



Elektrotechnika i elektronika

Moduł 3

Dr inż.
Patrik Król

v2021/2

1 / 33

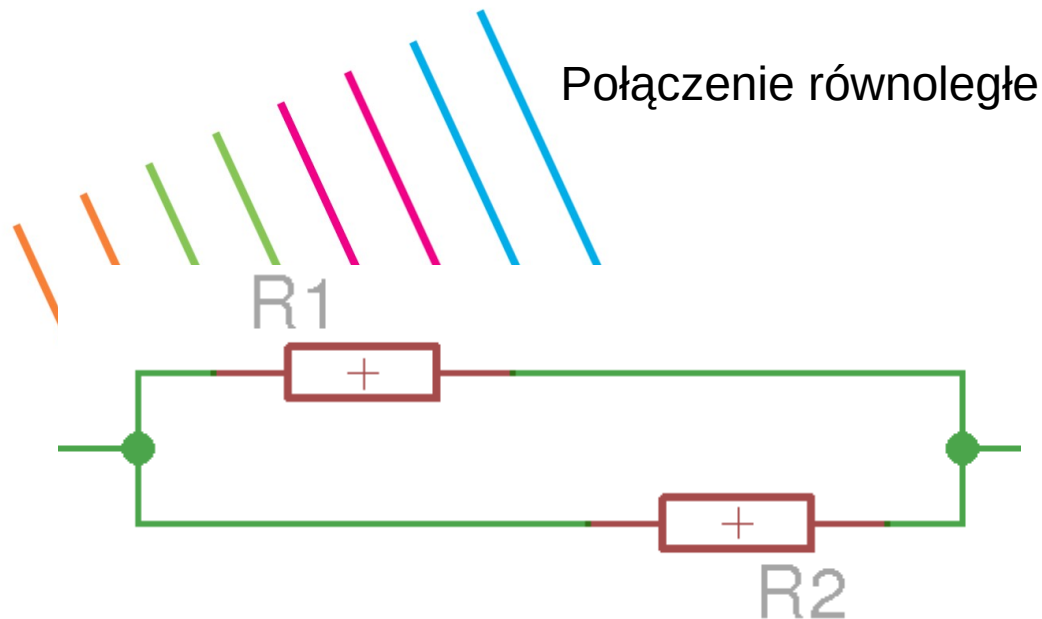


Moduł 3

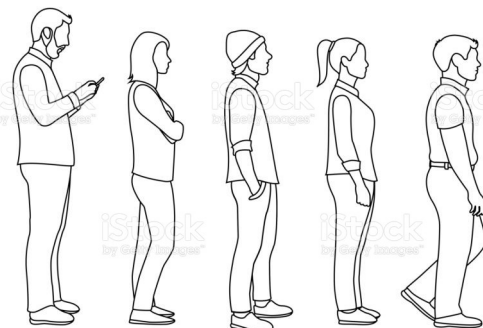
- Opór zastępczy
- Potencjometr
- Wzmacniacz (układy scalone)
- Termometr rezystancyjny

Opór zastępczy

Miejsce na przypomnienie wzoru na opór



Połączenie szeregowe



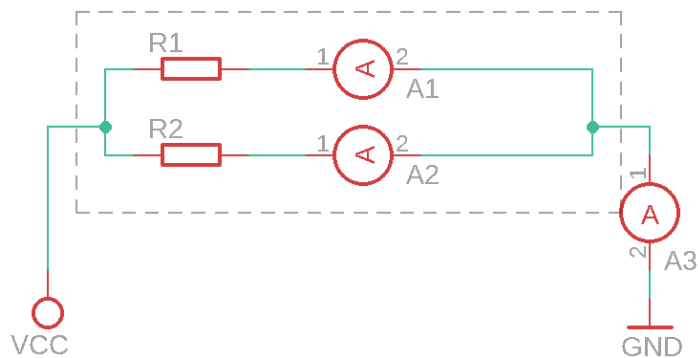
Źródła:

<https://www.istockphoto.com/pl/wektor/outline-men-and-women-queue-one-after-another-full-view-side-gm1221493838-358081837>

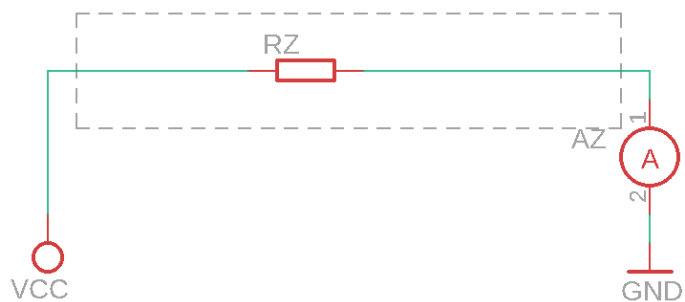
<https://www.theschoolrun.com/what-is-parallel>

Połączenie równoległe

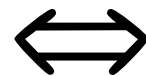
$$R = \frac{U_{cc}}{I_3}$$



$$R_z = \frac{U_{cc}}{I_z}$$



$$R = R_z$$



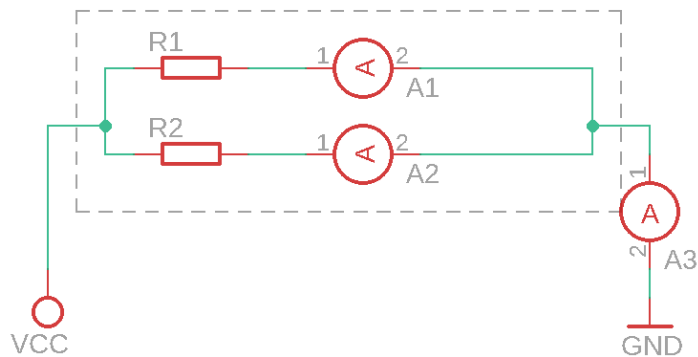
$$\frac{U_{cc}}{I_3} = \frac{U_{cc}}{I_z}$$



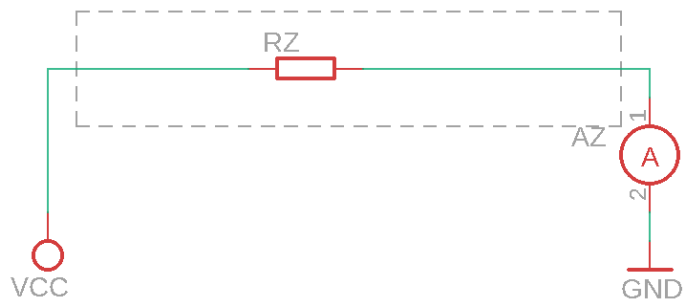
$$I_3 = I_z$$

Połączenie równoległe

$$R = \frac{U_{cc}}{I_3}$$



$$R_z = \frac{U_{cc}}{I_z}$$



Znane: V_{cc} oraz R_1
Szukane: I_1

$$I_3 = I_z$$



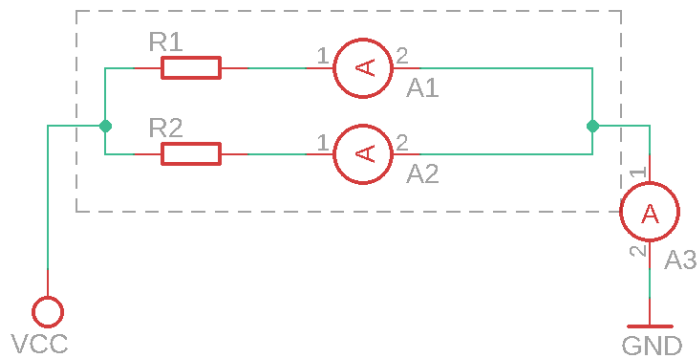
$$I_1 + I_2 = I_z$$

Znane: V_{cc} oraz R_2
Szukane: I_2

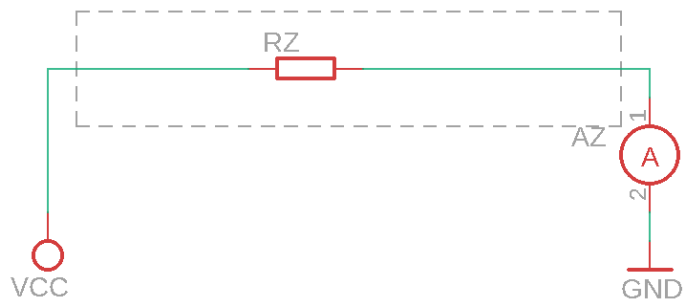
Znane: V_{cc} oraz R_z
Szukane: I_z

Połączenie równoległe

$$R = \frac{U_{cc}}{I_3}$$



$$R_z = \frac{U_{cc}}{I_z}$$



$$I_1 + I_2 = I_z$$



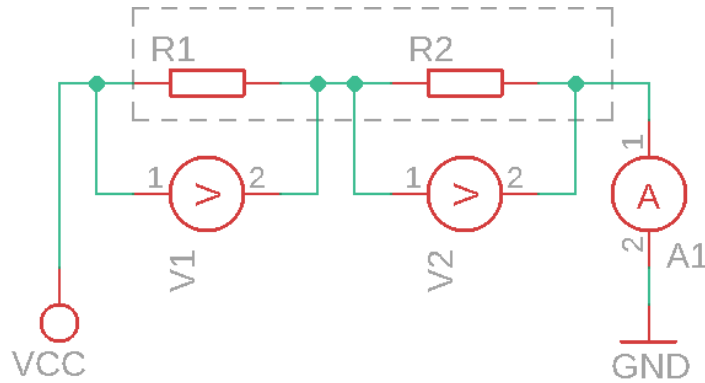
$$\frac{U_{cc}}{R_1} + \frac{U_{cc}}{R_2} = \frac{U_{cc}}{R_z}$$



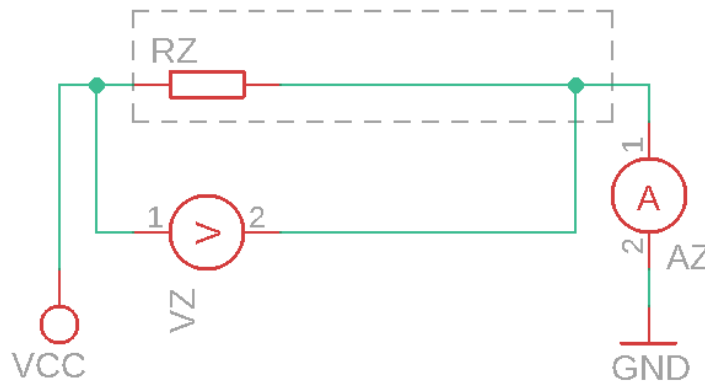
$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R_z}$$

