

Technologie numérique en images

Peter Niebert

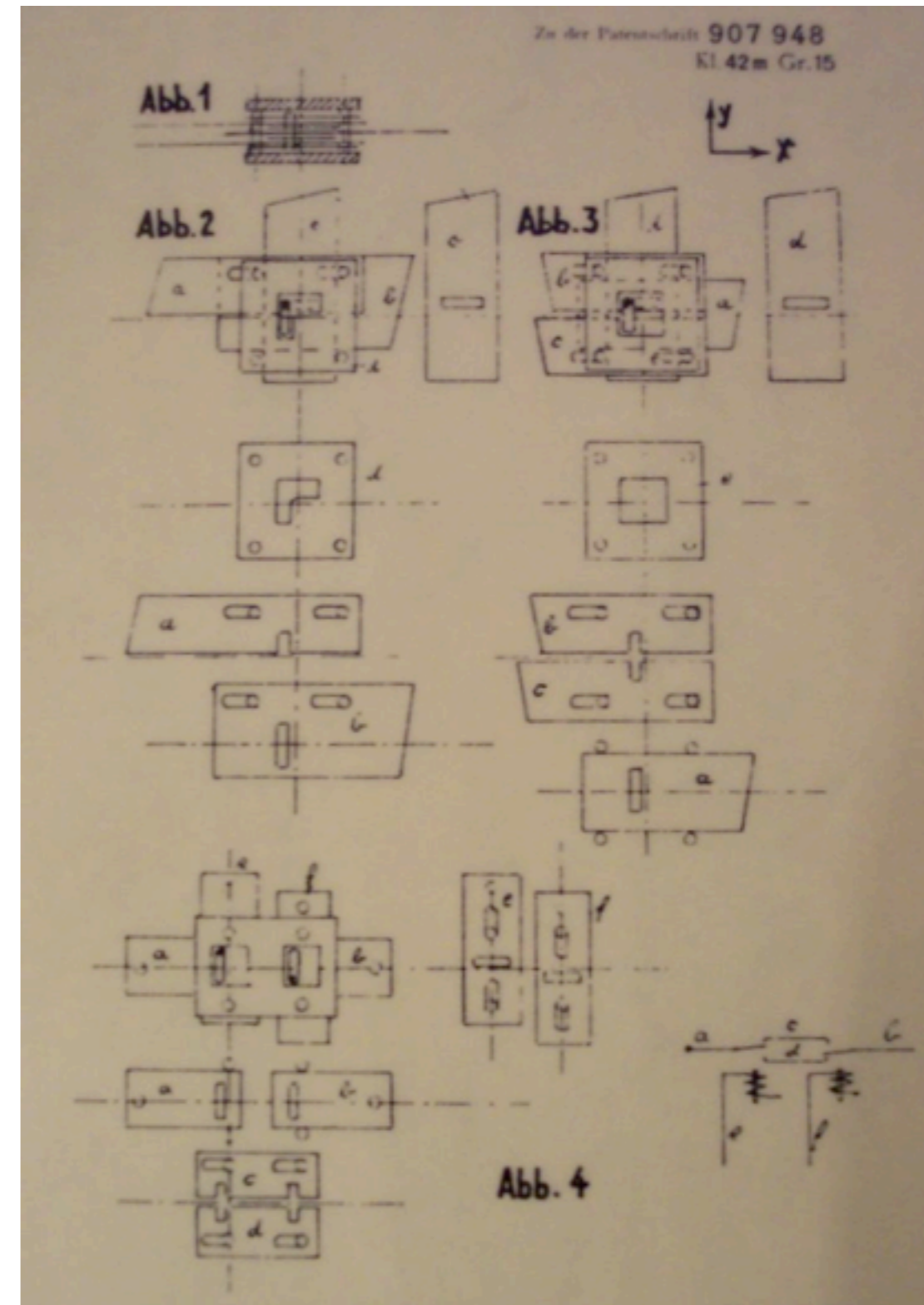
Logique mécanique

Zuse Z1, 1937

calculatrice programmable!

nombres flottants 64 bit

une opération dure plusieurs secondes



Logique électromécanique

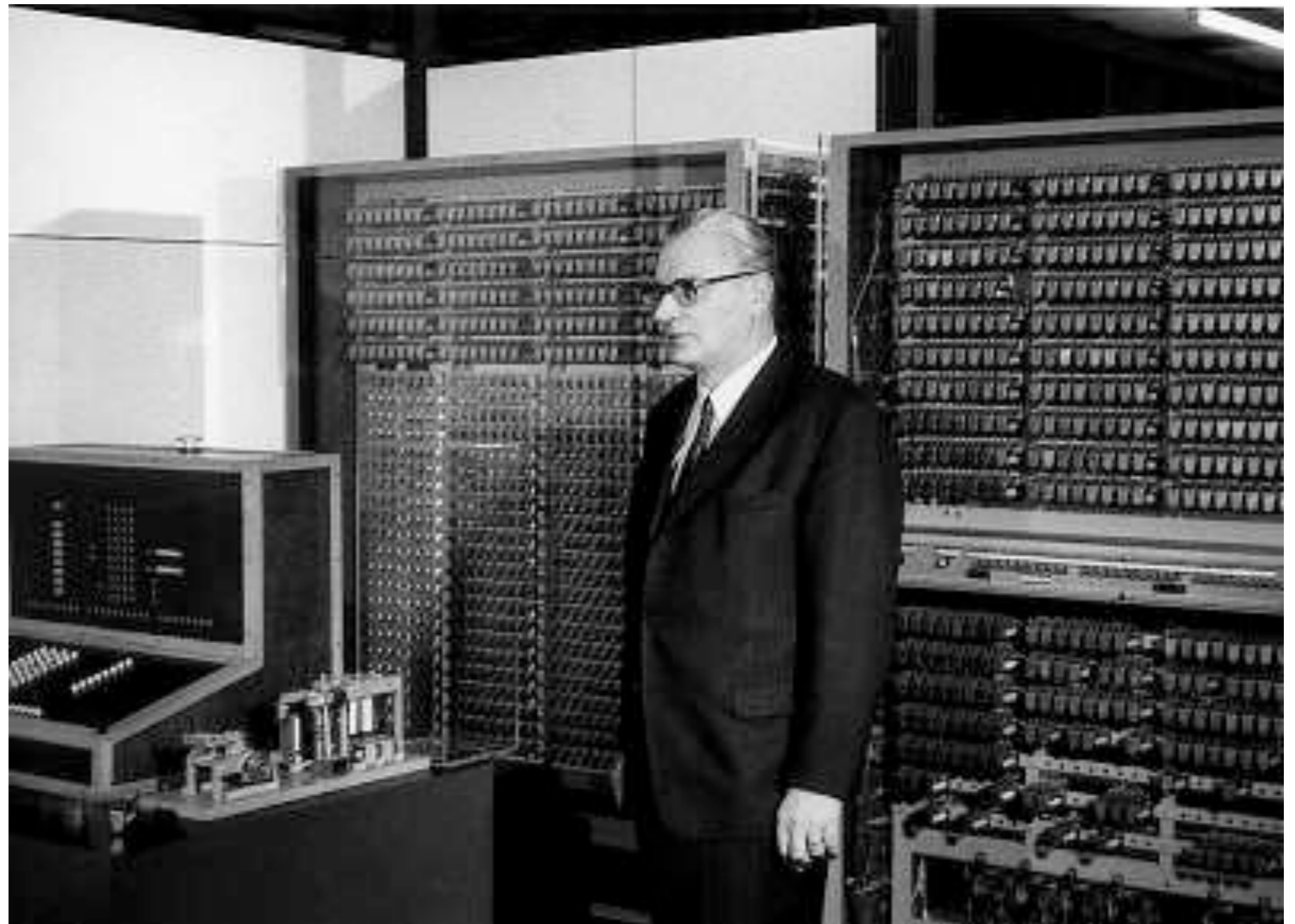
- 1941 Konrad Zuse «Z3» (reconstruction 1961)

~2500 relais

4kW

5Hz

programmable!



