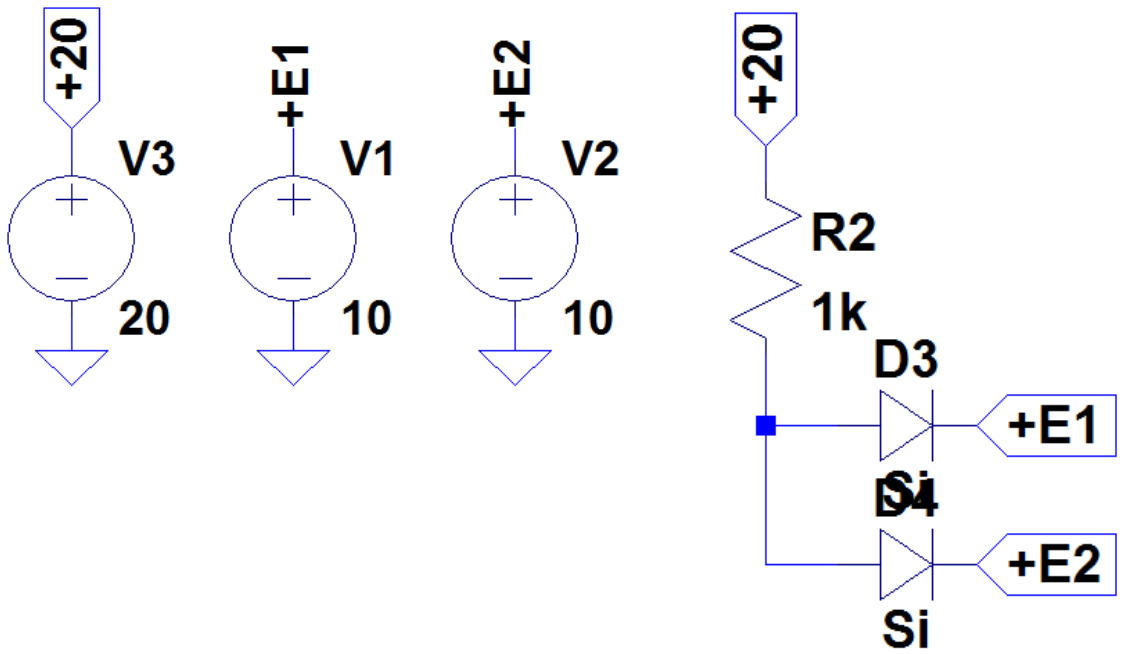



+E1
V1
10
+E2
V2
10


D1
+E1
Si
D2
+E2
Si
R1
1k

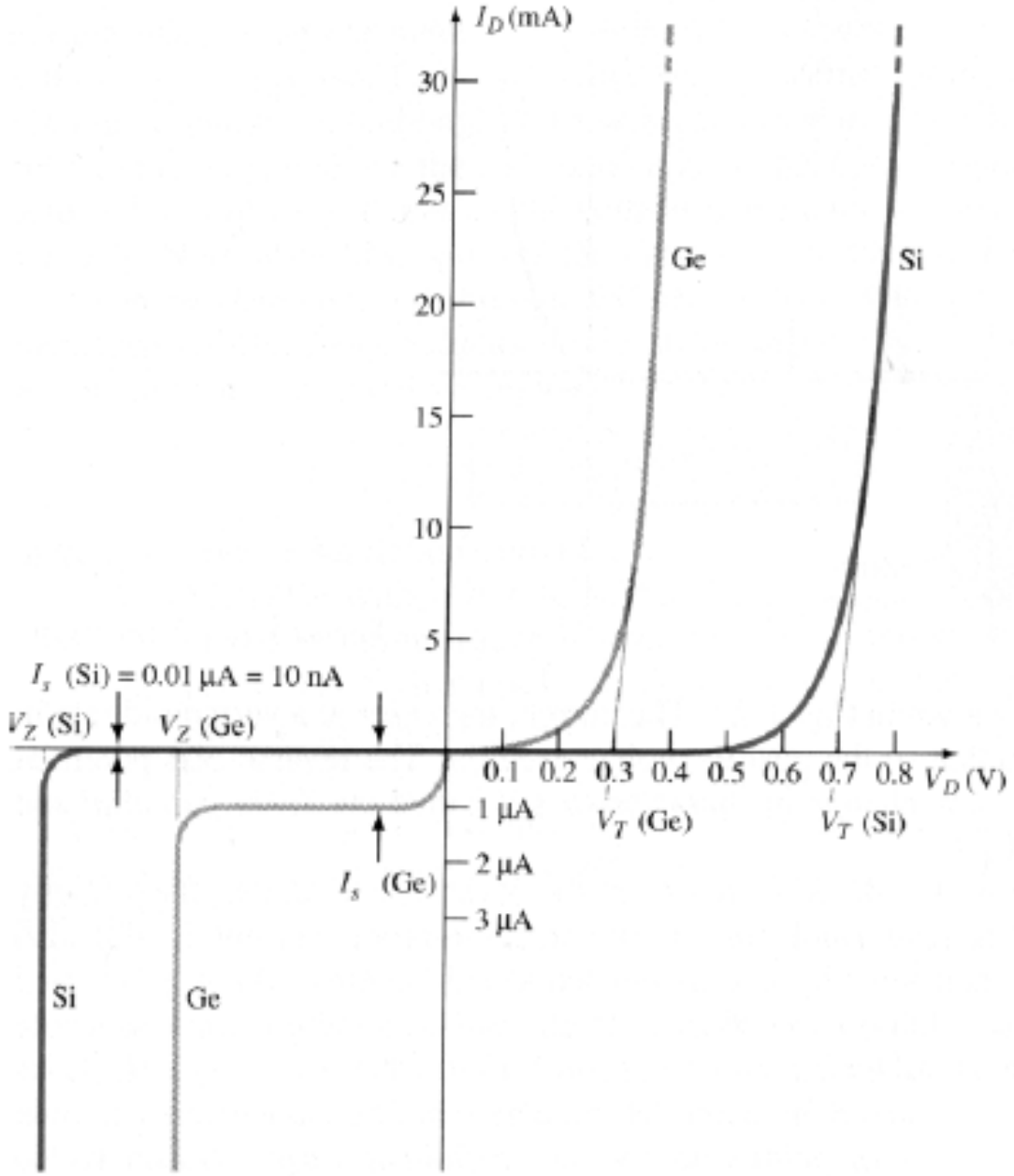
Gerbang AND



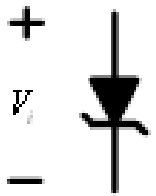

+20
V3
20
+E1
V1
10
+E2
V2
10
+20
R2
1k
D3
+E1
Si
D4
+E2
Si

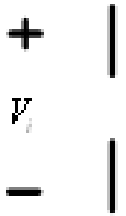
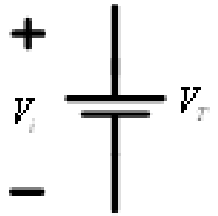
Dioda Zener

- Potensial prategangan mundur yang menghasilkan perubahan karakteristik secara drastis disebut potensial zener (Vz).
- Potensial maksimum dari prategangan mundur sebelum masuk daerah zener disebut *peak inverse voltage* (PIV) atau *peak reverse voltage* (PRV). → tegangan maksimum yang bisa ditahan sebuah dioda

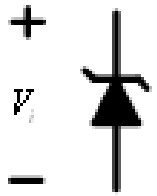

I_D (mA)
30
25
20
15
10
5
Ge
Si
I_s (Si) = 0.01 μA = 10 nA
V_Z (Si)
V_Z (Ge)
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 V_D (V)
V_T (Ge)
V_T (Si)
1 μA
2 μA
3 μA
I_s (Ge)
Si
Ge

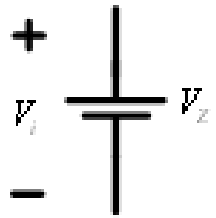
- Pada saat dioda zener mendapatkan prategangan maju atau *forward* bias, jika tegangannya lebih kecil daripada tegangan *threshold*, maka dioda zener tersebut kondisinya "OFF", sedangkan jika tegangannya lebih besar daripada tegangan *threshold*, maka dioda zener tersebut kondisinya "ON" dimana tegangan dioda zener samadengan tegangan *threshold.*