Połączenie szeregowe

$$R = \frac{U_{cc}}{I_1}$$



$$R_z = \frac{U_{cc}}{I_z}$$



$$R_z = R$$



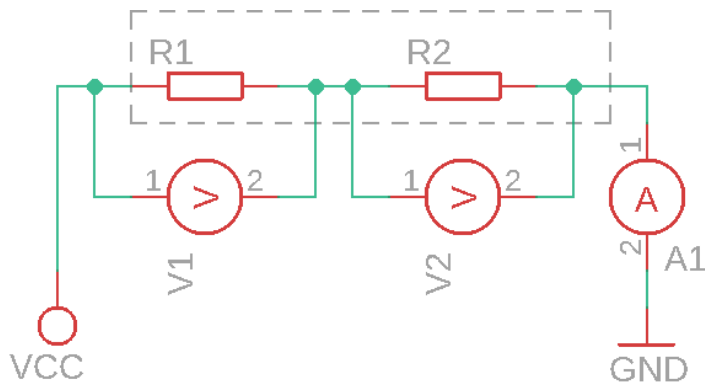
$$\frac{U_{cc}}{I_z} = \frac{U_{cc}}{I_1}$$



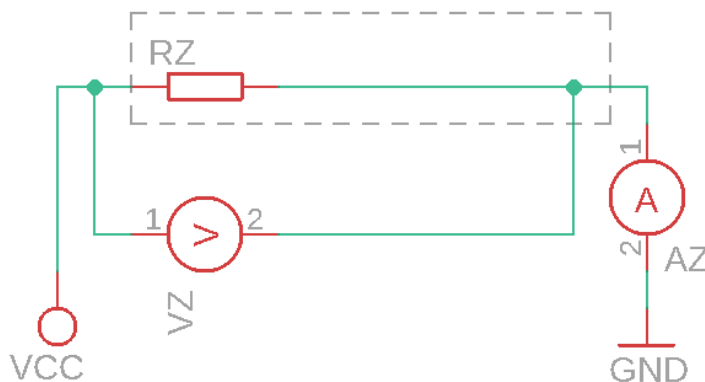
$$I_z = I_1$$

Połączenie szeregowe

$$R = \frac{U_{cc}}{I_1}$$



$$R_z = \frac{U_{cc}}{I_z}$$



$$R_z = R$$



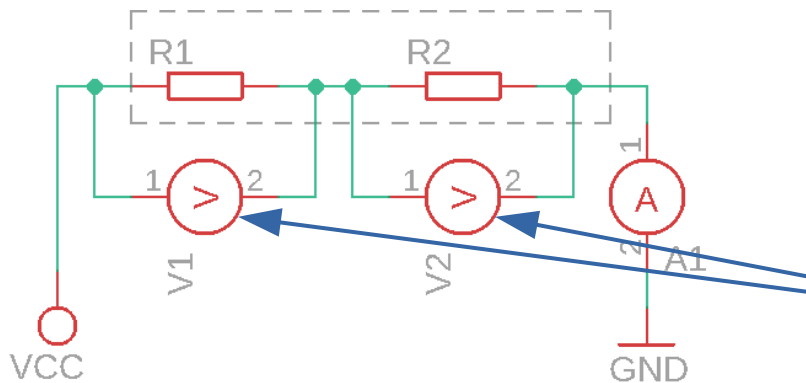
$$\frac{U_{cc}}{I_z} = \frac{U_{cc}}{I_1}$$



~~$$I_z = I_1$$~~

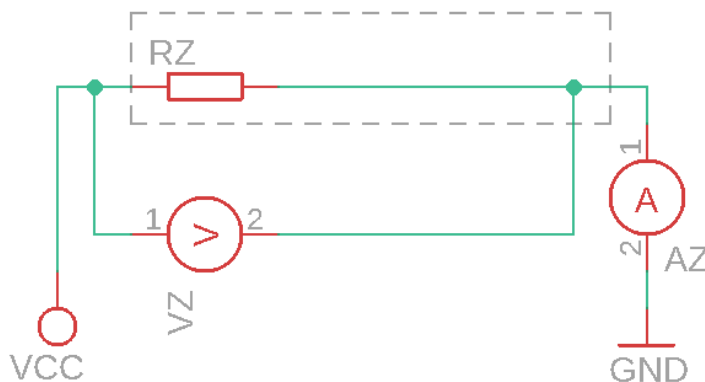
Połączenie szeregowe

$$R = \frac{U_{cc}}{I_1}$$



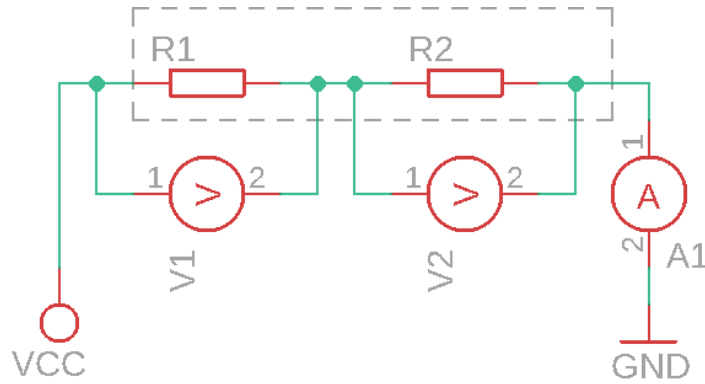
$$\frac{U_{cc}}{I_1} = \frac{U_{cc}}{I_z}$$

$$R_z = \frac{U_{cc}}{I_z}$$

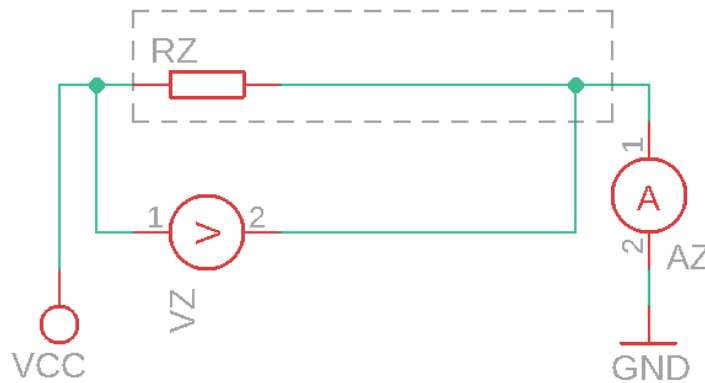


Połączenie szeregowe

$$R = \frac{U_{cc}}{I_1}$$



$$R_z = \frac{U_{cc}}{I_z}$$



$$U_{cc} = U_1 + U_2$$

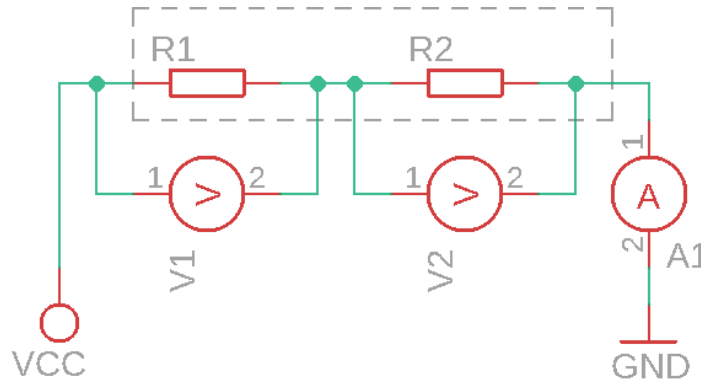
$$I_1 = I_2$$

$$\frac{U_1 + U_2}{I_1} = \frac{U_{cc}}{I_z}$$

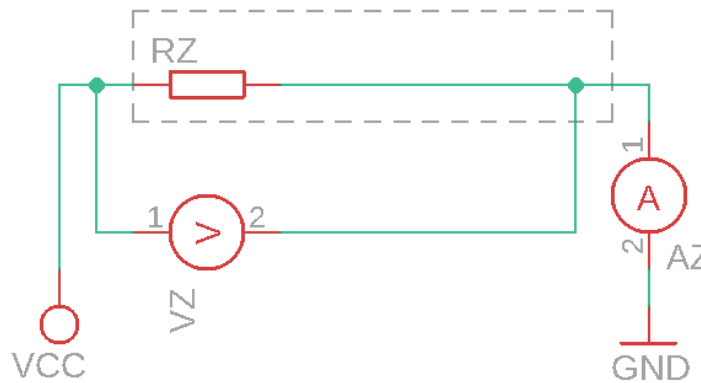
$$\frac{U_1}{I_1} + \frac{U_2}{I_2} = \frac{U_{cc}}{I_z}$$

