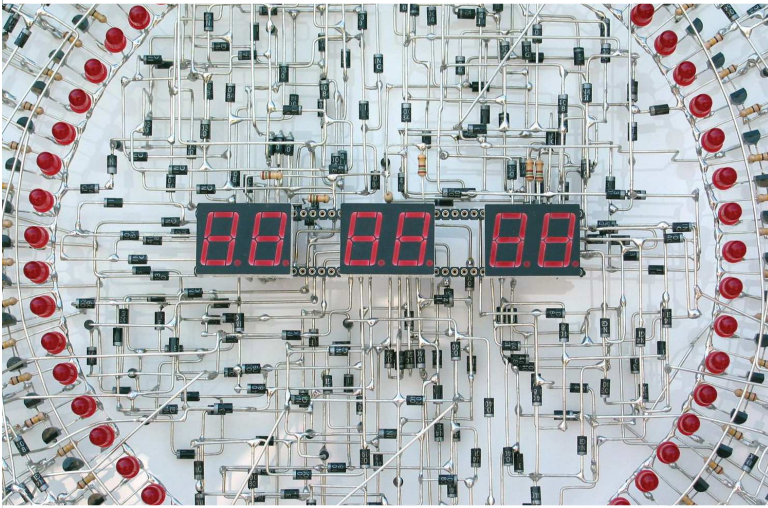


# Elektronika

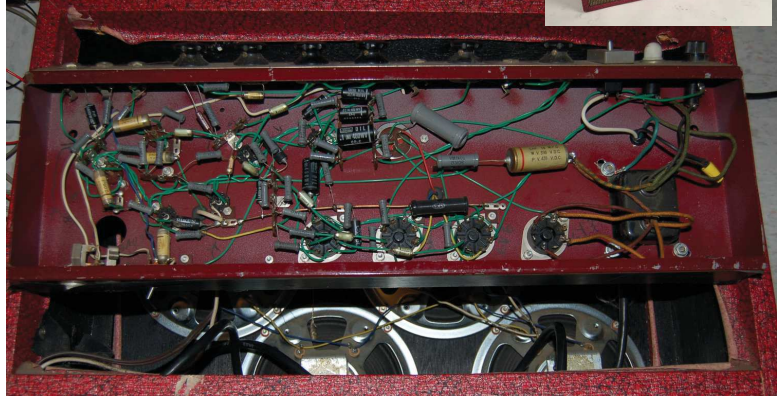


Gislain Benoit: The Clock. <http://techno-logic-art.com/clock.htm>

## Point-to-Point (PtP) – vrabčie hniezdo

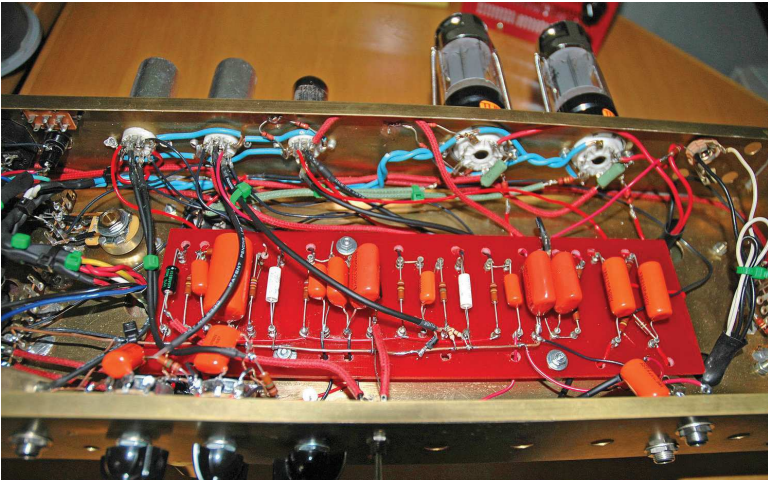
Japan: chassis from a 1960s-vintage Teisco guitar amplifier with 6V6GT valves.

[https://commons.wikimedia.org/wiki/File:TEISCO\\_74R\\_guitar\\_amp\\_\(1960s\\_black-on-red\\_cover\)\\_-\\_chassis\\_underside\\_\(2006-12-14\\_22:28:41\).jpg](https://commons.wikimedia.org/wiki/File:TEISCO_74R_guitar_amp_(1960s_black-on-red_cover)_-_chassis_underside_(2006-12-14_22:28:41).jpg)



