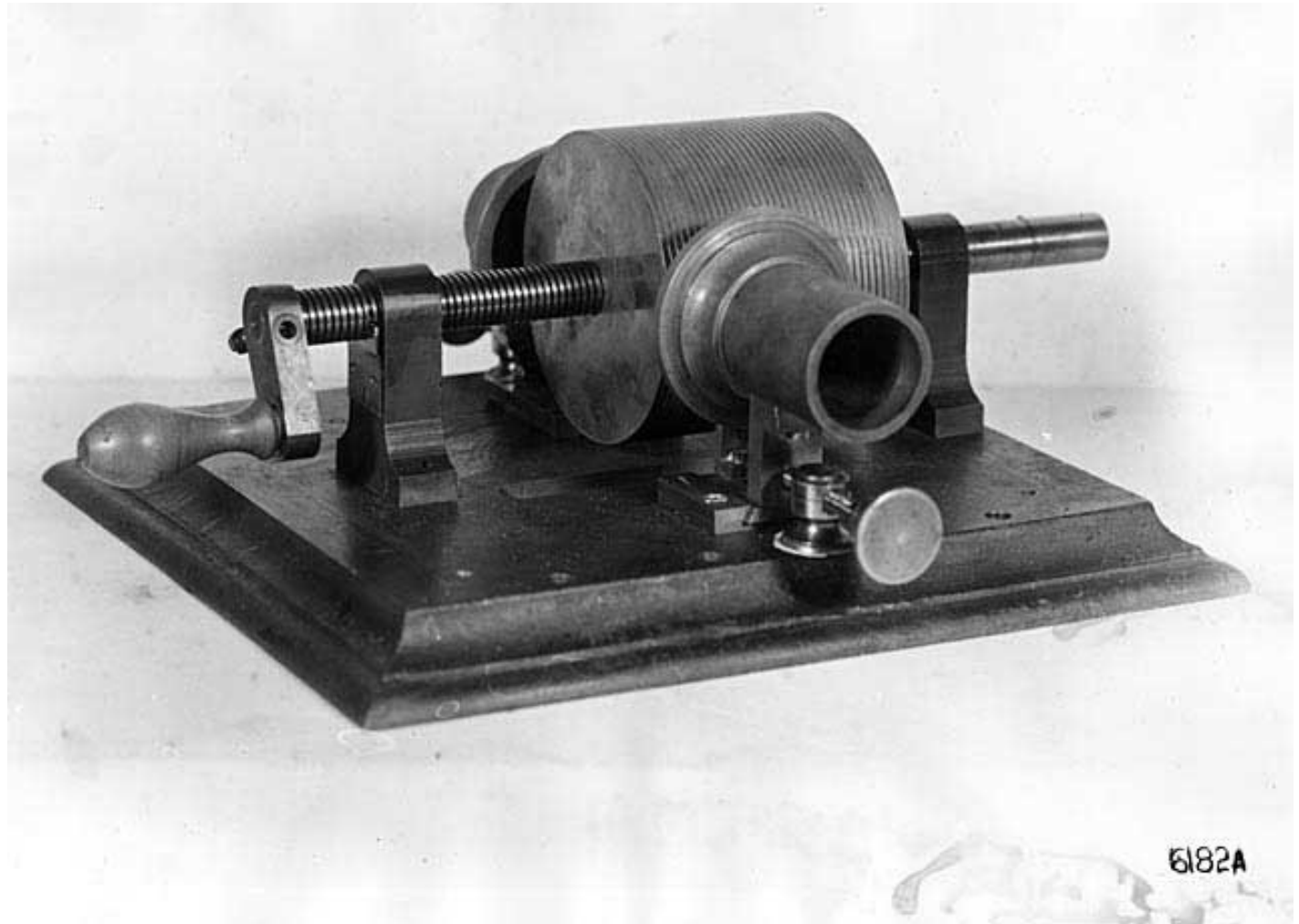
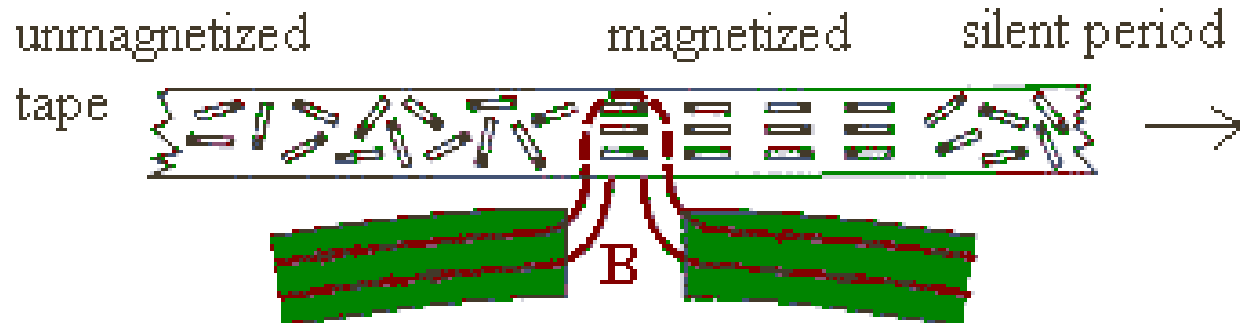
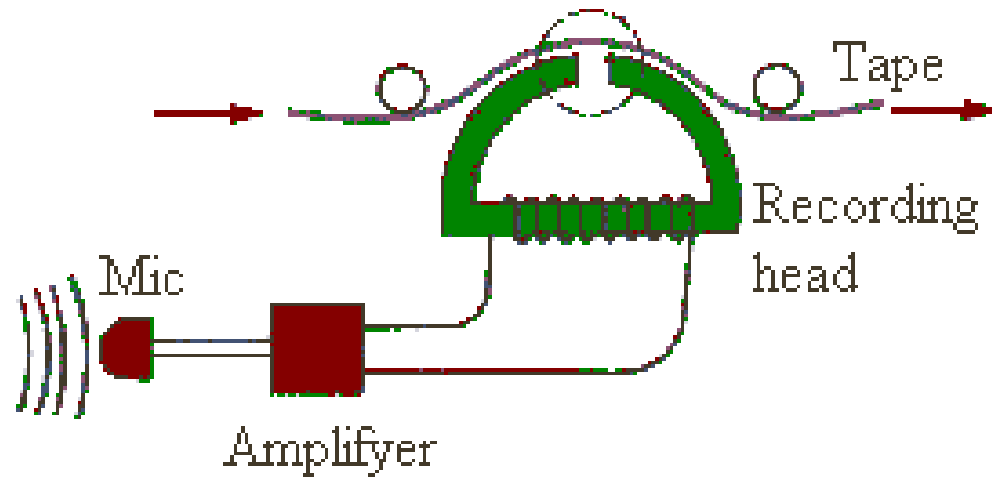


Paměti

# 1877 Edisonův fonograf



# Magnetický záznam dat

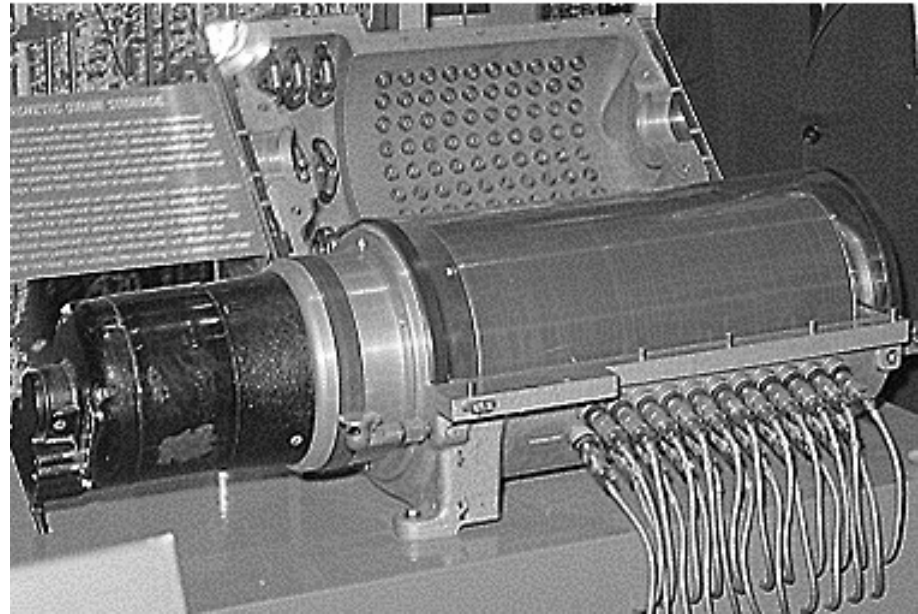




**Německý magnetofon, 1945**

# Magnetický buben 1932

From Computer Desktop Encyclopedia  
Reproduced with permission.  
© 2000 The MITRE Corporation Archives



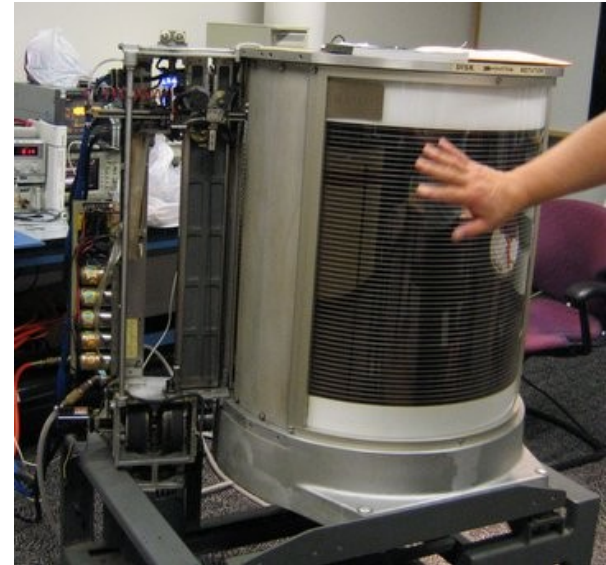
Magnetický zápis po obvodu rotujícího válce s feromagnetickou vrstvou. Každá stopa měla samostatnou zapisovací a čtecí hlavu.

Digitální data, kapacita 500 000bitů

Typ počítačové paměti hojně využívány v 50-tých a 60-tých letech 20. stol.

