Logic Design

BCD Addition and Subtraction Examples

▪ BCD Addition

Steps:

1- Convert the decimal numbers to BCD digit.

2- Add each number independently.

3- Check if any of the result is not a BCD number

a. If Yes, add 6 (0110) to that number.

4- If you have a carry number, add it to the adjacent number.

Example #1:

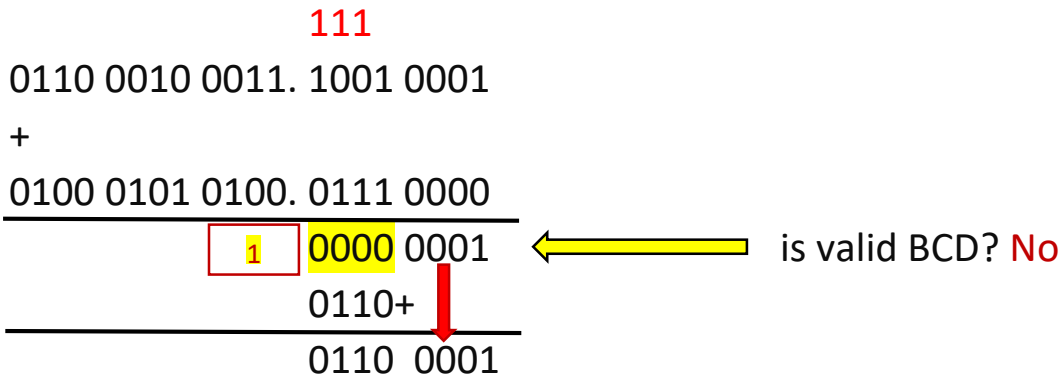
623.91 + 454.70

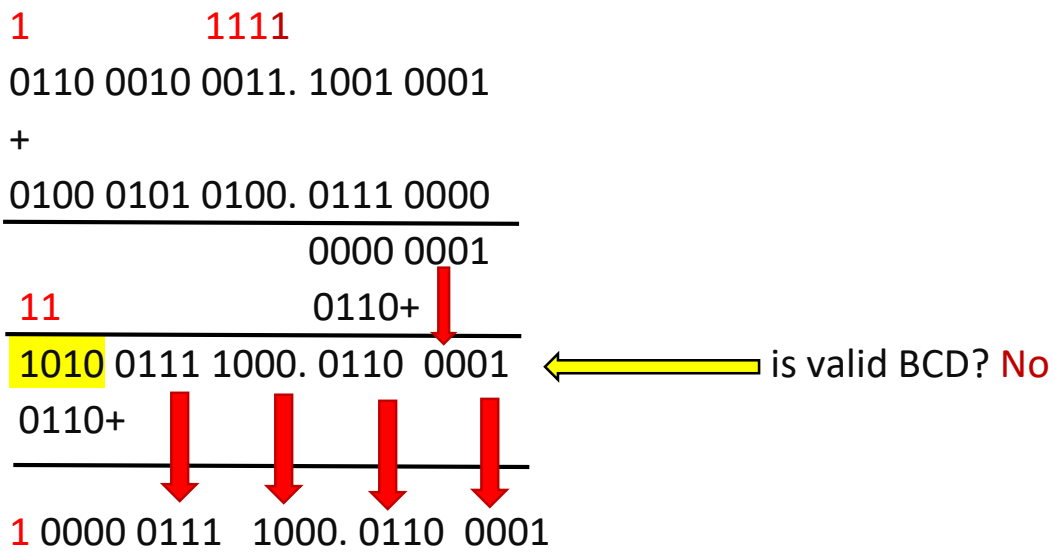
1. Convert decimal numbers to BCD

623.91 **BCD** → 0110 0010 0011. 1001 0001

454.70 **BCD** → 0100 0101 0100. 0111 0000

2. Add the two BCD numbers





so the final result is

0001 0000 0111 1000. 0110 0001

BCD Subtraction

Idea

- (A)BCD - (B)BCD = (A)BCD + 10's Comp(B)BCD
- 10's Comp(B)BCD= 9's Comp(B)BCD + 1
- Remember: 9's Complement of a BCD code is the number which if added to the original code the sum will be 9.

