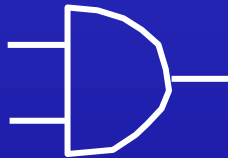


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Logic Families

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A.B		A	
		0	1
B	0	0	0
	1	0	1



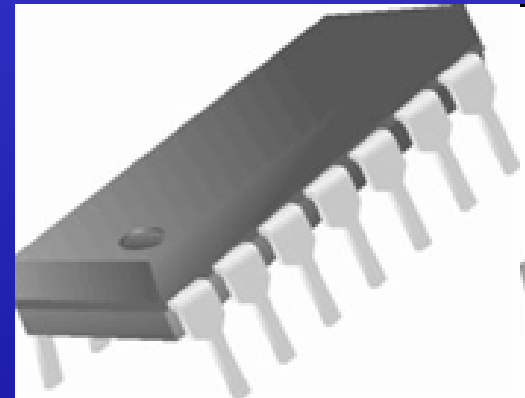
So far we have looked at logic gates ideal elements with binary inputs and outputs.

How are these logic gates made in practice?

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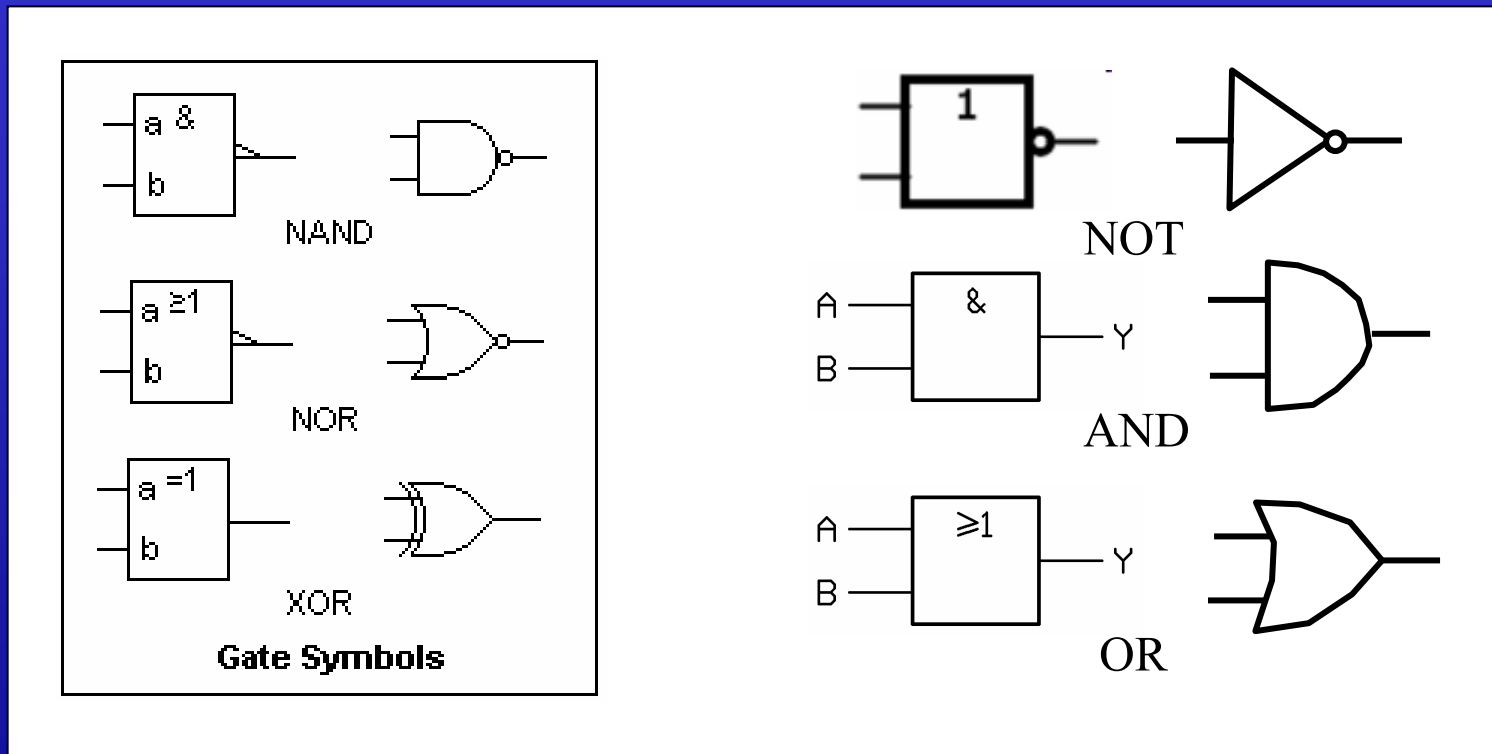
The ideal logic family should have or be:

- low power
- high speed
- easy to use
- many different logic functions
- clear voltage levels for 0 and 1



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IEC and traditional logic symbols

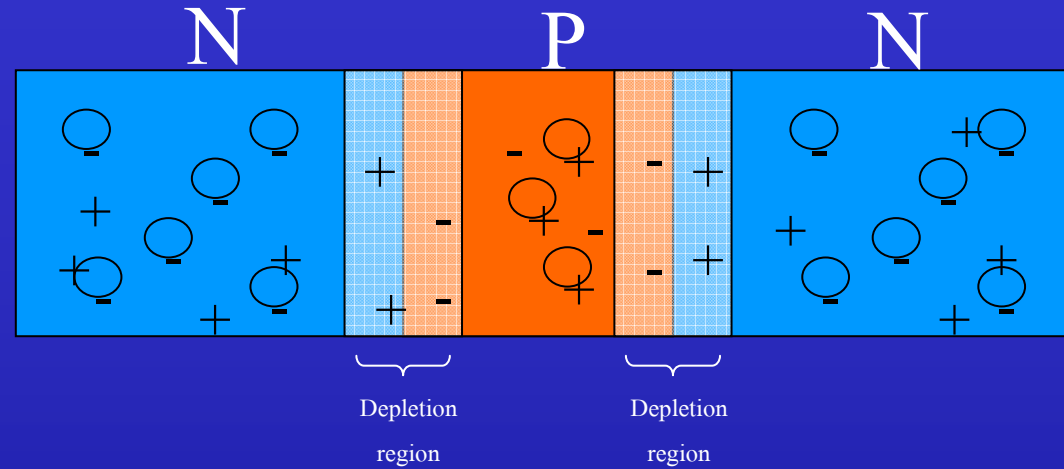


<http://mysite.du.edu/~etu>

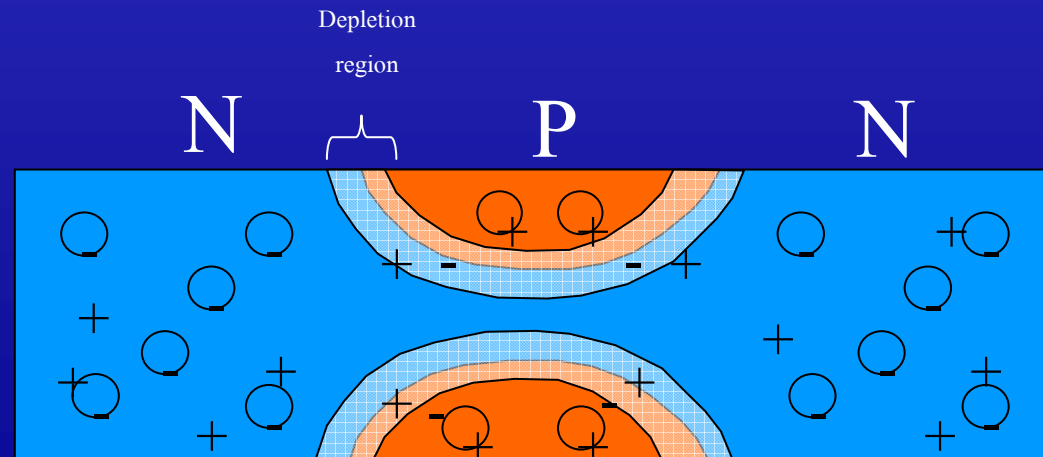
[ttitle/electron/elect13.htm](http://mysite.du.edu/~etutitle/electron/elect13.htm)

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Bipolar transistors

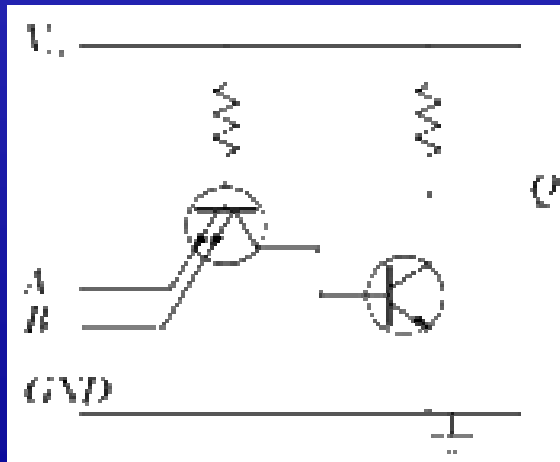


Field Effect transistors

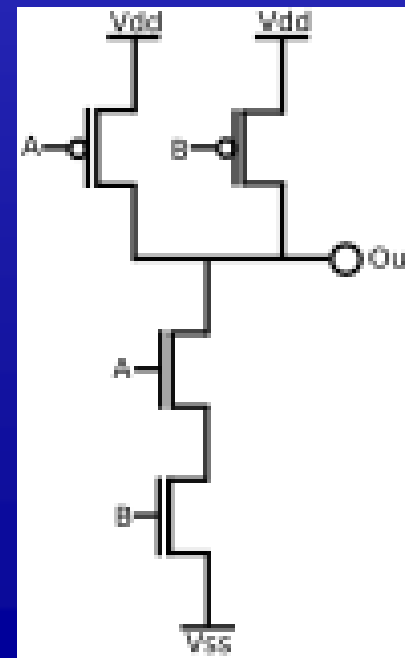


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TTL or Transistor-Transistor
Logic is made using bipolar
transistors.



CMOS or Complementary
Metal Oxide Semiconductor
logic is made using field
effect transistors.



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A comparison of some common logic families.

Family	Power	Speed	Power Supply
TTL	10 mW	10 ns	4.75-5.25 V
CMOS 4000	1.2 mW	30 ns	3-18 V
TTL ALS	1.3 mW	4 ns	4.75-5.25 V
CMOS AC	0.5 mW	3 ns	3.3 V or 5 V
TTL AS	8 mW	2 ns	4.5 – 5.5 V