# 1956 Hard disk

těžkopádné zařízení



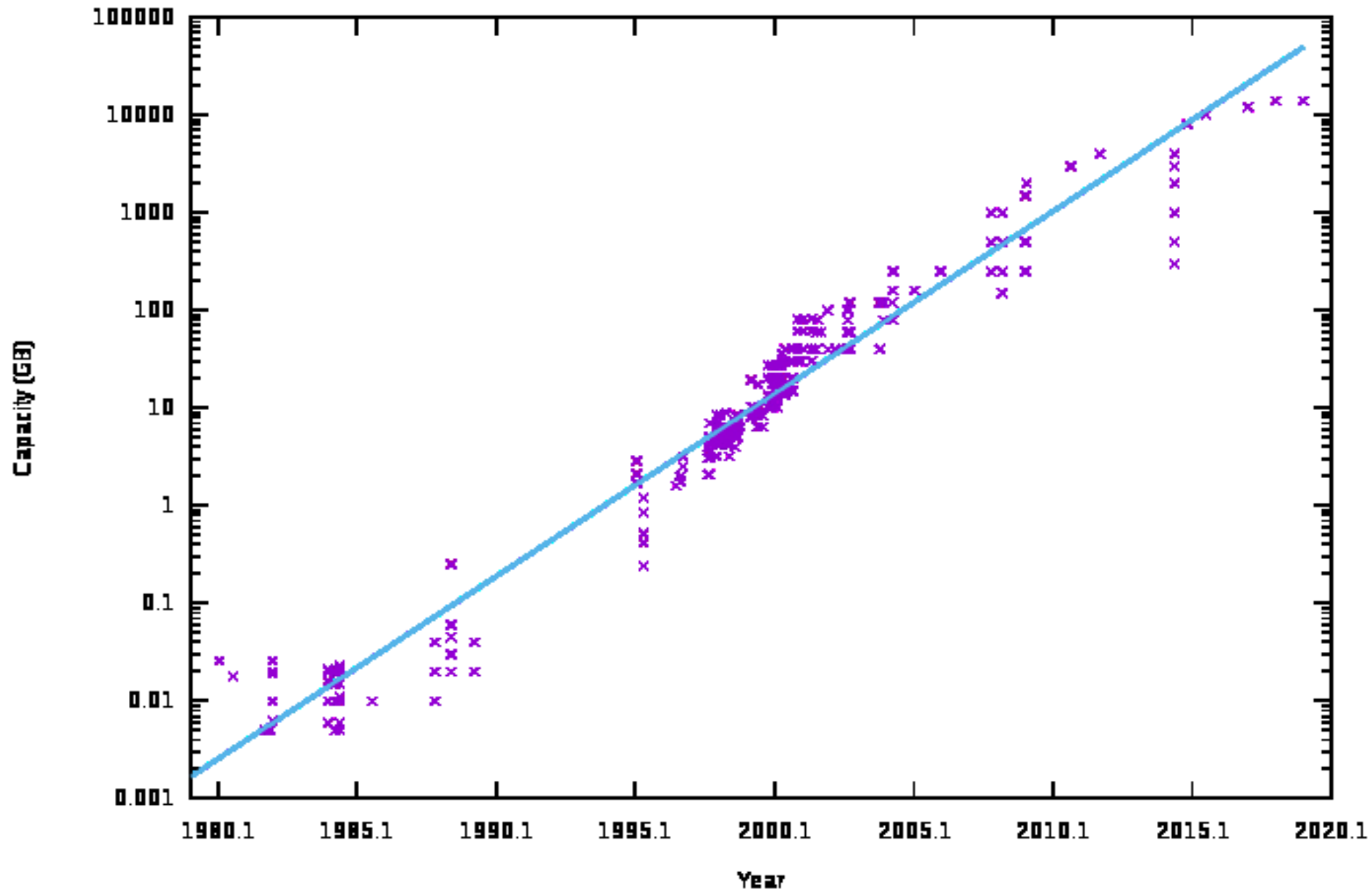
Quelle: Deutsche Fotothek



**1980 Seagate  
5,25" disk (5 MB)**

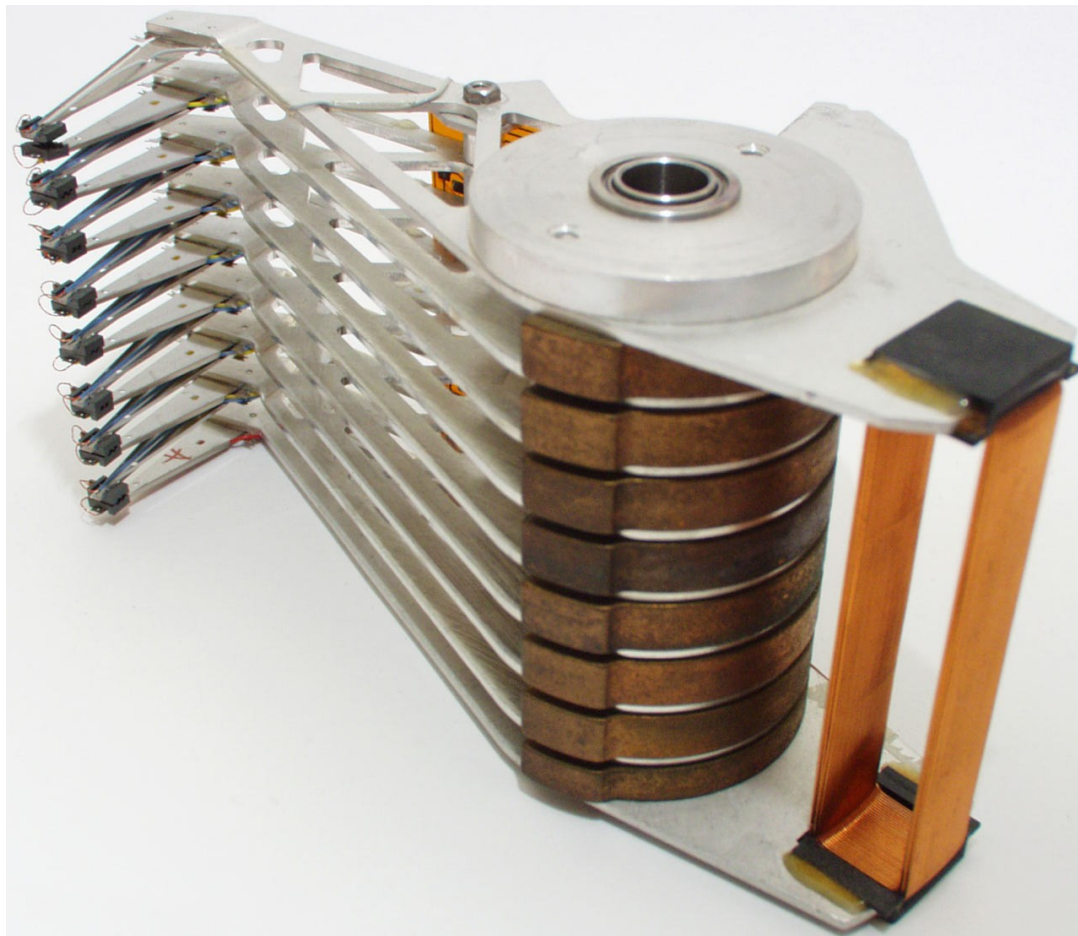


# Kapacita pevného disku





## Zvyšování kapacity „hrubou silou“



# Zvyšování kapacity technologickým vývojem

- tenká feromagnetická vrstva
- úzká štěrbina v prstenci
- blízkost hlavy na povrchem HD (nyní desítky nm)
- MR čtecí prvek

Lubricant, ~1 nm

Lubricant, ~1 nm
Carbon overcoat, <15 nm
Magnetic layer, ~30 nm
Cr underlayer, ~50 nm
Ni-P sublayer, ~10,000 nm
Metal substrate

Současný stav - analogie

Boeing 747: 70.6 m long



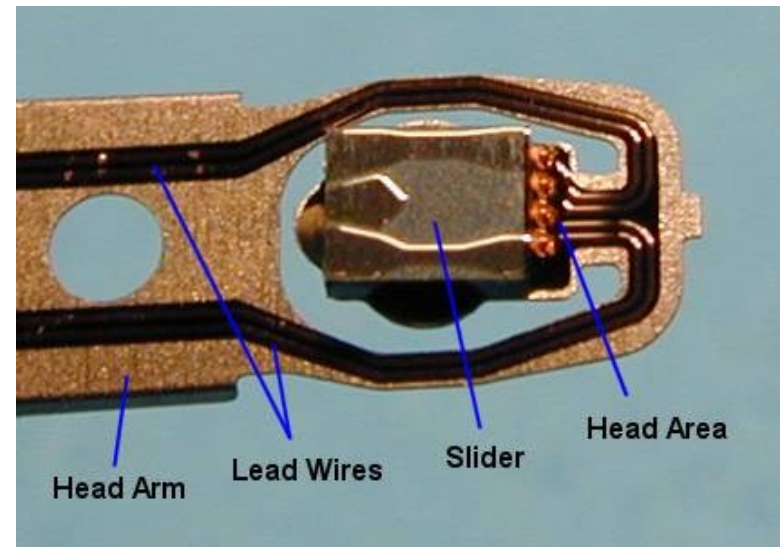
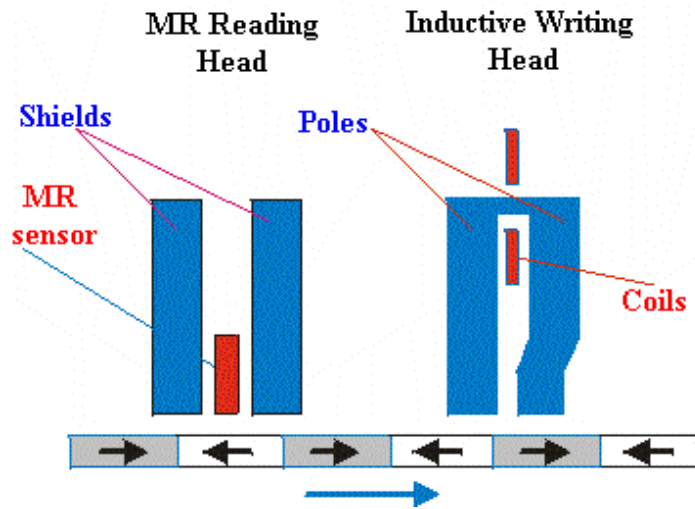
Altitude: 1.5 mm

Lubricant: 0.15 mm

Carbon overcoat: 0.5 mm

Altitude: 1.5 mm	Lubricant: 0.15 mm
Carbon overcoat: 0.5 mm	
Scaled-up disk structure	
Metal substrate	

# MR hlavička



## 1963 Hudební kazeta



## 1981 Sinclair ZX81

150 USD

stavebnice 99,95 USD



**1971 8" floppy disk**

**1976 5,25" floppy disk**

**1981 3,5" floppy disk**

**1994 3,5" zip disk**

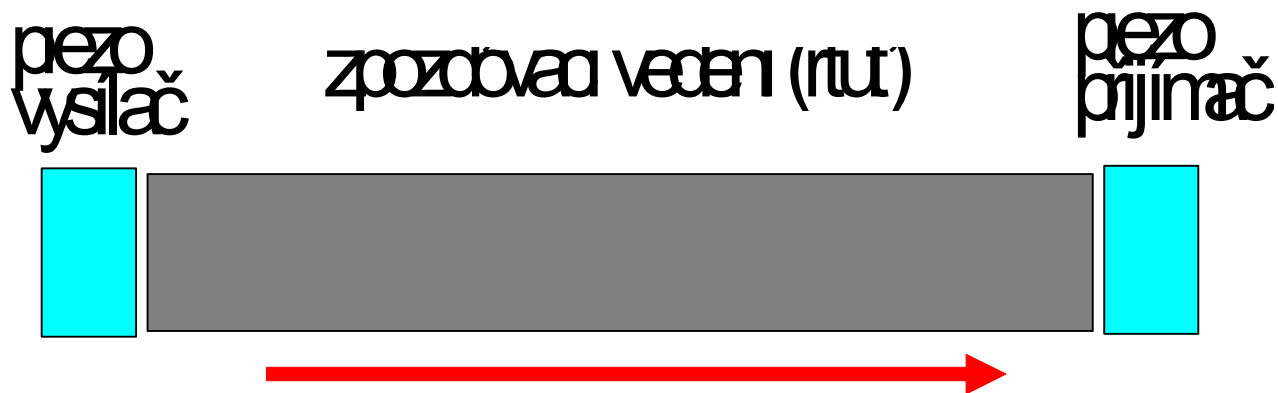


# Dvě kuriozity

## 1949 Delay line memory

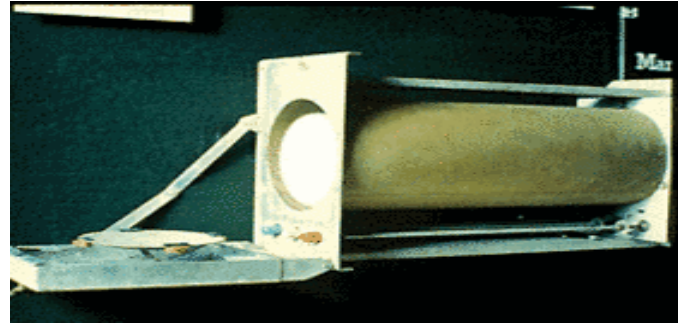


Mercury memory of UNIVAC (1951)



