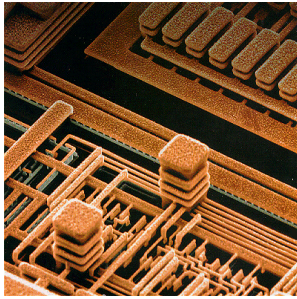


SEM Photo of Metal Layers



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Printed Circuit Board and Packaging

- Printed Circuit Board (PCB)
- Packaging Technology:

- Dual Inline Package (DIP)
- Quad Flat Package (QFP)
- Pin Grid Array (PGA) Package



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Types of Integrated Circuits (ICs)

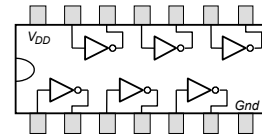
- Standard Chips
- Programmable Logic Devices (PLDs):
 - Programmable Logic Array (PLA)
 - Programmable Array Logic (PAL)
 - Complex Programmable Logic Device (CPLD)
 - Field-Programmable Gate Array (FPGA)
- Non-Programmable Devices:
 - Custom Design
 - Standard-Cell Design
 - Application Specific Integrated Circuit (ASIC)
 - Gate-Array Design

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Standard Chips

- A collection of specific gates in a chip
- Popular until mid-80s
- 7400-Series Standard Chips

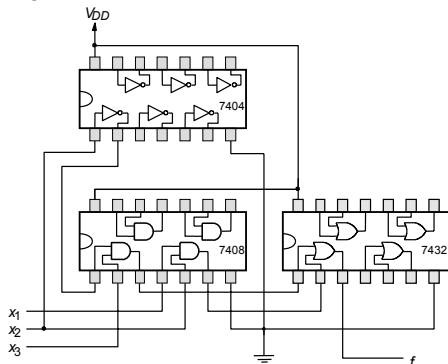
- 7404 : NOT gates



- 7408 : AND gates
- 7432 : OR gates
- 74244 : Tri-State Buffers

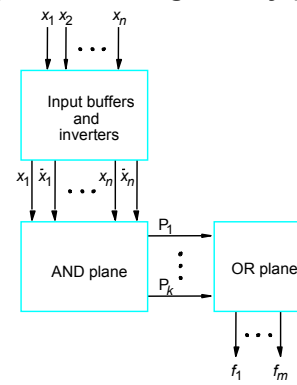
16

Implementation of $f = x_1x_2 + x_2'x_3$

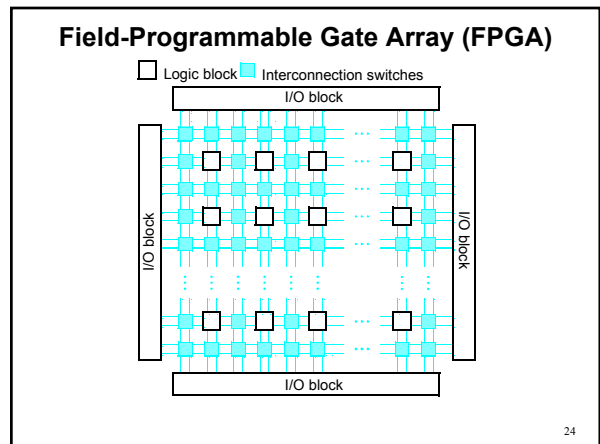
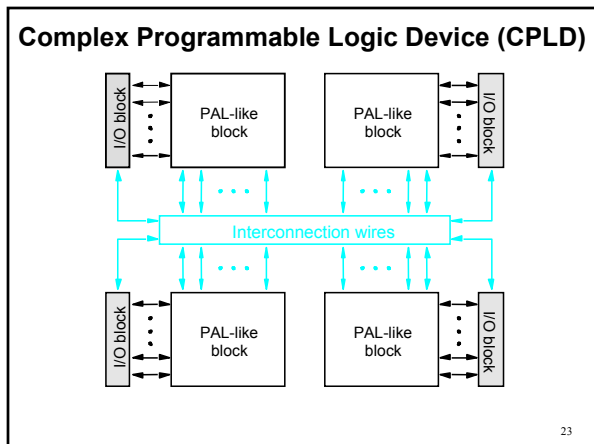
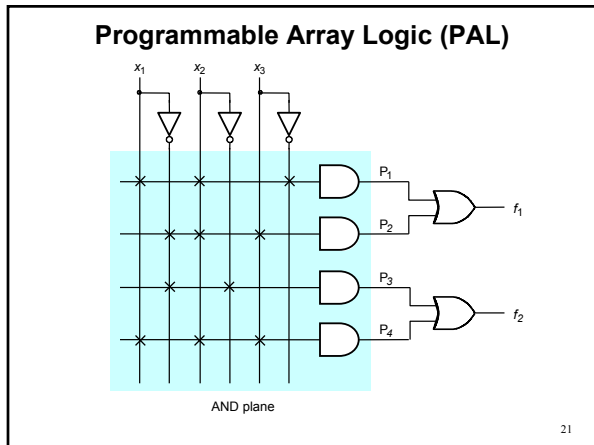
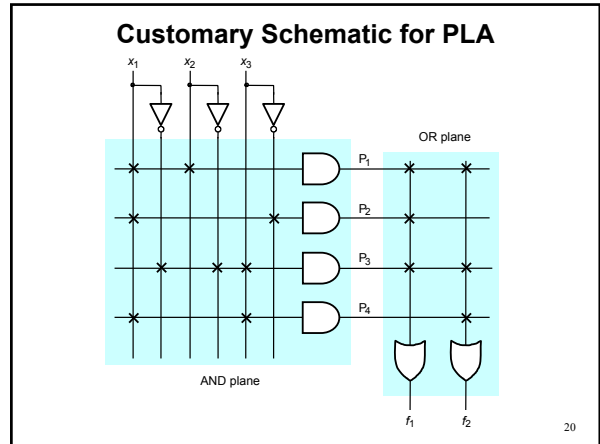
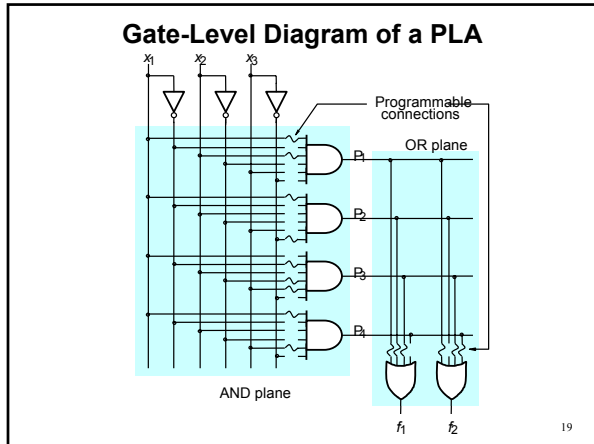


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Programmable Logic Array (PLA)



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Lookup Table (LUT)

(a) Circuit for a two-input LUT

x_1	x_2	f_1
0	0	1
0	1	0
1	0	0
1	1	1

(b) $f_1 = \bar{x}_1\bar{x}_2 + x_1x_2$

(c) Storage cell contents in the LUT

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Custom Design

Intel 4004 Microprocessor
1971

Intel Pentium 4 Processor
2000

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Standard-Cell Design

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Standard-Cell Design

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Gate Array Design

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