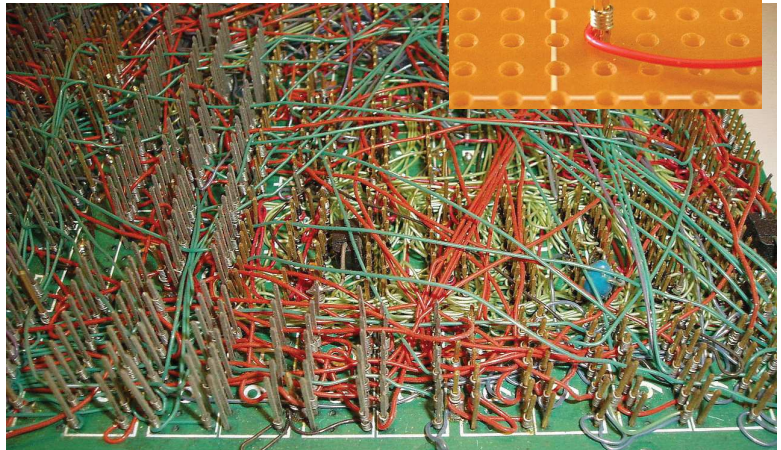
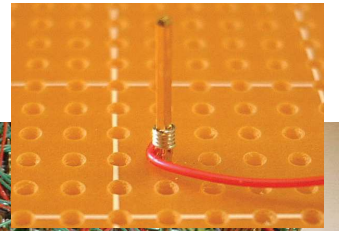
## Point-to-Point (PtP) – vrabčie hniezdo

[https://commons.wikimedia.org/wiki/File:Point\\_to\\_point\\_wiring.jpg](https://commons.wikimedia.org/wiki/File:Point_to_point_wiring.jpg)

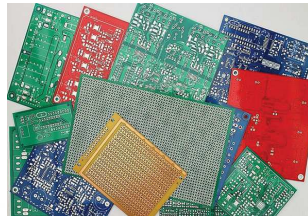


## Wire Wrap – ovíjané spoje

[https://commons.wikimedia.org/wiki/Category:Wire\\_wrapping](https://commons.wikimedia.org/wiki/Category:Wire_wrapping)

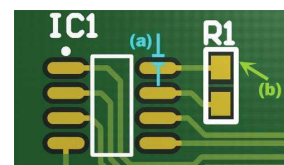
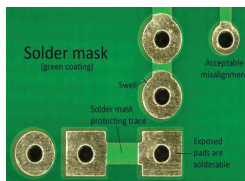
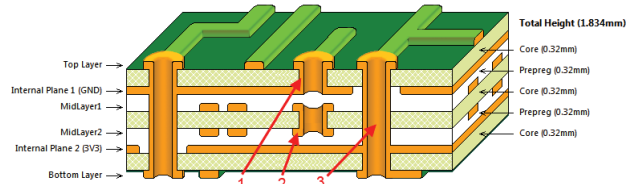


## Plošné spoje



[https://commons.wikimedia.org/wiki/File:PCB\\_with\\_discrete\\_DTL\\_modules\\_-\\_TOP\\_side.jpg](https://commons.wikimedia.org/wiki/File:PCB_with_discrete_DTL_modules_-_TOP_side.jpg)