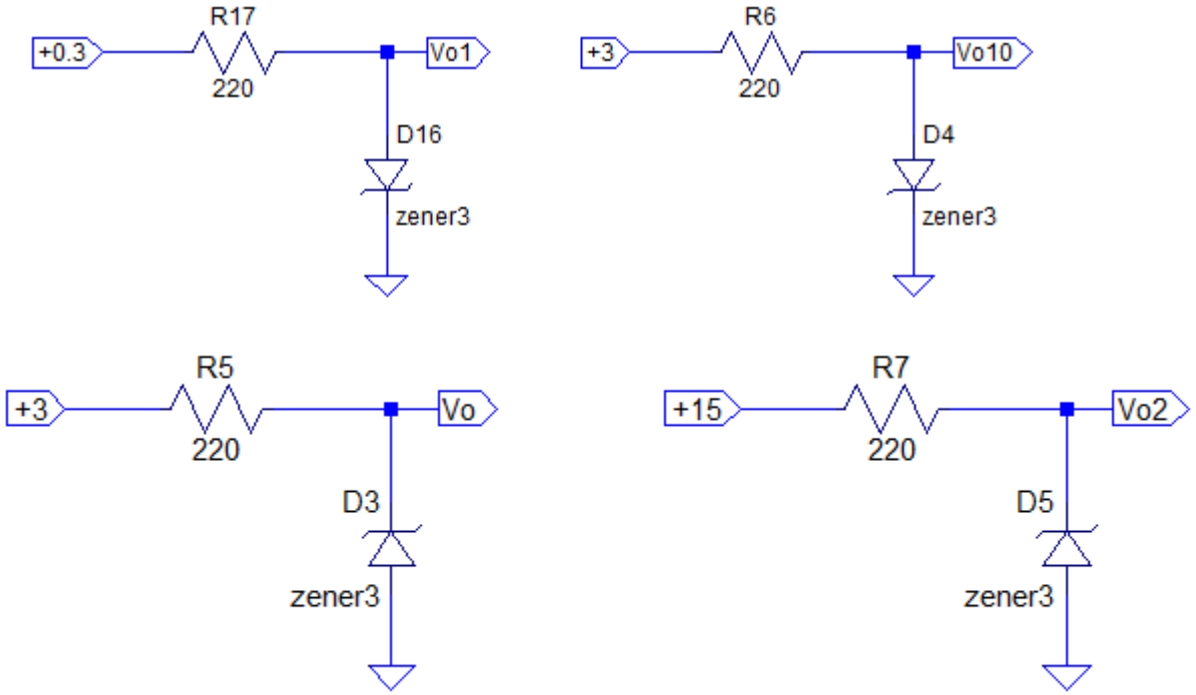
Saat $V_i \leq V_T$	Saat $V_i > V_T$
	

- Pada saat dioda zener mendapatkan prategangan mundur atau *reverse* bias, jika tegangannya lebih kecil daripada tegangan zener, maka dioda zener tersebut kondisinya "OFF", sedangkan jika tegangannya lebih besar daripada tegangan zener, maka dioda zener tersebut kondisinya "ON" dimana tegangan dioda zener samadengan tegangan zener.

