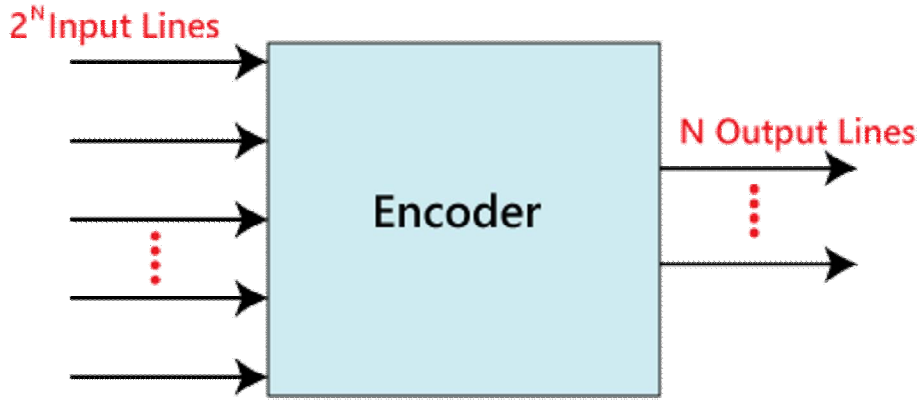
Encoders

The combinational circuits that change the binary information into N output lines are known as **Encoders**. The binary information is passed in the form of 2^N input lines. The output lines define the N-bit code for the binary information. In simple words, the **Encoder** performs the reverse operation of the **Decoder**. At a time, only one input line is activated for simplicity. The produced N-bit output code is equivalent to the binary information.

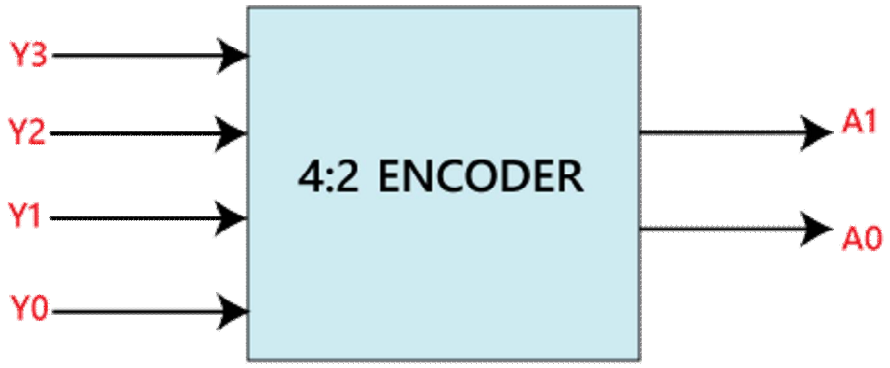


There are various types of encoders which are as follows:

4 to 2 line Encoder:

In 4 to 2 line encoder, there are total of four inputs, i.e., Y_0, Y_1, Y_2, and Y_3, and two outputs, i.e., A_0 and A_1. In 4-input lines, one input-line is set to true at a time to get the respective binary code in the output side. Below are the block diagram and the truth table of the 4 to 2 line encoder.

Block Diagram:



Truth Table:

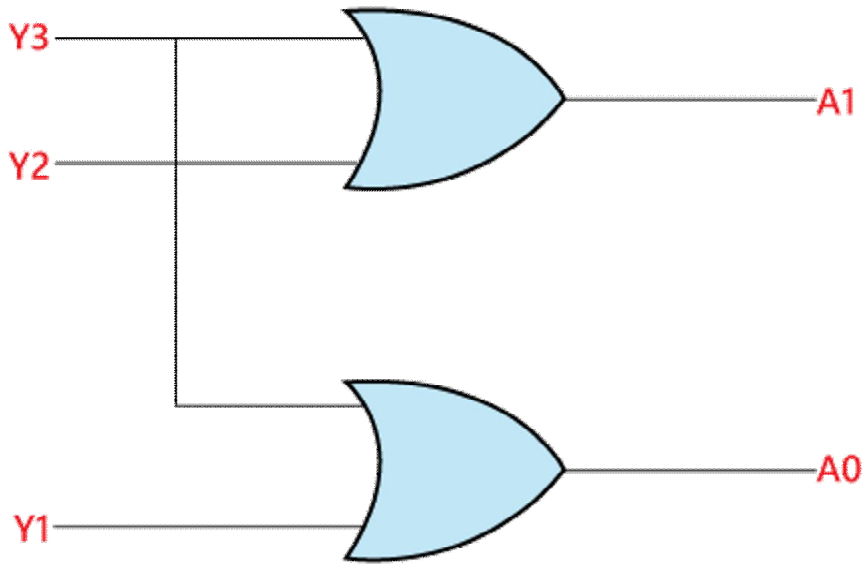
INPUTS				OUTPUTS	
Y_3	Y_2	Y_1	Y_0	A_1	A_0
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

The logical expression of the term A0 and A1 is as follows:

$A_1 = Y_3 + Y_2$

$A_0 = Y_3 + Y_1$

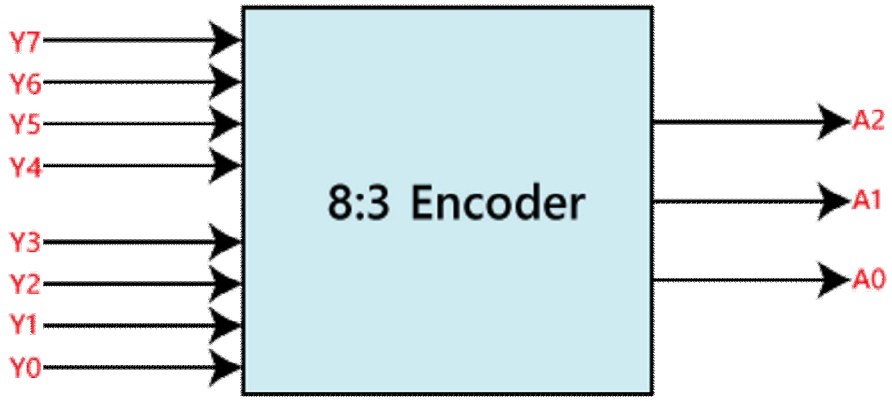
Logical circuit of the above expressions is given below:



8 to 3 line Encoder:

The 8 to 3 line Encoder is also known as **Octal to Binary Encoder**. In 8 to 3 line encoder, there is a total of eight inputs, i.e., Y_0, Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, and Y_7 and three outputs, i.e., A_0, A1, and A_2. In 8-input lines, one input-line is set to true at a time to get the respective binary code in the output side. Below are the block diagram and the truth table of the 8 to 3 line encoder.

Block Diagram:



Truth Table:

INPUTS								OUTPUTS		
Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0	A_2	A_1	A_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