Steps

1- Get the 9's complement of the second number.

2- Convert the decimal numbers to BCD digit.

3- Add each number independently.

4- Check if any of the result is not a BCD number
   a. If Yes, add 6 (0110) to that number.

5. If we have carry bit from the previous step:
   a. Check if it is not in the last digit, then add it to the adjacent digit.
   b. If it is in the last digit, then ignore it.

6. Add one to the first digit.

Example #1:

752.03 – 441.30

1. Get 9's complement of 441.30

441.30 **9's complement** → 558.69

2. Convert decimal numbers to BCD

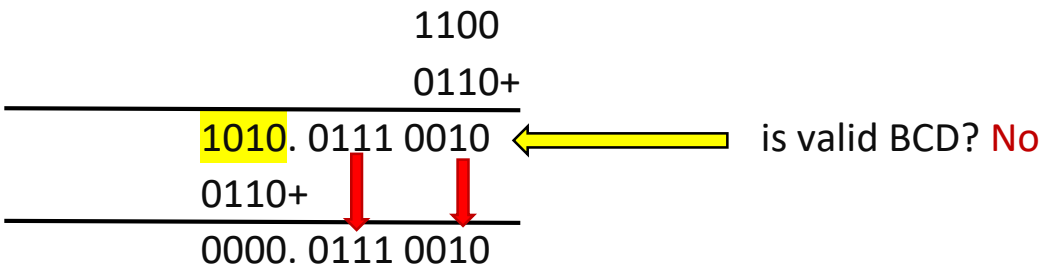
752.03 **BCD** → 0111 0101 0010. 0000 0011

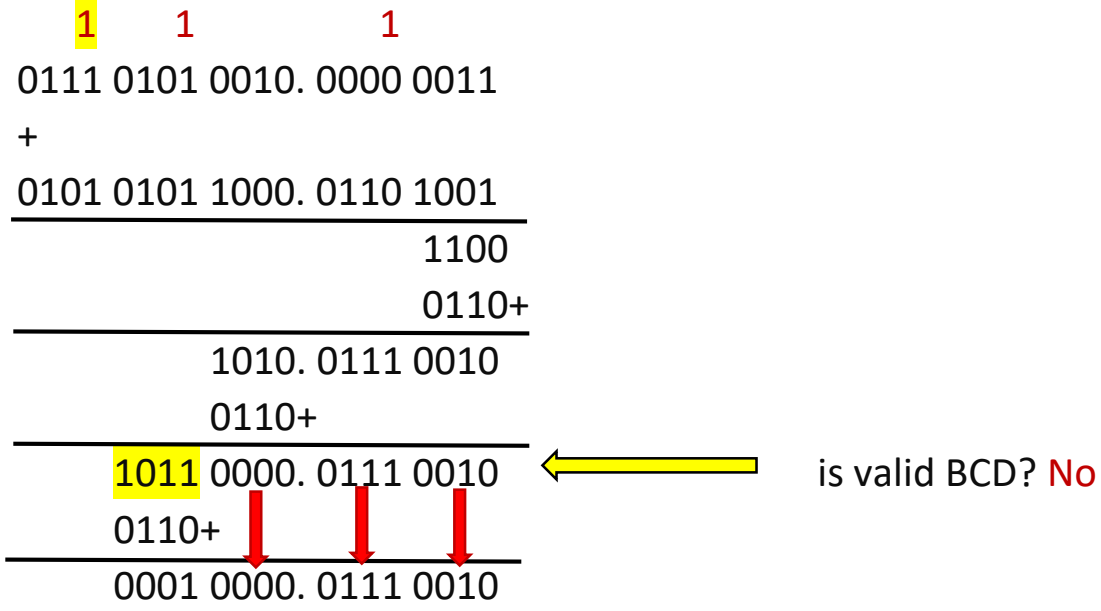
558.69 **BCD** → 0101 0101 1000. 0110 1001