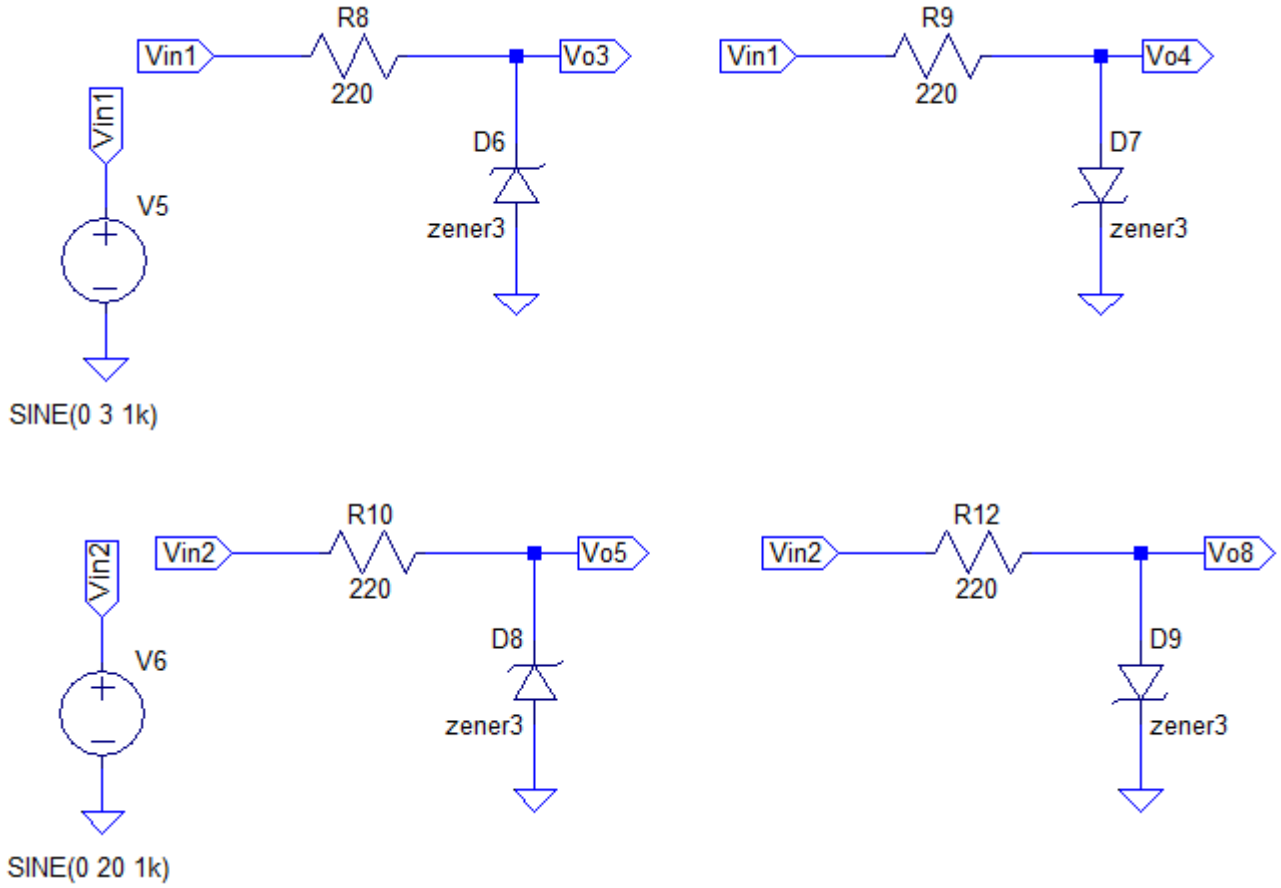


Saat $V_i \leq V_Z$	Saat $V_i > V_Z$
	

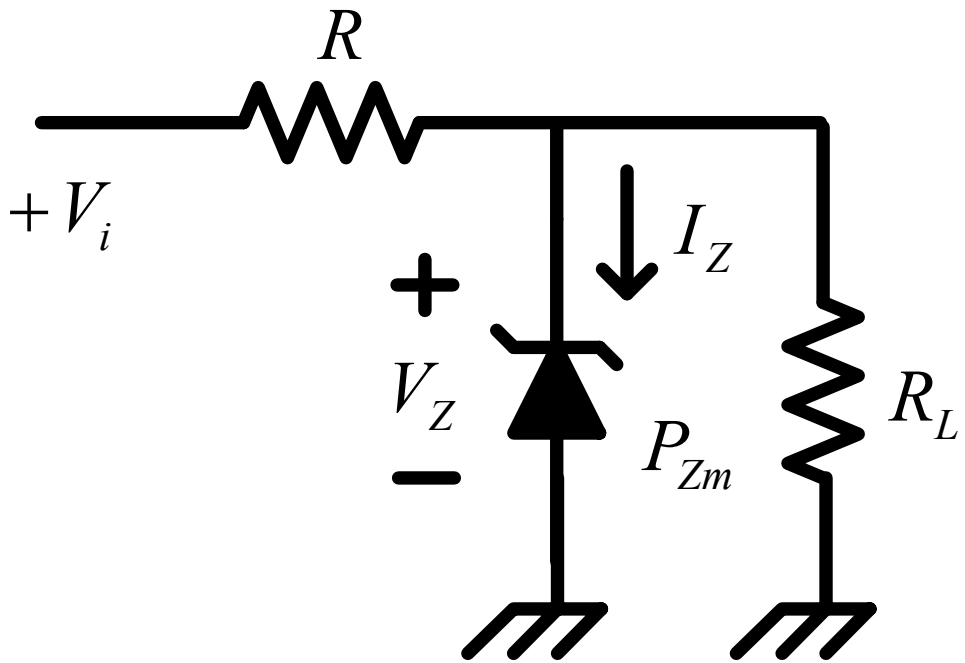
.model zener3 D (Rs=0 VJ=0.7 BV=10 IBV=5mA)



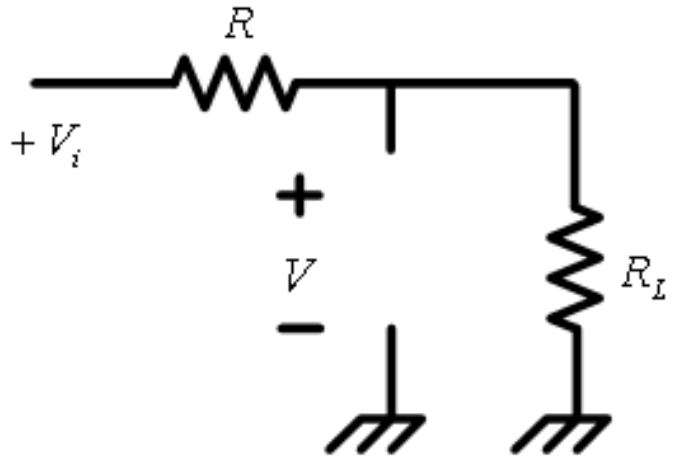
.model zener3 D (Rs=0 VJ=0.7 BV=10 IBV=5mA)



