



EE301 – Electrical Engineering Laboratory

Faculty of Engineering, Thammasat University

Lab Two – 7-Segment Display

Name: _____ ID no. _____

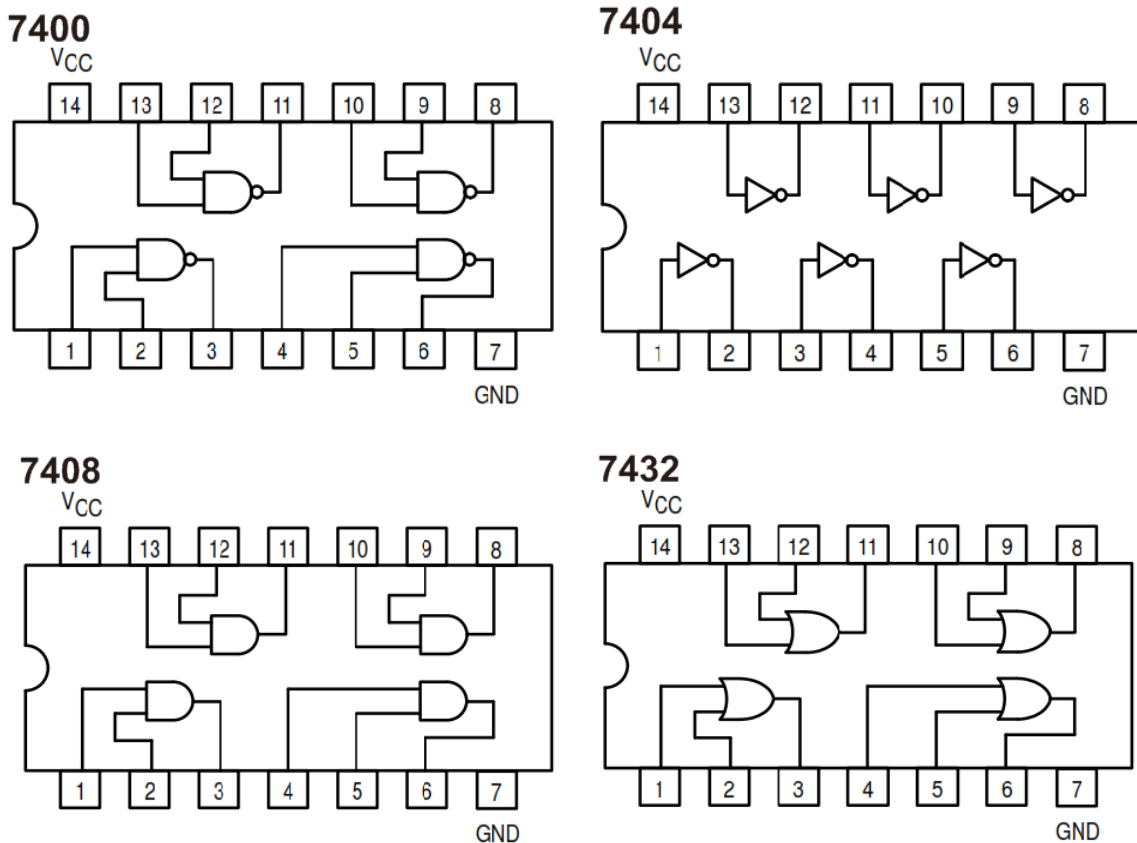
_____ ID no. _____

Equipment Needed

- Digital Electronics Training Board
- IC 7404 (NOT) 1 chip
- IC 7408 (AND) 2 chips
- IC 7432 (OR) 2 chips

Instructions

1. For your safety, unplug the power supply while you are building your logic circuits.
2. If you find the digital board operate incorrectly (i.e., LED lights are not turned on as they are supposed to be, etc), unplug the power supply. You may accidentally build a short circuit.