rtuť má podobnou akustickou impedanci jako křemen

## Williams-Kilburn tube 1946

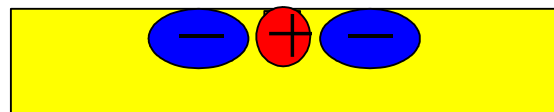
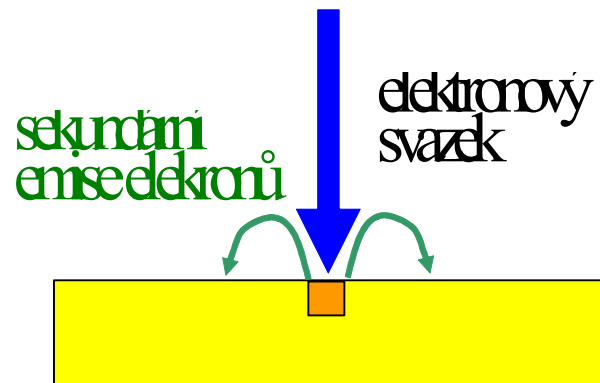
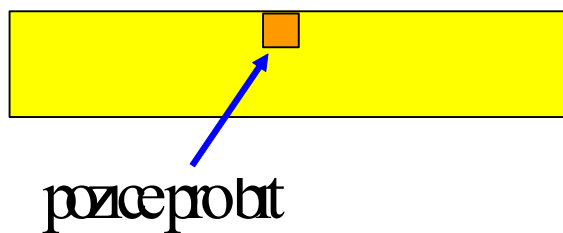


první paměť typu RAM

kapacita cca 1kbit

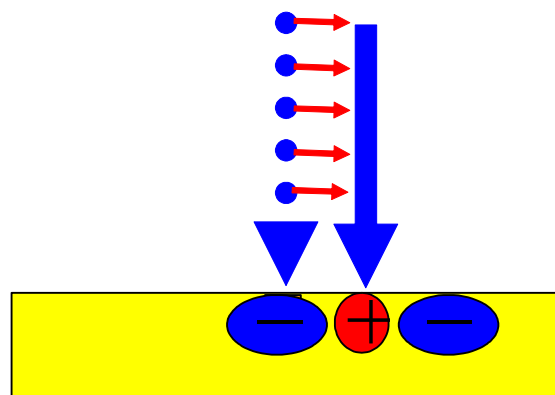
Manchester 'Baby' (1948)

Manchester Mark I (1949)



Zápis log 0 – píše tečku

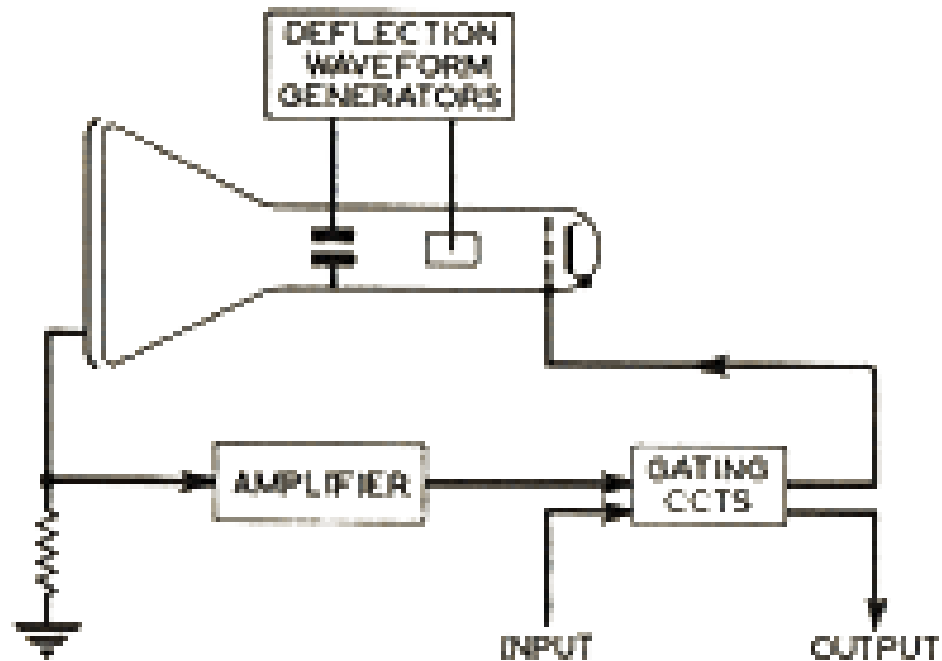
Zápis log 1 – píše čárku



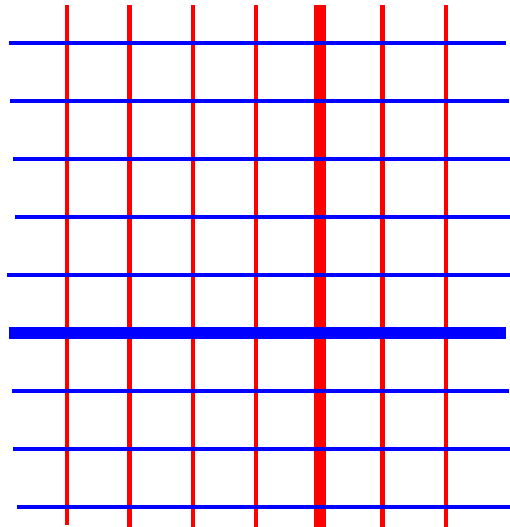


# Čtení

Z vnější strany trubice je umístěna kovová deska. Při čtení se elektronový paprsek zaměří na daný bit. Pokud byl kladný - log 0, nedojde k velké změně jeho náboje. Pokud byl záporný, tak se přebije na kladný a to indukuje proud ve vnějším obvodu (změna náboje na kondenzátoru).



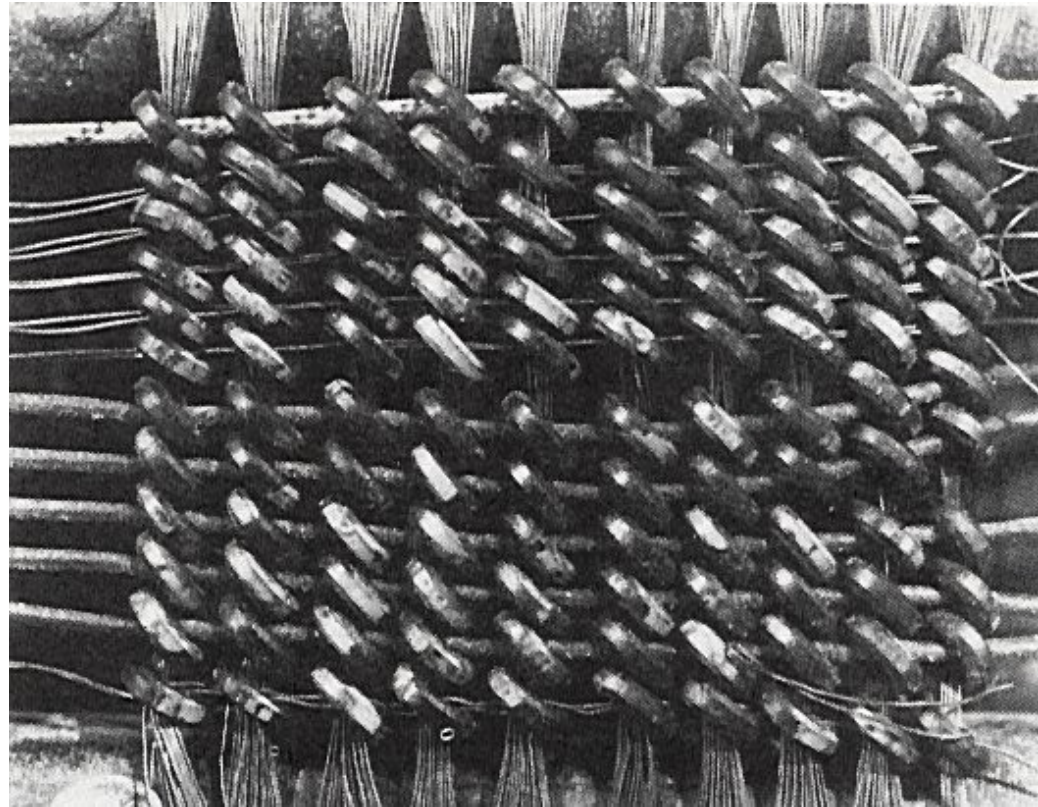
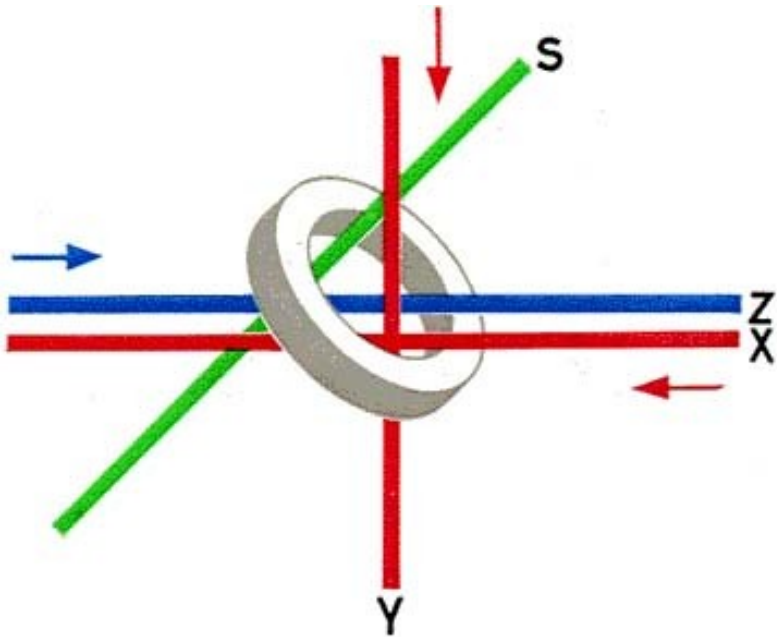
# Paměti RAM (Random access memory)