Le premier « bug », Harvard Mark II, 1947

9/9

0800 Anttan started
 1000 " stopped - anttan ✓
 13⁰⁰ (032) MP - MC ~~1.582147000~~ { 1.2700 9.037 847 025
 (033) PRO 2 2.130476415 } 9.037 846 995 correct
 correct 2.130676415 4.615925059(-2)

Relays 6-2 in 033 failed special speed test
 in relay " 10.000 test -

Relay
 2145
 Relay 3376

1100 Started Cosine Tape (Sine check)
 1525 Started Multi-Adder Test.
 Relays changed

1545



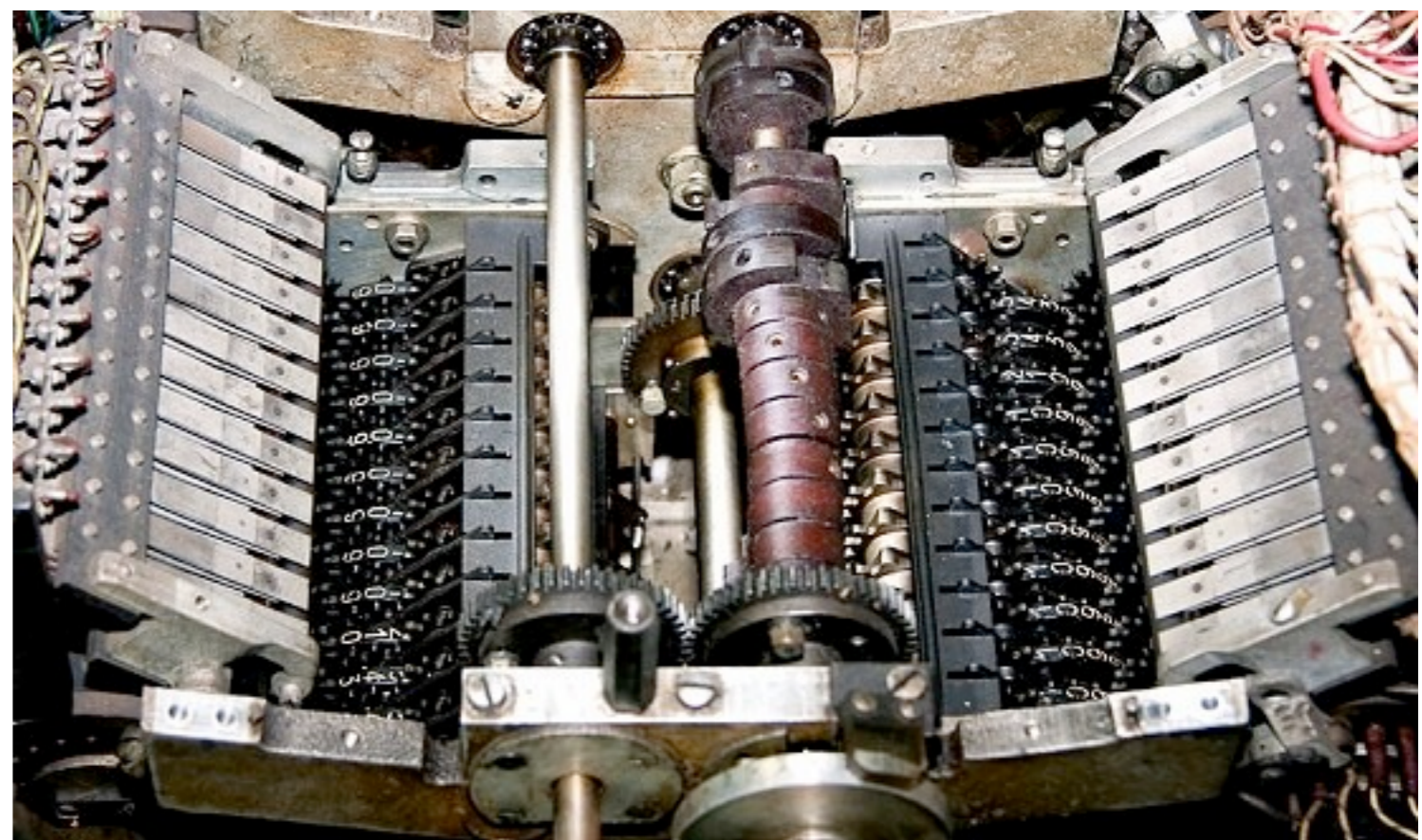
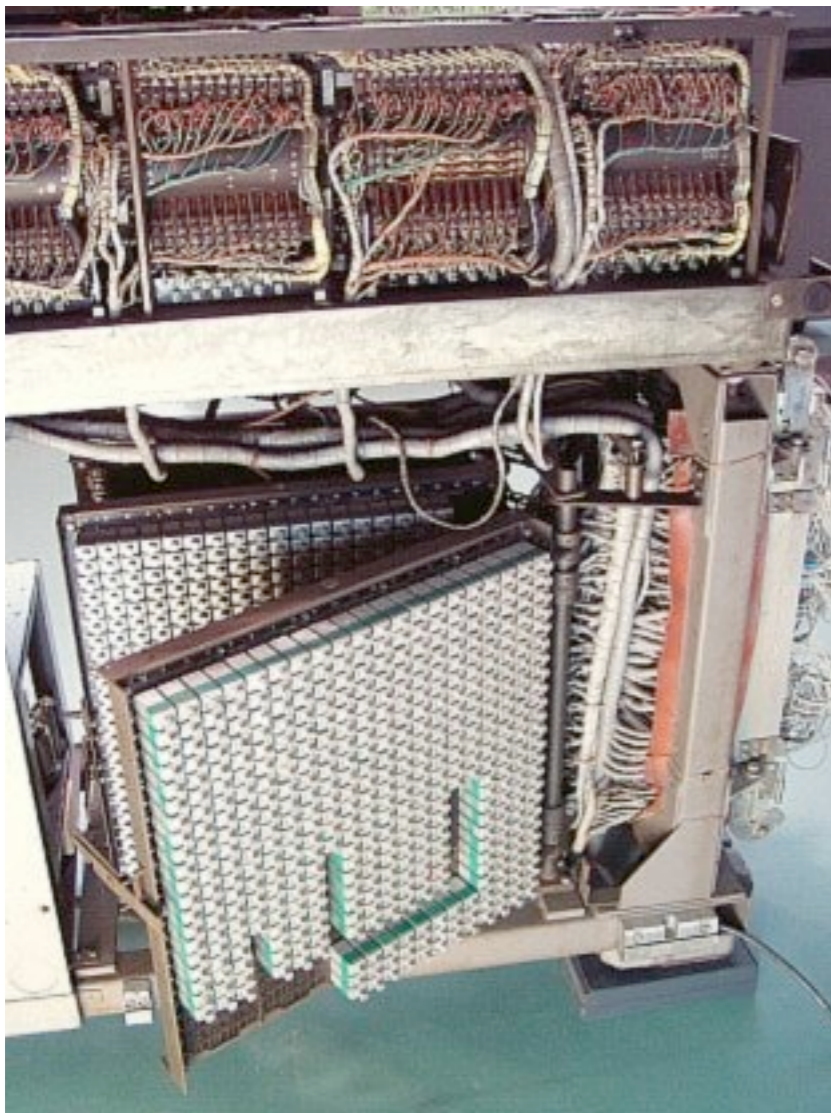
Relay #70 Panel F
 (moth) in relay.

First actual case of bug being found.

