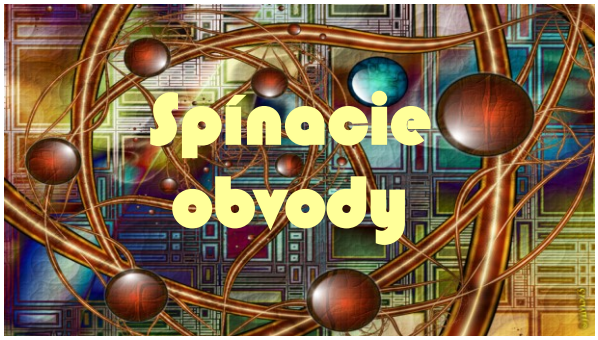
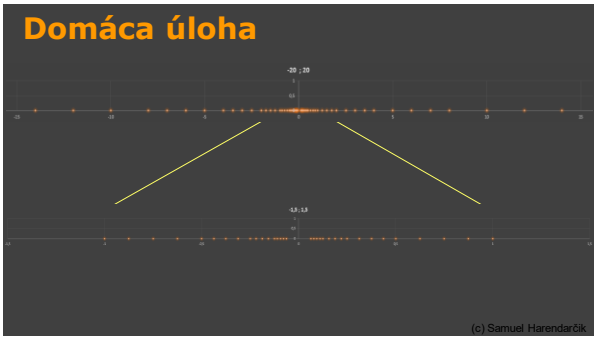
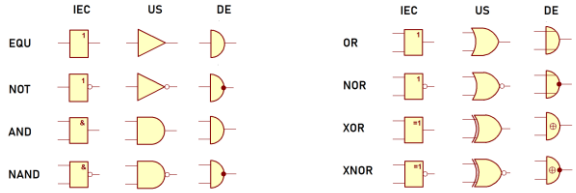


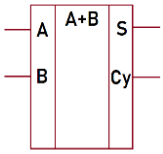


Značky (rôzne normy)



Sčítačka

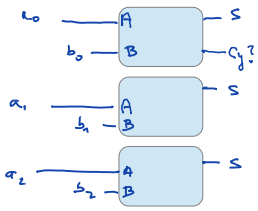
0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 10



A	B	S	Cy
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Cy: CARRY = prenos

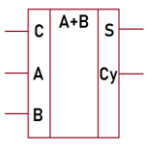
3-bitová sčítačka



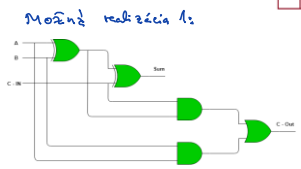
Úplná sčítačka

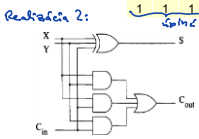
S = A·B·C + A·B·C + A·B·C + A·B·C =
= C (A·B + A·B) + C (A·B + A·B) =
= C ⊕(A ⊕ B)

Cy = A·B·C + A·B·C + A·B·C + A·B·C =
= A·B + B·C + A·C

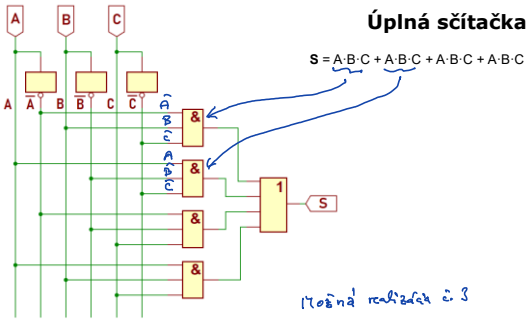


C				
0				
0				
0				
0				
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

