EXPERIMENT – III

ANALYSIS OF CODE CONVERTERS USING LT SPICE

SLOT: L37+L38

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AIM

To design and implement a logic circuit that converts Binary Coded Decimal (BCD) input to Excess 3 Code.

Materials

Latest version of LT Spice with the Digital logic library.

Pre Requisites

know how the logic gates work and how the output varies depending on the input from the voltage source.

How to construct and operate code converters.

How to use LT spice and install the necessary libraries.

PROCEDURE

1. Download and install the LT spice with the correct libraries.

2. Once operational create a new simulation profile and name it.

3. Drag and drop all the necessary components to complete the circuit, once completed.

4. Go to the advance settings and select PULSE under function

I. V(Initial) = 0
II. V(on) = 5
III. T (rise) = 1n
IV. T (fall) = 1n
V. And depending on the number of inputs

a. A input

I. V (delay) = 8 m
II. T (on) = 8 m
III. T (period) = 16 m

b. B input

I. V (delay) = 4 m
II. T (on) = 4 m
III. T (period) = 8 m

c. C input

I. V (delay) = 2 m
II. T (on) = 2 m
III. T (period) = 4 m

d. D input

I. V (delay) = 0 m
II. T (on) = 1 m
III. T (period) = 2 m

4. Connect all of them accordingly using the appropriate labels and make sure to ground all negatives end of the voltage source.

5. Once done run the simulation under trans for 10 m and plot the output waveforms for W, X, Y 2 and how they compare to A, B, C and D.

THEORY

CODE CONVERTERS

CODE CONVERTERS

The code converter is used to convert one type of binary code to another. There are different types of binary codes like BCD code, gray code, excess 3 code etc. Different codes are used for different type of application. To get the required code from any one type of code, the single code conversion process is done with the help of combinational circuits.

BCD (BINARY CODED DECIMAL)

BCD (Binary Coded Decimal)

In computing and electronic systems, Binary Coded Decimal (BCD) is a class of binary encoded decimals where each digit is represented by a fixed number of bits, usually four or eight. Sometimes special bit pattern are used for a sign or other indications (eg error or overflow)

EXCESS 3 CODE

Excess 3 Code

The Excess 3 code (XS3) is a non weighted code used to express decimal numbers. It is a self complimentary BCD code and numerical system which has biased representation. It is particularly significant for arithmetic operations as it overcomes short comings encountered while using 8421 BCD code to add two decimal digits whose sum exceeds 9. Excess 3 arithmetic uses different algorithm than normal non-biased BCD or binary positional number system.

BCD TO EXCESS 3 CODE CONVERTERS

BCD to Excess 3 code converter.

As is clear by the name, BCD digit can be converted to its corresponding Excess 3 code by simply adding 3 to it. Let A, B, C and D be the bits representing the binary number, where D is the LSB and A is the MSB, and let w, x, y and z be the bits representing the grey code of the binary number, where z is the LSB and w is the MSB. The truth table for the conversion is given below. The x's mark dont care condition.

BCD (8421)				Excess 3			
A	B	C	D	w	x	y	z
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	x	x	x	x
1	0	1	1	x	x	x	x
1	1	0	0	x	x	x	x
1	1	0	1	x	x	x	x
1	1	1	0	x	x	x	x
1	1	1	1	x	x	x	x

To find the corresponding digital circuit, we will use the K-map technique for each of the Excess 3 code bits as output with all of the bits of the BCD number as input