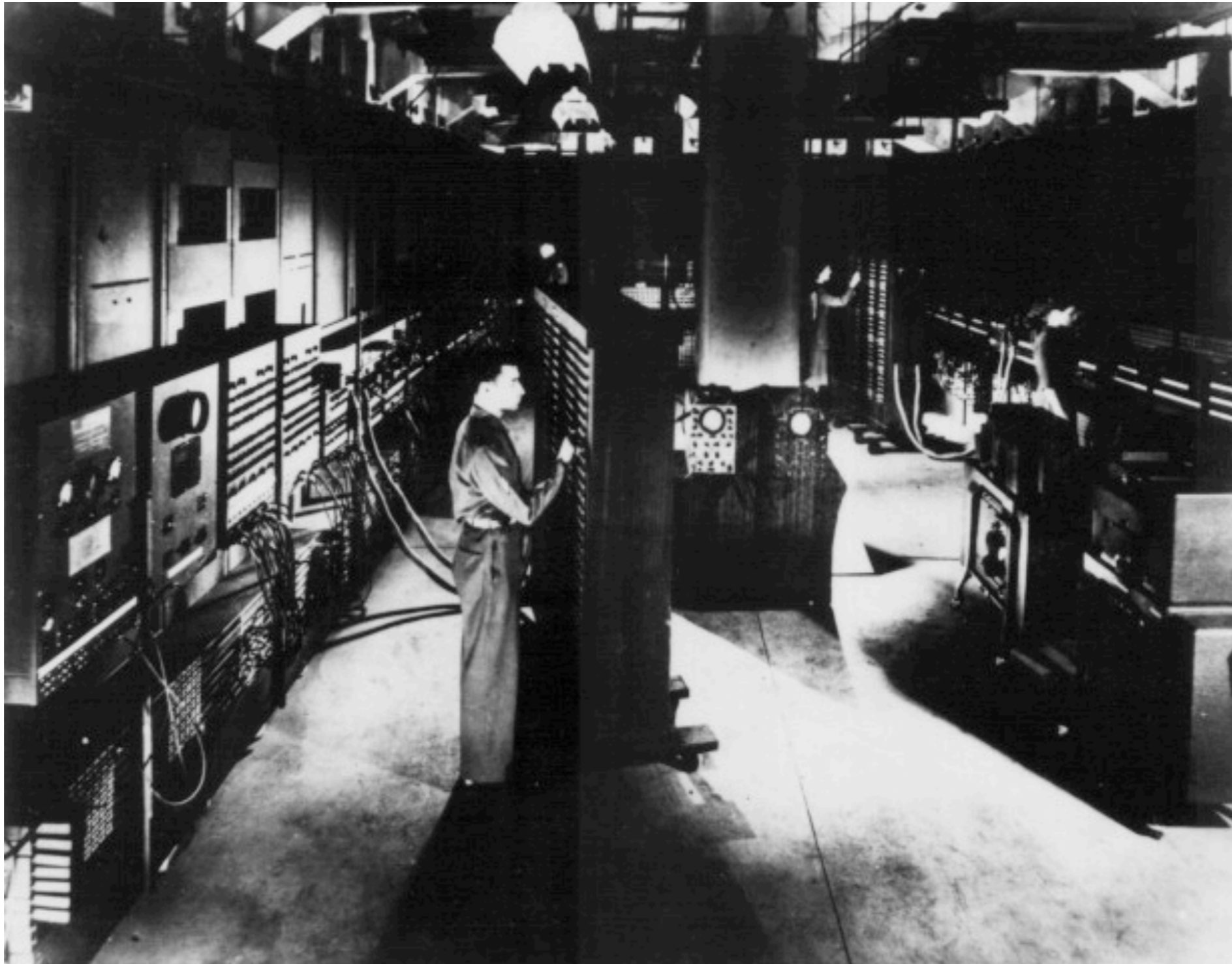
~~1630~~ Anttan started.
 1700 closed down.

Logique électromécanique

- Tabulator Bull 1956, calcul avec système décimal!



ENIAC 1942: ordinateur électronique

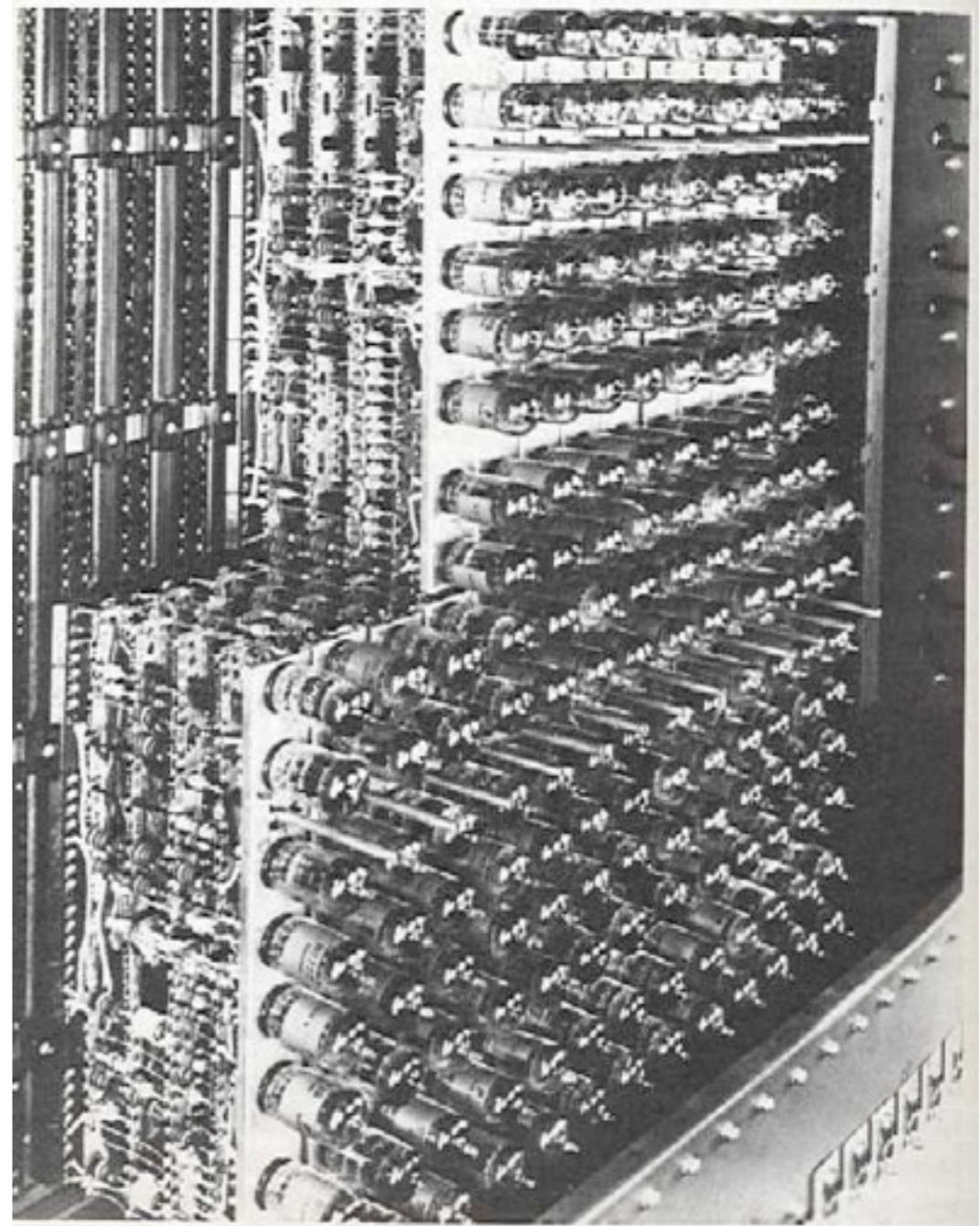


ENIAC : Logique électronique

- ENIAC 1942, premier ordinateur électronique
- 17486 tubes (radio), 7200 diodes, 1500 relais
- 5M points de soudure (à la main, svp!).
- 30m x 2,4m x 0,9m, 27t, 150kW
- 100kHz, 20 cycles par instruction
- Plusieurs tubes à remplacer chaque jour!