Pin assignments of the ICs

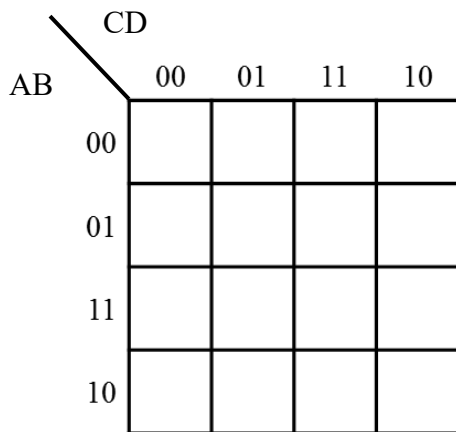
EXE 1: 4-variable K-map

Table 1 shows the truth table of outputs G1 and G2. Do the following.

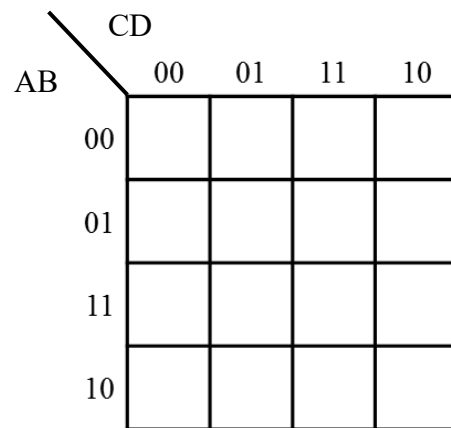
Table 1.

Input				Output	
A	B	C	D	G1	G2
0	0	0	0	0	1
0	0	0	1	0	0
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	1	1
0	1	0	1	1	0
0	1	1	0	0	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	1
1	0	1	0	1	0
1	0	1	1	1	1
1	1	0	0	1	1
1	1	0	1	1	0
1	1	1	0	0	0
1	1	1	1	0	0

Use Logisim to simplify the outputs G1 and G2 in sum-of-products (SOP) forms by means of Karnaugh maps.



K-map for G1



K-map for G2

G1 = _____

G2 = _____

EXE 2: Letter Display on 7-Segment Display

We want to design a circuit that displays letters A through F on the 7-segment display that correspond to binary inputs 000 to 101, respectively. Figure 1 shows how the letters A through F are displayed on the 7-segment display.

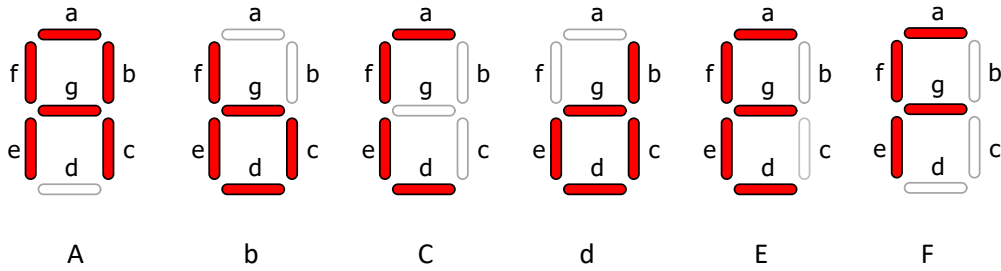
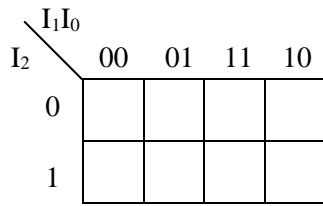


Figure 1. Letters A through F shown on the 7-segment display.

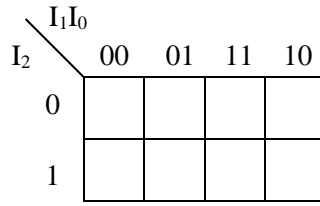
2.1 Fill out the truth table of this letter display converter circuit.

Inputs			Letter Results	7-Segment Display						
l_2	l_1	l_0		a	b	c	d	e	f	g
0	0	0	A	—	—	—	—	—	—	—
0	0	1	b	—	—	—	—	—	—	—
0	1	0	C	—	—	—	—	—	—	—
0	1	1	d	—	—	—	—	—	—	—
1	0	0	E	—	—	—	—	—	—	—
1	0	1	F	—	—	—	—	—	—	—
1	1	0	Don't care	X	X	X	X	X	X	X
1	1	1	Don't care	X	X	X	X	X	X	X

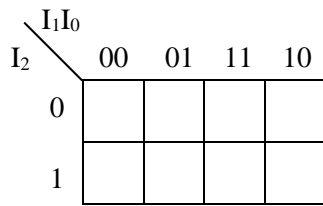
2.2 Simplify the outputs, a - g, of the letter display converter circuit into sum-of-products forms by means of K-maps.



