

Lecture 6: More Gates and their Applications

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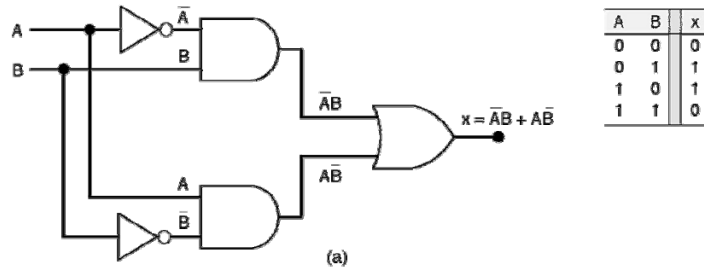
(Floyd 3.6, 6.8-6.10)
(Tocci 3.13-3.15, 4.6-4.8, 9.6-9.8)

Points Addressed in this Lecture

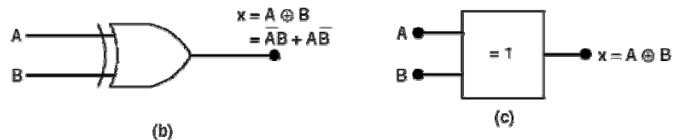
- Exclusive-OR & Exclusive NOR gates
- Usefulness of Logic Gates (as functions)
- Parity Circuits using XOR gates
- Multiplexer and Demultiplexer circuits
- Alternative logic symbols – IEEE Standard

Exclusive-OR

Exclusive-OR (XOR) produces a HIGH output whenever the two inputs are at opposite levels.

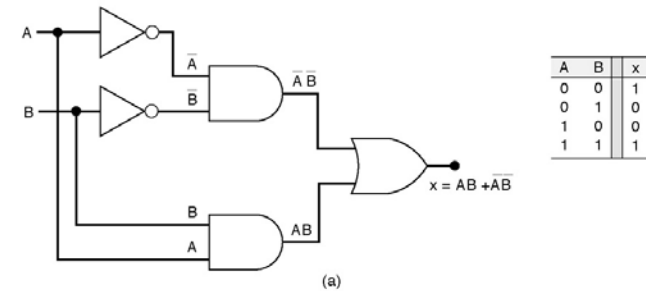


XOR gate symbols

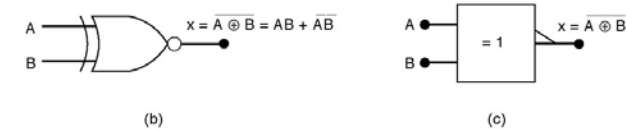


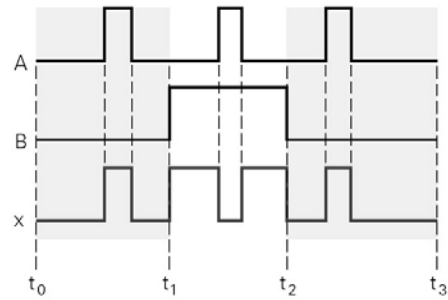
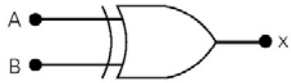
Exclusive-XNOR

Exclusive-NOR (XNOR) produces a HIGH output whenever the two inputs are at the same level.

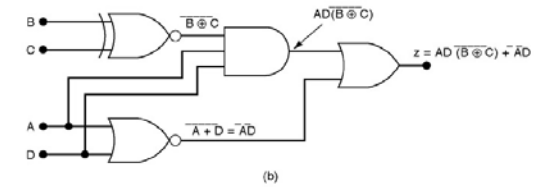
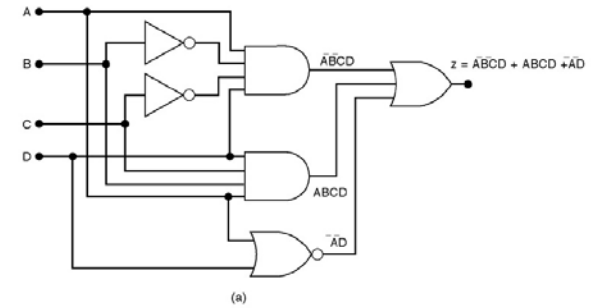