Połączenie szeregowe

$$R = \frac{U_{cc}}{I_1}$$



$$R_z = \frac{U_{cc}}{I_z}$$

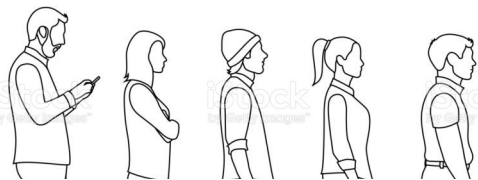


$$\frac{U_1}{I_1} + \frac{U_2}{I_2} = \frac{U_{cc}}{I_z}$$



$$R_1 + R_2 = R_z$$

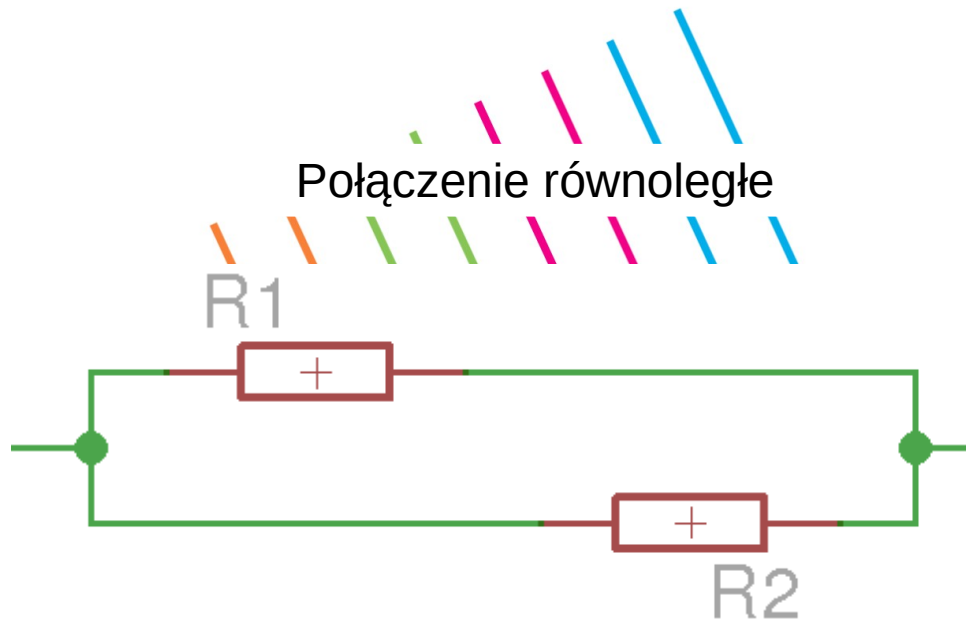
Opór zastępczy



Połączenie szeregowe



Połączenie równoległe



$$R_1 + R_2 = R_z$$

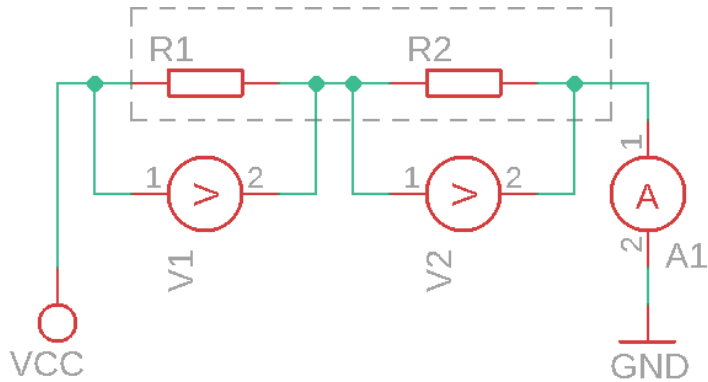
$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R_z}$$

Źródła:

<https://www.istockphoto.com/pl/wektor/outline-men-and-women-queue-one-after-another-full-view-side-gm1221493838-358081837>

<https://www.theschoolrun.com/what-is-parallel>

Potencjometr



$$R_1 = 2k5$$

$$R_2 = 2k5$$

$$V_{CC} = 5V$$

$$R = \frac{U}{I} \Leftrightarrow U = R \cdot I$$

$$A_1 = A_2, R_1 = R_2$$

$$U_1 + U_2 = U_{CC}$$

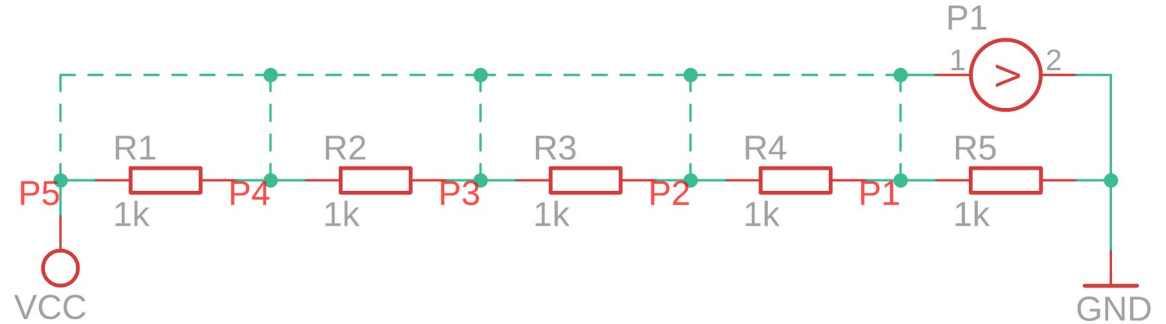
$$\Leftrightarrow$$

$$2U_1 = U_{CC}$$

$$\Leftrightarrow$$

$$U_1 = U_2 = 1/2 U_{CC}$$

Potencjometr



$$R_1 = R_2 = R_3 = R_4 = R_5,$$

$$I_1 = I_2 = I_3 = I_4 = I_5$$

$$\Rightarrow U_1 = U_2 = U_3 = U_4 = U_5$$

$$V_{CC} = 5\text{ V}$$

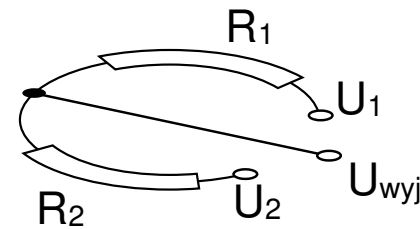
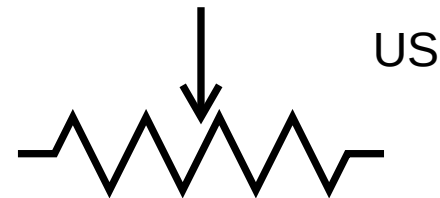
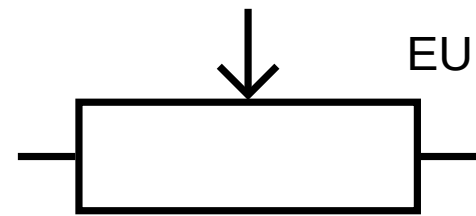
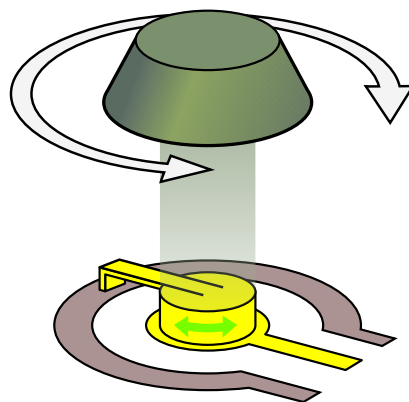
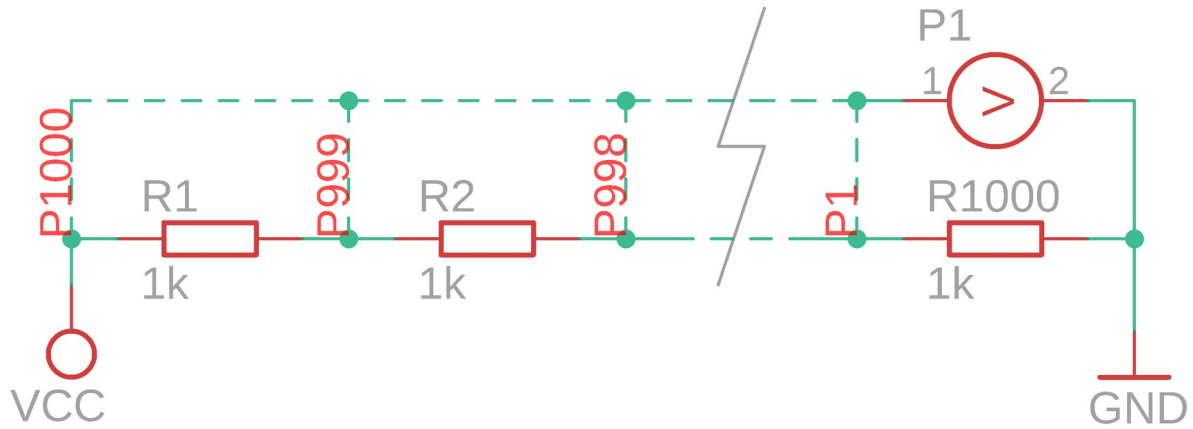
$$V_{P1} = ?$$

$$V_{P2} = ?$$

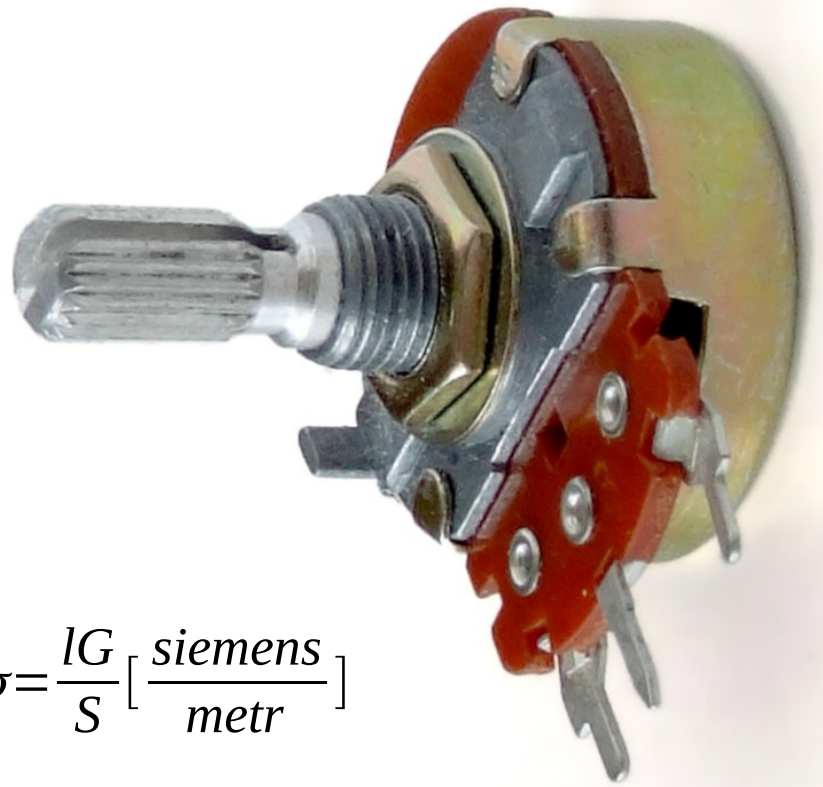
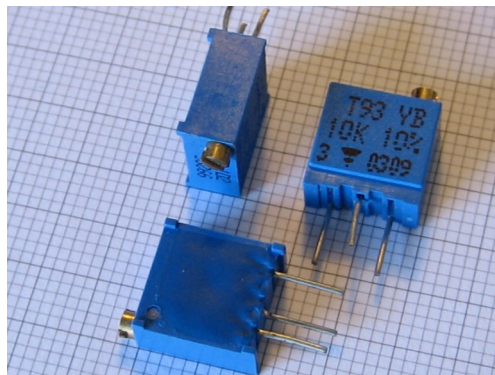
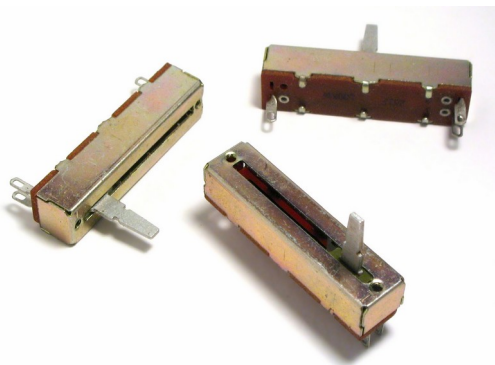
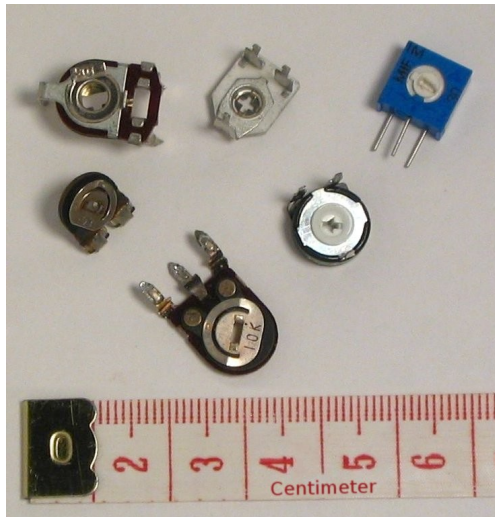
...

