Elektrotechnika i elektronika

Moduł 1B

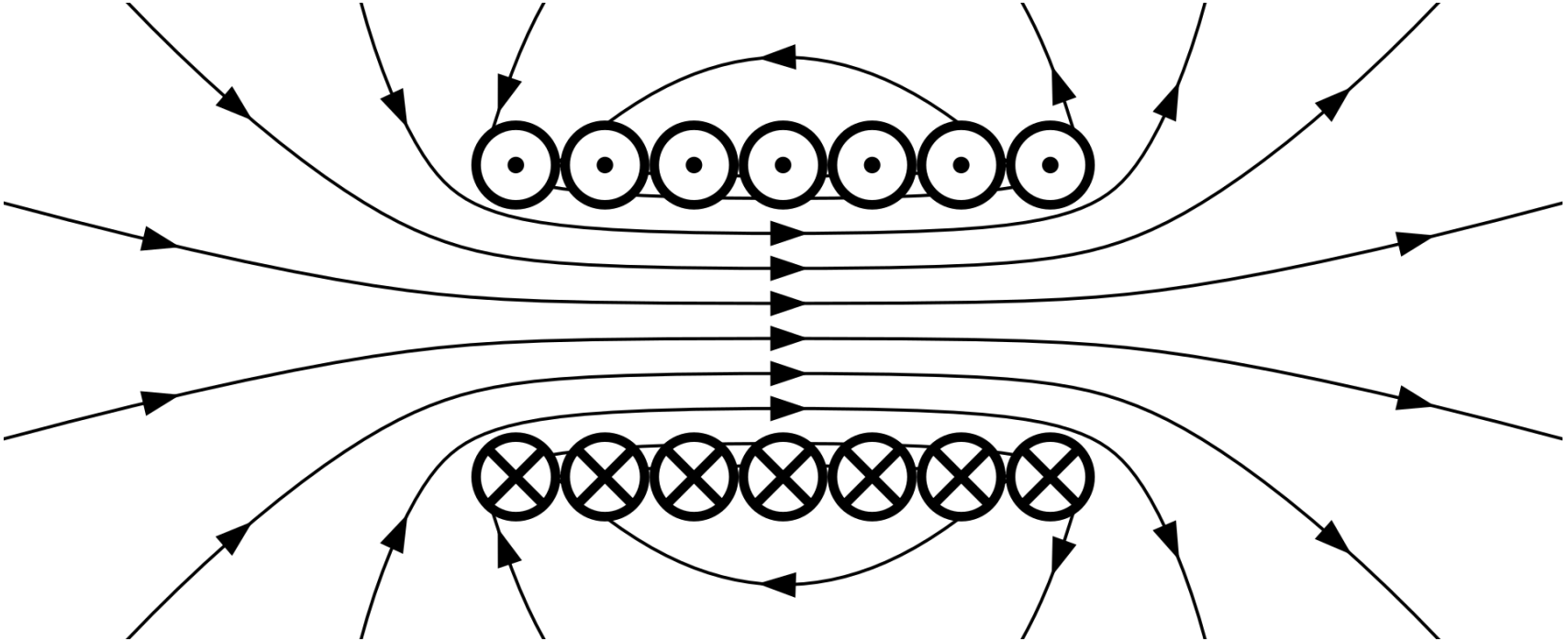
Dr inż.
Patryk Król

v2022/1

Moduł 1B

- Pole elektromagnetyczne
- Podstawowe podzespoły cd.: przekaźnik (elektromagnes), tranzystory, kondensatory

Pole elektromagnetyczne



Źródło: https://en.wikipedia.org/wiki/Electromagnetic_field

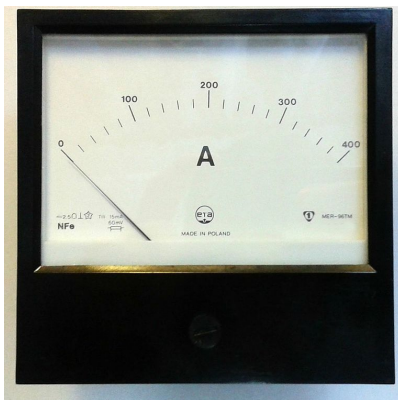
Cewka

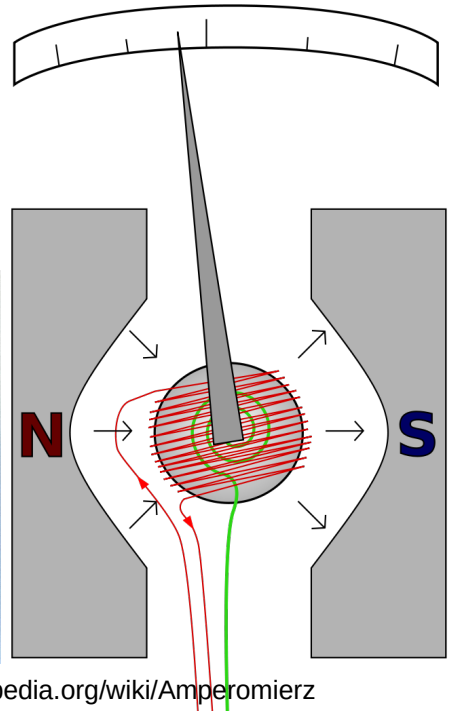
Elektromagnes

Źródło: https://adstechnic.pl/elektromagnes-hydrauliczny/

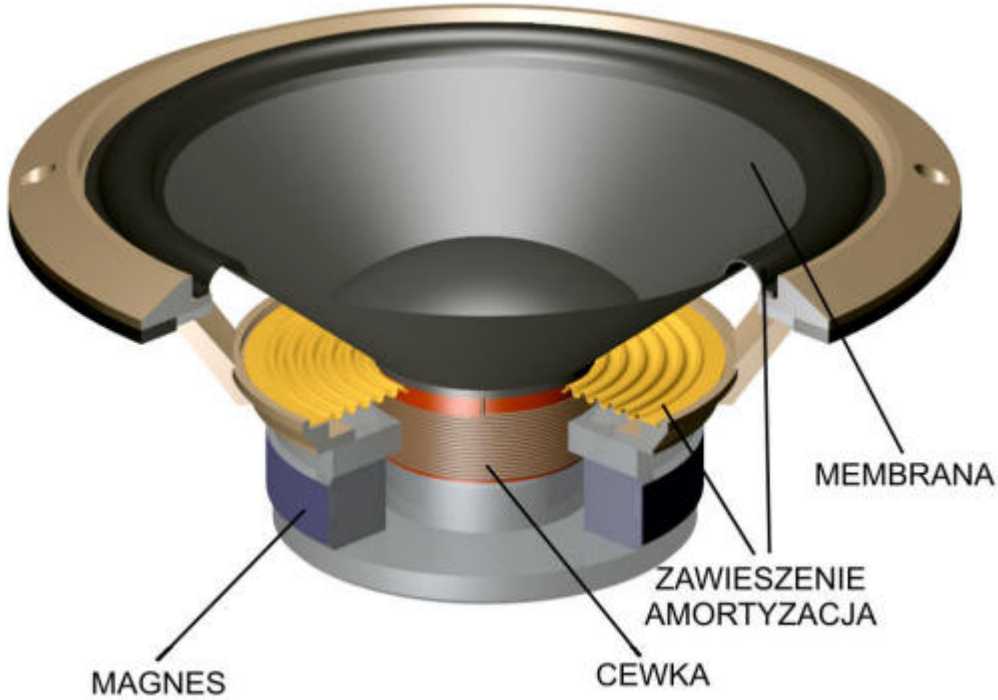
Gdzie jeszcze może być wykorzystywane to zjawisko?