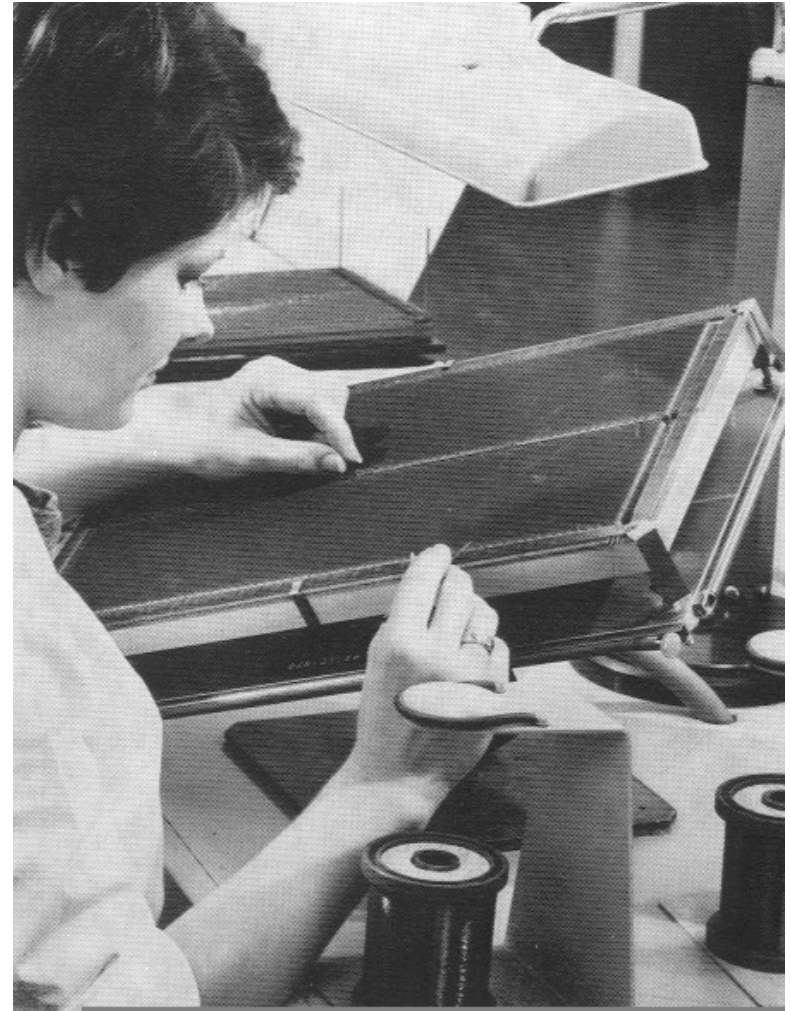
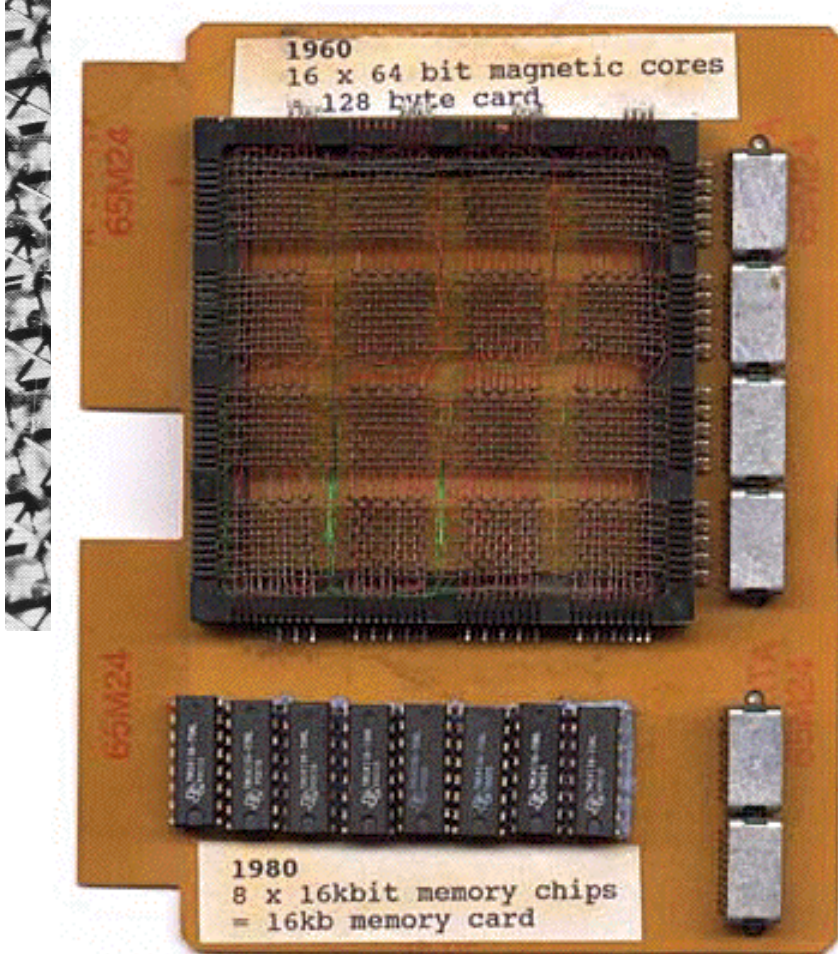
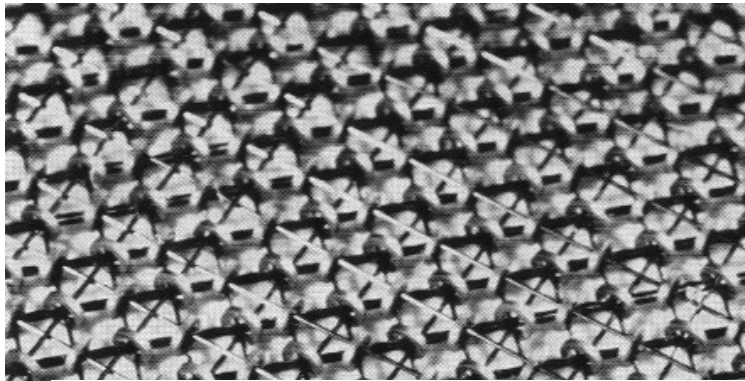


Počet prvků  $n \cdot n$

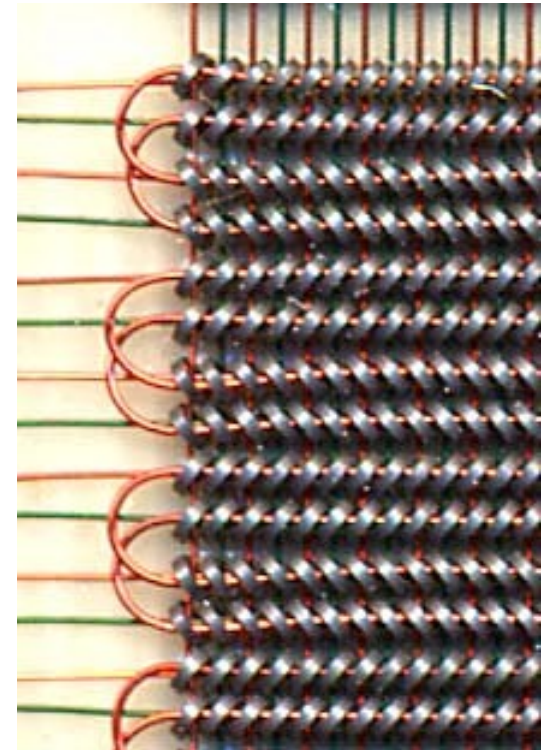
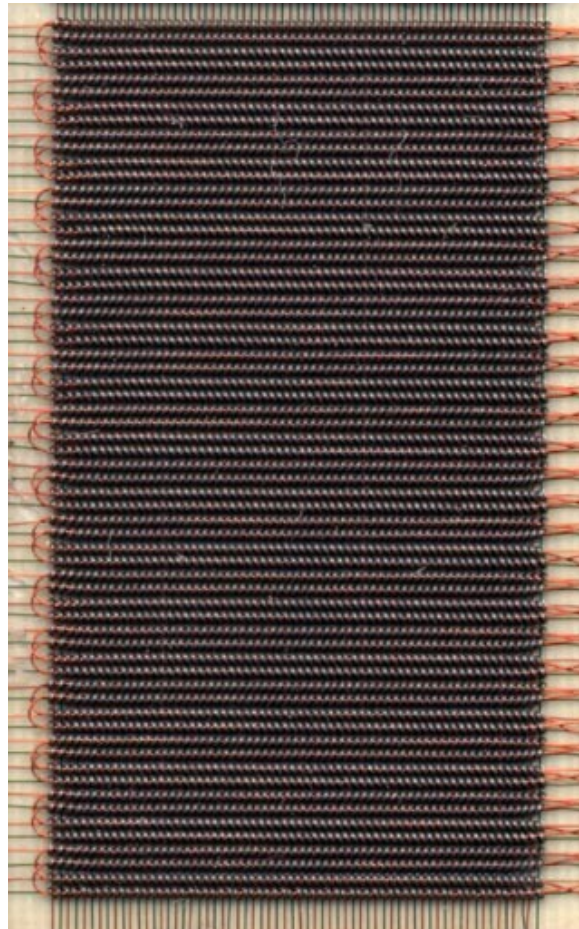
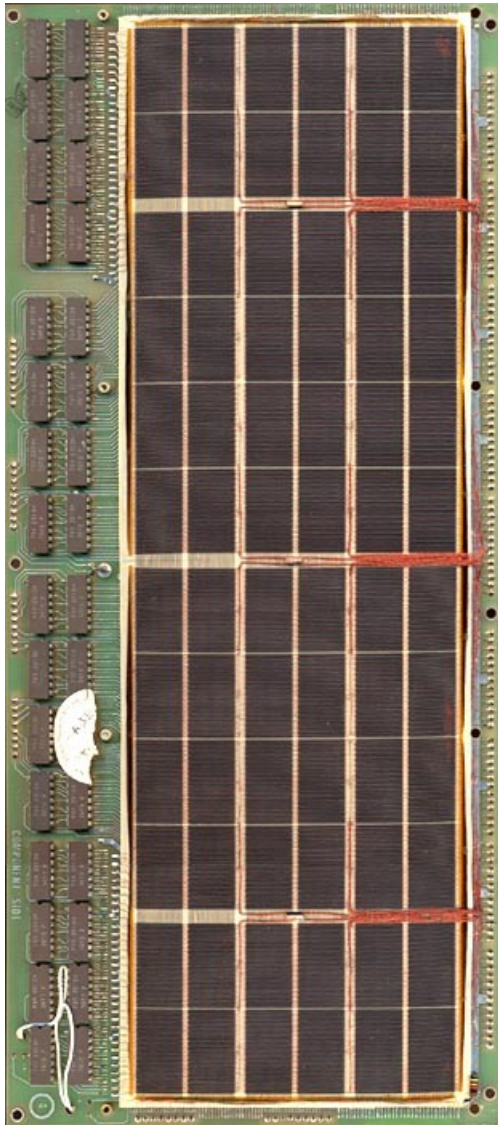
Počet datových vodičů  $2 \cdot n$