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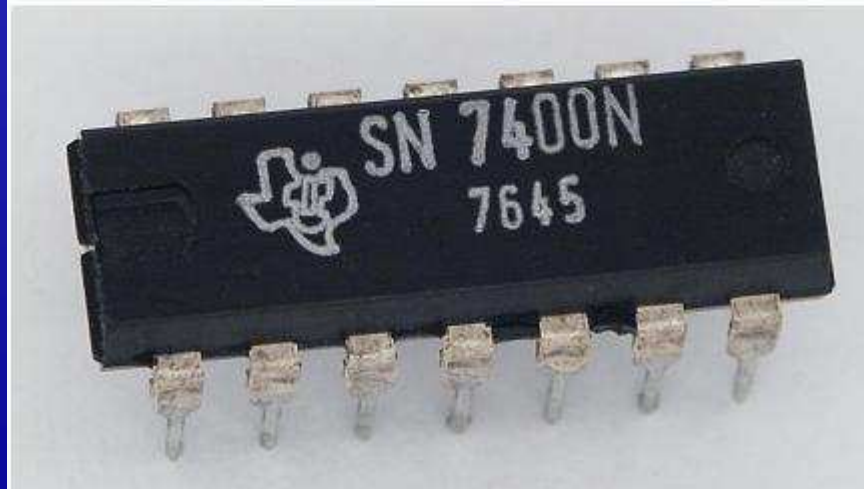
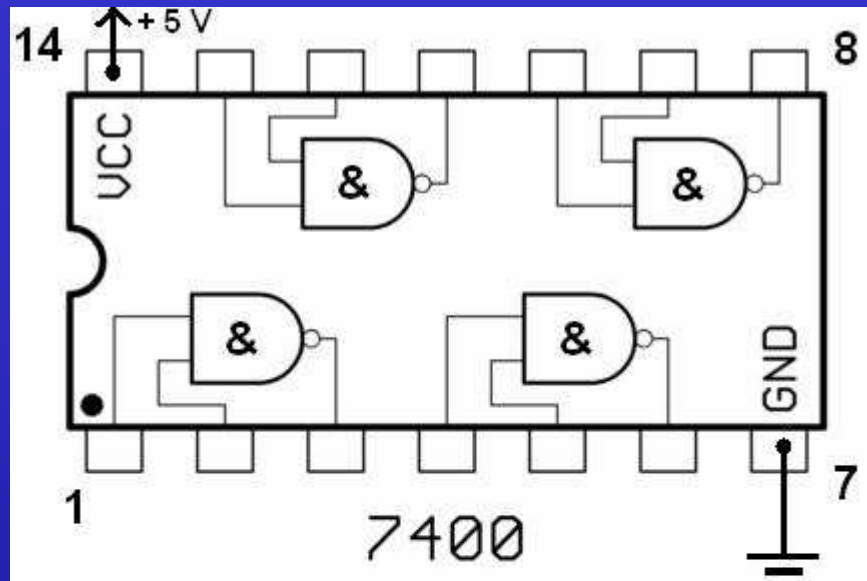
CMOS 4000 is good for:

- battery equipment
- where speed is not so important

TTL is good for

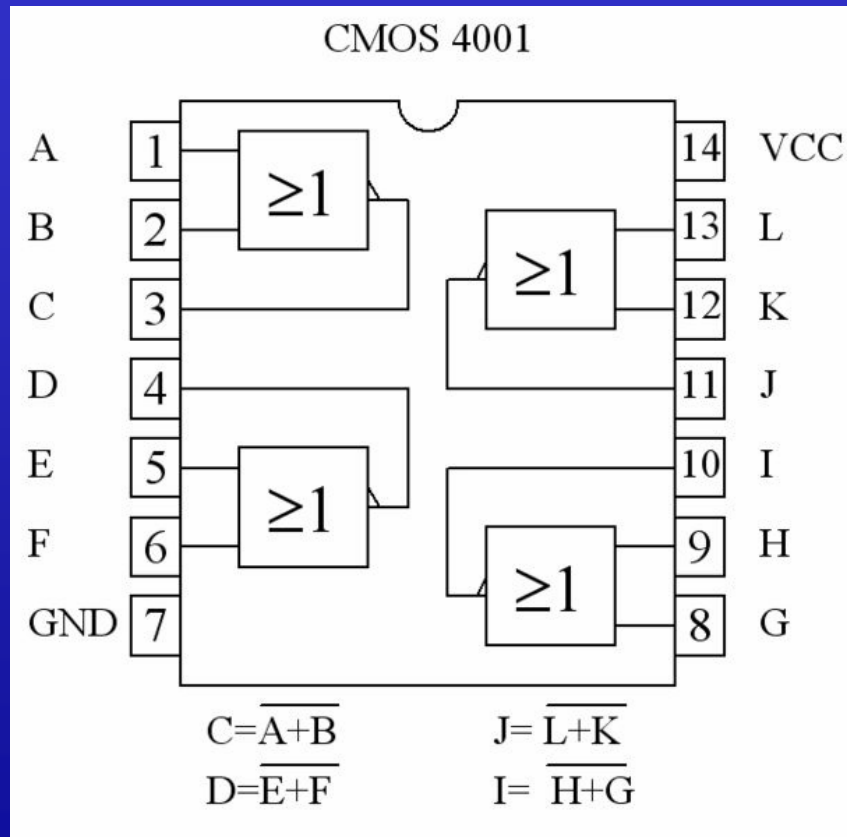
- where you have a good power supply
- where you want high speed

