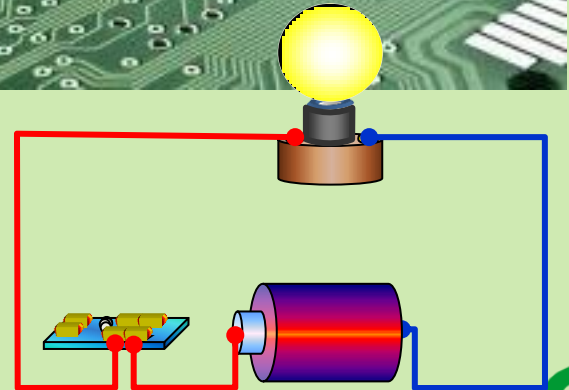


RANGKAIAN LISTRIK

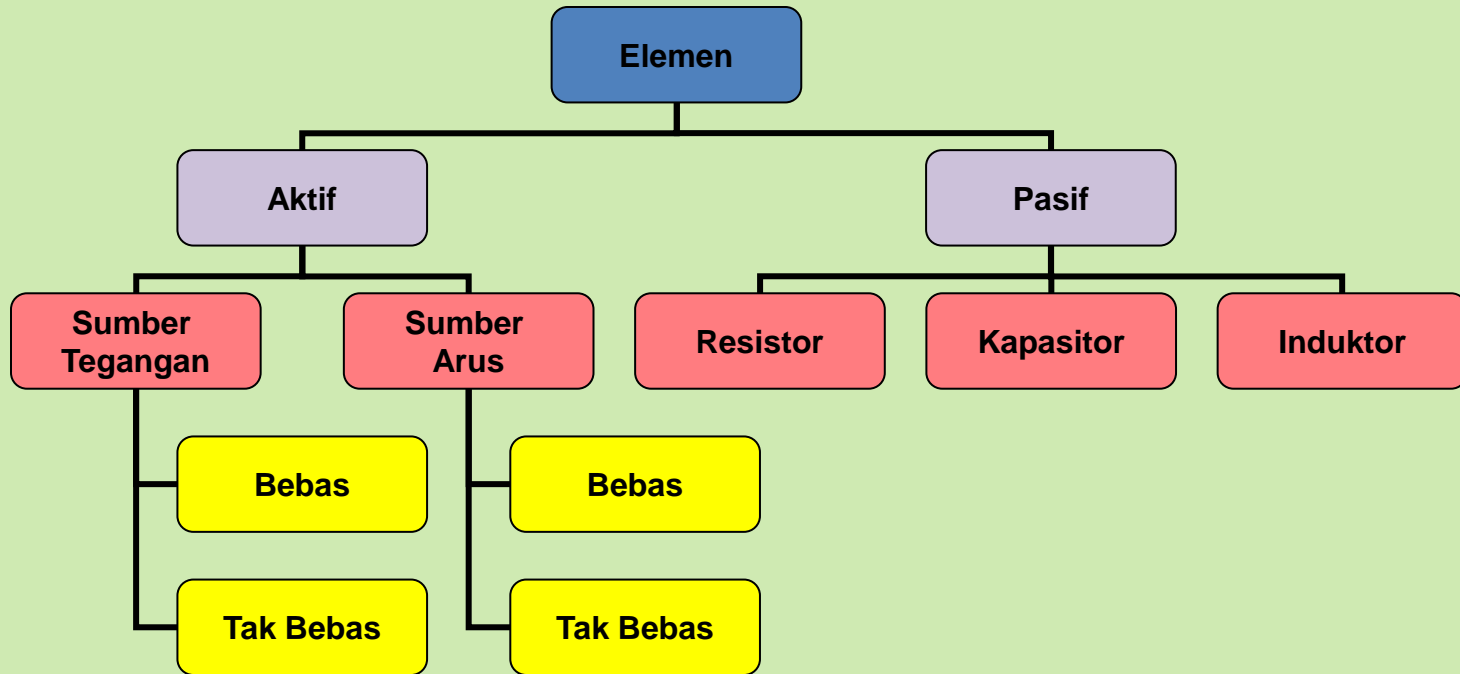


Elemen Rangkaian Listrik

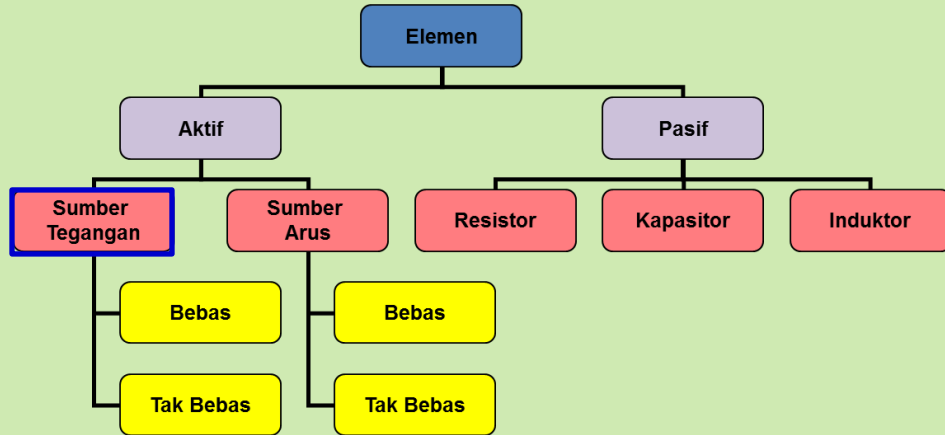


By Dwi Andi Nurmantris

Elemen Rangkaian Listrik



Elemen Rangkaian Listrik

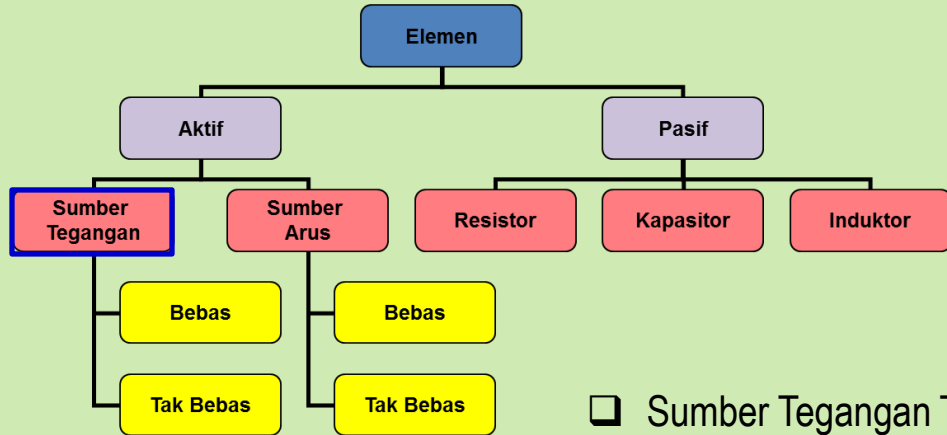


Karakteristik sumber tegangan ideal :

- Menghasilkan tegangan yang tetap
- Tidak tergantung pada arus yang mengalir pada sumber tersebut, meskipun tegangan tersebut merupakan fungsi dari t .
- Mempunyai nilai resistansi dalam $R_d = 0$ (sumber tegangan ideal)



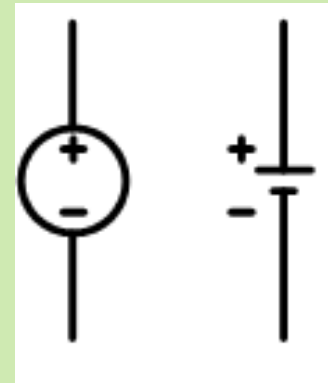
Elemen Rangkaian Listrik



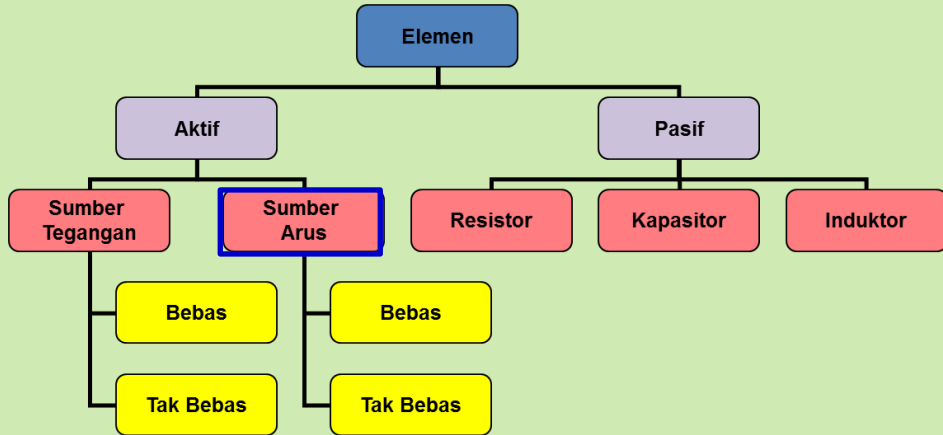
Klasifikasi Sumber Tegangan (Voltage Source) :