Źródło: electricmobile.pl



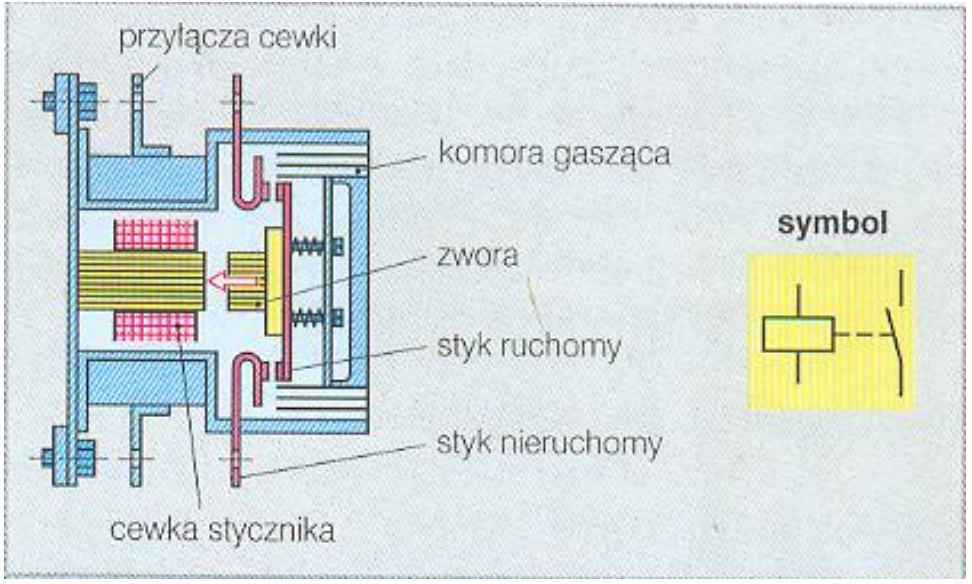


Żródło: https://pl.wikipedia.org/wiki/Amperomierz



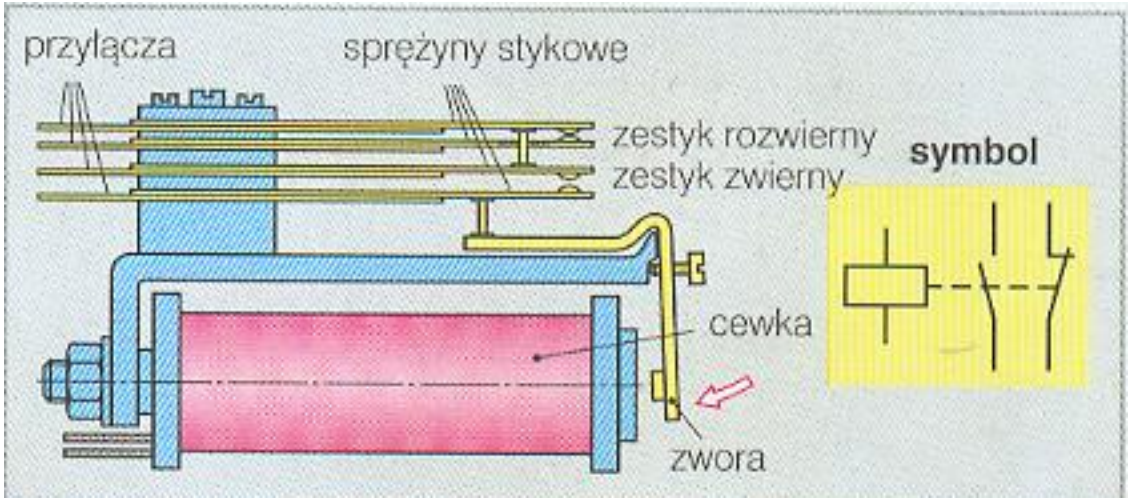
Źródło: https://eduinf.waw.pl/inf/prg/009_kurs_avr/2015.php

