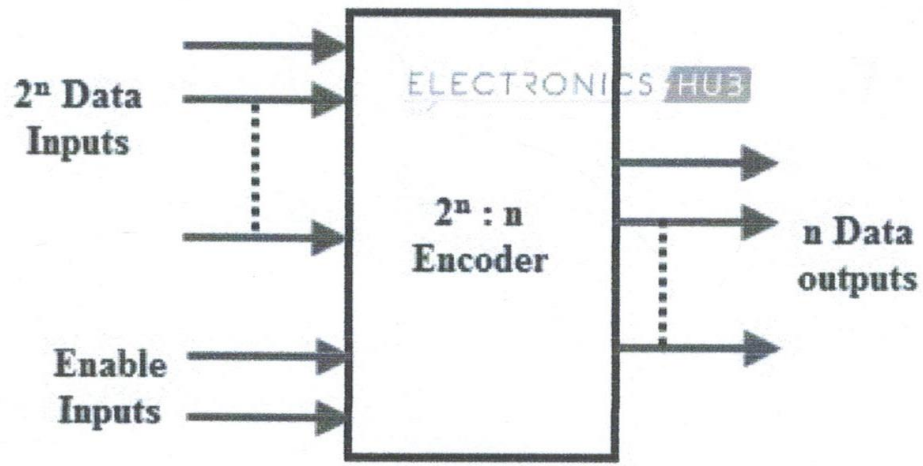
Encoder

Digital Encoder/ Priority Encoder

Encoder

Encoder

Encoder is a combinational circuit that accepts multiple input signals and produces the outputs as a coded representation of the inputs. A binary encoder has 2n input lines and n output lines. From all the input lines, only one of an input line is activated at a time, and depending on the input line, it produces the n bit output code.



Digital Encoder Applications

Encoders are very common electronic circuits used in all digital systems. In case of pocket calculators, these are used to translate the decimal values to the binary in order to perform the binary functions such as addition, subtraction, multiplication, etc.

Limitations of Standard Digital Encoder

The main disadvantages of standard digital encoder is that they can generate the wrong output code when there is more than one input present at logic level "1". For example, if we make inputs D1 and D2 HIGH at logic "1" both at the same time, the resulting output is neither at "01" or at "10" but will be at "11" which is an output binary number that is different to the actual input present. Also, an output code of all logic "0"s can be generated when all of its inputs are at "0" OR when input D0 is equal to one.

4 to 2-line Encoder

It is an encoder that accepts four input signals and codes them to the 2-bit binary form. It has four input lines and two output lines.