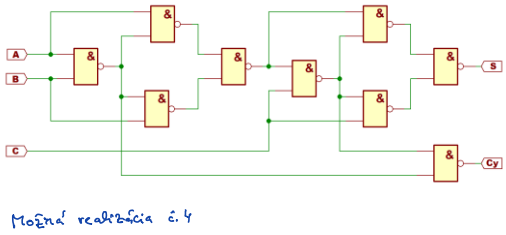




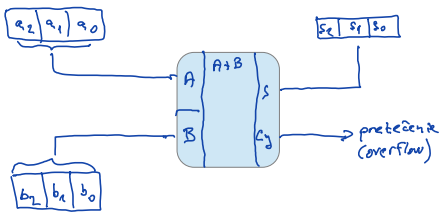
Úplná sčítačka



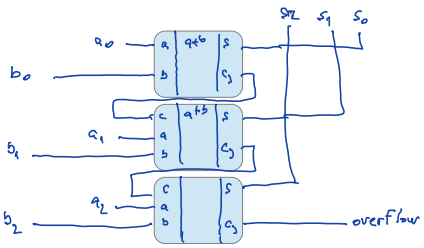
Úplná sčítačka - realizácia len z NAND

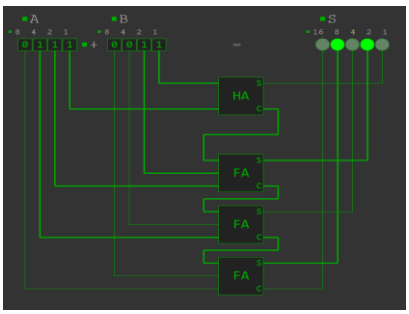


3-bitová sčítačka



3-bitová sčítačka





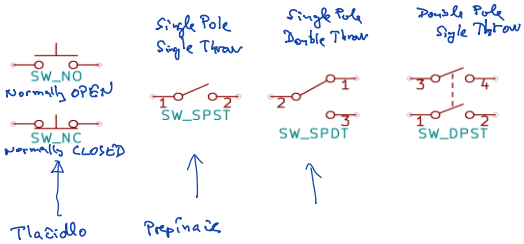
4-bitová sčítačka v simulátore

https://simulator.io/board/VuE4wWhzhF/4

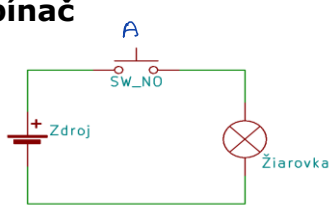
Spínač

Source: Wikipedia

Spínač



Spínač



Tabuľka

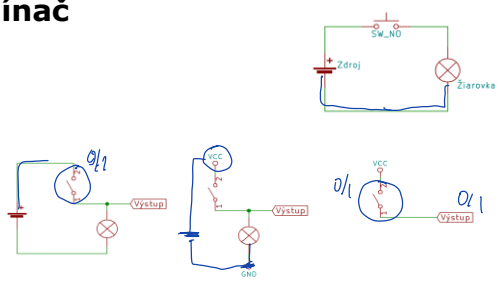
A	Ž
0	0
1	1

Rovnica:

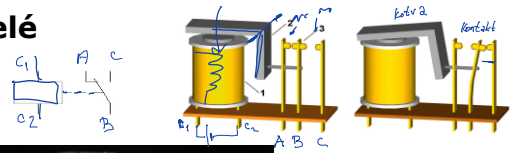
$\check{Z} = A$

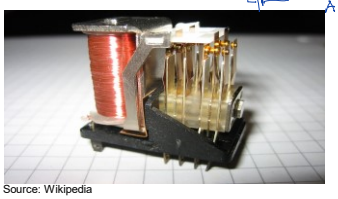
(pri tlačidle typu NC je $\check{Z} = \bar{A}$)

Spínač



Relé





1. Cievka (coil)
2. Kotva (armature)
3. Kontakt (contact)

Počet
elektrických cyklov: 10^5
mechanických cyklov: 10^7

Source: Wikipedia

Claude Elwood Shannon

* 30. apríla 1916, Michigan
† 24. február 2001, Massachusetts

– profesor na MIT

Kybernetika, Teória informácie, Entropia

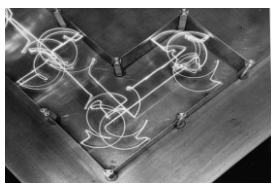
Symbolická analýza zmeny a spínacie obvody

