Chapter 1
Introduction to Electronics

Microelectronic Circuit Design

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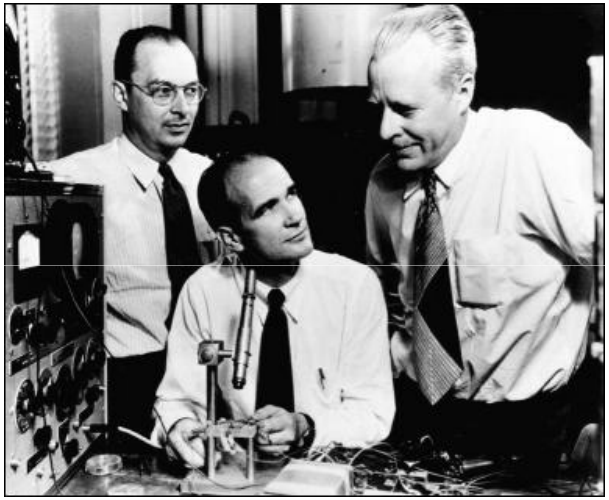
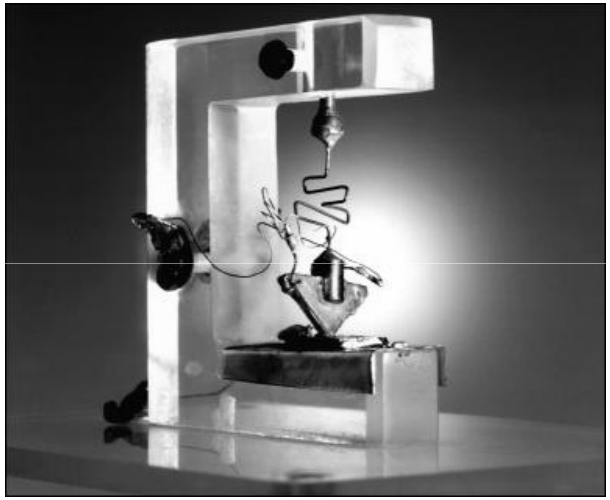
The Start of the Modern Electronics Era



Bardeen, Shockley, and Brattain at Bell Labs - Brattain and Bardeen invented the bipolar transistor in 1947.



The first germanium bipolar transistor. Roughly 50 years later, electronics account for 10% (4 trillion dollars) of the world GDP.

Electronics Milestones

1874 Braun invents the solid-state rectifier.

1906 DeForest invents triode vacuum tube.

1907-1927 First radio circuits developed from diodes and triodes.

1925 Lilienfeld field-effect device patent filed.

1947 Bardeen and Brattain at Bell Laboratories invent bipolar transistors.

1952 Commercial bipolar transistor production at Texas Instruments.

1956 Bardeen, Brattain, and Shockley receive Nobel prize.

1958 Integrated circuit developed by Kilby and Noyce

1961 First commercial IC from Fairchild Semiconductor

1968 First commercial IC opamp

1970 One transistor DRAM cell invented by Dennard at IBM.

1971 4004 Intel microprocessor introduced.

1978 First commercial 1-kilobit memory.

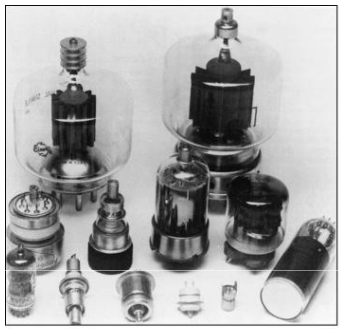
1984 8080 microprocessor introduced.

1984 Megabit memory chip introduced.

2000 Alferov, Kilby, and Kromer share Nobel prize

Evolution of Electronic Devices

Vacuum Tubes



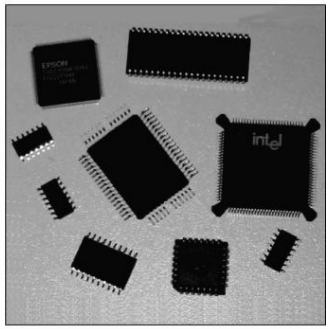
(a)

(b)