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The 7400 has
four NAND gates
in one IC.

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The 4001 has 4 NOR gates in one IC

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7400: Quad 2-input NAND gate

7401: Quad 2-input NAND gate with open collector outputs

7402: Quad 2-input NOR Gate

7403: Quad 2-input NAND Gate with open collector outputs

7404: Hex Inverter

7405: Hex Inverter with open collector outputs

7406: Hex Inverter Buffer/Driver with 30V open collector outputs

7407: Hex Buffer/Driver with 30V open collector outputs

7408: Quad 2-input AND gate

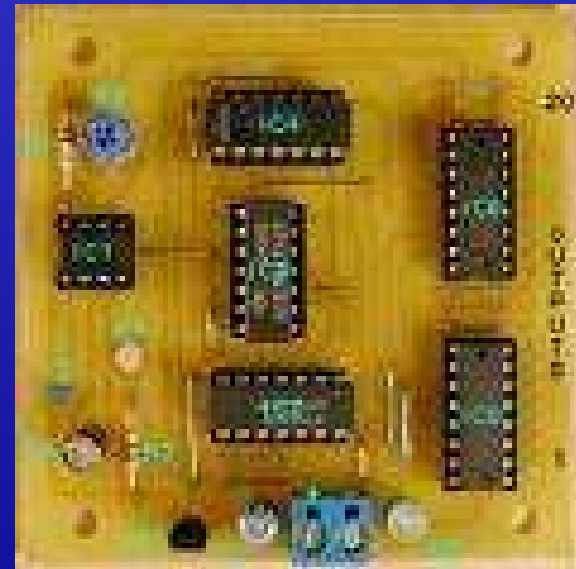
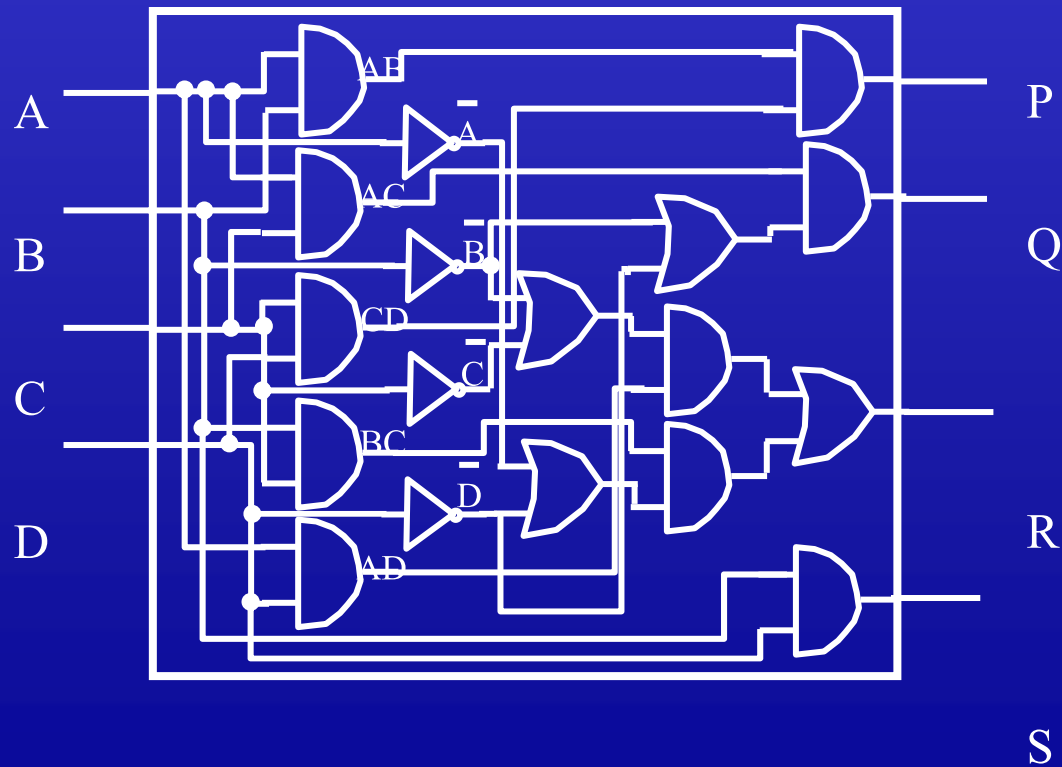
7409: Quad 2-input AND gate with open collector outputs

