



Exp. No. (4)

Decoders and Encoders

Object

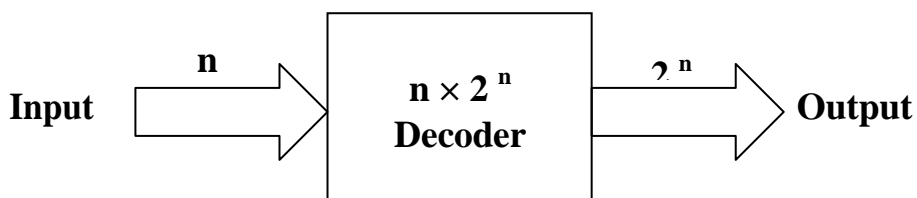
To be familiar with basics of conversion from binary to decimal by using decoder networks.

Theory

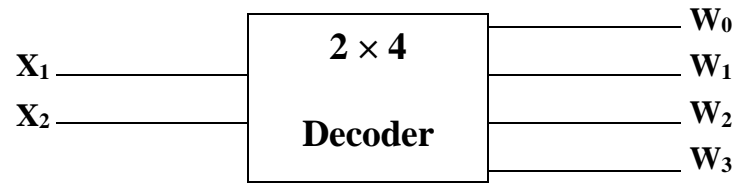
1. Decoder

The process of taking some type of code and determining what it represents in terms of a recognizable number or character is called decoding. A decoder is a combinational logic circuit that performs the decoding function, and produce an output that indicates the (meaning) of the input code.

The decoder is an important part of the system which selects the cells to be read from and write into. This particular circuit is called a decoder matrix, or simply a decoder, and has a characteristic that for each of the possible 2^n binary input number which can be taken by the n input cells, the matrix will have a unique one of its 2^n output lines selected.



The decoder is called n to m where $m < 2^n$ for example two to four line decoder, Fig. (1) shows a two to four line decoder and its truth table.



INPUTS		OUTPUTS			
X_2	X_1	W_0	W_1	W_2	W_3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Table (1)
Two to Four Decoder Truth Table