Stycznik



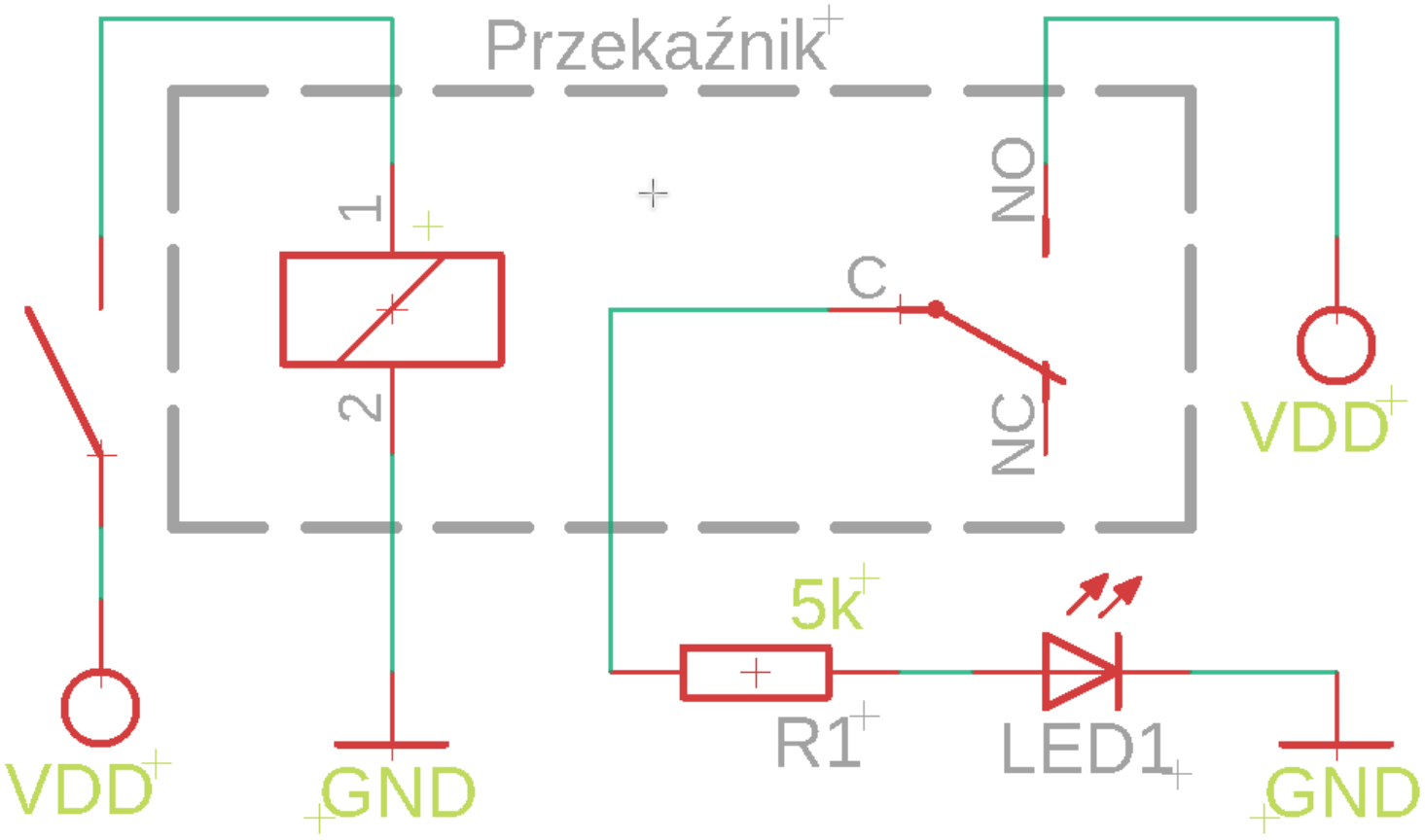
Źródło: M. Olszewski - Mechatronika

Przekaźnik

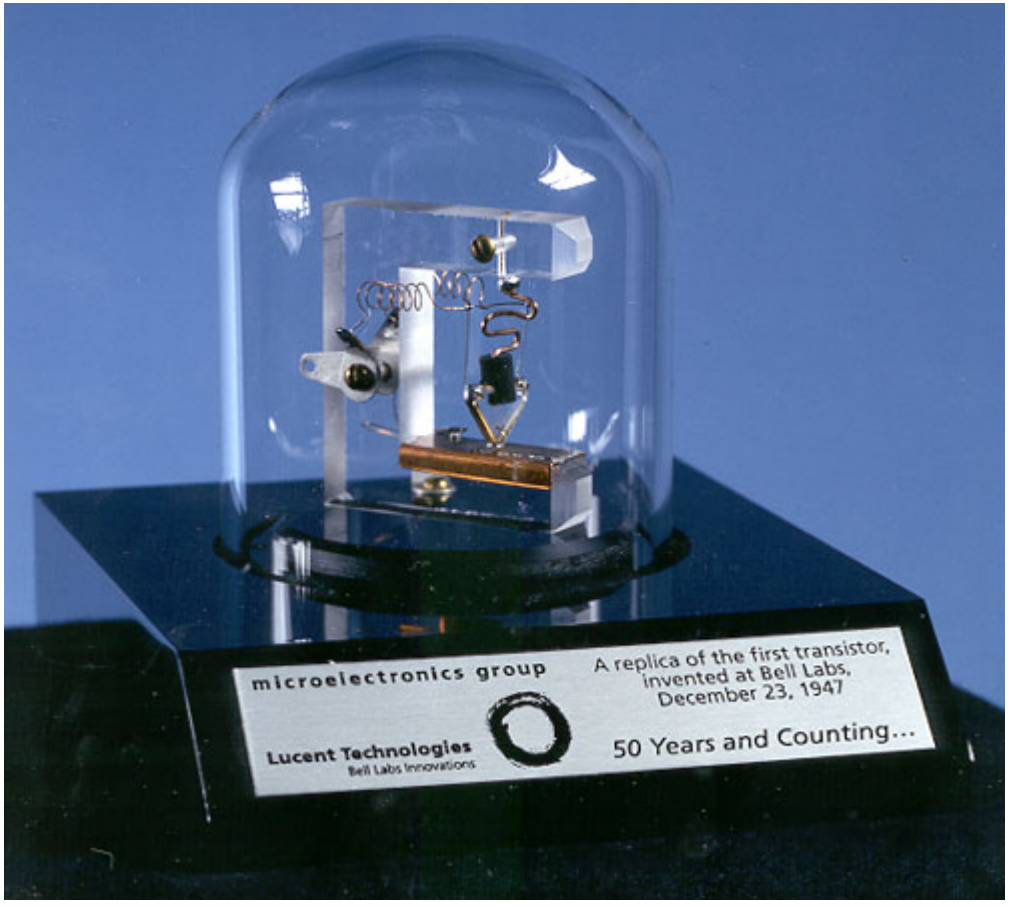


Źródło: https://pl.wikipedia.org/wiki/Przekaźnik, M. Olszewski - Mechatronika

Przekaźnik



Tranzystory - historia

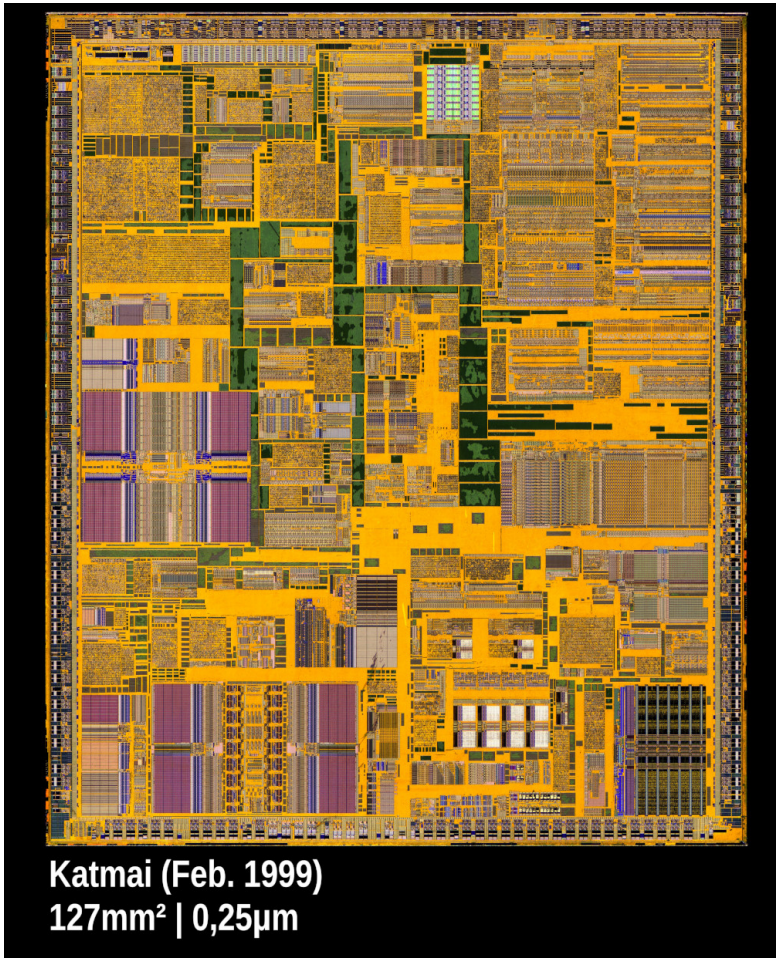


Replika pierwszego działającego tranzystora z 1947

(Źródło: https://pl.wikipedia.org/wiki/Tranzystor)

Dygresja: o procesorach

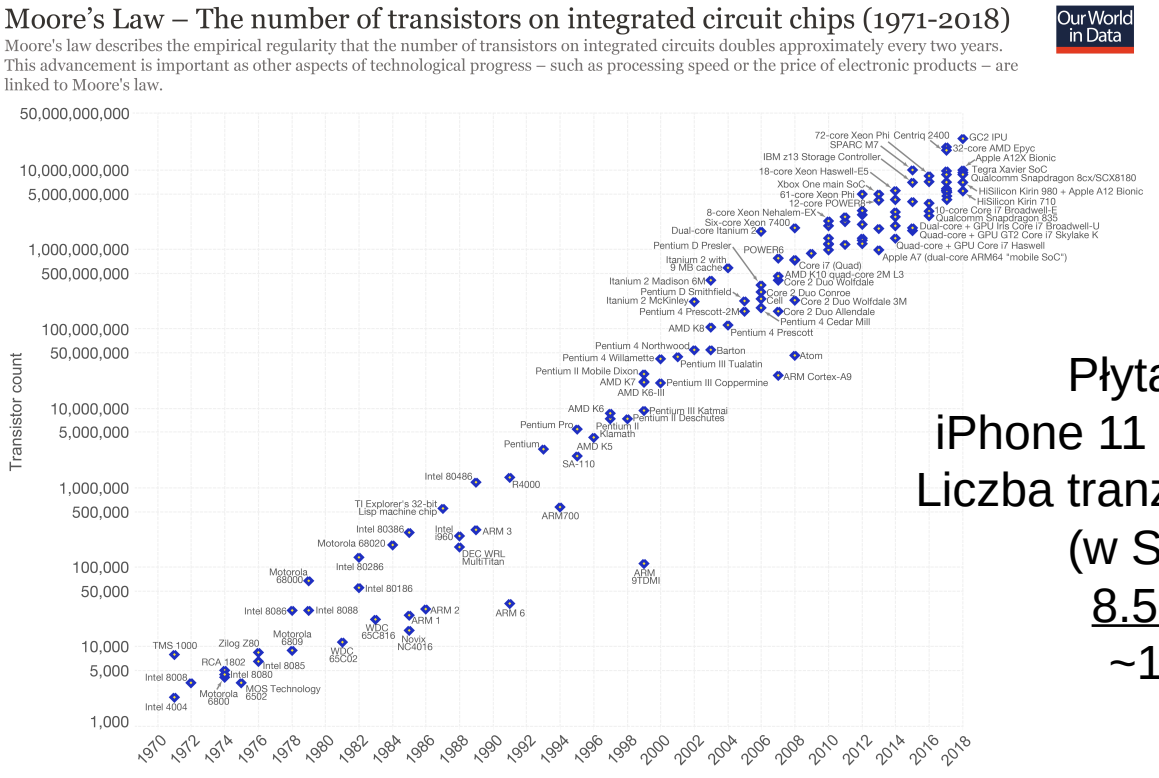
Rok 1999: Intel Pentium III,
9.5 + 25 milionów tranzystorów
(źródło: https://www.purepc.pl/pamietacie-intel-pentium-iii-pierwszy-model-pojawil-sie-20-lat-temu)