Logique électronique

- Mémoire à tubes, IBM 1952



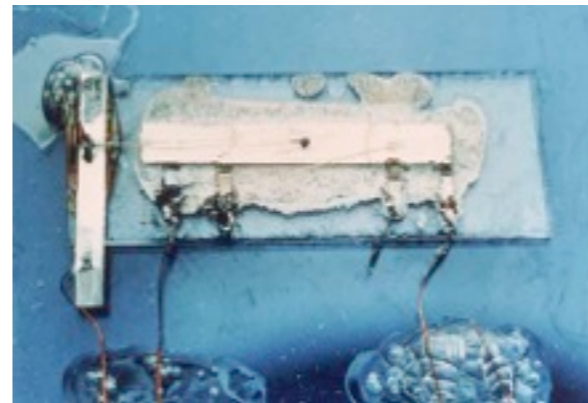
Logique électronique

- Des tubes aux transistors
- Fonction analogique :
 - amplifier
- Fonction numérique
 - préserver qualité du signale

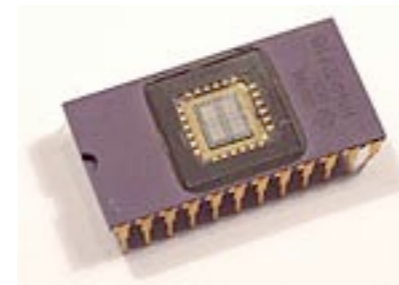
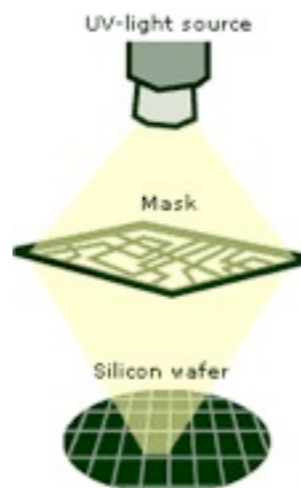
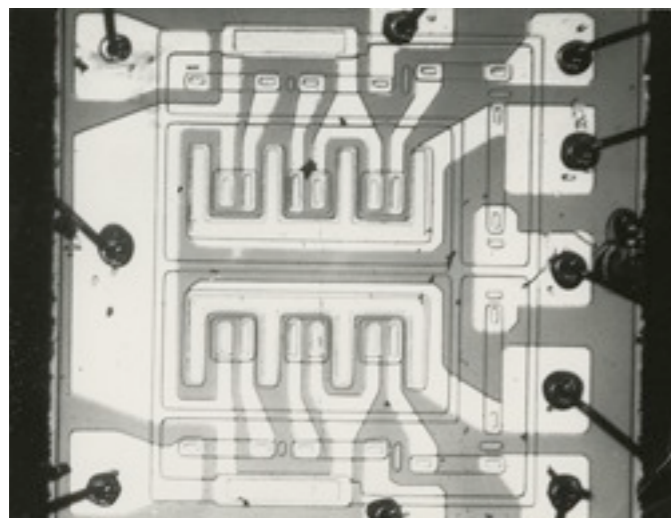


Circuits intégrés

- Jack S. Kilby 1958 (prix Nobel 2000)



- Production industrielle plus tard




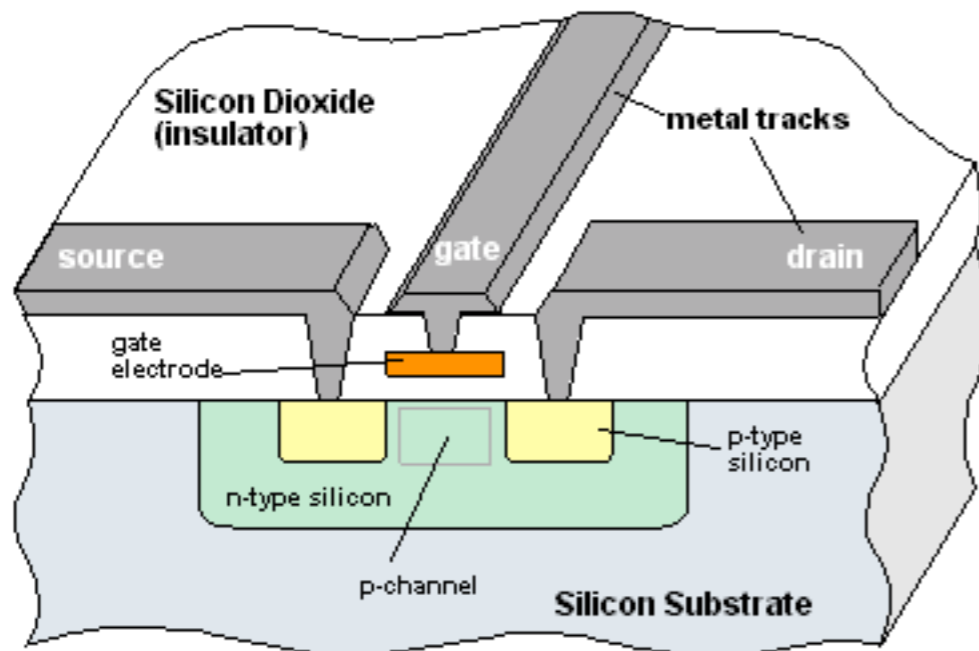
Circuits intégrés : CMOS

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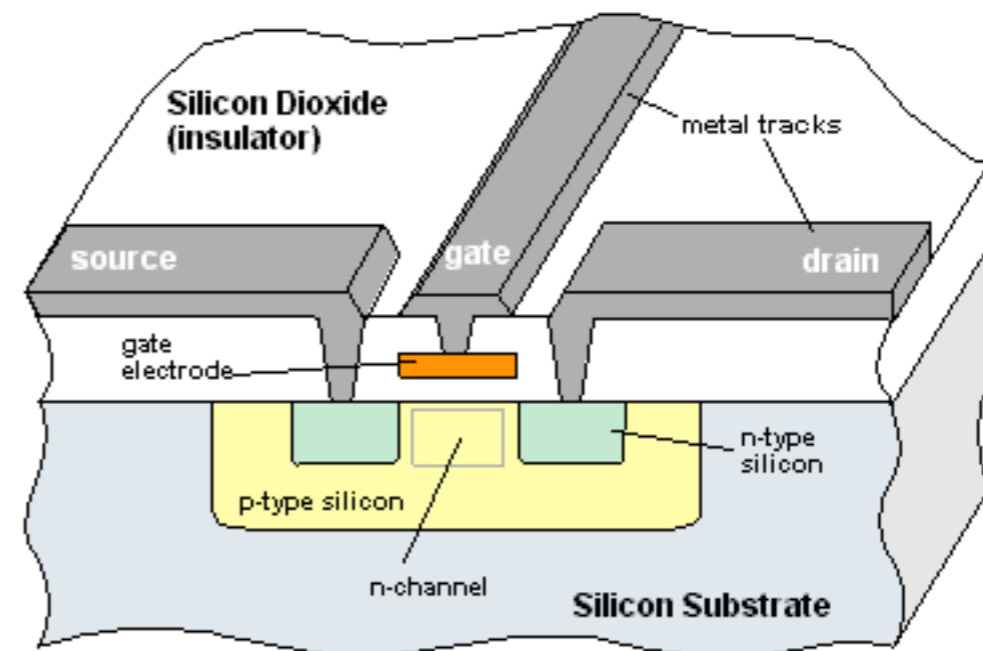
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**PMOS Transistor
(p-channel MOSFET)**