# 1949 Magnetic core memory





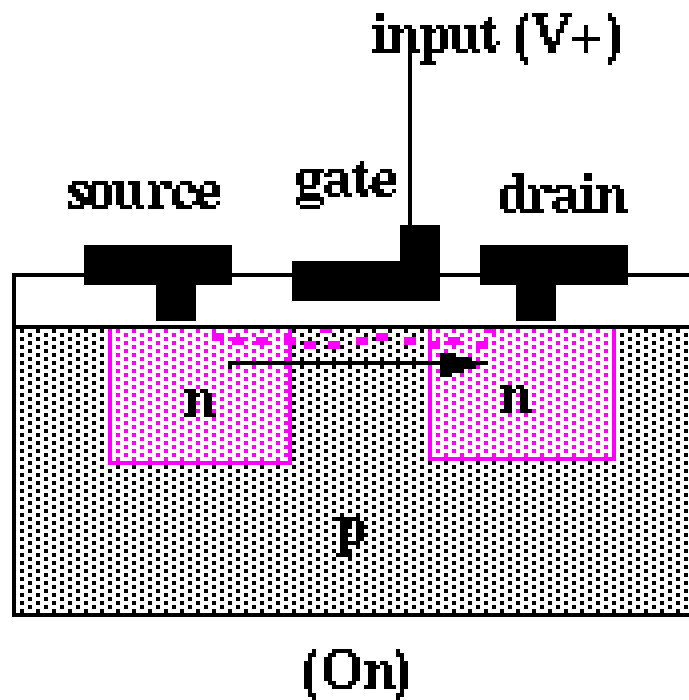
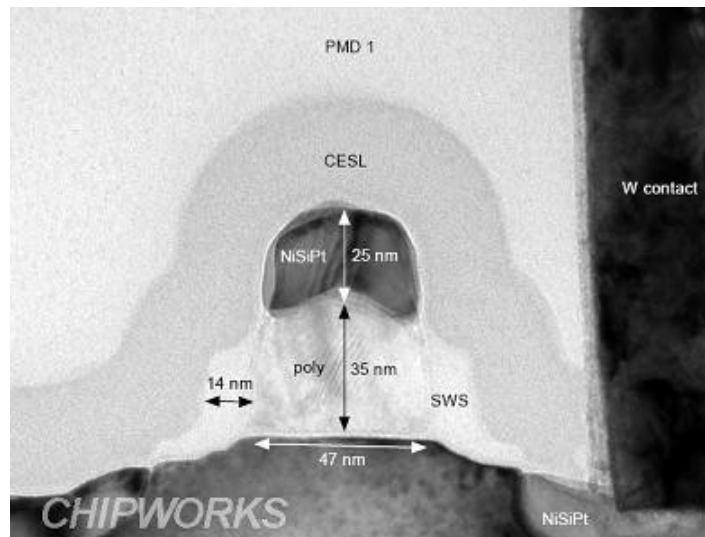
294,912 jader (bitü)



# Integrované paměti

## Struktura MOS (Metal Oxide Semiconductor)

### N-MOS Transistor



# 1966 DRAM

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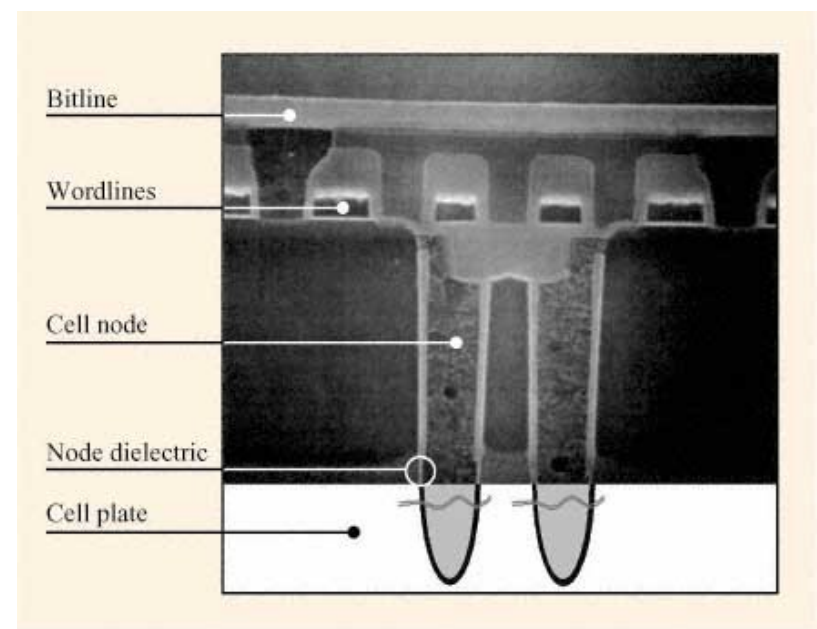
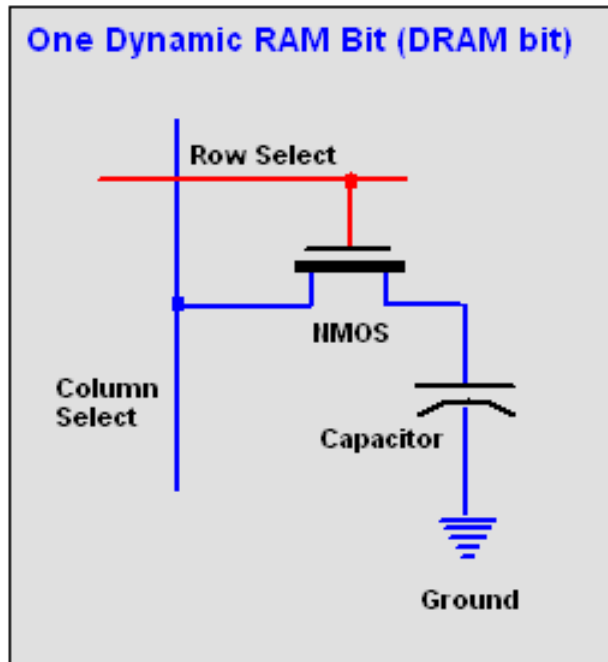
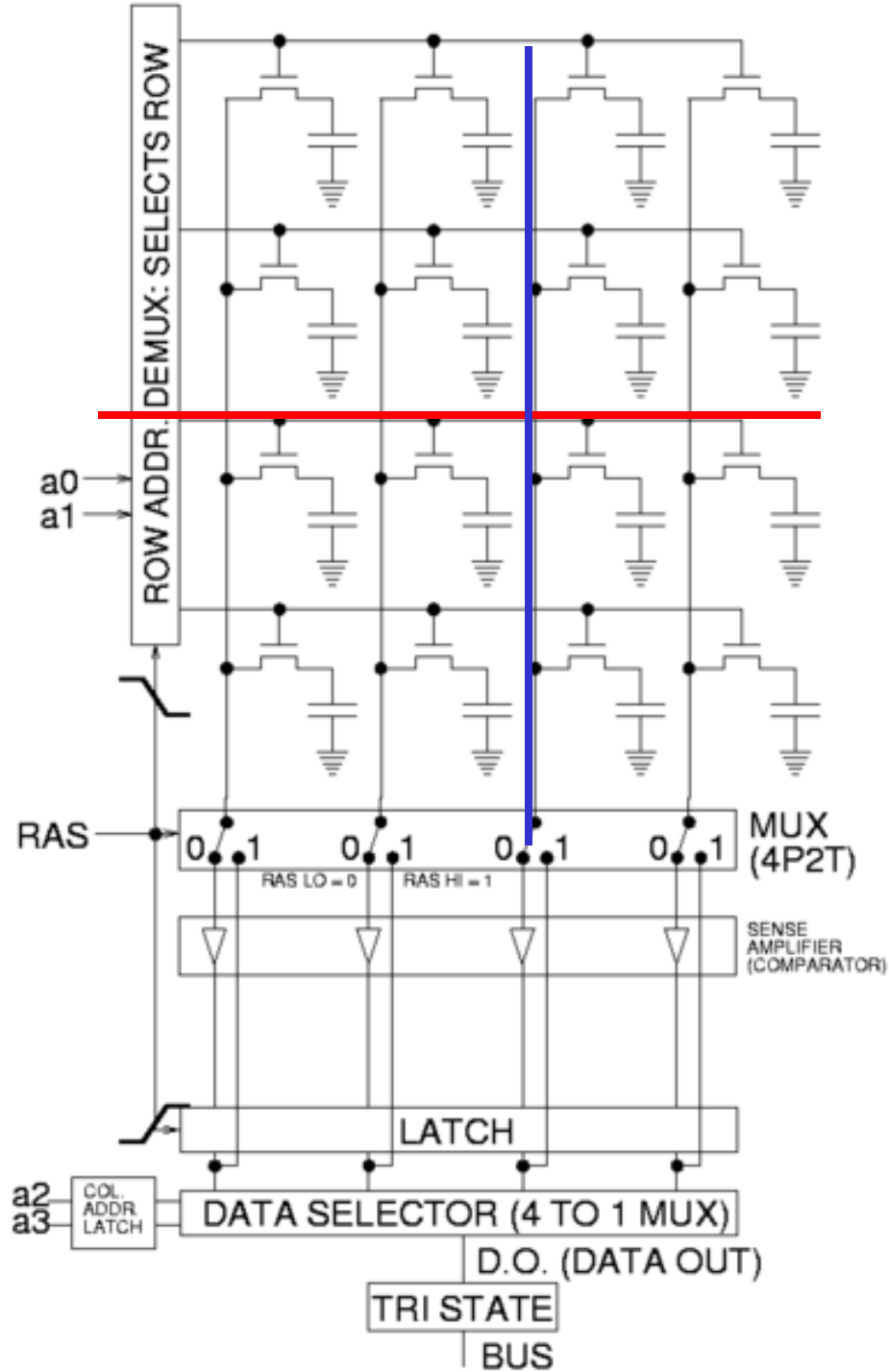


Figure 4

SEM photomicrograph of 0.25- $\mu\text{m}$  trench DRAM cell suitable for scaling to 0.15 $\mu\text{m}$  and below. Reprinted with permission from [17]; © 1995 IEEE.



tranzistory v  
řadě otevřeny

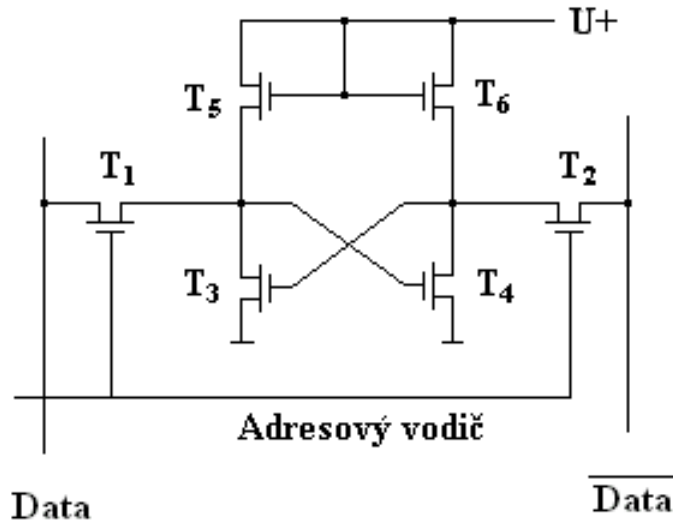
čtecí vodič  
zapojen



SDRAM: Synchronous DRAM

DDR SDRAM: Double Data Rate Synchronous DRAM

# SRAM – Static RAM



# Bistabilní klopný obvod

Data – zápis

~~Data~~ – čtení

T5, T6 - odpory

Zápis hodnoty 1:

Adresový vodič 1, T1, T2 otevřeno

Data: 1 T4 otevřeno, T3 uzavřeno

Na T4 0 – zapsáno Neg(1)

Zápis hodnoty 0:

Adresový vodič 1, T1, T2 otevřeno

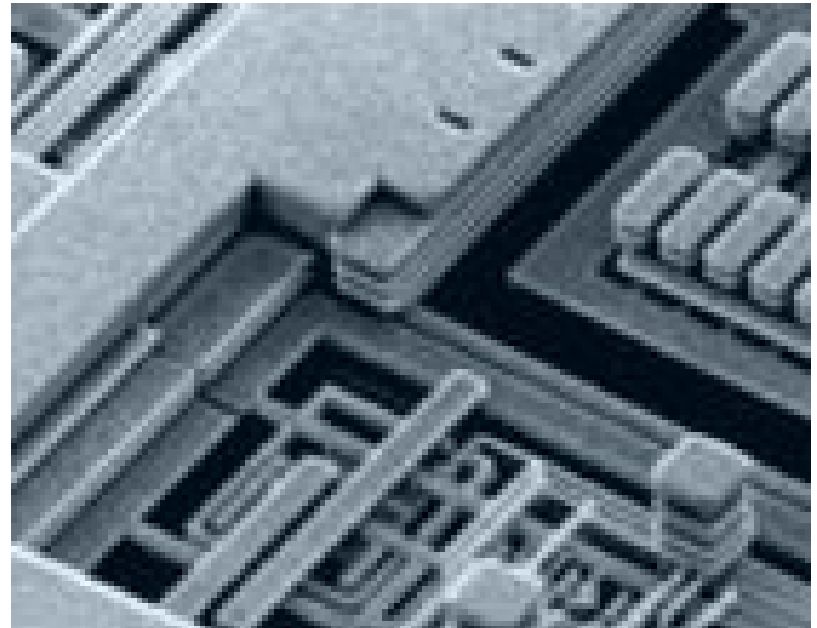
Data: 0 T4 uzavřeno, T3 otevřeno

Na T4 1 – zapsáno Neg(0)

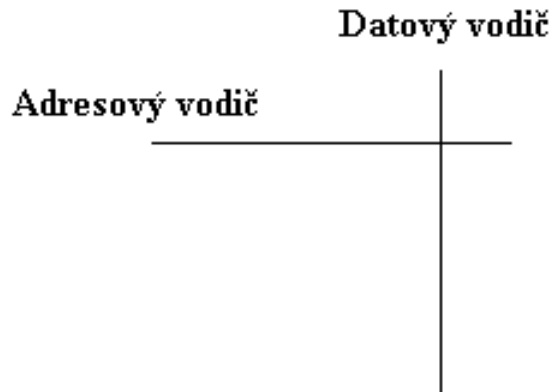
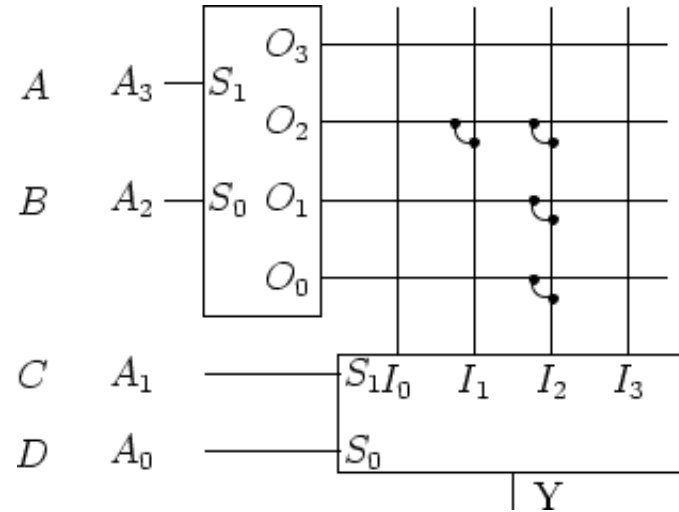
Výhody: Rychlejší než DRAM (10ns)

Nevýhody: Větší počet součástek pro jednu buňku → větší cena.

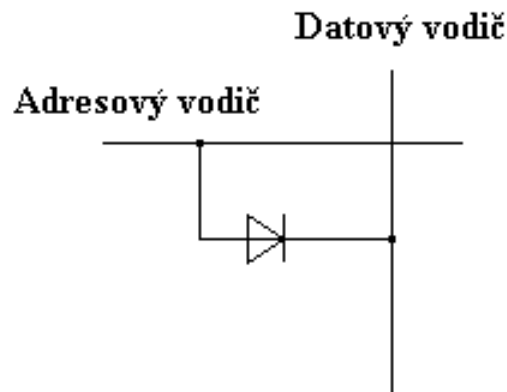
Paměti CACHE, videopaměti



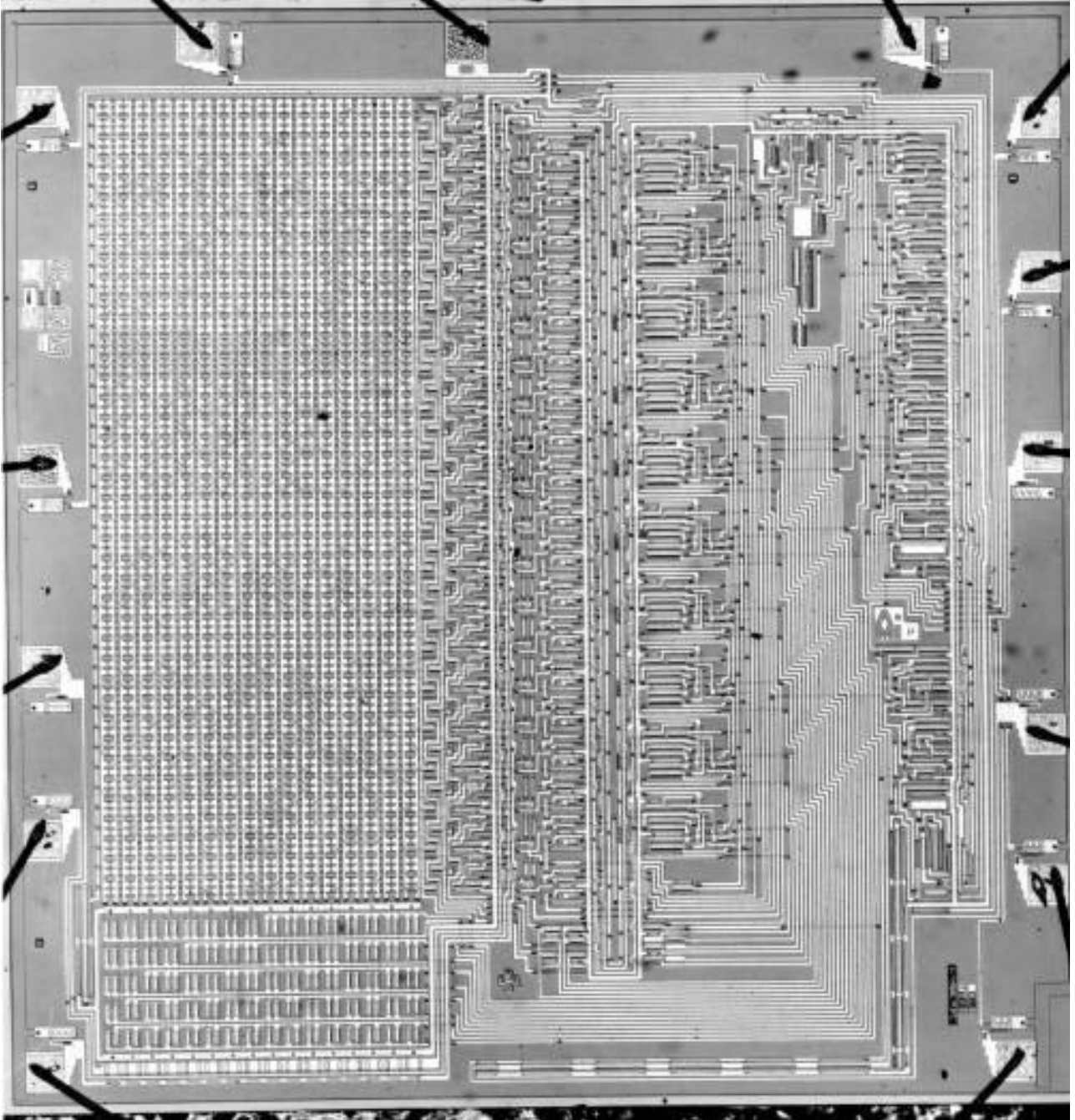
# ROM (Read only memory)



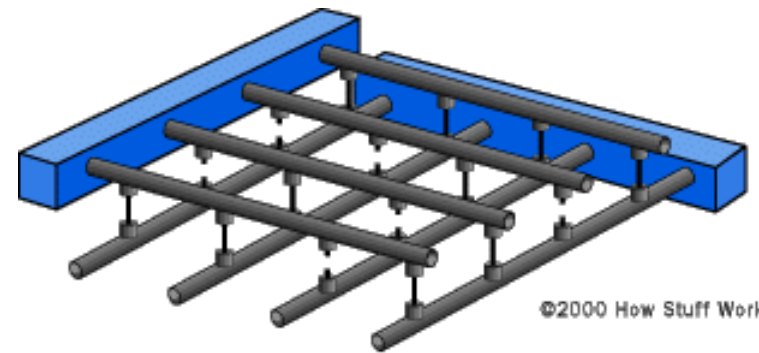
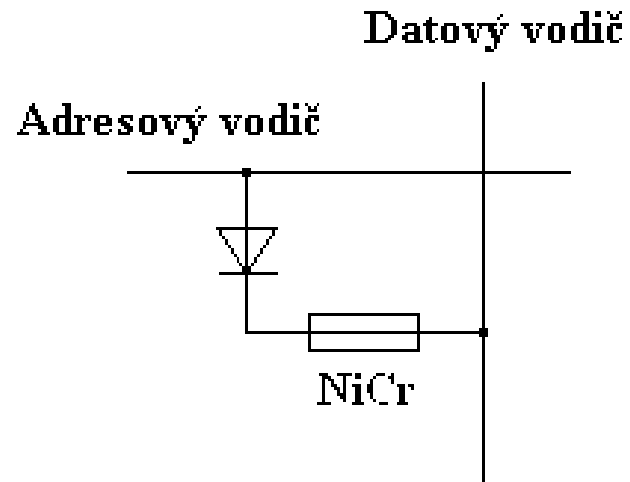
Hodnota "0"



Hodnota "1"