Źródło: https://www.flickr.com/photos/130561288@N04/37346274254/in/album-72157650403404920/

Dla ciekawskich:
https://pl.wikipedia.org/wiki/Fotolitografia + YT

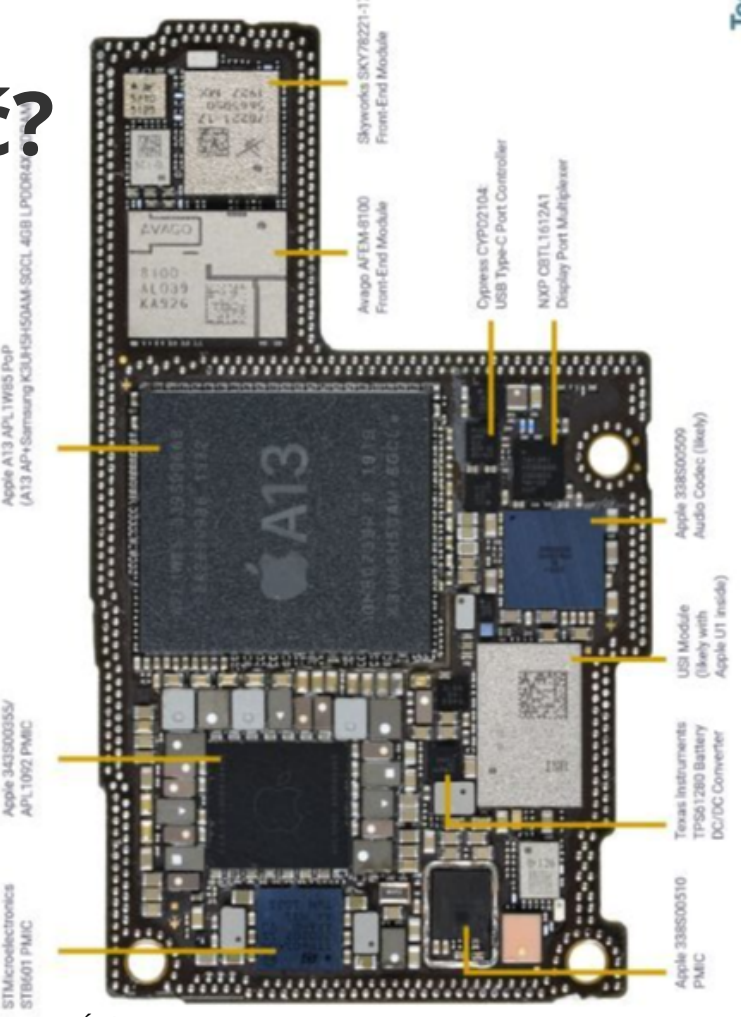
Tranzystory – teraźniejszość?



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)
The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

Źródło: https://en.wikipedia.org/wiki/Transistor_count

Płyta główna
iPhone 11 Pro Max
Liczba tranzystorów
(w Soc A13):
8.5 miliarda
~100 mm²



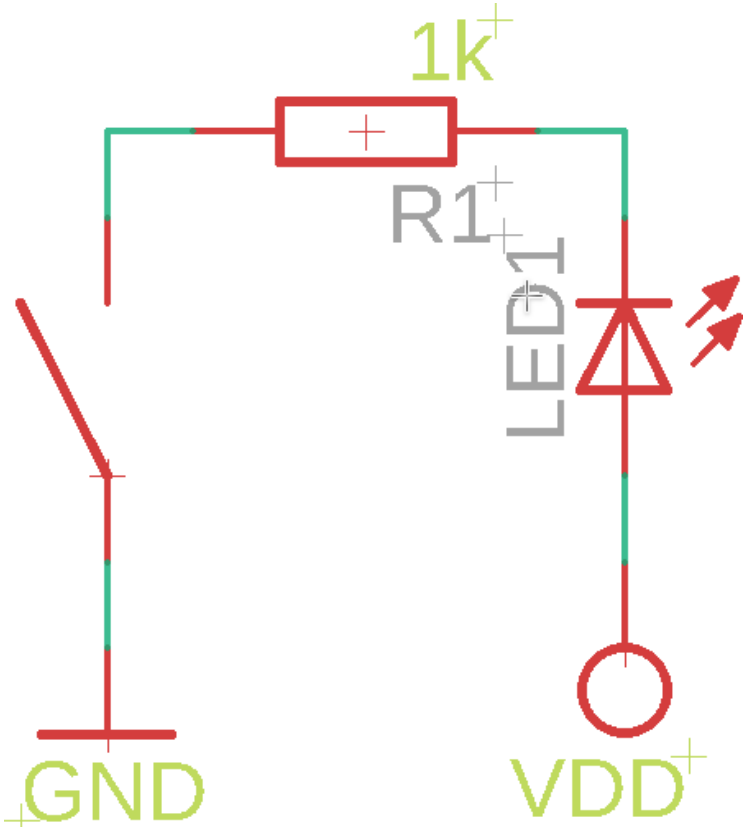
Źródło: https://www.ww01.net/en/archives/19185

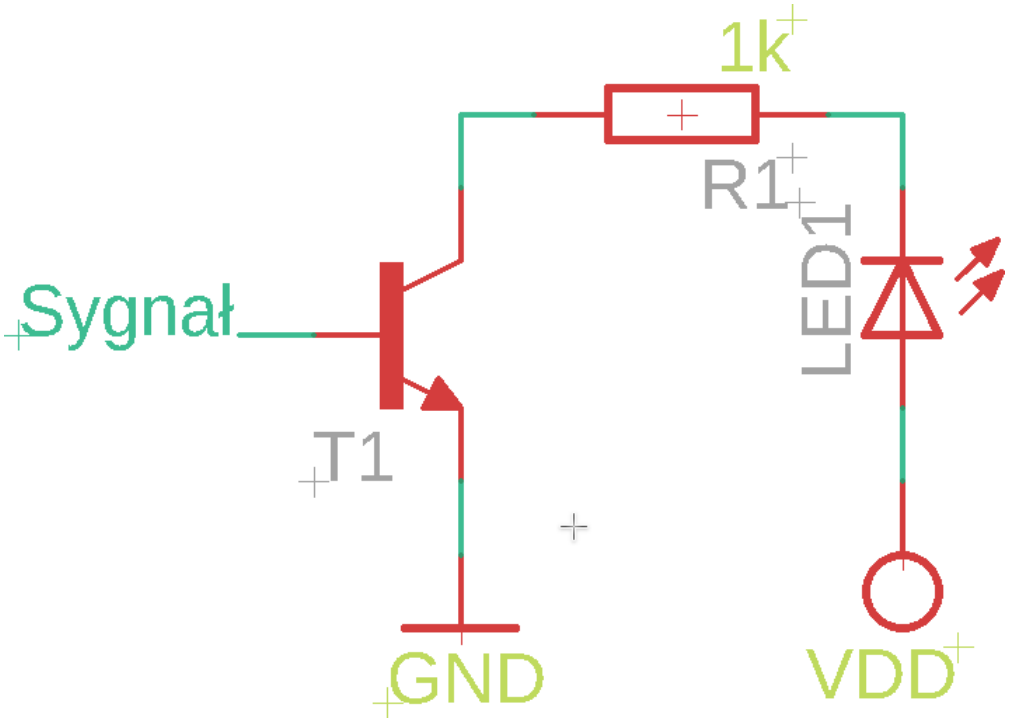
Apple M1 Max (10-core, 64-bit) – 57 miliardów tranzystorów

Co robi tranzystor?

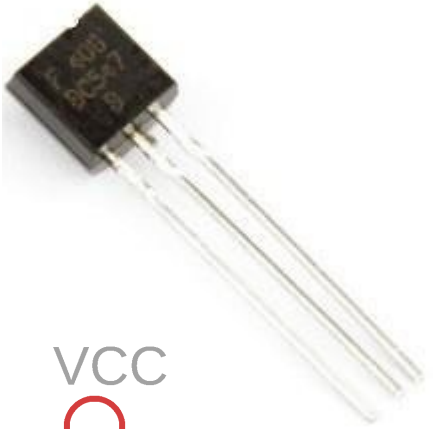
Źródło: https://en.wikipedia.org/wiki/Audio_power_amplifier

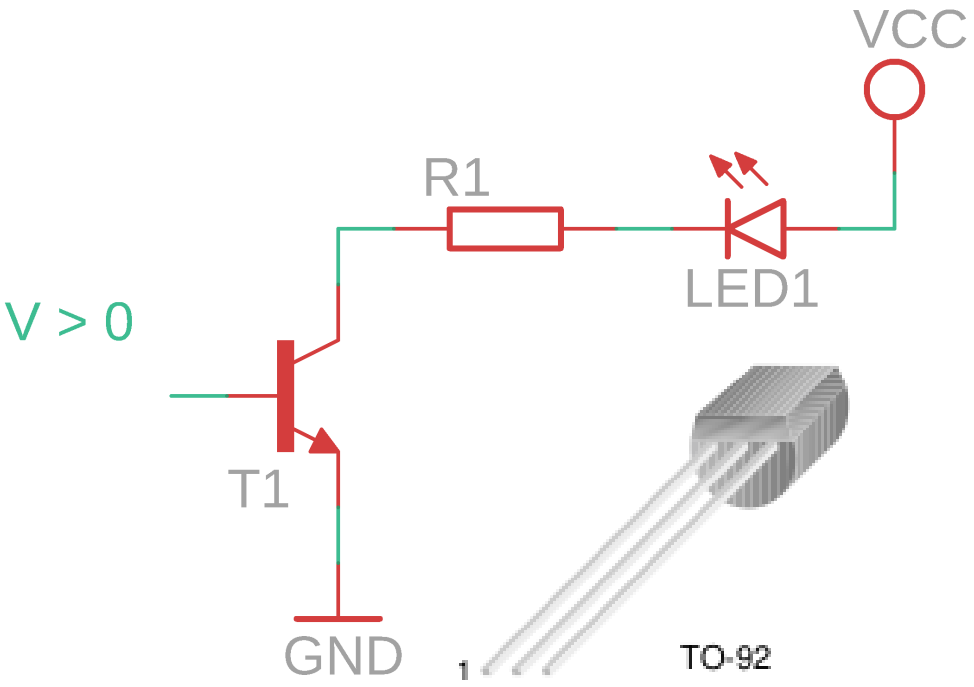
Tranzystor jako włącznik

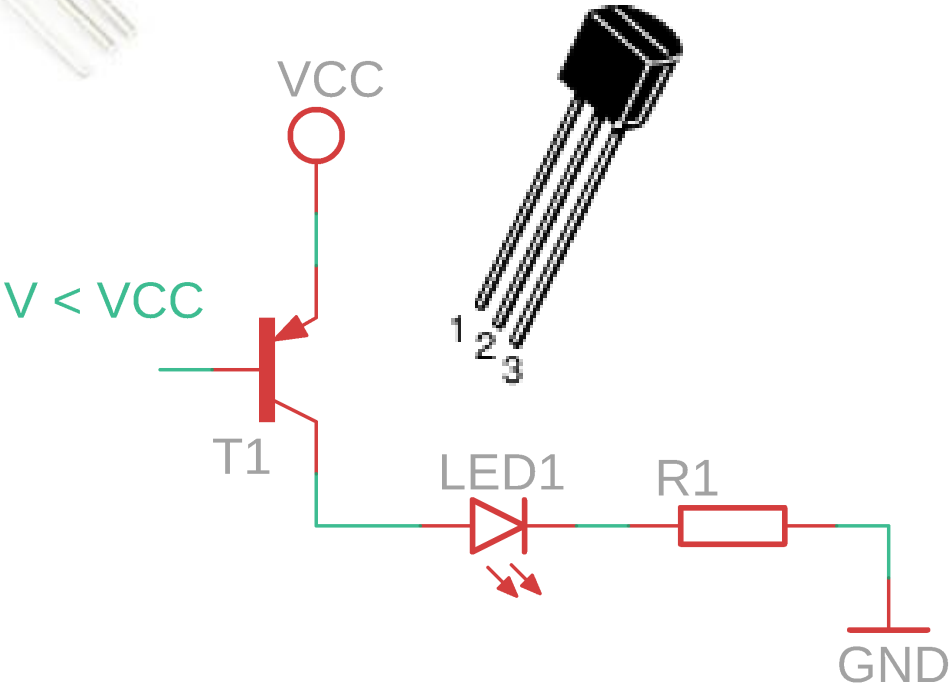




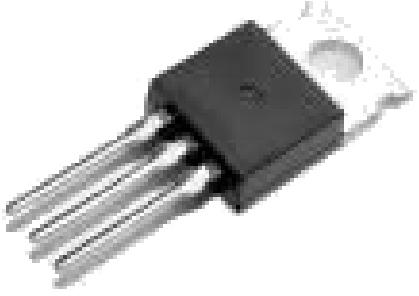
NPN i PNP



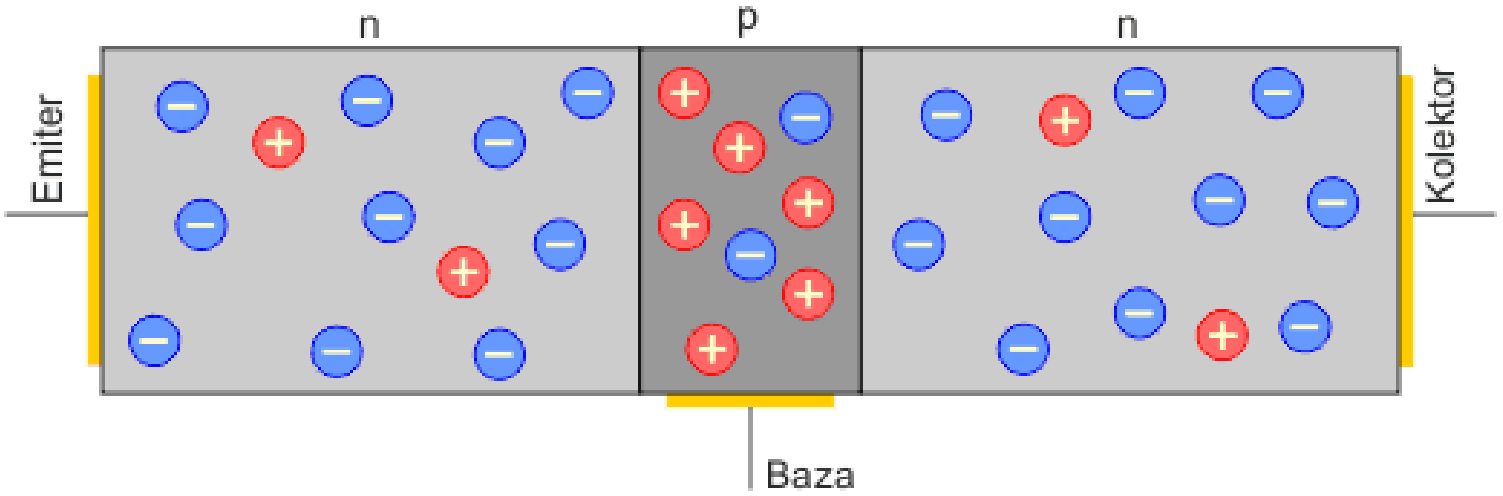




Inne obudowy

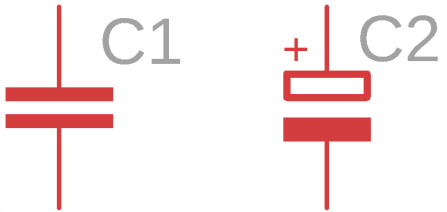


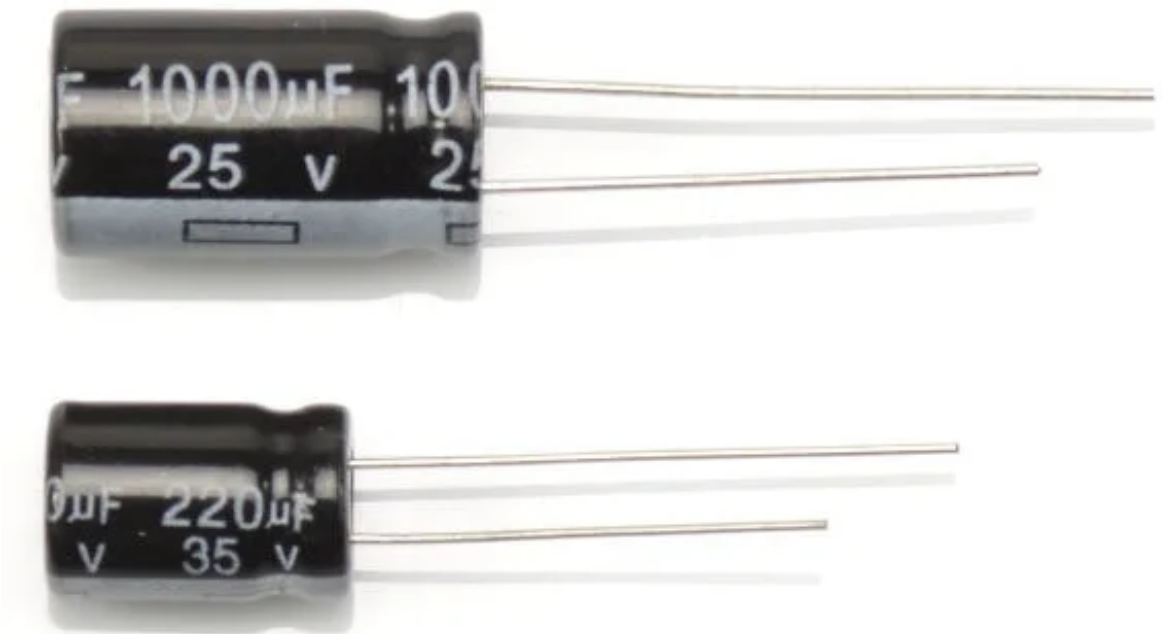