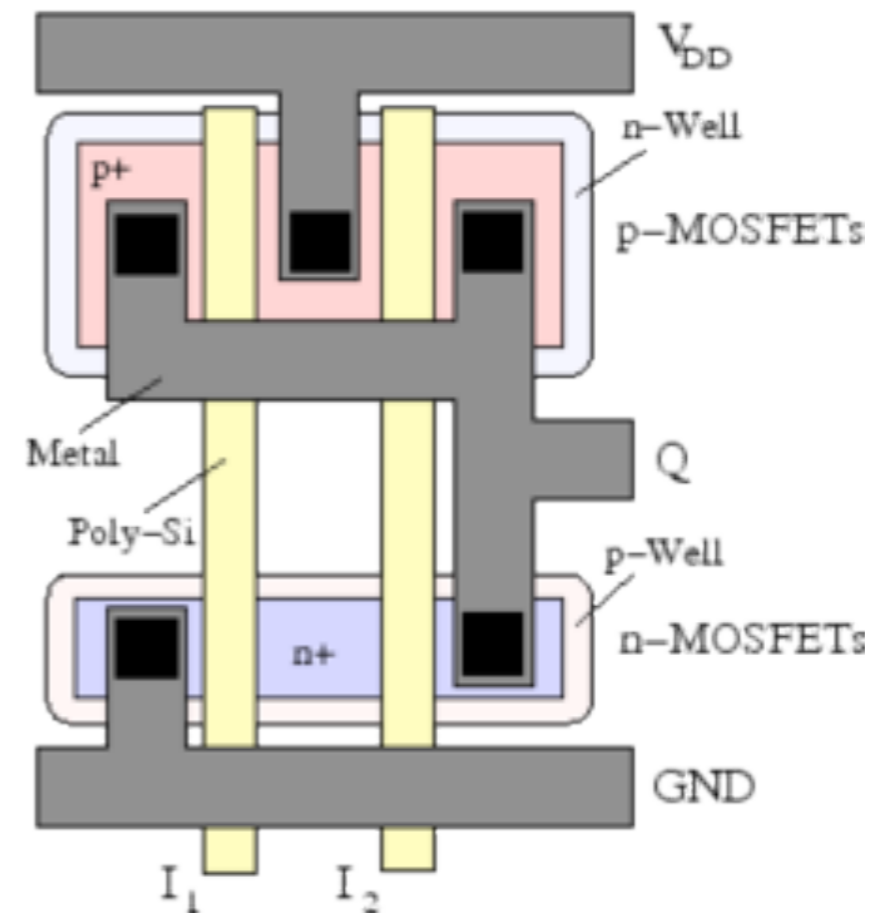
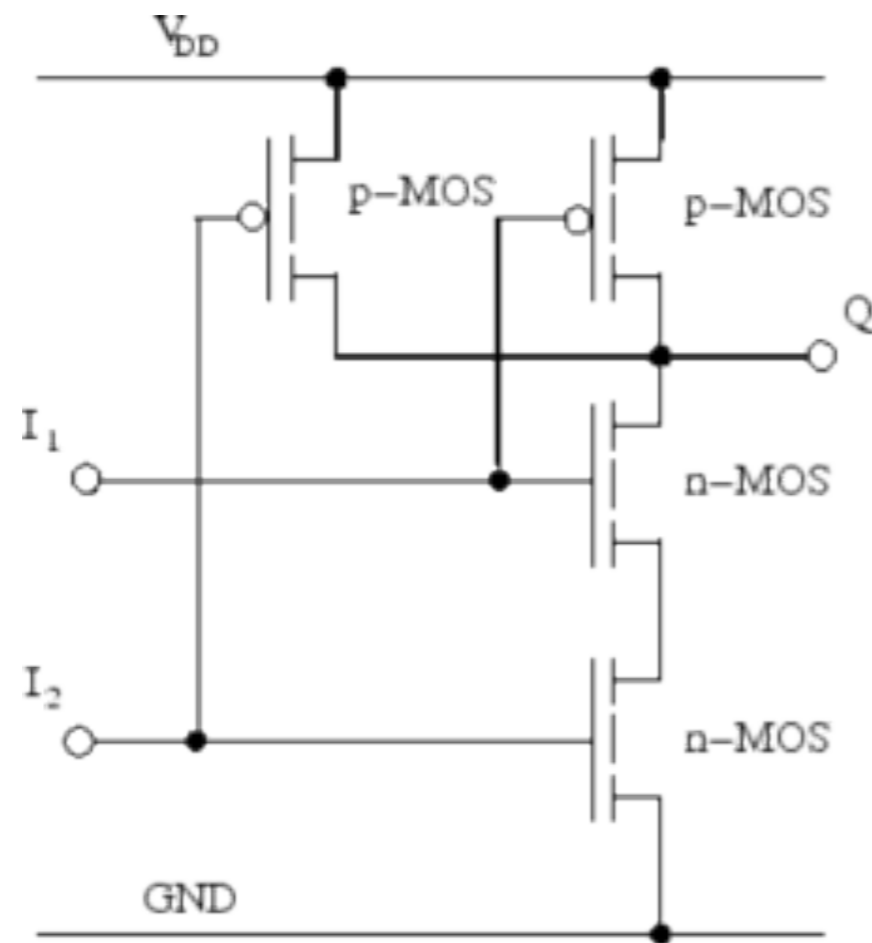
 poly-crystalline silicon gate electrode



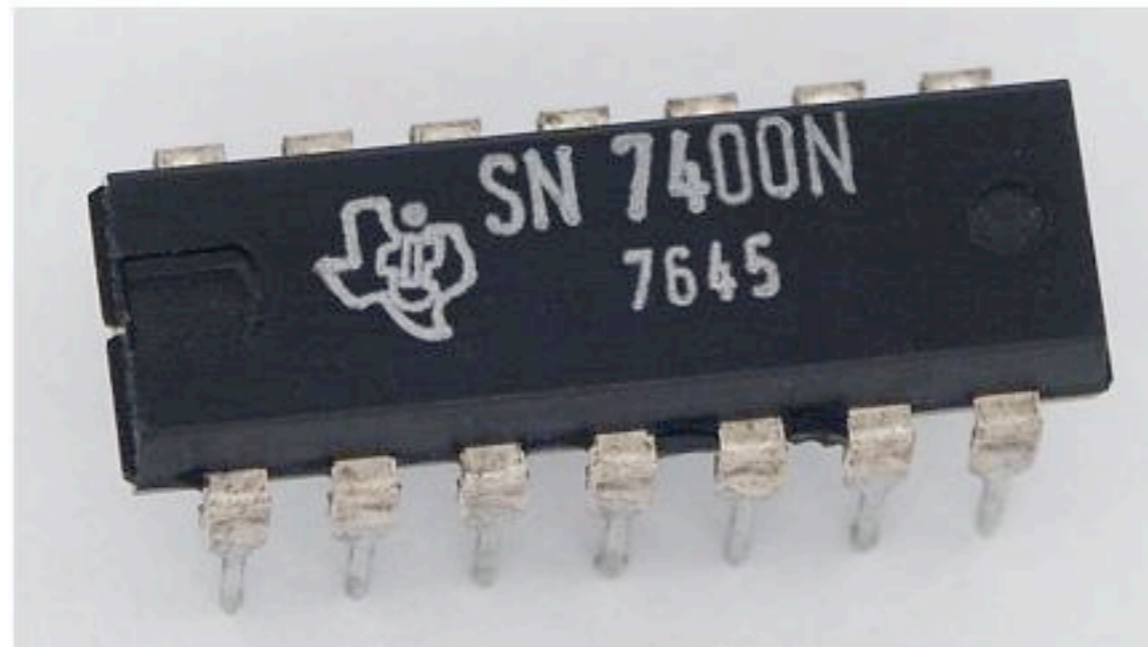
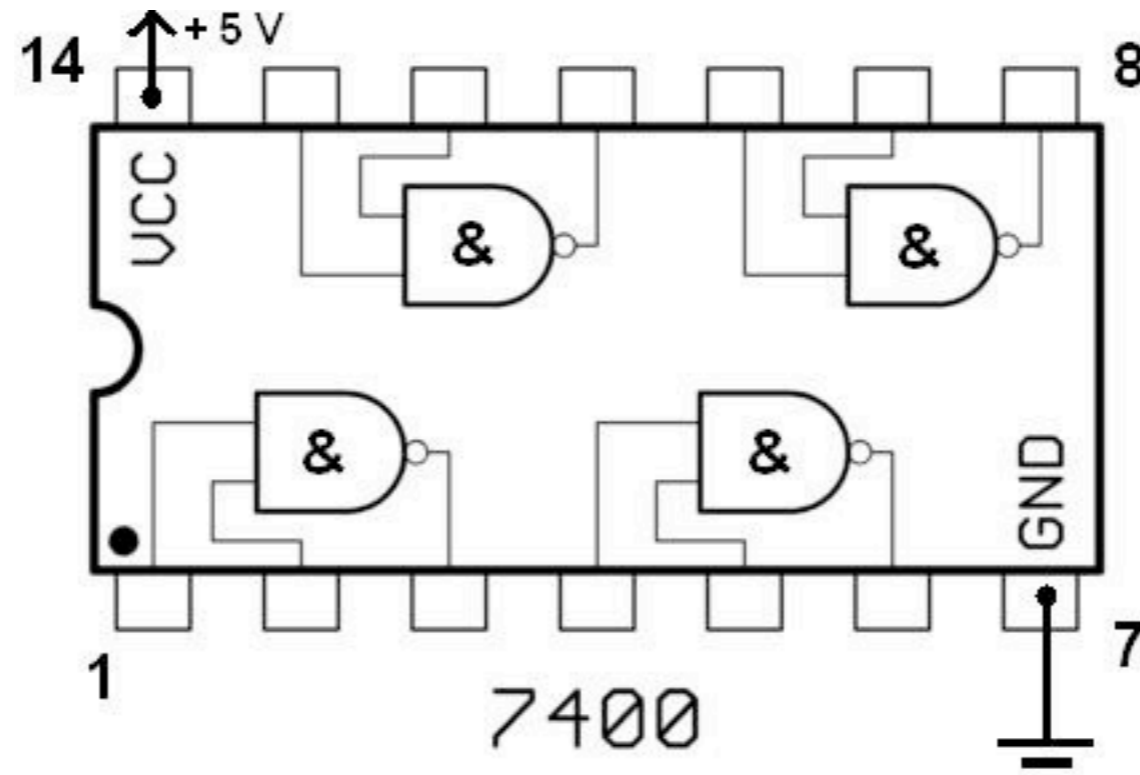
**NMOS Transistor
(n-channel MOSFET)**