☐ Sumber Tegangan Bebas/ *Independent Voltage Source*

☐ Sumber Tegangan Tidak Bebas/ *Dependent Voltage Source*



Elemen Rangkaian Listrik

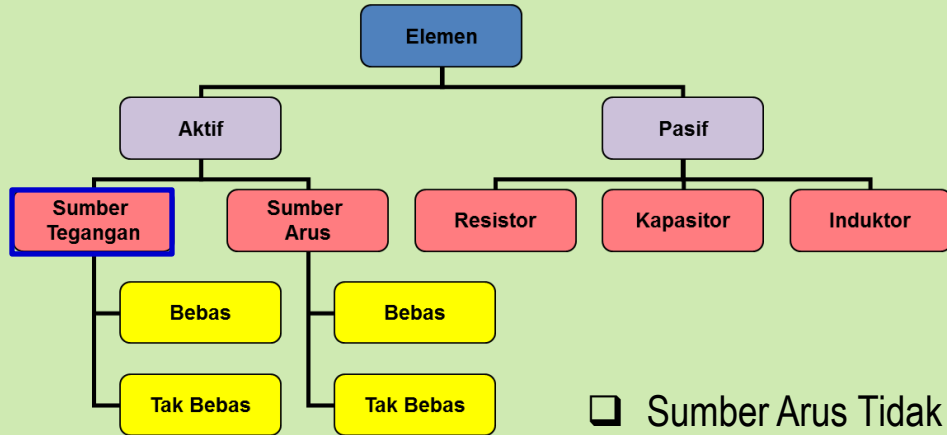


Karakteristik sumber Arus ideal :

- Menghasilkan arus yang tetap
- Tidak bergantung pada tegangan dari sumber arus
- Mempunyai nilai resistansi dalam $R_d = \infty$ (sumber arus ideal)



Elemen Rangkaian Listrik



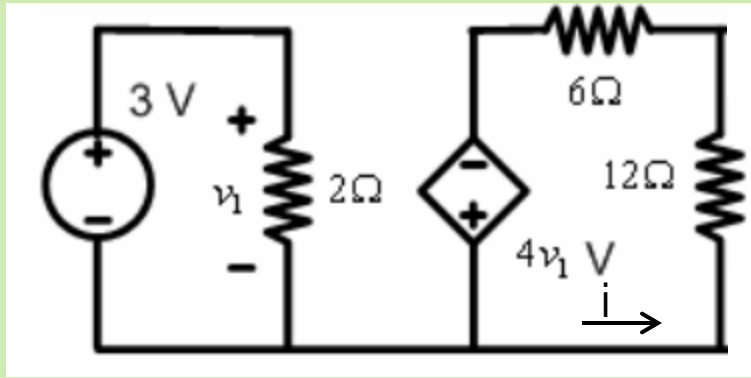
Klasifikasi Sumber Arus (*Current Source*):

Sumber Arus Bebas/ *Independent Current Source*

Sumber Arus Tidak Bebas/ *Dependent Current Source*



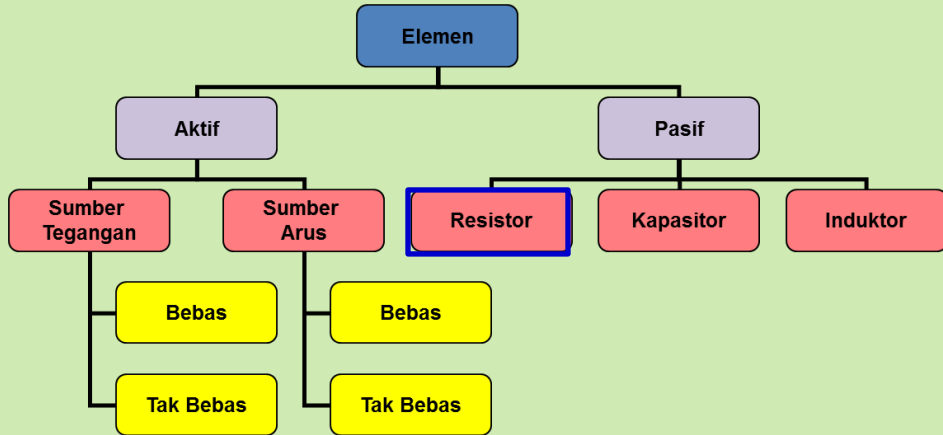
Contoh Soal



Cari Besar Arus i !



Elemen Rangkaian Listrik



Resistor (R)

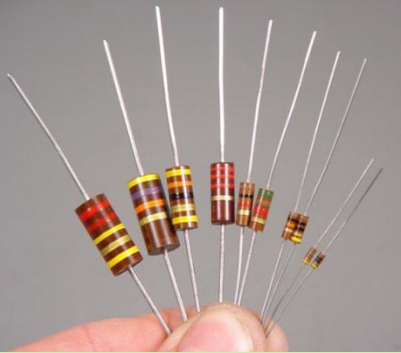
- Fungsi sebagai penghambat arus, pembagi arus, dan pembagi tegangan
- Nilai resistor tergantung dari hambatan jenis bahan resistor itu sendiri (tergantung dari bahan pembuatnya), panjang dari resistor itu sendiri dan luas penampang dari resistor itu sendiri

$$R = \rho \frac{l}{A}$$



Elemen Rangkaian Listrik

Carbon Composition Resistor



Wire Wound Resistor



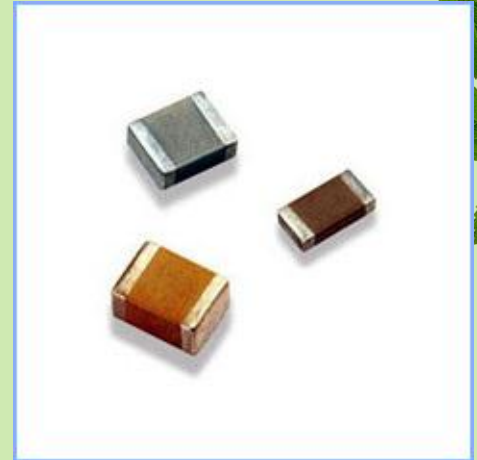
Metal Film Resistor



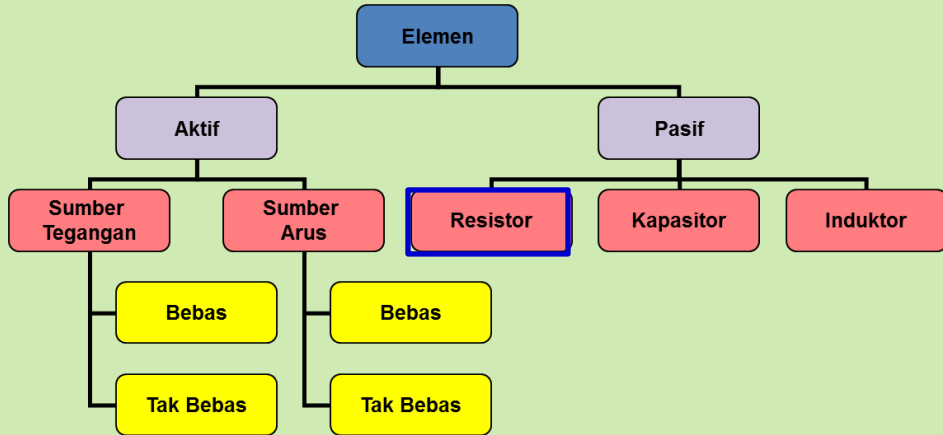
Carbon Film Resistor



Thin-Film Chip Resistor



Elemen Rangkaian Listrik

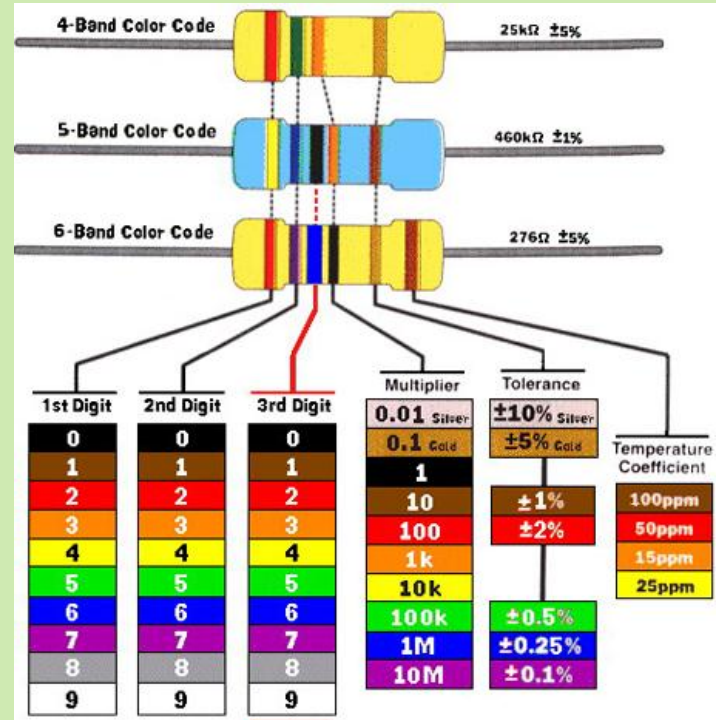


Koefisien suhu resistansi (**Temperature Coefficient of Resistance**) adalah koefisien perubahan nilai resistansi sebuah resistor setiap adanya perubahan suhu

$$TCR = \frac{R_1 - R_2}{R_1(T_1 - T_2)} 10^6$$



Resistor (R)



