CS 224- Hardware Lab

Assignment-2

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Group No-2

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Problem Statement →

Designing Gray code to Binary code conversion circuit.

IC used → Quad 2-input NOR

K-maps for b_0, b_1, b_2, b_3 :- (Inputs: $g_0, g_1, g_2, g_3, g_0', g_1', g_2', g_3'$) →

g_3g_2 \ g_1g_0	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	1	1	1	1
10	1	1	1	1

(b_3)

g_3g_2 \ g_1g_0	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

(b_2)

g_3g_2 \ g_1g_0	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	0	0	1	1
10	1	1	0	0

(b_1)

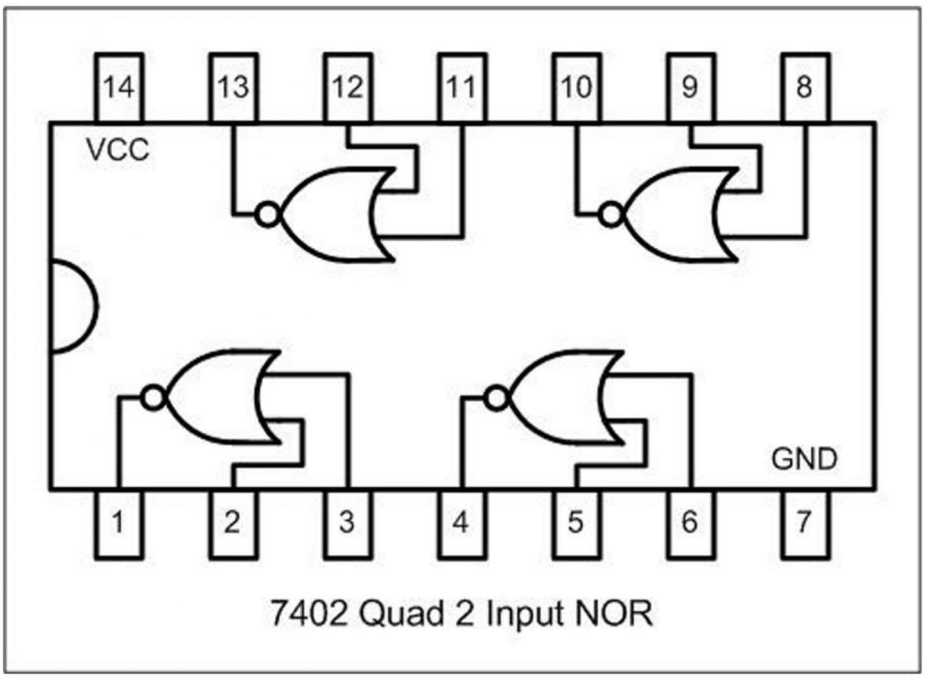
g_3g_2 \ g_1g_0	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	0	1	0	1
10	1	0	1	0

(b_0)

Gray code to Binary Conversion Table

Decimal number	Gray				Binary			
	g_3	g_2	g_1	g_0	b_3	b_2	b_1	b_0
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	1	0	0	1	0
3	0	0	1	0	0	0	1	1
4	0	1	1	0	0	1	0	0
5	0	1	1	1	0	1	0	1
6	0	1	0	1	0	1	1	0
7	0	1	0	0	0	1	1	1
8	1	1	0	0	1	0	0	0
9	1	1	0	1	1	0	0	1
10	1	1	1	1	1	0	1	0
11	1	1	1	0	1	0	1	1
12	1	0	1	0	1	1	0	0
13	1	0	1	1	1	1	0	1
14	1	0	0	1	1	1	1	0
15	1	0	0	0	1	1	1	1

IC Used: 7402 Quad 2 Input NOR



7402 Quad 2 Input NOR

Equations and derivations →

→ $b_3 = g_3$

→ $b_2 = \bar{g_3} g_2 + g_3 \bar{g_2}$ (from K-maps)

$= NOR(g_2 g_3, g_2' g_3')$

$= NOR(NOR(g_2', g_3'), NOR(g_2, g_3))$

→ $b_1 = g_3 g_2' g_1' + g_3' g_2 g_1' + g_3' g_2' g_1 + g_2 g_3 g_1$ (from K-map)

