Digital System Design Lab

Lab 6
Realization of a Boolean Function

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1. Objectives

- To learn how to generate waveform in Quartus II

2. Theorem

The Boolean algebra is a fundamental concept in digital logic and computer science, used for the manipulation and analysis of binary variables. In Boolean algebra, Boolean expressions can be represented using two standard forms: minterms and maxterms.
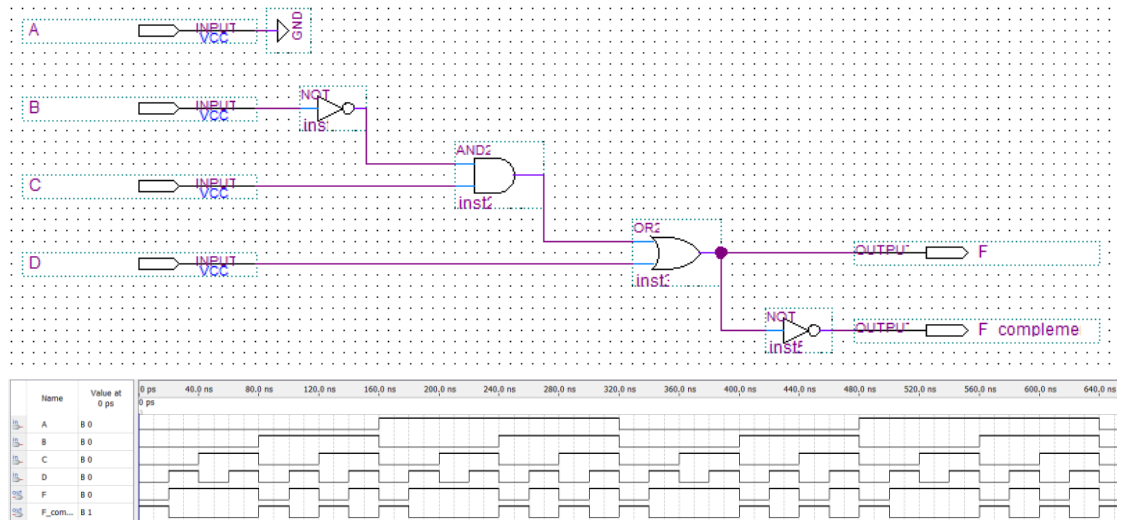
(1) Minterm

Minterms are the logical product (AND operation) of the input variables, where each term represents a specific combination of the variables that make the Boolean expression true. They are also known as the product terms and are characterized by their full disjunctive normal form.

(2) Maxterm

Maxterms are the logical sum (OR operation) of the input variables, where each term represents a specific combination of the variables that make the Boolean expression false. Maxterms are the dual of minterms and are characterized by their full conjunctive normal form.

3. Experimental Results

(1) Step 1

A	B	C	D	F(A, B, C, D)
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

a. *Minterm:*

F=A'B'C'D+ A'B'CD'+ A'B'CD+ A'BC'D+ A'BCD+ AB'C'D+

  AB'CD'+ AB'CD+ ABC'D+ ABCD

  =B'C'D+B'CD'+B'CD+BC'D+BCD

  =B'C+D(B'C'+B'C+BC+BC')

  =B'C+D

b. *Maxterm:*

F=(A+B+C+D)•(A+B'+C+D)•(A+B'+C'+D)•(A'+B+C+D)•

  (A'+B'+C+D)•(A'+B'+C'+D)

  =(B+C+D+BC+BD+CD)•(B'+C+D+B'C+B'D+CD)•

  (B'+C'+D+B'C'+B'D+C'D)

  =(C+D)(B'+C'+D)