$$w = A + BC + BD$$
$$x = B'C + B'D + BC'D'$$
$$y = CD + C'D'$$
$$z = D'$$

AB \ CD	00	01	11	10
00	1			1
01	1			1
11	X	X	X	X
10	1		X	X

$z = D'$

AB \ CD	00	01	11	10
00		1	1	1
01	1			
11	X	X	X	X
10		1	X	X

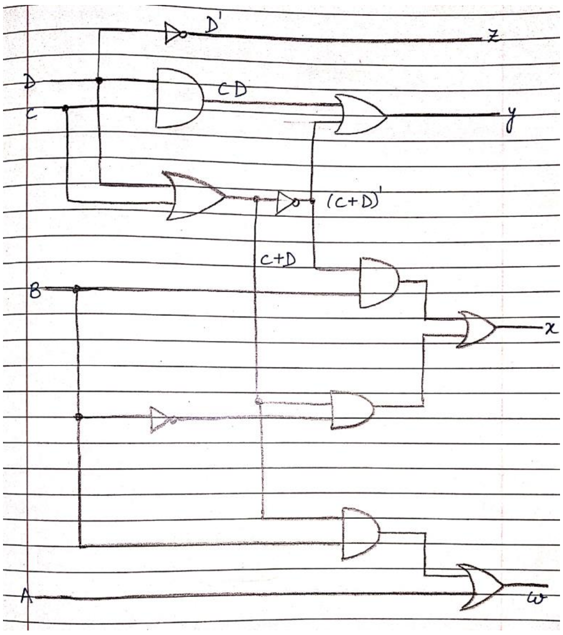
$x = B'C + B'D + BC'D'$

AB \ CD	00	01	11	10
00	1		1	
01	1		1	
11	X	X	X	X
10	1		X	X

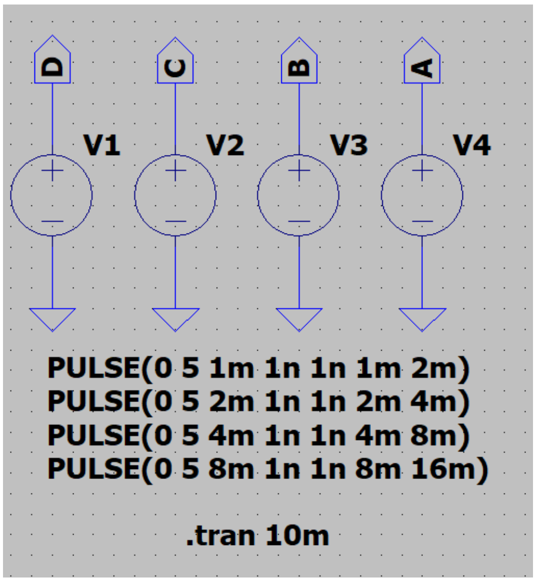
$y = CD + C'D'$

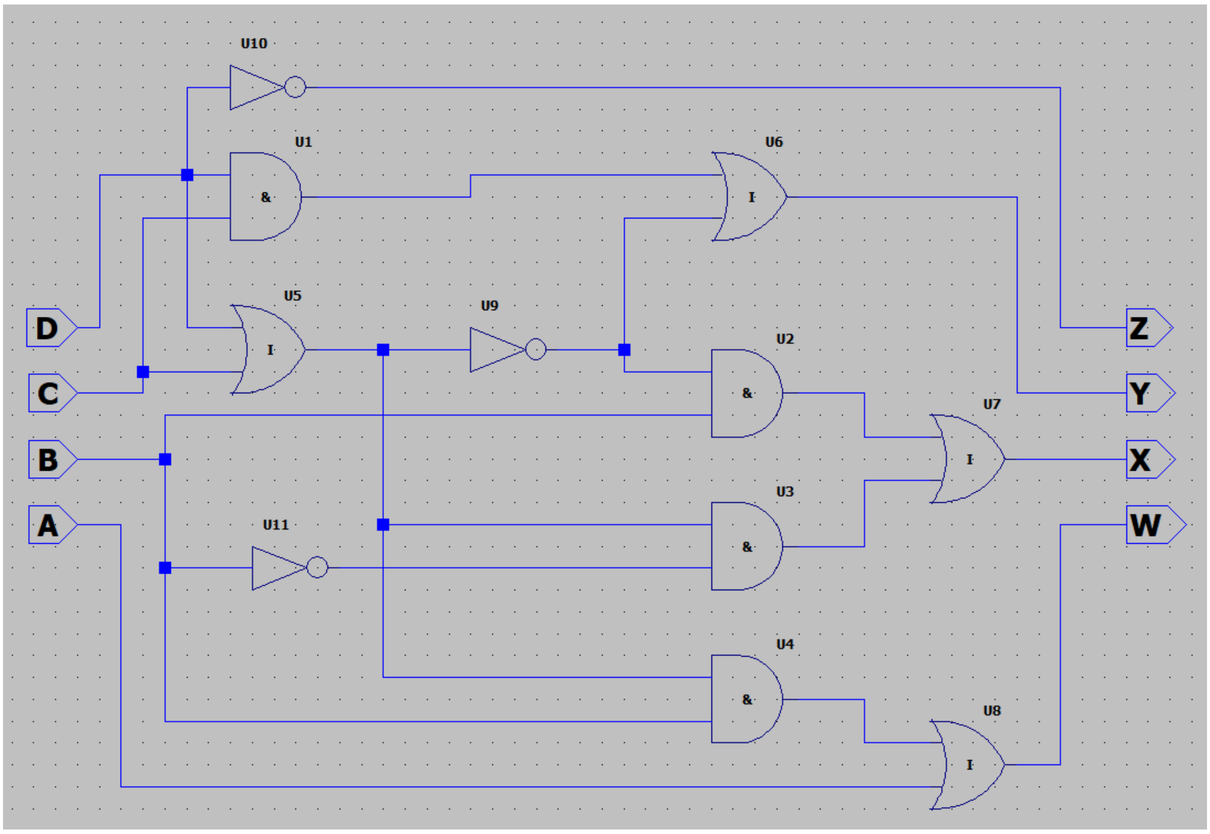
AB \ CD	00	01	11	10
00				
01		1	1	1
11	X	X	X	X
10	1	1	X	X