Bell Labs Inc. - reléová logika

Source: Wikipedia, http://cyberneticzoo.com

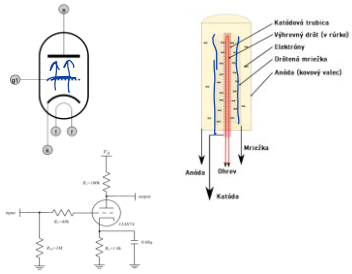
Theseus:

Maze-Solving Mouse (1952)



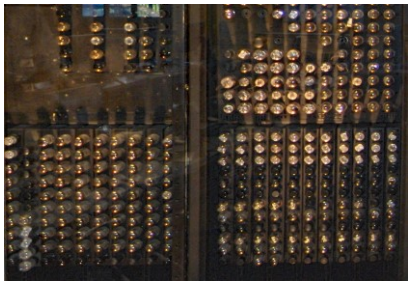
Source: http://cyberneticzoo.com

Elektrónka



Source: Wikipedia

Elektrónka

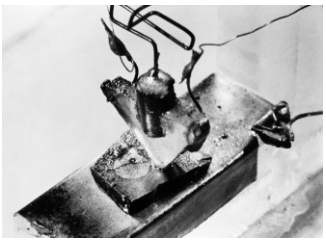


ENIAC

- r. 1946
- 17,468 elektróniek
- P =150 kW
- m = 27 000 kg
- 2,4 × 0,9 × 30 m
- $487,000
  (ekv. 2016: $6,740,000)

Source: Wikipedia

Tranzistor



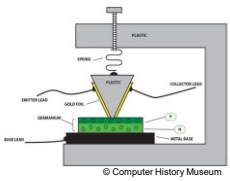
Bell Labs

John Bardeen, Walter Brattain, a William Shockley

Nobelova cena 1956

Source: Wikipedia

Tranzistor

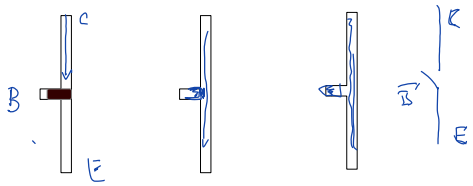


© Computer History Museum

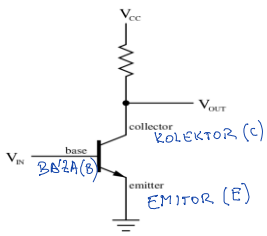
Source: Wikipedia

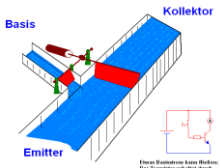
1939: William Shockley (AT&T's Bell Labs) myšlienka náhrady elektrónok
1947: Shockley -> John Bardeen and Walter Brattain prvý reálny tranzistorový zosilňovač
1956: Nobelova cena pre všetkých troch

Tranzistor

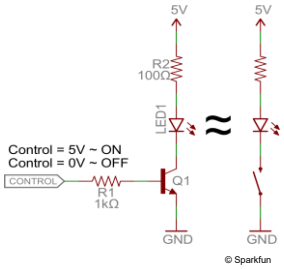


Tranzistor bipolárny





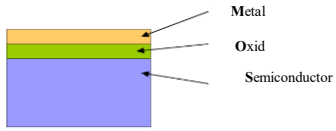
Tranzistor



Tranzistor unipolárny

Súčasné počítače využívajú unipolárne tranzistory

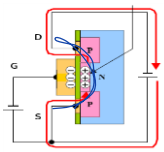
FET – Field Effect Transistor

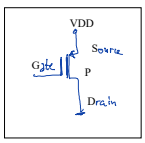


Metal **O**xid **S**emiconductor (MOS)

PMOS (MOS tranzistor s kanálom P)

- historicky najstaršia technológia:
- nevýhody: nízka rýchlosť a zlá zlučiteľnosť s TTL obvodmi



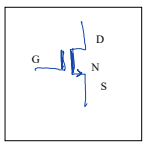


Náhrada: NMOS (MOS tranzistor s kanálom N).