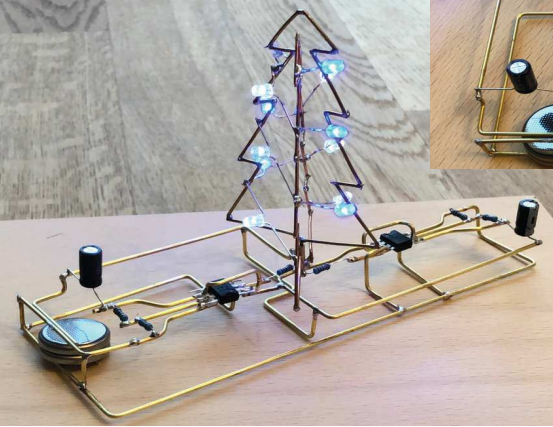
## Plošné spoje - vrstvy





## Free form konštrukcia

<https://hackaday.io/project/162741-ne555-christmas-tree>



7

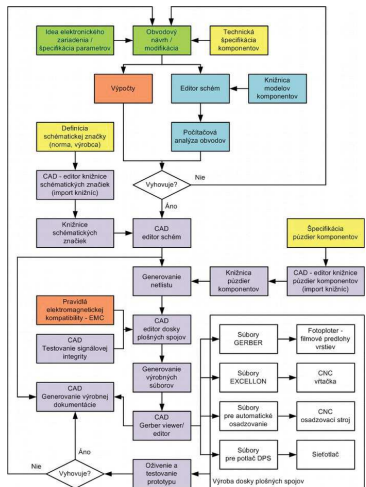
## Peter Vogel



<http://vogelxhibition.weebly.com/>

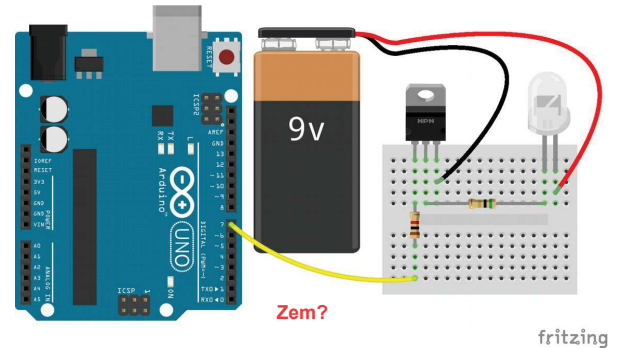


## Postupnosť vývoja prototypu elektronického zariadenia



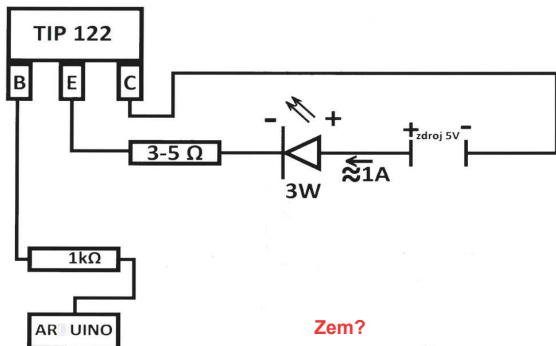
9

## Schéma zapojenia?



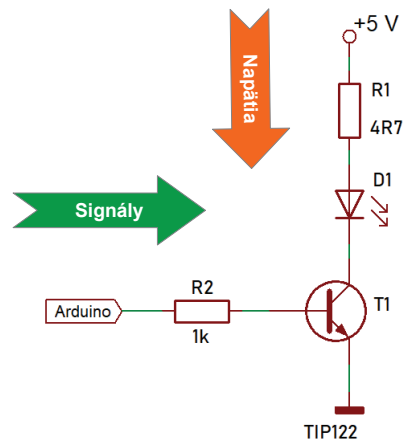
fritzing

## Schéma zapojenia?

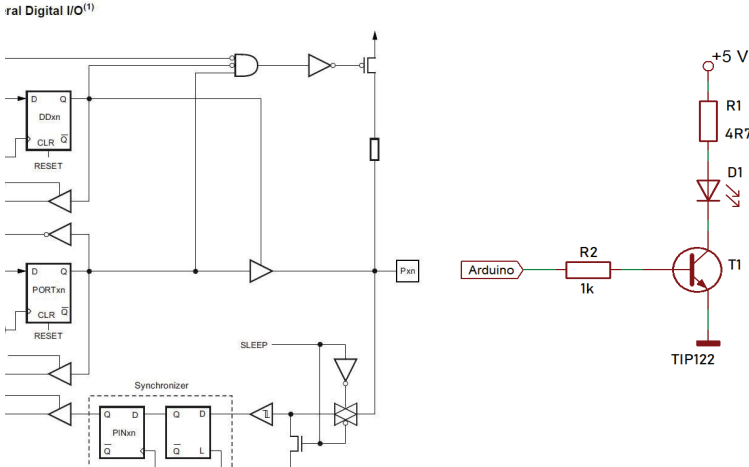


Zem?

## Schéma zapojenia



# Schéma zapojenia

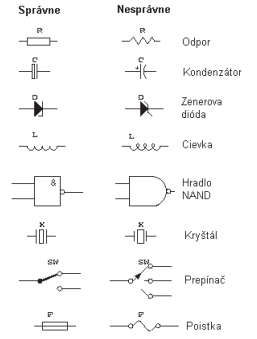


# Normy

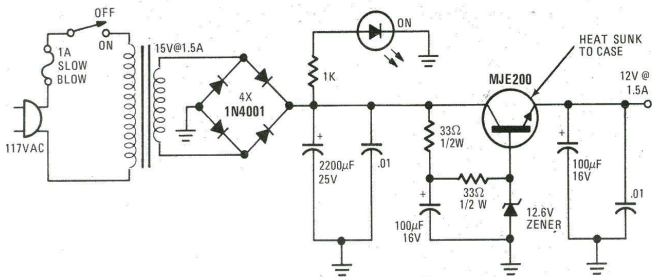
International Electrotechnical Commission  
IEC 60617 - Graphical Symbols for Diagrams

Tab. 1. Přeřídění zrušených norem a jejich náhrada

Papírová forma norem		Datařizová forma mezin. norem	
mezinárodní normy	národní normy	status	dosavadní / nová
IEC 60417-1:2002; IEC 60417-2:1999	ČSN EN 60417-1:2003; ČSN EN 60417-2:2003 (01 3765)	zrušené	IEC 60417 DB:2002 (náhrada zrušených mezinárodních norem) / IEC 60417-DB:2005
IEC 60617-1 až 13:1996 až 2002	ČSN IEC 60617-1:1996; ČSN EN 60617-2 až 12:2002; ČSN IEC 60617-11:1993; ČSN IEC 60617-13:1994 (01 3390)	zrušené	IEC 60617 DB:2001 (náhrada zrušených mezinárodních norem) / IEC 60617-DB:2005
IEC 80416-1:2001; ISO 80416-2:2001; IEC 80416-3:2002; ISO 80416-4:2005	ČSN EN 80416-1:2002; ČSN EN 80416-2:2002; ČSN EN 80416-3:2003 (01 3765)	nadále platné	datařizová forma neexistuje

