Decoder

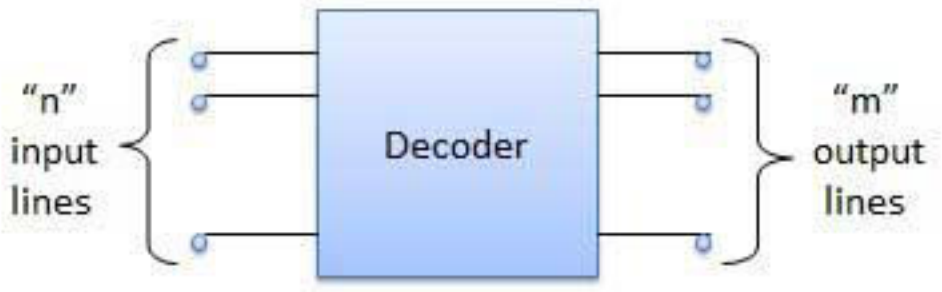
- A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2^n unique information from n input lines to a maximum of 2^n unique output lines.

- A decoder is a circuit that changes a code into a set of signals. It is called a decoder because it does the reverse of encoding

- Decoding is the conversion of an encoded format back into the original sequence of characters.

- A common type of decoder is the line decoder which takes an n-digit binary number and decodes it into 2^n data lines.

Block diagram



1. 2-to-4 line decoder

Truth Table

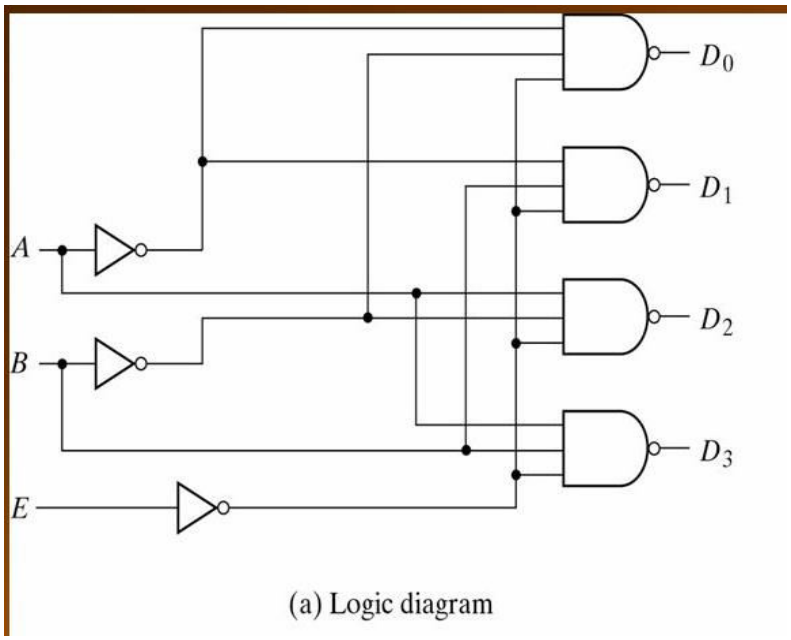
- **The** circuit operates on complemented outputs and complemented enable input E.

- The decoder is enable when E is equal to 0, only one output is equal to 0 at a given time and other three are equal to 1.

- The circuit is disabled when E is equal to 1.