$w = A + BC + BD$

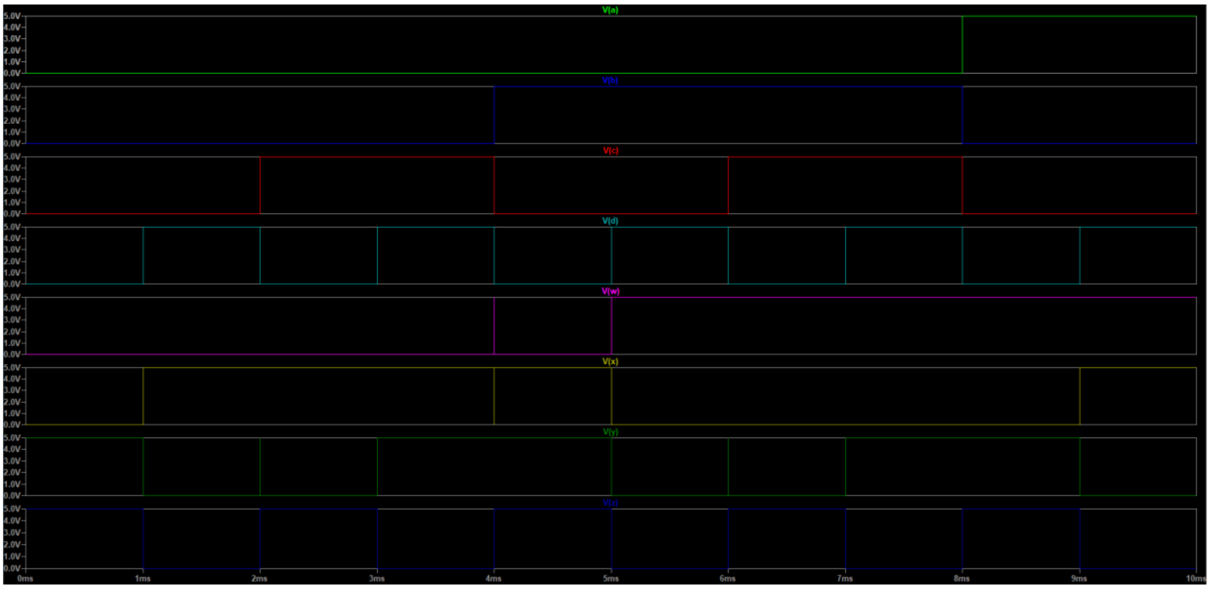


SCHEMATIC DIAGRAM:





OUTPUT WAVEFORMS



RESULTS AND INFERENCE:

The results are verified with the help of truth tables and LT SPICE results and hence the code converters are verified.