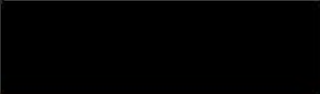







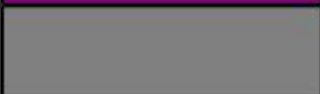





Lestvica E6 20%	Lestvica E12 10%	Lestvica E24 5%	Koda kondenzatorja
1.0	1.0	1.0	A
-	-	1.1	B
-	1.2	1.2	C
-	-	1.3	D
1.5	1.5	1.5	E
-	-	1.6	F
-	1.8	1.8	G
-	-	2.0	H
2.2	2.2	2.2	J
-	-	2.4	K
-	2.7	2.7	L
-	-	3.0	M
3.3	3.3	3.3	N
-	-	3.6	P
-	3.9	3.9	Q
-	-	4.3	R
4.7	4.7	4.7	S
-	-	5.1	T
-	5.6	5.6	U
-	-	6.2	V
6.8	6.8	6.8	W
-	-	7.5	X
-	8.2	8.2	Y
-	-	9.1	Z
10.0	10.0	10.0	A (naslednji)

EIA Standard Resistor Values by ± Tolerance%

Move the decimal point to achieve the actual value desired.

E6	E12	E24	E48	E96	E6	E12	E24	E48	E96	E6	E12	E24	E48	E96													
± 20%	± 10%	± 5%	± 2%	± 1%	± 20%	± 10%	± 5%	± 2%	± 1%	± 20%	± 10%	± 5%	± 2%	± 1%													
100	100	100	100	100	220	220	220	215	215	470	470	470	464	464													
				102					221					475													
			105	105	110			105	240				270	226	237	226	560	560	487	511	487						
								107								232					499						
				110	110			115	110					300	300	237			249	237	620	620	511	536	511		
									113											243					523		
		115			115		121	115	270			270				249			261	249			560	560	536	549	261
								118												255							562
		120	120	120	121		121	270	270			261	121	560	560	560	562	121									
							124						267					576									
					127		127						133				127	300	300	274	127	620	620	620	590	604	127
				130								280				590											
	133			133		140				133	330	330				287	133				680						680
					137		294			619																	
			140		140		147	140	360	360			301	140	750		750	750	649	665		140					
	143			309		649																					
	150			150		150		147			147	330		330		316					147	680	680	680	681	147	
			150		316		681																				
			154		154		162	154	360	360	332		154		750		750	750	715	732	154						
				158		340		715																			
		162		162		169		162					390			390					348			162	820	820	820
			165		357		750																				
	169		169		178		169	422	422	365	169	820		820	820		787	806	169								
		174		374		787																					
180		180		180		178	178				390		390			383			178	820	820	820	825	178			
	182		392		825																						
	187		187		196	187	430	430	402	187		910		910	910		866	887	187								
		191		412		866																					
		196		196		205				196						442			442			422	196	953	953	953	909
	200		432		909																						
205	205		210		205		453	453	442	205	976	976	976	953	976		205										
		210		453	953																						

Barva	Izgled	Vrednost lestvice XX	Ničle eksponenta	Odstopanje (zadnja)	TK uporov (dodatno)
Črna		0	XX	-	-
Rjava		1	XX0	1% (širši)	100ppm/K
Rdeča		2	XX00	2% (širši)	50ppm/K
Oranžna		3	XX000	-	15ppm/K
Rumena		4	XX0000	-	25ppm/K
Zelena		5	XX00000	0.5%	-
Modra		6	XX000000	0.25%	-
Vijolična		7	XX0000000	0.1%	-
Siva		8	-	0.05%	-
Bela		9	-	-	-
brez barve	-	-	-	20%	(običajno)
Srebrna		-	0.XX	10%	-
Zlata		-	X.X	5%	-

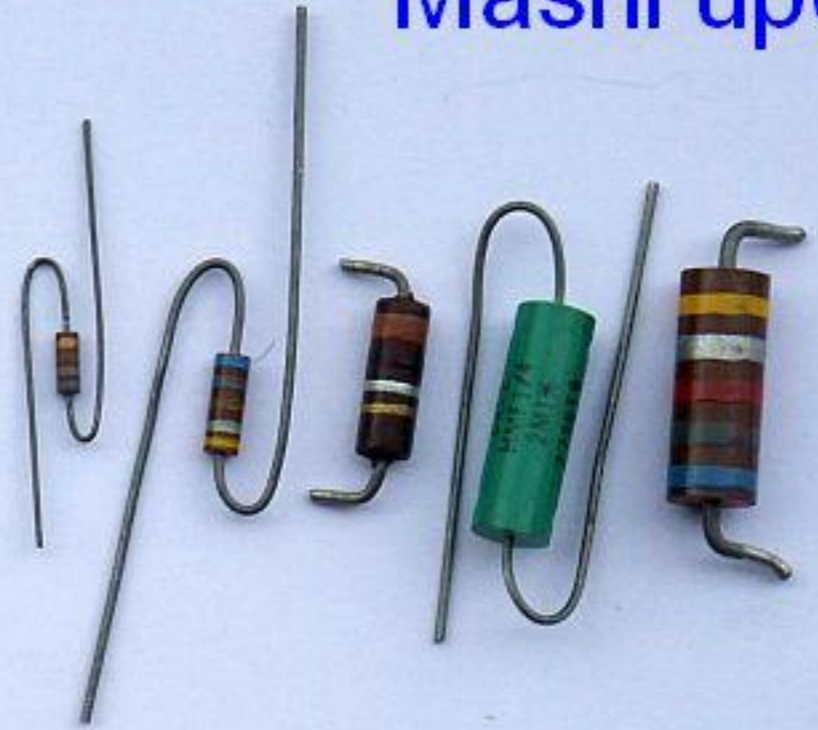
Vrednost=Koda	Vrednost=Koda	Vrednost=Koda	Vrednost=Koda
100=01	178=25	316=49	562=73
102=02	182=26	324=50	576=74
105=03	187=27	332=51	590=75
107=04	191=28	340=52	604=76
110=05	196=29	348=53	619=77
113=06	200=30	357=54	634=78
115=07	205=31	365=55	649=79
118=08	210=32	374=56	665=80
121=09	215=33	383=57	681=81
124=10	221=34	392=58	698=82
127=11	226=35	402=59	715=83
130=12	232=36	412=60	732=84
133=13	237=37	422=61	750=85
137=14	243=38	432=62	768=86
140=15	249=39	442=63	787=87
143=16	255=40	453=64	806=88
147=17	261=41	464=65	825=89
150=18	267=42	475=66	845=90
154=19	274=43	487=67	866=91
158=20	280=44	499=68	887=92
162=21	287=45	511=69	909=93
165=22	294=46	523=70	931=94
169=23	301=47	536=71	953=95
174=24	309=48	549=72	976=96

Koda eksponenta (zadnji znak)	Niĉle eksponenta
Z	0.XXX
Y ali R	X.XX
X ali S	XX.X
A	XXX
B ali H	XXX0
C	XXX00
D	XXX000
E	XXX0000
F	XXX00000

Slojni upori brez kopic



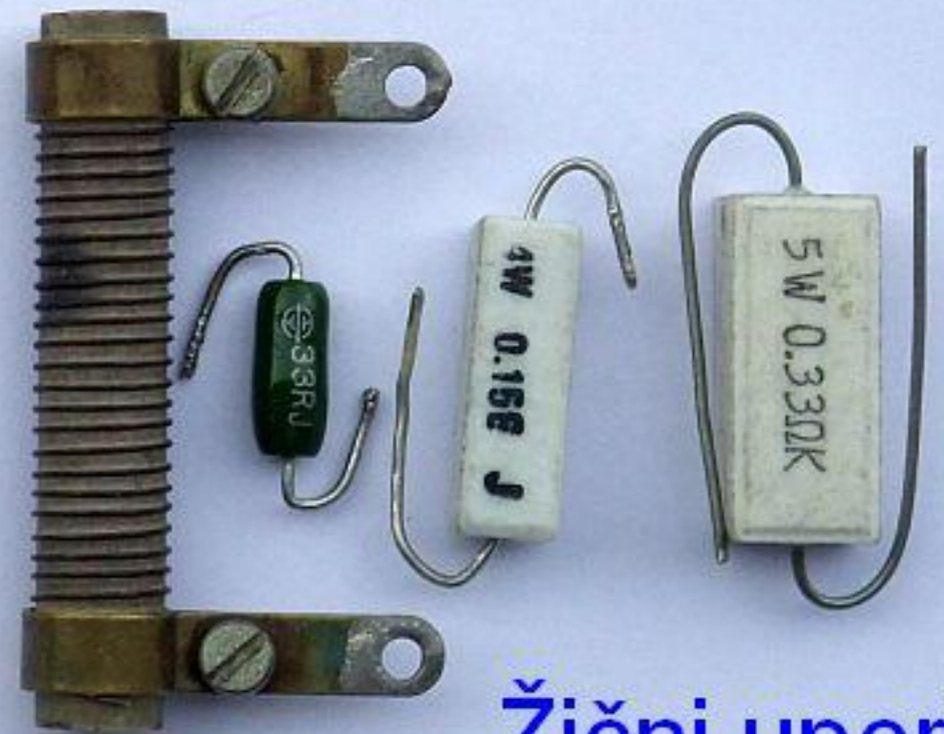
Masni upori



SMD upori



Slojni upori



Žični upori

Velikosti SMD uporov

1612



0402



0603



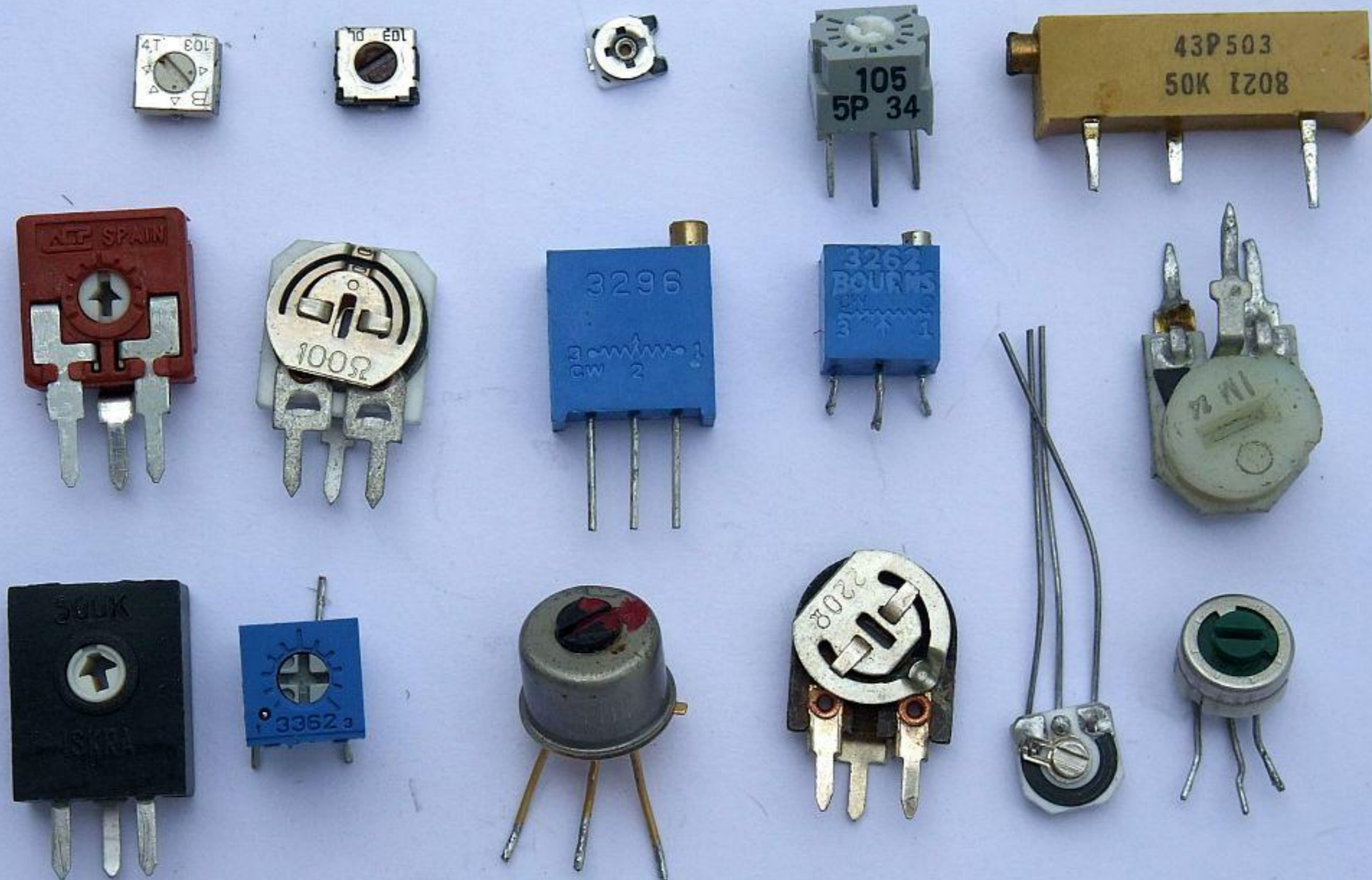
0805



1206



SMD velikost	Velikost v colah	Velikost v milimetrih
0402	0.04" X 0.02"	1mm X 0.5mm
0603	0.06" X 0.03"	1.5mm X 0.8mm
0805	0.08" X 0.05"	2mm X 1.3mm
1206	0.12" X 0.06"	3mm X 1.5mm
1612	0.16" X 0.12"	4mm X 3mm

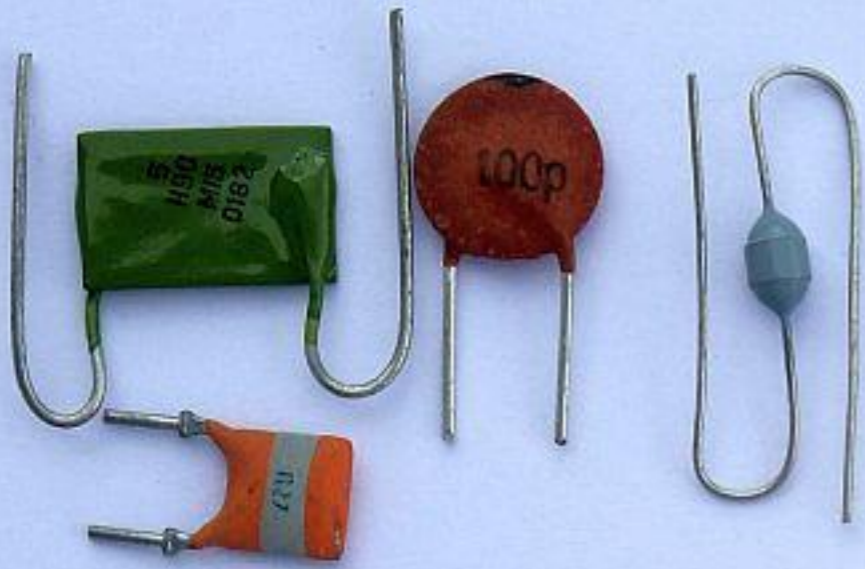


Nastavljivi upori

Helipot



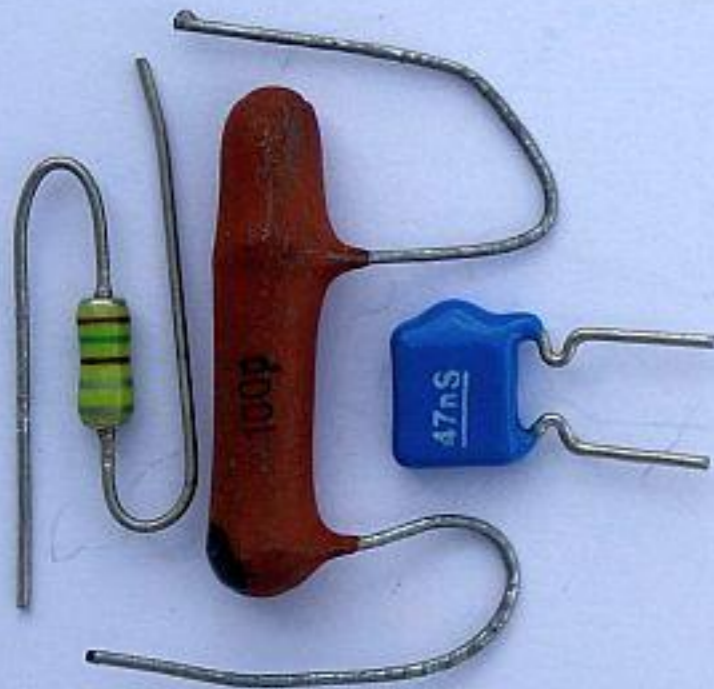
Ploščati



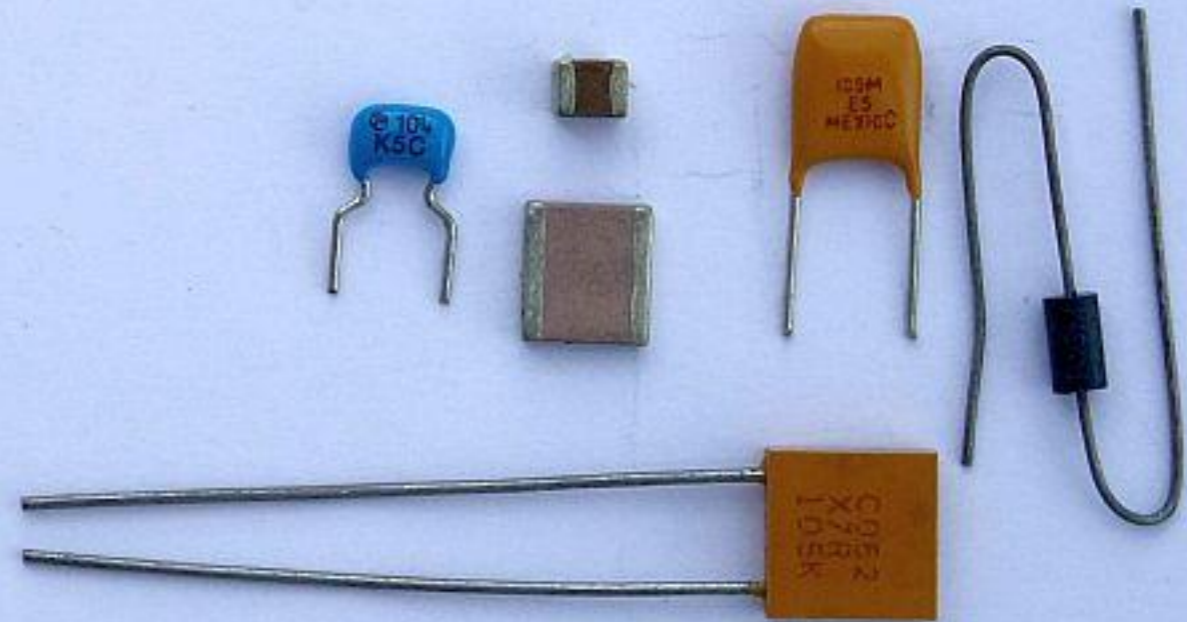
Brez priključkov



Keramični kondenzatorji



Skozniki



Cevni

Večslojni

2025



1210



1206



0805



0603



0402



Velikosti kondenzatorjev 100nF

Vrsta keramike	Temperaturni koeficient	Barvna oznaka
P100 ali AG ali M7G	+100 (± 30) ppm/K	rdeča/vijolična
NP0 ali CG ali C0G	0 (± 30) ppm/K	črna
N75 ali LG ali L2G	-75 (± 30) ppm/K	rdeča
N150 ali PH ali P2H	-150 (± 60) ppm/K	oranžna
N220 ali RH ali R2H	-220 (± 60) ppm/K	rumena
N330 ali SH ali S2H	-330 (± 60) ppm/K	zelena
N470 ali TH ali T2H	-470 (± 60) ppm/K	modra
N750 ali UJ ali U2J	-750 (± 120) ppm/K	vijolična
N1500 ali VK ali P3K	-1500 (± 250) ppm/K	oranžna/oranžna

P100



NP0



N75



N150



N470



N750



N1500



Temperaturni koeficient

0805 Kemet
Y2=820pF

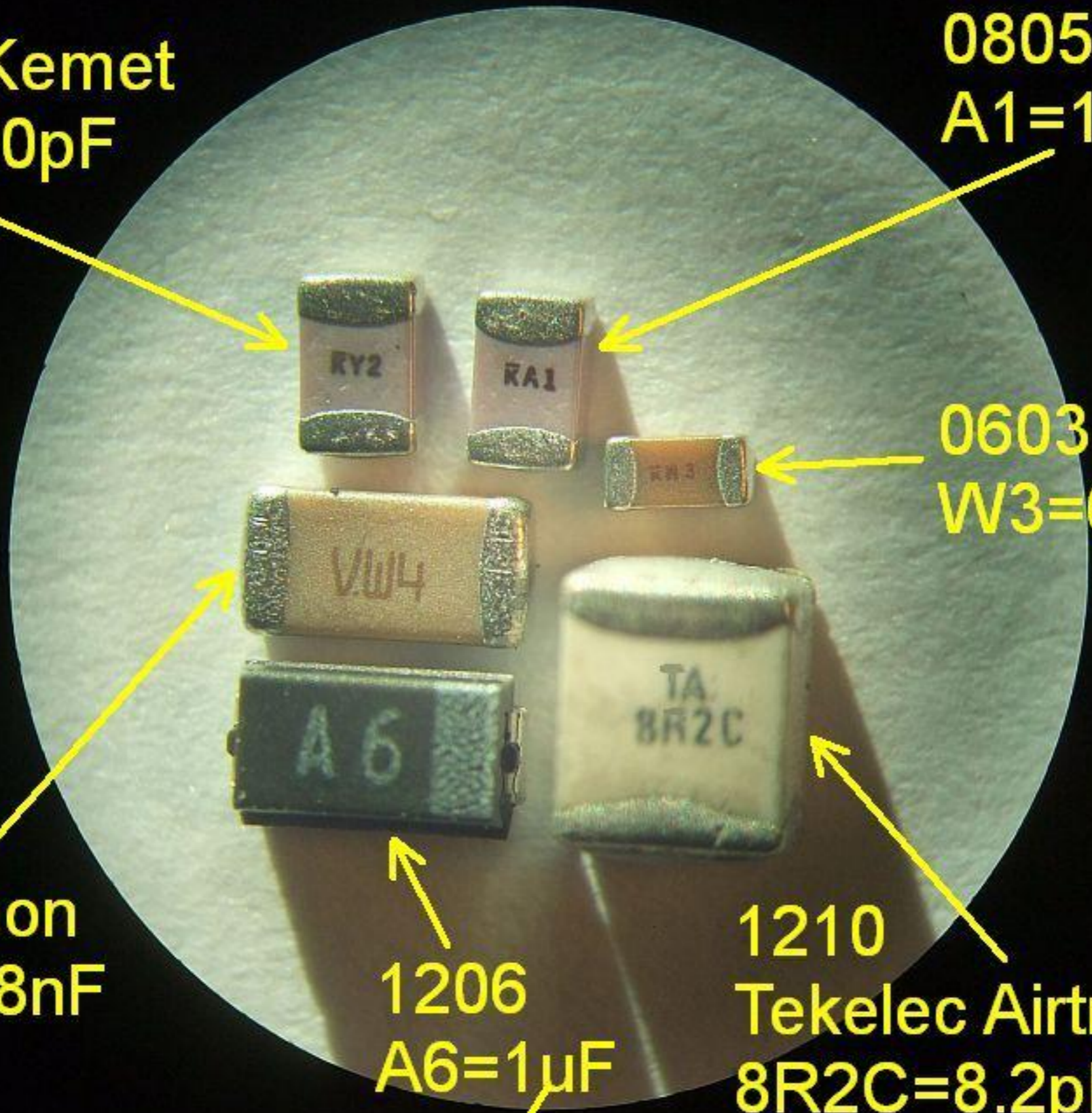
0805 Kemet
A1=10pF

0603 Kemet
W3=6.8nF

1206
Vitramon
W4=68nF

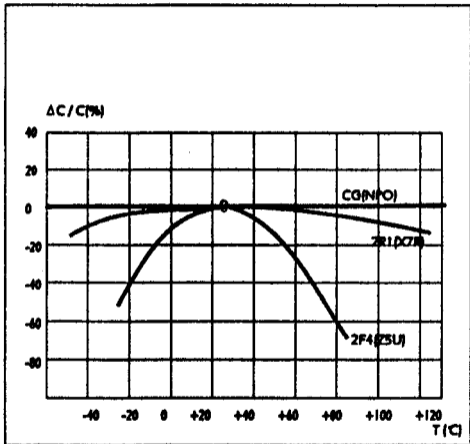
1206
A6=1μF

1210
Tekelec Airtronic
8R2C=8.2pF

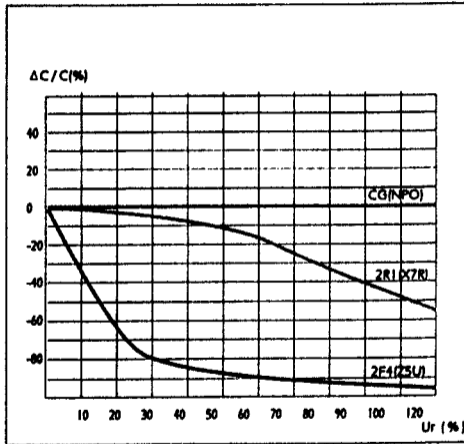


Prvi znak - črka		Drugi znak - številka		Tretji znak - črka	
Spodnja meja temperature		Gornja meja temperatre		Odstopanje (toleranca)	
X	-55°C	4	+65°C	V	-82%..+22%
Y	-30°C	5	+85°C	U	-56%..+22%
Z	+10°C	6	+105°C	T	-33%..+22%
		7	+125°C	S	±22%
		8	+150°C	R	±15%
		9	+200°C	P	±10%
				F	±7.5%
				E	±4.7%

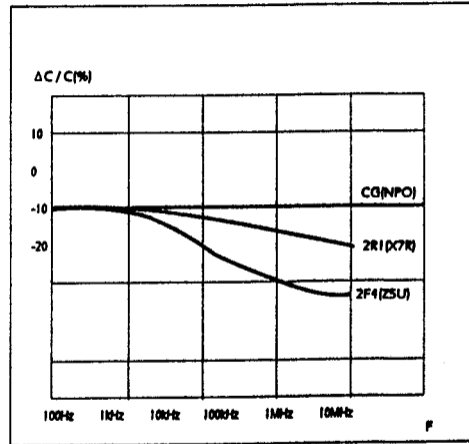
Capacitance as a function of temperature



Capacitance as a function of DC voltage ($U_r=50V$)