E	A	B	D_0	D_1	D_2	D_3
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

Logic Circuit



(a) Logic diagram

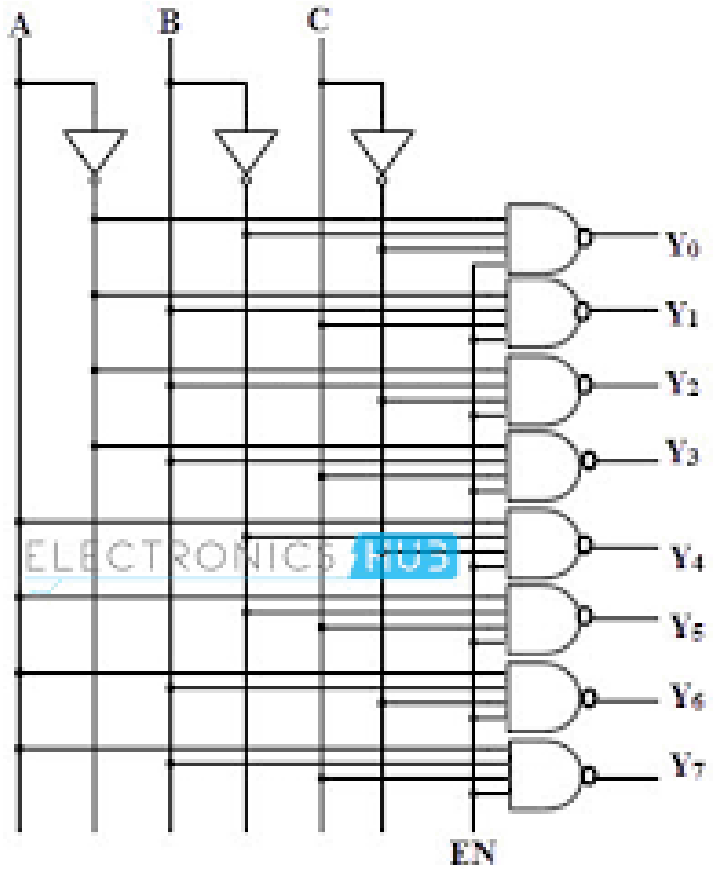
2. 3-to-8 line decoder

Truth Table

- When enable input E is equal to 0, the output are equal to 0.
- When enable input E is equal to 1, decoder operates in normal condition. For each possible combination there are seven outputs that are equal to 0 and only one that is equal to 1.

Inputs				Outputs							
EN	A	B	C	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	×	×	×	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	0	0	1	0
1	0	1	0	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0	0
1	1	0	0	0	0	0	1	0	0	0	0
1	1	0	1	0	0	1	0	0	0	0	0
1	1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0