Dioda zener sebagai regulator tegangan



Vi dan R tetap

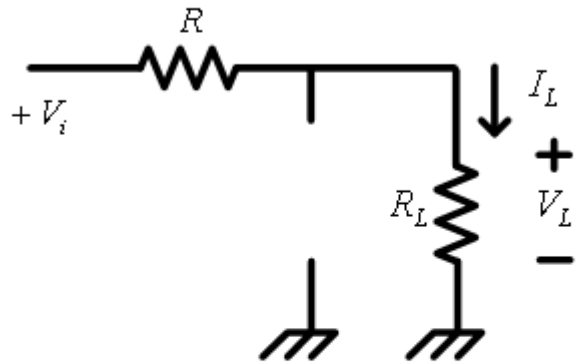


$$V = \frac{R_L}{R_L + R} V_i$$

Jika $V \geq V_Z$ → dioda zener "ON"

Jika $V < V_Z$ → dioda zener "OFF"

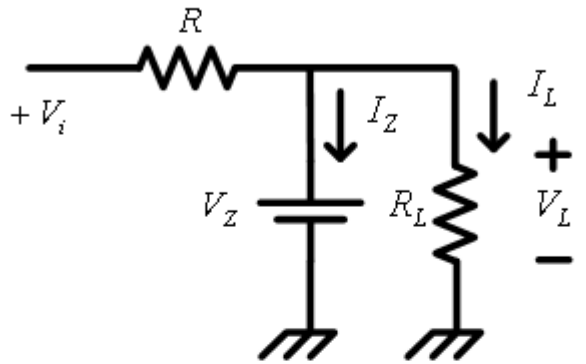
Jika kondisi dioda zener "OFF" maka :