$$V_{P5} = ?$$

Potencjometr



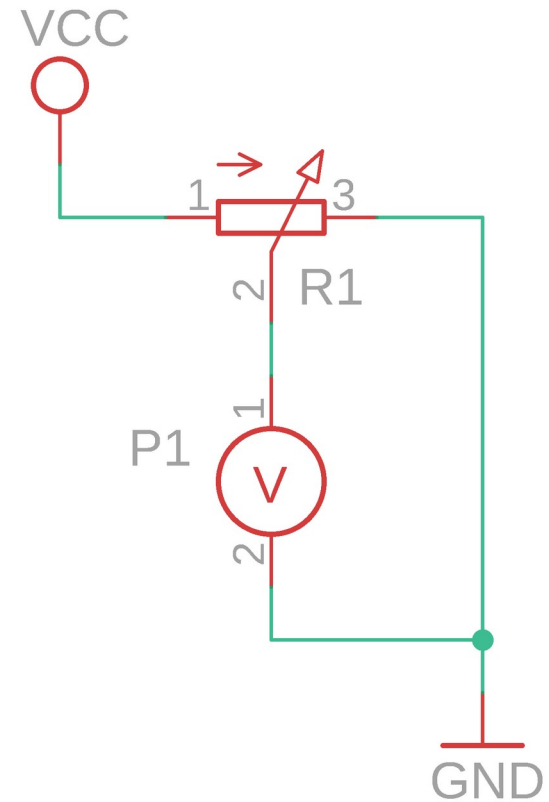
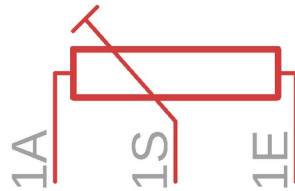
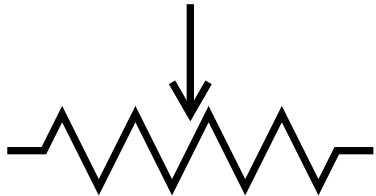
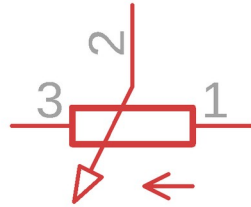
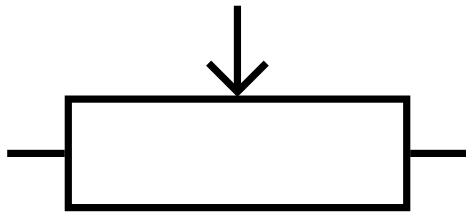
Potencjometr



$$\sigma = \frac{lG}{S} \left[\frac{\text{siemens}}{\text{metr}} \right]$$

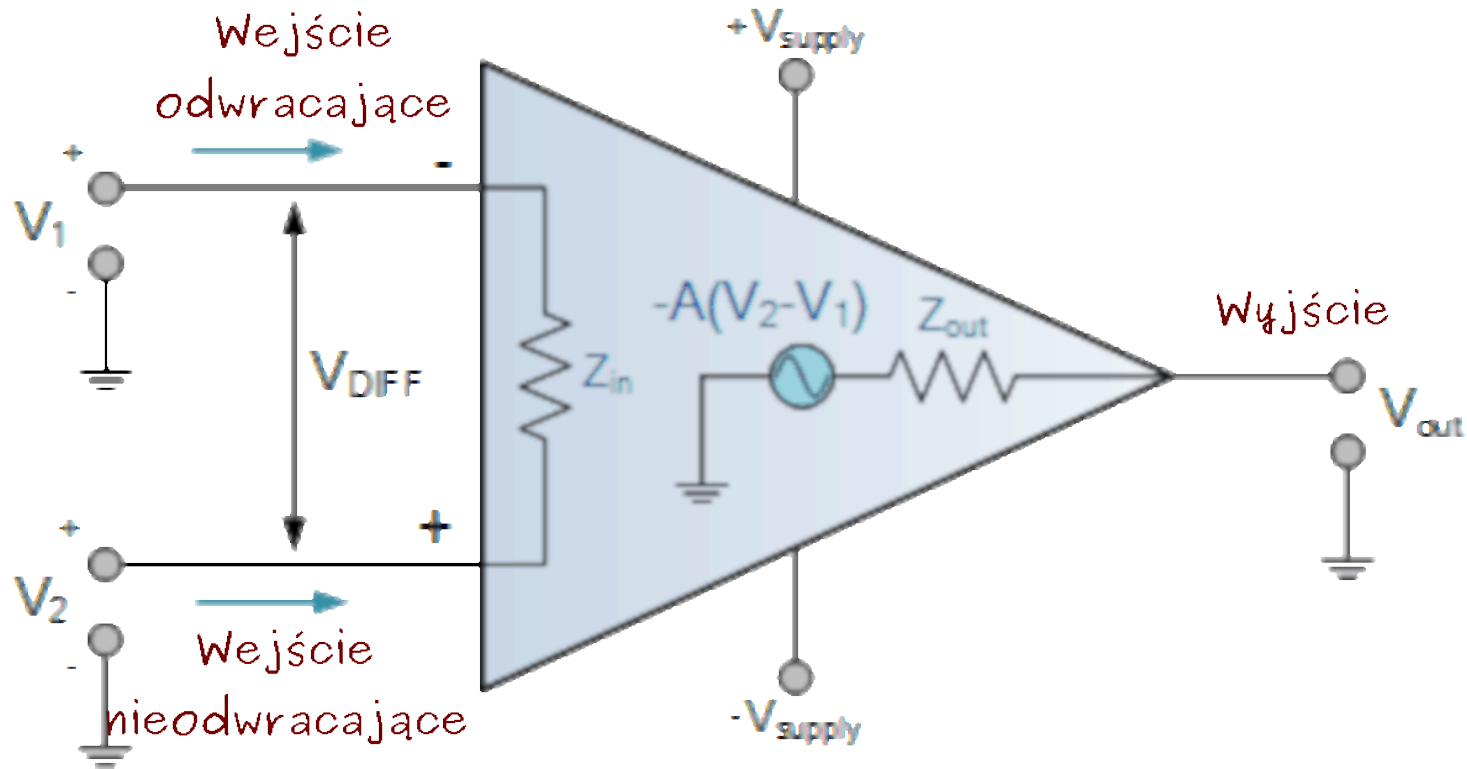
σ - Przewodnictwo właściwe materiału
 G – przewodnictwo elektryczne
 S – pole przekroju poprzecznego elementu
 l – długość bloku