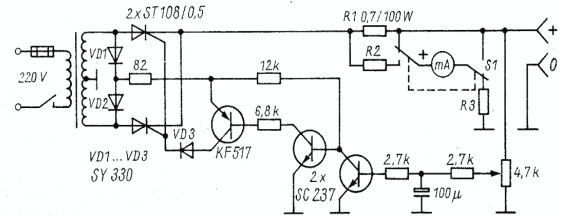


# USA



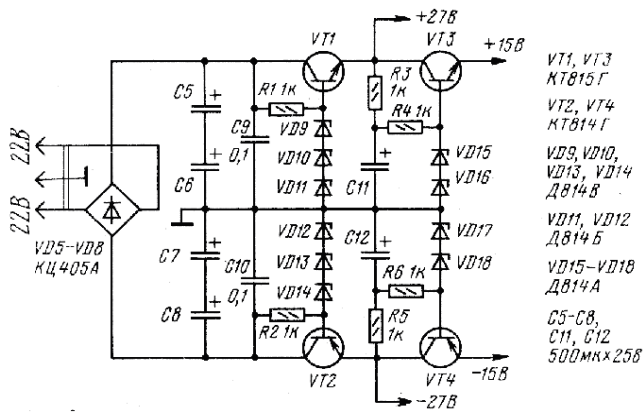
Power supply for the frequency counter. (Radio-Electronics, september/1977, s.43)

# NDR



Ladegerät für Kfz-Akkumulatoren. (Funkamateure, c.12/1987, s.613)

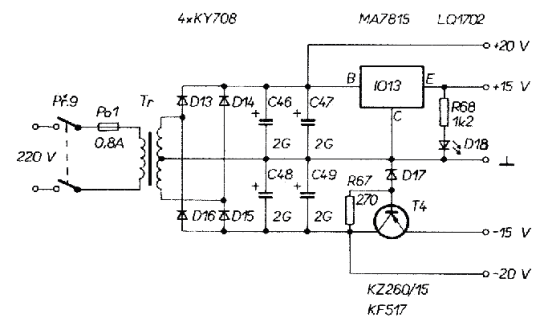
# CCCP



Gromkogovoritel' s EMOS. Istočnik pitaniya. (Radio, c.8/1989, s.52)

dôsledné oznacovanie výkonovej zatažitelnosti odporov

# ČSSR



Nizkofrekvenční zesilovač pro CD. Zapojení napájecího zdroje. (Amatérské Radio A, c.2/1989, s.54)

# Vodiče

Wire Symbols		
	Electrical Wire	Conductor of electrical current
	Connected Wires	Connected crossing
	Not Connected Wires	Wires are not connected

Ground Symbols		
	Earth Ground	Used for zero potential reference and electrical shock protection.
	Chassis Ground	Connected to the chassis of the circuit
	Digital / Common Ground	

# Vodiče

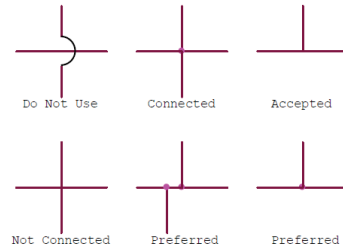


Figure 4. Conventions for crossing or connecting nets

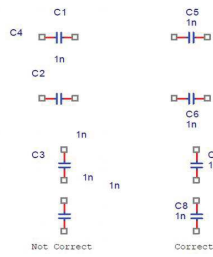


Figure 6. Positioning reference designators

Table 1. Common reference designators

Code	Package	Code	Package
C	Capacitor	P	Connector, Plug
D or CR	Diode	PS	Power Supply
D or VR	Zener or Breakdown Diode	Q	BJT, SCR, SCS
D	LED	R	Resistor
F	Fuse	S	Switch
J	JFET, Connector, Jack, Jumper	T	Transformer
K	Relay	TP	Testpoint
L	Inductor	U or IC	IC
M	MOSFET	X or Y	Crystal