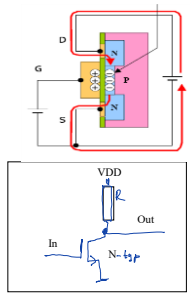
Technológia NMOS

Výhody: rýchlejšie,
zlučiteľné s TTL

Nevýhody: „straty“

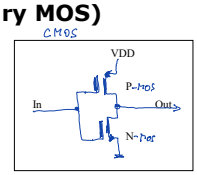


Náhrada: CMOS



Technológia CMOS (Complentary MOS)

Výhody:
minimalizované straty
zlučiteľné s TTL



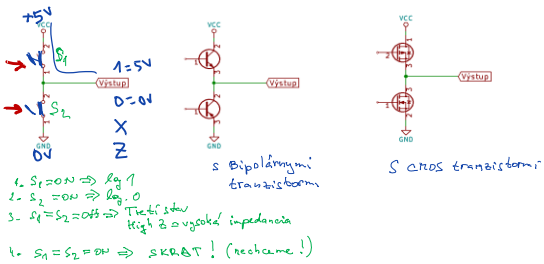
Logické úrovne:

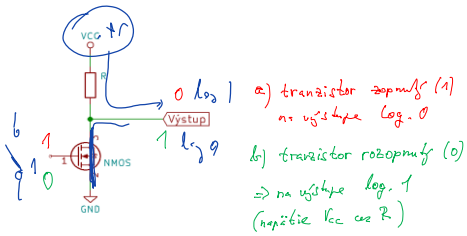
log. 0 = 0,0 až 0,3×V_{DD} Ak V_{DD} = 5,0V je to 0 až 1,5 V

log. 1 = 0,7×V_{DD} až V_{DD} Ak V_{DD} = 5,0V je to 3,5 až 5,0 V

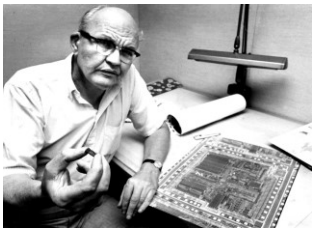
- Okrem V_{DD} = 5,0V sa používa aj V_{DD} = 3,3V a V_{DD} = 2,9V a iné.

Totem pole





Integrovaný obvod



12. 9. 1958
Americký fyzik Jack Kilby vytvoril prvý integrovaný obvod na jedinom čipe
2000 - Nobel Prize in physics

Integrovaný obvod

Name	Signification	Year	Transistors number[47]	Logic gates number[48]
SSI	*small-scale integration*	1964	1 to 10	1 to 12
MSI	*medium-scale integration*	1968	10 to 500	13 to 99
LSI	*large-scale integration*	1971	500 to 20,000	100 to 9,999
VLSI	*very large-scale integration*	1980	20,000 to 1,000,000	10,000 to 99,999
ULSI	*ultra-large-scale integration*	1984	1,000,000 and more	100,000 and more

Moorov zákon

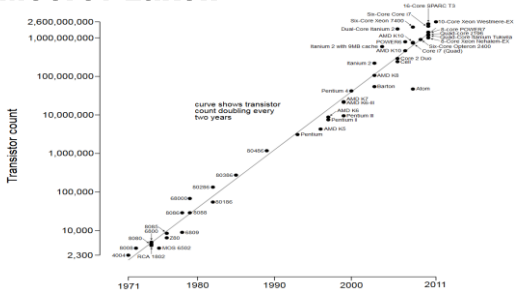
Gordon Moore

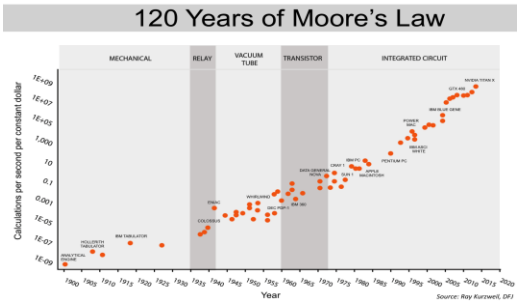
spoluzakladateľ firiem Intel
a Fairchild Semiconductor

Moore's law is the observation:

The number of transistors in a dense integrated circuit ***doubles*** *approximately every* ***two years*** *(1965)*