XNOR gate symbols

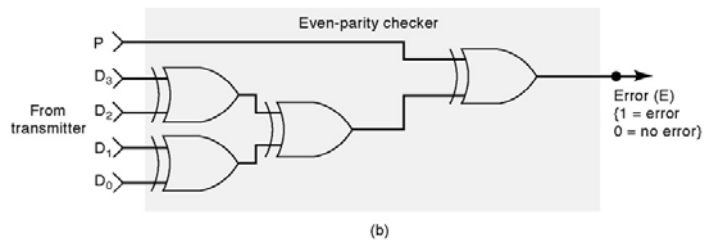
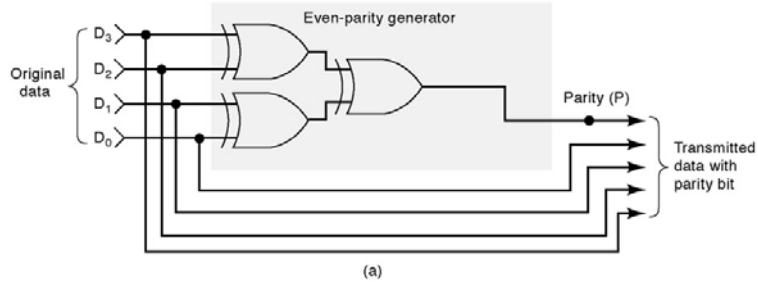




XNOR gate may be used to simplify circuit implementation.

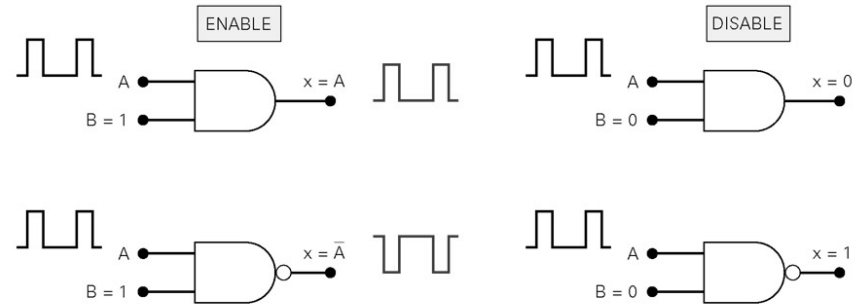


Parity Generator and Checker



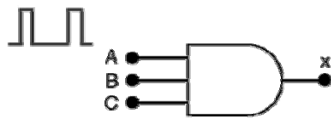
Enable/Disable Circuits

AND gate function act as enable/disable circuits:-

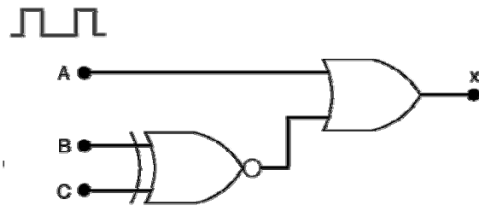


Enable/Disable Circuits cont.

Design a logic circuit that will allow a signal to pass to the output only when control inputs B and C are both HIGH; otherwise, the output will stay LOW.

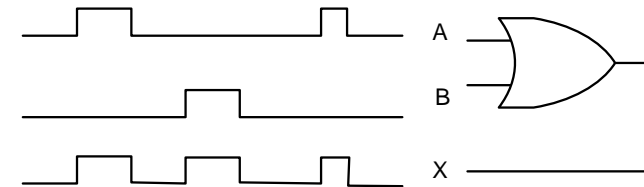


Design a logic circuit that will allow a signal to pass to the output only when one, but not both, of the control inputs are HIGH; otherwise, the output will stay HIGH.

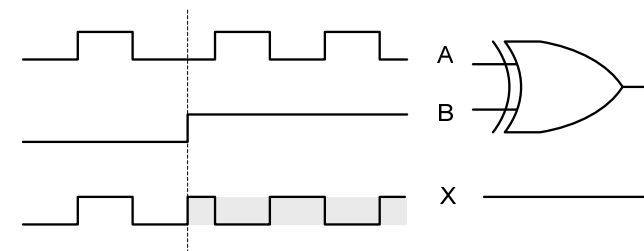


Merging & Inversion Circuits

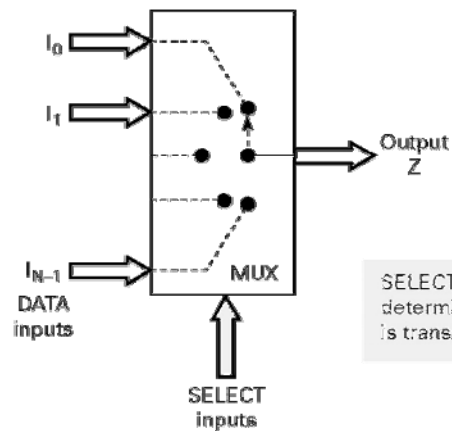
OR gate performs signal merging function:-



