



Encoder

An encoder is a digital circuit that performs the **inverse** operation of a decoder. An encoder has 2^n input lines and n output lines. The output lines generate the binary code corresponding to the input value.

An example of an encoder is the octal-to-binary encoder whose truth table is given as:

Inputs								Outputs		
D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	x	y	z
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

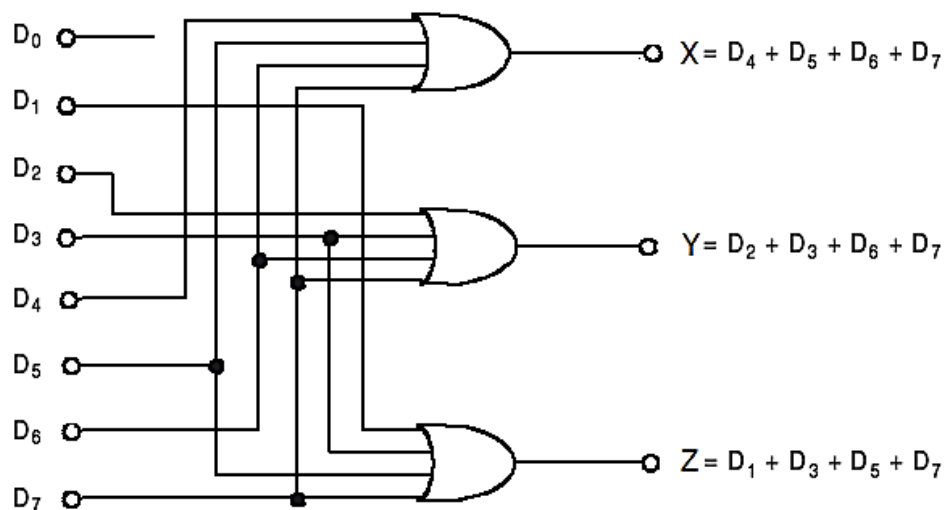
This table gives the following Boolean output functions:

$$z = D_1 + D_3 + D_5 + D_7$$

$$y = D_2 + D_3 + D_6 + D_7$$

$$x = D_4 + D_5 + D_6 + D_7$$

The encoder can be implemented with three OR gates:



It may also be noted that D_0 input is not connected to any gate. Thus, output 000 can be obtained if $D_0 = 1$ & other input = 0 or if all inputs are equal to zero.

This problem can be resolved by providing one more output to indicate if all inputs are equal to zero.

Also, this encoder has the **limitation** that only one input can be active at any time. Thus, if two inputs are active simultaneously, the output produces an undefined combination.

For example, if D_3 and D_6 are 1, the output of the encoder will be 111 which does not represent the case where only D_7 equal to 1 and the rest of the inputs are equal to 0.

To solve this problem, encoder circuits must establish an input priority to ensure that only one input is encoded.

Priority Encoders

These encoders establish an input priority to ensure that only the highest priority input is encoded. As an example, if both D_2 and D_4 inputs are logic 1 at the same time, then output will be according to D_4 only and that is 100.

In addition to the two outputs x and y , the circuit has a third output which is called valid bit indicator (V).

$V = 1$ when one or more inputs are equal to 1.

$V = 0$ there is no valid input.

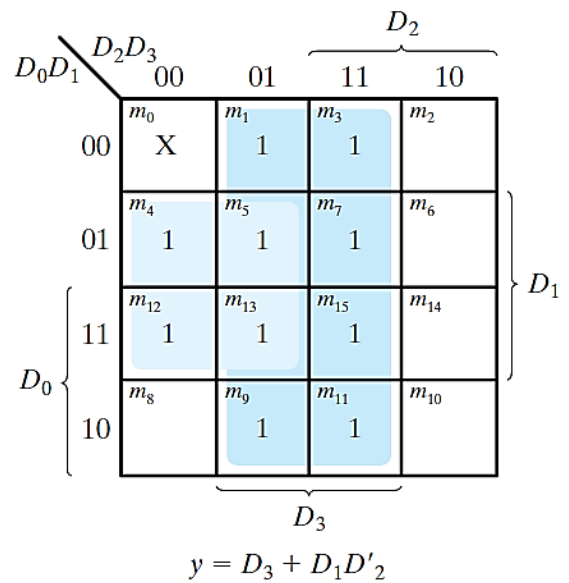
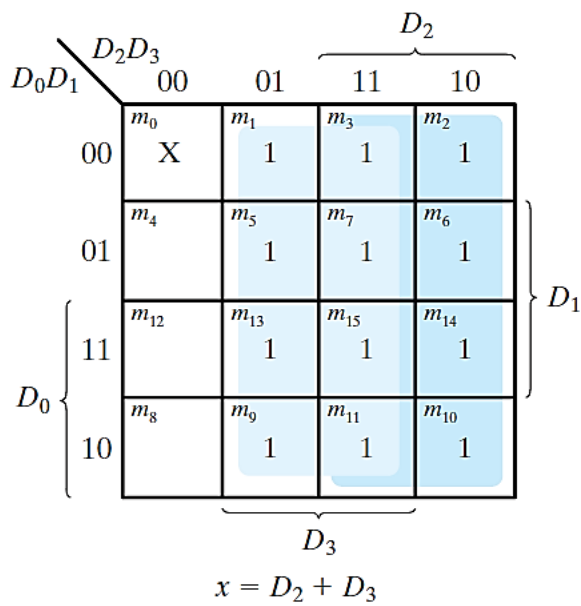
The other two outputs are not inspected when V equals 0 and are specified as don't-care.

4-2 Priority Encoder

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

K - Map



The Boolean function for output V is an OR function of all the input variables.

The priority encoder is implemented as follow:

