

Lab 2 Report: Design of Combinational Circuits

Submitted by:

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Course: DIGITAL ELECTRONICS AND VLSI DESIGN LAB (AV232)

* Pre-Labwork sheet is uploaded in a separate PDF file.

Aim: Designing a logic circuit to convert BCD code (4 bit) to Seven Segment Display (8 bit) with deduced equations using K-MAP, and displaying few numbers (1, 4 and 7) using it.

Components Required:

- Digital Practice Board, having 7 segment display
- SN54/74LS48 Decoder IC
- Gate ICs (IC 7408 AND, IC 7432 OR, IC 7404 NOT, IC 7486 XOR)
- Connecting wires

Theory:

Types of Seven Segment Display:

1. **Common Cathode:** In this, all the cathodes of the 7 LEDs are connected to the ground or -VCC and the individual anodes are supplied with HIGH voltage.
2. **Common Anode:** In this, all the anodes are connected to +VCC and the individual cathodes are supplied with LOW voltage.

Circuit Truth Table: (For Common Cathode Type)

Digits	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	1	0

1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	1	0	1

With K-MAP deduction, we get following logic equations:

$$a = A + C + BD + B'D'$$

$$b = B' + C'D' + CD$$

$$c = B + C' + D$$

$$d = B'D' + CD' + BC'D + B'C + A$$

$$e = B'D' + CD'$$

$$f = A + C'D' + BC' + BD'$$

$$g = B'C + CD' + BC' + A$$

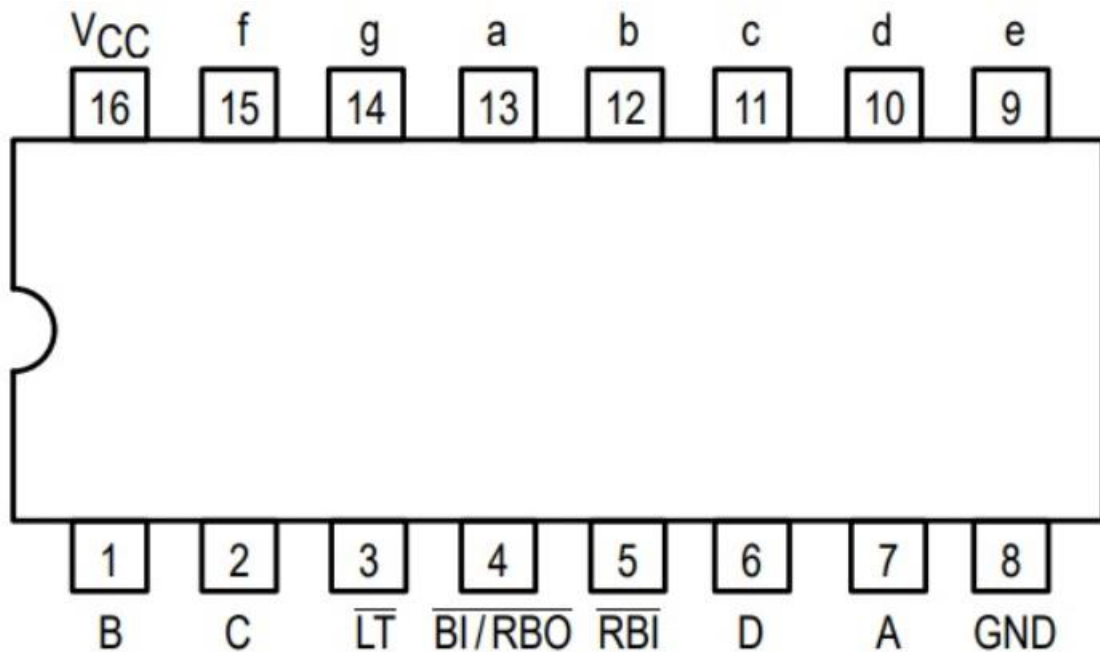
Procedure:

Design the logic circuit as per the equations, connecting all the ICs to the 16 pin socket, and connecting them to the input pins via decoder IC.

The typical connection diagram for an IC is given below.

- Give VCC, 3 (LT), 4 (BI/RBO) and 5 (RBI) pins high voltage from the board.
- Ground GND pin.
- Connect 1 (B), 2 (C), 6 (D) and 7 (A) pins to the inputs of the decoder IC, D being the LSB.

- Connect f (15), g (14), a (13), b (12), c (11), d (10) and e (9) pins to the output 7-segment LED display.



In this way, connect the AND, OR and NOT gate ICs to the board.

To glow, for example, 'a' segment, take high voltage inputs from B and D to the AND gate. Also take inputs from B and D pins to the NOT gate, connect the result pins to the AND gate. Finally, connect the results BD and $B'D'$, and inputs A and C to the OR gate, whose result is the output 'a'.

Observations and Conclusions:

- To display '1', the input ABCD should be 0001, which glows b and c segments, thus making '1'.
- To display '4', the input ABCD should be 0100, which glows b, c, f and g segments, thus making '4'.
- To display '7', the input ABCD should be 0111, which glows a, b and c segments, thus making '7'.

Similarly, remaining digits can be displayed