Capacitance as a function of frequency



Primerjava lastnosti keramik NP0, X7R in Z5U

18pF
NP0



47pF
NP0



4.7nF
X7R

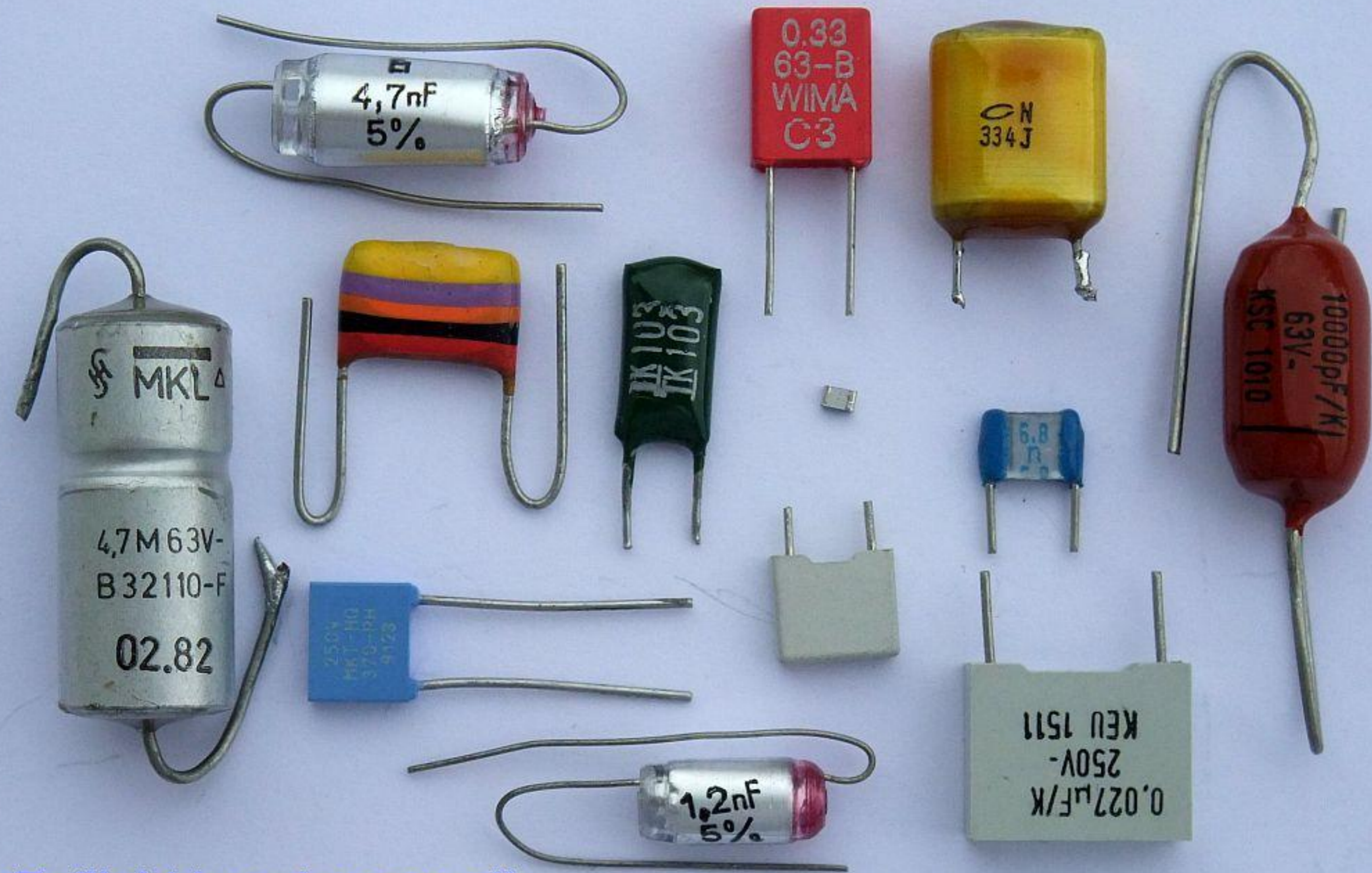


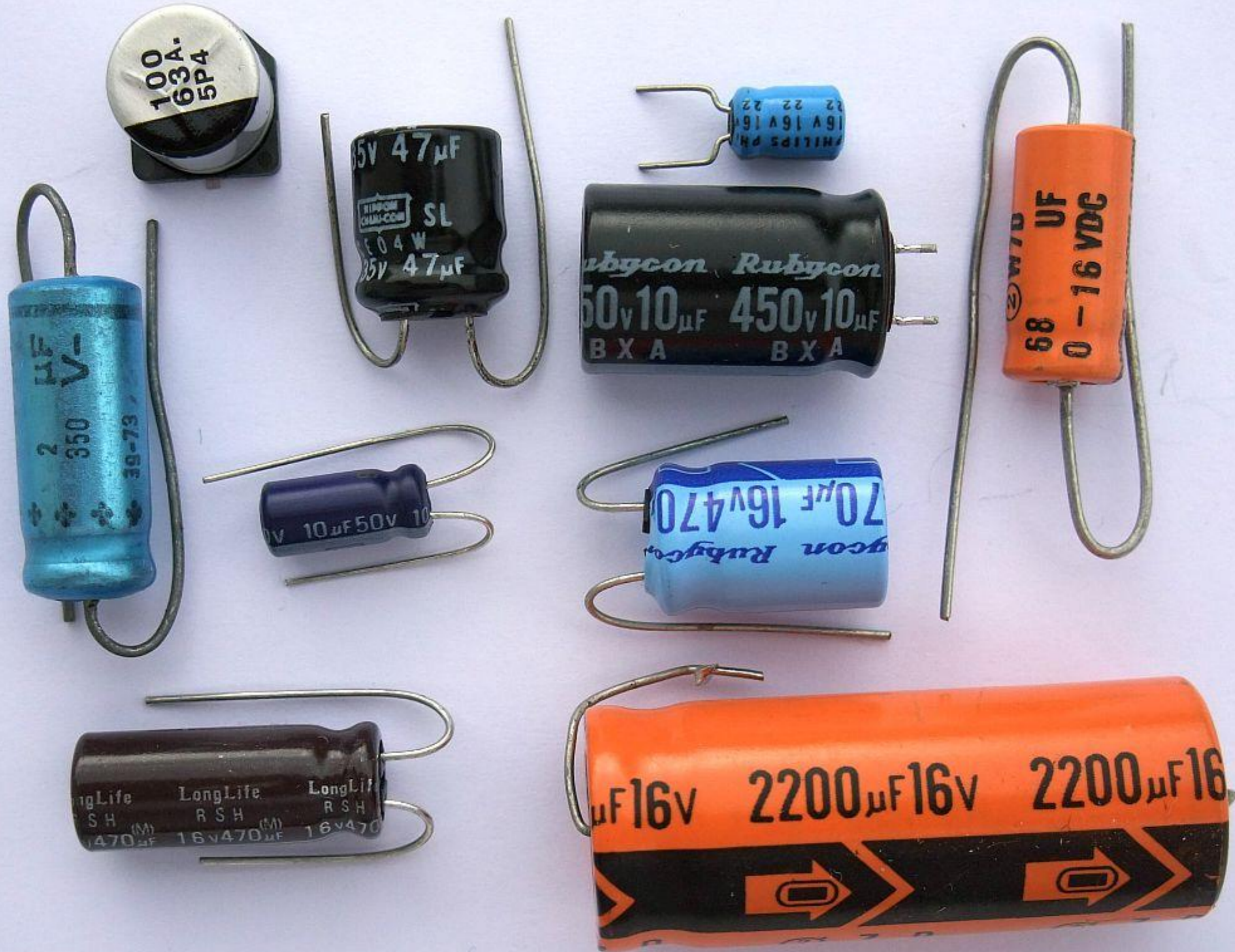
100nF
Z5U



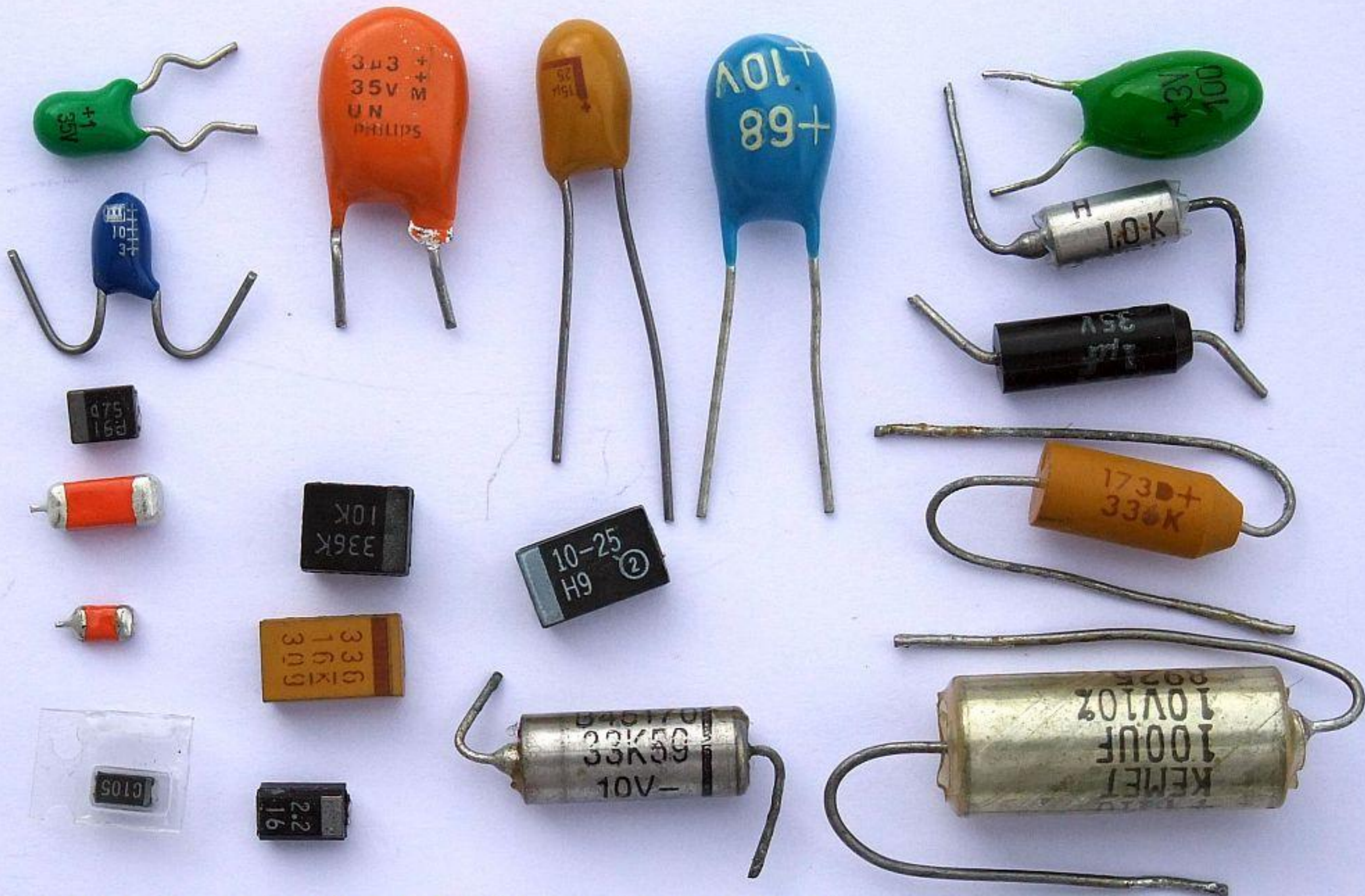
Barve keramik NP0 (CG), X7R in Z5U

Folijski kondenzatorji





Aluminijevi elektrolitski kondenzatorji



Tantalovi elektrolitski kondenzatorji



Superkondenzatorji

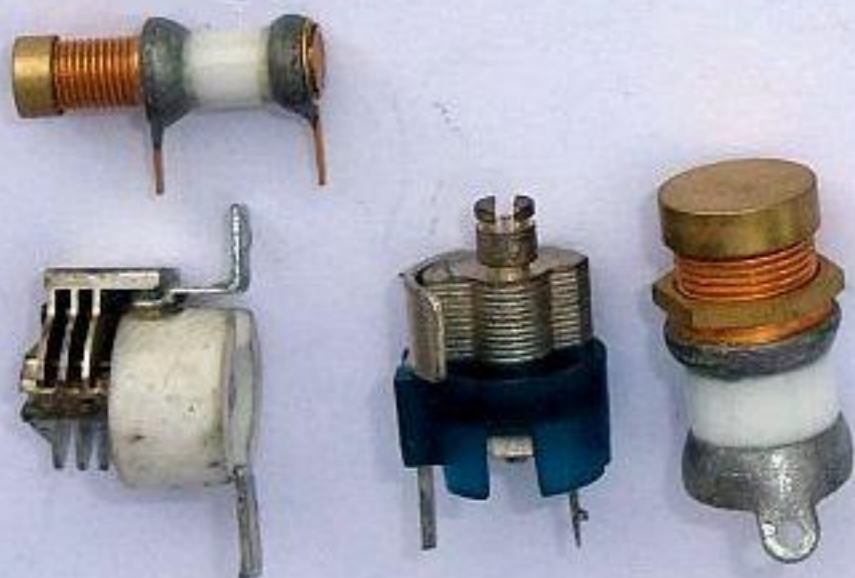
Folijski



Keramični



Stekleni



Zračni



Nastavljivi kondenzatorji

Samonoseče tuljave



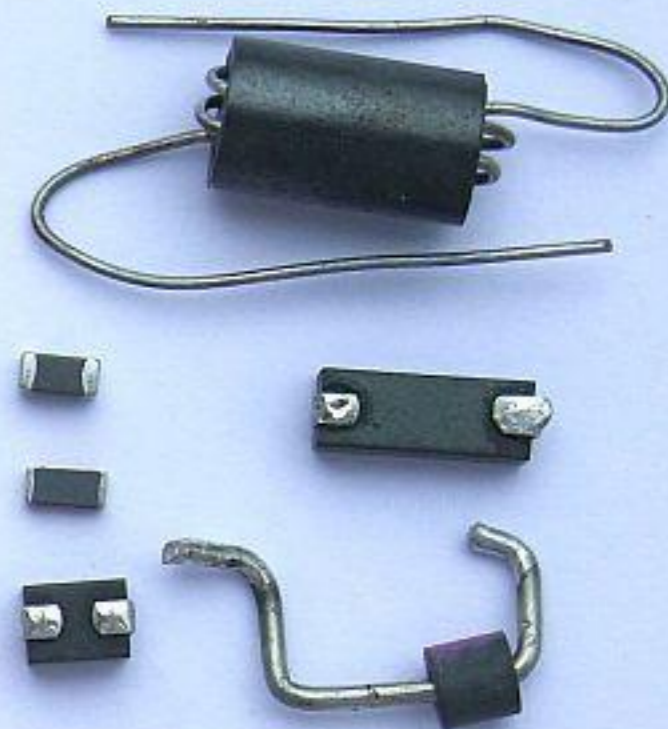
SMD



Tuljave



Feritne dušilke

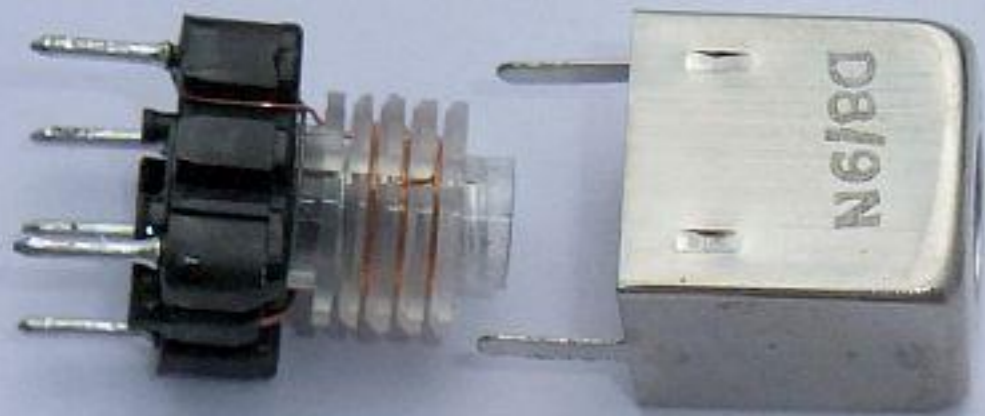