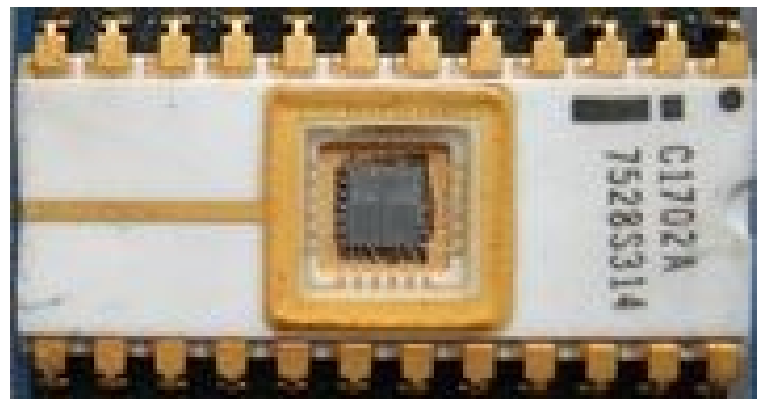
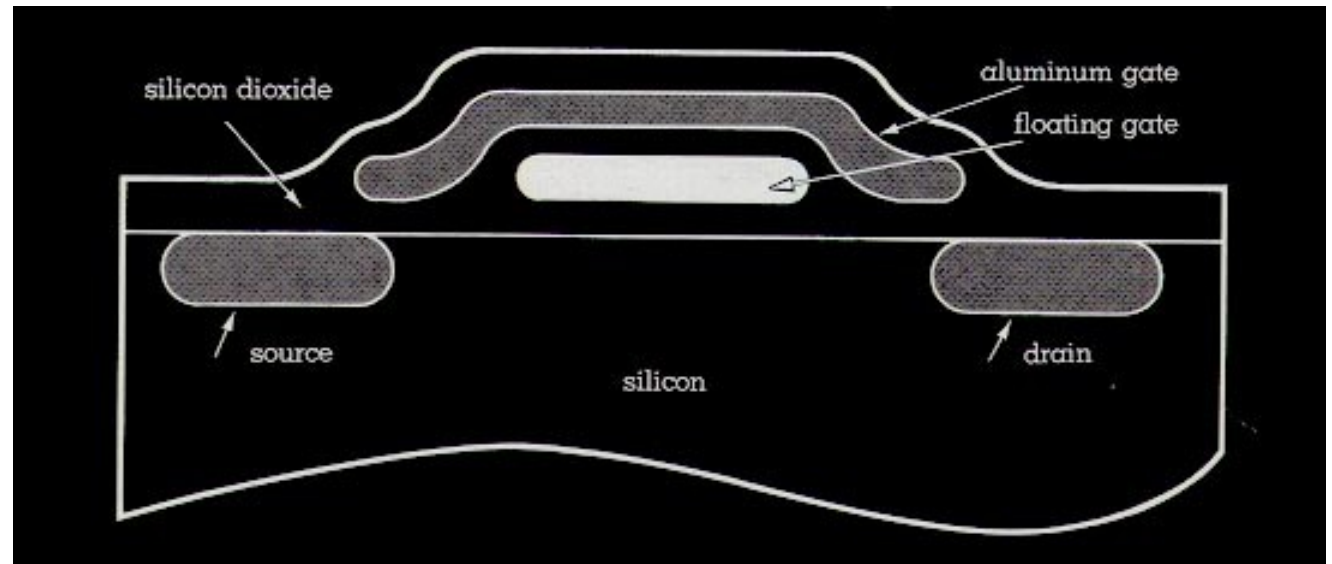


# PROM

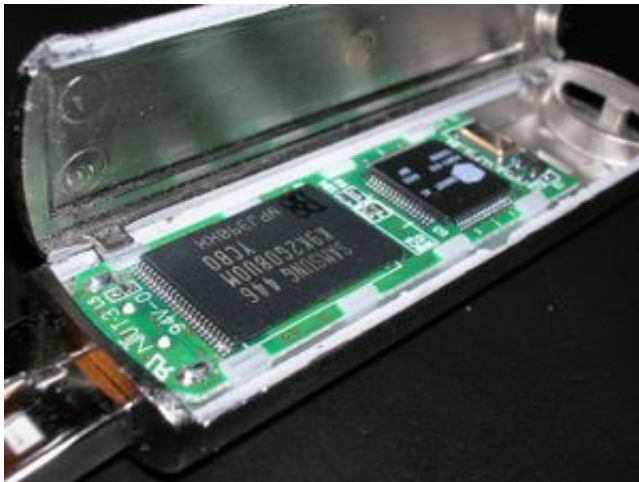
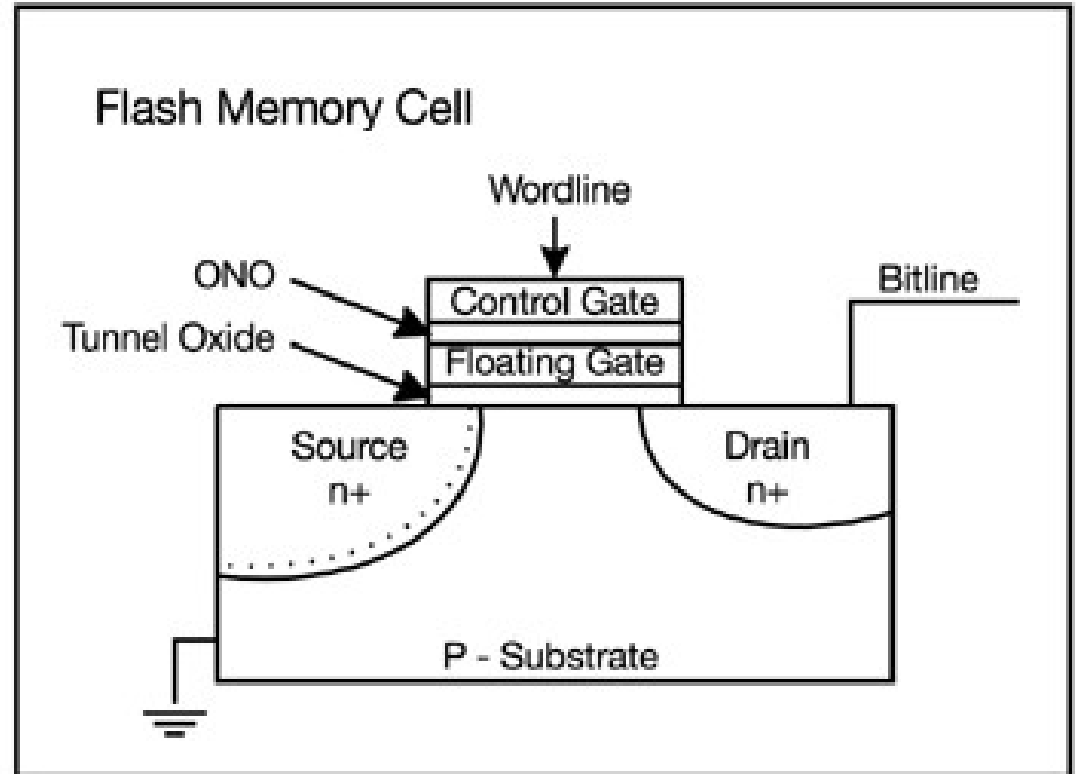


**PROM**

# EPROM

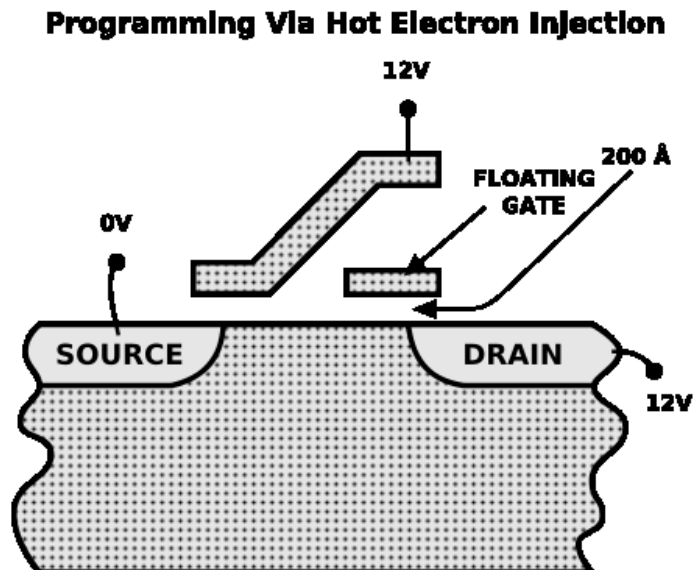


# Flash memory



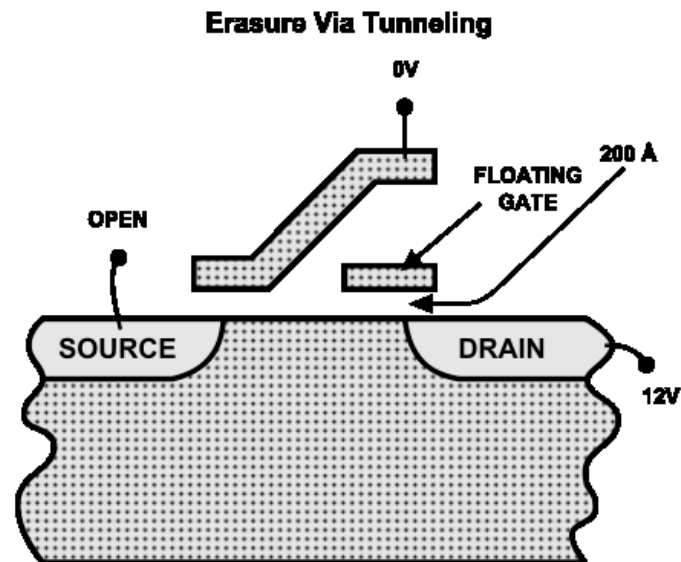


zápis log 0



Vyšší kladné napětí na Gate, velký SD proud, některé elektrony „zabloudí“ na floating gate – injekce horkých elektronů.

