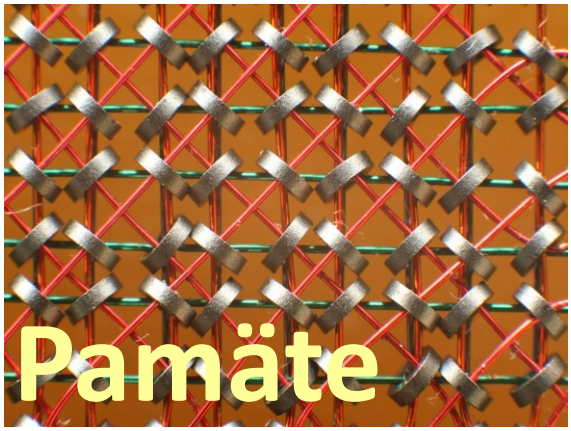
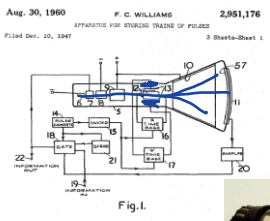
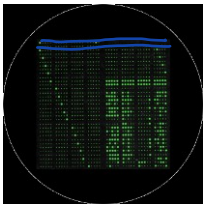


Prvé pamäte

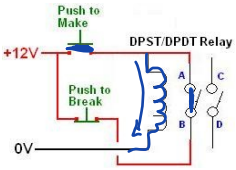




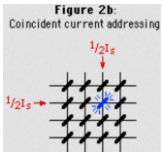
Mark I computer

IBM 701

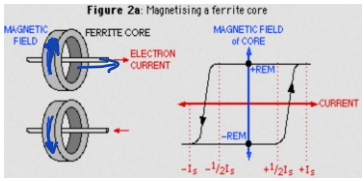
Reléové pamäte



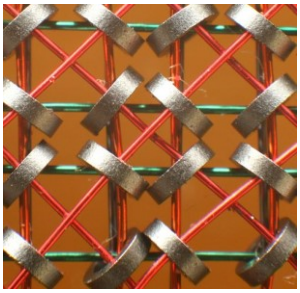
Feritové pamäte



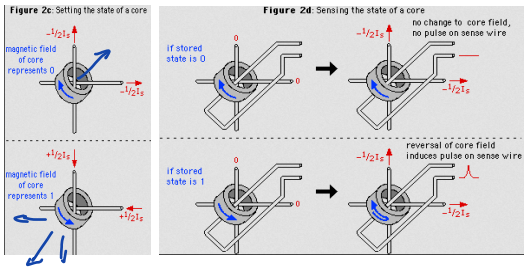
* 1952 na MIT, Jay Forrester



Feritové pamäte

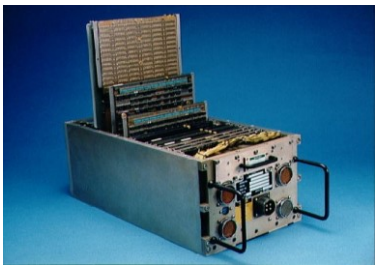


Feritové pamäte



https://web.archive.org/web/20111118002956/
http://www.cs.ubc.ca/~hilpert/e/coremem/index.html

Feritové pamäte



Space Shuttle IBM AP-101B flight computers

Polovodičové pamäte

	Capacity	Speed (latency)
Logic:	2x in 3 years	2x in 3 years
DRAM:	4x in 3 years	2x in 10 years
Disk:	4x in 3 years	2x in 10 years

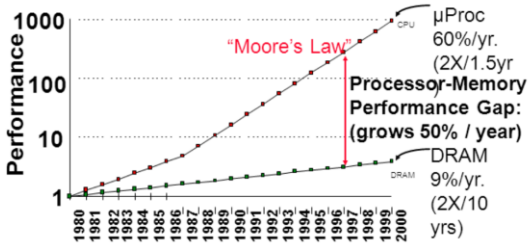
Technology Trends

DRAM

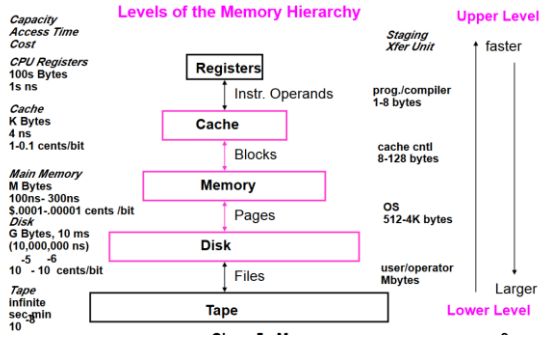
Year	Size	Cycle Time
1980	64 Kb	250 ns
1983	256 Kb	220 ns
1986	1 Mb	190 ns
1989	4 Mb	165 ns
1992	16 Mb	145 ns
1995	64 Mb	120 ns

