Decoders

Module 7

10/2/2023

1 Active Inputs And Outputs

Logic device inputs and outputs can be active high or low.

- Active HIGH is when a 1 `activates` a given input, or output.
- Active LOW is when a 0 `activates` a given input, or output.

2 Decoding

It's taking an input combination, which can be called a code, and translating it to one or more active ouputs.

- BCD Decoder Decodes the BCD input to various outputs - BCD to 7 segment
- X of Y decoder (standard decoder)-Decodes input X to activate (only) one of the Y outputs.

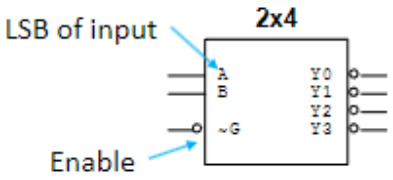
2.1 Standard Decoder

- One output is active at a time. Active high refers to only one output being 1 at a time, while active low refers to only one being 0.
- number of outputs is 2^n, n being the number of inputs.
  Its tytpical nomenclature is <number of inputs> to <number of outputs> (not including enable input) decoder.
- 3 to 8 decoder, 3 x 8 decoder

Most decoders are active low outputs which use active low enable.

2.1.1 2 x 4 decoder

- if enable is not active, output is inactive
- only one output is active at a time
- Negation bubble on an enable, input, and an output indicates that it's an active low

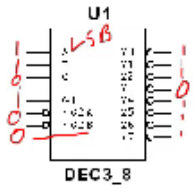


G	B	A	Y0	Y1	Y2	Y3
1	X	X	1	1	1	1
0	0	0	0	1	1	1
0	0	1	1	0	1	1
0	1	0	1	1	0	1
0	1	1	1	1	1	0

If input is decimal 0, then output 0 is a
If input is decimal 1, then output 1 is a
If input is decimal 2, then output 2 is a

3 x 8 Decoder

011 → 3 Y3



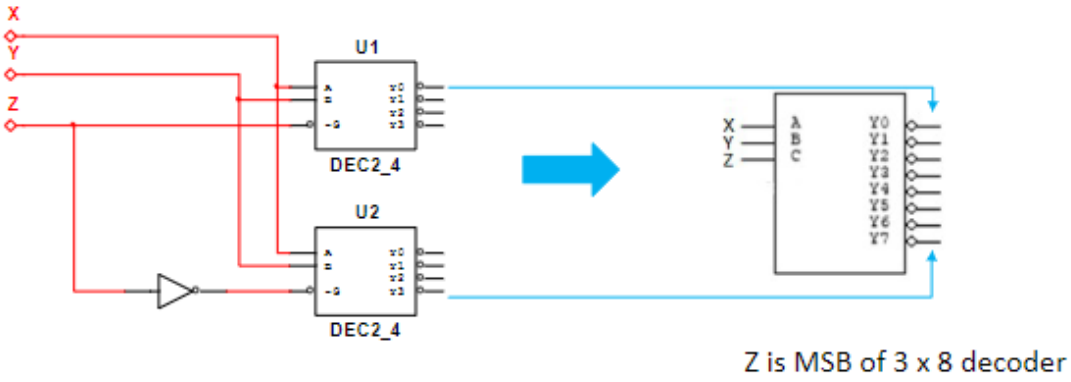
G1	G2A	G2B	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
*	*	*	X	X	X	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	1	1	1	1	1	1	1
1	0	0	0	0	1	1	0	1	1	1	1	1	1
1	0	0	0	1	0	1	1	0	1	1	1	1	1
1	0	0	0	1	1	1	1	1	0	1	1	1	1
1	0	0	1	0	0	1	1	1	1	0	1	1	1
1	0	0	1	0	1	1	1	1	1	1	0	1	1
1	0	0	1	1	0	1	1	1	1	1	1	0	1
1	0	0	1	1	1	1	1	1	1	1	1	1	0

* Any input that is not 100 will make encoder inactive

3 Cascading Decoders

Cascading another decoder will add 1 more input and double the output.

- Cascading 2x4 decoders will produce a 3x8 decoder
- Enable input becomes MSB of input of cascaded decoder

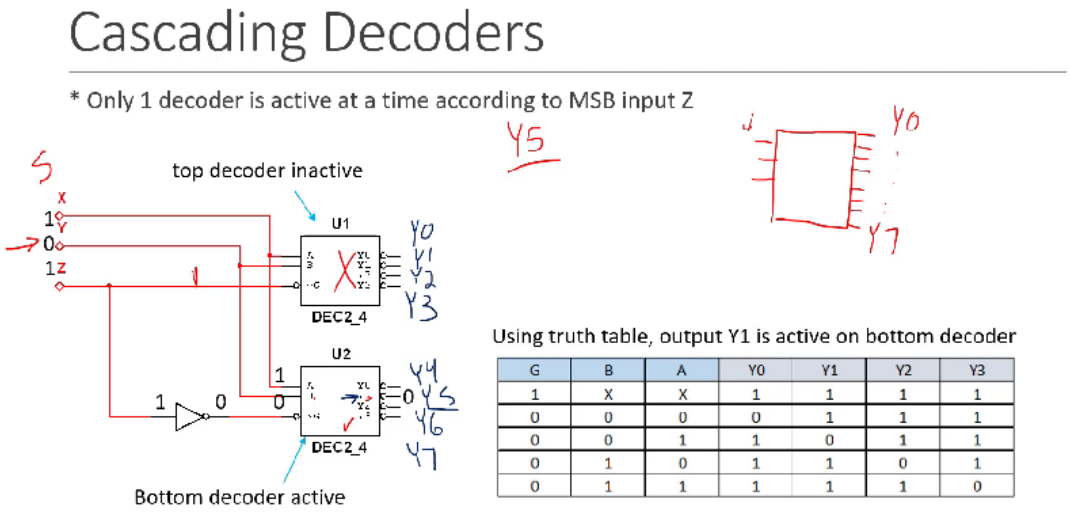


The reason for having a not gate at the bottom enabler input, is that only one decoder is desired to be active at a time for any input combination.