Circuits intégrés : CMOS

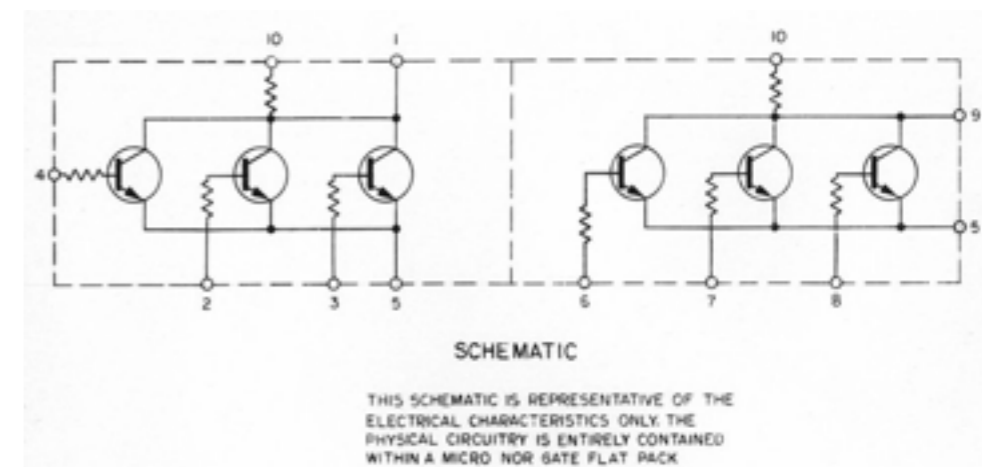
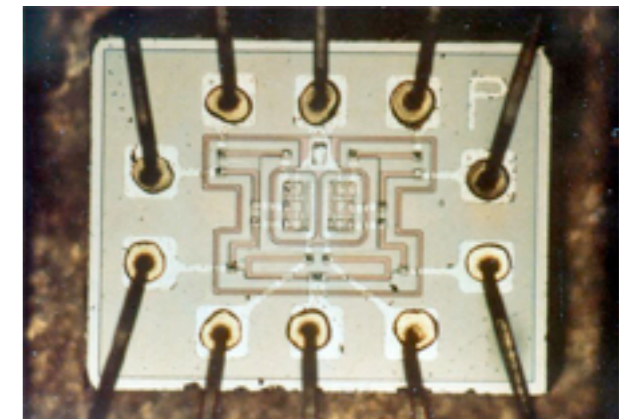
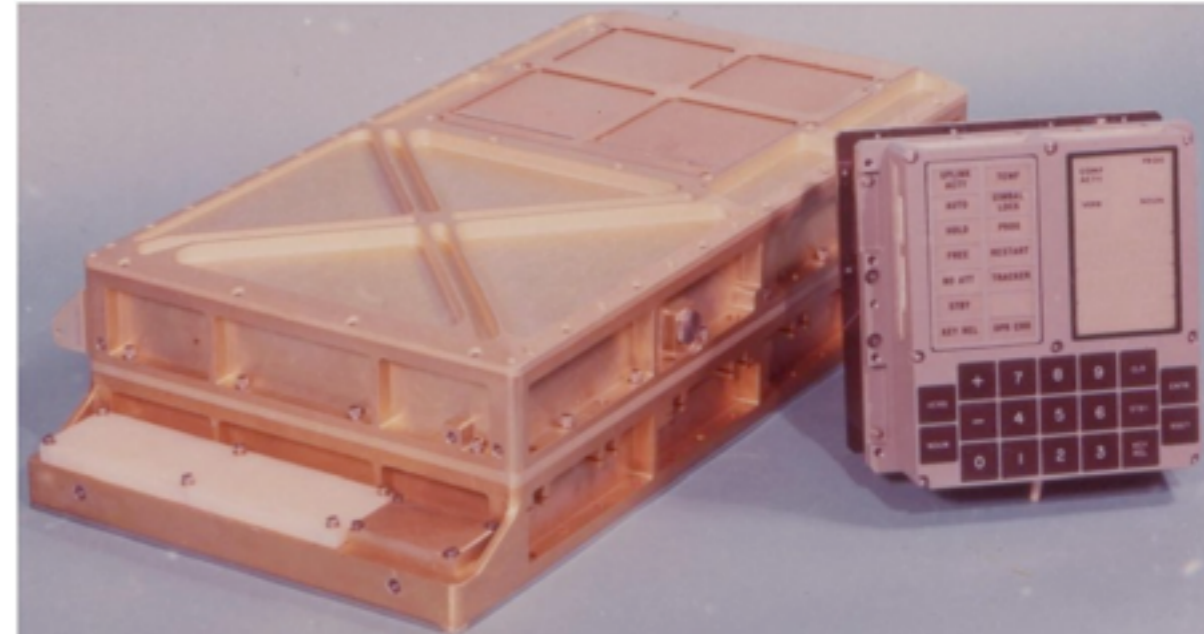


