Project Name

Refrigerator Temperature Controller Circuit

Description

We will design a digital logic circuit which will control the temperature of a refrigerator. We assume that our refrigerator has 4 buttons, each button can be used to increase and decrease the temperature of the refrigerator. The maximum temperature of the refrigerator will be 9-Degree Celsius and the minimum temperature will be 0-Degree Celsius. And the more the button is raised from 0, the higher the temperature of the refrigerator will be. Suppose when the button is at number 0 then the temperature inside the refrigerator will be 0-Degree Celsius, on the other hand if the button is at number 2 then the temperature will be 6-Degree Celsius. We will calculate the temperature change across the button using an equation. The equation is,

$Temperature = (3x)\ ℃$ Here, x = 0,1,2,3 (Four Buttons)

To implement our project, we will create a truth table first, from the table we will generate K-map and with the help of K-map we get some equations and finally we will design our logical circuit with these equations.

Calculations

$$\boxed{Temperature = (3x)\ ℃ \quad \text{Here, x = 0,1,2,3 (Four Buttons)}}$$

when the button is at number 0,

$$\begin{aligned} Temperature &= (3x)\ ℃ \\ &= (3 \times 0)\ ℃ \\ &= 0\ ℃ \end{aligned}$$

when the button is at number 1,

$$\begin{aligned} Temperature &= (3x)\ ℃ \\ &= (3 \times 1)\ ℃ \\ &= 3\ ℃ \end{aligned}$$

when the button is at number 2,

$$\begin{aligned} Temperature &= (3x)\ ℃ \\ &= (3 \times 2)\ ℃ \\ &= 6\ ℃ \end{aligned}$$

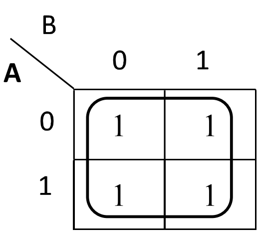
when the button is at number 3,

$$\begin{aligned} Temperature &= (3x)\ ℃ \\ &= (3 \times 3)\ ℃ \\ &= 9\ ℃ \end{aligned}$$

Truth Table

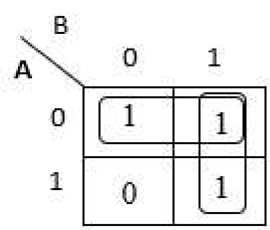
Input			Output							
Index (Buttons)	A	B	a	b	c	d	e	f	g	T°C in Binary Digit
0	0	0	1	1	1	1	1	1	0	0 ℃
1	0	1	1	1	1	1	0	0	1	3 ℃
2	1	0	1	0	1	1	1	1	1	6 ℃
3	1	1	1	1	1	1	0	1	1	9 ℃