Toroidne



SMD močnostne





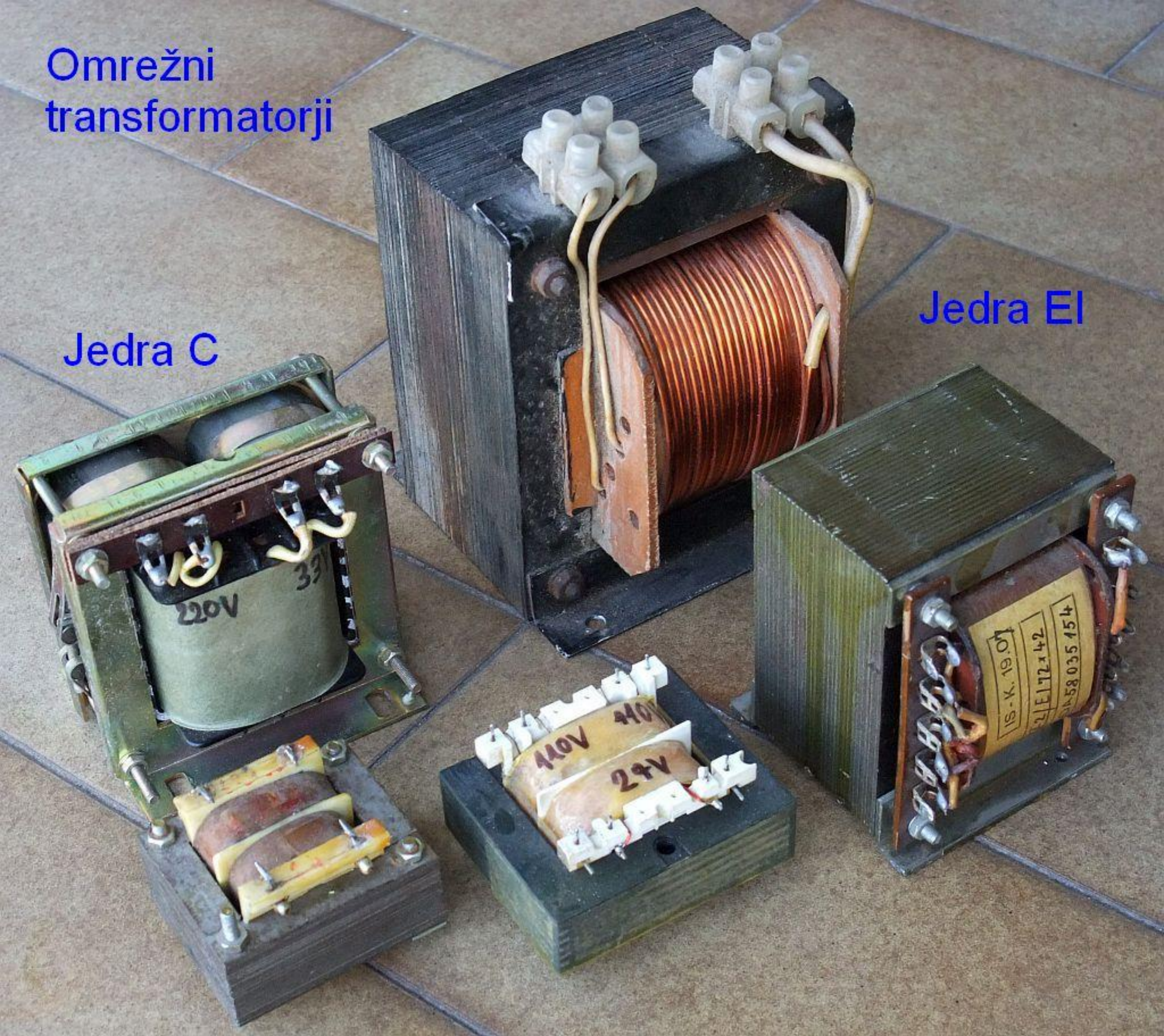
Nastavljive tuljave



Omrežni transformatorji

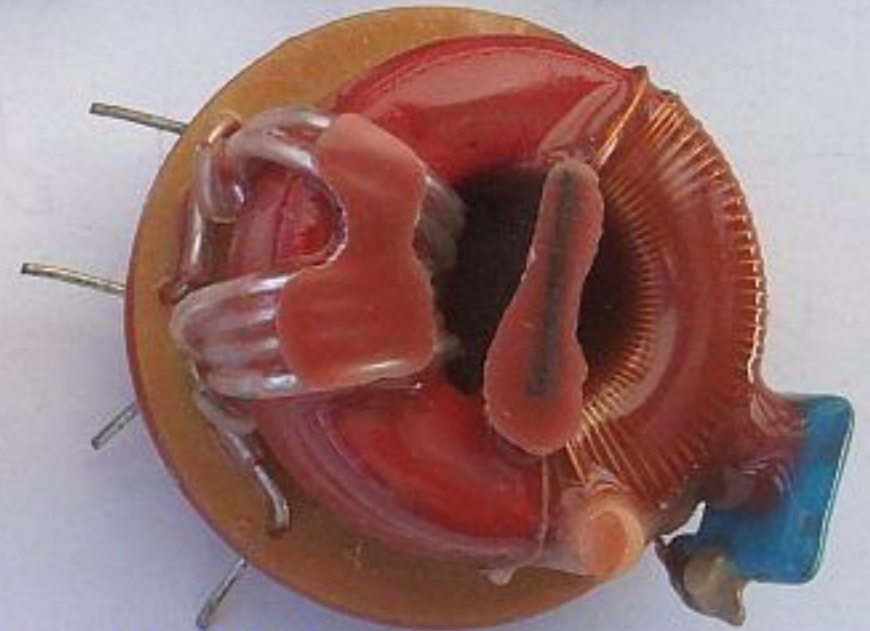
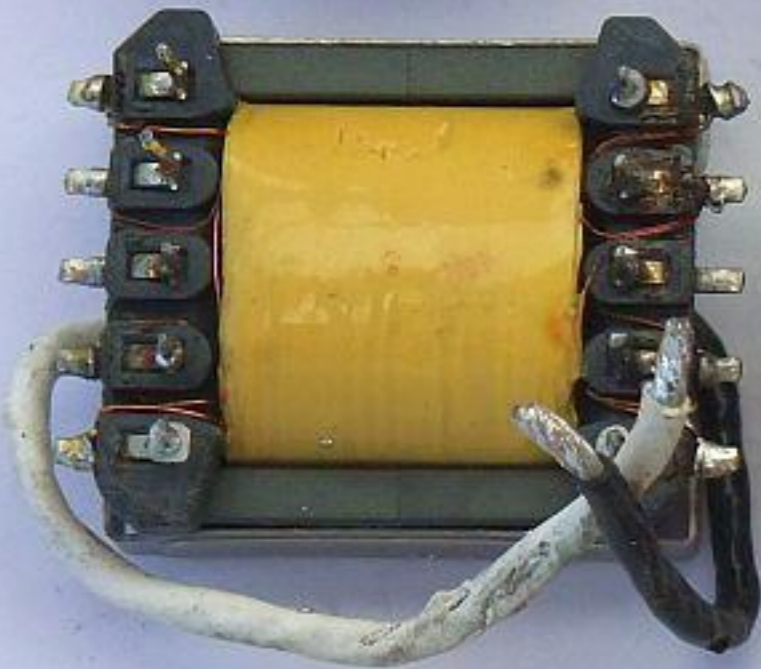
Jedra C

Jedra EI



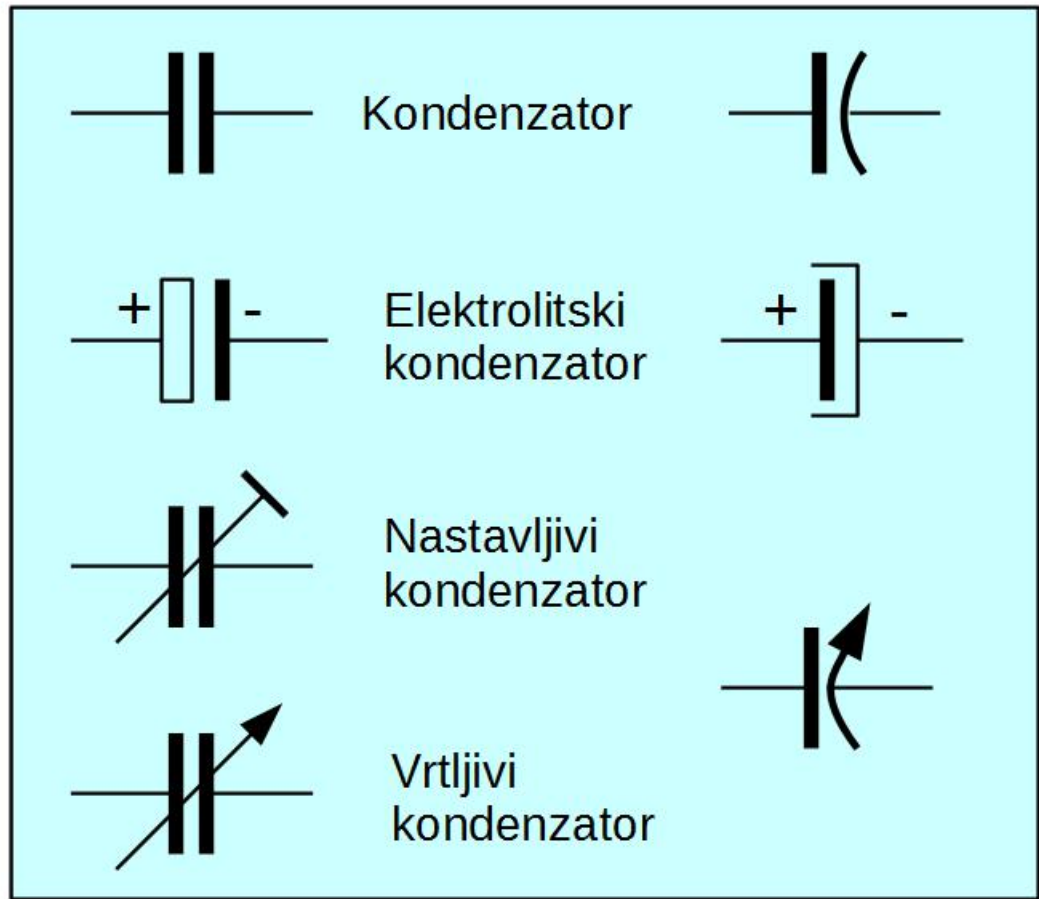
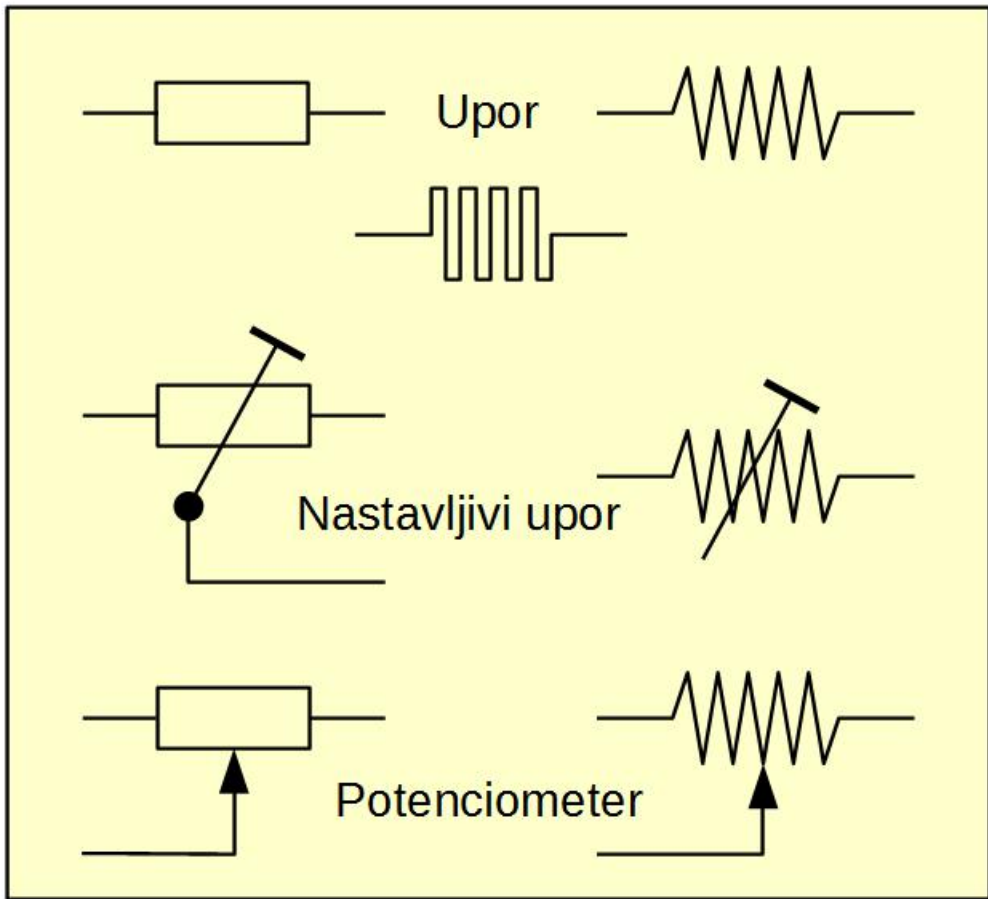
Lončki

Ethernet

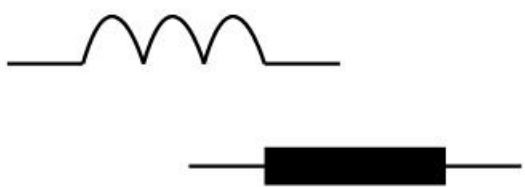


Transformatorji

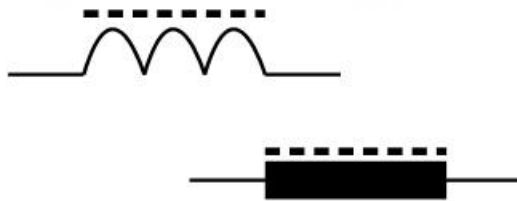
Toroidni



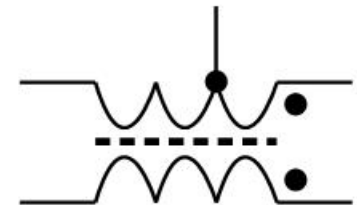
Tuljava z zračnim jedrom



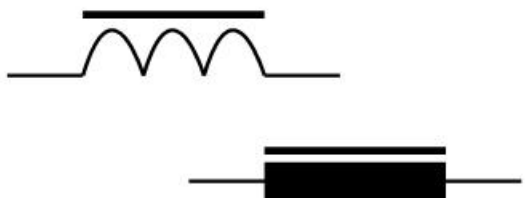
Tuljava s feritnim jedrom



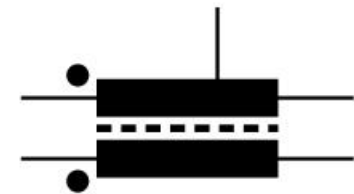
Transformator s feritnim jedrom in odcepom