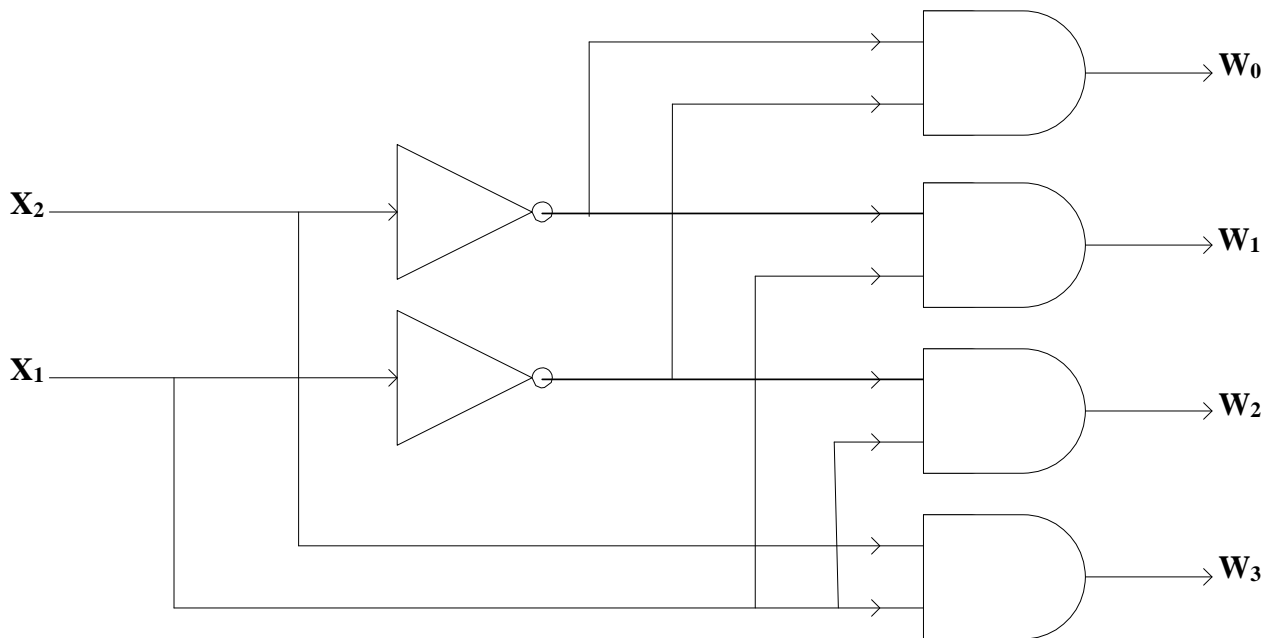


Fig. (1)
Two to Four Line Decoder

The BCD Decoder

The BCD decoder converts each BCD code (8421) into one of ten possible decimal digit indications. It is typically referred to as a 1 of 10 or 4 to 10 lines decoder, although other types of decoder also fall into this category (such as an ExeCs – 3 decoder). A list of the ten BCD code words and their corresponding decoding functions is shown in Table (2). Each of these decoding functions is implemented with NAND gates to provide active LOW outputs, as shown in Fig. (2).

DECIMAL DIGIT	OUTPUTS										LOGIC FUNCTION (X)
0	0	1	1	1	1	1	1	1	1	1	$\overline{D}\overline{C}\overline{B}A$
1	1	0	1	1	1	1	1	1	1	1	$\overline{D}\overline{C}BA$
2	1	1	0	1	1	1	1	1	1	1	$\overline{D}C\overline{B}A$
3	1	1	1	0	1	1	1	1	1	1	$\overline{D}CBA$
4	1	1	1	1	0	1	1	1	1	1	$\overline{D}C\overline{B}\overline{A}$
5	1	1	1	1	1	0	1	1	1	1	$\overline{D}CBA$
6	1	1	1	1	1	1	0	1	1	1	$\overline{D}CBA$
7	1	1	1	1	1	1	1	0	1	1	$DCBA$
8	1	1	1	1	1	1	1	1	0	1	$D\overline{C}\overline{B}A$
9	1	1	1	1	1	1	1	1	1	0	$D\overline{C}BA$

Table (2)
Truth Table of BDC to Decimal Decoder

The 7442 is an integrated circuit BCD to Decimal decoder. Note that on this device the inputs are A, B, C, and D where A is the least significant bit.

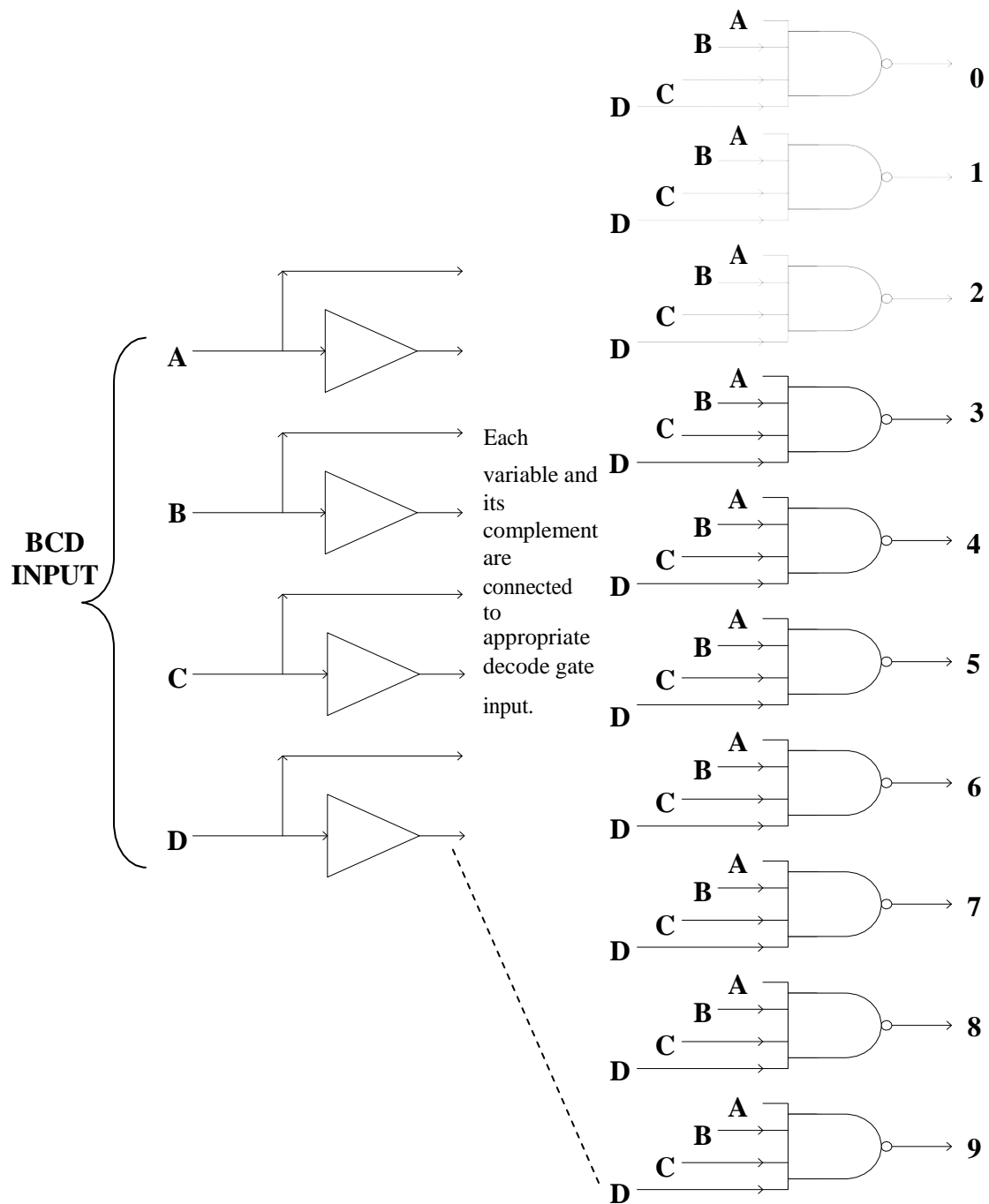
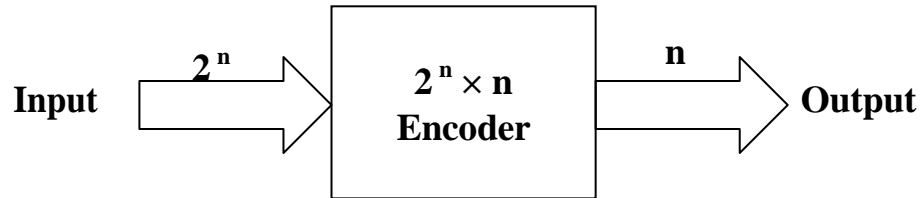