XOR gate performs selectable inversion function:-

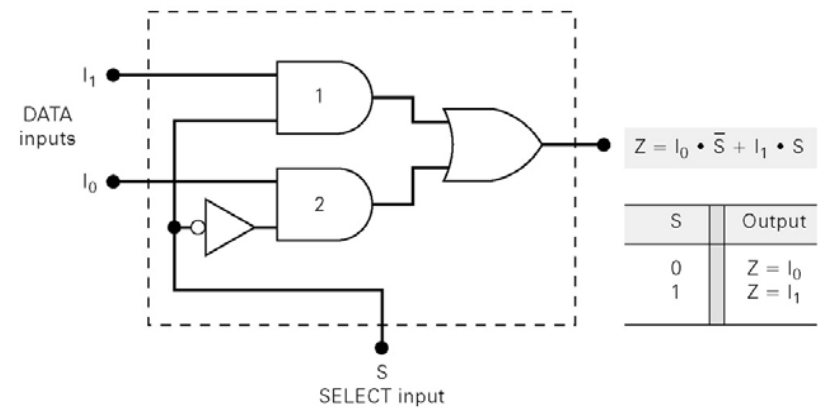


Multiplexers (Data Selectors)



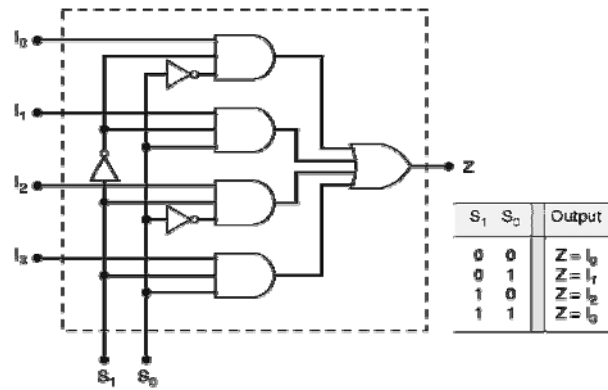
SELECT input code determines which input is transmitted to output Z.

Multiplexers cont.

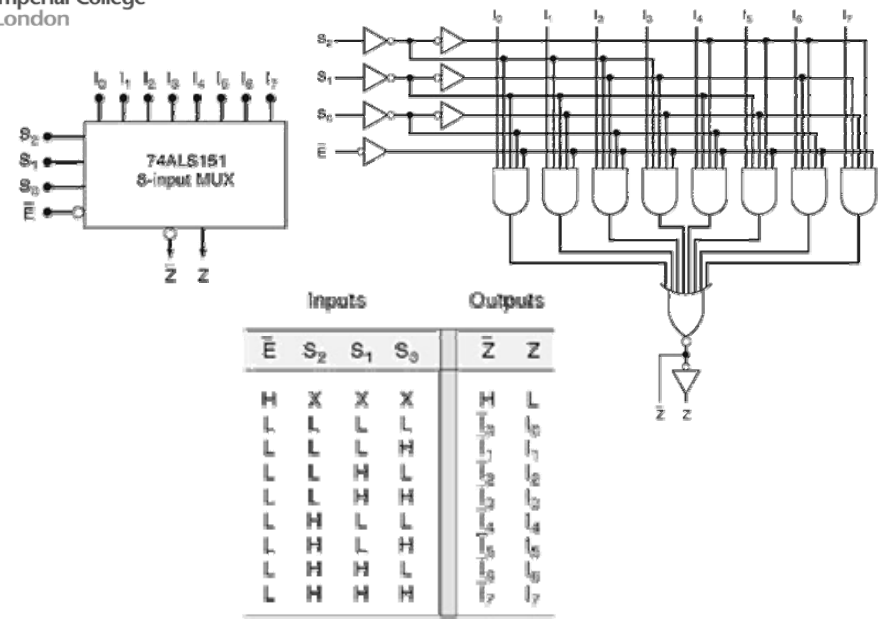


Two-input multiplexer.

Multiplexers cont.