Jak działa tranzystor?

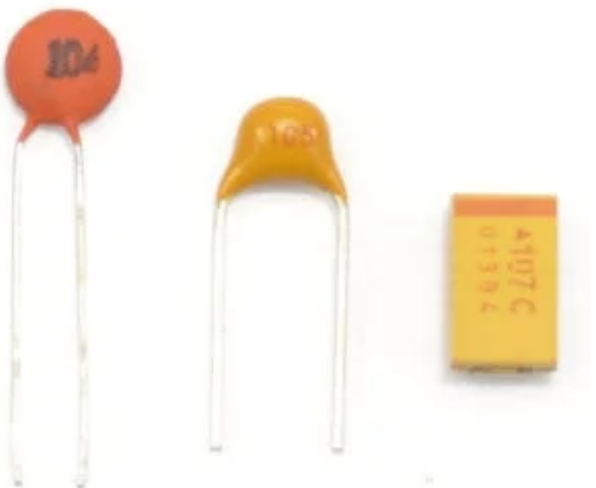


Źródło: https://eduinf.waw.pl/inf/prg/009_kurs_avr/2008.php

Kondensatory







Źródła: https://pl.wikipedia.org/wiki/Kondensator
https://forbot.pl/blog/kurs-elektroniki-kondensatory-elektrolityczne-ceramiczne-id4236

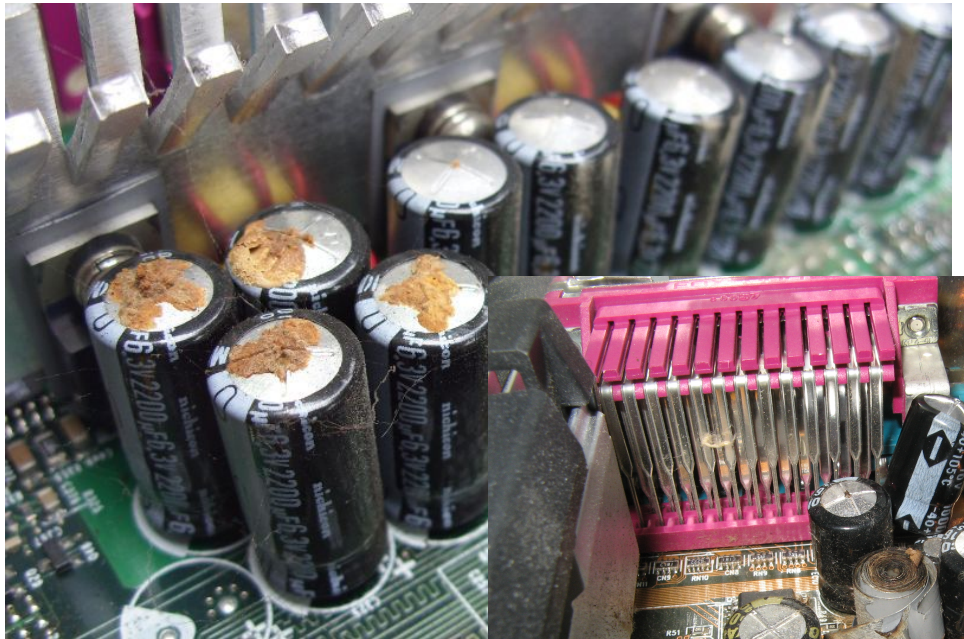
Źródło: https://www.123rf.com/photo_46728419_stock-vector-danger-high-voltage-sign-high-voltage-symbol.html