7410: Triple 3-input NAND Gate

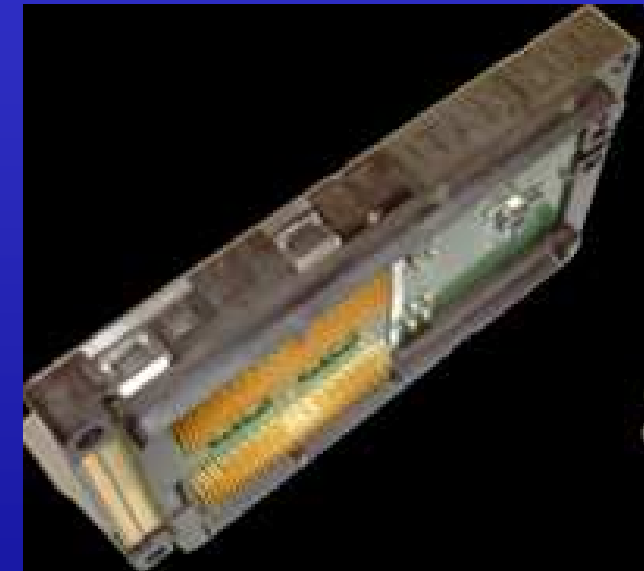
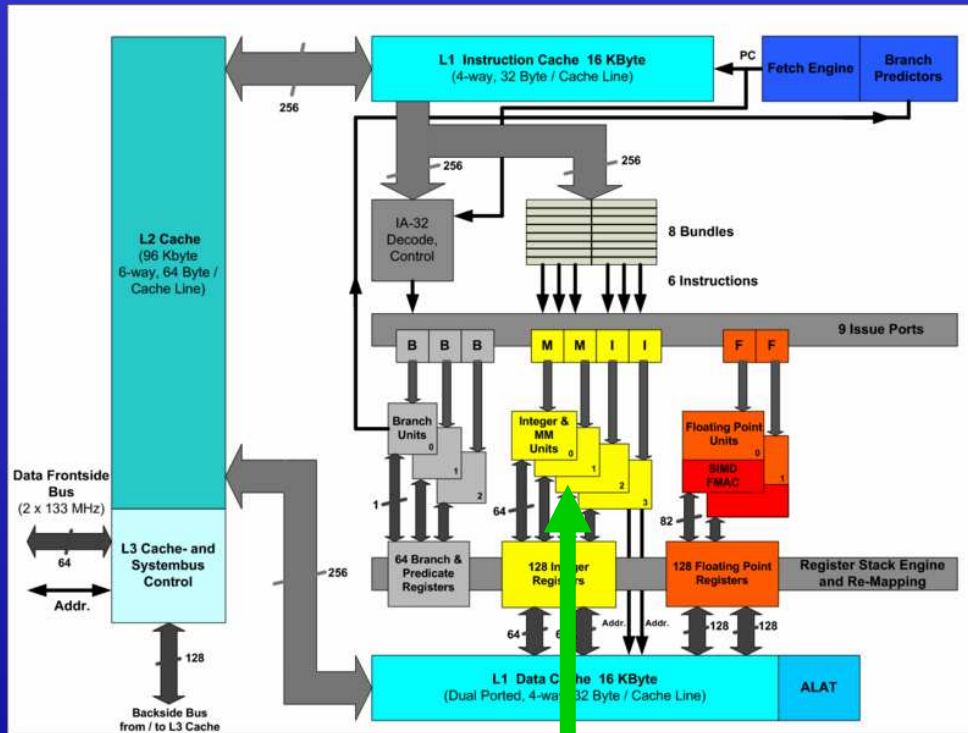
There are
hundreds of
different TTL
or CMOS logic
gates available.