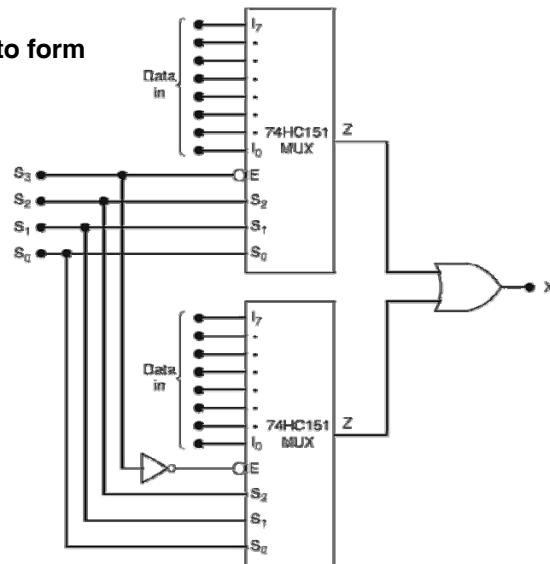


Four-input multiplexer.



Multiplexers cont.

two 74HC151s combined to form
a 16-input multiplexer.

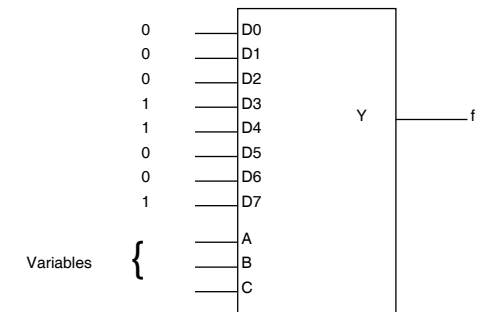


Mux used to Implement Logic Function

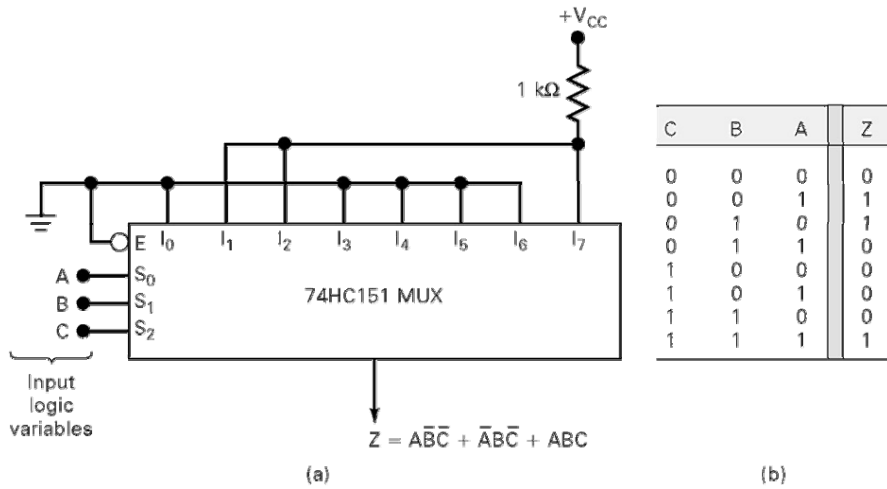
$$f = \bar{A}BC + A\bar{B}\bar{C} + ABC$$