Portes sur puces

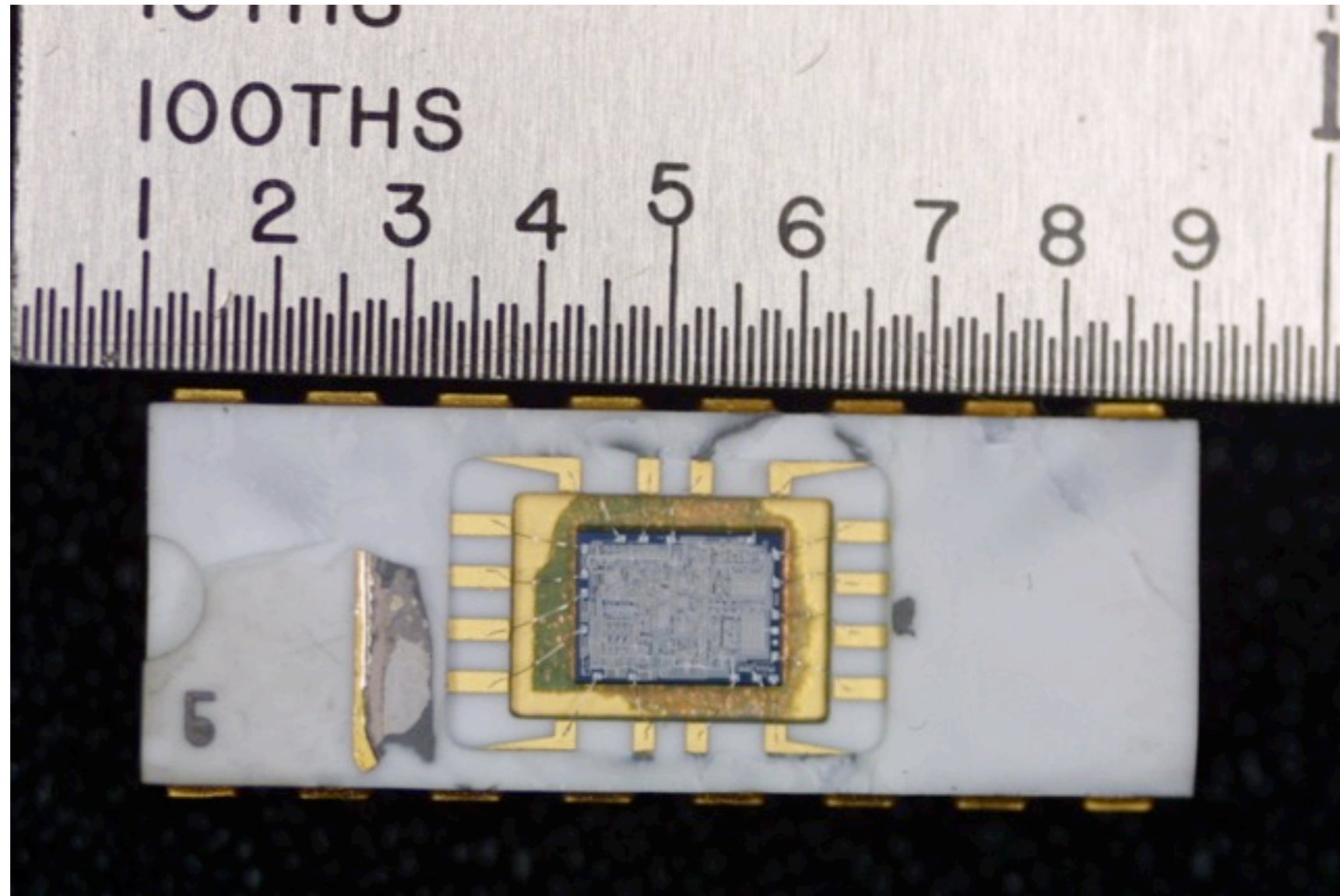


Exemple : Apollo Guidance Computer

- Application : contrôler le vol dans les missions Apollo
- coeur : 2800CI avec 2 portes NOR chacun
- 4kO RAM, 64kO ROM
- Arch. 16bit, 2,048 MHz
- ~35kg, 55W

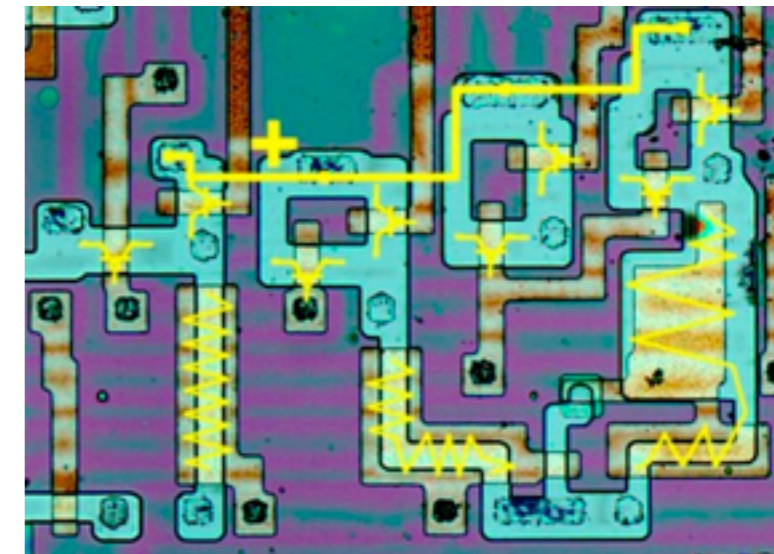
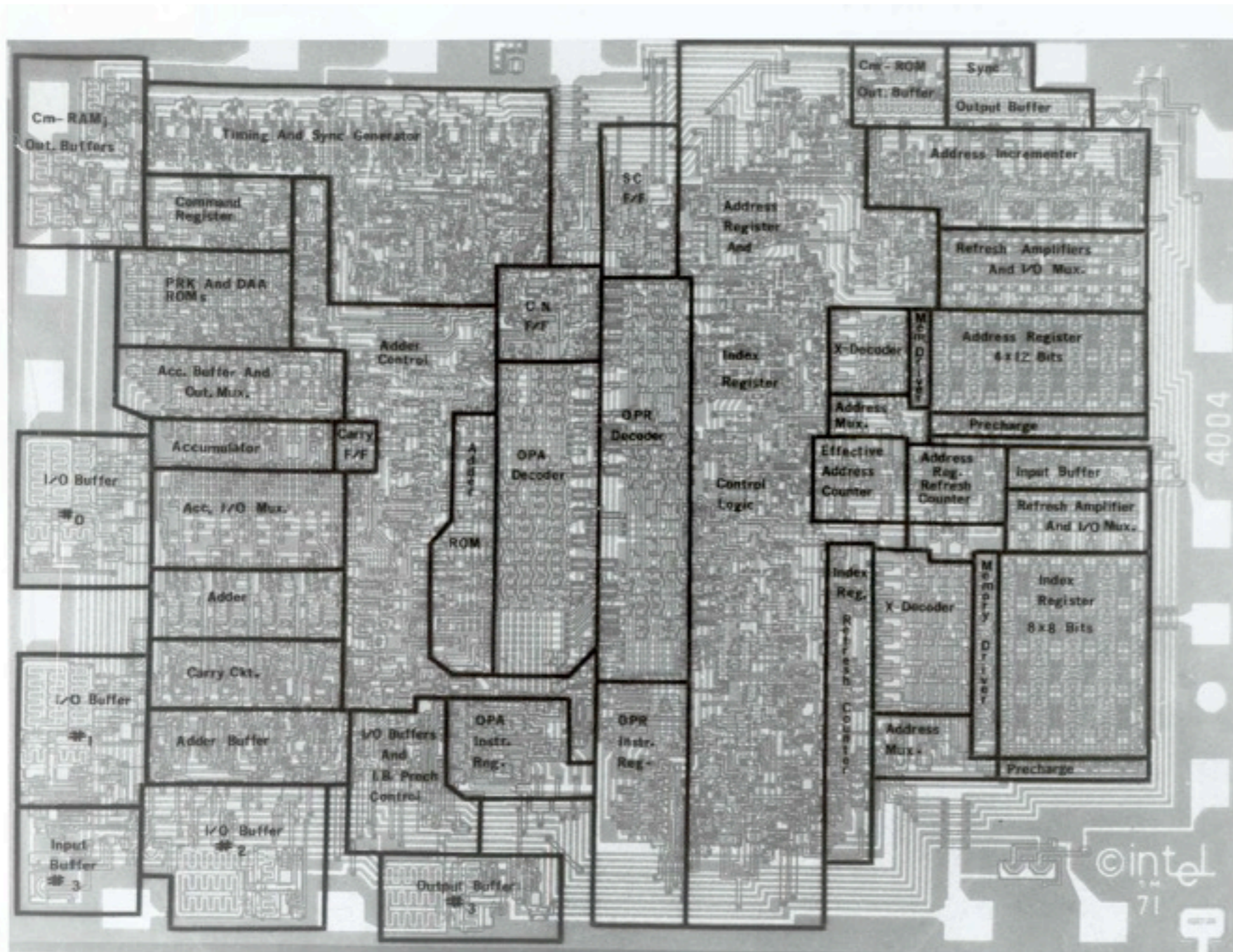


