Encoder, Priority Encoder

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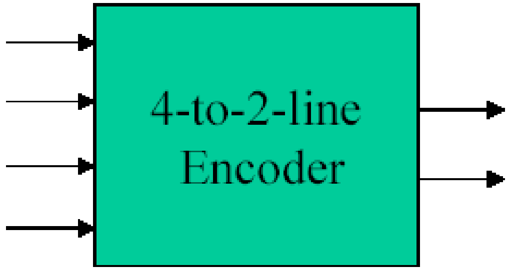
Encoders

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



Truth Table: Octal to Binary Encoder

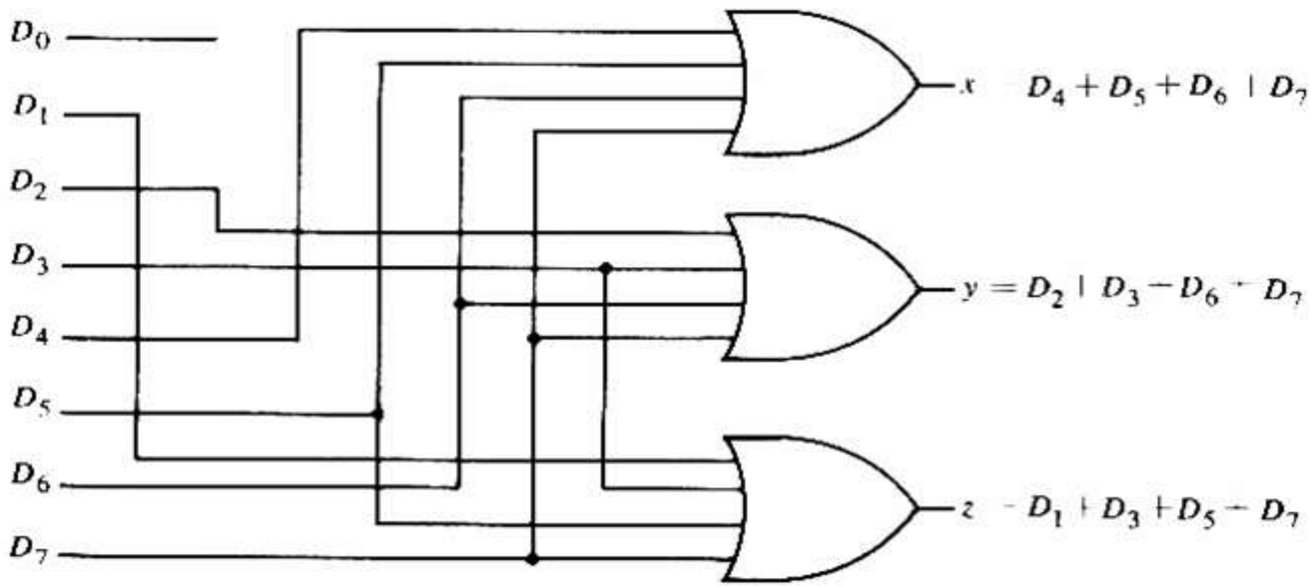
Inputs								Outputs		
D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	x	y	z
1	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	0	1	0	0	1	0	1
0	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1

$z=D_1+D_3+D_5+D_7$ $y=D_2+D_3+D_6+D_7$ $x=D_4+D_5+D_6+D_7$

Encoder: Example

- An example of encoder is octal-to-binary encoder
- It has eight inputs (one for each octal digits) and three outputs that generate the corresponding binary number
- It is assumed that only one input has a value of 1 at any given time
- The encoder can be implemented with OR gates whose inputs are determined directly from the truth table
- Output z is equal to 1 when the input octal digit is 1,3,5 or 7. Output y is 1 for octal digits 2,3,6 or 7 and output x is 1 for digits 4,5,6 or 7. These conditions can be expressed as by the Boolean functions as shown in the previous slide

Octal to Binary Encoder Implementation



$z=D_1+D_3+D_5+D_7$ $y=D_2+D_3+D_6+D_7$ $x=D_4+D_5+D_6+D_7$

Priority Encoder

- A priority encoder is an encoder circuit that includes the priority function.
- The operation of the priority encoder is such that if two or more inputs are equal to 1 at the same time, the input having the highest priority will take precedence
  - D_3 has the highest priority
  - D_0 has the lowest priority
- Valid bit indicator (V) is set to 1 when one or more inputs are equal to 1. If all inputs are 0, there is no valid inputs and V is equal to 0. The other two outputs are not inspected when V equals 0 and are specified as don’t care conditions

Priority Encoder: Expanded Truth Table

D_0	D_1	D_2	D_3	x	y	V
0	0	0	0	X	X	0
0	0	0	1	1	1	1
0	0	1	0	1	0	1
0	0	1	1	1	1	1
0	1	0	0	0	1	1
0	1	0	1	1	1	1
0	1	1	0	1	0	1
0	1	1	1	1	1	1
1	0	0	0	0	0	1
1	0	0	1	1	1	1
1	0	1	0	1	0	1
1	0	1	1	1	1	1
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	0	1
1	1	1	1	1	1	1

Truth Table of a Priority Encoder

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

Priority Encoder: Truth Table

Input				Output		
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

–X: don't-care conditions in the output, used in the inputs to condense truth table, replaced by both 0 and then 1