Moorov zákon





Moorov zákon

Ak by sa rovnako rozvíjal automobilový priemysel:

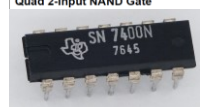
300 000 km/h   850 000 km / liter   0,04 $ / ks

7400

TTL (Transistor-Transistor-Logic)
Integrovaný obvod 4x 2-vst. NAND
Technológia SSI – obsahuje cca **16 tranzistorov** a ďalšie súčiastky
Cena cca 0,30 $ ale bola aj 22$ r. 1965

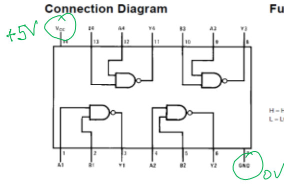
Nie Intel Core i5-7400 Quad-Core, 3,0 GHz (65 W), TurboBoost 3,5 GHz, Intel HD Graphics 630 (1000 MHz), 6 MB L3 cache, socket 1151, Kaby lake 14 nm
182,- USD   **Tranzistorov: 750 000 000**

FAIRCHILD SEMICONDUCTOR™
DM74LS00
Quad 2-Input NAND Gate



SN7400

Connection Diagram



High = log. 1
Low = log. 0

Function Table

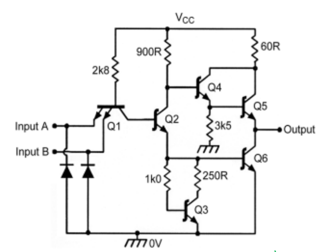
A, B → & → Y

$Y = \overline{AB}$

Inputs		Output
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

H = HIGH Logic Level = 1
L = LOW Logic Level = 0

SN7400



Vnútorné zapojenie jedného NAND člena

katalógový list = datasheet

inžinierov každodenný chlebíček!

DM74LS00

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

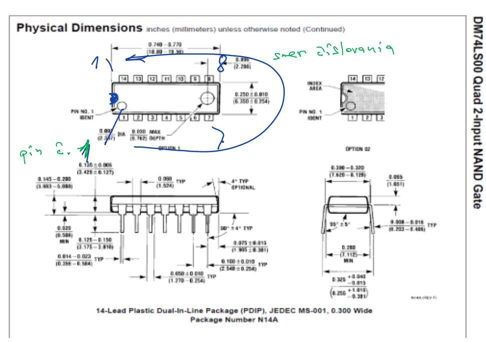
Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−0.4	mA
I_{OL}	LOW Level Output Current			8	mA
T_A	Free Air Operating Temperature	0		70	°C

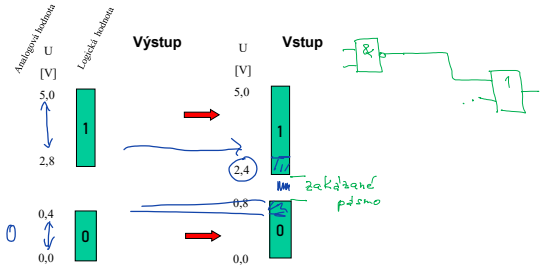
Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

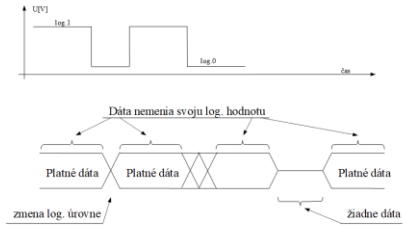
Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max	2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min		0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min		0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V			0.1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			20	µA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−0.36	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)	−20		−100	mA
I_{CCH}	Supply Current with Outputs HIGH	V_{CC} = Max		0.8	1.6	mA



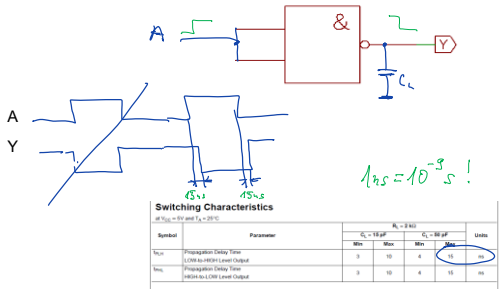
TTL obvody: logické úrovne



Časové diagramy



Oneskorenie



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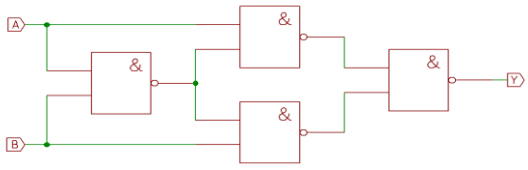