Tuljava z železnim jedrom



Tuljava z nastavljivim feritnim jedrom

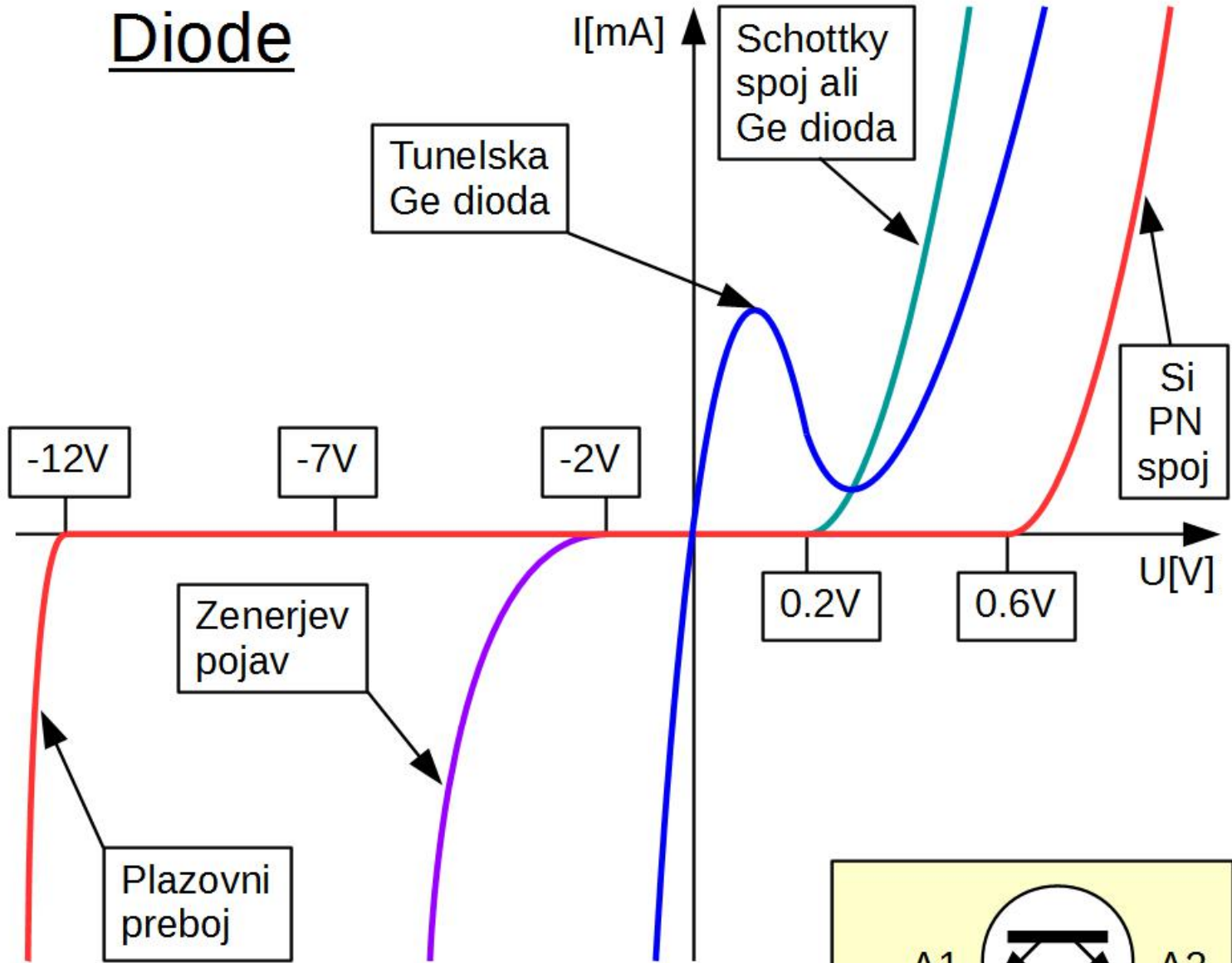
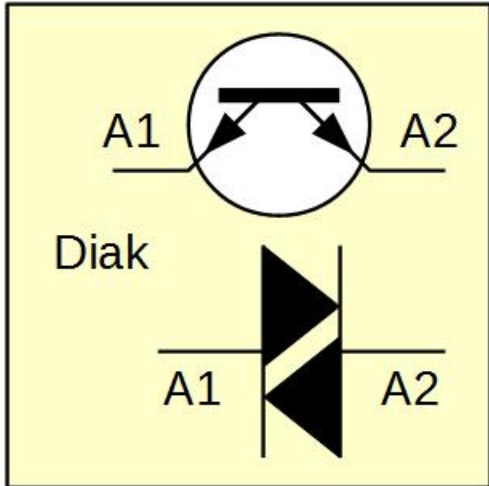
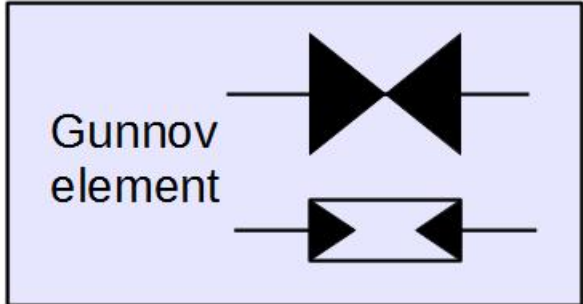
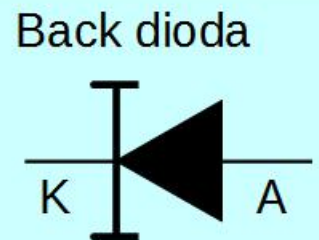
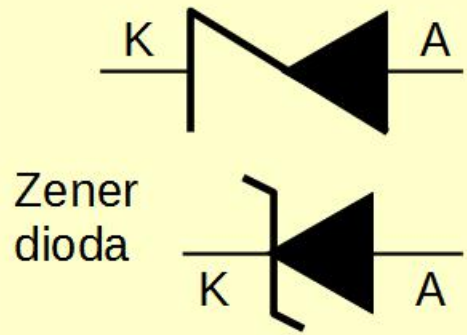
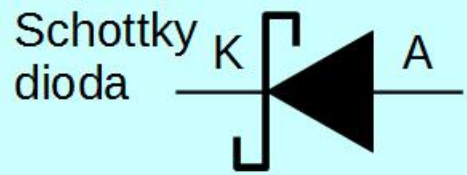


RLC merilnik za SMD gradnike

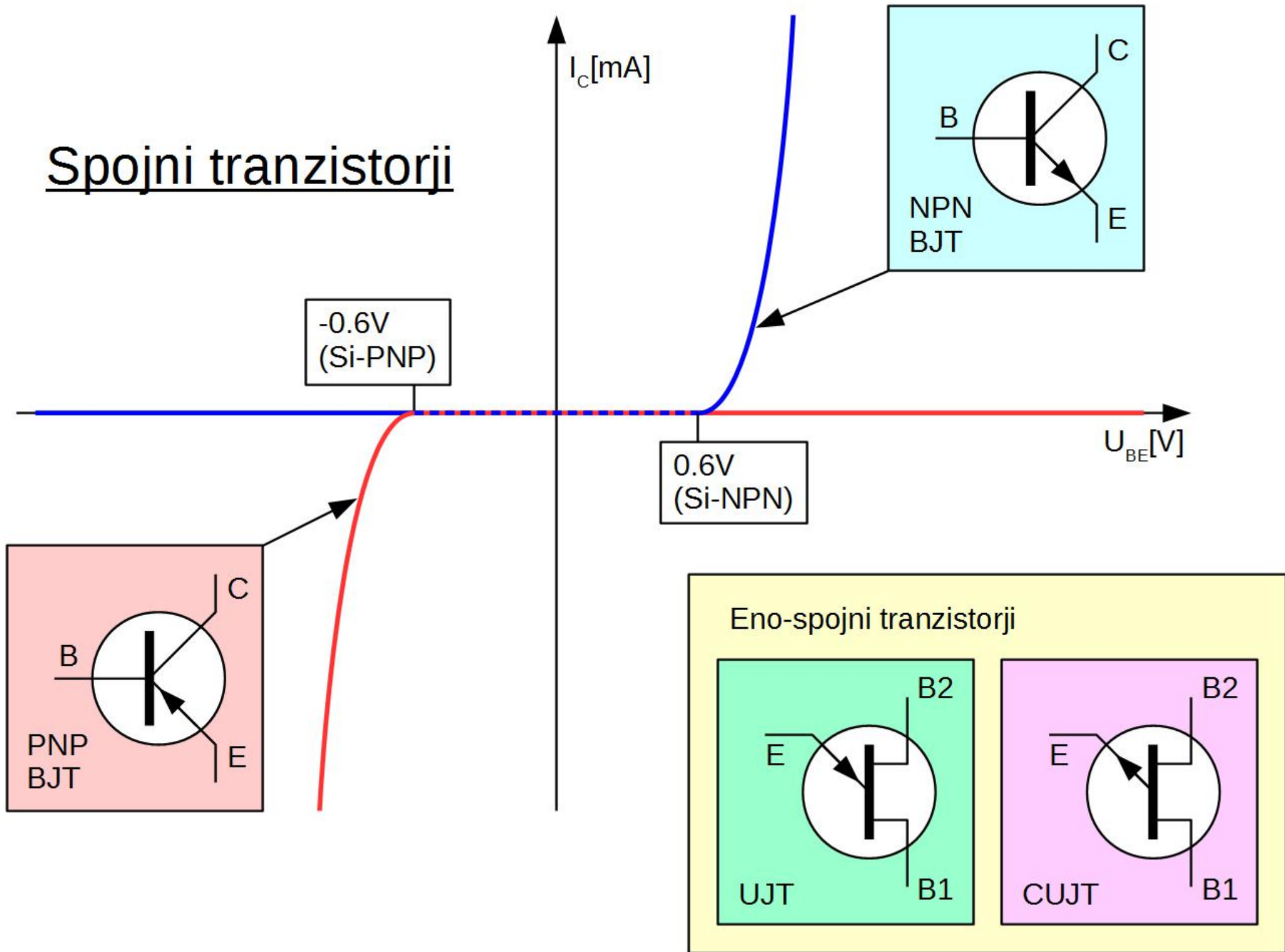


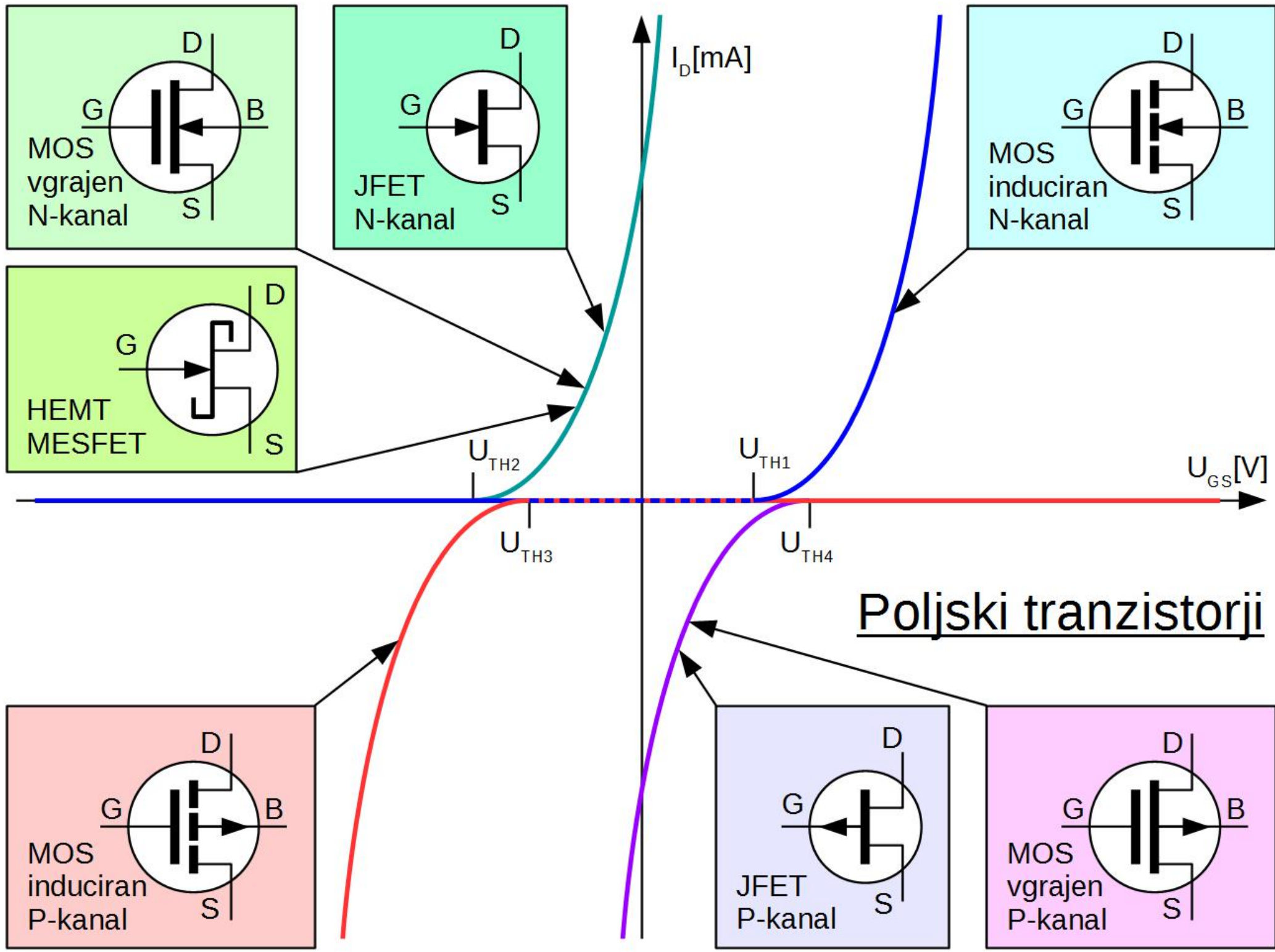
Polprevodnik	Prepovedan energijski pas ΔW [eV]	Prebojna trdnost E_{MAX} [V/cm]	Mobilnost elektronov μ_n [cm ² /Vs]	Mobilnost vrzeli μ_p [cm ² /Vs]
PbS	0.37	(preboj<2V)	600	200
Se	1.95	(preboj<25V)	0.005	0.14
PbSe	0.27		900	700
PbTe	0.32		1700	930
Cu ₂ O	2.137	(preboj<8V)	0.2	0.1
Si	1.11	$3 \cdot 10^5$	1400	450
Ge	0.67	10^5	3900	1900
Si _{1-x} Ge _x	0.67-1.11	$3 \cdot 10^5$		
SiO ₂	9	10^6 - 10^7		
Si ₃ N ₄	5.4	$3 \cdot 10^6$		
C (diamant)	5.5	10^6 - 10^7	2200	1800
3C-SiC	2.36	10^6	800	320
4H-SiC	3.23	$3 \cdot 10^6$ - $5 \cdot 10^6$	900	120
6H-SiC	3.05	$3 \cdot 10^6$ - $5 \cdot 10^6$	400	90
GaAs	1.43	$4 \cdot 10^5$	5000	400
AlAs	2.16	$6 \cdot 10^5$	1200	420
InP	1.344	$5 \cdot 10^5$	5400	200
GaP	2.26	10^6	250	150
GaSb	0.726	50000	3000	1000
InAs	0.354	40000	40000	400
InSb	0.17	1000	77000	850
GaN	3.4	$5 \cdot 10^6$	1800	30
AlN	6.28	$1.2 \cdot 10^6$ - $1.8 \cdot 10^6$	300	14
InN	0.65		3200	
BN	5.4	$3 \cdot 10^6$ - $6 \cdot 10^6$	200	500
CdS	2.42		400	
CdSe	1.74		650	
CdTe	1.44		1100	100
Hg _{1-x} Cd _x Te	0-1.5			