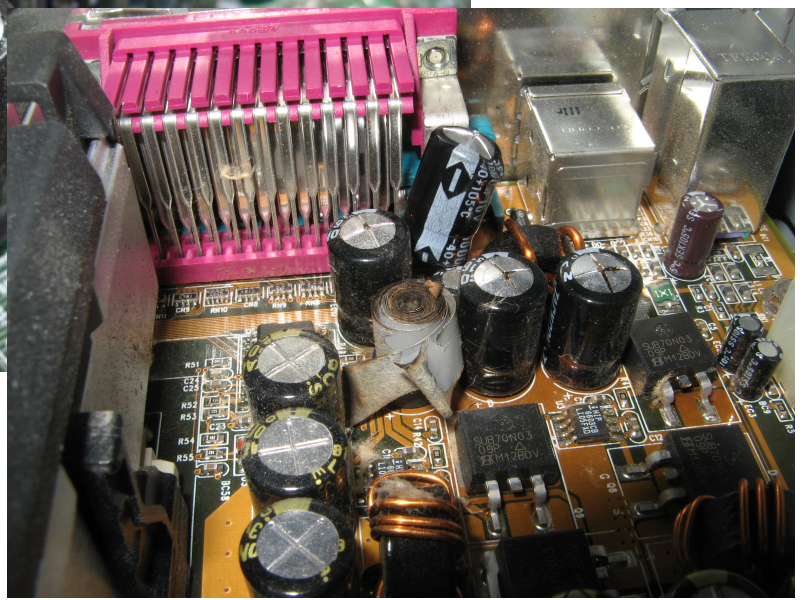
Kondensatory są niebezpieczne

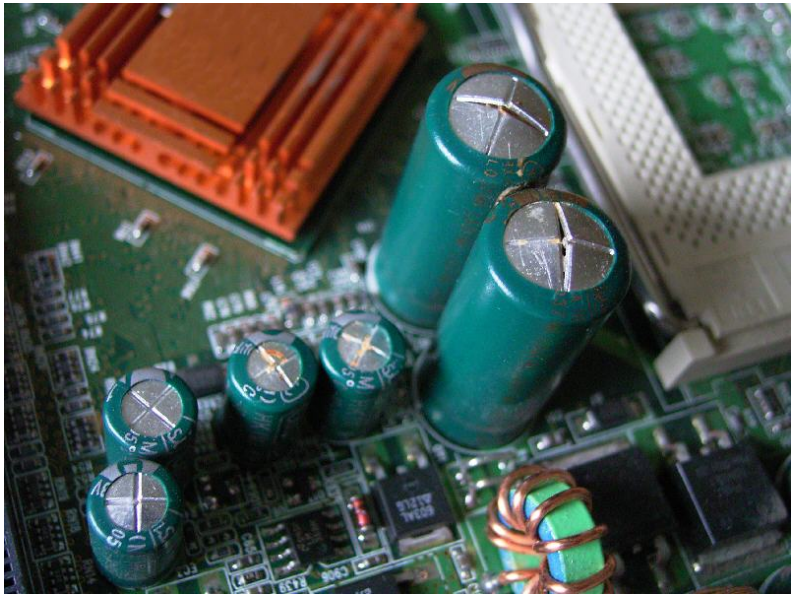
https://youtu.be/PkXI8V5dbaI

Źródło: https://blog.adafruit.com/2016/12/23/teardown-of-faulty-electrolytic-capacitor-from-expensive-name-brand-monitor/

Uszkodzone kondensatory

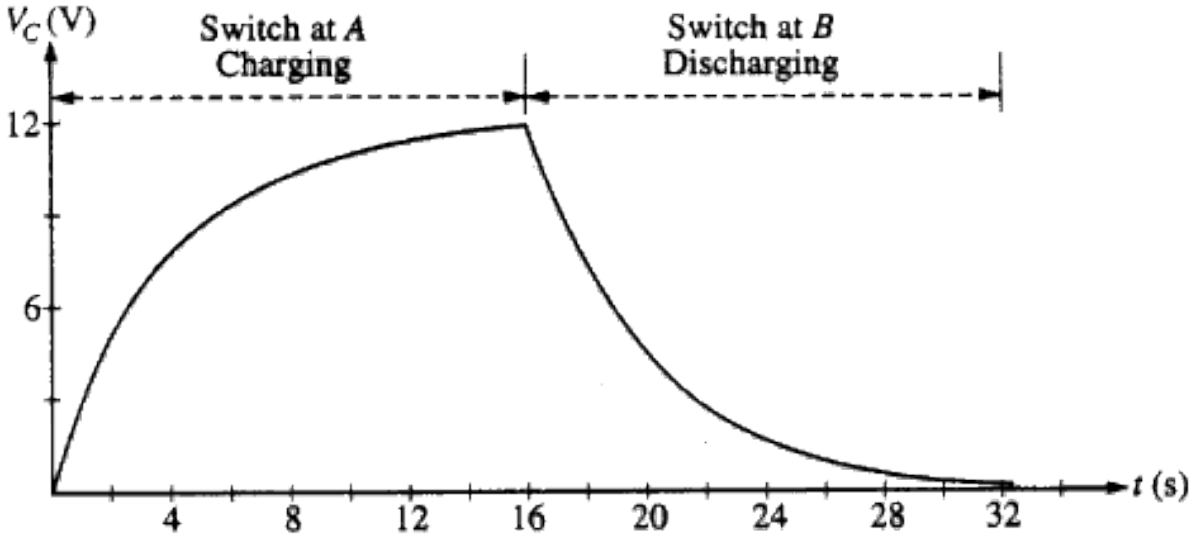






Źródła: https://hackaday.com/2019/04/12/ask-hackaday-experiences-with-capacitor-failure/
https://en.wikipedia.org/wiki/Capacitor_plague

Co robi kondensator?



https://youtu.be/_xo5yJ1z5NQ

Łączenie kondensatorów

Szeregowo

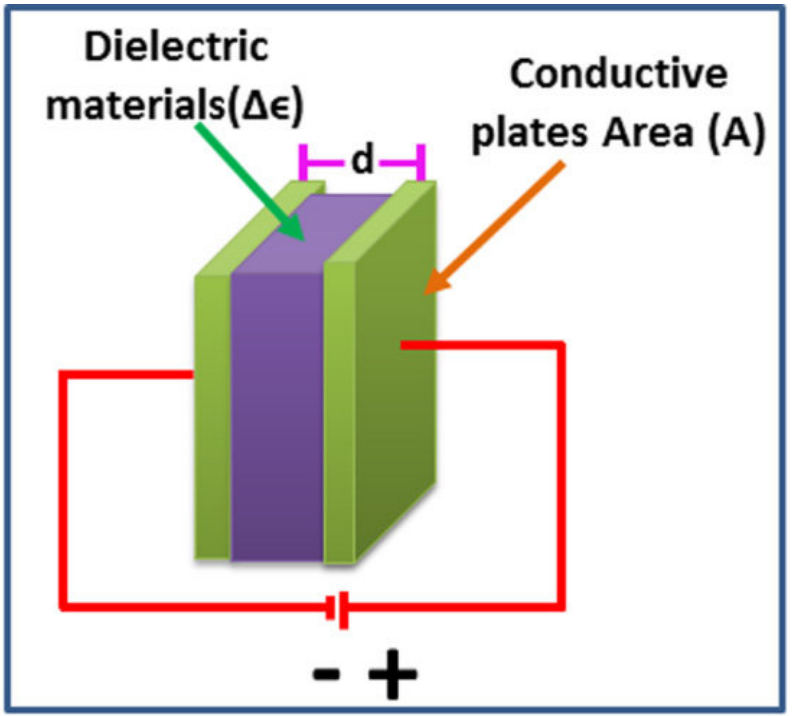
$$\frac{1}{C_z}=\frac{1}{C_1}+\frac{1}{C_2}$$

Równolegle

$$C_z=C_1+C_2$$

Źródło: http://www.physicslab.org/Document.aspx?doctype=1&filename=questions_2003C2E-M.xml

Jak jest zbudowany kondensator?