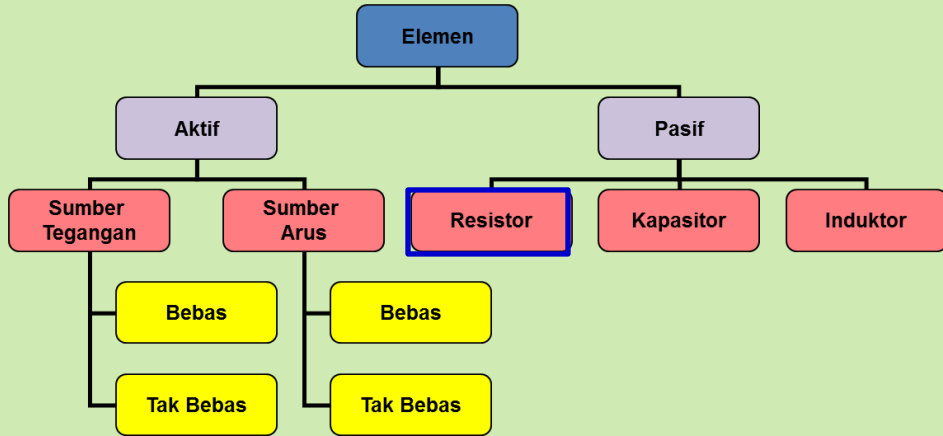
Contoh Soal



Berapa Nilai Resistansi Kapasitor?



Elemen Rangkaian Listrik

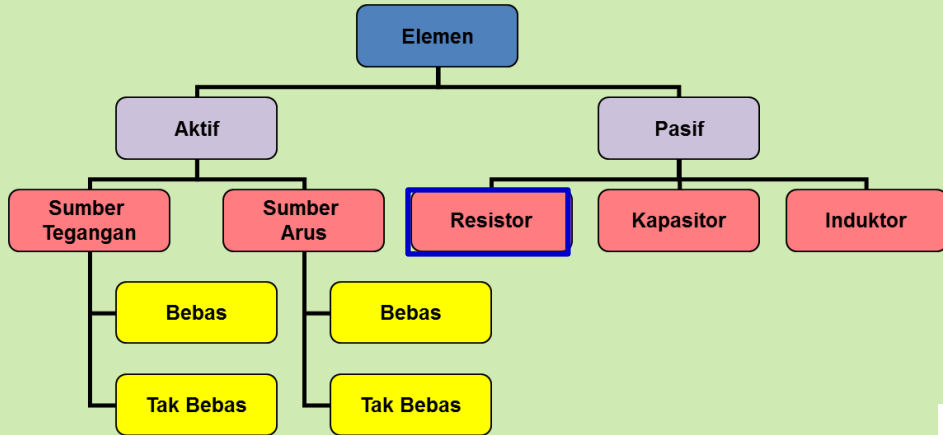


Resistor (R)

472 4700 Ω / 4K7	8202 82000 Ω / 82 KΩ
4R2 4,2 Ω	0R22 0,22 Ω
0 0 Ω	0000 0 Ω

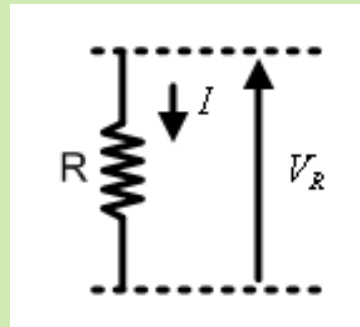


Elemen Rangkaian Listrik



Resistor (R)

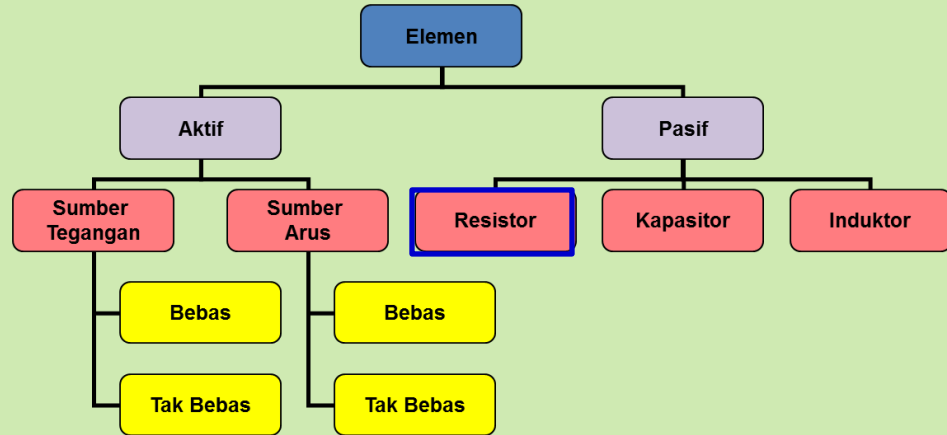
Jika suatu resistor dilewati oleh sebuah arus maka pada kedua ujung dari resistor tersebut akan menimbulkan beda potensial atau tegangan



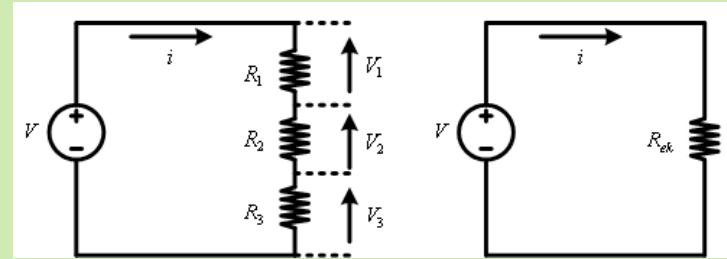
$$V_R = IR$$



Elemen Rangkaian Listrik



Resistor Seri



R ekivalen

$$KVL : \sum V = 0$$

$$V_1 + V_2 + V_3 - V = 0$$

$$V = V_1 + V_2 + V_3 = iR_1 + iR_2 + iR_3$$

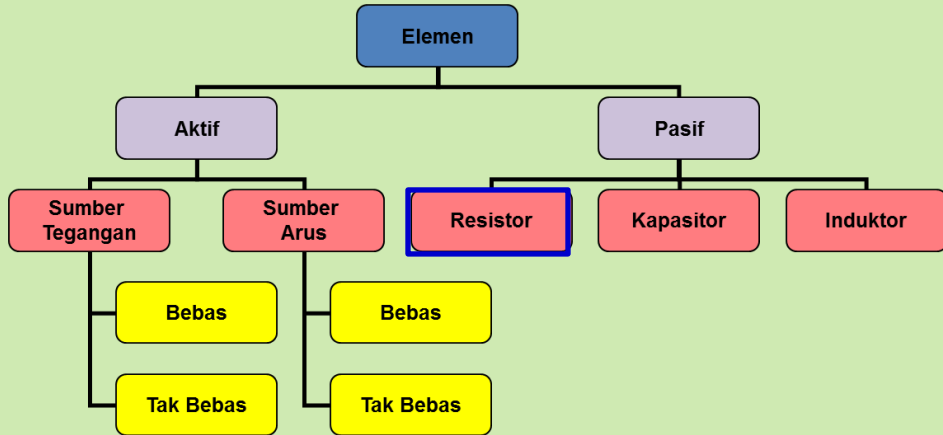
$$V = i(R_1 + R_2 + R_3)$$

$$\frac{V}{i} = R_1 + R_2 + R_3$$

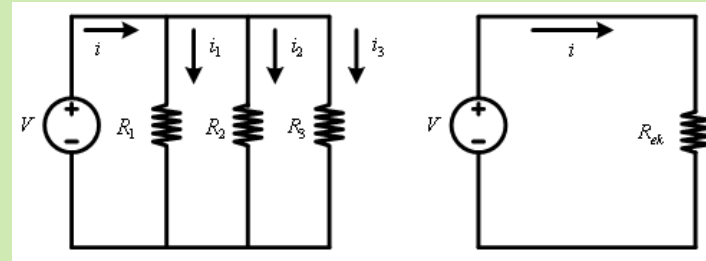
$$R_{ek} = R_1 + R_2 + R_3$$



Elemen Rangkaian Listrik



Resistor Paralel



R ekivalen

KCL:

$$\sum i = 0$$

$$i - i_1 - i_2 - i_3 = 0$$

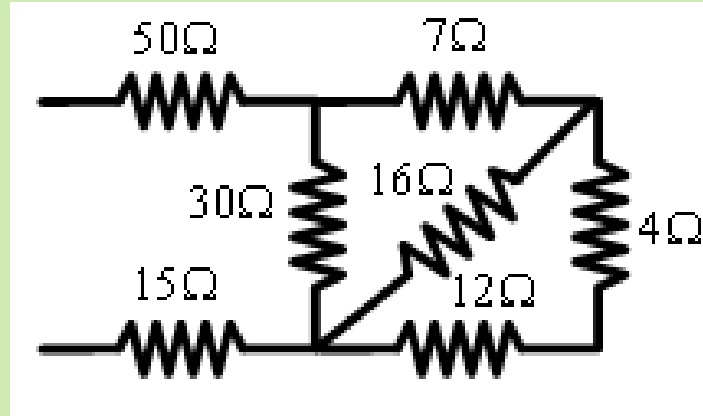
$$i = i_1 + i_2 + i_3$$

$$\frac{V}{R_{ek}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{1}{R_{ek}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$



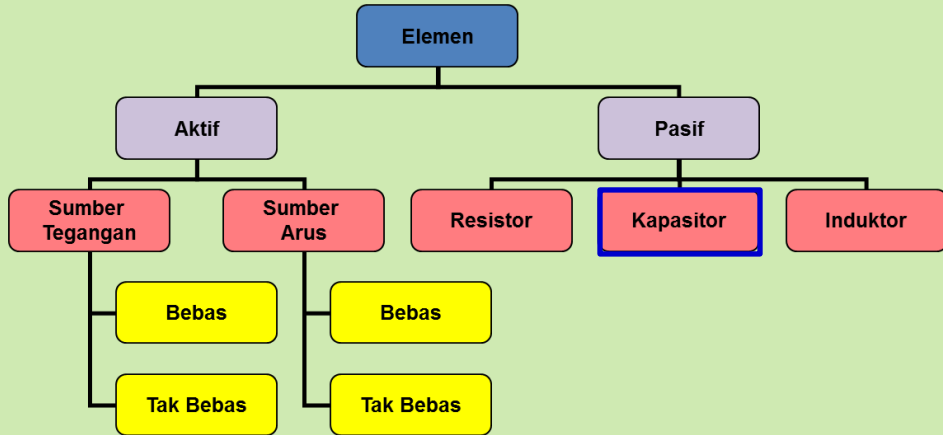
Contoh Soal



Hitung R_{ek} !



Elemen Rangkaian Listrik



Kapasitor (C)







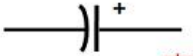

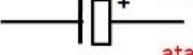
- Fungsi Kapasitor untuk membatasi arus DC yang mengalir pada kapasitor tersebut, dan dapat menyimpan energi dalam bentuk medan listrik
- Nilai suatu kapasitor tergantung dari nilai permitivitas bahan pembuat kapasitor, luas penampang dari kapasitor tersebut dan jarak antara dua keping penyusun dari kapasitor tersebut

$$C = \varepsilon \frac{A}{d}$$



Elemen Rangkaian Listrik

KAPASITOR NILAI TETAP (FIXED CAPACITOR)

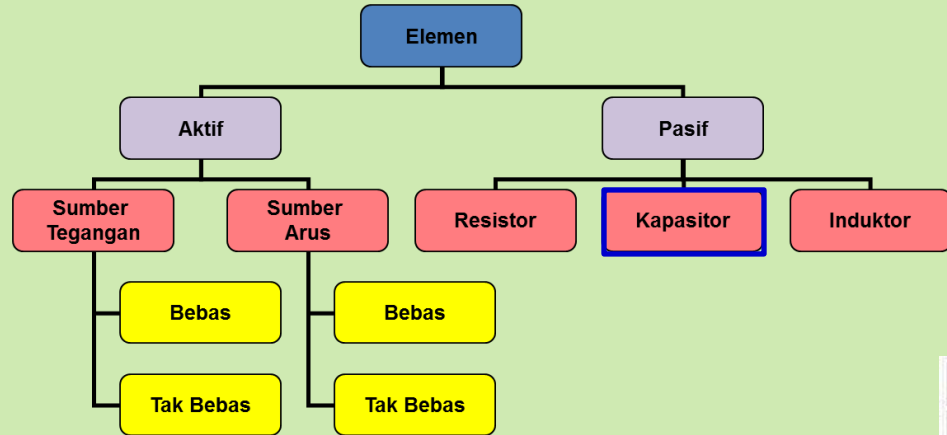
Nama Komponen	Gambar	Simbol
Kapasitor Keramik (Ceramic Capacitor)		
Kapasitor Polyester (Polyester Capacitor)		
Kapasitor Kertas (Paper Capacitor)		
Kapasitor Mika (Mica Capacitor)		
Kapasitor Elektrolit (Electrolyte Capacitor)		 atau
Kapasitor Tantalum (Tantalum Capacitor)		 atau

KAPASITOR VARIABEL (VARIABLE CAPACITOR)

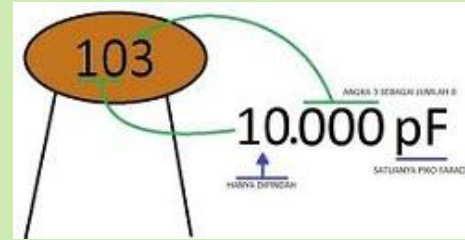
Nama Komponen	Gambar	Simbol
VARCO (Variable Condensator)		
Trimmer		

teknikelektronika.com

Elemen Rangkaian Listrik



Kapasitor (C)



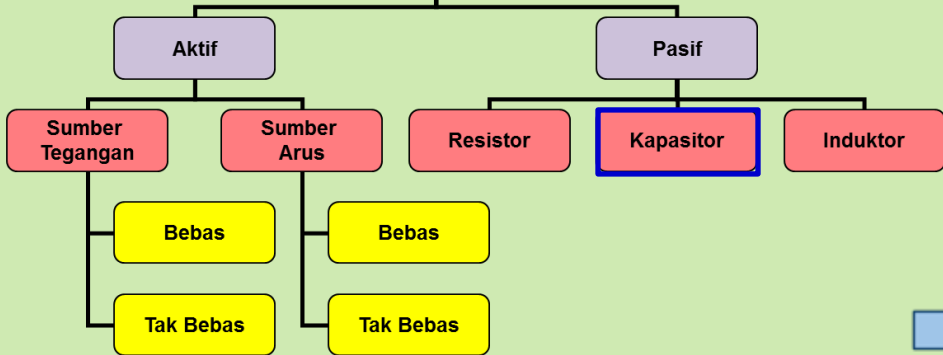
Angka ke-3	Pengali
0	1
1	10
2	100
3	1,000
4	10,000
5	100,000
6	not used
7	not used



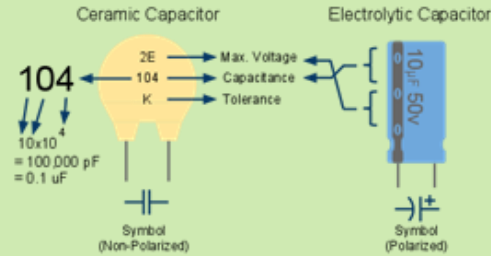
Elemen Rangkaian Listrik



Elemen



Kapasitor (C)



Max. Operating Voltage	
Code	Max. Voltage
1H	50V
2A	100V
2T	150V
2D	200V
2E	250V
2G	400V
2J	630V

Capacitance Conversion Values		
Microfarads (µF)	Nanofarads (nF)	Picofarads (pF)
0.000001 µF	0.001 nF	1 pF
0.00001 µF	0.01 nF	10 pF
0.0001 µF	0.1 nF	100 pF
0.001 µF	1 nF	1,000 pF
0.01 µF	10 nF	10,000 pF
0.1 µF	100 nF	100,000 pF
1 µF	1,000 nF	1,000,000 pF
10 µF	10,000 nF	10,000,000 pF
100 µF	100,000 nF	100,000,000 pF