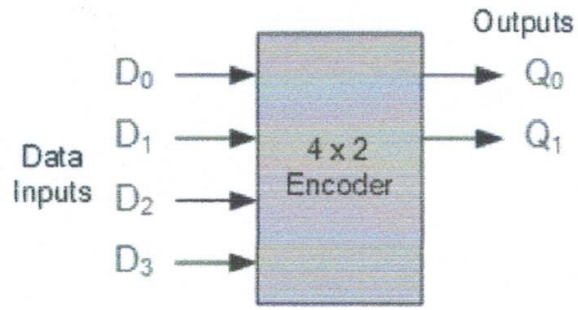


Fig: Block diagram of 4 to 1 Demultiplexer

Truth Table

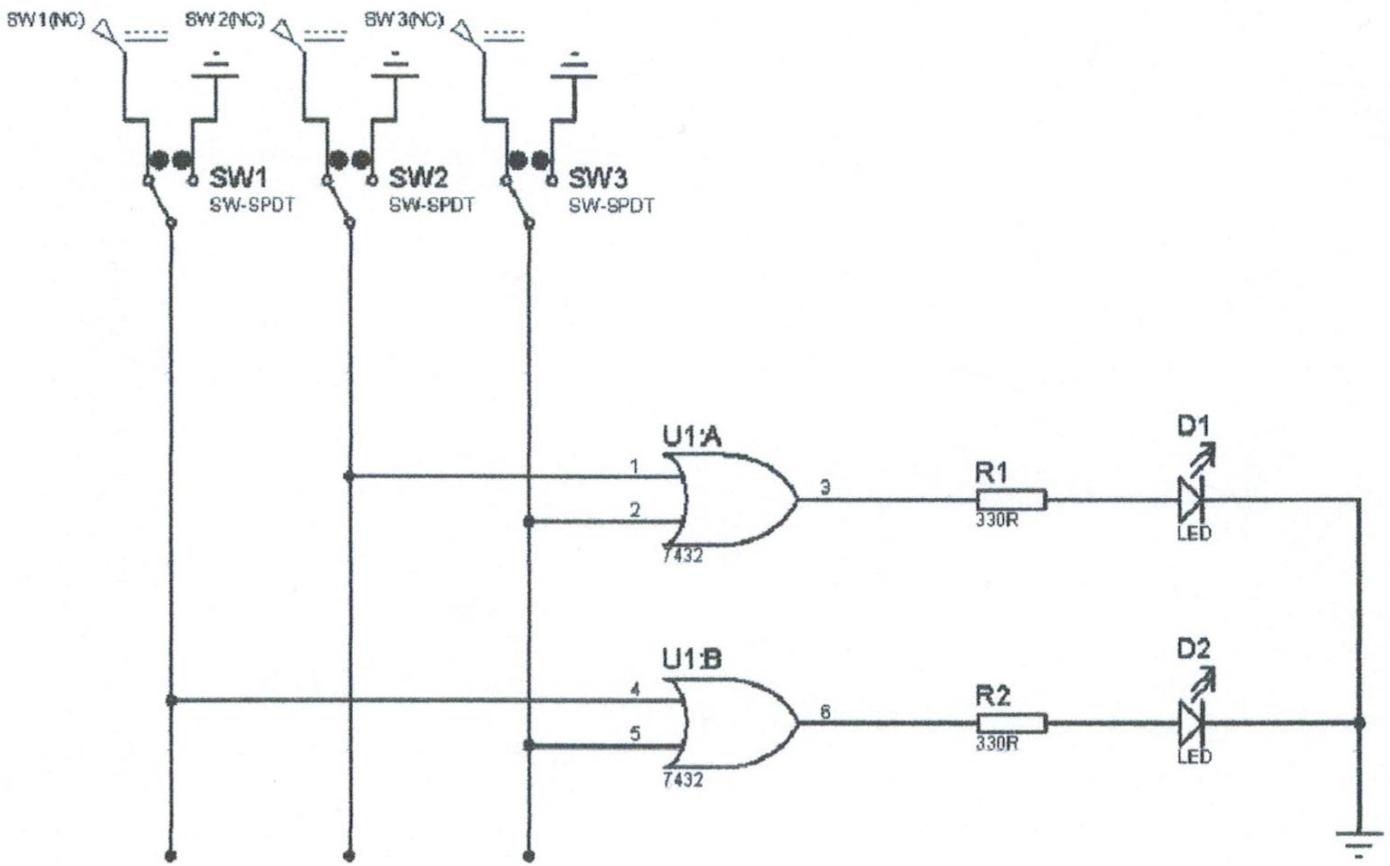
Inputs				Output	
Y_0	Y_1	Y_2	Y_3	Q_0	Q_1
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Note: E is assumed to be 1. If it is 0, the circuit wouldn't operate.

So, from the above Truth Table, the Boolean expression for output is: -

$$Q_0 = Y_2 + Y_3 \qquad Q_1 = Y_0 + Y_3$$

4 to 2 line Encoder Practical logic Diagram



Priortise and Priority Encoder

Prioritise

One simple way to overcome this problem generated in the standard digital encoder is to "Prioritise" the level of each input pin and if there was more than one input at logic level "1" the actual output code would only correspond to the input with the highest designated priority. Then this type of digital encoder is known commonly as a **Priority Encoder** or **P-encoder** for short.

Priority Encoder

The Priority Encoder solves the problems mentioned above by allocating a priority level to each input. The priority encoders output corresponds to the currently active input which has the highest priority. So when an input with a higher priority is present, all other inputs with a lower priority will be ignored. The priority encoder comes in many different forms with an example of an 8-input priority encoder along with its truth table shown below.