Fig (2)
Logic for BCD Decoder.

2. Encoder

An encoder is a combinational logic circuit that generate n output lines from 2^n (or less) inputs. It has the reverse function of the decoder.



An encoder accepts digit on its inputs, such as a decimal or octal digit, and converts it to a coded output, such as a binary or BCD. Encoder can also be devised to encode various symbol and alphabetic characters. This process of converting from familiar symbols or numbers to a coded format is called encoding.

Figure (2) shown a four to two line encoder and its truth table.

INPUTS				OUTPUTS	
W_3	W_2	W_1	W_0	X_2	X_1
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1

Table (3)
Truth Table of Four to Two Line Encoder.

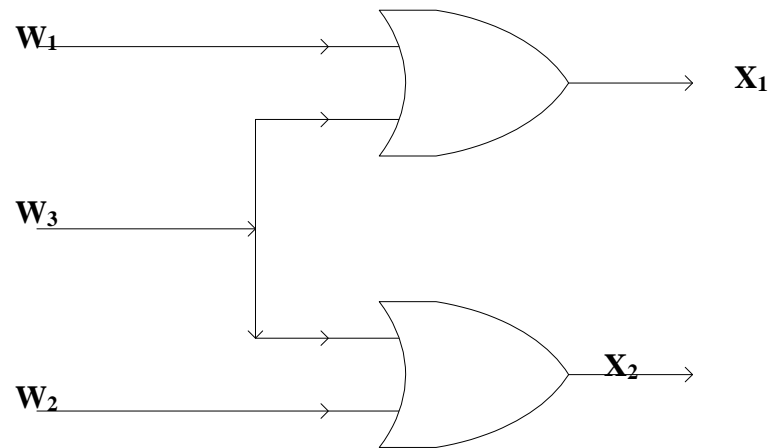


Fig. (3)
Four to Two line Encoder

Procedure

1. Construct a circuit as shown in Fig. (1), set data switches as shown in the two to four lines decoder output table. Record the output indications of L_1 to L_4 .
2. Install one 7442 BCD to Decimal Decoder in the logic lab. Set data switches as shown in the BCD to Decimal Decoder output table in Fig. (2). Record the output indications output pins.
3. Construct the circuit as shown in Fig. (3), set data switches as shown in the four to two line encoder truth table. Record the output indications of L_1 & L_2 .

Discussion

1. Design a full adder circuit using decoder.
2. Design 3×8 decoder from 2×4 decoder.
3. Design 4×16 decoder from 3×8 decoder.
4. Design octal to binary encoder.