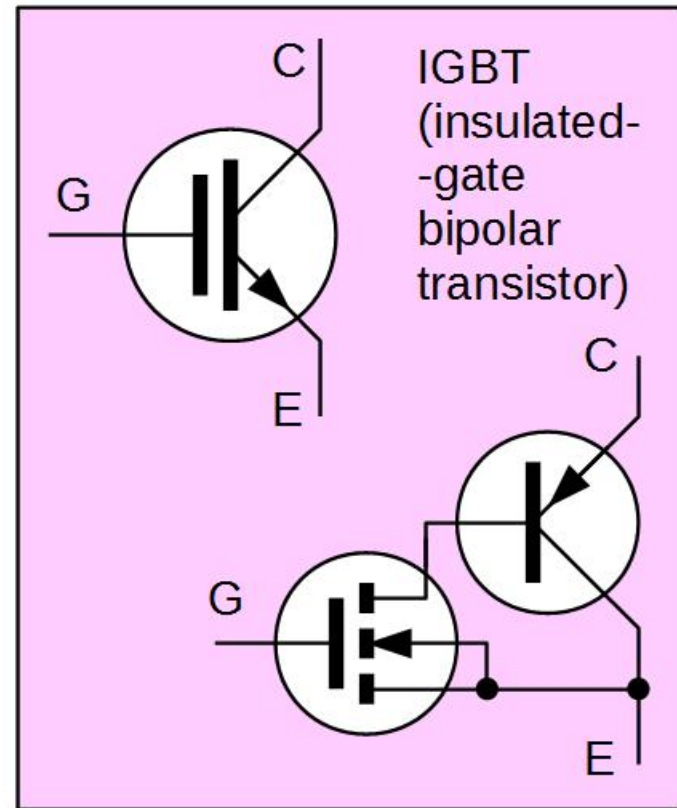
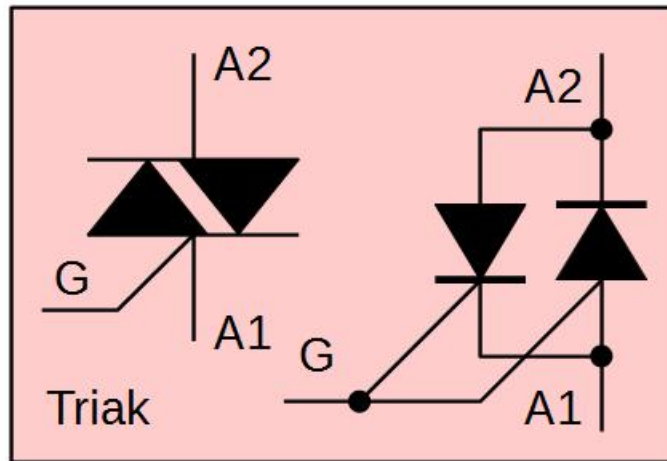
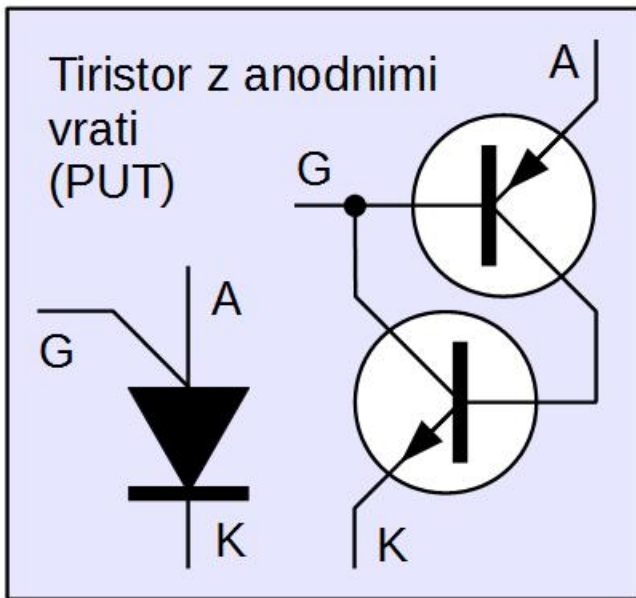
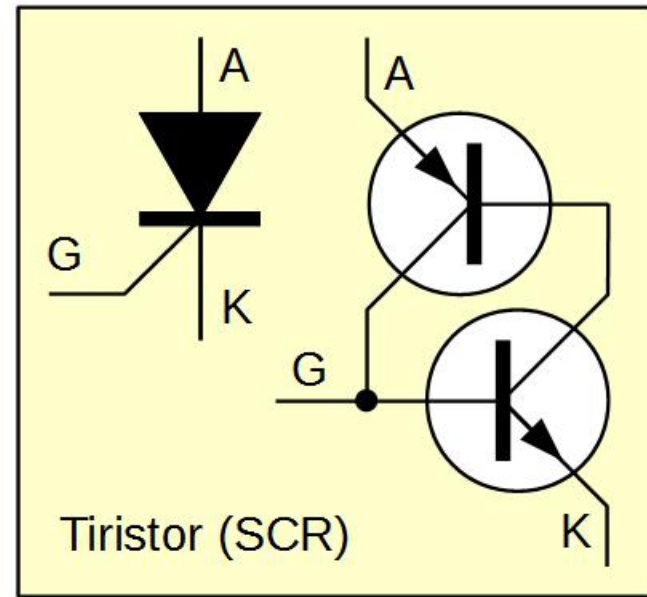
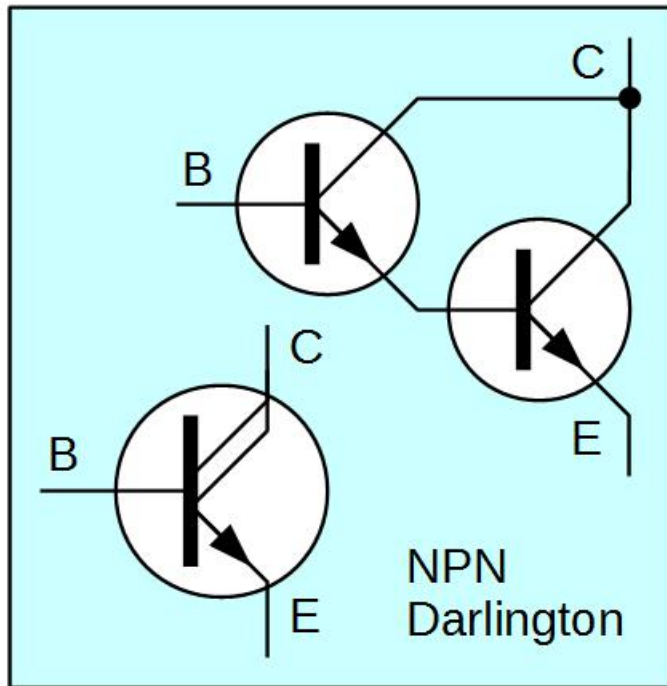
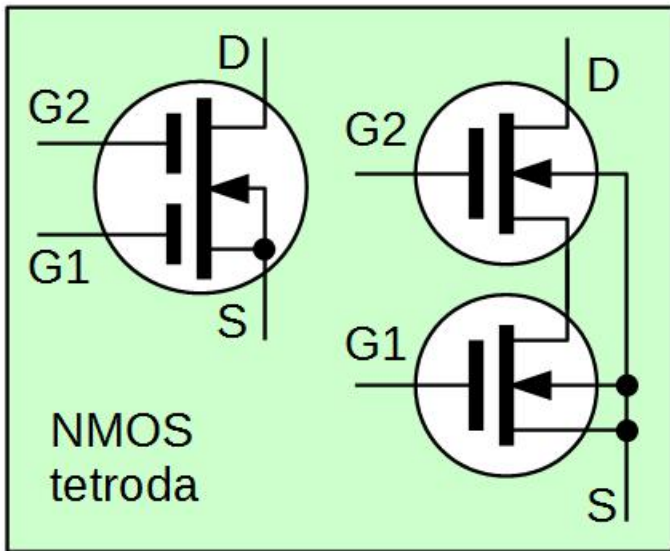
Diode



Spojni tranzistorji



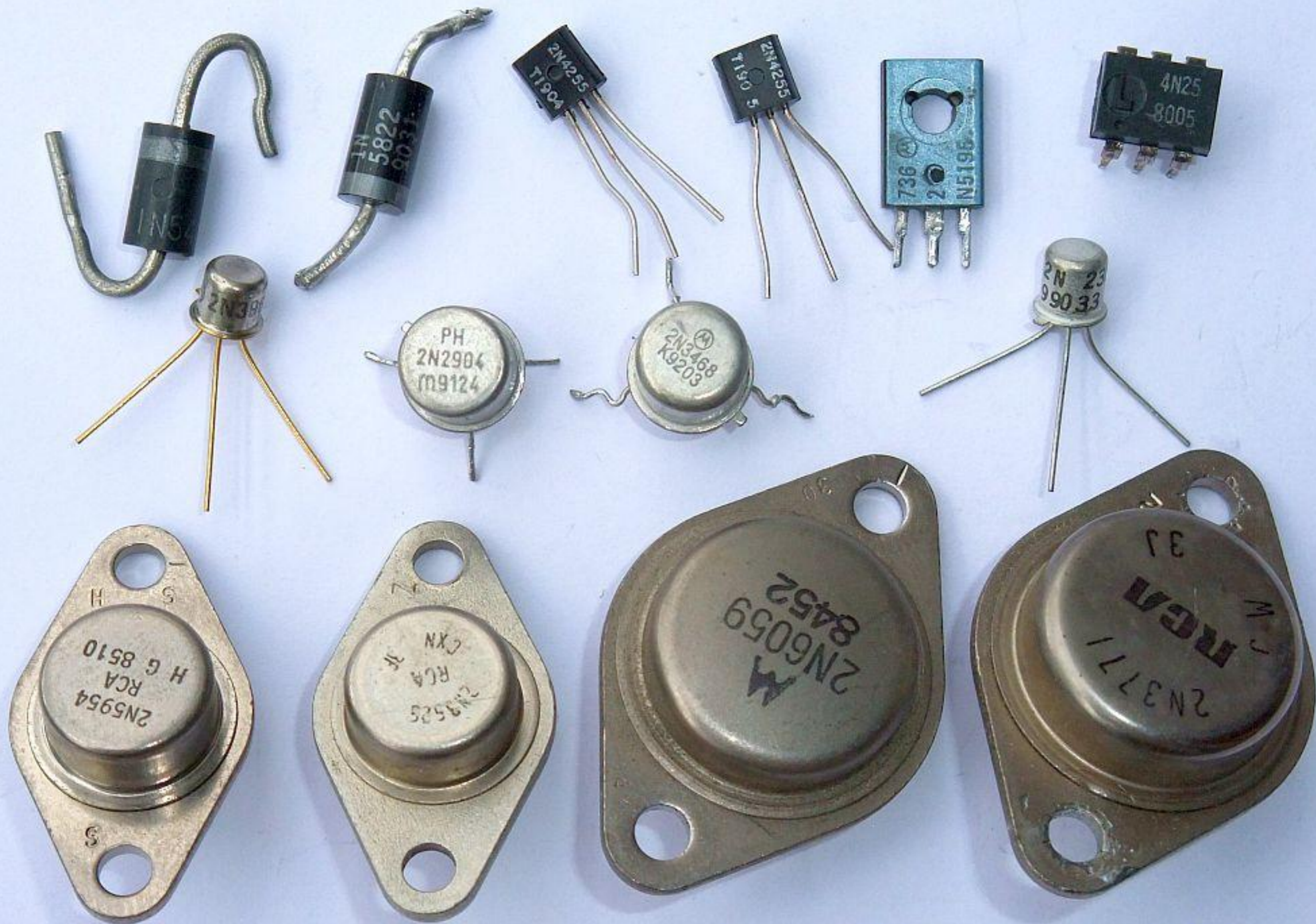




Sestavljeni gradniki

Črka	Širina prepovedanega energijskega pasu ΔW [eV]
A	$0.6\text{eV} < \Delta W < 1.0\text{eV}$ običajno germanij (Ge)
B	$1.0\text{eV} < \Delta W < 1.3\text{eV}$ običajno silicij (Si)
C	$\Delta W > 1.3\text{eV}$ na primer galijev arzenid (GaAs)
D	$\Delta W < 0.6\text{eV}$ na primer indijev antimonid (InSb)
R	Polprevodniki za fotoupore in Hallova tipala brez PN spojev

Črka	Vrsta in namen gradnika
A	Malosignalna dioda (detektor, preklopna, mešalnik, PIN)
B	Uglaševalna varikap dioda (uglaševalni varaktor)
C	Malosignalni nizkofrekvenčni tranzistor ($R_{TH} > 15K/W$)
D	Močnostni nizkofrekvenčni tranzistor ($R_{TH} \leq 15K/W$)
E	Tunelska dioda (negativna diferencialna upornost)
F	Malosignalni visokofrekvenčni tranzistor ($R_{TH} > 15K/W$)
G	Hibridno vezje oziroma sestavljen gradnik
H	Samostojno Hallovo tipalo magnetnega polja
K	Hallovo tipalo v magnetnem vezju
L	Močnostni visokofrekvenčni tranzistor ($R_{TH} \leq 15K/W$)
M	Analogni množilnik, frekvenčni mešalnik ali modulator
N	Opto-sklopnik
P	Fotodioda ali fototranzistor
Q	Svetleča dioda ali polprevodniški laser
R	Malosignalni tiristor, diak, triak, UJT, PUT ($R_{TH} > 15K/W$)
S	Malosignalni stikalni tranzistor ($R_{TH} > 15K/W$)
T	Močnostni tiristor ali triak ($R_{TH} \leq 15K/W$)
U	Močnostni stikalni tranzistor ($R_{TH} \leq 15K/W$)
V	Antena
W	Gradnik s površinskim zvočnim valovanjem (SAW)
X	Frekvenčni množilnik (varikap dioda, varaktor, SRD)
Y	Močnostna usmerniška dioda
Z	Stabilizatorska (Zener) dioda ali prenapetostna zaščita