K-Map for a



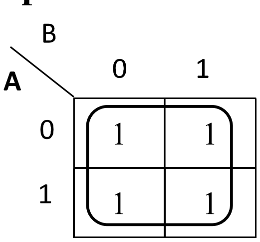
Equation for a = None

K-map for b



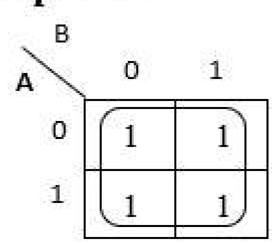
Equation for b = $\bar{A}+B$

K-Map for c



Equation for c = None

K-Map for d



Equation for d = None

K-Map for e

A \ B	0	1
0	1	0
1	1	0

Equation for e = $\overline{B}$

K-Map for f

A \ B	0	1
0	1	0
1	1	1

Equation for f = $A+\overline{B}$

K-Map for g

A \ B	0	1
0	0	1
1	1	1

Equation for g = A+B

Logical Expressions

Logical expression of a = 1

Logical expression of b = $\overline{A}+B$

Logical expression of c = 1

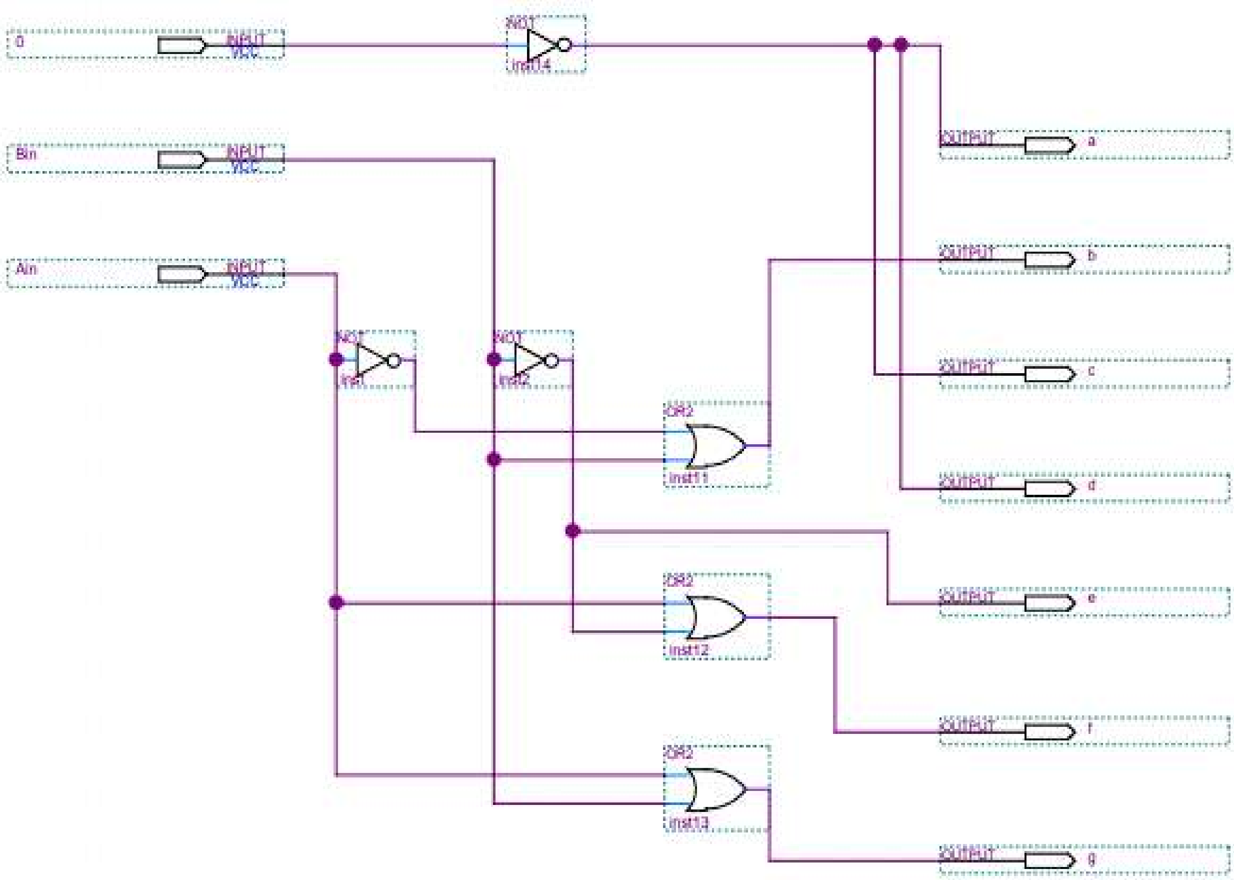
Logical expression of d = 1

Logical expression of e = $\overline{B}$

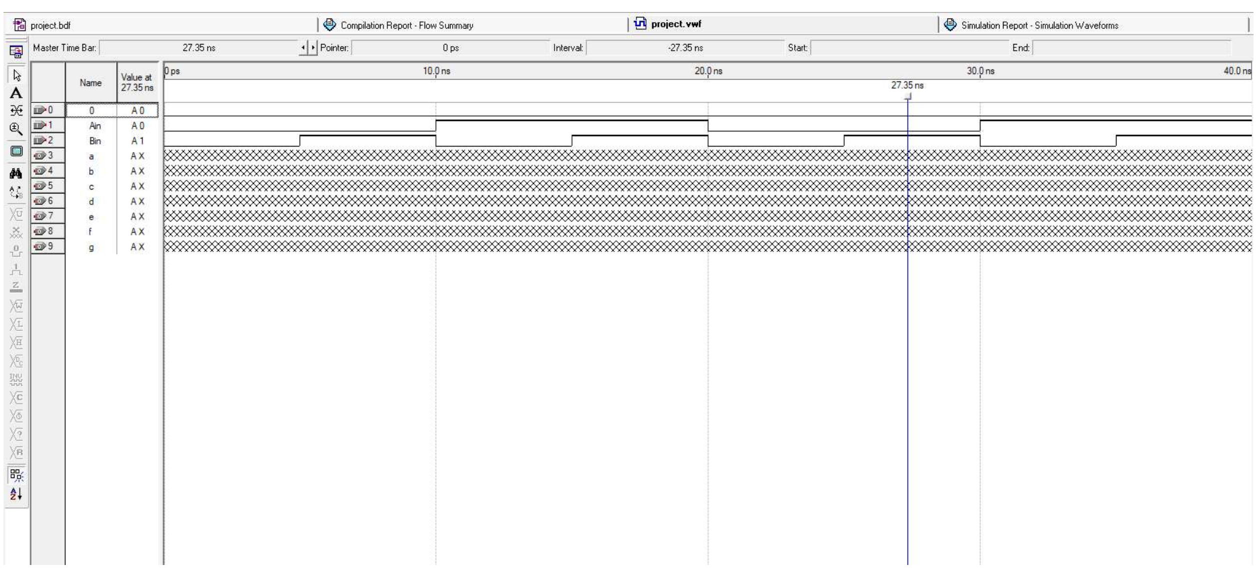
Logical expression of f = $A+\overline{B}$