Tolerance	
Code	Percentage
B	± 0.1 pF
C	±0.25 pF
D	±0.5 pF
F	±1%
G	±2%
H	±3%
J	±5%
K	±10%
M	±20%
Z	+80%, -20%



Elemen Rangkaian Listrik

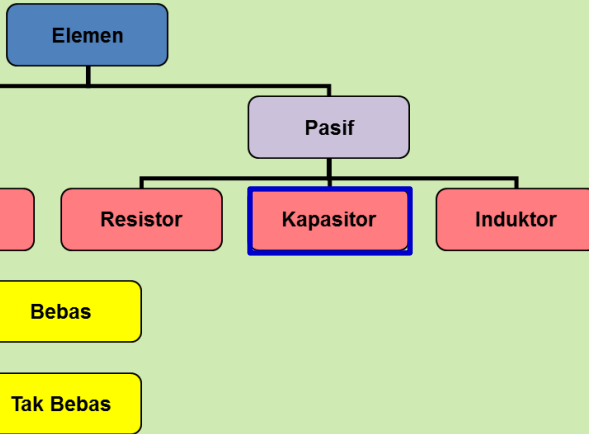


Kapasitor (C)

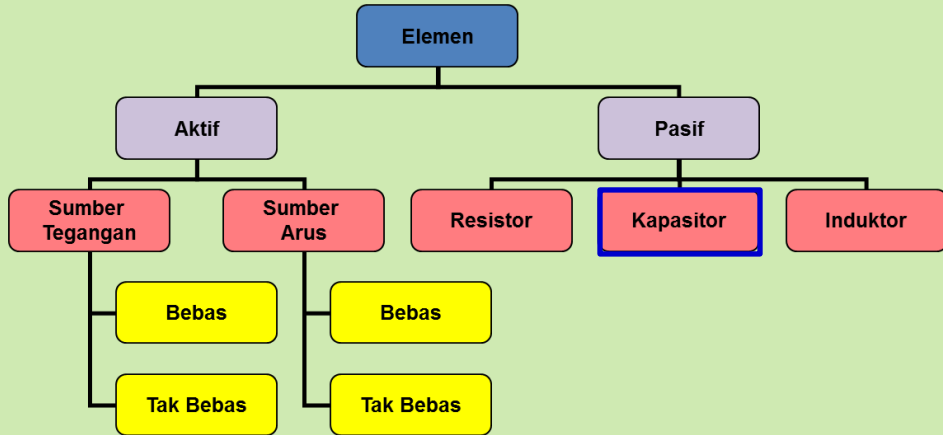


TABEL KODE WARNA KAPASITOR

Warna	Cincin Pertama	Cincin Kedua	Cincin Ketiga (Faktor Pengali)	Cincin Keempat (Toleransi)	Tegangan Kerja	
					VDC	VAC
Hitam	0	0	-----	-----	100V	-----
Coklat	1	1	10^1	20%	250V	160V
Merah	2	2	10^2	-----	-----	-----
Orange	3	3	10^3	-----	-----	-----
Kuning	4	4	10^4	-----	400V	200V
Hijau	5	5	10^5	5%	-----	-----
Biru	6	6	10^6	-----	630V	220V
Ungu	7	7	10^7	-----	-----	-----
Abu-abu	8	8	10^8	-----	-----	-----
Putih	9	9	10^9	10%	-----	-----

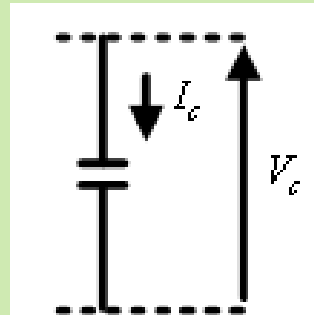


Elemen Rangkaian Listrik



Kapasitor (C)

Jika sebuah kapasitor dilewati oleh sebuah arus maka pada kedua ujung kapaistor tersebut akan muncul beda potensial atau tegangan

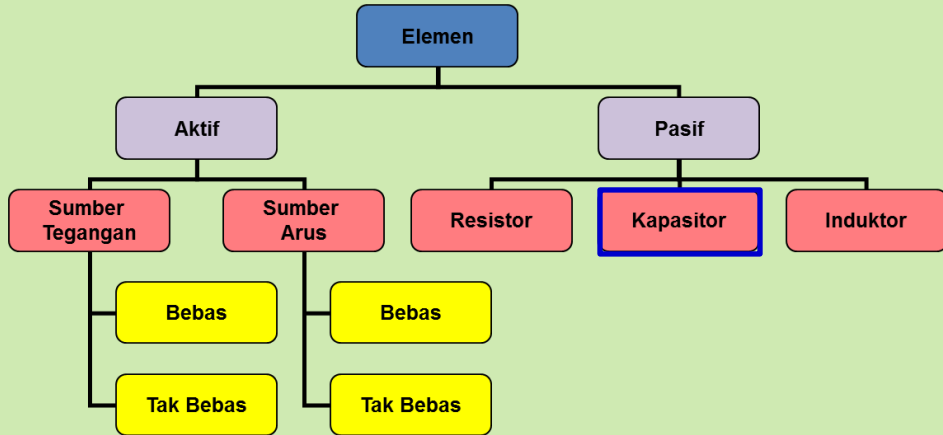


$$i_c = C \frac{dv_c}{dt}$$

$$V_c = \frac{1}{C} \int i dt$$



Elemen Rangkaian Listrik

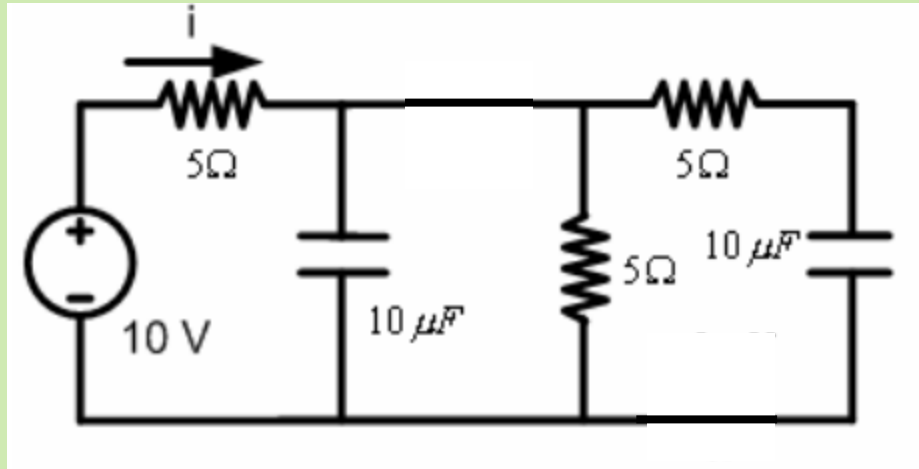


Kapasitor (C)

Jika kapasitor dipasang tegangan konstan/DC, maka arus sama dengan nol. Sehingga kapasitor bertindak sebagai rangkaian terbuka/ *open circuit* untuk tegangan DC



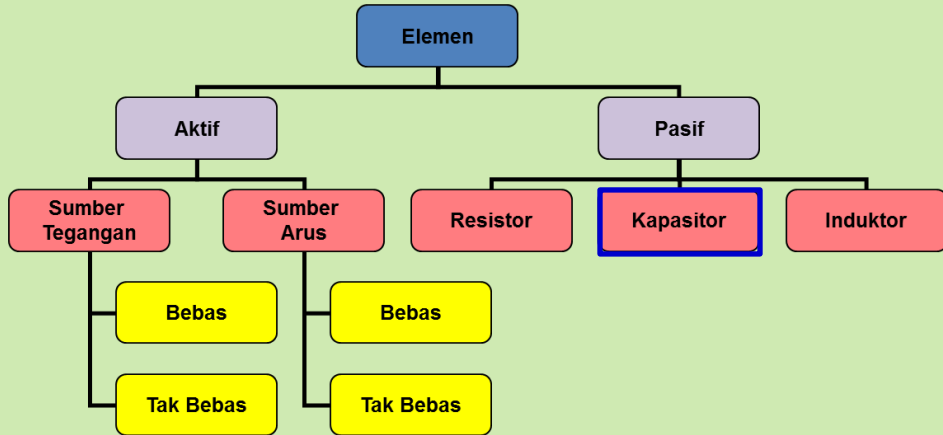
Contoh Soal



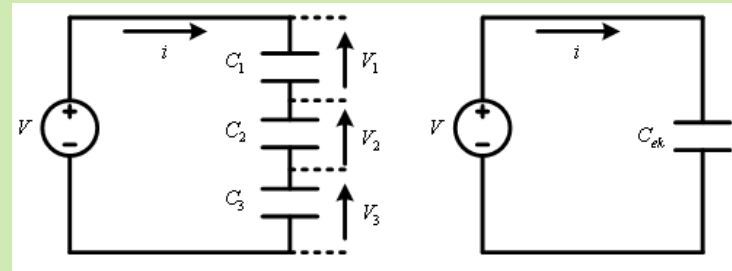
Carilah Arus i !