Potencjometr

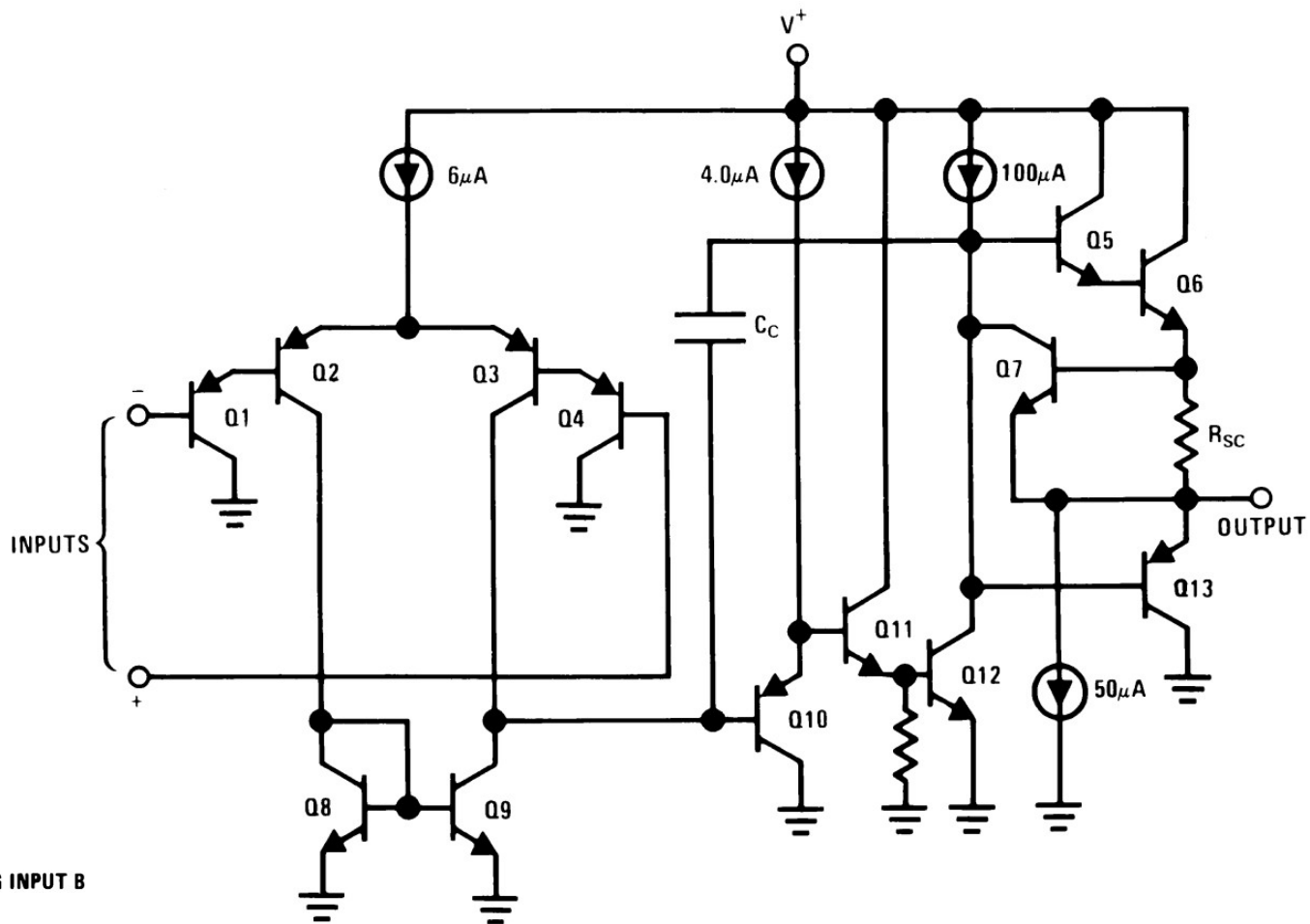
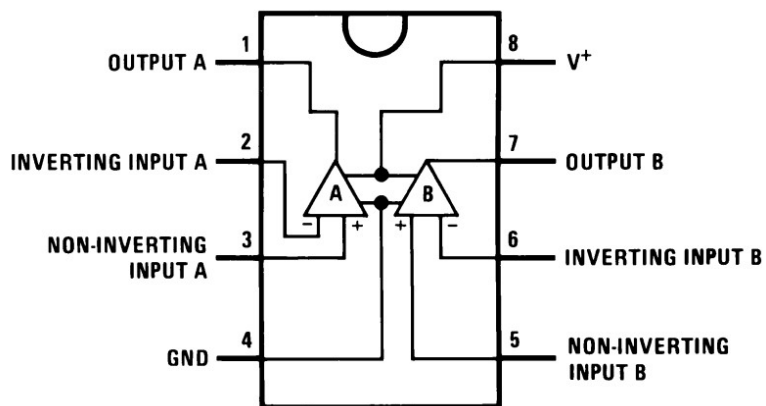
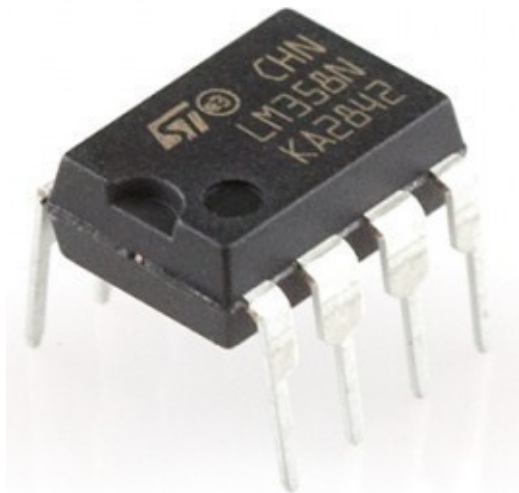


$$V_1 = V_{cc} * \frac{R_{23}}{R_{13}}$$

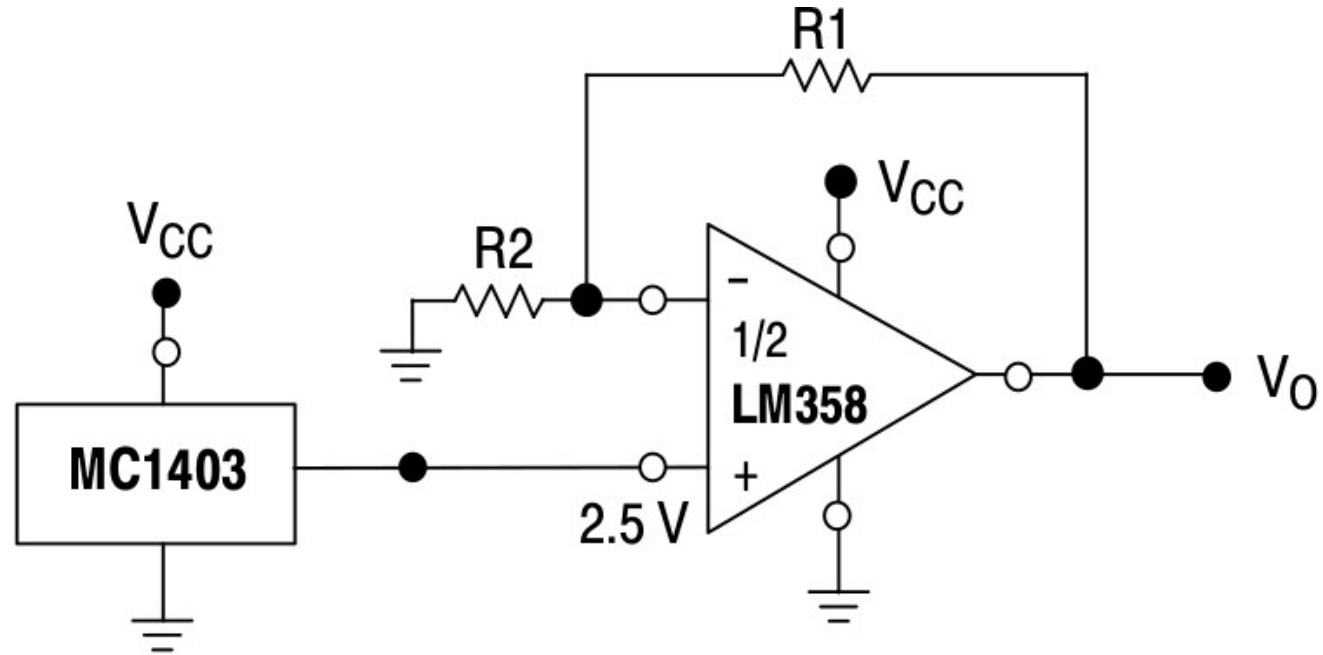
Wzmacniacz operacyjny (op-amp)



LM358

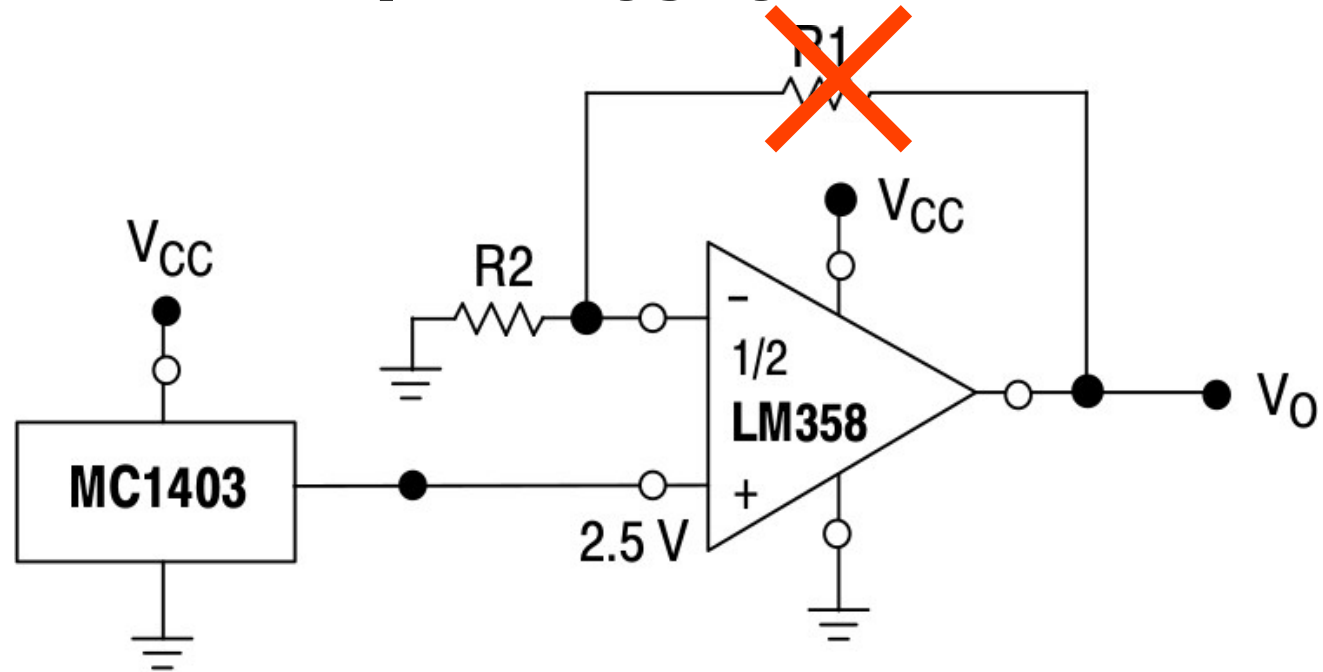


LM358



$$V_O = 2.5 V \left(1 + \frac{R_1}{R_2} \right)$$

Wzmacniacz operacyjny



$$V_0 = 2.5 \text{ V} \left(1 + \frac{R_1}{R_2} \right)$$

Czujniki

Parametryczne

- rezystancyjne,
- indukcyjne,
- pojemnościowe.

Generacyjne

- dynamiczne,
- termoelektryczne
- piezoelektryczne,
- elektrochemiczne,
- fotoelektryczne.