$$V_L = \frac{R_L}{R_L + R} V_i$$

$$I_L = \frac{V_i}{R_L + R}$$

Jika kondisi dioda zener "ON" maka :



$$V_L = V_Z$$

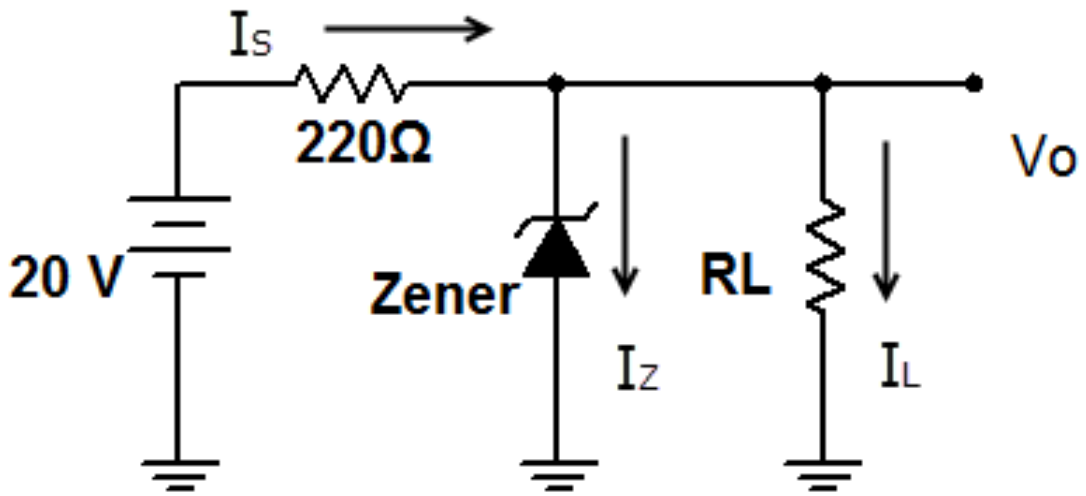
$$I_L = \frac{V_L}{R_L} = \frac{V_Z}{R_L}$$

$$I_Z = \frac{V_i - V_Z}{R} - I_L$$

$$P_Z = V_Z I_Z$$

dimana $P_Z \le P_{Zm}$

Jika Vz = 10 V dan Pzmax = 400 mW, hitung setiap parameter jika RL = 180 Ohm dan 270 Ohm



Vi tetap, R_L berubah-ubah

$$V_L = V_Z = \frac{R_L}{R_L + R} V_i$$

$$V_L(R_L + R) = R_L V_i$$

$$R_L = \frac{V_L}{V_i - V_L} R$$

Beban yang kecil R_L menyebabkan tegangan yang melintasinya pun kecil, sehingga jika lebih kecil dari V_Z menyebabkan dioda "OFF", maka nilai resistansi beban minimumnya :

$$R_{L\min} = \frac{V_L}{V_i - V_L} R = \frac{V_Z}{V_i - V_Z} R$$

$$I_{L\max} = \frac{V_L}{R_L} = \frac{V_Z}{R_{L\min}}$$

Saat dioda "ON" :

$$I_R = \frac{V_R}{R} = \frac{V_i - V_Z}{R}$$

$I_Z = I_R - I_L$ → dimana I_{zmin} saat I_{Lmax} dan I_{zmax} saat I_{Lmin}

$I_{L\min} = I_R - I_{Zm}$ → dimana I_{zm} adalah arus maksimum dioda zener pada datasheet

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

Vi Berubah-ubah dan R_L Tetap

Supaya dioda "ON" V_i harus besar, maka nilai minimum V_i :

$$V_L = V_Z = \frac{R_L}{R_L + R} V_i$$

$$V_{i\min} = \frac{R_L + R}{R_L} V_Z$$

Maksimum nilai V_i dibatasi oleh arus maksimum dioda zener I_{Zm}

$$I_{Zm} = I_R - I_L$$

$$I_{R\max} = I_{Zm} + I_L$$

$$V_{i\max} = V_{R\max} + V_Z$$

$$V_{i\max} = I_{R\max} R + V_Z$$