4 to 2 line Priority Encoder table

D3	D2	D1	D0	X(MSB)	Y(LSB)	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

Derivation

X = D3’D2+D2 = D3+D2 // Using Distributive property

Y = D3’D2’D1+D3 = D2’D1+D3// Using Distributive property

V = D3’D2’D1’D0+D3’D2’D1+D3’D2+D3 // Using Distributive property

= D3’D2’(D1’D0+D1)+D3’D2+D3 // Using Distributive property

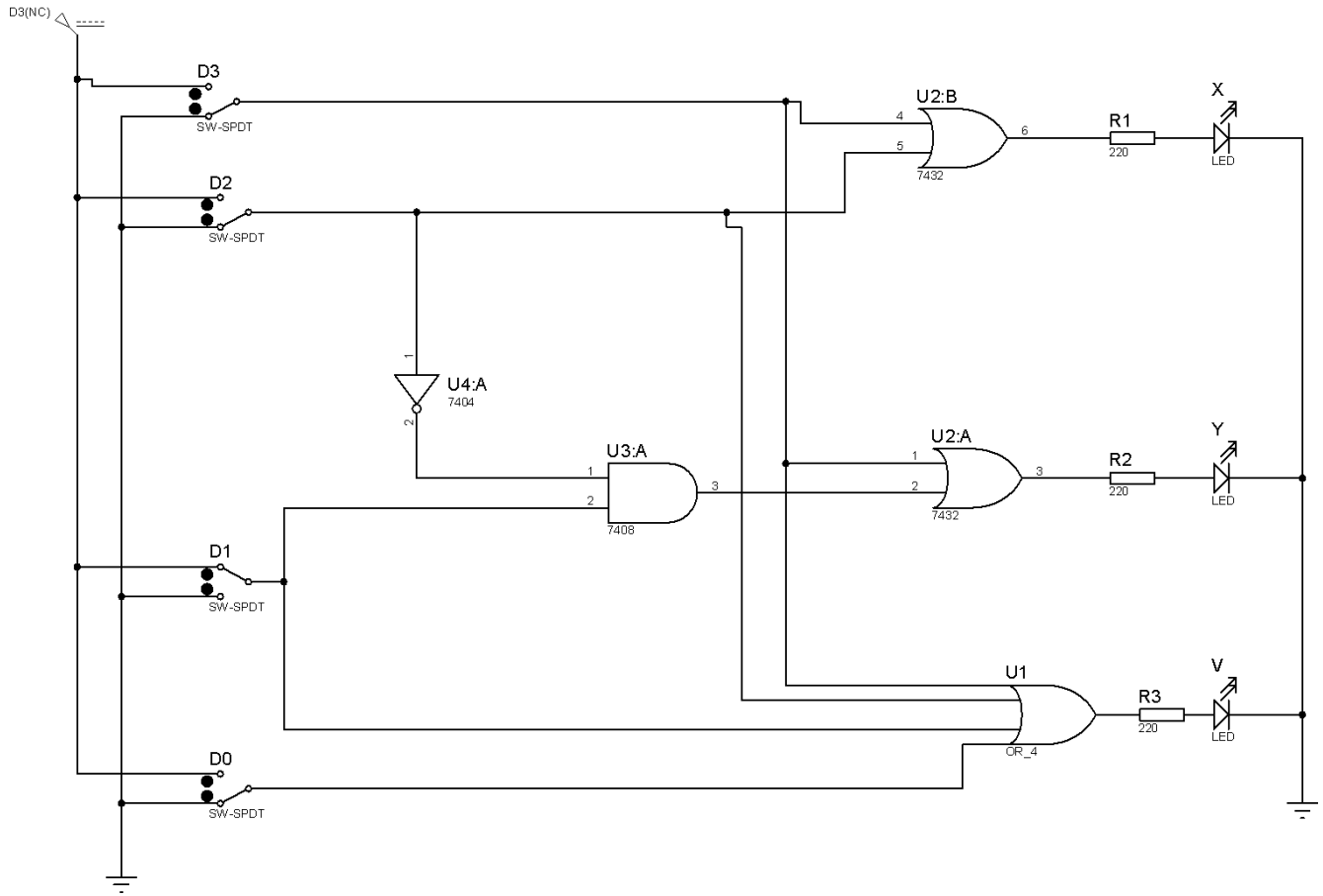
= D3’D2’(D1+D0)+D3’D2+D3 // Using Distributive property

