Sairam INSTITUTIONS

Sri SAI RAM ENGINEERING COLLEGE
INSTITUTE OF TECHNOLOGY
West Tambaram, Chennai - 44

YEAR II | SEM III

CS8351

Digital Principles and System Design
(Common to CSE & IT)

UNIT II COMBINATIONAL LOGIC

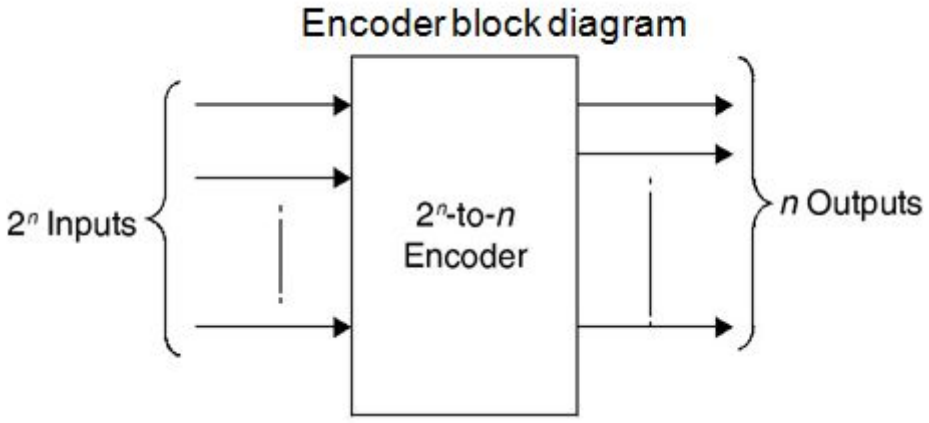
2.9 ENCODERS

ENCODERS

An encoder is a device, circuit, transducer, software program, algorithm or person that converts information from one format or code to another. The purpose of encoder is standardization, speed, secrecy, security, or saving space by shrinking size.

An Encoder is a combinational circuit that performs the reverse operation of Decoder. It has maximum of 2^n input lines and 'n' output lines.

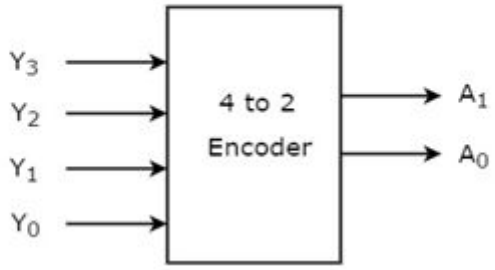
Out of the 2^n inputs only one input can be logic 1 at any given time and this is referred as active input, while all other inputs must be 0. The output corresponding to the active input is generated in binary code.



4 : 2 Encoder

The 4 to 2 Encoder consists of four inputs Y3, Y2, Y1 & Y0 and two outputs A1 & A0. At any time, only one of these 4 inputs can be '1' in order to get the respective binary code at the output. The figure below shows the logic symbol of 4 to 2 encoder :

Block Diagram



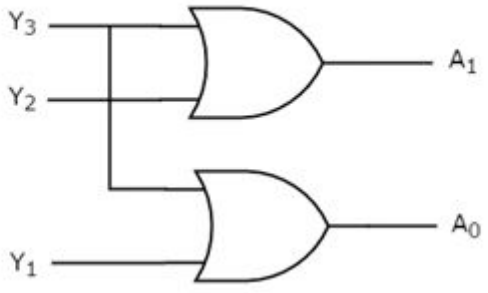
The Truth table of 4 to 2 encoder

Inputs				Outputs	
Y_3	Y_2	Y_1	Y_0	A_1	A_0
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1

Logical expression for A1 and A0 :

A1=Y3+Y2
A0=Y3+Y1

Circuit Diagram



8 : 3 Encoder (Octal to Binary)

It has eight inputs (one for each of the octal digits) and the three outputs that generate the corresponding binary number. It is assumed that only one input has a value of 1 at any given time.

logic symbol of octal to binary encoder:

8 : 3 Encoder (Octal to Binary)