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Using one of these logic families we can make a PCB (printed circuit board) to use the circuit which we have designed.



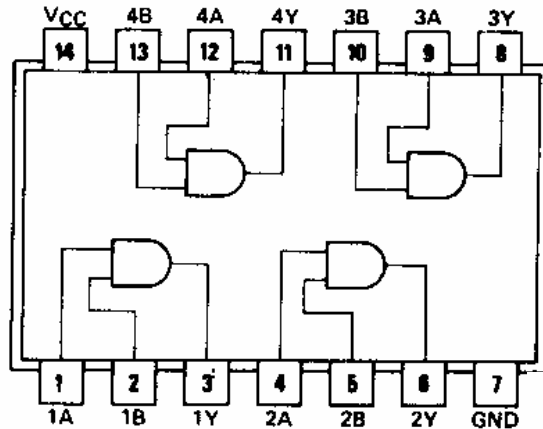
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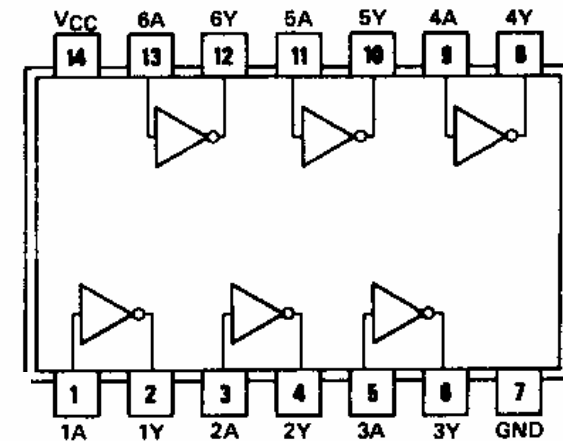
But nowadays circuits like the multiplier that we designed are just one part of a microprocessor, like this Itanium.

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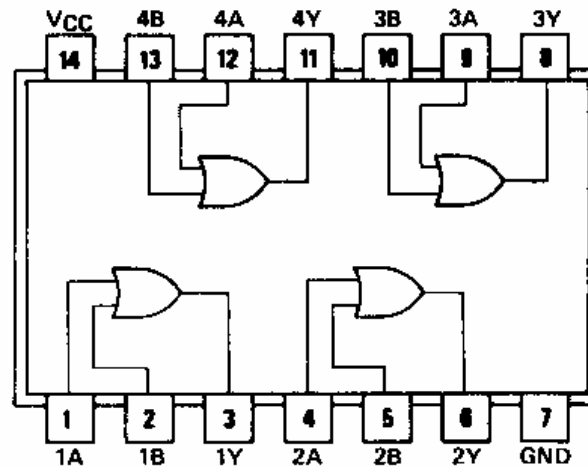
7408