$$f = \sum(3,4,7)$$

A	B	C	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

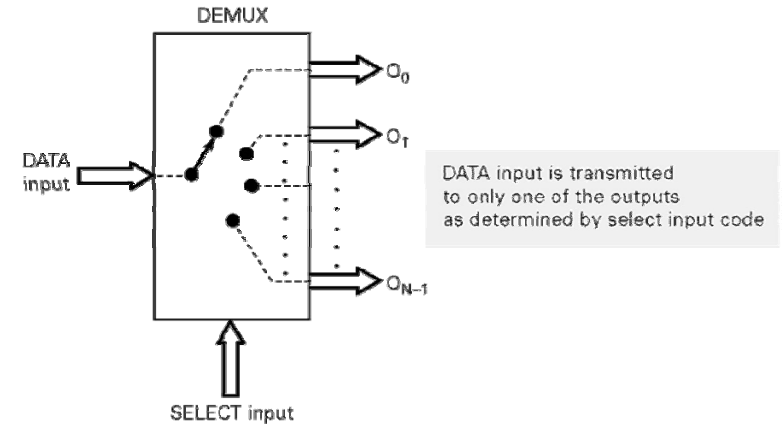


Another example



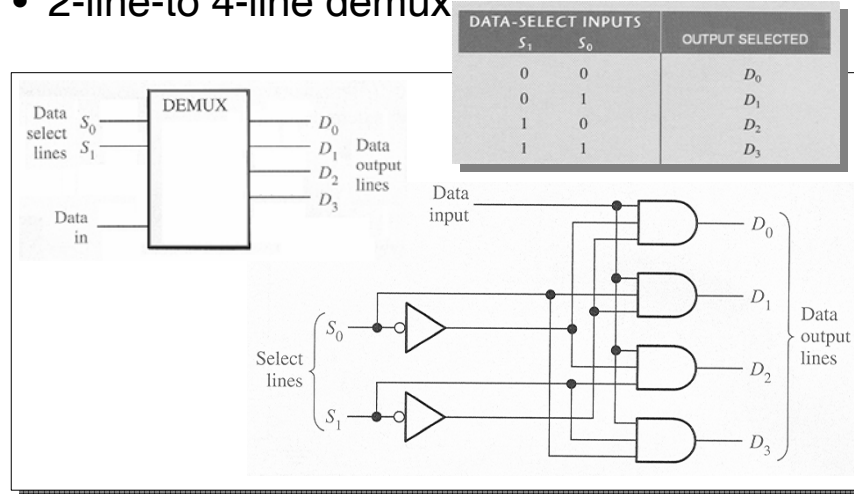
Demultiplexers (Data Distributors)

A DEMUX takes a single input and distributes it over several outputs.

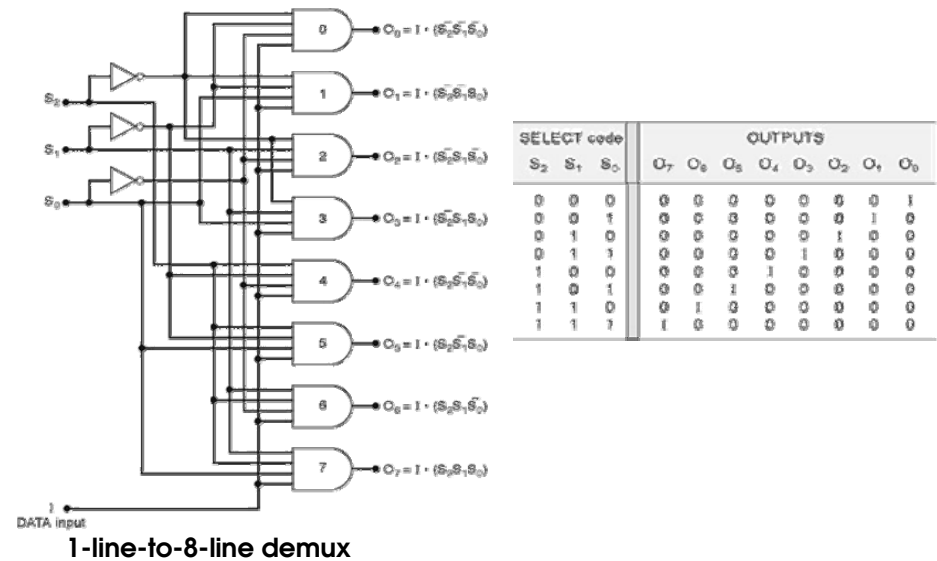


Demultiplexers

- 2-line-to-4-line demux

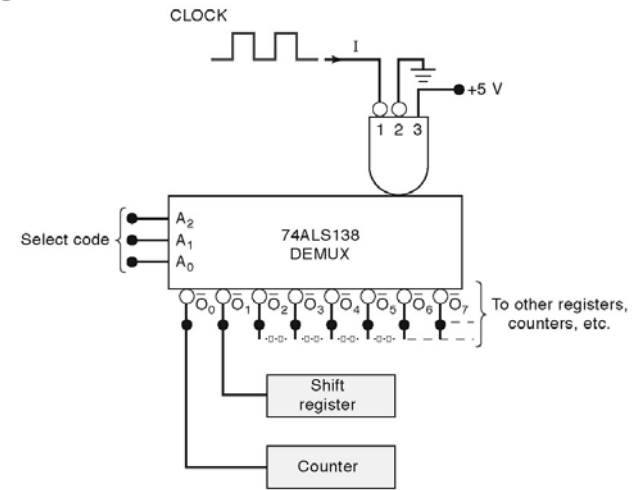
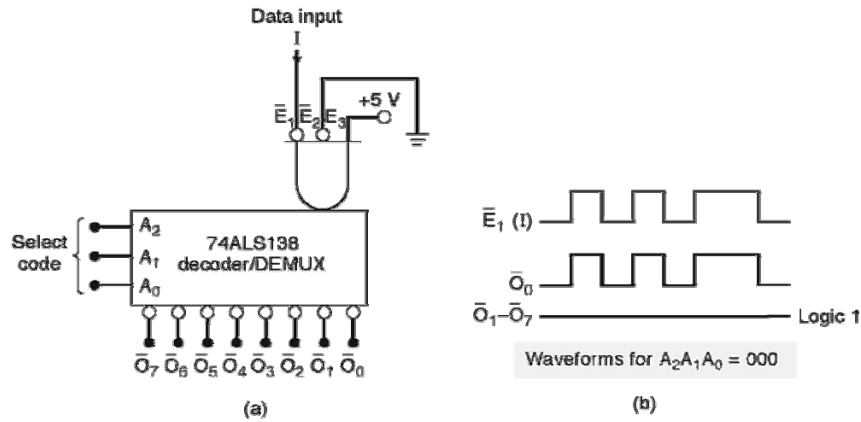