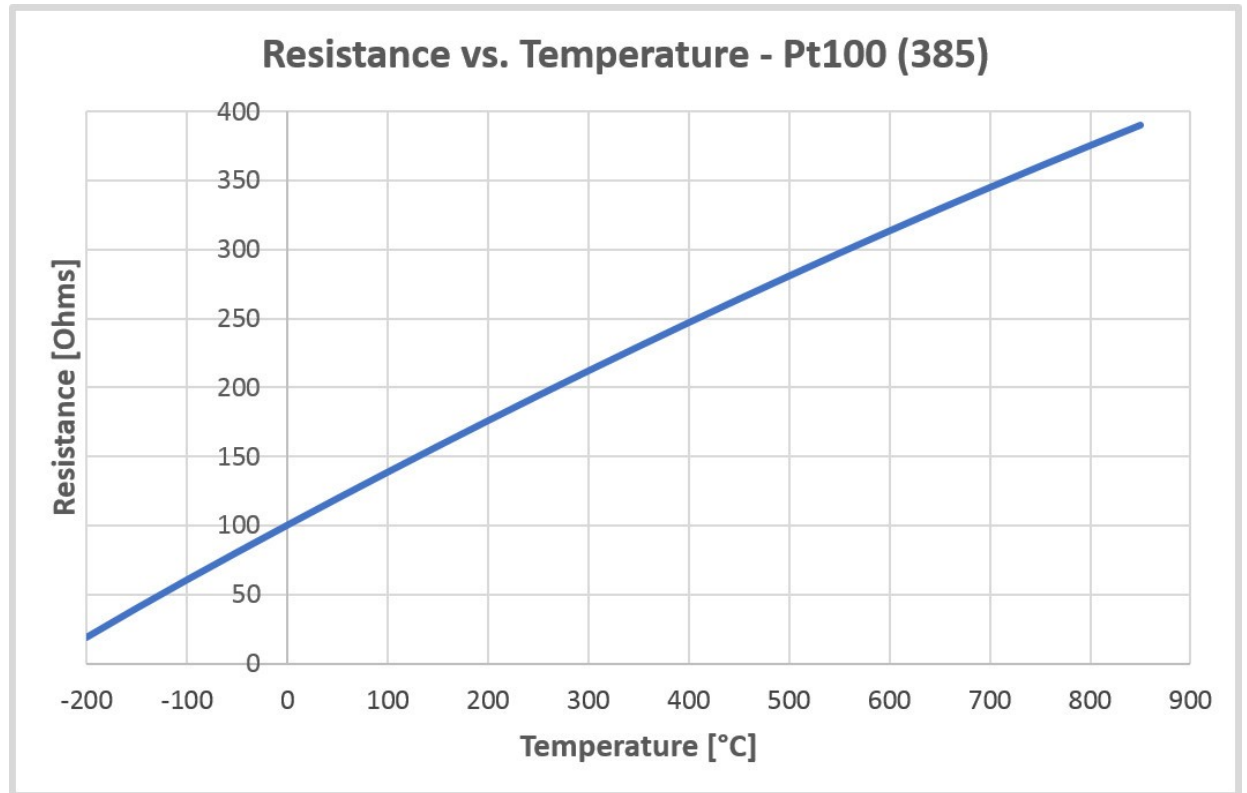
Źródła:

<https://sklepautomatyka.com.pl/produkt/czujnik-indukcyjny-ims18-08bpsnc0s-sick/>

<http://www.hvac4u.pl/81,ls-cap-czujnik-poziomu-cieczy-pojemnoscowy.html>

<http://seneca.energoelektronika.pl/produkt/urządzenia-pomiarowe-i-sterujace/czujniki-temperatury/czujniki-temperatury-czujniki-temperatury/sonda-temperatury-czujnik-temperatury-pt100/>

Termometr rezystancyjny PT100

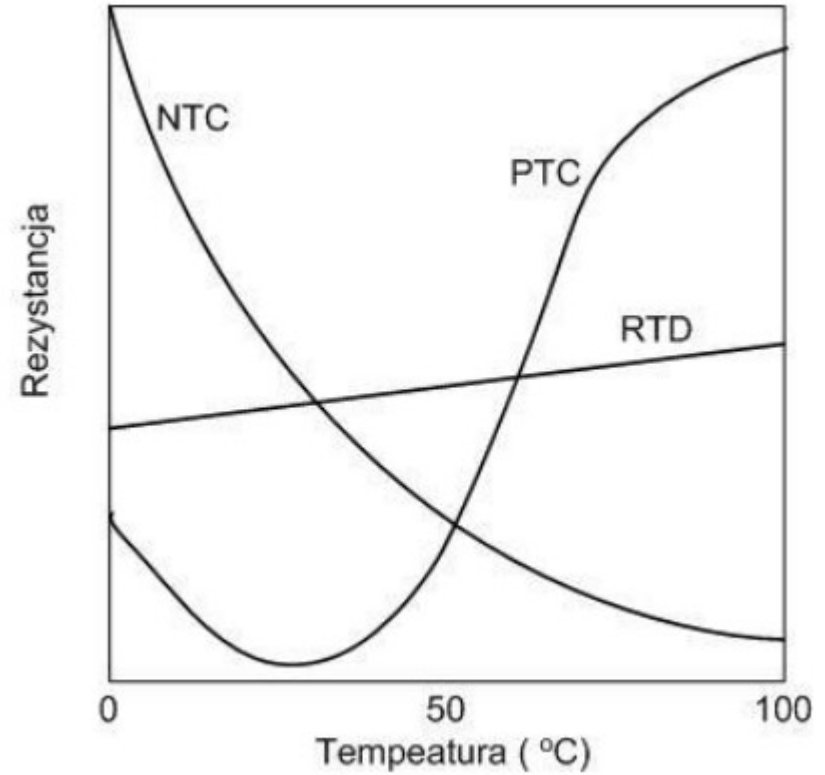
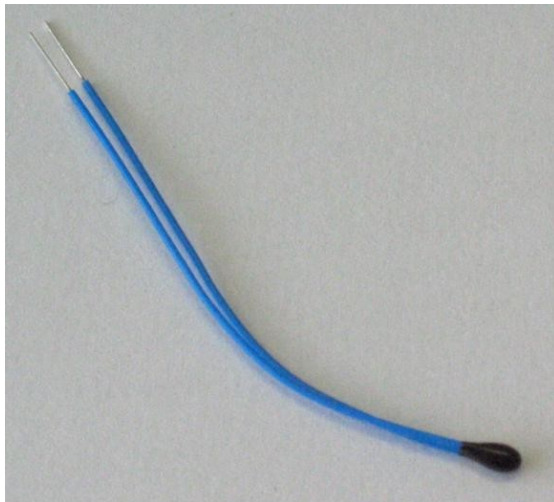


Termistory (termometry półprzewodnikowe)

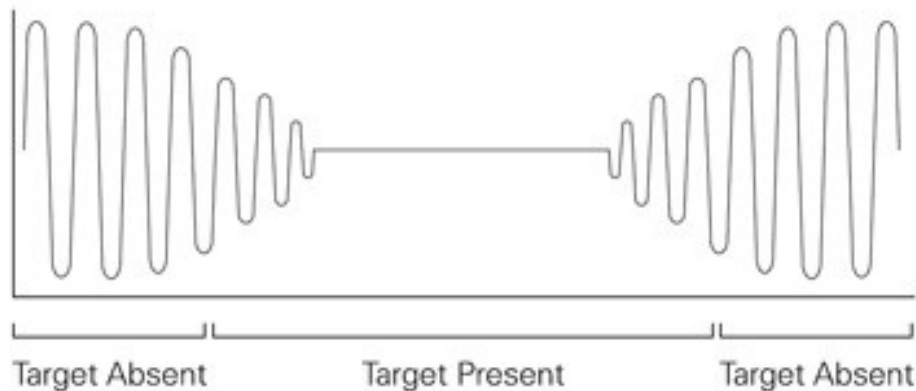
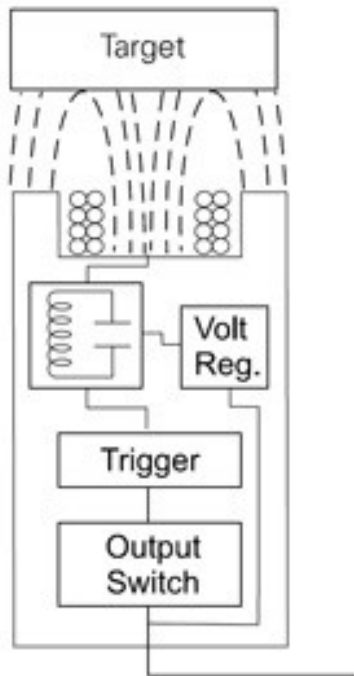
NTC – negative temp. coefficient

$$R_T = A \exp [\beta / T]$$

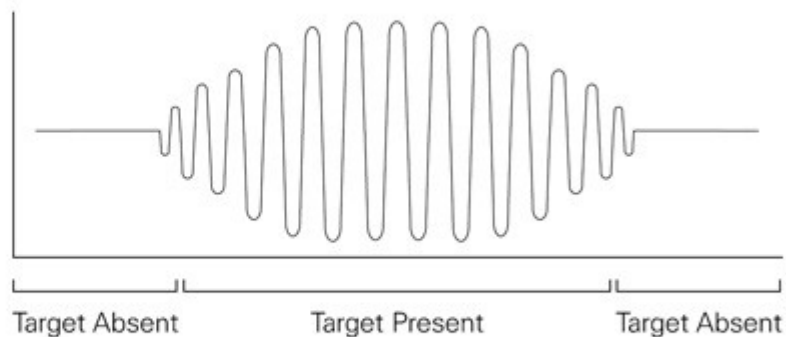
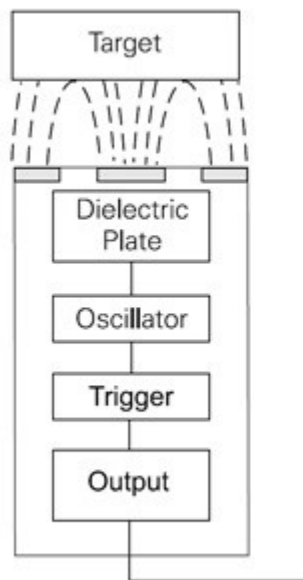
A – wsp. Rozmiaru próbki
 β – stała materiałowa