7404

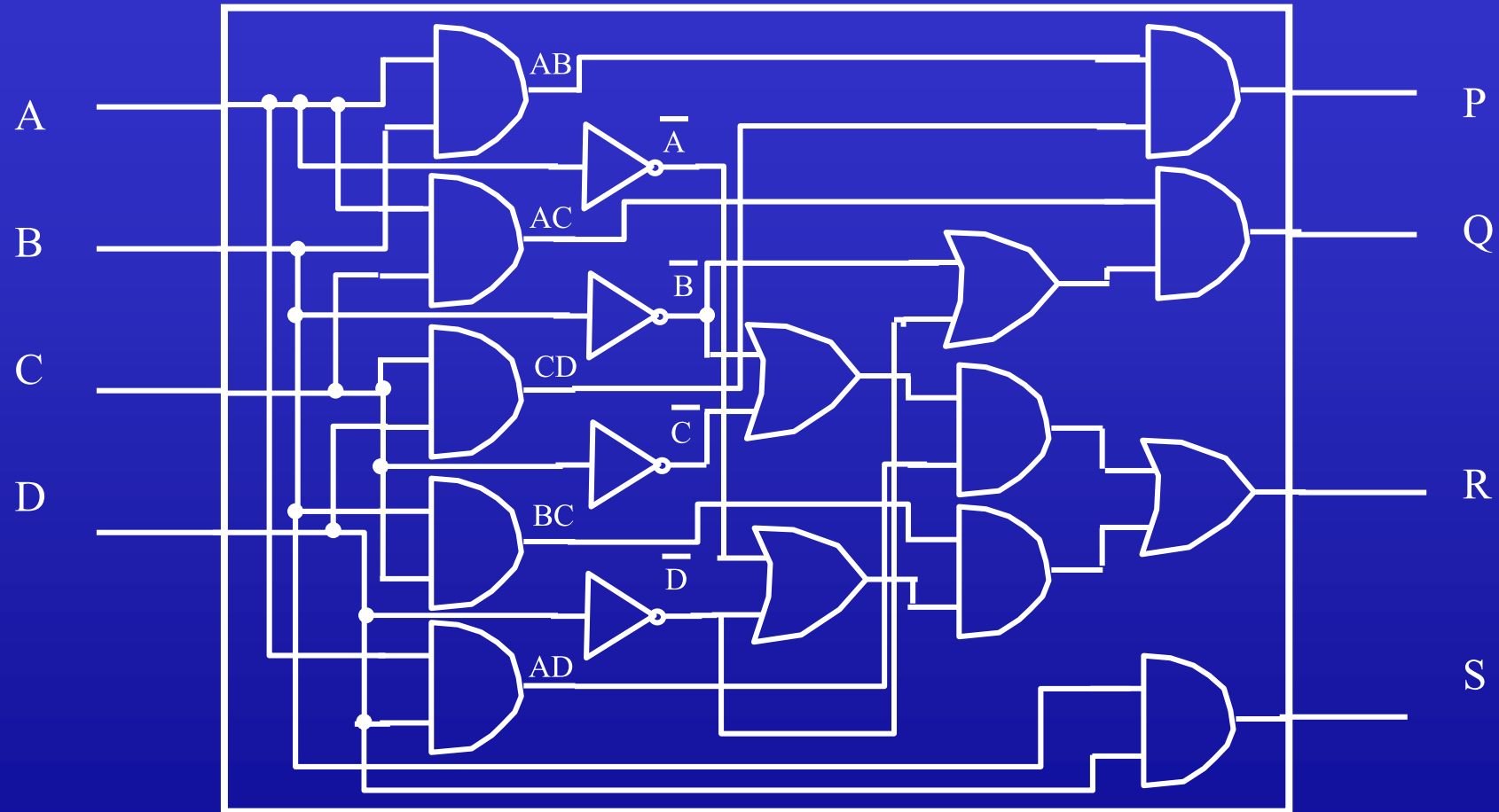


7432



For the multiplier circuit we would need to use these three ICs from the TTL family.

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How many ICs will we need to use for this circuit?