## Basic Electrical & Electronic Symbols

www.electricaltechnology.org


# Switches Symbols

www.electricaltechnology.org


## Resistors Symbols

www.electricaltechnology.org

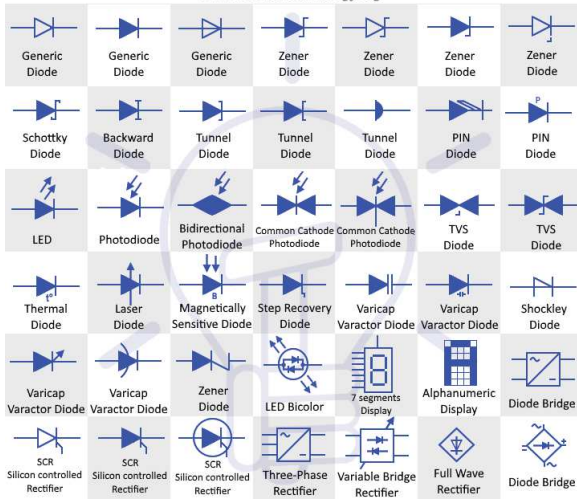

## Capacitors & Condensers Symbols

www.electricaltechnology.org



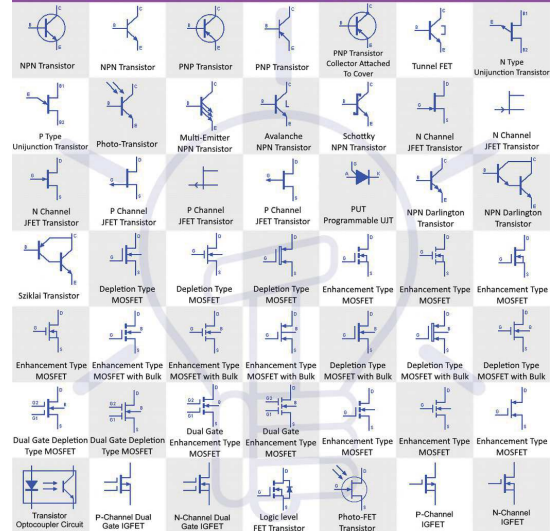

## Diodes Symbols

www.electricaltechnology.org



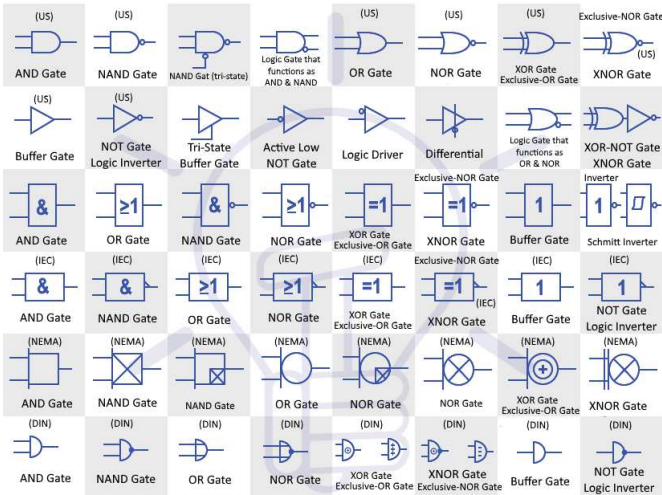
## Transistors, MOSFETS & IGFET Symbols

www.electricaltechnology.org



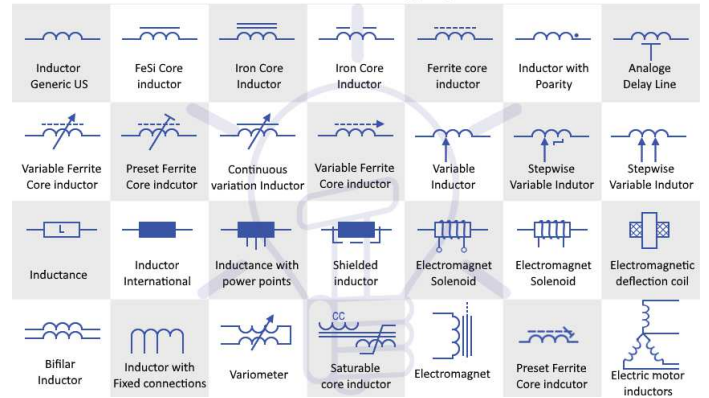
## Logic Gates Symbols

www.electricaltechnology.org



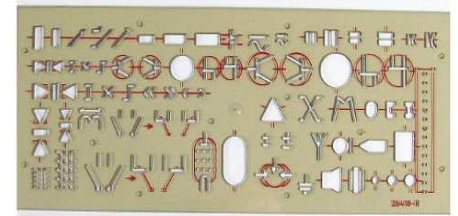
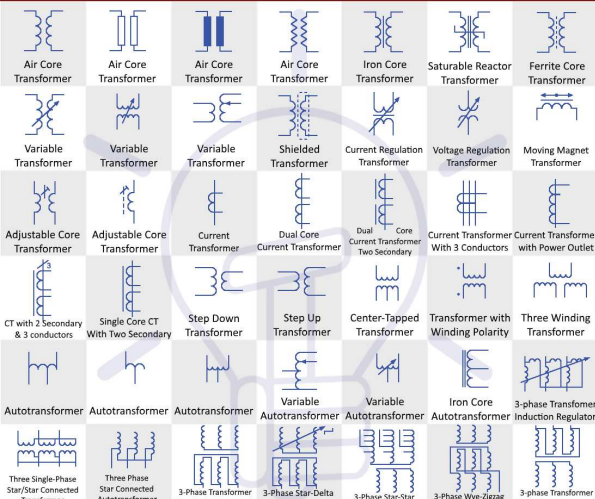
## Inductor Symbols

www.electricaltechnology.org



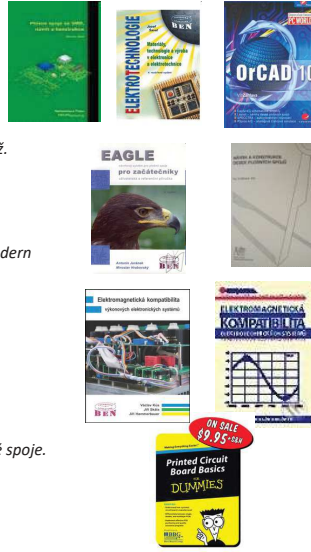
## Transformer Symbols

www.electricaltechnology.org

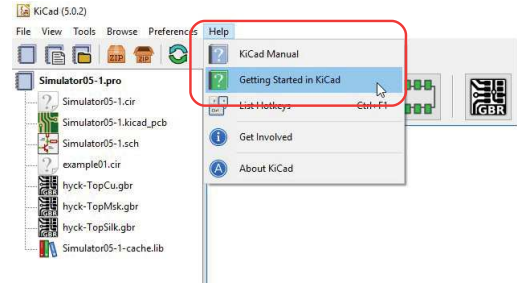


## Literatúra

- [1] Abel: *Plošné spoje se SMD, návrh a konstrukce*. Platan, Pardubice 2000. ISBN 80-902733-2-7
- [2] Starý, Šandera, Kahle: *Plošné spoje a povrchová montáž*. Skriptum VUT, Brno 1999. ISBN 80-214-1499-5
- [3] Šavel: *Materiály, technologie a výroba v elektronice*. BEN, Praha 2004. ISBN 80-7300-154-3
- [4] Tikkanen: *Printed Circuit Board Design Guide Using Modern CAD Systems: Examples Form PADS*. Jyväskylä, 2004, ISBN: 952-99423-0-3
- [5] Záhlava: *Metodika návrhu plošných spojů*. Skriptum ČVUT, Praha 2000. ISBN 80-01-02193-9
- [6] Záhlava: *OrCAD 10*. Grada Publishing, Praha 2004. ISBN 80-247-0904-X
- [7] Juránek, Hrabovský: *EAGLE návrhový systém pro plošné spoje*. Vydavateľstvo: BEN - technická literatúra, 2007
- [8] Vaculíková a kol.: *Elektromagnetická kompatibilita*. Grada, 1998.
- [9] Kůs Skála Hammerbauer: *Elektromagnetická kompatibilita*

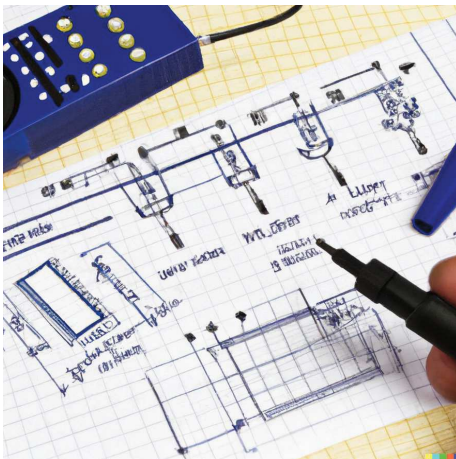


## Literatúra



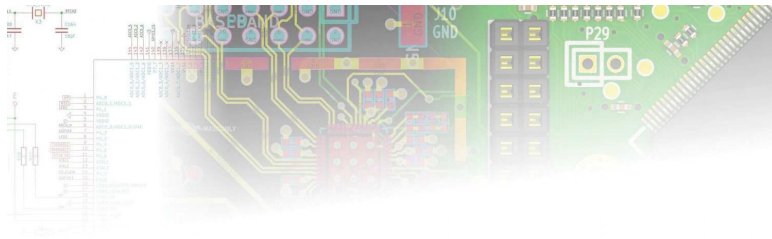
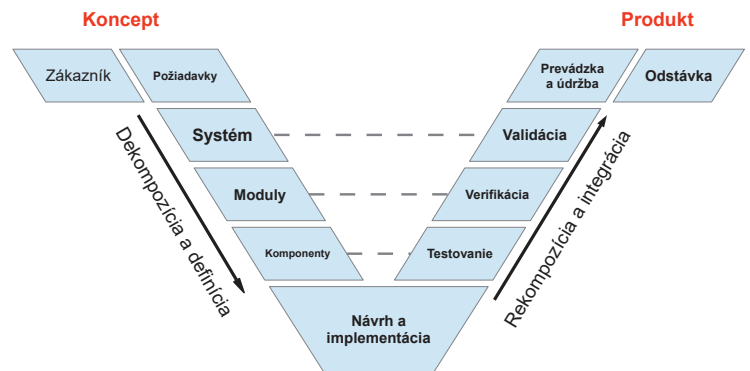
32

## Návrh elektronického obvodu



(c) Dall-E (<https://labs.openai.com/s/aCl15i9QZtivCoyhTYBGorGc>)