Logical expression of g = A+B

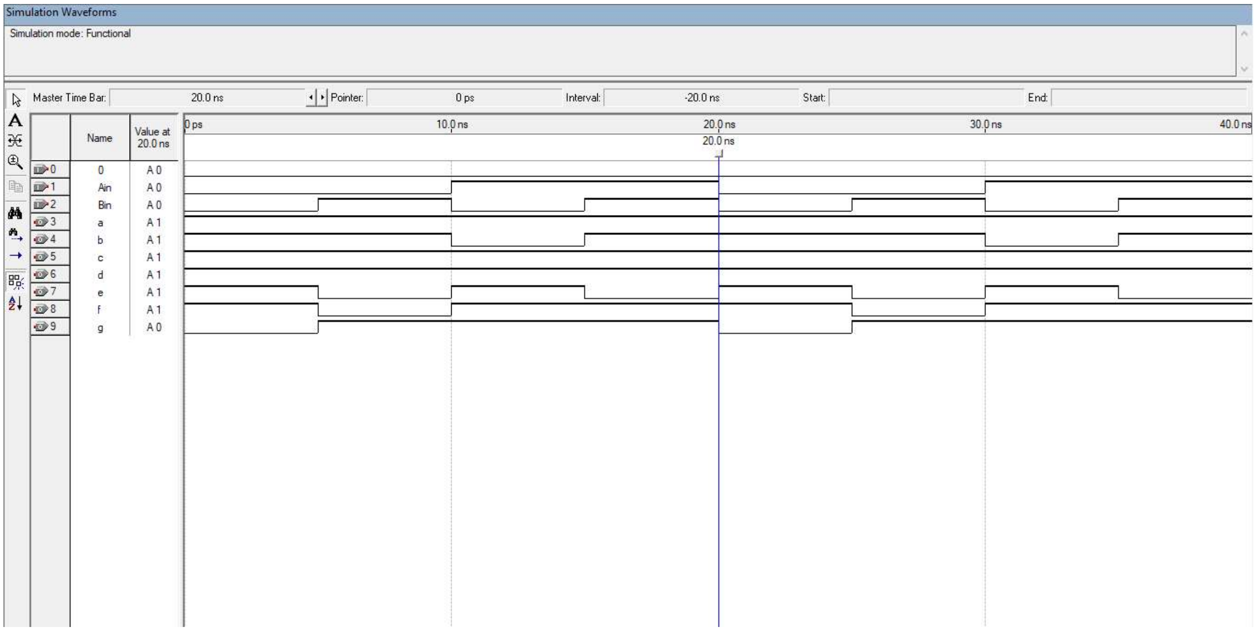
Circuit Diagram

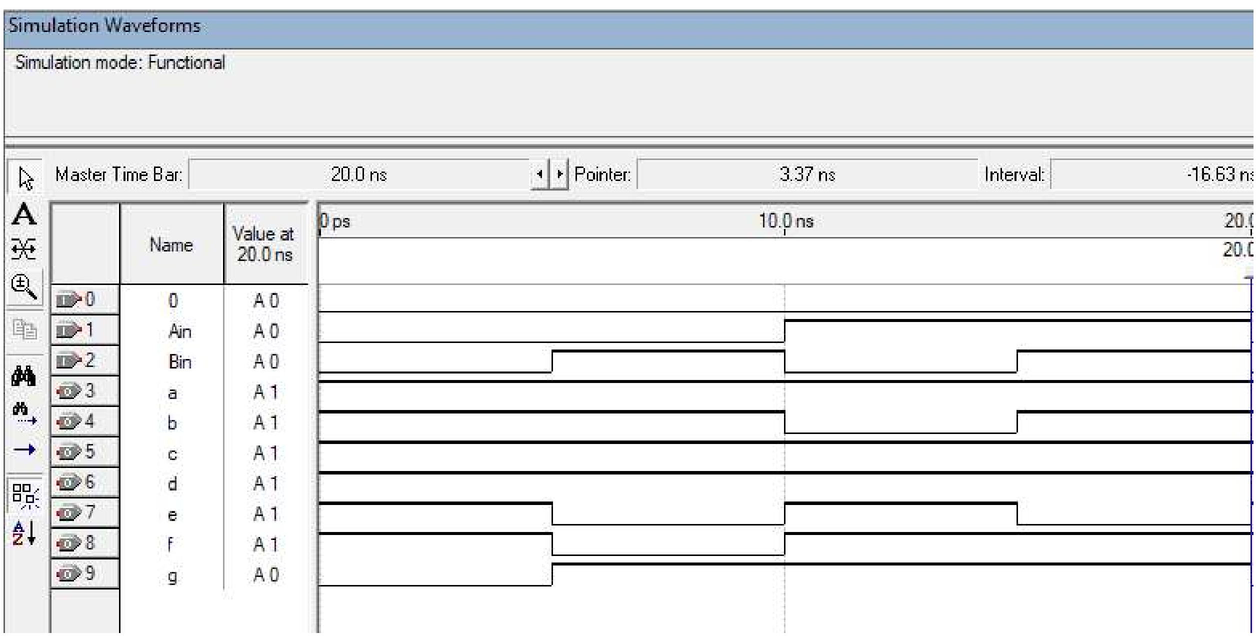


Vector Waveforms

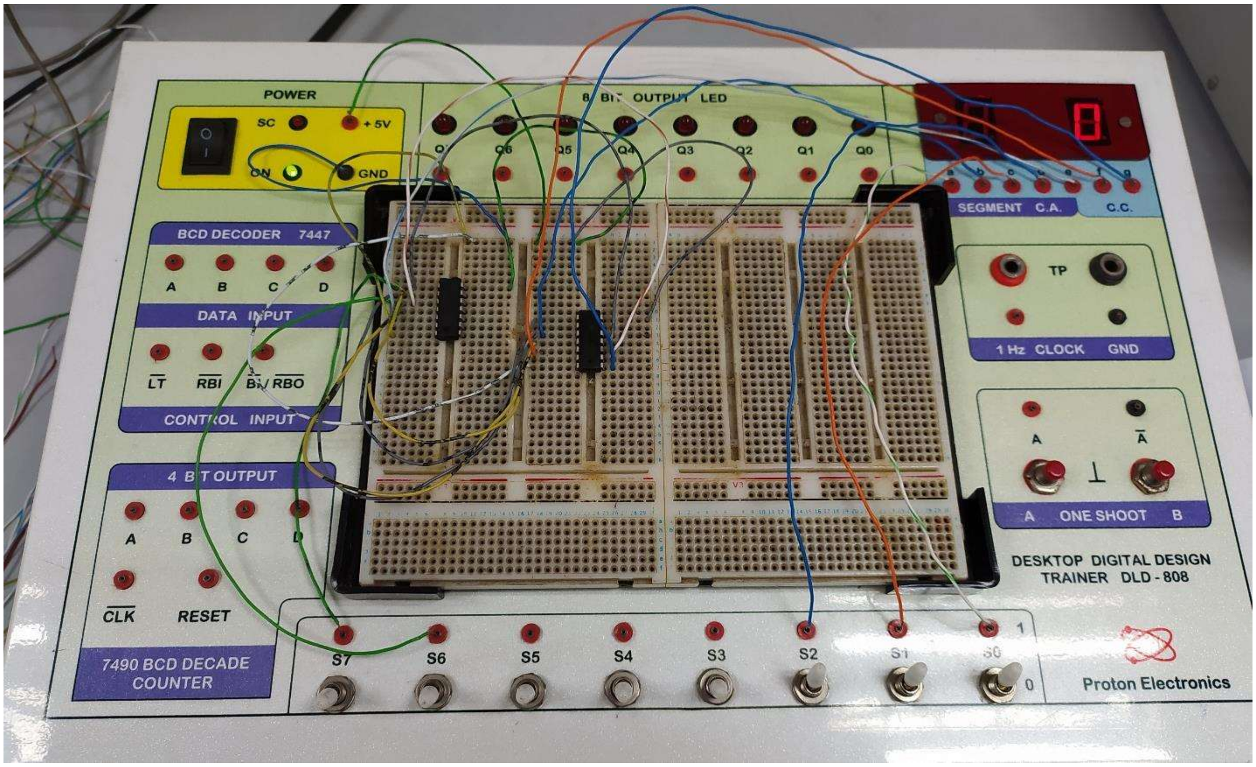


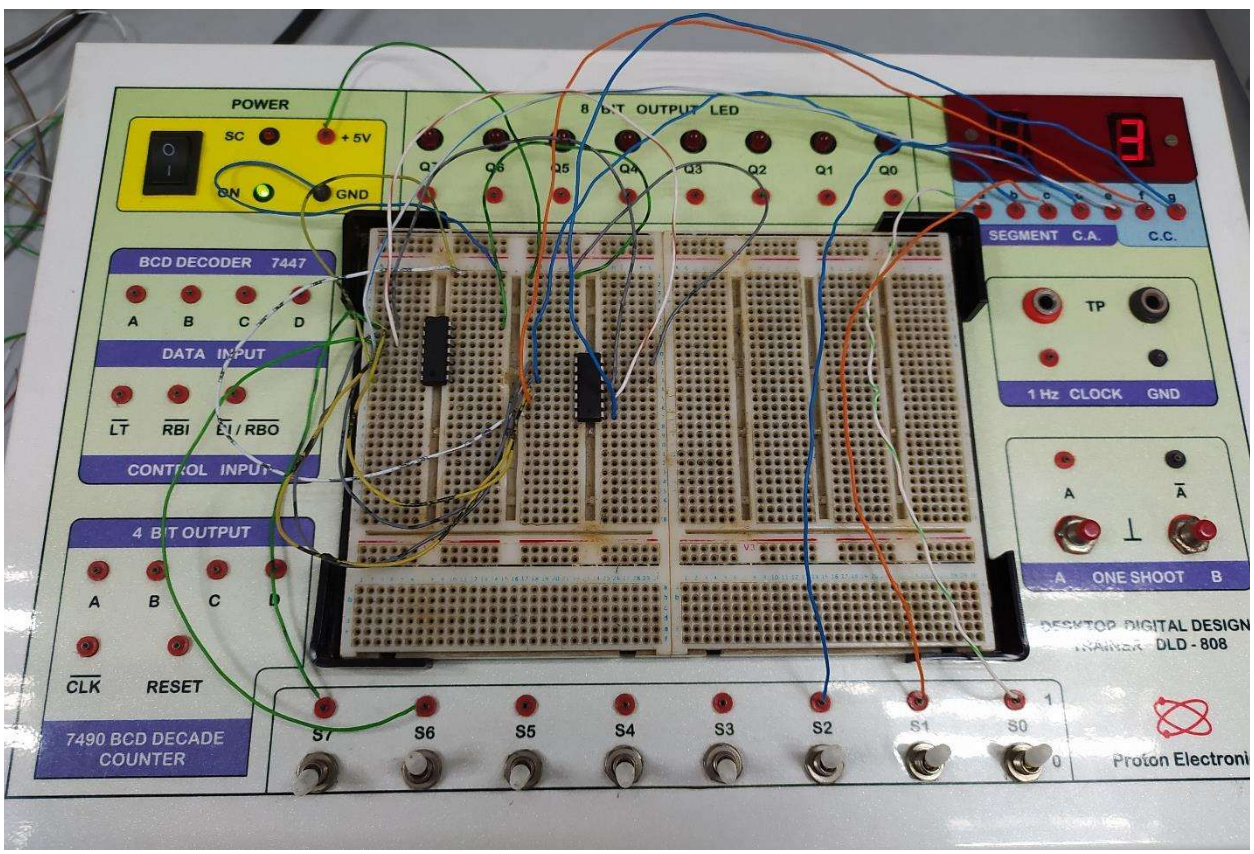
Simulation Waveforms

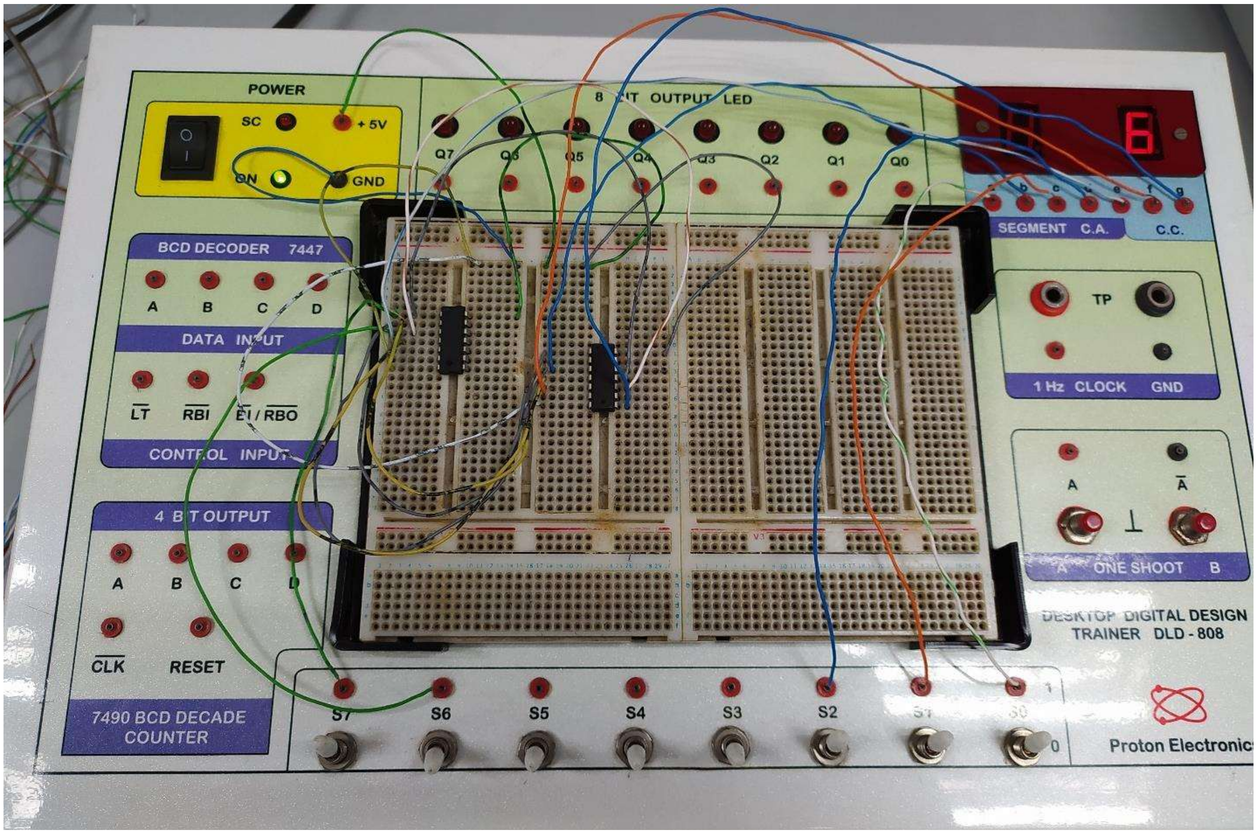