= D3’{D2’(D1+D0)+D2}+D3 // Using Distributive property

= D3’{D0+D1+D2}+D3 // Using Distributive property

= D0+D1+D2+D3

4 to 2 line Priority Encoder Practical Diagram



8 to 3-line Priority Encoder

It is a priority encoder that accepts eight input signals and codes them to the 3-bit binary form. It has eight input lines and three output lines.

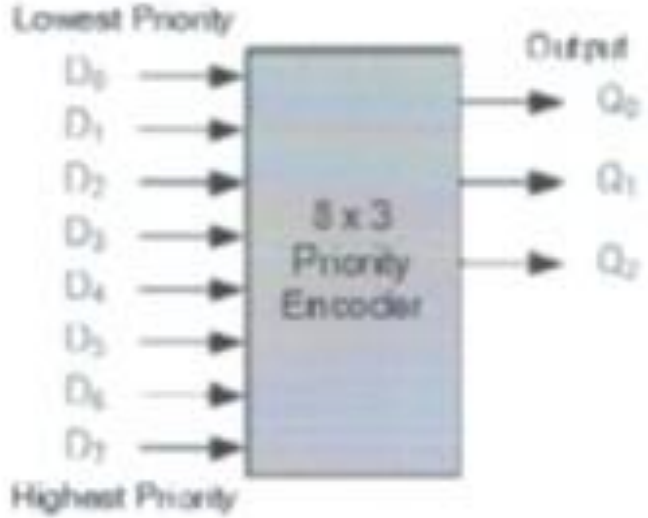


Fig: Block diagram of 8 by 3 priority encoder

8 to 3 line Priority Encoder Table

Truth Table

Inputs								Outputs		
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Q_2	Q_1	Q_0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	X	0	0	1
0	0	0	0	0	1	X	X	0	1	0
0	0	0	0	1	X	X	X	0	1	1
0	0	0	1	X	X	X	X	1	0	0
0	0	1	X	X	X	X	X	1	0	1
0	1	X	X	X	X	X	X	1	1	0
1	X	X	X	X	X	X	X	1	1	1

Logic equations:

So, from the above Truth Table, the Boolean expression for output is:

$$Q_0 = D_7'.D_6'.D_5'.D_4'.D_3'.D_2'.D_1 + D_7'.D_6'.D_5'.D_4'.D_3 + D_7'.D_6'.D_5 + D_7$$

$$\mathbf{Q_0 = D_6'.D_5'.D_4'.D_3'.D_2'.D_1 + D_6'.D_5'.D_4'.D_3 + D_6'.D_5 + D_7}$$

$$Q_1 = D_7'.D_6'.D_5'.D_4'.D_3'.D_2 + D_7'.D_6'.D_5'.D_4'.D_3 + D_7'.D_6 + D_7$$

$$Q_1 = D_6'.D_5'.D_4'.D_3'.D_2 + D_6'.D_5'.D_4'.D_3 + D_6 + D_7$$

$$\mathbf{Q_1 = D_5'.D_4'.D_3'.D_2 + D_5'.D_4'.D_3 + D_6 + D_7}$$

$$Q_2 = D_7'.D_6'.D_5'.D_4 + D_7'.D_6'.D_5 + D_7'.D_6 + D_7$$

$$Q_2 = D_6'.D_5'.D_4 + D_6'.D_5 + D_6 + D_7$$

$$Q_2 = D_5'.D_4 + D_5 + D_6 + D_7$$

$$\mathbf{Q_2 = D_4 + D_5 + D_6 + D_7}$$

Simplified Logic Equations:

- Q0 = D7+D6+D5+D4
- Q1 = D7+D6+D5’D4’(D3+D2)
- Q2 = D7+D6’(D5+D4’D3+D4’D3’D2’D1)
- V = D7+D6+D5+D4+D3+D2+D1+D0

8 to 3 line priority encoder