0	0	0
0	0	1
0	1	0
0	1	1

1	0	0
1	0	1
1	1	0
1	1	1

The top Decoder takes the first half of the inputs, while the bottom takes the bottom half of the inputs



G	B	A	Y0	Y1	Y2	Y3
1	X	X	1	1	1	1
0	0	0	0	1	1	1
0	0	1	1	0	1	1
0	1	0	1	1	0	1
0	1	1	1	1	1	0

3.1 adding enables

Whenever decoders are cascaded together, the enables are used to add a new input.

- for `active low enables` use an **OR** gate
- for `active high enables` use an **AND** gate

$$X \text{ AND } 1 = X$$

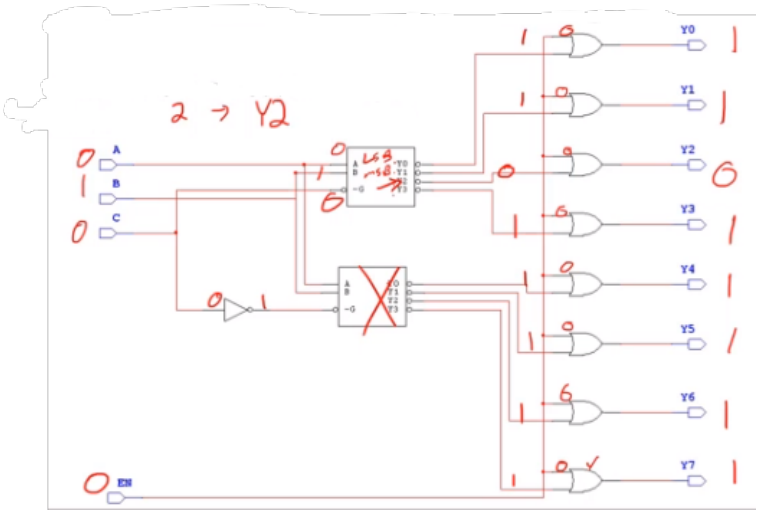
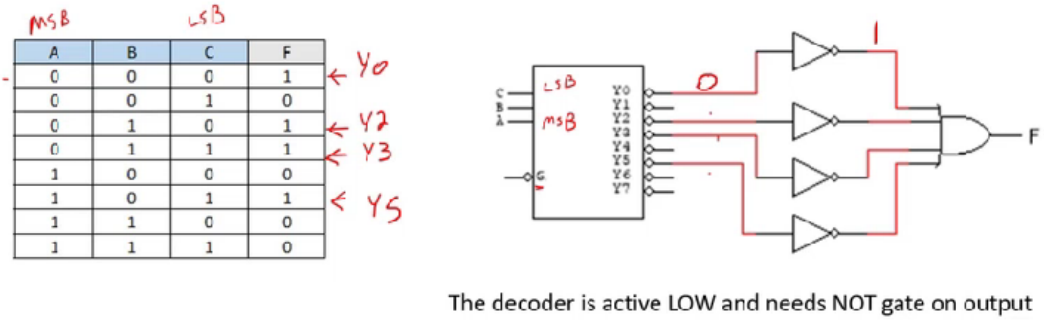


Figure 1: Example of adding active low enable

$$X \text{ OR } 0 = X$$

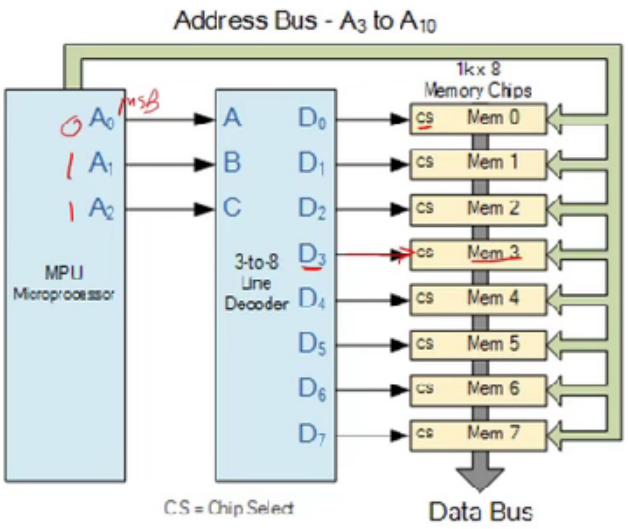
4 Using Decoders to Implement Minterms



5 Where Decoders are Used

5.1 Memory Addressing

- Microprocessor needs to write to memory location
- Microprocessor will send out binary code
- Binary code determines which memory location should be active
- Works the same for reading a memory location



Selecting Sensors & translating Binary Code