Logic Circuit

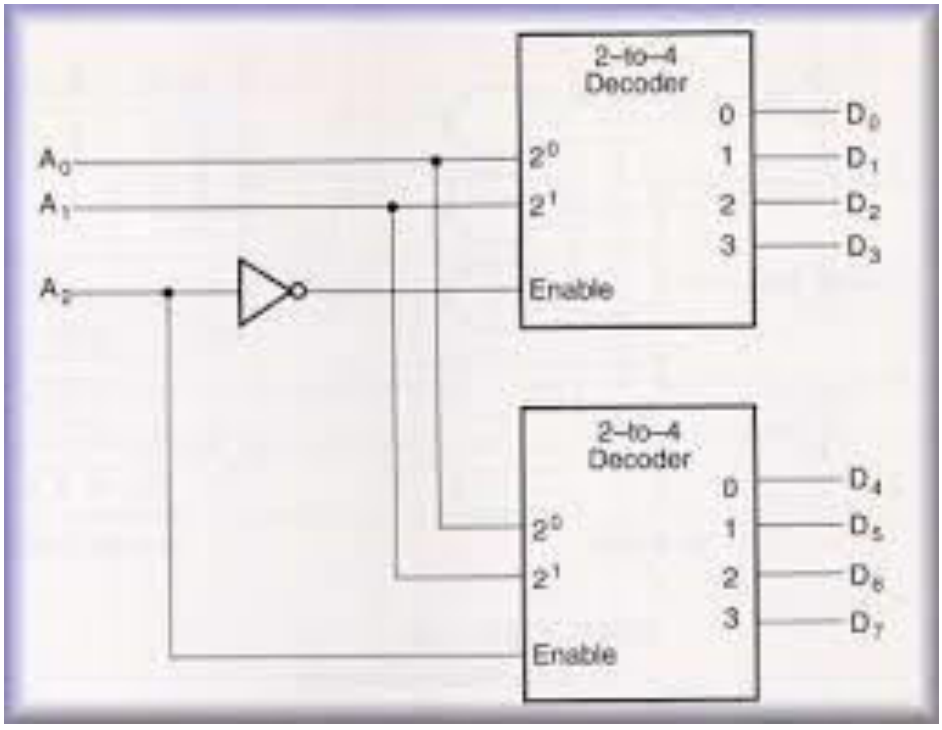


Decoder Expansion

- When a certain size decoder is needed but only smaller sizes are available. When this occurs it is possible to combine two or more decoders with enable inputs to form a larger decoder.

- Following diagram shows two 2-to-4-line decoders are combined to achieve 3-to-8-line decoder.

- The two least significant bits is connected to the enable input of both decoders. The most significant bit is connected to the enable input of one decoder and through an inverter to the enable input of other decoder.



- It is assumed that each decoder is enabled when its E is equal to 1.When E is equal to 0, the decoder is disabled.

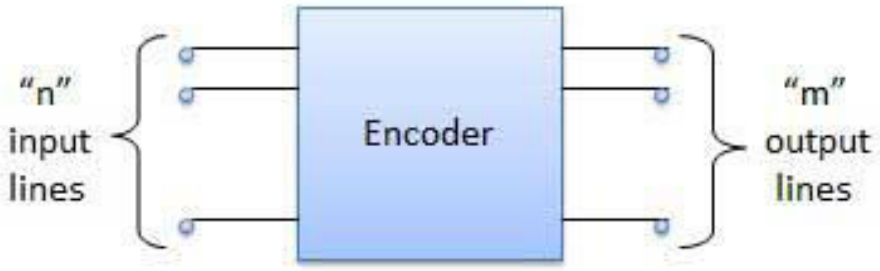
- **When A_2=0,** the upper decoder is enable and the lower is disabled. The lower decoder outputs become inactive with all outputs D_0 through D_3

- **When A_2=1**, the lower decoder is enabled and upper is disabled. The upper decoder outputs become inactive with all outputs D_4 through D_7

Encoder

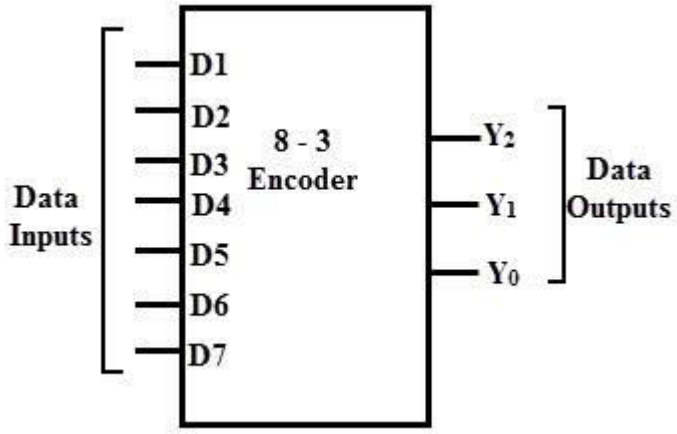
- Encoder is a combinational circuit which is designed to perform the inverse operation of the decoder.
- An encoder has n number of input lines and m number of output lines.
- An encoder produces an m bit binary code corresponding to the digital input number. The encoder accepts an n input digital word and converts it into an m bit another digital word.

Block diagram



Octal to Binary Encoder

Block Diagram



- An octal to binary encoder has 8 input lines D0 to D7 and 3 output lines Y0 to Y2.

Truth table

Inputs								Outputs		
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	1	0	0	0	1	0
0	0	0	0	1	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0	1	0	1
0	1	0	0	0	0	0	0	1	1	0
1	0	0	0	0	0	0	0	1	1	1

From the truth table, the outputs can be expressed by following Boolean Function.

Y0 = D1 + D3 + D5 + D7

Y1 = D2 + D3 + D6 + D7

Y2 = D4 + D5 + D6 + D7