Elemen Rangkaian Listrik



Kapasitor Seri



$$KVL: \sum V = 0$$

$$V_1 + V_2 + V_3 - V = 0$$

$$V = V_1 + V_2 + V_3$$

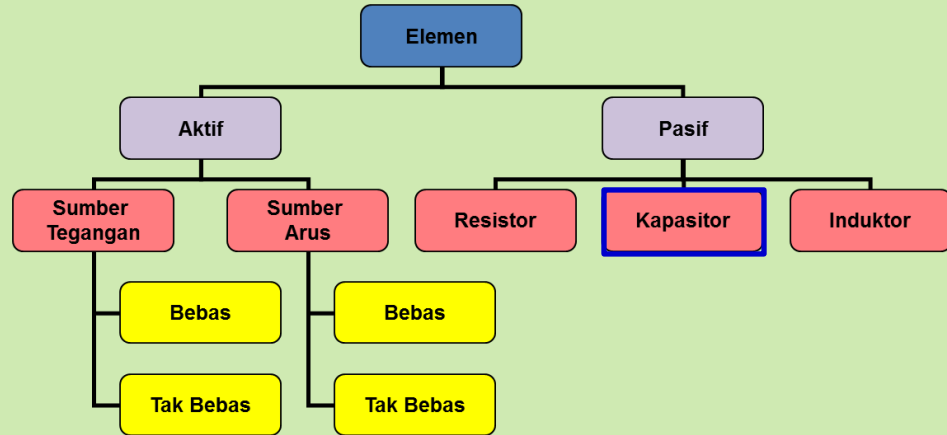
$$V = \frac{1}{C_1} \int idt + \frac{1}{C_2} \int idt + \frac{1}{C_3} \int idt$$

$$\frac{1}{C_{ek}} \int idt = \frac{1}{C_1} \int idt + \frac{1}{C_2} \int idt + \frac{1}{C_3} \int idt$$

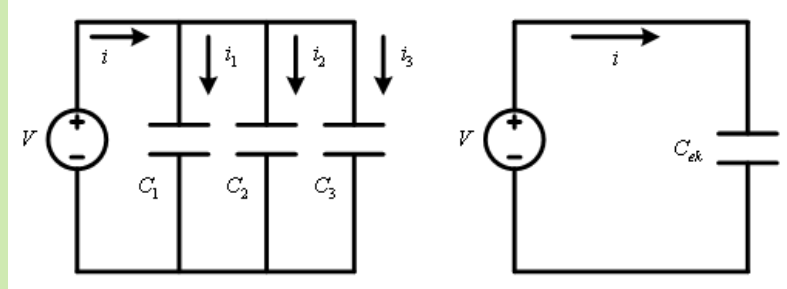
$$\frac{1}{C_{ek}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$



Elemen Rangkaian Listrik



Kapasitor Paralel



KCL :

$$\sum i = 0$$

$$i - i_1 - i_2 - i_3 = 0$$

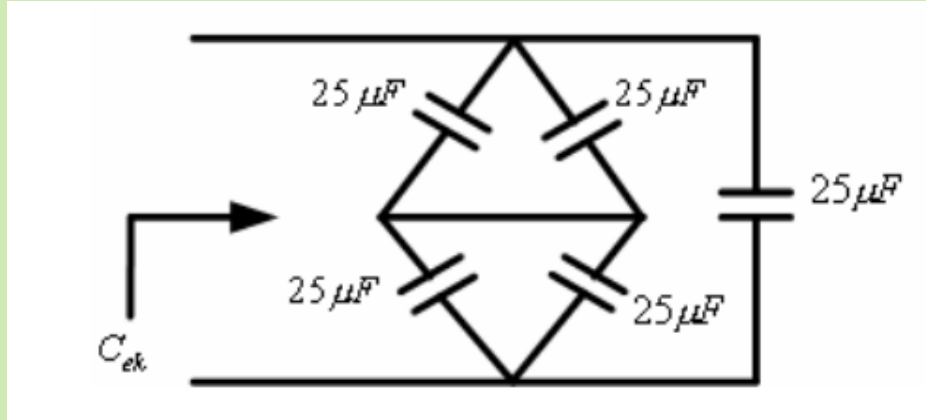
$$i = i_1 + i_2 + i_3$$

$$C_{ek} \frac{dV}{dt} = C_1 \frac{dV}{dt} + C_2 \frac{dV}{dt} + C_3 \frac{dV}{dt}$$

$$C_{ek} = C_1 + C_2 + C_3$$



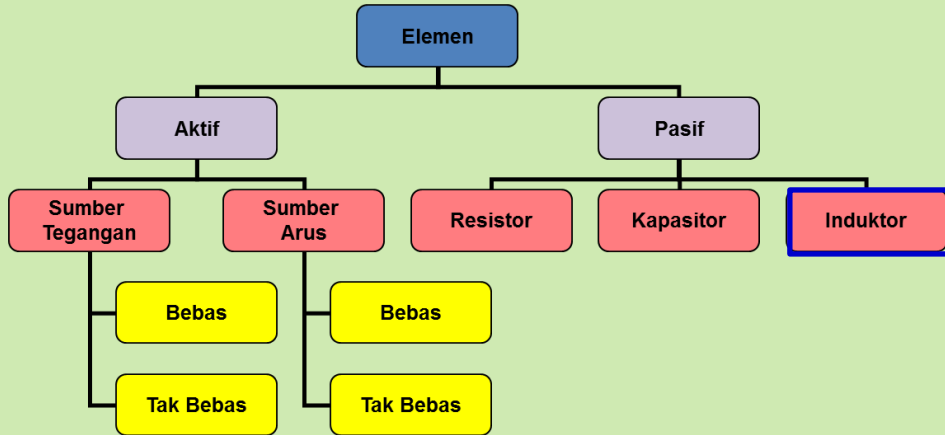
Contoh Soal



Carilah C_{ek} !

