BCD to Excess-3 Converter

Truth table

Binary	BCD Input				Excess-3 output			
	B_3	B_2	B_1	B_0	E_3	E_2	E_1	E_0
0	0	0	0	0	0	0	1	1
1	0	0	0	1	0	1	0	0
2	0	0	1	0	0	1	0	1
3	0	0	1	1	0	1	1	0
4	0	1	0	0	0	1	1	1
5	0	1	0	1	1	0	0	0
6	0	1	1	0	1	0	0	1
7	0	1	1	1	1	0	1	0
8	1	0	0	0	1	0	1	1
9	1	0	0	1	1	1	0	0

$E_3 =$

B_3B_2 \ B_1B_0	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	X	X	X	X
10	1	1	X	X

$G_2 = B_2B_0$

$G_3 = B_1B_2$

$G_1 = B_3$

$E_3 = B_0 + B_2B_0 + B_2B_1$

$E_3 = B_3 + B_2(B_0 + B_1)$

$\overline{A}\,\overline{B} = \overline{A+B}$

$B_2(B_1+B_0) + B_2\overline{B}_1\overline{B}_0$

$\overline{B}_2(B_1+B_0) + B_2(\overline{B_1+B_0})$

$= B_2 \oplus (B_1+B_0)$

$E_2 =$

B_3B_2 \ B_1B_0	00	01	11	10
$\overline{B}_3\overline{B}_2$	0	1	1	1
$\overline{B}_3B_2$	1	0	0	0
B_3B_2	X	X	X	X

$G_1 = \overline{B}_2B_1$

$E_2 = \overline{B}_2B_1 + \overline{B}_2B_0 + B_2\overline{B}_1\overline{B}_0$

B_3B_2 \ B_1B_0	00	01	11	10
00	1	0	1	0
01	1	0	1	0
11	×	×	×	×
10	1	0	×	×

$G_1 = \bar{B}_1\bar{B}_0$ $\quad$ $G_2 = B_1B_0$

$$E_1 = \bar{B}_1\bar{B}_0 + B_1B_0$$

$$\boxed{E_1 = B_1 \oplus B_0}$$

$E_0 =$

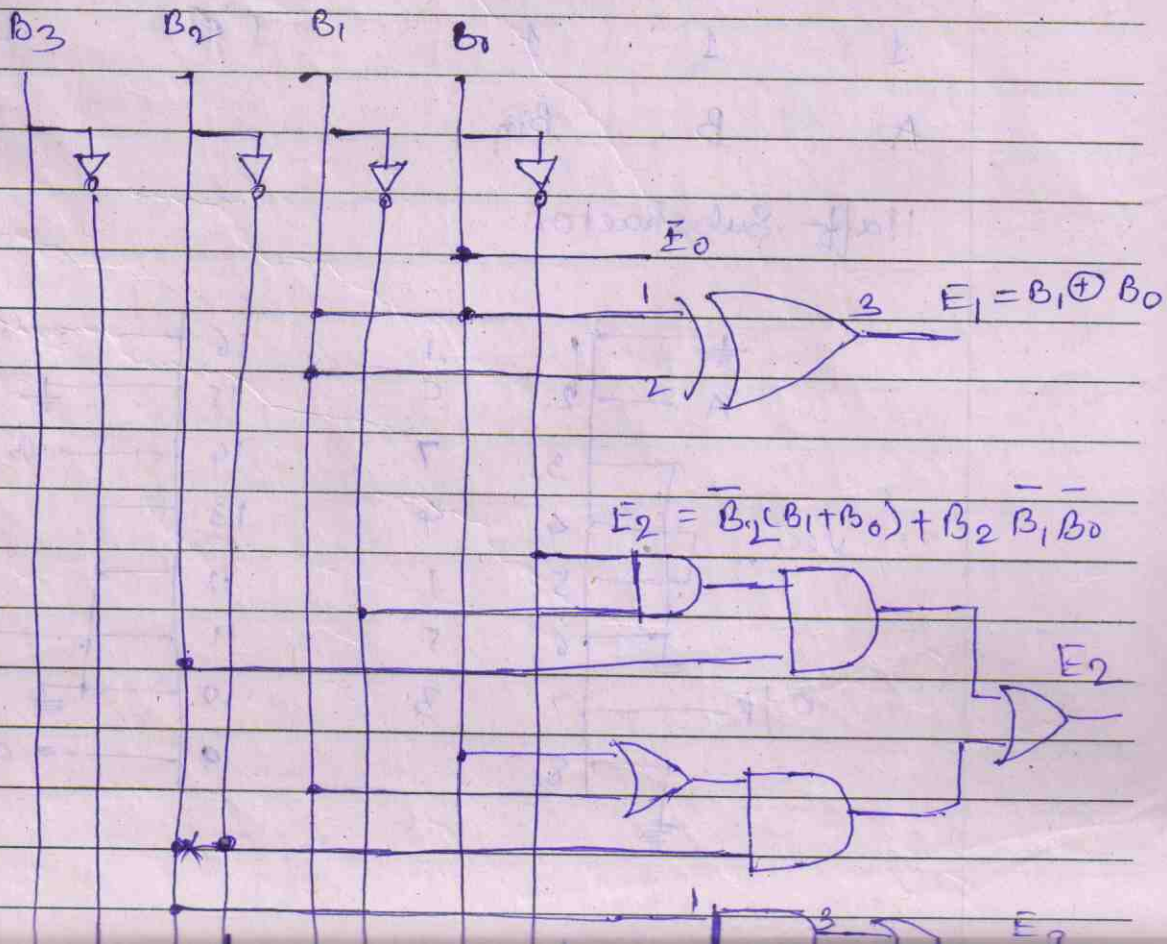
B_3B_2 \ B_1B_0	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	×	×	×	×
10	1	0	×	×

