

Chapter 1

Introduction to Electronics

Microelectronic Circuit Design

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1 Microelettronica – Elettronica analogica 2/ed
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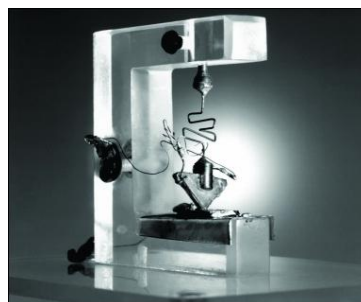
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The Start of the Modern Electronics Era



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.

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Electronics Milestones

1874	Braun invents the solid-state rectifier.	1958	Integrated circuit developed by Kilby and Noyce
1906	DeForest invents triode vacuum tube.	1961	First commercial IC from Fairchild Semiconductor
1907-1927	First radio circuits developed from diodes and triodes.	1963	IEEE formed from merger of IRE and AIEE
1925	Lilienfeld field-effect device patent filed.	1968	First commercial IC opamp
1947	Bardeen and Brattain at Bell Laboratories invent bipolar transistors.	1970	One transistor DRAM cell invented by Dennard at IBM.
1952	Commercial bipolar transistor production at Texas Instruments.	1971	4004 Intel microprocessor introduced.
1956	Bardeen, Brattain, and Shockley receive Nobel prize.	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)

Discrete Transistors



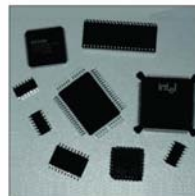
(b)

SSI and MSI Integrated Circuits



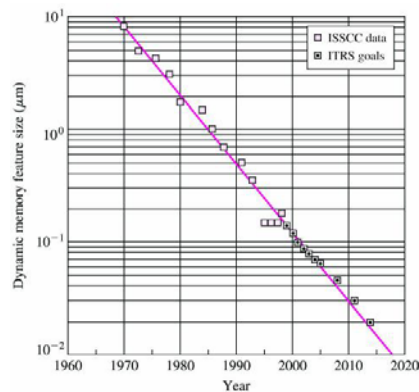
(c)

VLSI Surface-Mount Circuits



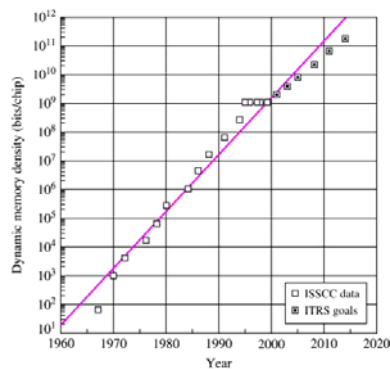
(d)

Device Feature Size

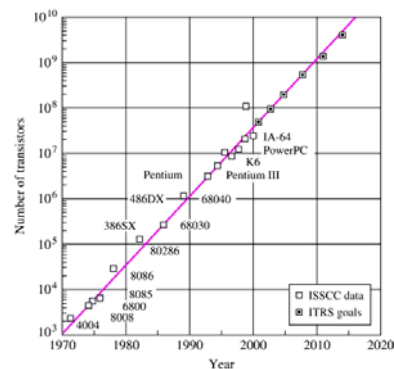


- Feature size reductions enabled by process innovations.
- Smaller features lead to more transistors per unit area and therefore higher density.

Rapid Increase in Density of Microelectronics



Memory chip density
versus time.



Microprocessor complexity
versus time.