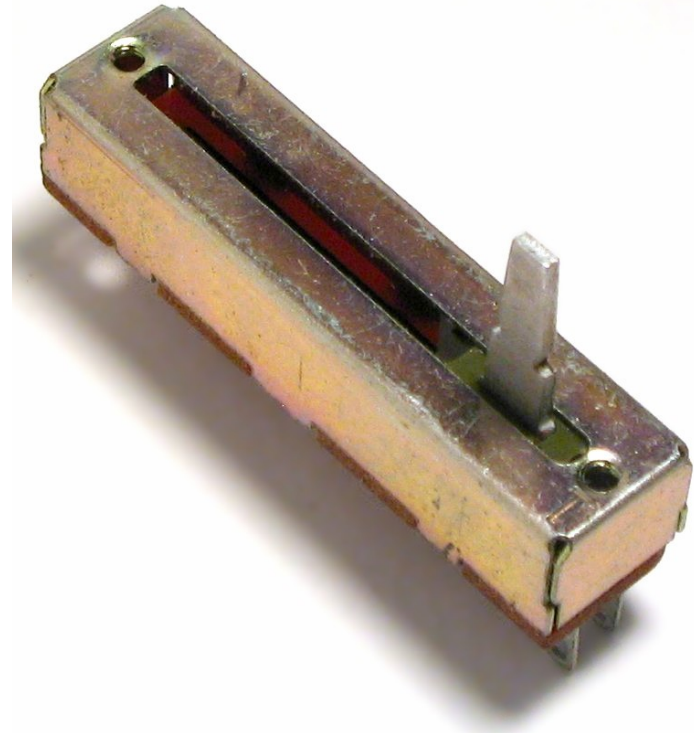
Czujnik indukcyjny



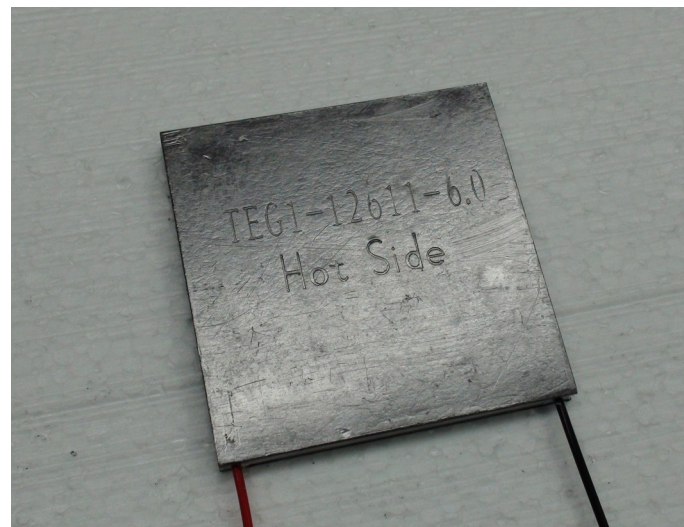
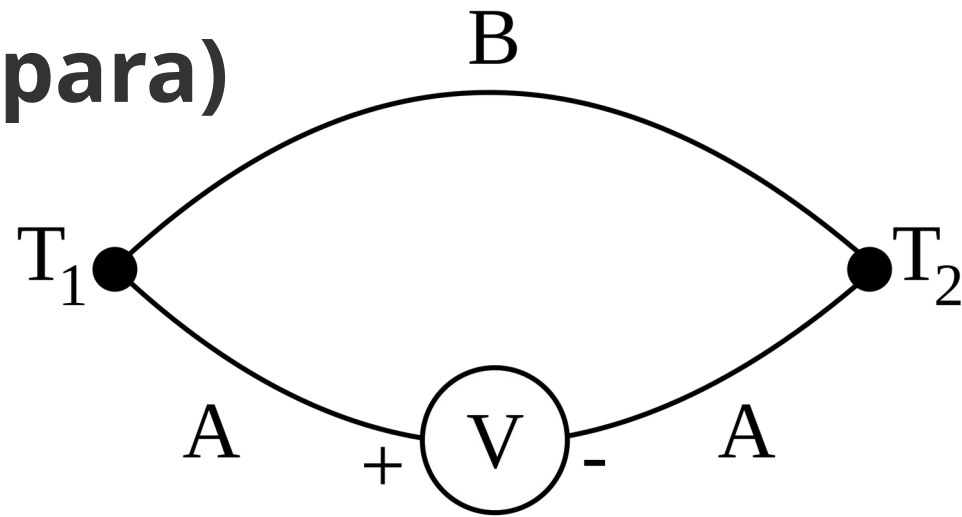
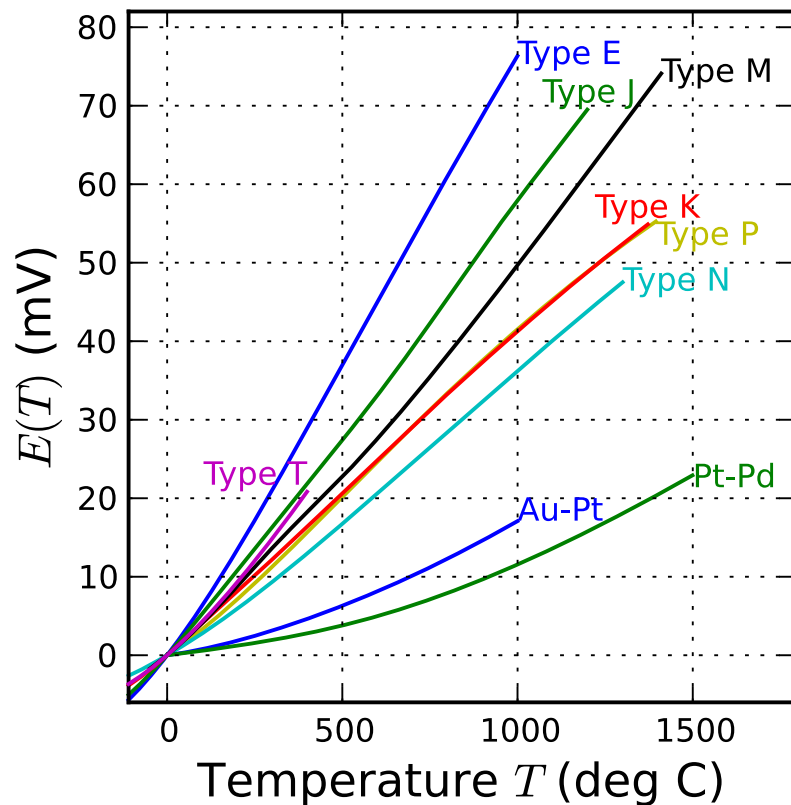
Czujnik pojemnościowy