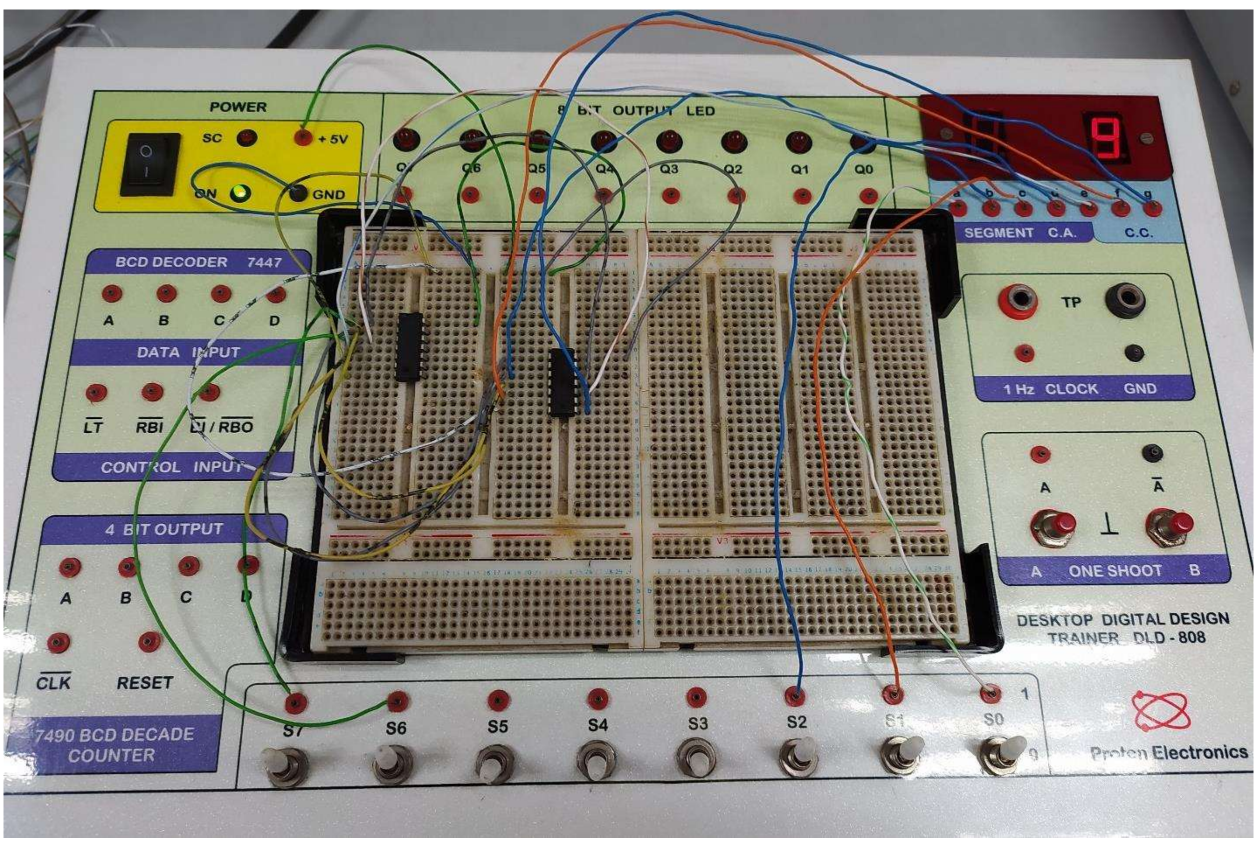


Hardware Implementation






POWER
SC
+ 5V
ON
GND
8 BIT OUTPUT LED
Q7
Q5
Q4
Q3
Q2
Q1
Q0
SEGMENT C.A.
C.C.
BCD DECODER 7447
A
B
C
D
DATA INPUT
LT
RBI
EI / RBO
CONTROL INPUT
4 BIT OUTPUT
A
B
C
D
CLK
RESET
7490 BCD DECADE COUNTER
TP
1 Hz CLOCK
GND
A
ONE SHOOT
B
DESKTOP DIGITAL DESIGN