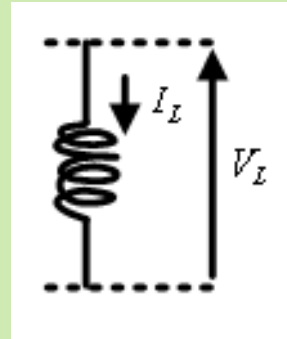


Elemen Rangkaian Listrik



Induktor

- Pada induktor mempunyai sifat dapat menyimpan energi dalam bentuk medan magnet



$$V_L = \frac{d\Phi}{dt} = L \frac{di}{dt}$$

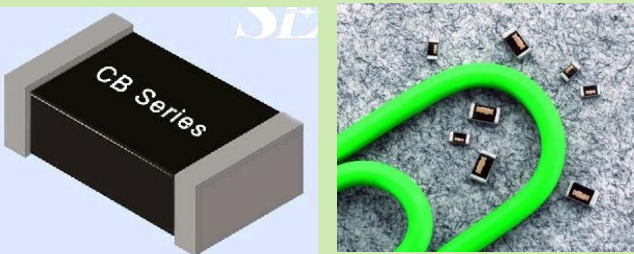


Elemen Rangkaian Listrik

Single Layer Air Core Inductor



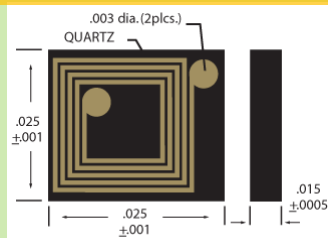
microminiature fixed-chip inductors



Magnetic-Core Materials Inductor



Planar Chip Conductor



Toroid



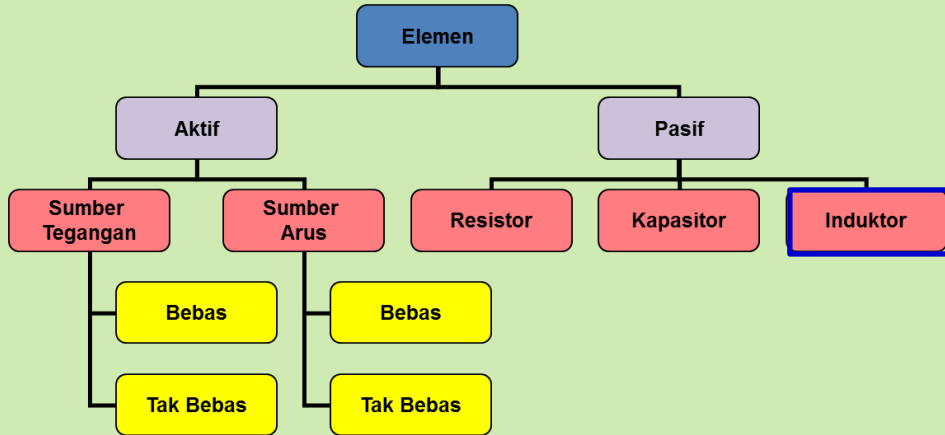
Ferrite Material



Iron-Powder Material

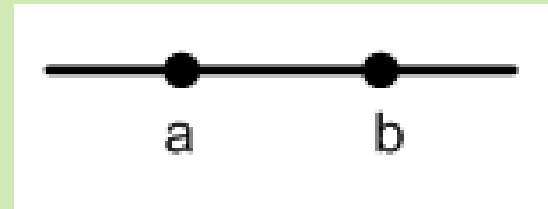


Elemen Rangkaian Listrik

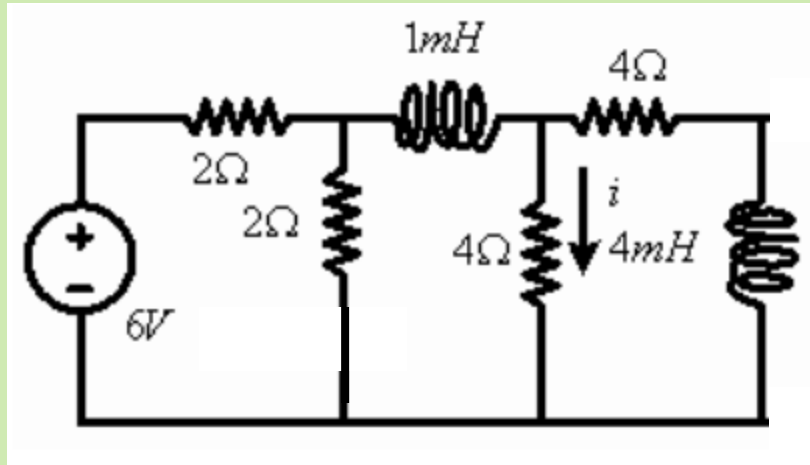


Induktor

- Jika induktor dipasang arus konstan/DC, maka tegangan sama dengan nol. Sehingga induktor bertindak sebagai rangkaian hubung singkat/ *short circuit*



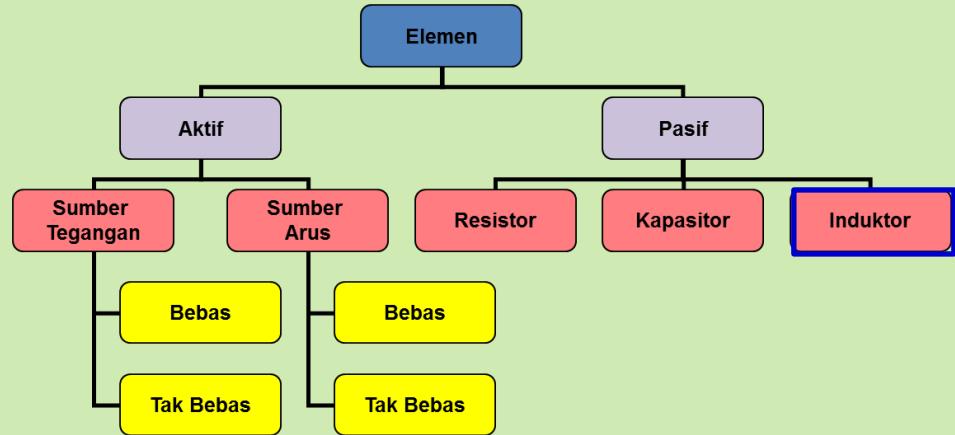
Contoh Soal



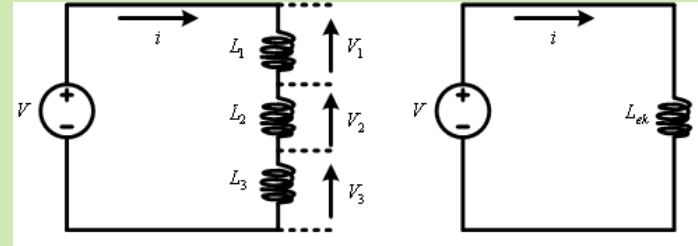
Carilah Arus i !



Elemen Rangkaian Listrik



Induktor Seri



$$KVL: \sum V = 0$$

$$V_1 + V_2 + V_3 - V = 0$$

$$V = V_1 + V_2 + V_3$$

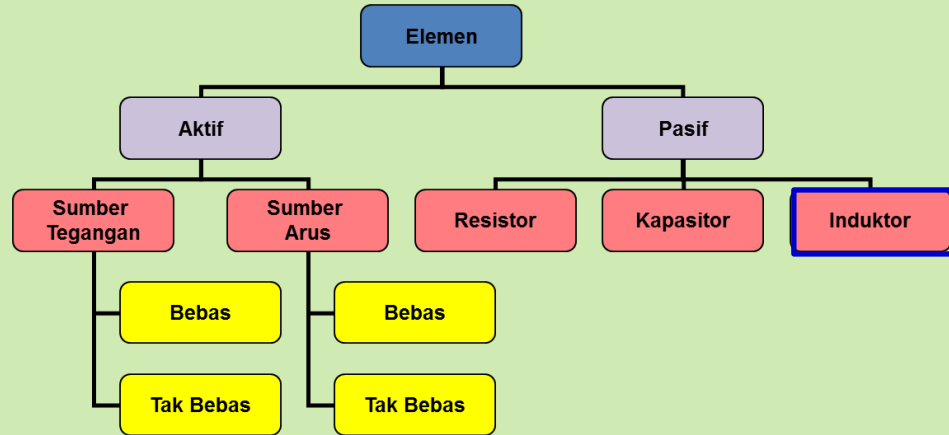
$$V = L_1 \frac{di}{dt} + L_2 \frac{di}{dt} + L_3 \frac{di}{dt}$$

$$L_{ek} \frac{di}{dt} = L_1 \frac{di}{dt} + L_2 \frac{di}{dt} + L_3 \frac{di}{dt}$$

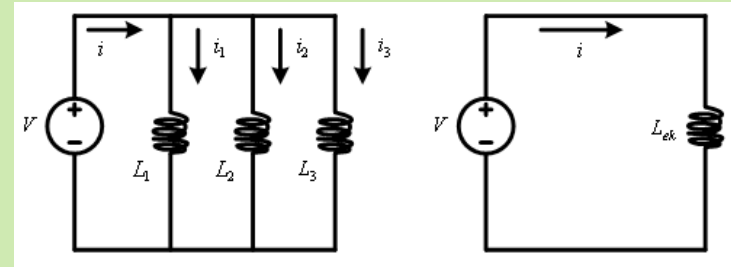
$$L_{ek} = L_1 + L_2 + L_3$$



Elemen Rangkaian Listrik



Induktor Paralel



KCL :

$$\sum i = 0$$

$$i - i_1 - i_2 - i_3 = 0$$

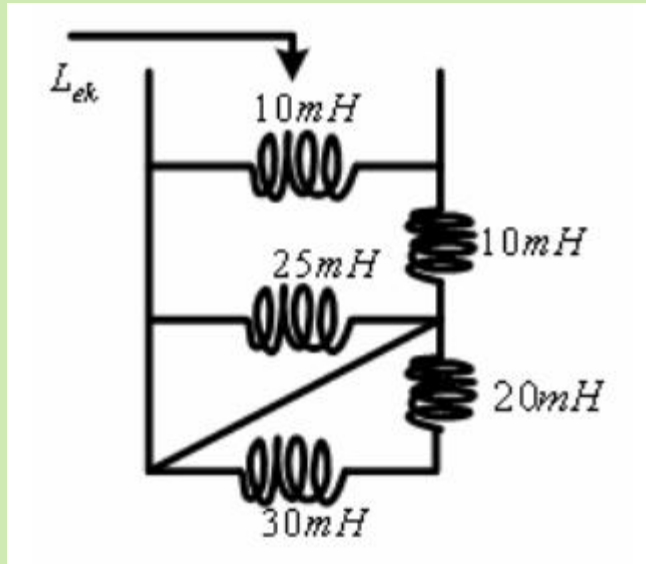
$$i = i_1 + i_2 + i_3$$

$$\frac{1}{L_{ek}} \int V dt = \frac{1}{L_1} \int V dt + \frac{1}{L_2} \int V dt + \frac{1}{L_3} \int V dt$$