Microprocesseurs Intel 4004 (1971)



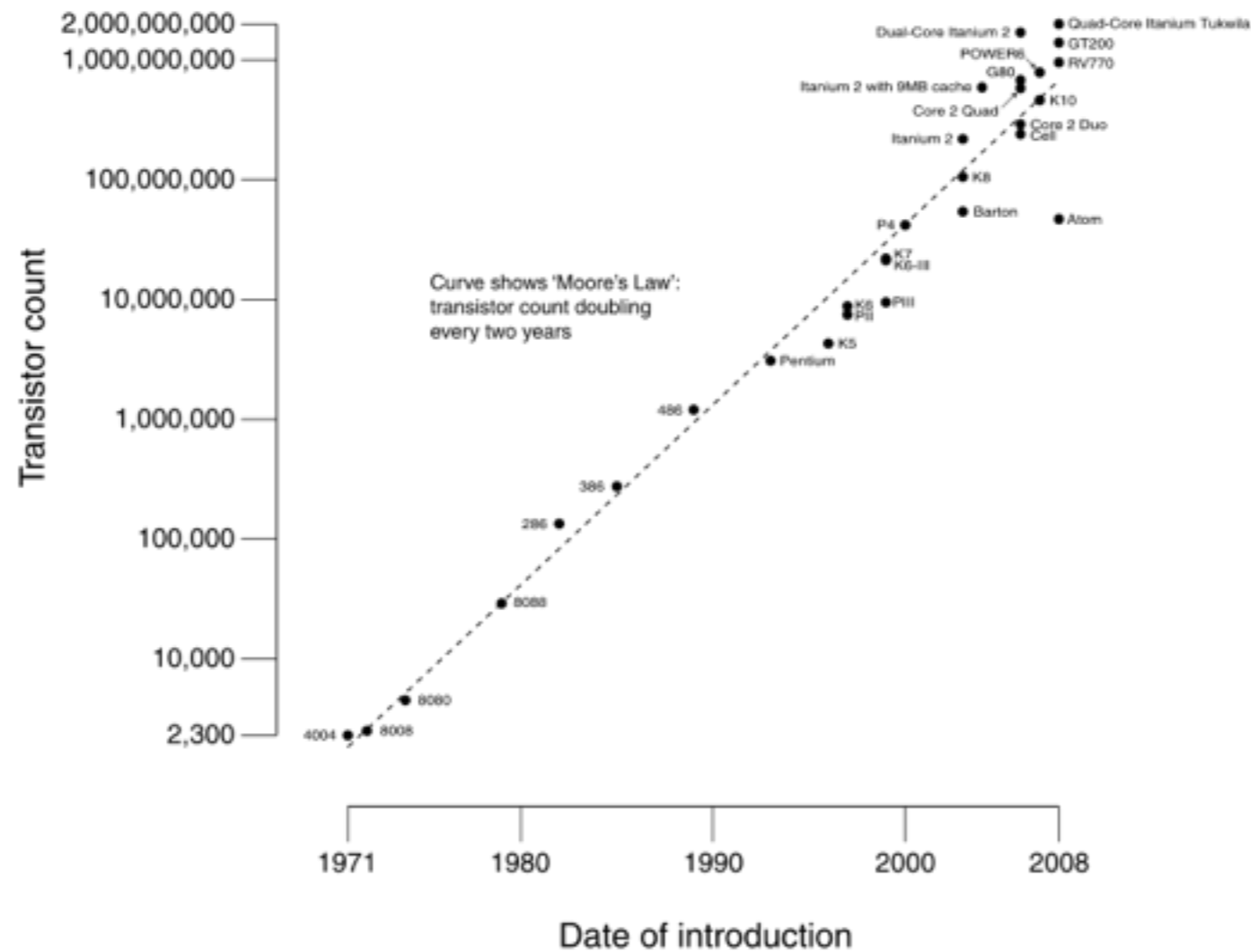
Microprocesseurs

Intel 4004 (1971)

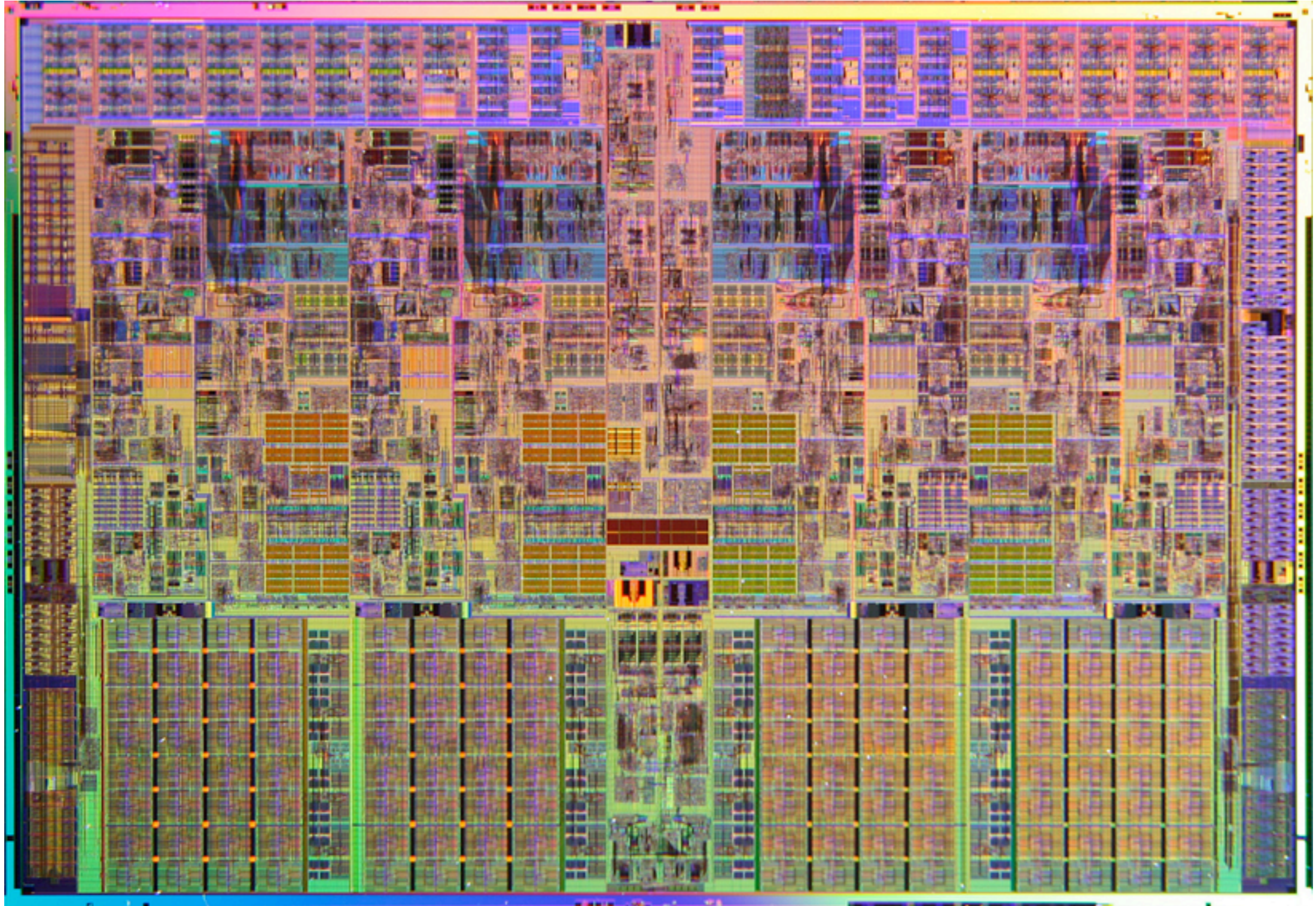


«Loi de Moore»

CPU Transistor Counts 1971-2008 & Moore's Law



Intel Core i7



Intel Core i7

