CLASS: S.E. COMPUTER   **SUBJECT: DEL**

EXPT. NO.: 3   **DATE:**

TITLE   **:**   Design BCD Adder and Binary Adder using 4-bit Binary Adder

(IC 7483) and Realization of Binary Adder using IC 7483.

OBJECTIVE   **:**   To learn different types of adder

APPARATUS   **:**

Digital Trainer Kit, IC 7483,7432 7408, GP-4Patch-Cords, + 5V Power
Supply required Logic gates if any.

THEORY   :

- Carry Save Adder:

  A carry save adder is just a set of one-bit full adder, without any carry
  chaining. Therefore n-bit CSA receivers three n-bit operands, namely
  A(n-1), A (0) and CIN(n-1) -------------------------------------- CIN (0)
  and generate two n-bit result values, sum(n-1) -----------sum (0) and
  count(n-1) --- count
  (0).

- Carry Propagation Adder:

  The parallel adder is ripple carry type in which the carry

  output of each full adder stage is connected to the carry

  input of the next highest order stage.

  Therefore, the sum and carry outputs of any stage cannot be produced
  until the carry occurs. This leads to a time delay in addition process.

  This is known as Carry Propagation Delay.

- BCD Adder: It is a circuit that adds two BCD digits & produces a sum of digits
  also in BCD.

- ✓ Rules for BCD addition:

1. Add two numbers using rules of Binary addition.

2. If the 4 bit sum is greater than 9 or if carry is generated then the sum is invalid. To correct the sum add 0110 i.e. (6)10 to sum. If carry is generated from this addition add it to next higher order BCD digit.

3. If the 4 bit sum is less than 9 or equal to 9 then sum is in proper form.

✓ The BCD addition can be explained with the help of

Following 3 cases - CASE I: Sum <= 9 & carry = 0.

    Add BCD digits 3 & 4

    1.   0 0 1 1

      + 0 1 0 0

      ----

      0 1 1 1

    Answer is valid BCD number = (7) BCD & so 0110 is not added.

CASE II: Sum > 9 & carry = 0.

    Add BCD digits 6 & 5

    1.   0 1 1 0

      + 0 1 0 1

      ----

      1 0 1 1

Invalid BCD (since sum > 9) so 0110 is to be added

2.   1 0 1 1

    + 0 1 1 0

    ----

    1 0 0 0 1

    | |

    ‾‾‾‾‾

(1   1)BCD

    |

Valid BCD result = (11) BCD

CASE III: Sum < = 9 & carry = 1.

Add BCD digits 9 & 9

1.   1 0 0 1

    + 1 0 0 1

    ----

    1 0 0 1 0

Invalid BCD (since Carry = 1) so 0110 is to be added

2.   1 0 0 1 0
    + 0 1 1 0

    ----
    1 1 0 0 0

    (1   8)BCD

Valid BCD result = (18) BCD

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Design of BCD adder:

1. 4-bit binary adder is used for initial addition. i.e. binary addition of two 4-bit numbers. (with Cin = 0),
2. Logic circuit to sense if sum exceeds 9 or carry = 1, this digital circuit will produce high output otherwise its output will be zero.
3. One more 4-bit adder to add $(0110)_2$ in the sum is greater than 9 or carry is

Truth Table: -

For design of combinational circuit for BCD adder to check invalid BCD

INPUT				OUTPUT
S3	S2	S1	S0	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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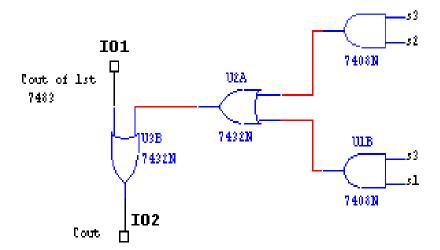
K-map: -

For reduced Boolean expressions of output

S3S2 \ S1S0	00	10	11	01
00	0	0	0	0
01	0	0	0	0
11	1	1	1	1
10	0	0	1	1
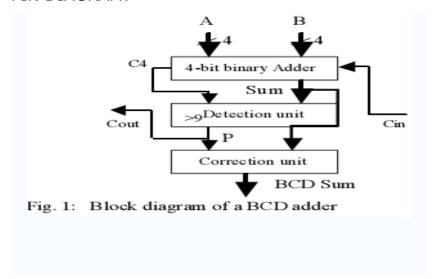
Circuit diagram:

For invalid BCD detection

PIN DIAGRAM:

Fig. 1: Block diagram of a BCD adder
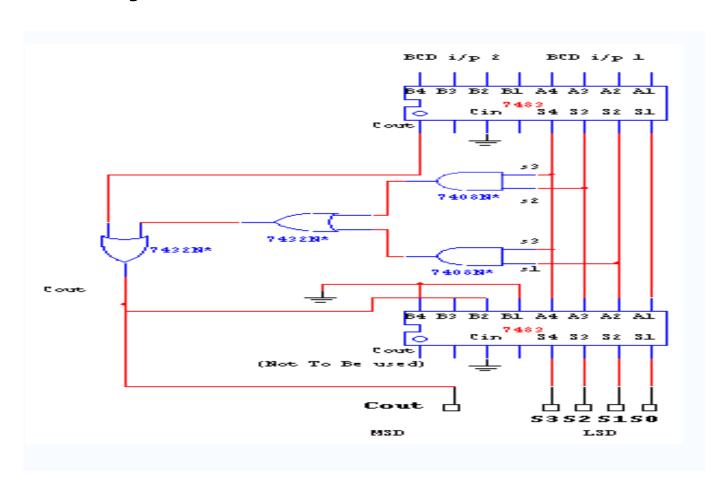
Circuit diagram for BCD adder:

Observation Table of BCD adder:

INPUT								OUTPUT				
1st Operand				**2nd Operand**				**MSD**	**LSD**			
A3 (MSB)	**A2**	**A1**	**A0** (LSB)	**B3** (MSB)	**B2**	**B1**	**B0** (LSB)	**Cout**	**S3** (MSB)	**S2**	**S1**	**S0** (LSB)

OUTCOME:

  Thus, we studied single bit BCD adder using 4 bit parallel binary adder / 4 bit full adder the observation table has been verified have been verified using IC 7483 & some logic gates**.**

REFERENCE:

1. **R.P. Jain "Modern Digital Electronics" TMH 4th Edition**

2. **D.Leach, Malvino, Saha," Digital Principles and Applications", TMH**