Ameriški polprevodniki

Oznaka	Vrsta in namen gradnika
2SA...	Visokofrekvenčni bipolarni PNP tranzistor
2SB...	Nizkofrekvenčni bipolarni PNP tranzistor
2SC...	Visokofrekvenčni (stikalni) bipolarni NPN tranzistor
2SD...	Nizkofrekvenčni bipolarni NPN tranzistor
1SE...	Dioda
2SF...	Tiristor
1SG...	Gunnov element
2SH...	Eno-spojni tranzistor (UJT)
2SJ...	P-kanalni JFET ali MOSFET
2SK...	N-kanalni JFET ali MOSFET ali MESFET ali HEMT
3SK...	MOS tetroda
2SM...	Triak
1SQ...	Svetleča dioda
1SR...	Usmerniška (močnostna) dioda
1SS...	Malosignalna dioda (detektor, preklopna, mešalnik)
1ST...	Plazovna dioda
1SV...	Varikap dioda (varaktor)
1SZ...	Zener dioda



Japonski polprevodniki

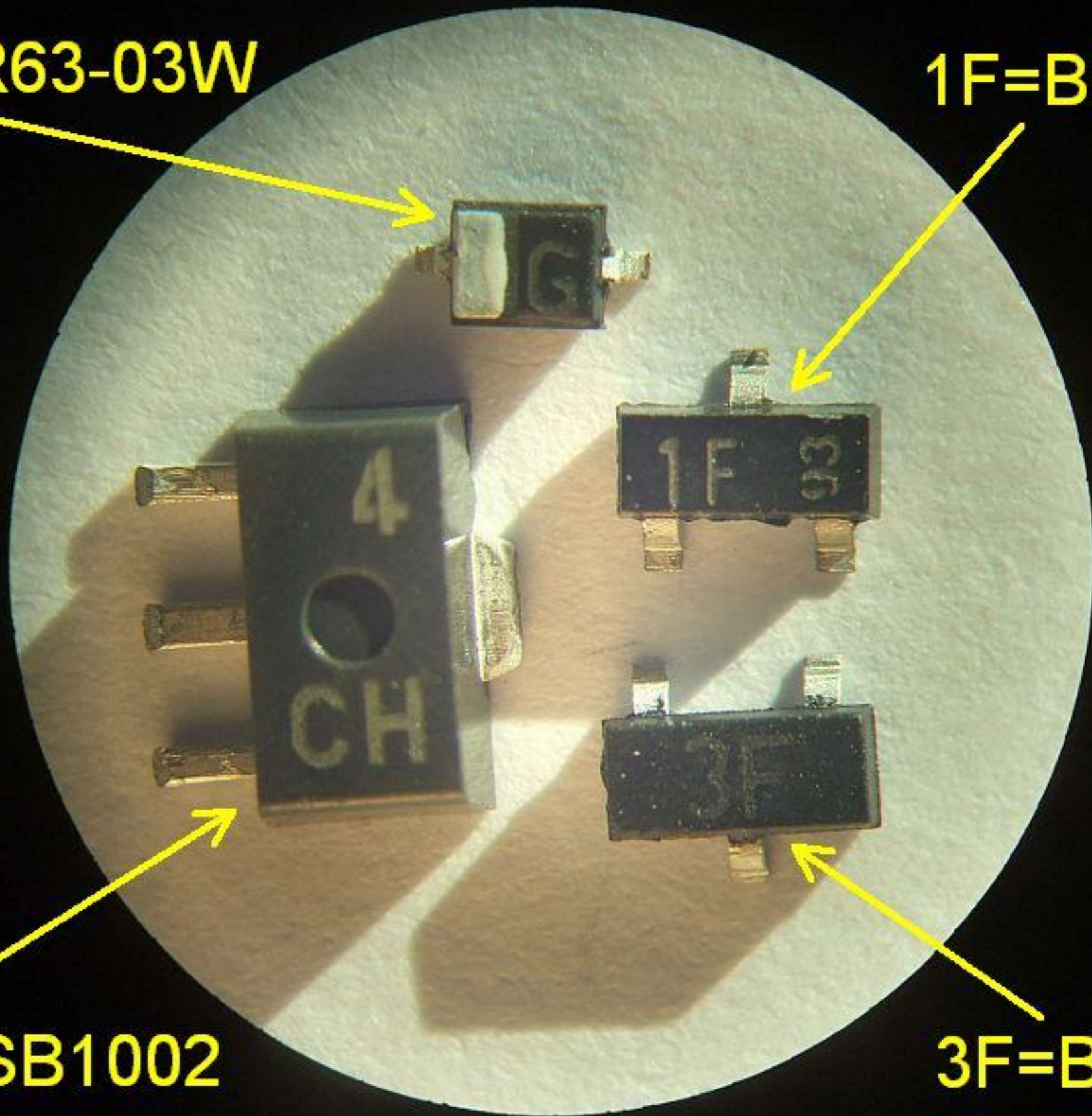




Močnostni MOSFET

G=BAR63-03W

1F=BC847B



CH=2SB1002

3F=BC857B

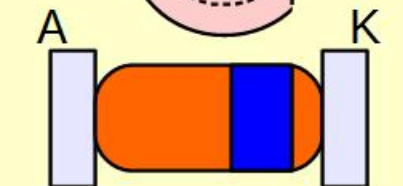
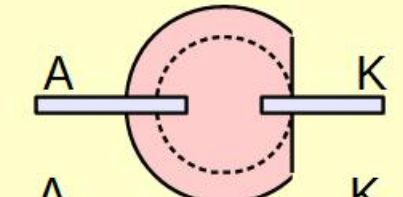
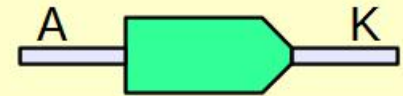
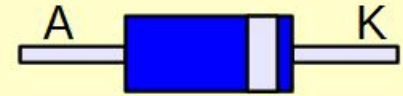
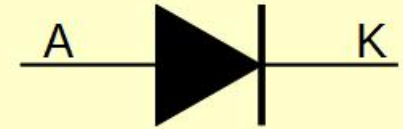
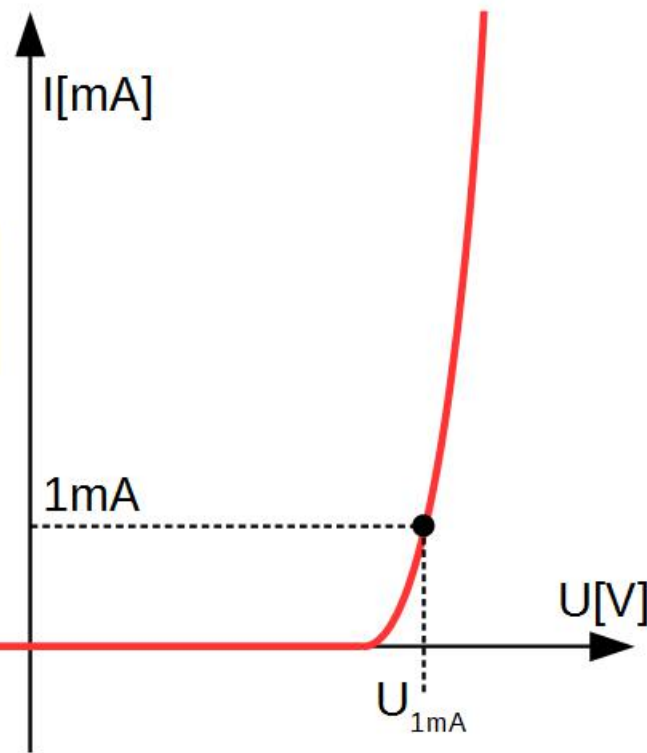
Enačba diode

$$I = I_s \left(e^{\frac{U|Q_e|}{nk_B T}} - 1 \right) \approx I_s \left(e^{\frac{U}{26\text{mV}}} - 1 \right)$$

$$1 \leq n \leq 2$$

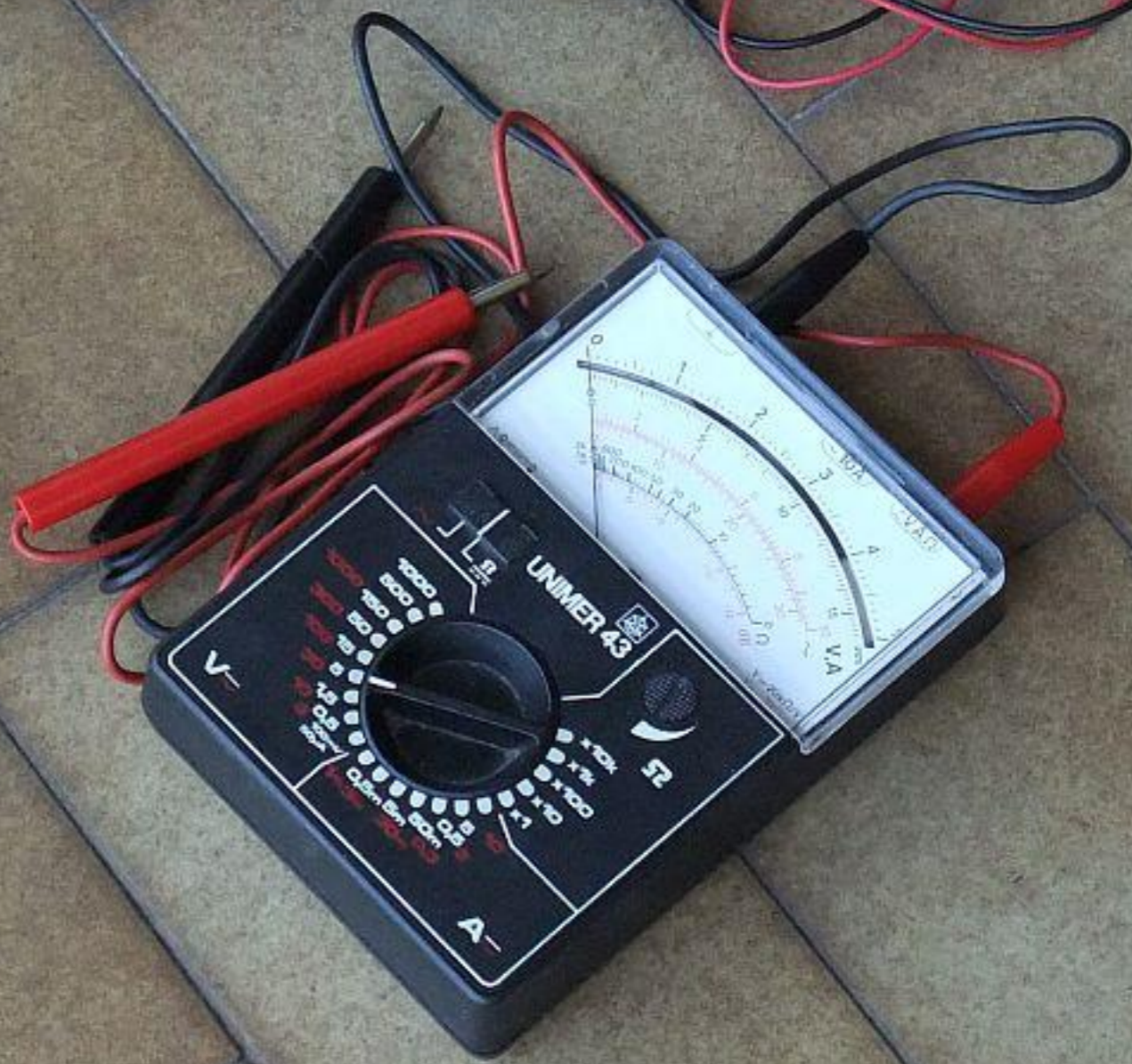
$$\frac{k_B T}{|Q_e|} \approx 26\text{mV}$$

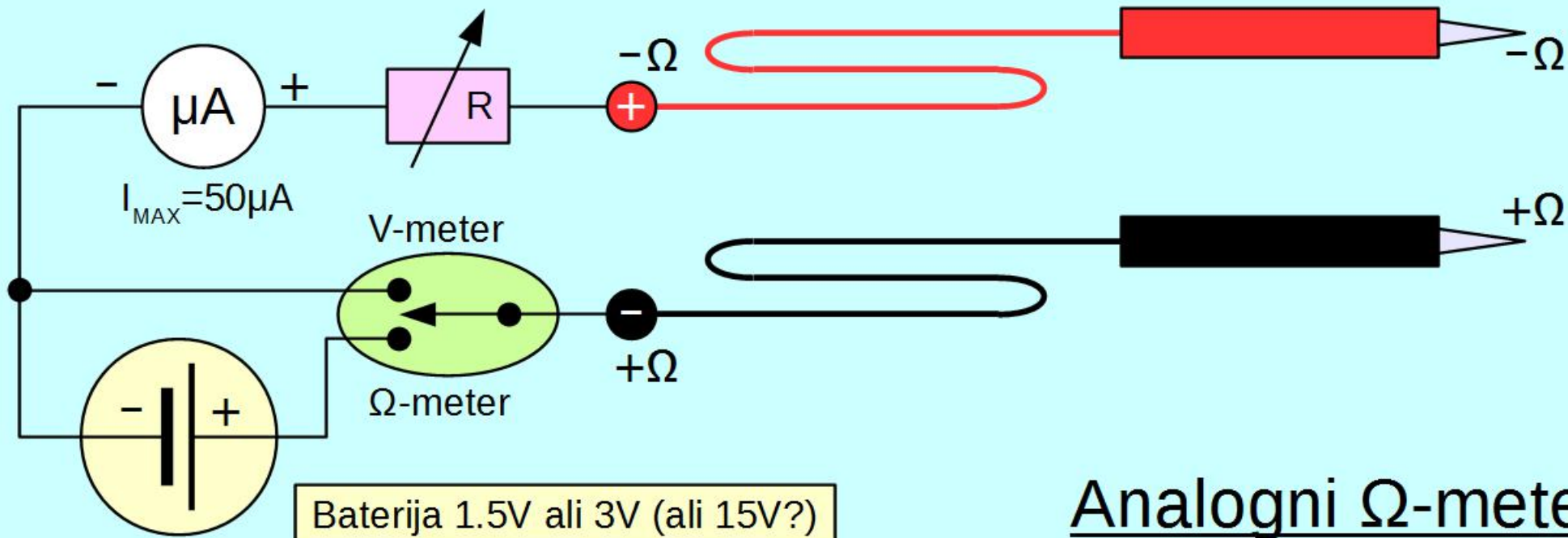
$n \approx 1$ (PN, Schottky)