Demultiplexers (Data Distributors) cont.



Demultiplexers (Data Distributors) cont.

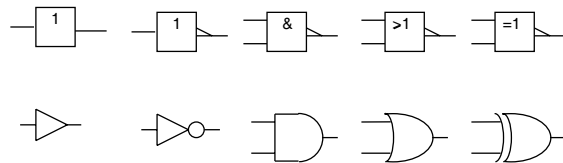
The 74ALS138 demultiplexer with E_1 used as the data input. (b) Typical waveforms for a select code of $A_2 A_1 A_0 = 000$ show that O_0 is identical to the data input I on E_1 .



A clock demultiplexer transmits the clock signal to a destination determined by the select code inputs.

Alternative Symbols for Gates

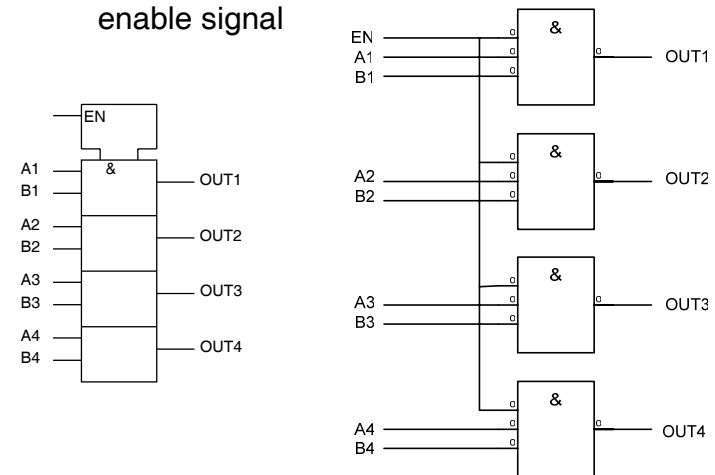
- The symbols presented so far are International Standards of ANSI and IEEE
- Other (older) symbols are still widely used



- inputs are on the left, outputs on the right
- qualifying symbol top centre:

1	Straight through (buffer)		
&	AND	≥1	OR
=1	XOR	Σ	Adder
P	Multiplier	MUX	Multiplexer

- identical elements can be grouped as an array with common control signals
- Here is a 4 identical AND gates sharing a single enable signal

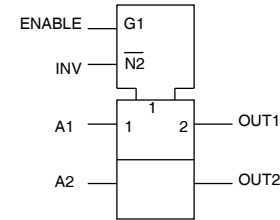


• Other Dependencies

Label	Name	On assertion ...	On de-assertion ...
EN	Enable	permits action	prevents action
G	AND (Gate)	permits action	forces output low
V	OR	forces output high	permits action
N	NOT (Invert)	Inverts output	No effect
S	Set	forces output high	No effect
R	Reset	forces output low	No effect

Numbered Dependencies

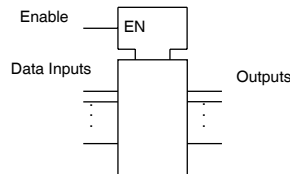
- Data inputs and outputs can be uniquely numbered
- Control input dependency labels can be followed by a number
 - indicates which inputs or outputs they affect
 - E.g.



- An array of buffers with
 - inputs (1) are ANDed with the ENABLE signal
 - outputs (2) are inverted if INV is asserted (active low)

Active High and Active Low Inputs

- Consider a device with an additional "enable" input



- The chip is enabled if the Enable input is "asserted".
- What does asserted mean?
 - If the input is labelled EN, asserted means set Enable to 1
 - Active High
 - If the input is labelled \overline{EN} , asserted means set Enable to 0
 - Active Low

IEEE Standard symbol for 4-input MUX