Pojemność kondensatora płaskiego

$$C = \frac{\varepsilon_0 \varepsilon_r S}{d},$$

gdzie:

S – powierzchnia jednej okładki kondensatora,

d – odległość między okładkami.

ε_0 – przenikalność elektryczna próżni
ε_r – względna przenikalność elektryczna ośrodka, z którego wykonano dzielący okładki izolator

Tripathy, Ashis & Pramanik, Sumit & Cho, Jongman & Santhosh, Jayasree & Abu Osman, Noor Azuan. (2014). Role of Morphological Structure, Doping, and Coating of Different Materials in the Sensing Characteristics of Humidity Sensors. Sensors (Basel, Switzerland). 14. 16343-16422. 10.3390/s140916343.

Czytanie kart charakterystyki

LED: 334-15/T1C1-4WYA

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Rating	Unit
Continuous Forward Current	I_F	30	mA
Peak Forward Current(Duty /10 @ 1KHZ)	I_{FP}	100	mA
Reverse Voltage	V_R	5	V
Operating Temperature	T_{opr}	-40 ~ +85	℃
Storage Temperature	T_{stg}	-40 ~ +100	℃
Soldering Temperature (T=5 sec)	T_{sol}	260 ± 5	℃
Power Dissipation	P_d	100	mW
Zener Reverse Current	Iz	100	mA
Electrostatic Discharge	ESD	4K	V

Electro-Optical Characteristics (Ta=25℃)

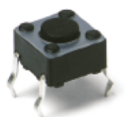
Parameter	Symbol	Condition	Min.	Typ.	Max.	Units
Forward Voltage	V_F	I_F=20mA	3.0	----	3.6	V
Zener Reverse Voltage	Vz	Iz=5mA	5.2	----	----	V
Reverse Current	I_R	V_R=5V	----	----	50	uA
Luminous Intensity	I_V	I_F=20mA	14250	----	28500	mcd
Viewing Angle	2θ 1/2	I_F=20mA	----	15	----	deg
Chromaticity Coordinates	x	I_F=20mA	----	0.30	----	
	y		----	0.29	----	

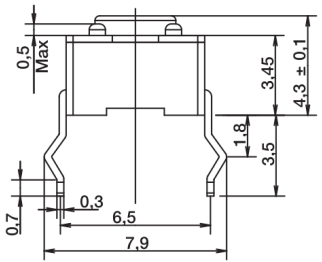
Źródło: Everlight: Technical Data Sheet 5 mm Round White LED (T-1 3/4) [334-15/T1C1-4WYA]

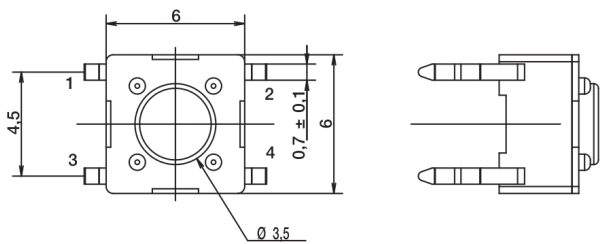
Czytanie kart charakterystyki

Przycisk: PTS645-S

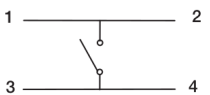
S STRAIGHT



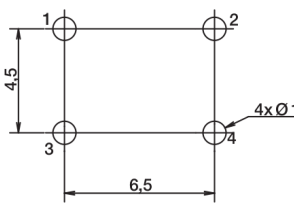




SCHEMATIC



PCB LAYOUT



Tactile Switches

Specification

FUNCTION: Momentary action
CONTACT ARRANGEMENT: SPST, N.O.
TERMINALS: PC pins

Mechanical

ACTUATION FORCE: 130 grams, 160 grams, 200 grams, 260 grams
LIFE EXPECTANCY: 100,000 operations.

Electrical

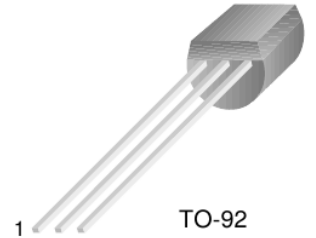
CONTACT RATING: 50 mA @ 12 V DC.
DIELECTRIC STRENGTH: 250 V AC min.
CONTACT RESISTANCE: 100 mΩ max. initial.
INSULATION RESISTANCE: 10^{11} Ω min.

Environmental

OPERATING TEMPERATURE: -20˚C to 60˚C

Źródło: C&K: PTS645 Series 6 mm Tact Switches

Czytanie kart charakterystyki



1. Collector 2. Base 3. Emitter

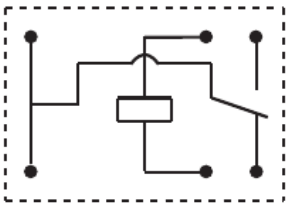
Tranzystor: BC546

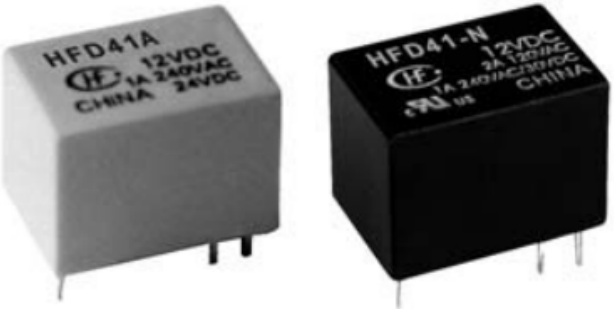
Absolute Maximum Ratings T_a=25◦C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage : BC546	80	V
	: BC547/550	50	V
	: BC548/549	30	V
V_{CEO}	Collector-Emitter Voltage : BC546	65	V
	: BC547/550	45	V
	: BC548/549	30	V
V_{EBO}	Emitter-Base Voltage : BC546/547	6	V
	: BC548/549/550	5	V
I_C	Collector Current (DC)	100	mA
P_C	Collector Power Dissipation	500	mW
T_J	Junction Temperature	150	◦C
T_{STG}	Storage Temperature	-65 ~ 150	◦C

Źródło: FAIRCHILD: BC546/547/548/549/550

Czytanie kart charakterystyk





Przekaźnik: HFD41

CONTACT DATA

Concat arrangement	1C
Contact resistance	100mΩ max. (at 1A 6VDC)
Contact material	AgNi, AgCdO
Contact rating (Res. load)	1A 120VAC, 1A 240VAC / 30VDC 3A 120VAC 2A 120VAC, 5A 120VAC
Max. switching voltage	240VAC / 30VDC
Max. switching current	5A
Max. switching power	600VA / 30W
Mechanical endurance	1 x 10^7OPS
Electrical endurance	9.9 x 10^4OPS (1A 120VAC, 1A 30VDC, Resistive load, Room temp., 1s on 9s off)

COIL DATA

at 23˚C

Nominal Voltage VDC	Pick-up Voltage VDC max.	Drop-out Voltage VDC min.	Max. Voltage VDC	Coil Resistance x (1±10%) Ω		
				H	N	B
3	2.3	0.3	3.9	45	25	20
5	3.8	0.5	6.5	120	70	56
6	4.5	0.6	7.8	180	100	80
9	6.8	0.9	11.7	400	220	180
12	9.0	1.2	15.6	700	400	320
24	18.0	2.4	31.2	2800	1600	1280

Źródło: Hongfa Relay: HFD41/D41A