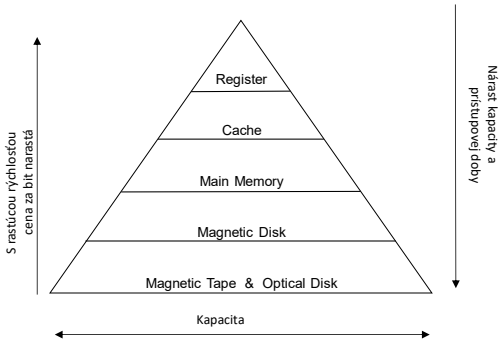
1000:1! 2:1!

Polovodičové pamäte

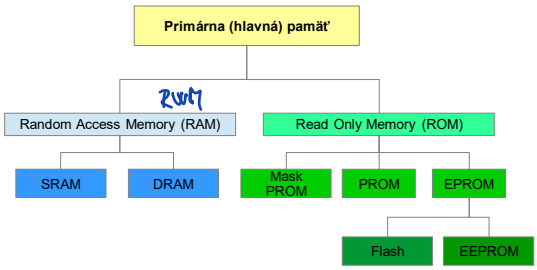


Polovodičové pamäte

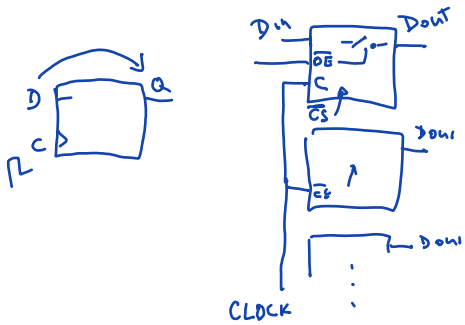




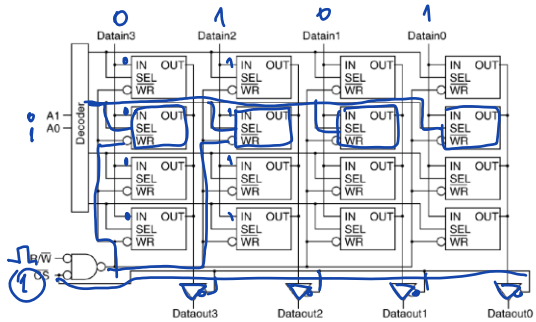
Polovodičové pamäte



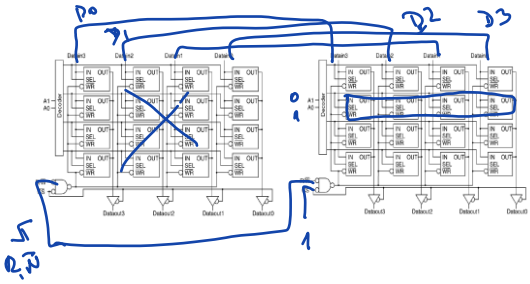
Pamäť RAM (Random Access Memory)



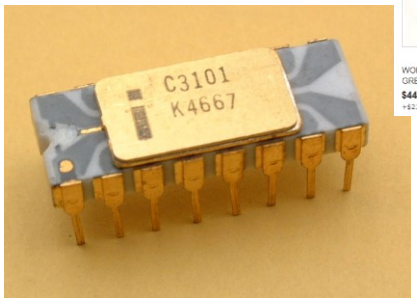
Statická RAM pamäť



Statická RAM pamäť



Statická RAM pamäť



WORLDs 1ST RAM: INTEL C3101 | GREY TRACE OLD GOLD

$449.95

+$21.72 shipping

intel

3101, 3101A

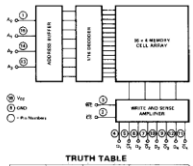
16 x 4 BIT HIGH SPEED RAM

- Fast Access Time — 35 nsec max over 0-75°C Temperature Range (3101A)