–V: valid output indication, implemented by OR function

Maps for Priority Encoder

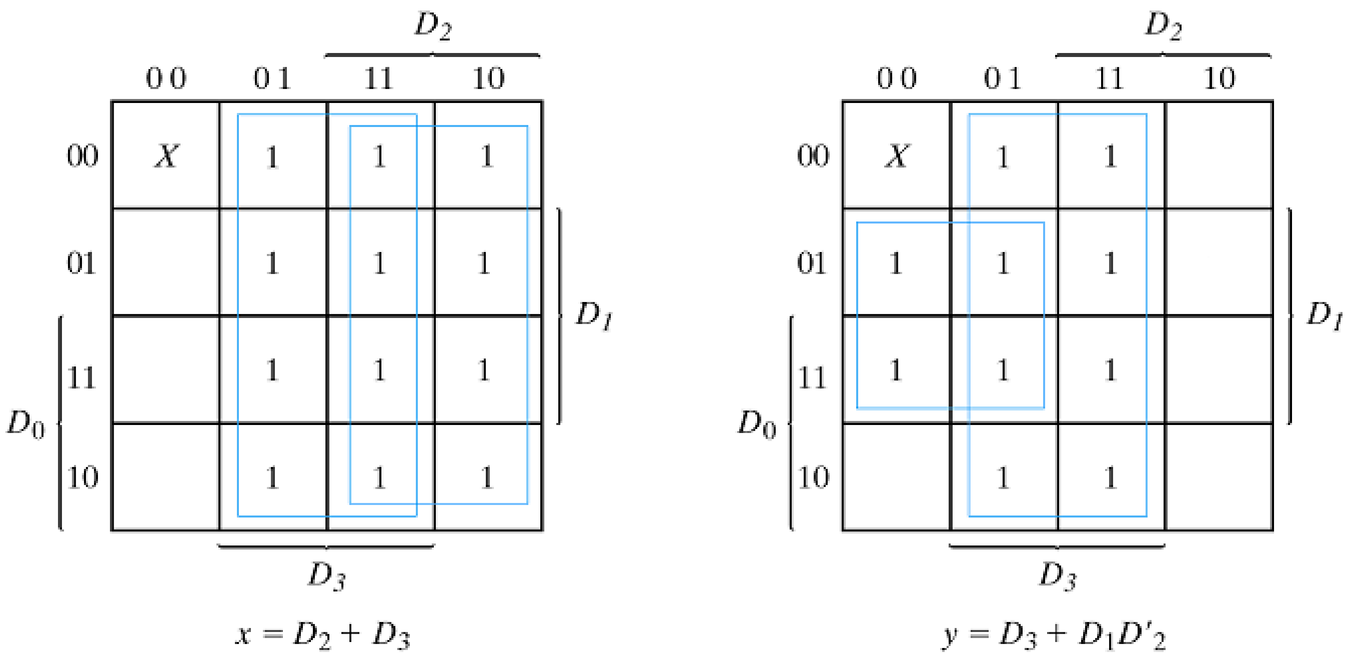
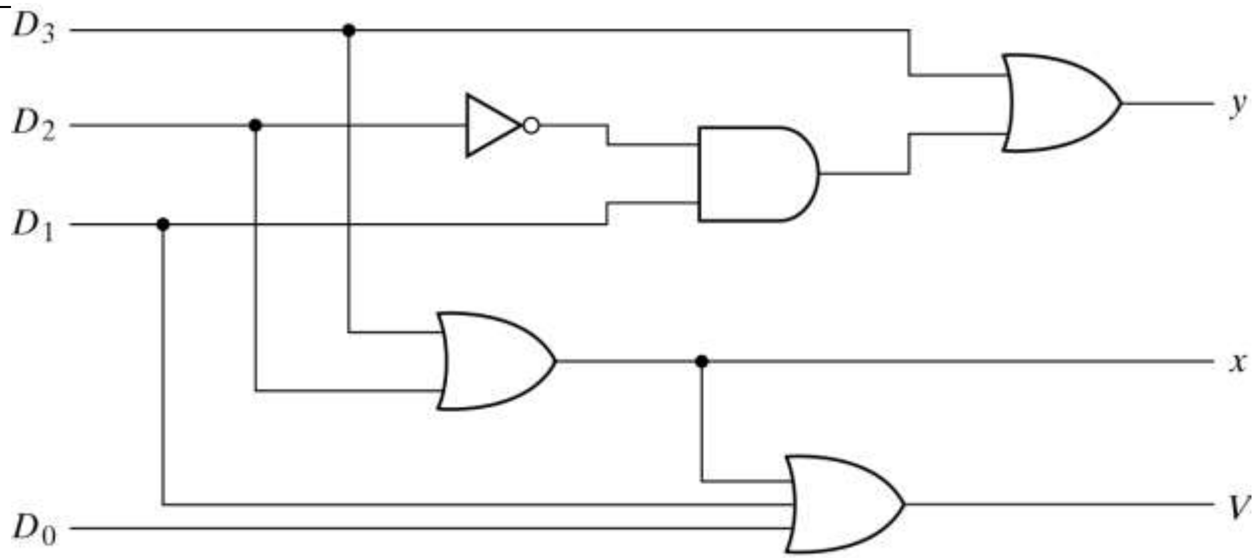


Fig. 4-22 Maps for a Priority Encoder

Priority Encoder: Logic circuit

Truth Table of a Priority Encoder

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



Practice Problem

- Design a Priority Encoder with Priority to Lower Subscript

End of Lecture