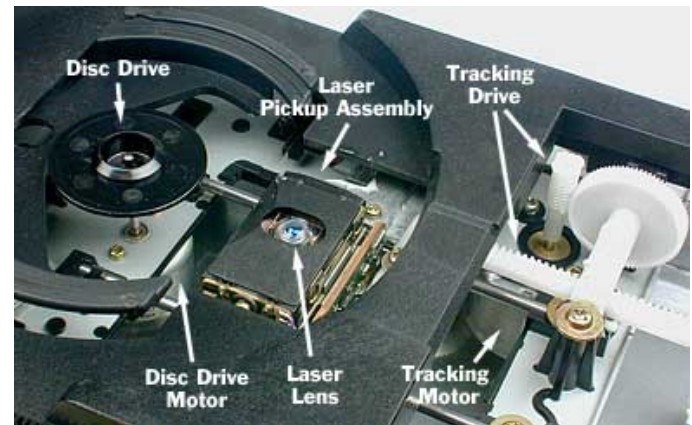
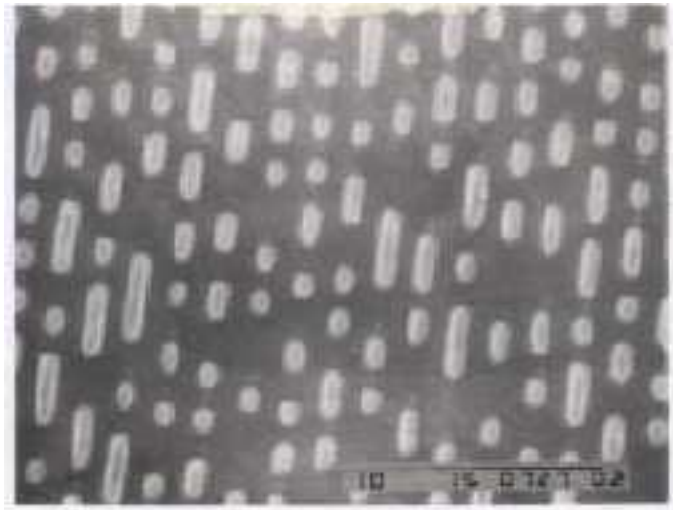
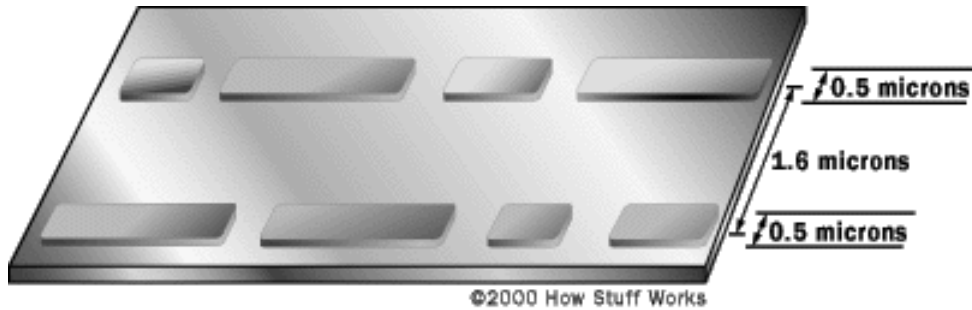
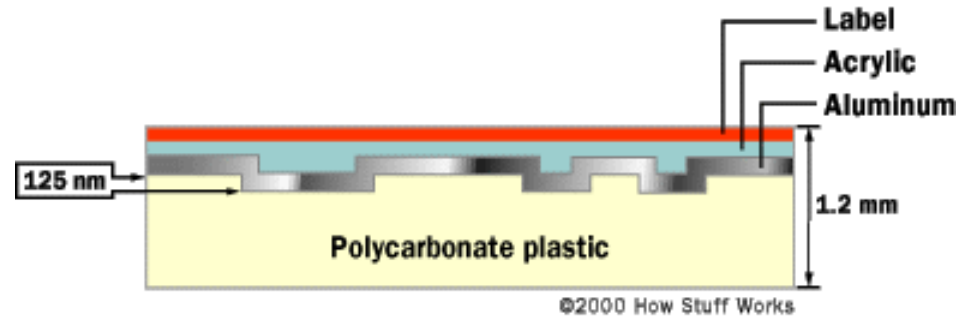
mazání (zápis log 1)



Source nezapojen, velký kladný potenciál pod floating gate, tunelování elektronů přes tenkou bariéru.

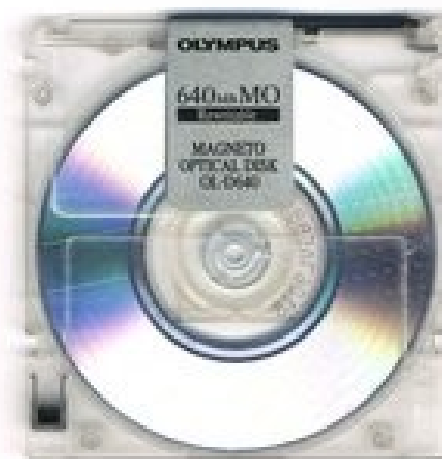
# 1977 CD

# 1984 CD-ROM



## 1990 Magneto optical disc

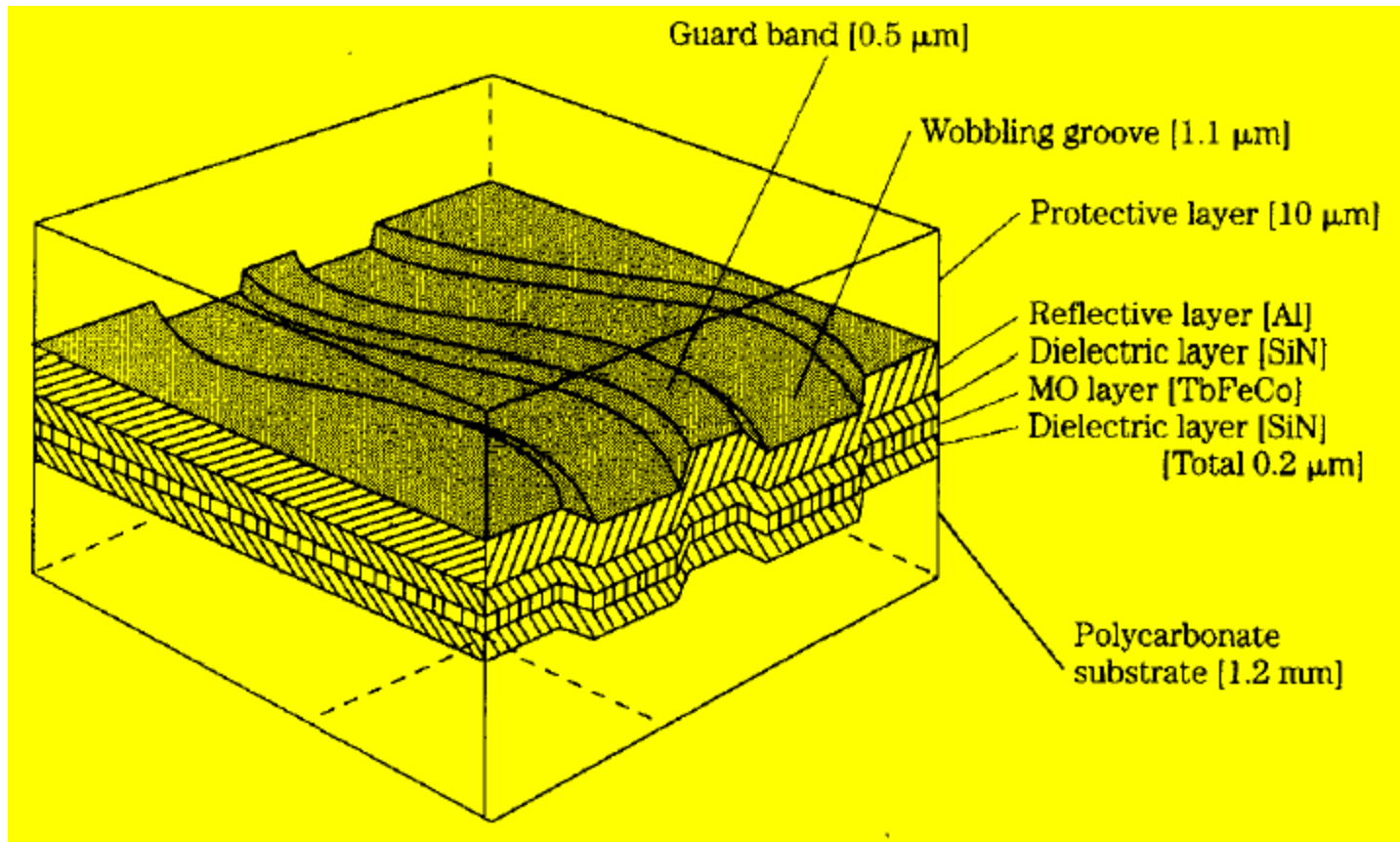
První přepisovatelný  
optický audio formát



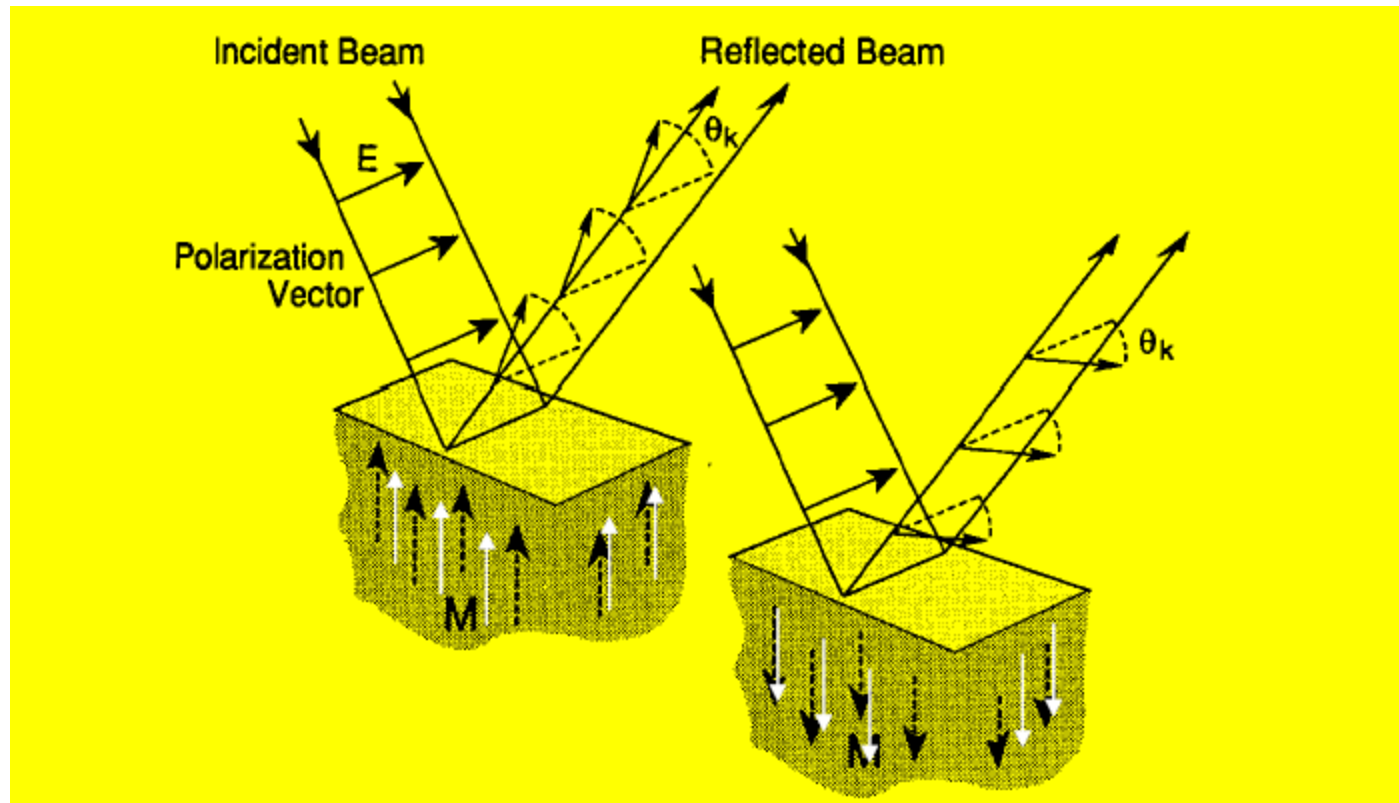
Magnetooptický Kerrův jev – změna  
lineárně polarizovaného světla na elipticky  
polarizované při magnetizaci materiálu

Zápis: zahřátí feromagnetika na Curieovu  
teplotu a ochlazení zpět ve vnějším mg. poli  
dané polarizace





**Figure 12.4** Recordable discs are manufactured with a pregroove configuration to guide the writing and reading laser within a spiral track. The MO recording layer is contained within dielectric layers. (*Sony Corporation*)



**Figure 1.20.** Schematic diagram describing the polar magneto-optical Kerr effect. Upon reflection from the surface of a perpendicularly magnetized medium, the polarization vector undergoes a rotation. The sense of rotation depends on the direction of the magnetization vector  $\mathbf{M}$ , and switches sign when  $\mathbf{M}$  is reversed.