  =B'C+B'D+CC'+C'D+CD+DD

  =B'C+D

c. *Simplify*

F=A'D+BD+B'C+AB'D

  =D(AB'+A')+BD+B'C

  =D(A'+B')+BD+B'C

  =B'D+A'D+BD+B'C

  =D(B+B')+A'D+B'C

  =D(1+A')+B'C

  =D+B'C

(2) Step 2
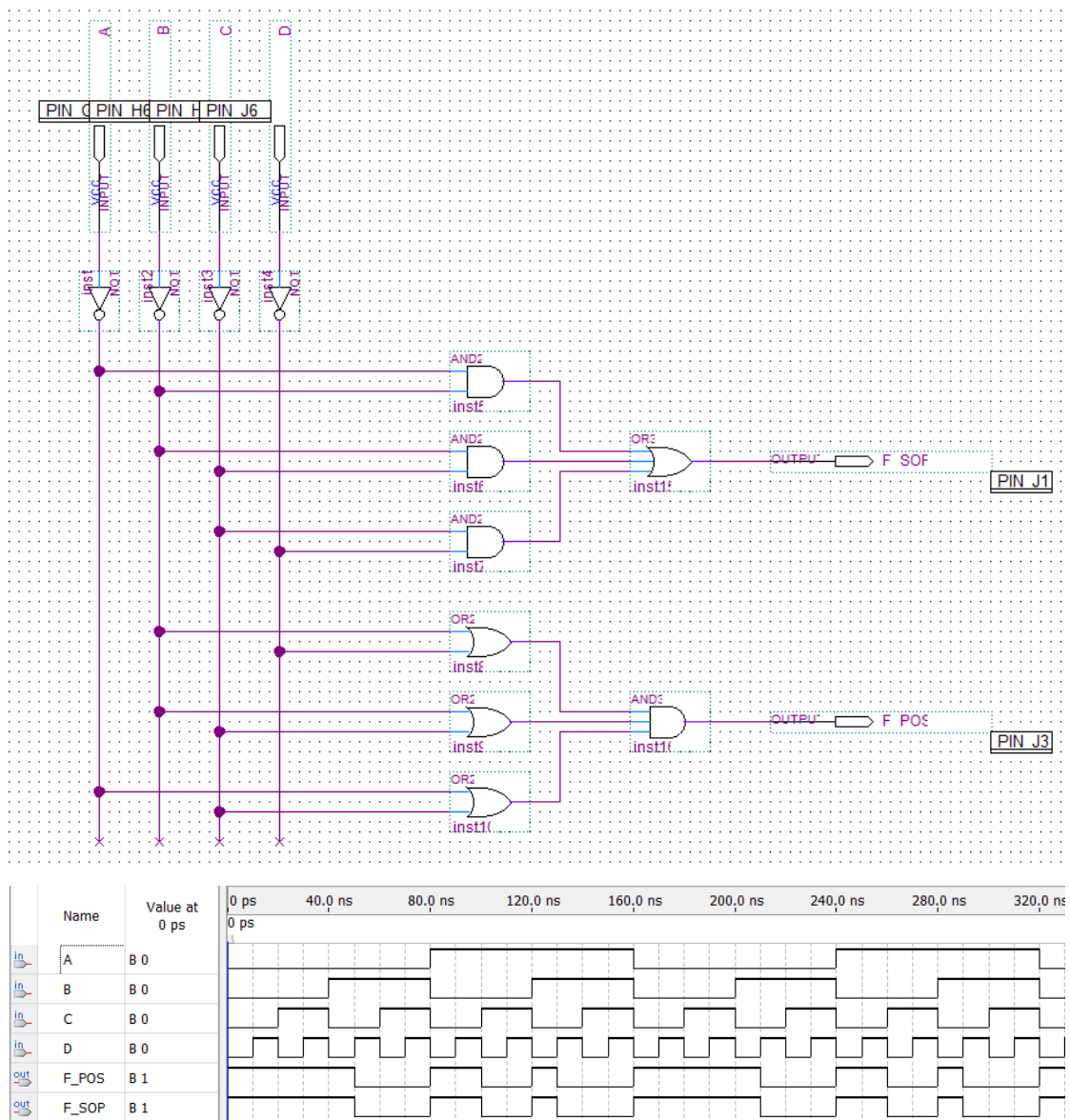
4. **Comments**

   None

5. **Problems & Solutions**

   When I tried to use input, I made a mistake—bind each input to a gnd. Because of it, it made my program ruined and can't be compiled. At the end, I removed the gnds and reconnected wires, and it works!

6. **Feedback**

   None