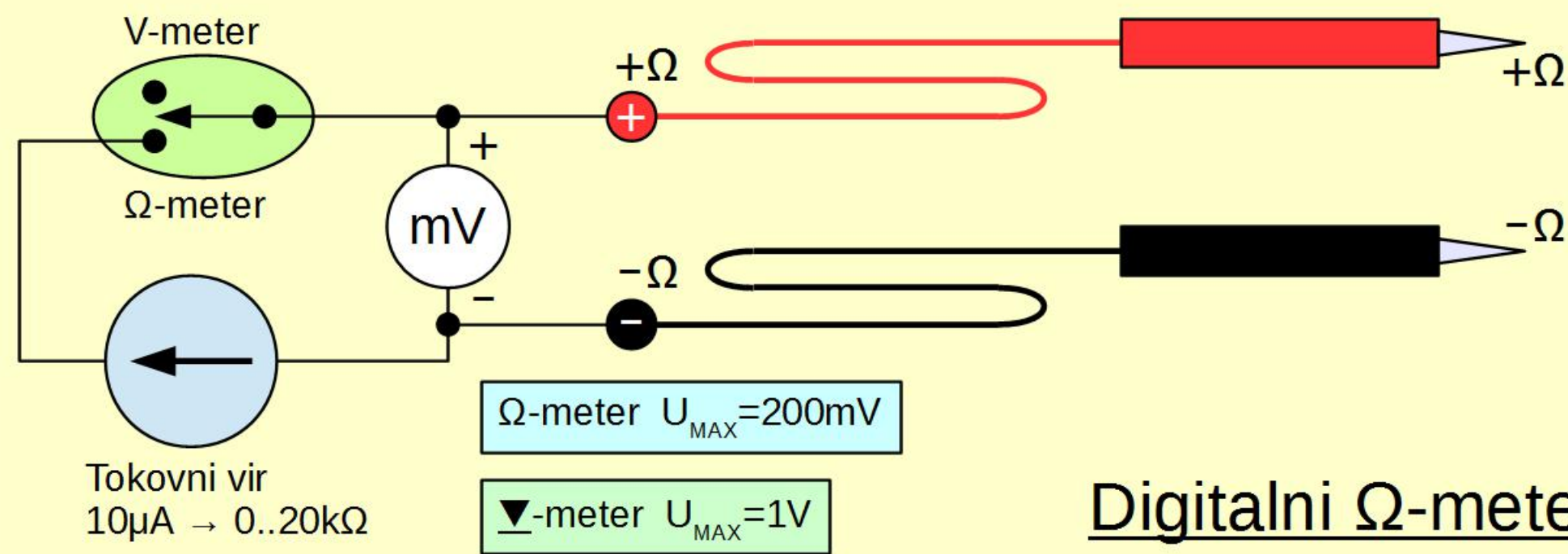
Vrsta diode	Polprevodnik	ΔW	$U_{1\text{mA}}$	I_s
PN spoj	Si	1.11eV	0.5-0.7V	$4 \cdot 10^{-12} - 2 \cdot 10^{-15} \text{A}$
PN spoj	Ge	0.67eV	0.1-0.2V	$2 \cdot 10^{-5} - 4 \cdot 10^{-7} \text{A}$
IR LED	GaAs	1.43eV	1V	$2 \cdot 10^{-20} \text{A}$
Zelena LED	GaP	2.26eV	1.8V	10^{-33}A
Modra LED	GaN	3.4eV	2.7V	10^{-48}A
Schottky	Si	1.11eV	0.1-0.4V	$2 \cdot 10^{-5} - 2 \cdot 10^{-10} \text{A}$
Schottky	GaAs	1.43eV	0.7V	$2 \cdot 10^{-15} \text{A}$
Schottky	GaN	3.4eV	1.6V	$2 \cdot 10^{-30} \text{A}$

Univerzalni inštrumenti

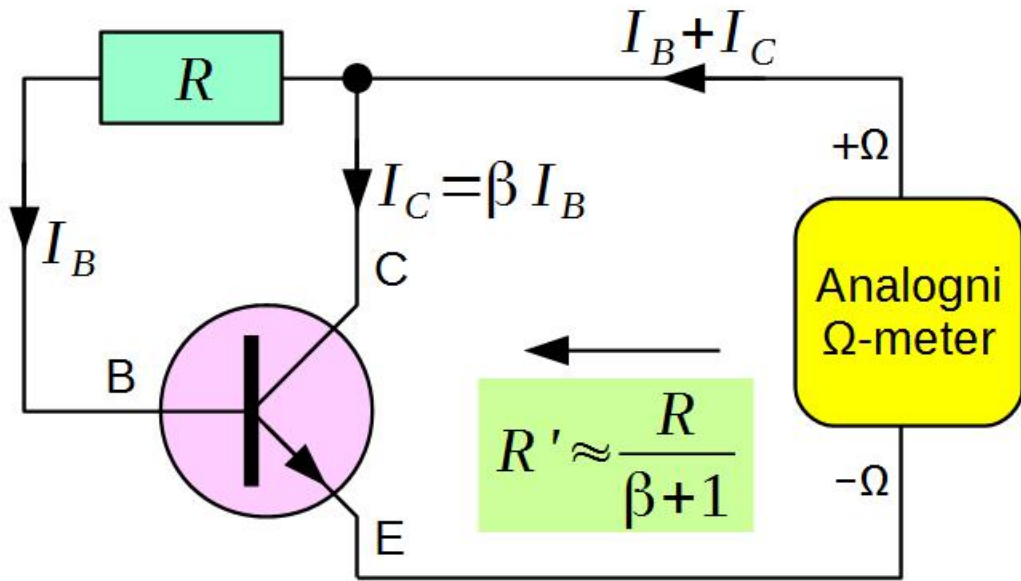
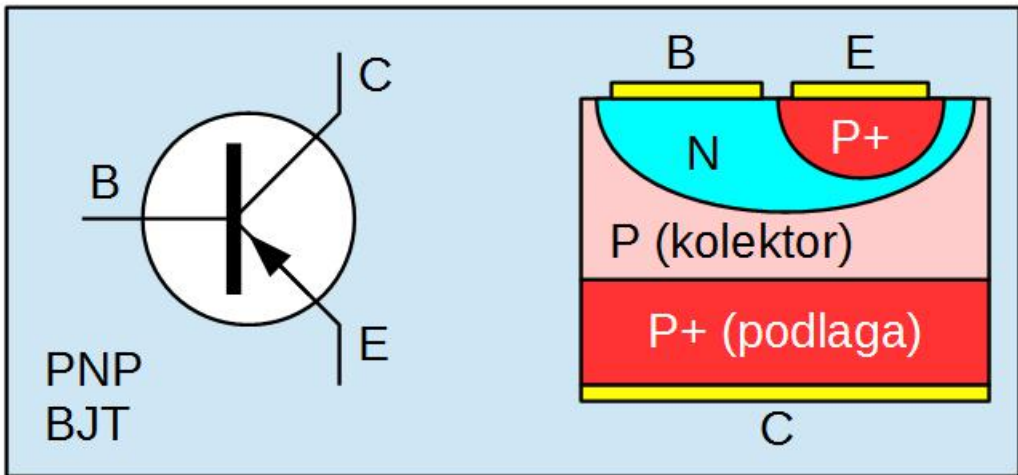
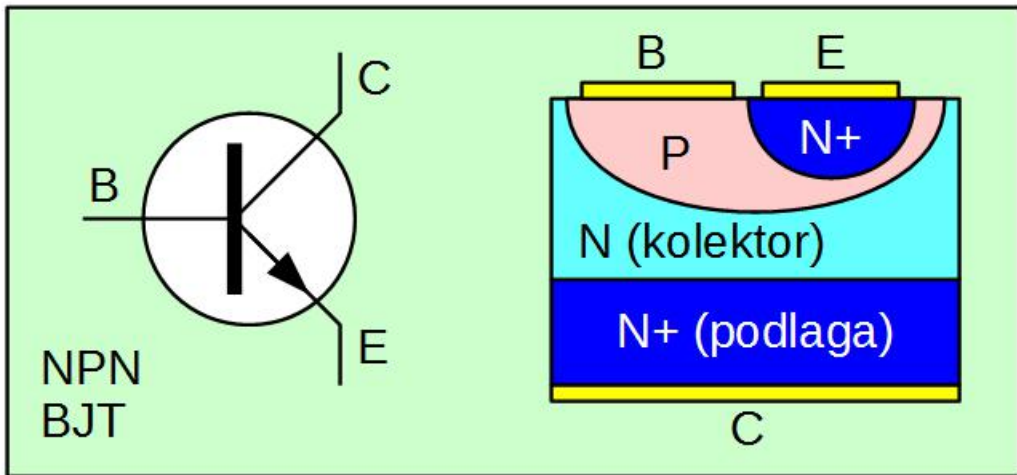




Analogni Ω -meter



Digitalni Ω -meter



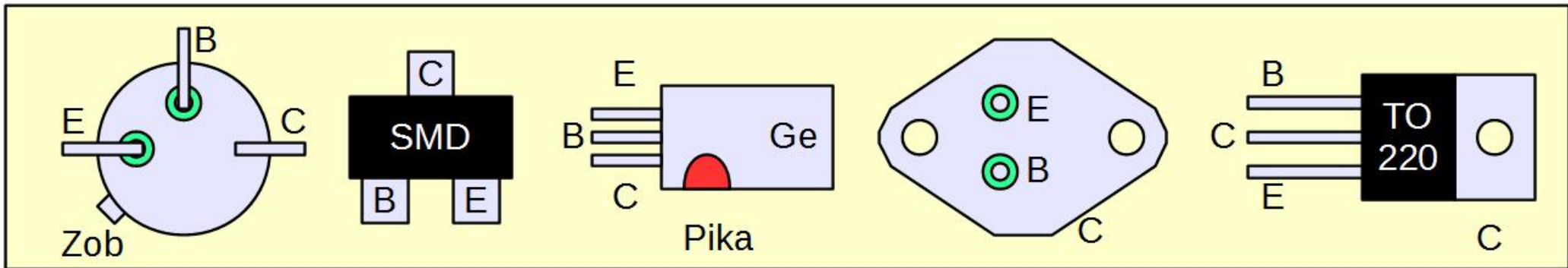
Bipolarni tranzistorji

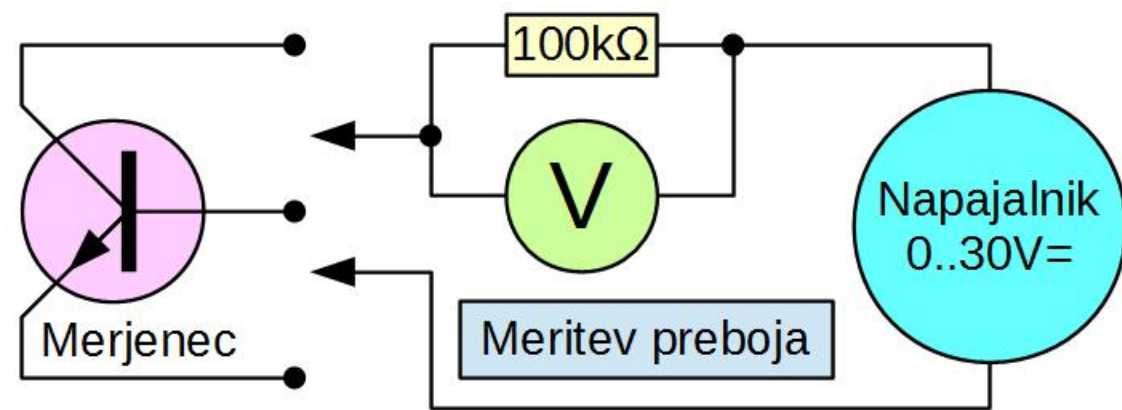
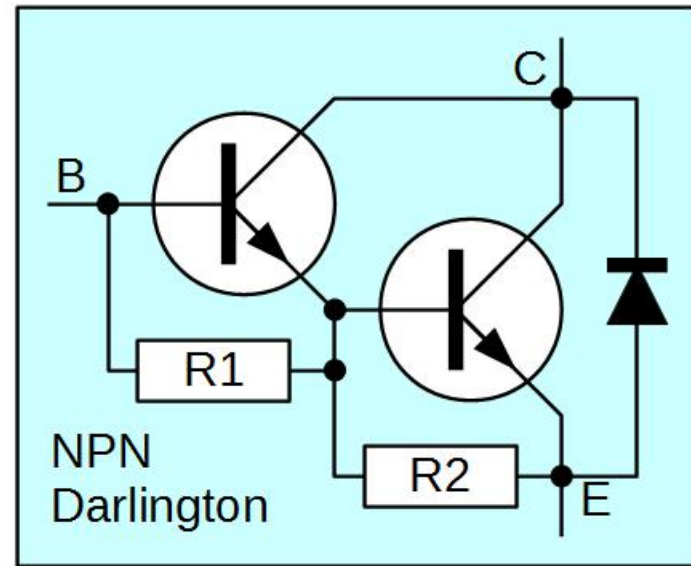
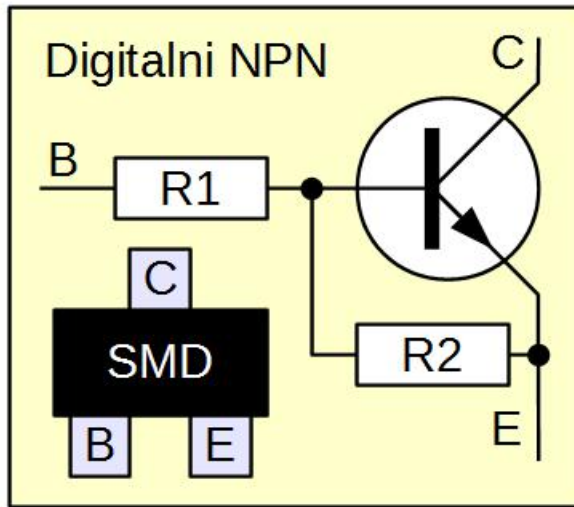
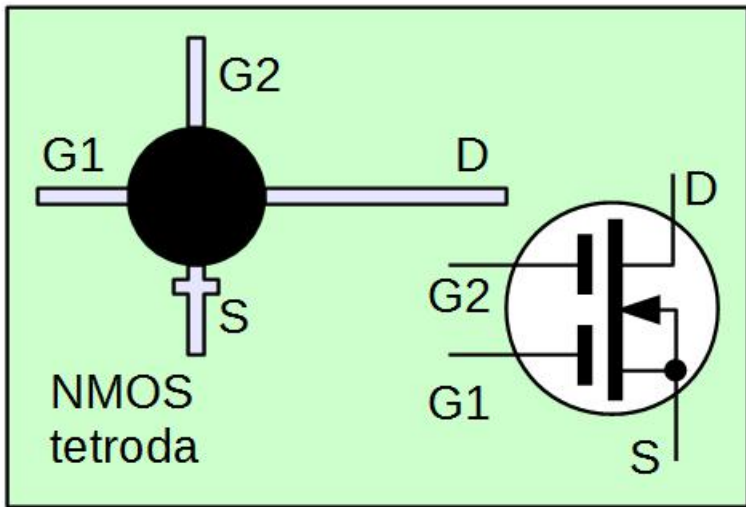
$$U_{prebojBE} \approx 3 \text{ V} \dots 10 \text{ V}$$

$$U_{prebojBC} \approx 30 \text{ V} \dots 100 \text{ V}$$

$$\beta \approx 60 \dots 1000$$

$$\beta \approx 3 \dots 10 \text{ (zamenjana E/C)}$$





Zahtevnejši merjenci