PIN CONFIGURATION

LOGIC SYMBOL

BLOCK DIAGRAM



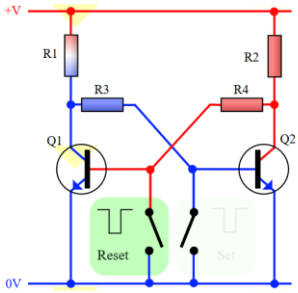
PIN NAMES

D_1–D_4	DATA INPUTS	$\overline{CS}$	CHIP SELECT INPUT
A_0–A_3	ADDRESS INPUTS	$\overline{O}_1$–$\overline{O}_4$	DATA OUTPUTS
$\overline{WE}$	WRITE ENABLE	V_{CC}	POWER (+5V)

TRUTH TABLE

CHIP SELECT	WRITE ENABLE	OPERATION	OUTPUT
LOW	LOW	WRITE	HIGH
LOW	HIGH	READ	COMPLEMENT OF WRITTEN DATA
HIGH	LOW	–	HIGH
HIGH	HIGH	–	HIGH

Statická RAM pamäť



Statická RAM pamäť

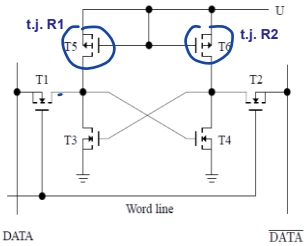


Figure 11: SRAM memory cell with 6 transistors [8]

- rýchlejšie ako ROM, prístupová doba cca 10ns (dnes 5ns)
- statická, volatile pamäť

Dynamická RAM

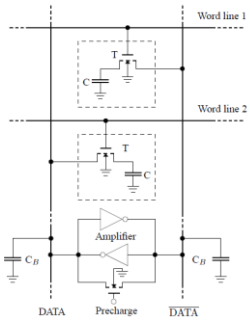
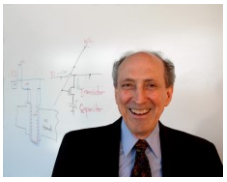
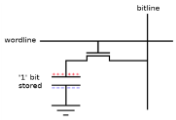


Figure 2: DRAM memory cell with 1 transistor [8]

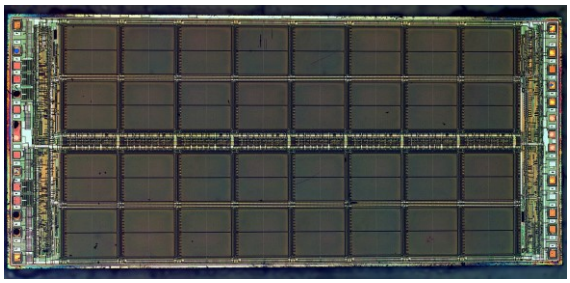


Robert H. Dennard, IBM



pravidelné obnovovanie informácie sa nazýva REFRESH

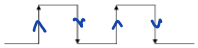
Dynamická RAM pamäť



1 megabit: Micron Technology MT4C1024 DRAM

Dynamická RAM pamäť

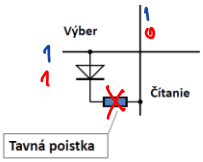
- **SDRAM** (Synchronous Dynamic Random Access Memory) – pamäť používaná ako operačná pamäť počítača. Taktovanie je odvodné od taktu zbernice. Informácia sa prenáša len na nábežnej hrane riadiaceho impulzu. Pamäť typu **SDRAM** vykoná na jeden impulz len jednu operáciu.
- **DDR** (Double Data Rate) tieto pamäte prenášajú informáciu na oboch hranách impulzu.



CMOS RAM – malá spotreba, (baterka)
Pamäť vyrobená technológiou CMOS. Má malú spotrebu. Používa sa na uloženie parametrov BIOSu. Po vypnutí býva napájaná z baterky. Často sa CMOS vyrába ako súčasť RTC.

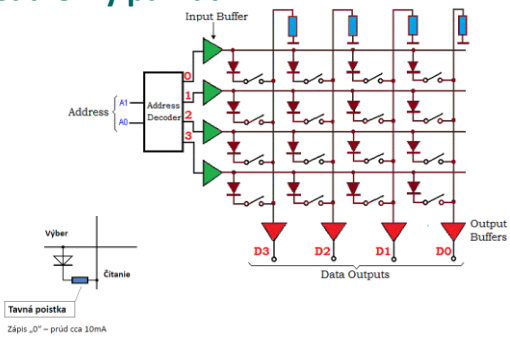
Direct Rambus DRAM (**DRDRAM**)
Synchronous graphics RAM (**SGRAM**)