$= NOR[(g_1' g_2 g_3 + g_1 g_2' g_3'), (g_1 g_2 g_3' + g_2' g_3 g_1)]$

$= NOR[NOR(g_1, g_2' g_3 + g_2 g_3'), NOR(g_2 g_3 + g_2' g_3', g_1')]$

$= NOR[NOR(g_1, b_2), NOR(g_1', b_2')]$

$b_2' = NOR(b_2, b_2)$

→ $b_0 = g_3' g_2' g_1' g_0 + g_3 g_2' g_1 g_0' + g_3' g_2 g_1' g_0' + g_3' g_2 g_1 g_0$
$+ g_3 g_2 g_1' g_0 + g_3 g_2 g_1 g_0' + g_3 g_2' g_1 g_0' + g_3 g_2' g_1' g_0$

$= NOR[NOR(g_0, b_1), NOR(g_0', b_1')]$

$b_1' = NOR(b_1, b_1)$

Total No. of NOR gate:

for $b_3 = 0$

$b_2 = 3$

$b_1 = 4$

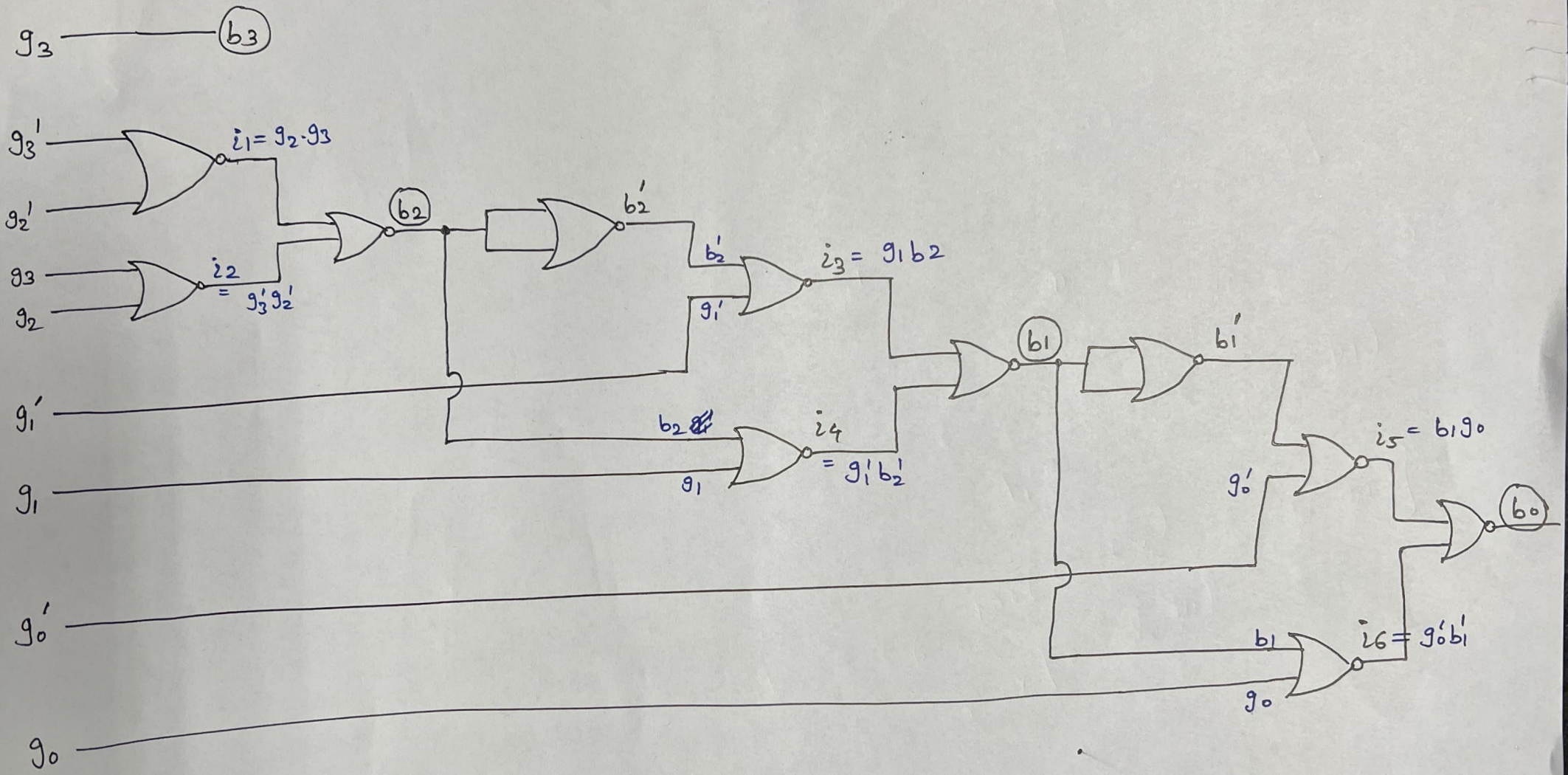
$b_0 = 4$

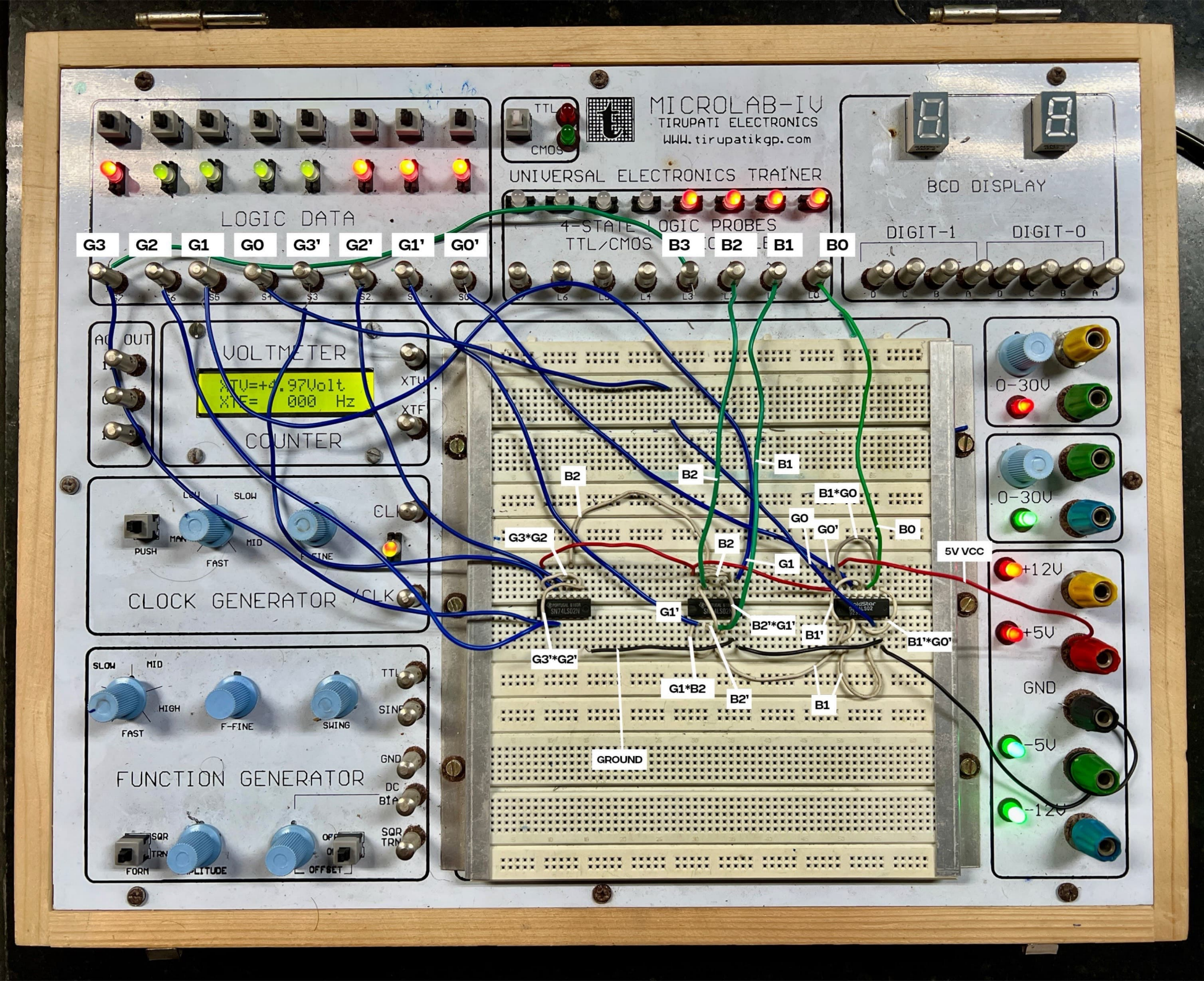
11

∴ Total 11 NOR gates are used.

(3)

Circuit Diagram

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BCD DISPLAY
DIGIT-1
DIGIT-0
G3
G2
G1
G0
G3'
G2'
G1'
G0'
B3
B2
B1
B0
VOLTMETER
COUNTER
CLOCK GENERATOR
FUNCTION GENERATOR
0-30V
0-30V
+12V
+5V
GND
-5V
-12V
5V VCC
GROUND
B2
B2
B1
B1*G0
G0
G0'
B0
G3*G2
B2
G1
G1'
B2'*G1'
B1'
B1'*G0'
G3'*G2'
G1*B2
B2'
B1