Discrete Transistors

SSI and MSI Integrated Circuits

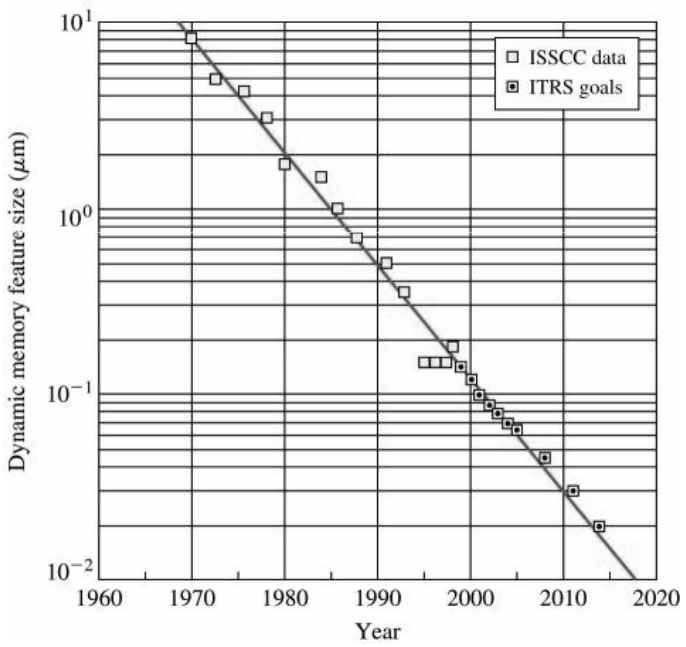
(c)



(d)

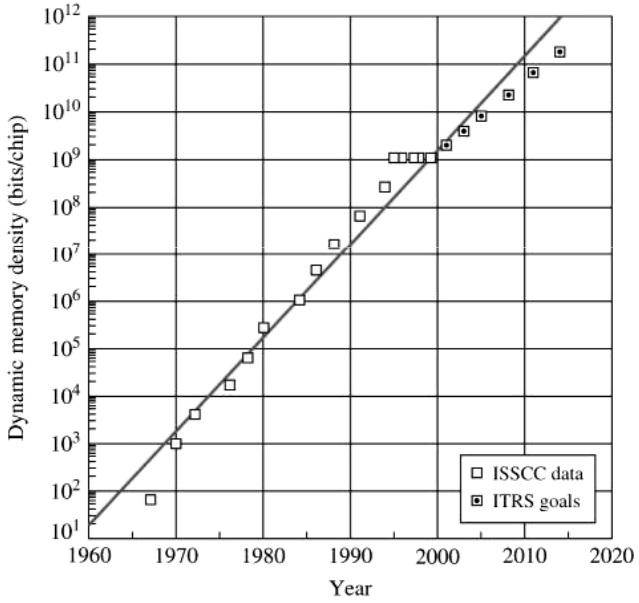
VLSI Surface-Mount Circuits

Device Feature Size

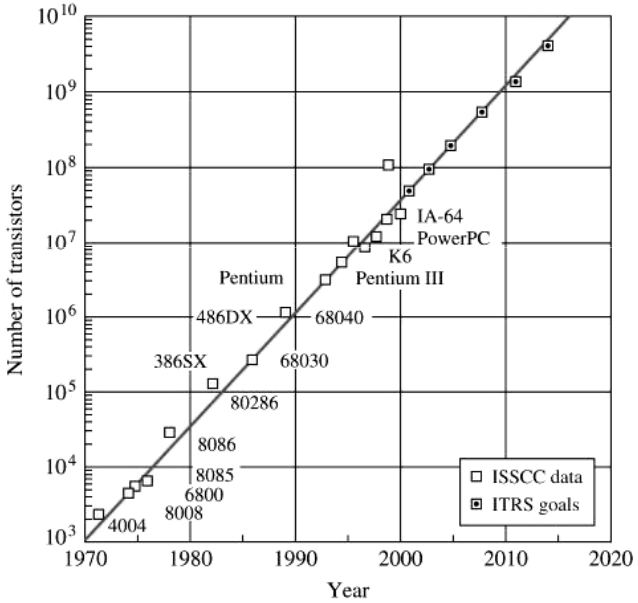


- Feature size reductions enabled by process innovations.
- Smaller features lead to more transistors per unit area and therefore higher density.

Rapid Increase in Density of Microelectronics



Memory chip density versus time.



Microprocessor complexity versus time.