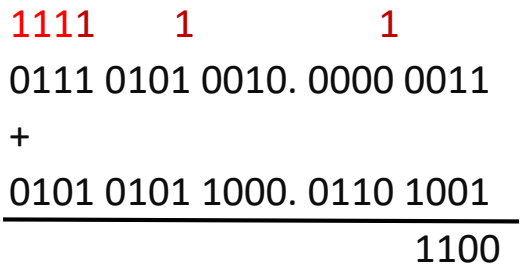
3. Add the two BCD numbers

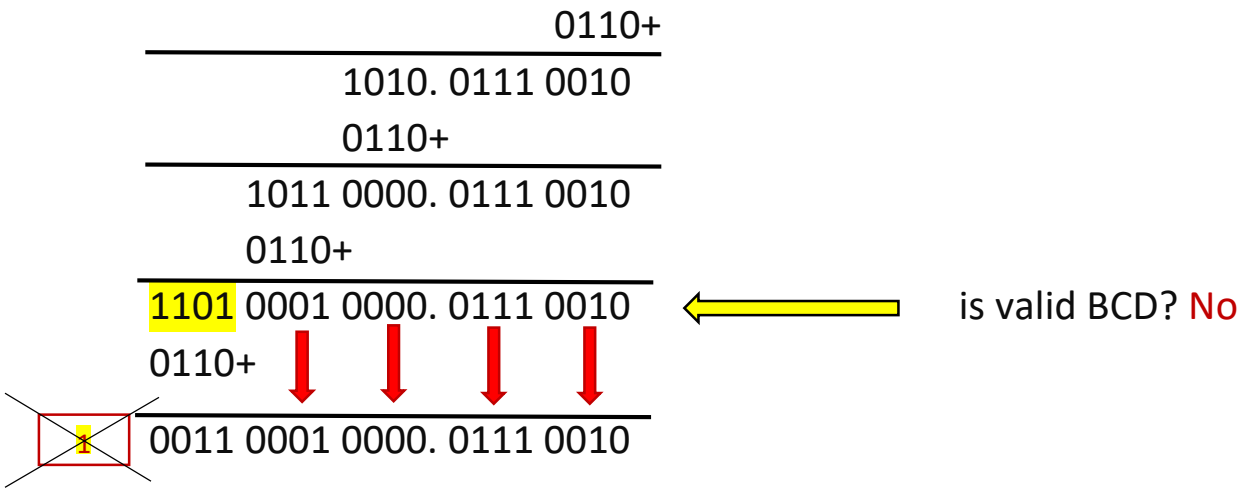
```
                        1   11
0111 0101 0010. 0000 0011
+
0101 0101 1000. 0110 1001
-------------------------
                    1100   <-- is valid BCD? No
                   0110+
-------------------------
                    0010
```

```
             1          1
0111 0101 0010. 0000 0011
+
0101 0101 1000. 0110 1001
-------------------------
```


1100
0110+
1010. 0111 0010
is valid BCD? No
0110+
0000. 0111 0010


1 1 1
0111 0101 0010. 0000 0011
+
0101 0101 1000. 0110 1001
1100
0110+
1010. 0111 0010
0110+
1011 0000. 0111 0010
is valid BCD? No
0110+
0001 0000. 0111 0010


1111 1 1
0111 0101 0010. 0000 0011
+
0101 0101 1000. 0110 1001
1100



3. *Add one to the final result of adding first number and 9's complement of second number.*

0011 0001 0000. 0111 0010 +
1
0011 0001 0000. 0111 0011

So the final result is
0011 0001 0000. 0111 0011

Note:
In subtraction case we ignore the last carry.