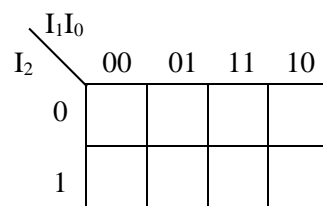
K-map for a



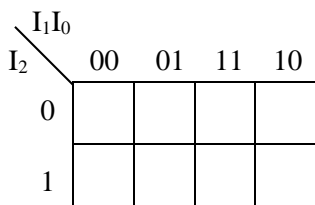
K-map for b



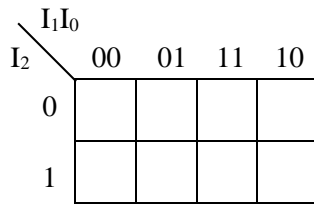
K-map for c



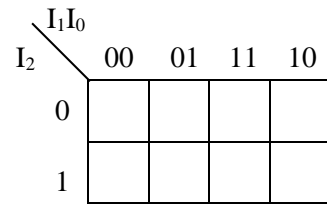
K-map for d



K-map for e



K-map for f



K-map for g

a = _____

b = _____

c = _____

d = _____

e = _____

f = _____

g = _____

2.3 **Simulation:** Build this circuit in Logisim as a sub-circuit by selecting Project → Add Circuit and naming it “Letter Display Converter”. In the explorer pane, you can now see that the project contains two circuits called “main” and “Letter Display Converter”. When you finish building your Letter display converter, you can use it as a sub-circuit by clicking on the “main” circuit and clicking the “Letter Display Converter” *once* in the explorer pane to select it as a tool and add it into the canvas of your “main”. To test your circuit, you need a 7-segment display, which can be found under the “Input/Output” library in the explorer pane. The correspondence of the 7-segment display is shown in Figure 2. Your final circuit in “main” should look something like Figure 3. Verify that your designed circuit works correctly and show it to the lab instructor.

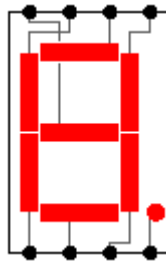


Figure 2. The correspondence of the 7-segment display.

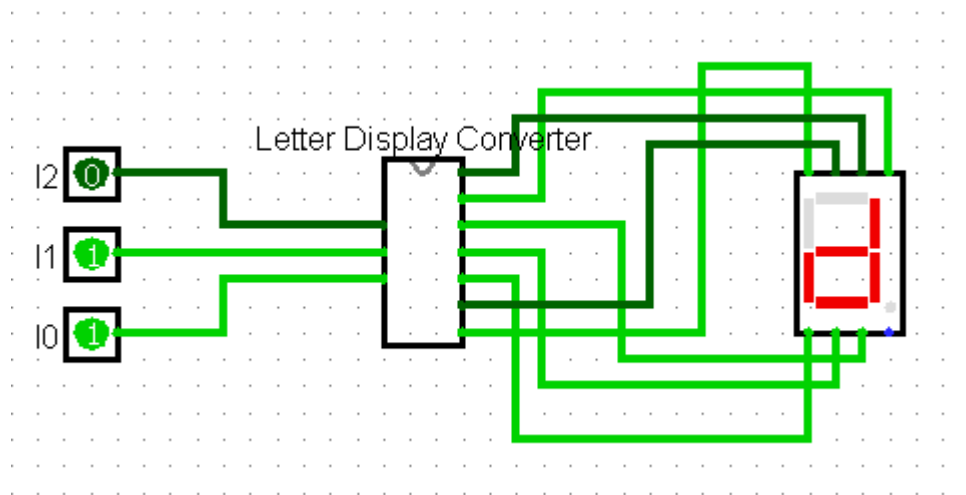


Figure 3. The main circuit.

2.4 **Training Board:** Build your circuit obtained from 2.3 on the digital board. Use the module direct 7-segment display on the digital board to test your design. Verify that your circuit works correctly and show it to the lab instructor.

Lab Instructor’s Signature _____ Time: _____