G_1 → $G_2 = B_0$

$E_0 = B_1\bar{B}_0 + \bar{B}_1\bar{B}_0$

$= \bar{B}_0$

$$\boxed{E_0 = \bar{B}_0}$$



Half Substractor:-

Input		Output		
A	B	Diff	Borrow	
0	0	0	0	D_0
0	1	1	1	D_1
1	0	1	0	D_2
1	1	0	0	D_3

Full Substractor:-

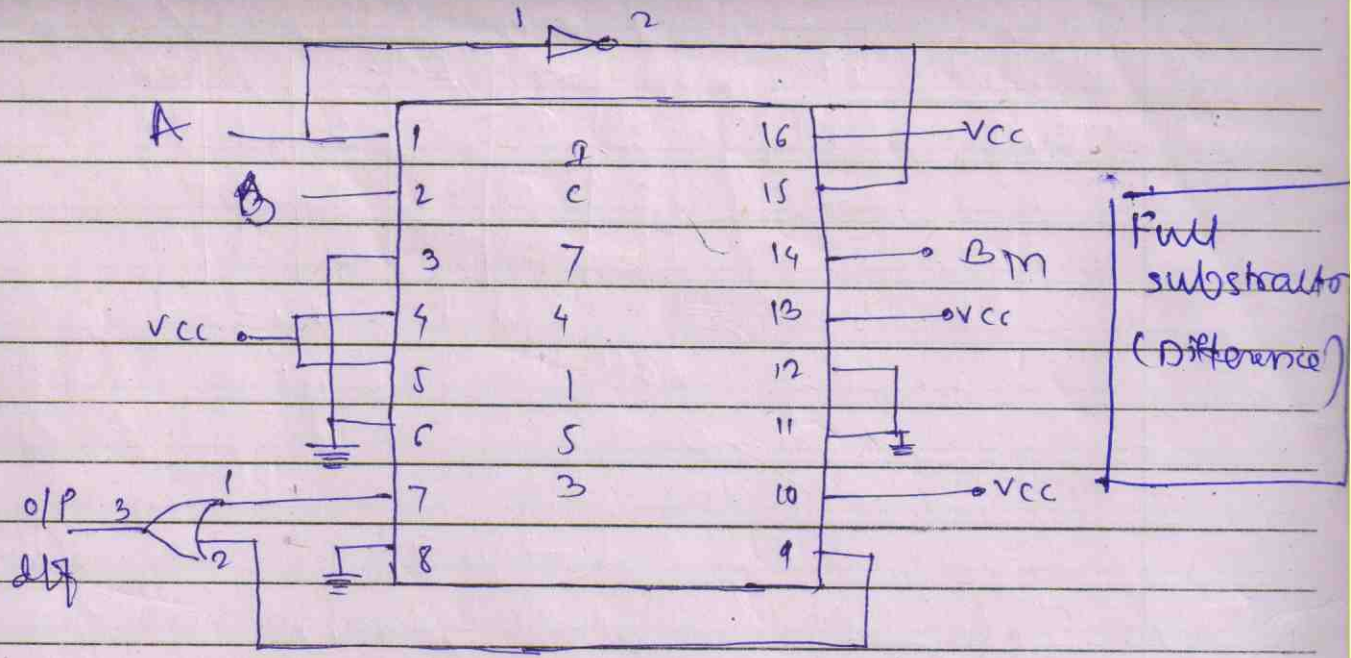
(S2) (S1)