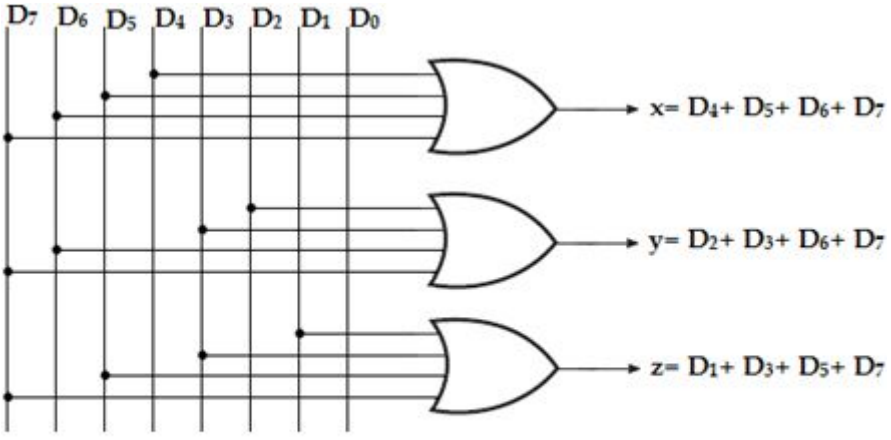
The truth table for 8 to 3 encoder

Inputs								Outputs		
D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	A	B	C
1	0	0	0	0	0	0	0	0	0	0

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

Logical expression for x,y,z :

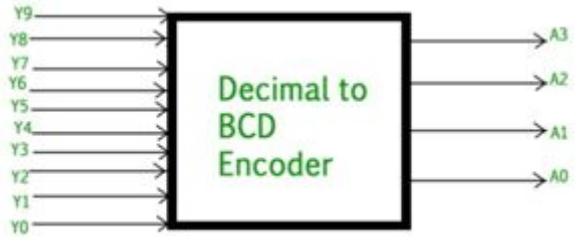
z= D1+ D3+ D5+ D7
y= D2+ D3+ D6+ D7
x= D4+ D5+ D6+ D7



Circuit Diagram

Decimal to BCD Encoder

The decimal to binary encoder usually consists of 10 input lines and 4 output lines. Each input line corresponds to the each decimal digit and 4 outputs correspond to the BCD code. This encoder accepts the decoded decimal data as an input and encodes it to the BCD output which is available on the output lines.



The truth table for decimal to BCD encoder

INPUTS										OUTPUTS			
Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	A3	A2	A1	A0
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

Decimal to BCD Encoder

Logical expression for A3,A2,A1 and A0:

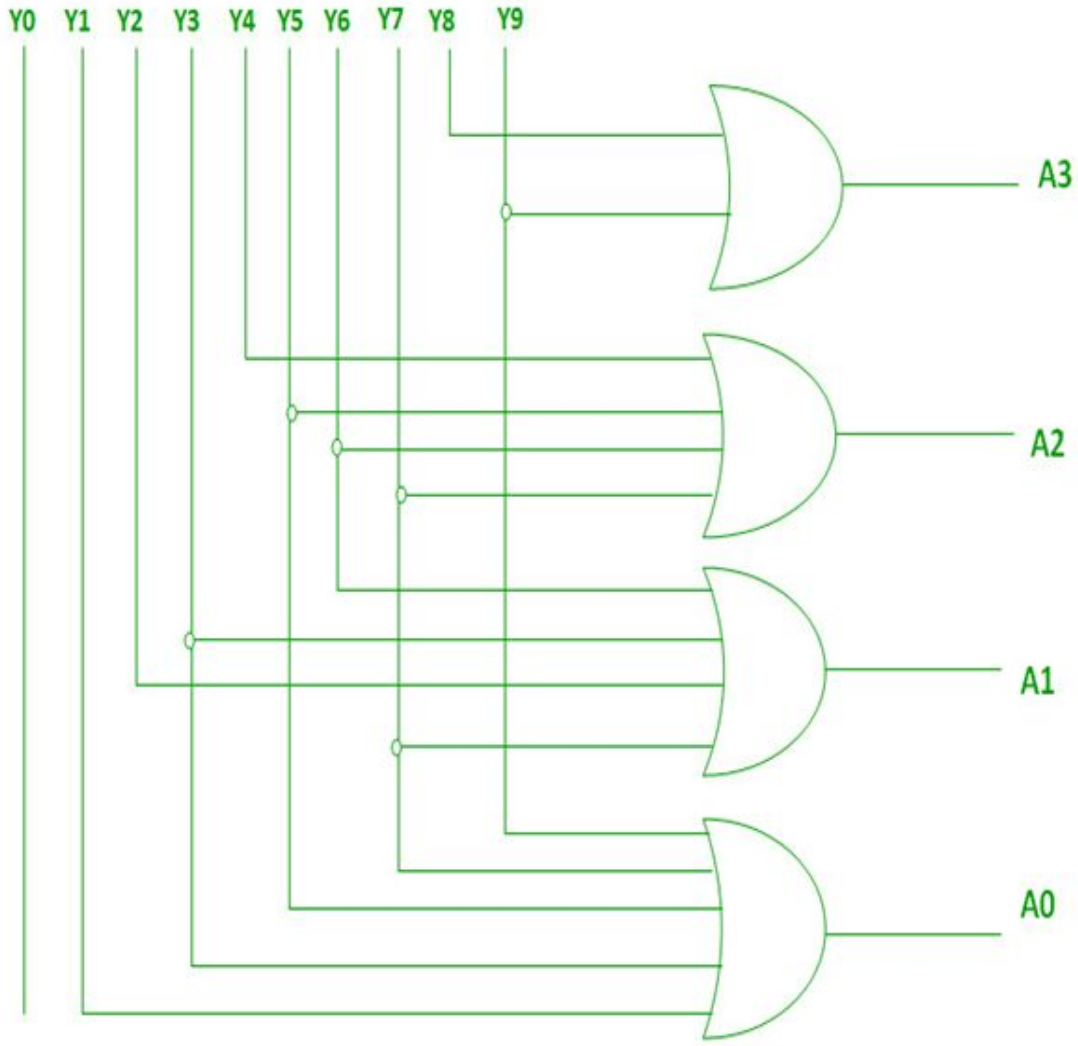
A3=Y9+Y8

A2=Y7+Y6+Y5+Y4

A1=Y7+Y6+Y3+Y2

A0=Y9+Y7+Y5+Y3+Y1

Circuit Diagram



Priority Encoder

A priority encoder is an encoder circuit that includes the priority function. In priority encoder, if two or more inputs are equal to 1 at the same time, the input having the highest priority will take precedence.

In addition to the two outputs x and y, the circuit has a third output, V (valid bit indicator). It is set to 1 when one or more inputs are equal to 1. If all inputs are 0, there is no valid input and V is equal to 0.

The higher the subscript number, higher the priority of the input. Input D3, has the highest priority. So, regardless of the values of the other inputs, when D3 is 1, the output for xy is 11.

D2 has the next priority level. The output is 10, if D2= 1 provided D3= 0. The output for D1 is generated only if higher priority inputs are 0, and so on down the priority levels.

Truth table:

Inputs				Outputs		
D_0	D_1	D_2	D_3	x	y	V
0	0	0	0	x	x	0
1	0	0	0	0	0	1
x	1	0	0	0	1	1
x	x	1	0	1	0	1
x	x	x	1	1	1	1

Although the above table has only five rows, when each don't care condition is replaced first by 0 and then by 1, we obtain all 16 possible input combinations. For example, the third row in the table with X100 represents minterms 0100 and 1100. The don't care condition is replaced by 0 and 1 as shown in the table below.

Modified Truth table:

Inputs				Outputs		
D_0	D_1	D_2	D_3	x	y	V
0	0	0	0	x	x	0
1	0	0	0	0	0	1
0	1	0	0	0	1	1
1	1	0	0			
0	0	1	0			
0	1	1	0	1	0	1
1	0	1	0			
1	1	1	0			
0	0	0	1			
0	0	1	1			
0	1	0	1			
0	1	1	1	1	1	1
1	0	0	1			
1	0	1	1			
1	1	0	1			

For x

D_0D_1 \ D_2D_3	00	01	11	10
00	x	1	1	1
01	0	1	1	1
11	0	1	1	1
10	0	1	1	1

$x = D_2 + D_3$

For y

D_0D_1 \ D_2D_3	00	01	11	10
00	x	1	1	0
01	1	1	1	0
11	1	1	1	0
10	0	1	1	0

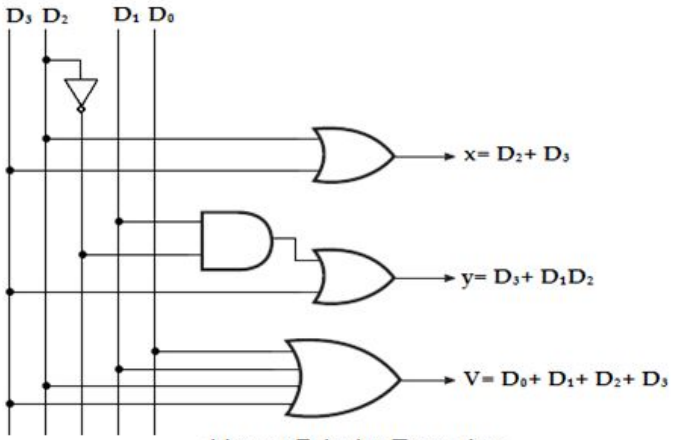
$y = D_3 + D_1D_2$

For V

D_0D_1 \ D_2D_3	00	01	11	10
00	0	1	1	1
01	1	1	1	1
11	1	1	1	1
10	1	1	1	1

$V = D_0 + D_1 + D_2 + D_3$

The priority encoder is implemented according to the above Boolean functions.



4 Input Priority Encoder