Read Only pamäť

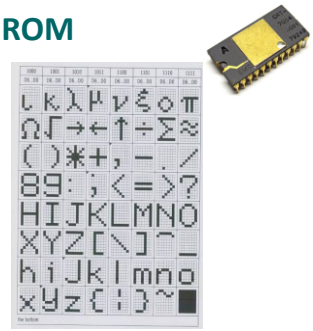


Zápis „0" – prúd cca 10mA

Read Only pamäť



ROM

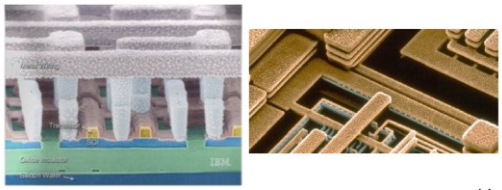


Standard Microsystems CRT-7004-001 is an ASCII character generator, capable of generating 77-bit 7x11 bitmap characters or segment characters

Titan 2 – Intercontinental ballistic missile

PROM was invented in 1956 by Wen Tsing Chow

Mask PROM



PROM

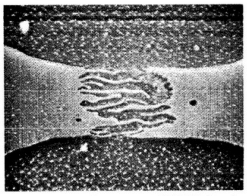


Photo courtesy of HI-REL Laboratories San Marina, California

Figure 4. Blown Nichrome Fuse.

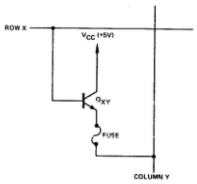
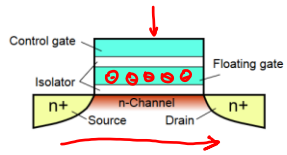
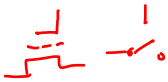


Figure 3. Typical Fuse Cell.

ROM

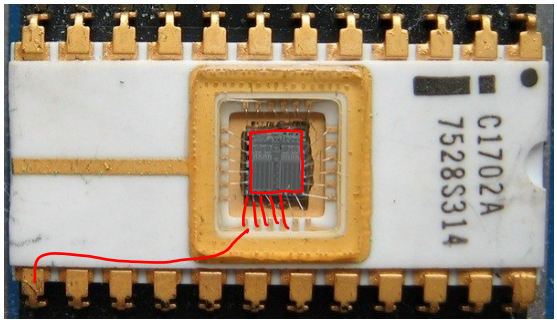
Floating-gate MOSFET
was made by Kahng and Sze, 1967





* EPROM was invented by Dov Frohman of Intel in 1971 -> US patent 3660819

EPROM – Intel 1702



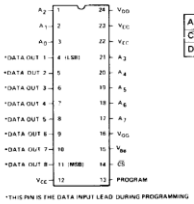
intel®

1702A

2K (256 x 8) UV ERASABLE PROM

1702A-2	0.65 us Max.
1702A	1.0 us Max.
1702A-6	1.5 us Max.

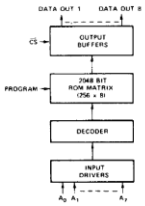
PIN CONFIGURATION



PIN NAMES

A_0–A_7	Address Inputs
$\overline{CS}$	Chip Select Input
D_{OUT1}–D_{OUT8}	Data Outputs

BLOCK DIAGRAM



EPROM -(Erasable PROM):

- statická, nonvolatile pamäť
- informácia – elektrický náboj
- mazanie (UV žiarenie – cca 20min)
- programovanie (elektricky) – užívateľ, opakovane - cca 20*

EEPROM, E2PROM - (Electrically EPROM):

- statická, nonvolatile pamäť, Podobná EPROM
- mazanie (elektrické, rádove mSec)
- programovanie (elektricky) – užívateľ (cca 100 mSec), opakovane, cca 100*

Informácia sa uchová cca 10 rokov.

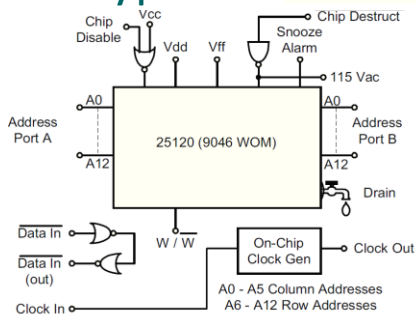
Fujio Masuoka at Toshiba

Flash – EPROM:

Rýchlejšia ako predchádzajúce typy. Dá sa s ňou pracovať ako s RAM. Dá sa cca 10 000 krát prepísať. Dá sa prepisovať priamo v zariadení.

Toshiba developed flash memory from EEPROM in the early 1980s

signetics FULLY ENCODED, 9046 X N, RANDOM ACCESS WRITE-ONLY-MEMORY **25120**

Write Only pamäť

FINAL SPECIFICATION[1b]