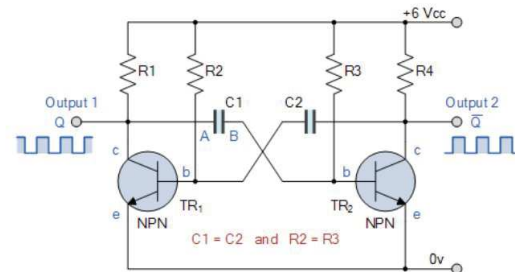
## V - design



Toto budu uz slajdy o KiCAD aplikácii, priklady atd.s bannerom hore

## Blikač

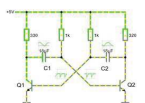
= Hello, World elektrotechnikov



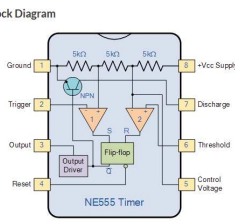
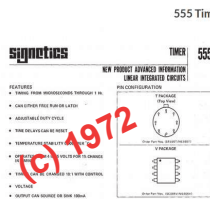
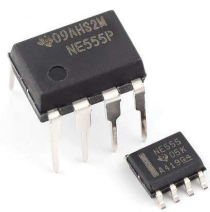
Periodic Time,  $T = t_1 + t_2$   
 $t_1 = 0.69C_1R_3$   
 $t_2 = 0.69C_2R_2$

$$f = \frac{1}{T} = \frac{1}{1.38RC}$$

<https://www.falstad.com/circuit/circuitjs.html>

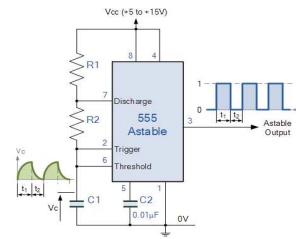


# Blikač Astabilný multivibrátor s NE 555



<https://senzor.robotika.sk/sensorwiki/index.php/555>

# Astabilný multivibrátor s NE 555



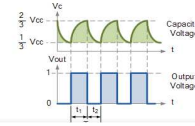
$$t_1 = 0.693(R_1 + R_2) \cdot C$$

and

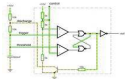
$$t_2 = 0.693 \times R_2 \times C$$

$$T = t_1 + t_2 = 0.693(R_1 + 2R_2) \cdot C$$

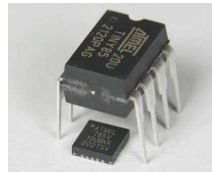
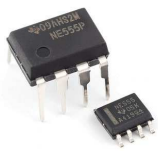
$$f = \frac{1}{T} = \frac{1.44}{(R_1 + 2R_2) \cdot C}$$



<https://www.falstad.com/circuit/circuitjs.html>



# NE 555 vs. ATtiny45



Model	Min. cena bez DPH (EUR/ks)	Max. cena bez DPH (EUR/ks)	Skladový stav	Výrobca
ATTINY25V-10PU	1.41 EUR/ks (Produkt ťažko dostupný)	1.08 EUR/ks (Produkt ťažko dostupný)	0	MICROCHIP (ATMEL)
NE555P	0.377 EUR/ks	0.159 EUR/ks	17885	TEXAS INSTRUMENTS

# ATtiny 25/45/85

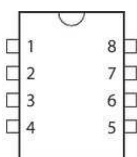
(PCINT5/RESET/ADC0/dw) PB5	1	8	VCC
(PCINT3/XTAL1/CLKI/OC1B/ADC3) PB3	2	7	PB2 (SCK/USCK/SCL/ADC1/T0/INT0/PCINT2)
(PCINT4/XTAL2/CLKO/OC1B/ADC2) PB4	3	6	PB1 (MISO/DO/AIN1/OC0B/OC1A/PCINT1)
GND	4	5	PB0 (MOSI/DI/SDA/AIN0/OC0A/OC1A/AREF/PCINT0)

Microcontroller	Package	Program Memory	SRAM	EEPROM	I/O Pins	Timers	A/D	SPI	PC	PWM	USART	Oscillator
8 Pin PDIP												
ATTINY12-8PU	PDIP8	1024		64	6							8
ATTINY13A-PU	PDIP8	1024	64	64	6	16-bit	4x10-bit	Yes				20
ATTINY15V-10PU	PDIP8	1024	64	64	6	16-bit	4x10-bit	Yes				10
ATTINY25-20PU	PDIP8	2048	128	128	6	2x8-bit	4x10-bit	Yes		2		20
ATTINY25V-10PU	PDIP8	2048	128	128	6	2x8-bit	4x10-bit	Yes		2		10
ATTINY45-20PU	PDIP8	4096	256	256	6	2x8-bit	4x10-bit	Yes		2		20
ATTINY45V-10PU	PDIP8	4096	256	256	6	2x8-bit	4x10-bit	Yes		2		10
ATTINY85-20PU	PDIP8	8192	512	512	6	2x8-bit	4x10-bit	Yes		2		20
ATTINY85V-10PU	PDIP8	8192	512	512	6	2x8-bit	4x10-bit	Yes		2		10