input			output		
Cin	A B	B Cin	Diff	Borrow	
0	0	0	0	0	D_0
0	0	1	1	1	D_1
0	1	0	1	1	D_2
0	1	1	0	1	D_3
1	0	0	1	0	D_4
1	0	1	0	0	D_5
1	1	0	0	0	D_6
1	1	1	1	1	D_7

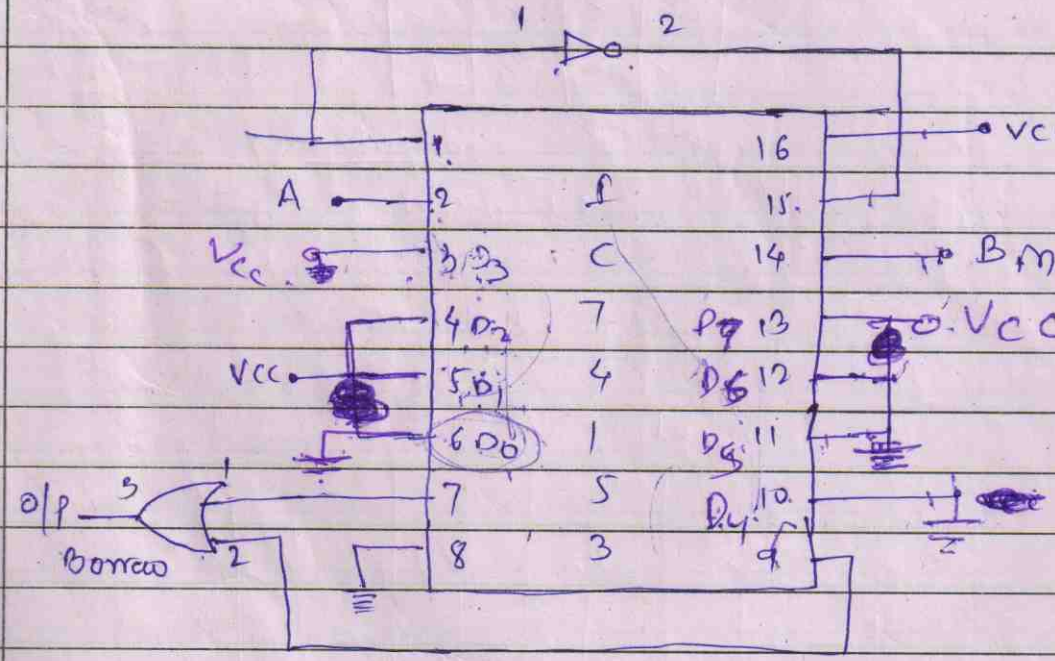
A B Bin

Half Substractor

full Substractor (Difference)



full Substractor (Borrow)



BCD Adder:-

- BCD is less effiient than binary.
- BCD Binary needs more bits than binary to encode the same decimal no.
- BCD anthmetic is more complicated than Binary anthmetic.
- The advantage of a BCD code is that the conversion from decimal to BCD or vice versa is simpler.

Decimal	Binary	BCD
0	0000	0000
1	0001	0001
2	0010	0010
3	0011	0011
4	0100	0100
5	0101	0101
6	0110	0110
7	0111	0111
8	1000	1000
9	1001	1001
10	1010	0001 0000
11	1011	0001 0001
12	1100	0001 0010
13	1101	0001 0011
14	1110	0001 0100
15	1111	0001 0101

BCD & Binary are same.

BCD & binary are different

Advantages of BCD codes.

1. It is very similar to decimal system.
2. We need to remember binary equivalent of decimal no. 0 to 9 only.

Disadvantages.

1. The addition & substraction of BCD have different rules
2. BCD arithmetic is more complicated.
3. BCD needs more no. of bits than binary to represent the same decimal no. so BCD is less efficient than binary.