$$\frac{1}{L_{ek}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$$



Contoh Soal



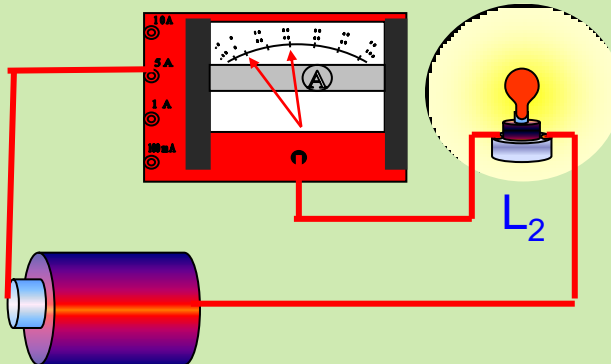
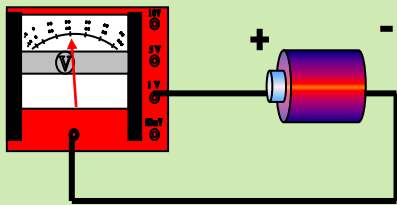
Carilah L_{ek} !



Elemen Rangkaian Listrik

VOLTMETER & AMPEREMETER

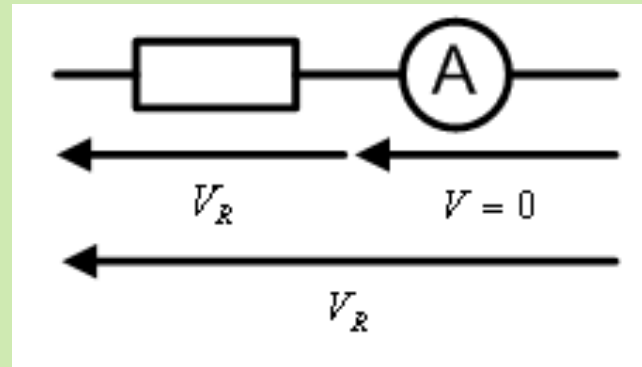
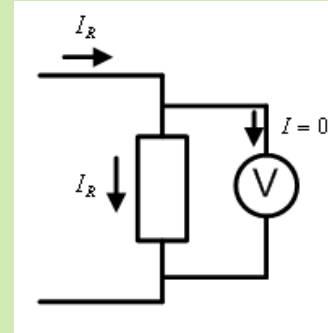
- ❑ **Voltmeter** berfungsi sebagai alat ukur tegangan. Voltmeter mempunyai karakteristik dimana nilai hambatan dalamnya besar sekali ($R_d = \sim$).
- ❑ **Amperemeter** berfungsi sebagai alat ukur arus. Amperemeter mempunyai karakteristik dimana nilai hambatan dalamnya kecil sekali ($R_d = 0$).



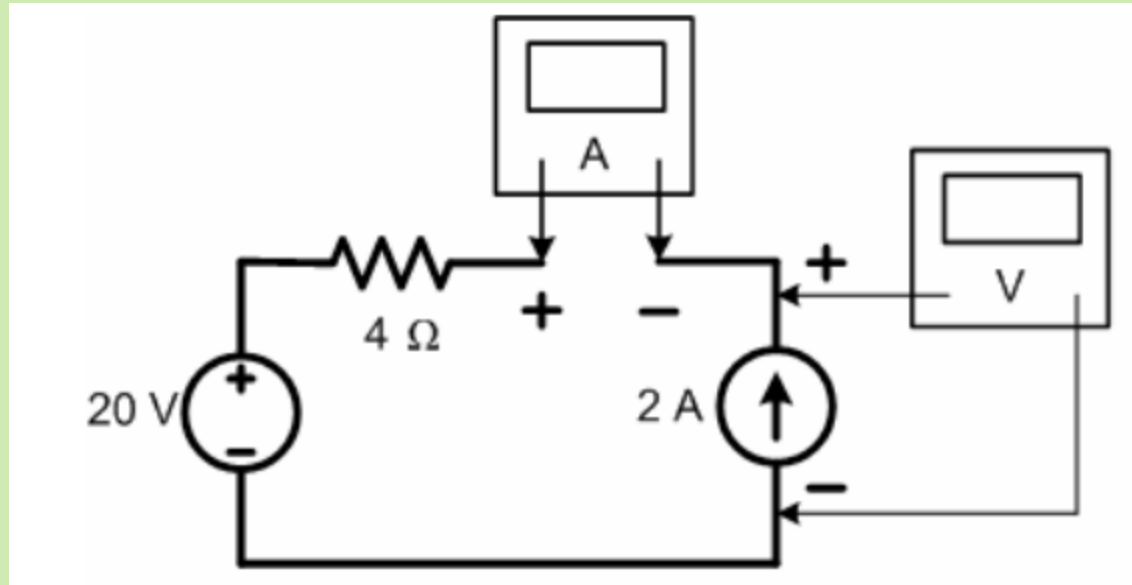
Elemen Rangkaian Listrik

VOLTMETER & AMPEREMETER

- ❑ **Voltmeter** dipasang paralel pada komponen yang akan diukur supaya tidak ada arus yang melalui Voltmeter.
- ❑ **Amperemeter** dipasang seri pada komponen yang akan diukur supaya tegangan pada Ampere



Contoh Soal

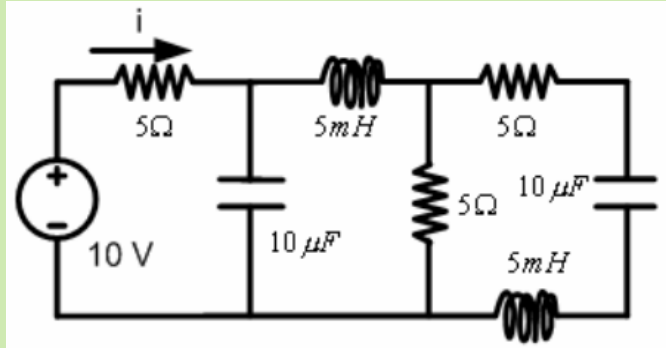


. Tentukan nilai pada masing-masing alat ukur!



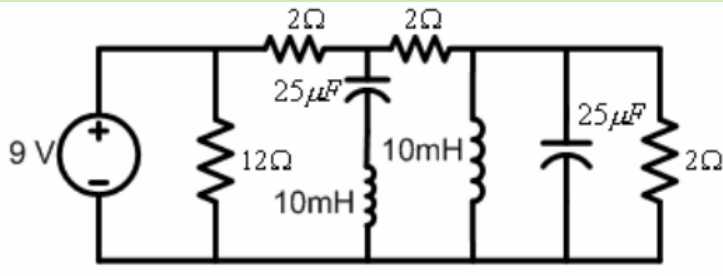
Latihan Soal

1.



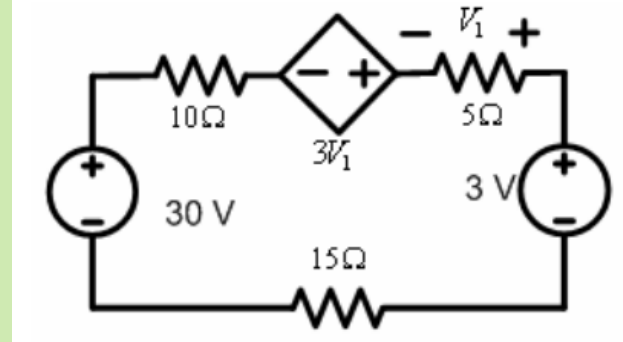
Tentukan Nilai i !

2.



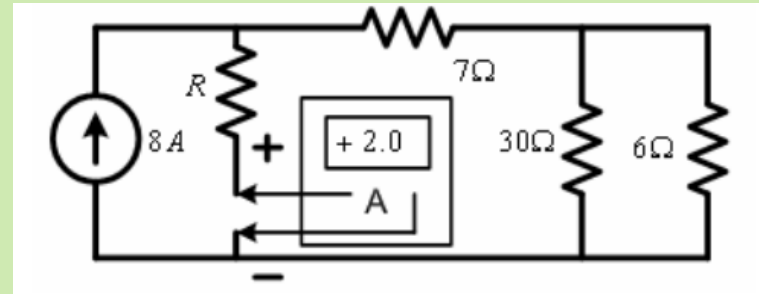
Carilah R_{ek} !

3.



Cari V_1 dan daya di $R=10\Omega$!

4.



Cari Nilai R !



Thank You!
😊