TRAINER DLD - 808
S7
S6
S5
S4
S3
S2
Proton Electronics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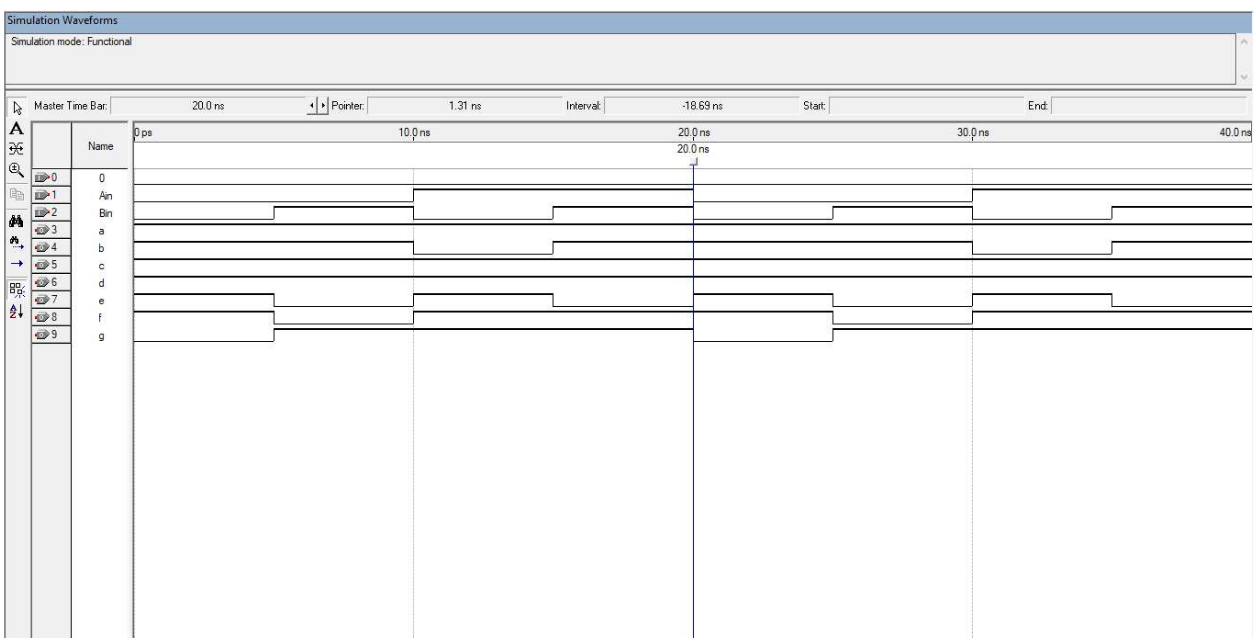
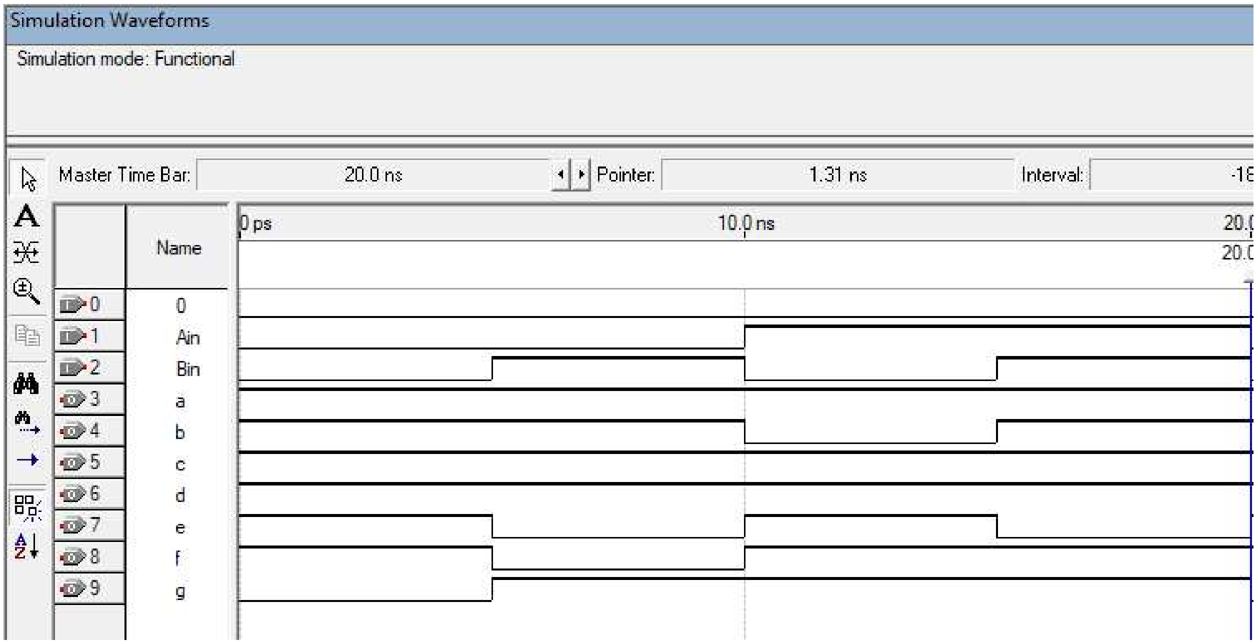
Verilog Code and Simulation

Structural Verilog Code,

```
module verilog1 (input A, B, O,
                output a, b, c, d, e, f, g);
                wire w1, w2, w3, w4, w5;
                not g1(w1, O),
                    g2(w2, B);
                or g3(w3, ~A, B),
                   g4(w4, A, ~B),
                   g5(w5, A, B);
                   g6(a, w1),
                   g7(b, w3),
                   g8(c, w1),
                   g9(d, w1),
                   g10(e, w2),
                   g11(f, w4),
                   g12(g, w5);
endmodule
```

Simulation Waveforms,





Conclusion

For implementing our refrigerator temperature controller circuit project, we first create a truth table. From the table we generate seven K-map and with the help of K-map we get seven equations. With these equations, we design our logical circuit. We also simulate our circuit with Quartus II software. However, we used our previous knowledge to implement this project properly. Besides, we got to learn how to implement seven-segment display through this project.