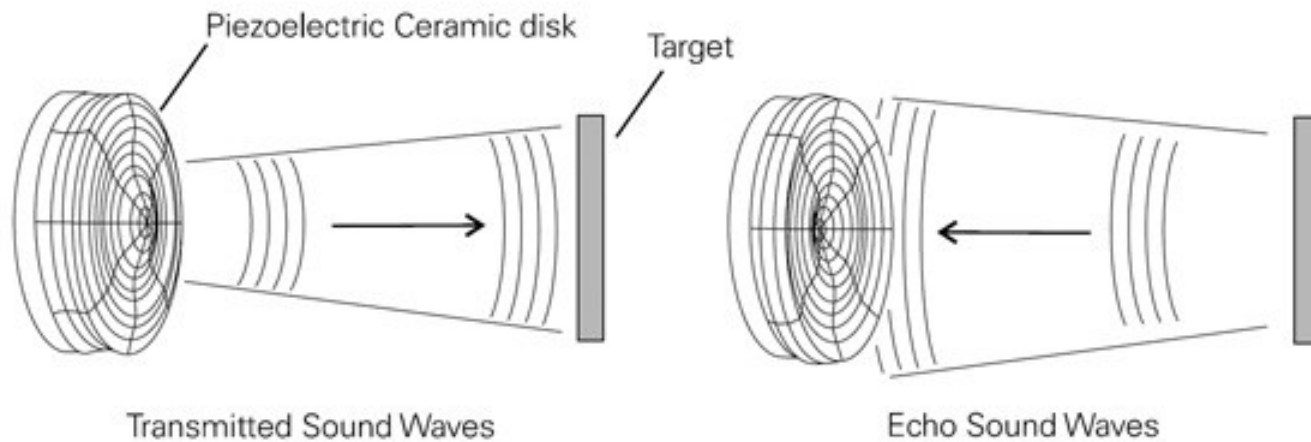
Kąt obrotu/przesunięcie



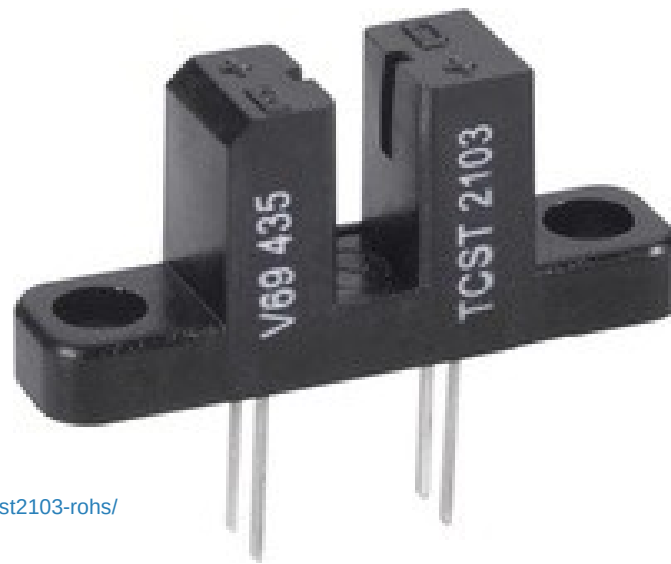
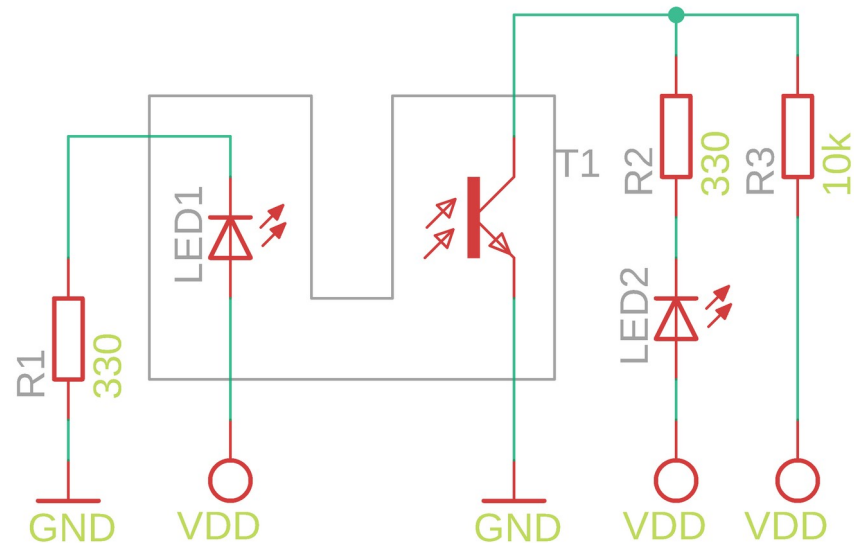
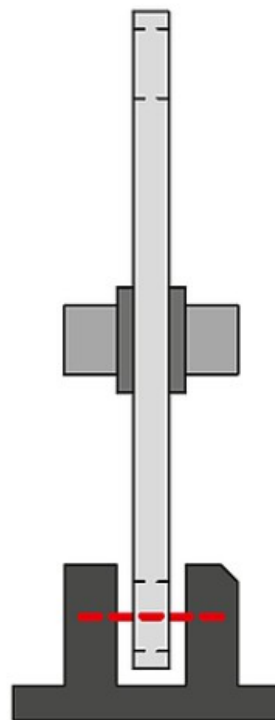
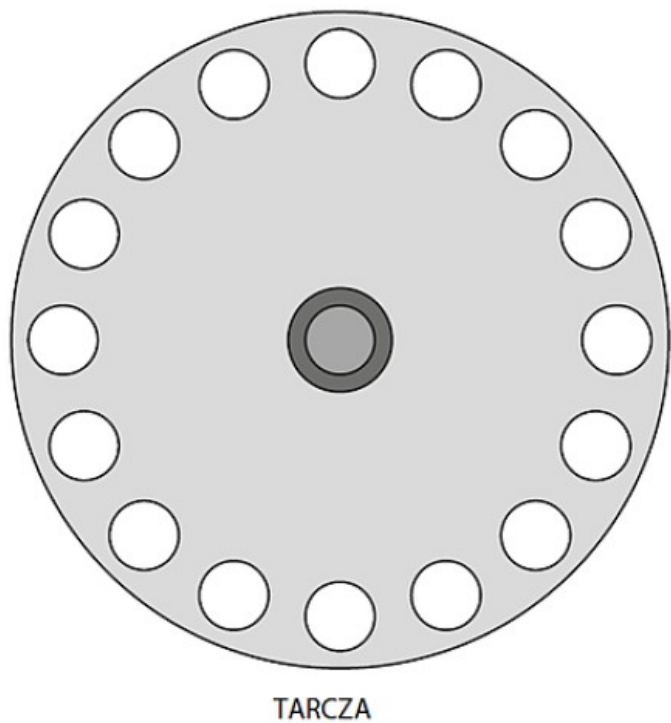
Termoelement (termopara)



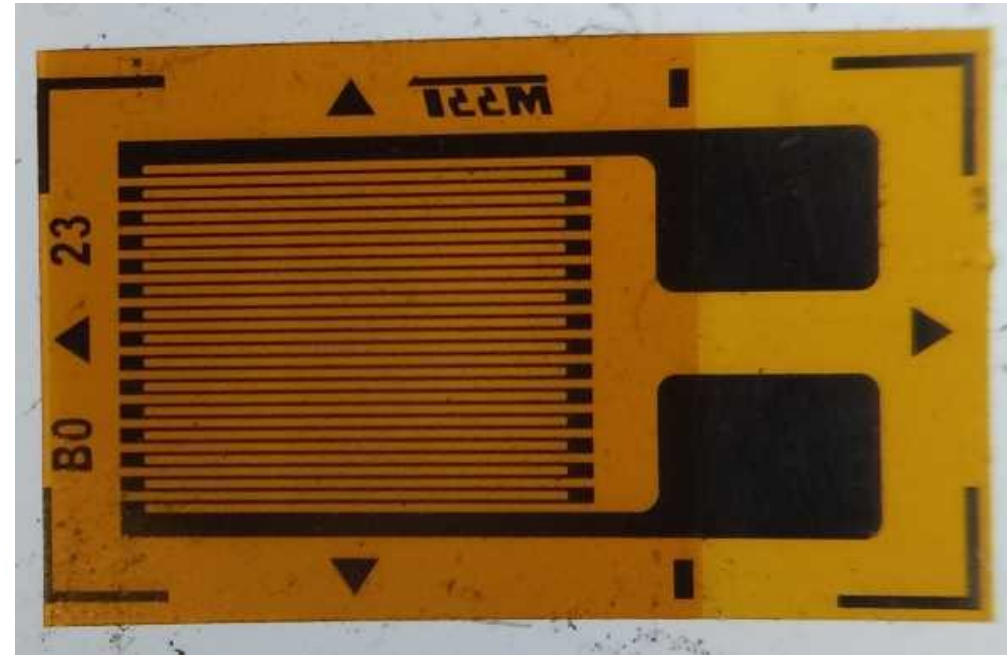
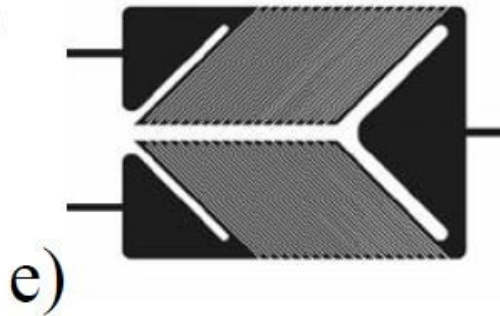
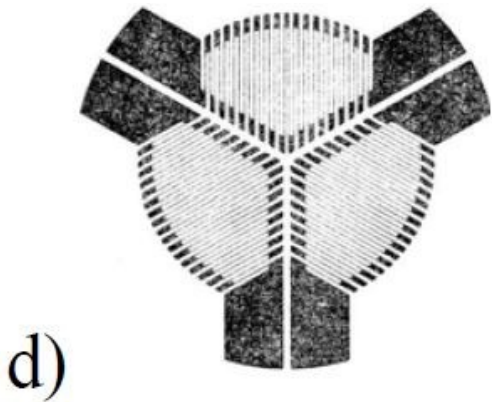
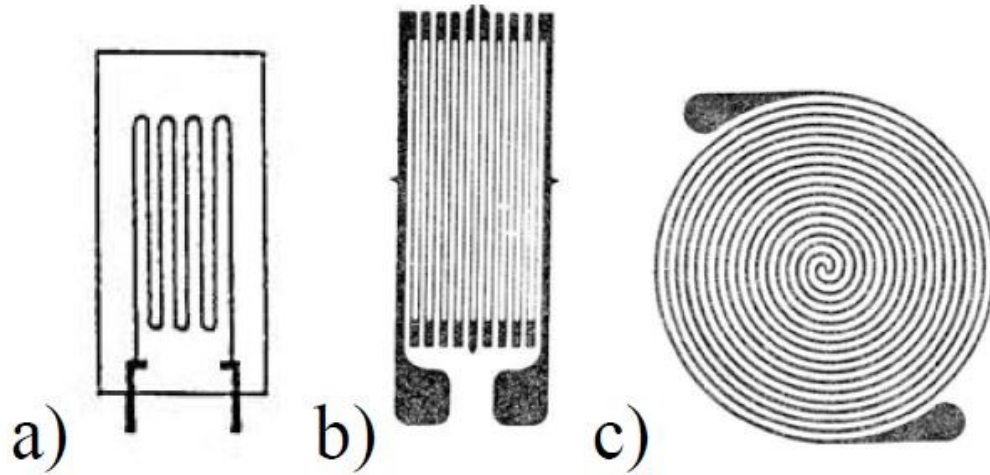
Czujnik ultradźwiękowy



Czujnik szczelinowy



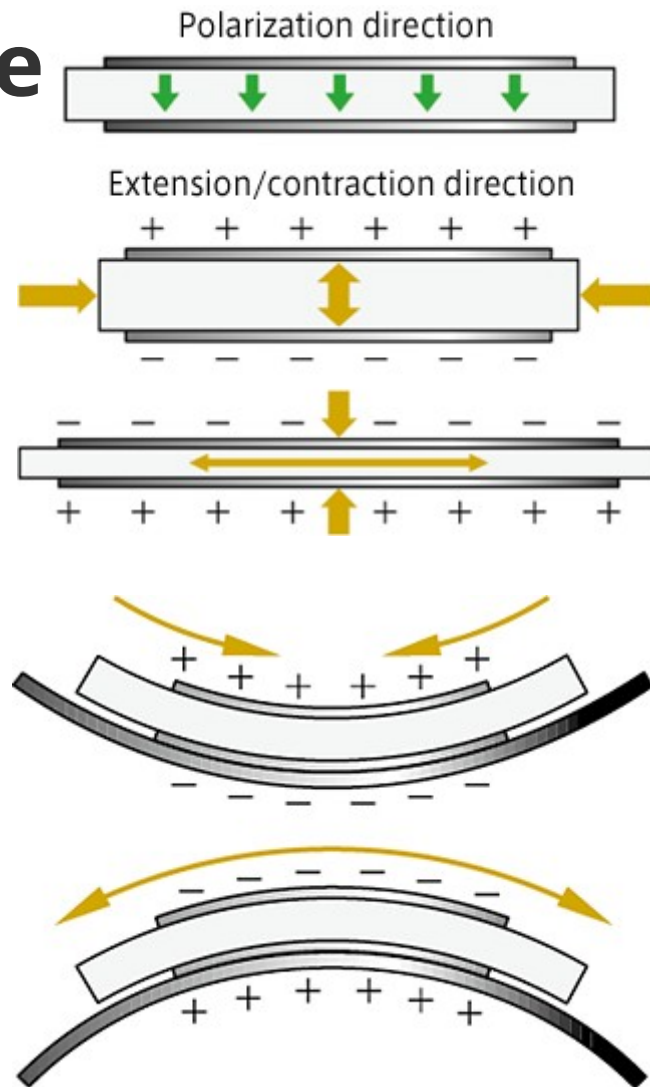
Tensometry oporowe



$$\sigma = \frac{lG}{S} \left[\frac{\text{siemens}}{\text{metr}} \right]$$

σ - Przewodnictwo właściwe materiału
 G - przewodnictwo elektryczne
 S - pole przekroju poprzecznego elementu
 l - długość bloku

Czujniki piezoelektryczne



Czujnik Halla (Hallotron)