[https://en.wikipedia.org/wiki/ATtiny\\_microcontroller\\_comparison\\_chart](https://en.wikipedia.org/wiki/ATtiny_microcontroller_comparison_chart)

# Brainstorming...

(PCINT5/RESET/ADC0/dw) PB5	1	8	VCC
(PCINT3/XTAL1/CLKI/OC1B/ADC3) PB3	2	7	PB2 (SCK/USCK/SCL/ADC1/T0/INT0/PCINT2)
(PCINT4/XTAL2/CLKO/OC1B/ADC2) PB4	3	6	PB1 (MISO/DO/AIN1/OC0B/OC1A/PCINT1)
GND	4	5	PB0 (MOSI/DI/SDA/AIN0/OC0A/OC1A/AREF/PCINT0)



# Inžiniering...

## Výpočet

Úlohou je navrhnuť rezistor R, tak, aby LED diódou tiekol dostatočný, ale nie zbytočne príliš veľký prúd.

Zvolíme  $I_f = 5 \text{ mA}$ .

Z grafu (datasheet) odčítame hodnotu  $U_f = \dots \text{ V}$ .

Teraz vieme vypočítať hodnotu R:

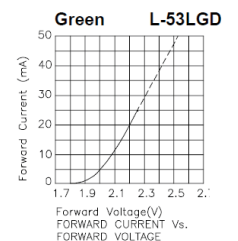
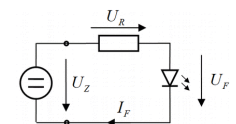
$$U_R = U_Z - U_F$$

$$R = U_R / I_f$$

Príkion rezistora je  $P = U_R \cdot I_f = \dots$

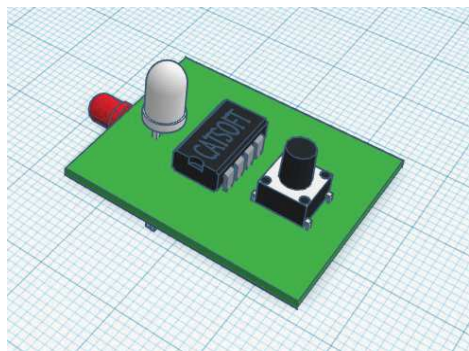
Takáto hodnota odporu sa nevyrába. Ako postupovať?

Rezistory sa vyrábajú v radoch	E6	E12	E24	E48	E96	E192
zodp. presnosť	±20 %	±10 %	±5 %	±2.5 %	±1 %	±0.5 %

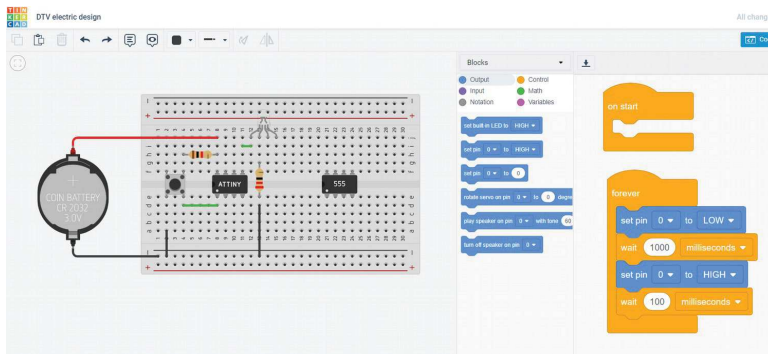




# Ako to bude vyzerat'?

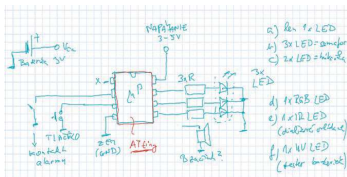


# Ako to bude fungovat'?



### Zadanie:

Navrhnete astabilny multivibrátor s mikroprocesorom. Vypočítajte hodnoty súčiastok, nakreslite schému zapojenia a vygenerujte zoznam súčiastok. Navrhnete plošný spoj a overte u výrobcu, že je návrh v poriadku.



### Úlohy:

- Brainstorming s návrhom funkcie zariadenia
- Analýza zapojenia (výpočet parametrov, hodnoty)
- Schéma zapojenia
- Zoznam súčiastok (Ref, Typ, Hodnota, Reálna súčiastka: puzdro, obj. č., kód, cena, datasheet)
- Návrh plošného spoja
- Kontrola návrhu u výrobcu

### Hodnotenie: v termíne treba odovzdať:

- Schému zapojenia v .pdf
- Schému zapojenia vo formáte KiCAD .sch
- Zoznam súčiastok v .pdf
- Návrh plošného spoja v .pdf
- Návrh plošného spoja vo formáte KiCAD .pcb
- Screenshot zo stránok výrobcu <http://aisler.net>

Deadline: 5. 3. 2023