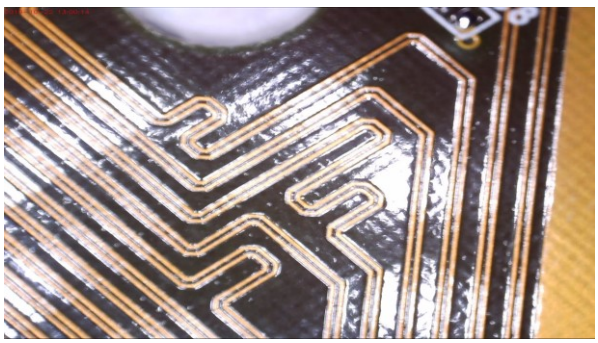
A

B

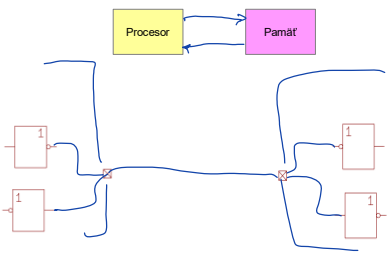
X

Y

GLITCH = Zákmit

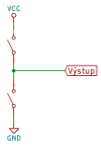


Zbernice – obojsmerný V/V

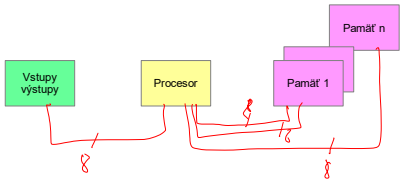


Pozn.:
ak sa obe zariadenia snažia na výstup pretlačiť svoju hodnotu, tak 0-0 alebo 1-1 je ešte OK, ale 0-1 alebo 1-0 spôsobia SKRAT, čomu sa chceme vyhnúť.

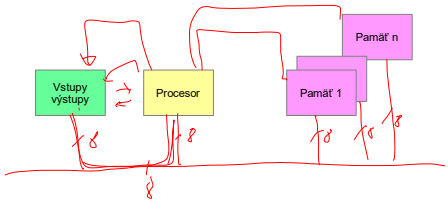
Zbernice – obojsmerný V/V



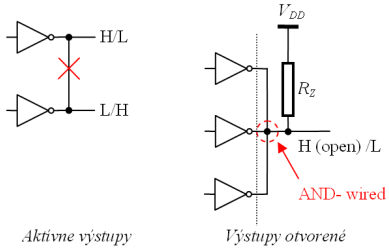
Zbernice – trojstavový výstup



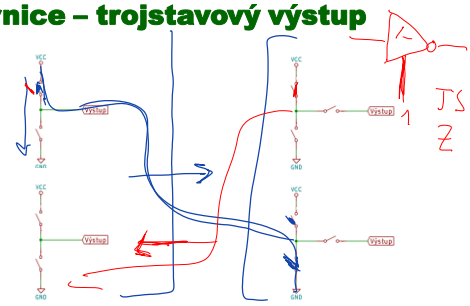
Zbernice – trojstavový výstup



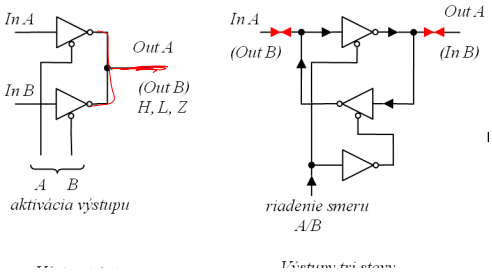
Spájanie vstupov a výstupov



Zbernice – trojstavový výstup



Zbernice



Chcem vedieť viac...

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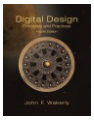

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