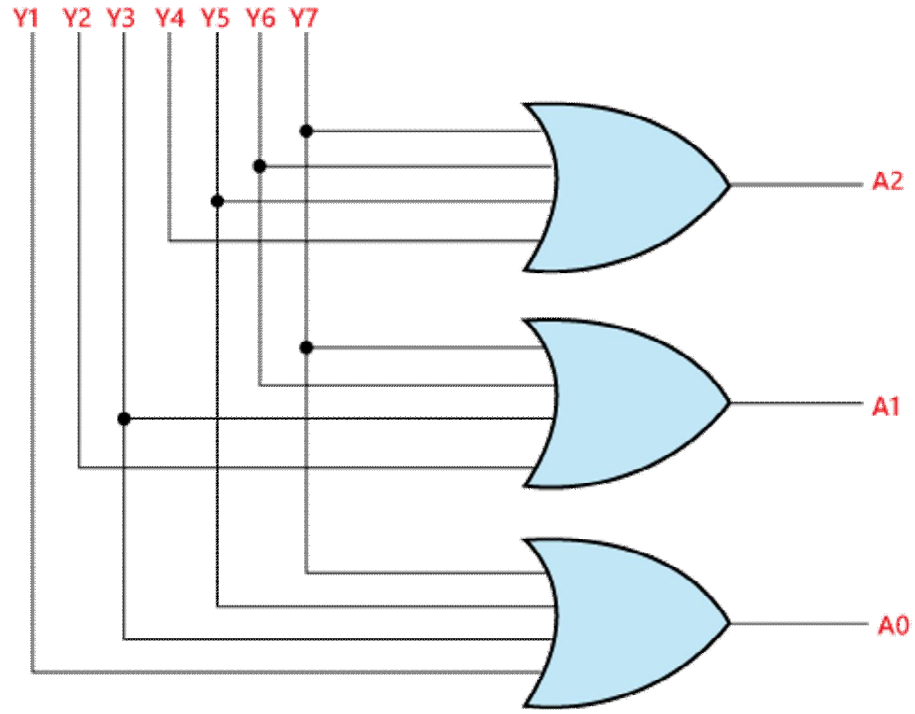
The logical expression of the term A0, A1, and A2 are as follows:

$A_2 = Y_4 + Y_5 + Y_6 + Y_7$

$A_1 = Y_2 + Y_3 + Y_6 + Y_7$

$A_0 = Y_7 + Y_5 + Y_3 + Y_1$

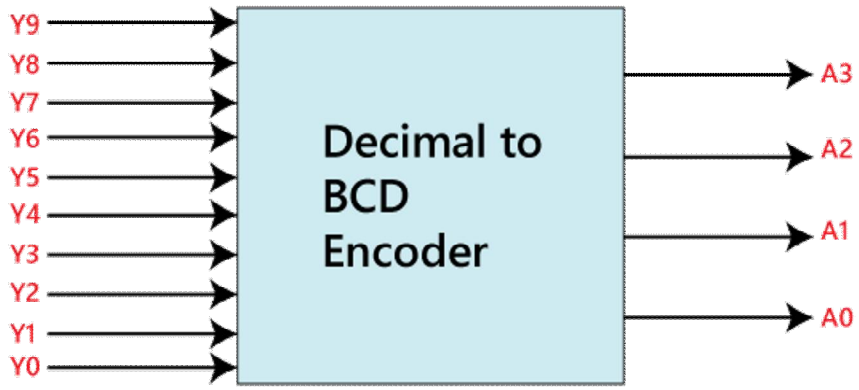
Logical circuit of the above expressions is given below:



Decimal to BCD Encoder

The Octal to Binary Encoder is also known as **10 to 4 line Encoder**. In 10 to 4 line encoder, there are total of ten inputs, i.e., Y_0, Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8, and Y_9 and four outputs, i.e., A_0, A1, A_2, and A_3. In 10-input lines, one input-line is set to true at a time to get the respective **BCD code** in the output side. The block diagram and the truth table of the decimal to BCD encoder are given below.

Block Diagram:



Truth Table:

INPUTS										OUTPUTS			
Y_9	Y_8	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0	A_3	A_2	A_1	A_0
0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0	1	0
0	0	0	0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	0	1	0	0	0	0	0	1	0	0
0	0	0	0	1	0	0	0	0	0	0	1	0	1
0	0	0	1	0	0	0	0	0	0	0	1	1	0
0	0	1	0	0	0	0	0	0	0	0	1	1	1
0	1	0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	1	0	0	1

The logical expression of the term A_0, A_1, A_2, and A_3 is as follows:

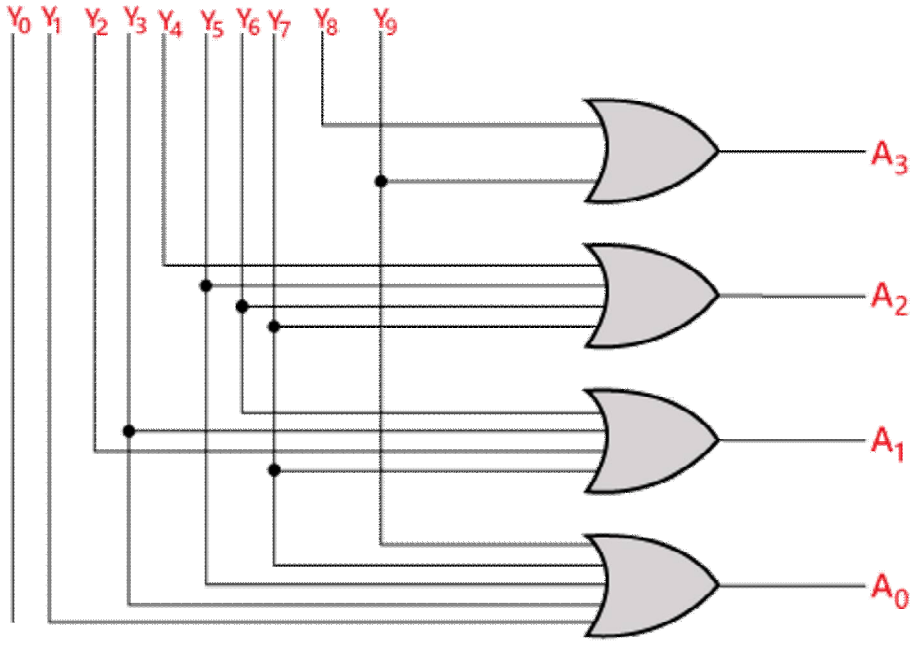
A3 = Y9 + Y8

A2 = Y7 + Y6 + Y5 +Y4

A1 = Y7 + Y6 + Y3 +Y2

A0 = Y9 + Y7 +Y5 +Y3 + Y1

Logical circuit of the above expressions is given below:



Priority Encoder:

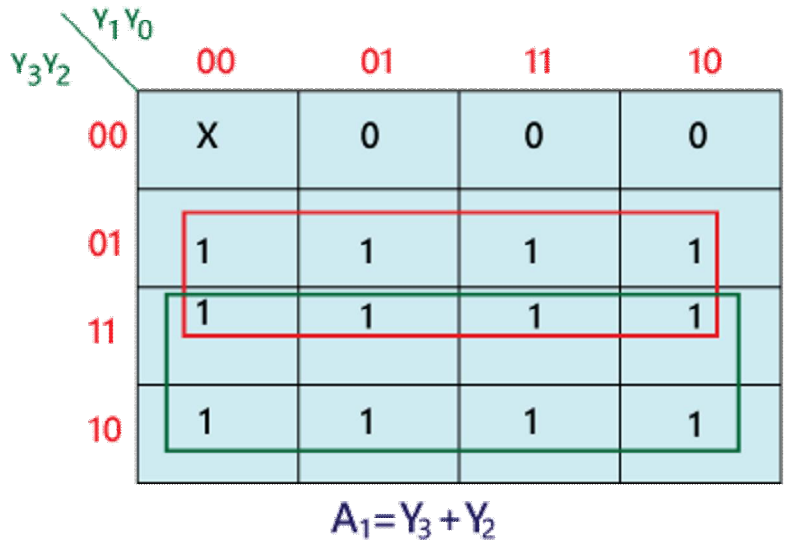
4 to 2 line Priority Encoder:

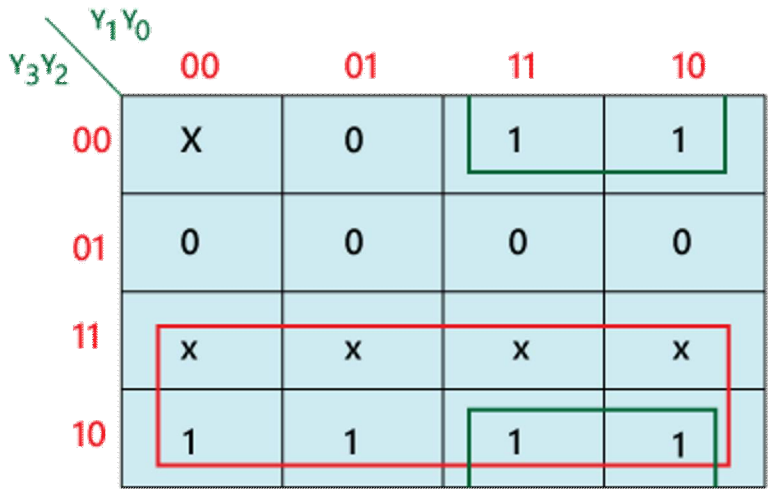
In this priority encoder, there are total of 4 inputs, i.e., Y_0, Y_1, Y_2, and Y_3, and two outputs, i.e., A_0 and A_1. The Y_3 has high and Y_0 has low priority inputs. When more than one input is '1' at the same time, the output will be the (binary) code corresponding to the higher priority input. Below is the truth table of the 4 to 2 line priority encoder.

Truth Table:

INPUTS				OUTPUTS		
Y_3	Y_2	Y_1	Y_0	A_1	A_0	V
0	0	0	0	X	x	0
0	0	0	1	0	0	1
0	0	1	X	0	1	1
0	1	x	X	1	0	1
1	X	x	X	1	1	1

The logical expression of the term A_0 and A_1 can be found using **K-map** as:



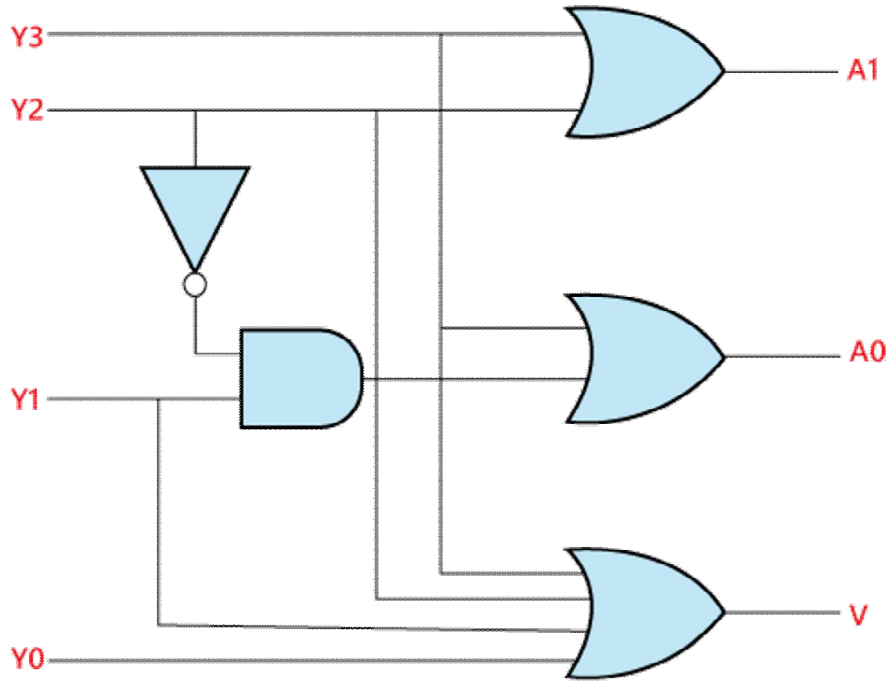


$A_0 = Y_3 + Y_2' Y_1$

$A_1 = Y_3 + Y_2$

$A_0 = Y_3 + Y_2'.Y_1$

Logical circuit of the above expressions is given below:



Uses of Encoders:

1. These systems are very easy to use in all digital systems.
2. Encoders are used to convert a decimal number into the binary number. The objective is to

perform a binary operation such as addition, subtraction, multiplication, etc.