EXPERIMENT NO. 11

TITLE: VERIFY THE TRUTH TABLE OF ONE BIT AND TWO BIT COMPARATOR USING LOGIC GATES.

▪ OBJECTIVE:

To analyses the truth table of 1-bit comparator by using NOT, AND and NOR logic gate ICs and 2-bit comparator by using 1-input NOT, 3-input AND, 2-input AND, 3-input OR and 2-input Ex-NOR logic gate ICs and to understand the working of 1-bit comparator and 2- bit comparator with the help of LEDs display.

▪ APPARATUS REQUIRED:

• Switches
• Power supply
• Resistances
• LEDs
• IC 7404, IC 7408, IC 7402,etc

▪ THEORY:

Comparator:

A magnitude digital comparator is a combinational circuit that compares two digital or binary numbers in order to find out whether one binary number is equal, less than or greater than the other binary number. We logically design a circuit for which we will have two inputs one for A and other for B and have three output terminals, one for A > B condition, one for A = B condition and one for A < B condition.

Figure-1: Block Diagram of Comparator

1) 1-Bit Magnitude Comparator:

A comparator used to compare two bits is called a single bit comparator. It consists of two inputs each for two single bit numbers and three outputs to generate less than, equal to and greater than between two binary numbers. The truth table for a 1-bit comparator is given below :

A	B	A<B	A=B	A>B
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

Figure-2: Truth Table of 1-Bit Comparator

From the above truth table logical expression for each output can be expressed as follows:

A > B : AB'
A < B : A'B
A = B : A'B' + AB

By using these Boolean expressions, we can implement a logic circuit for this comparator as given below:

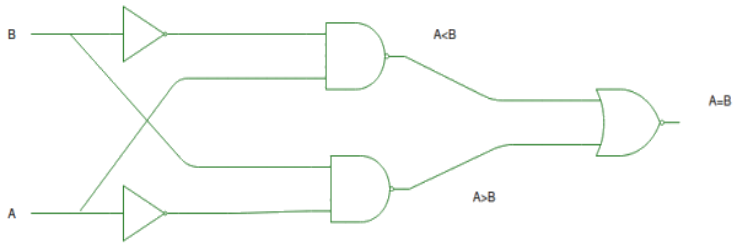


Figure-3: Logic Circuit of 1-Bit Comparator

2) 2-Bit Magnitude Comparator:

A comparator used to compare two binary numbers each of two bits is called a 2-bit magnitude comparator. It consists of four inputs and three outputs to generate less than, equal to and greater than between two binary numbers.

The truth table for a 2-bit comparator is given below:

INPUT				OUTPUT		
A1	A0	B1	B0	A<B	A=B	A>B
0	0	0	0	0	1	0
0	0	0	1	1	0	0
0	0	1	0	1	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	0	1	0
1	0	1	1	1	0	0
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	0	0	1
1	1	1	1	0	1	0

Figure-4: Truth Table of 2-Bit Comparator

From the above truth table logical expressions for each output can be expressed as follows:

$A > B : A_1B_1' + A_0B_1'B_0' + A_1A_0B_0'$

$A = B : A_1'A_0'B_1'B_0' + A_1'A_0B_1'B_0 + A_1A_0B_1B_0 + A_1A_0'B_1B_0'$

$: A_1'B_1' (A_0'B_0' + A_0B_0) + A_1B_1 (A_0B_0 + A_0'B_0')$

$: (A_0B_0 + A_0'B_0') (A_1B_1 + A_1'B_1')$

$: (A_0 \text{ Ex-Nor } B_0) (A_1 \text{ Ex-Nor } B_1)$

$A < B : A_1'B_1 + A_0'B_1B_0 + A_1'A0'B0$

By using these Boolean expressions, we can implement a logic circuit for this comparator as given below :

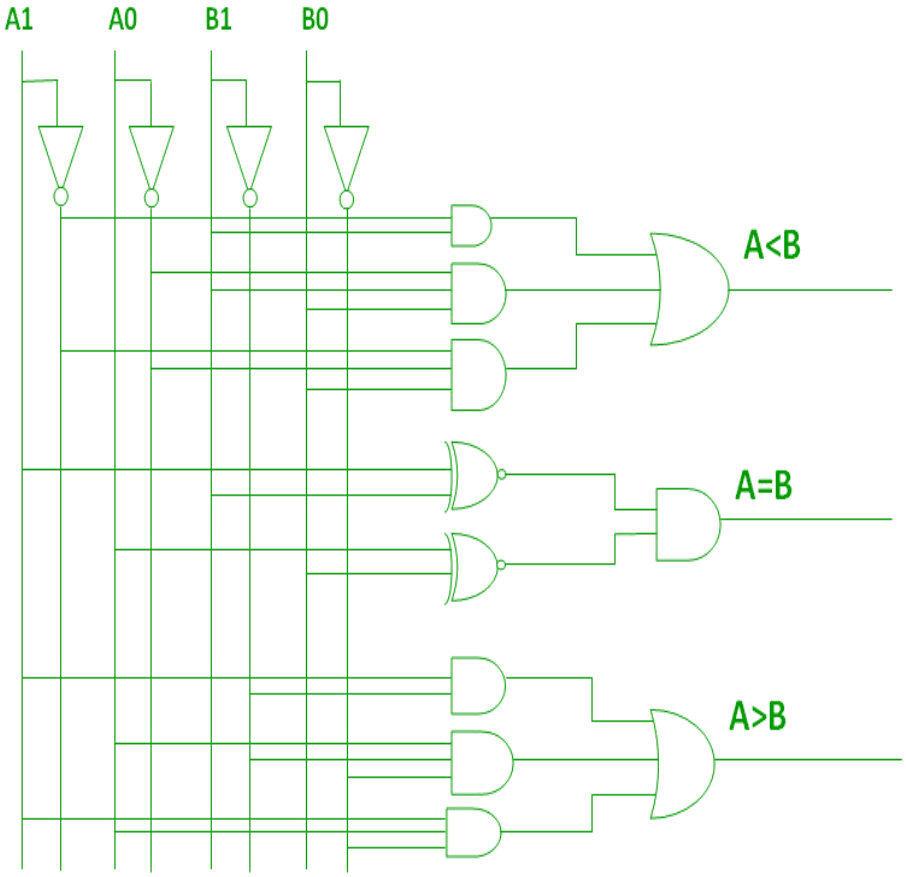
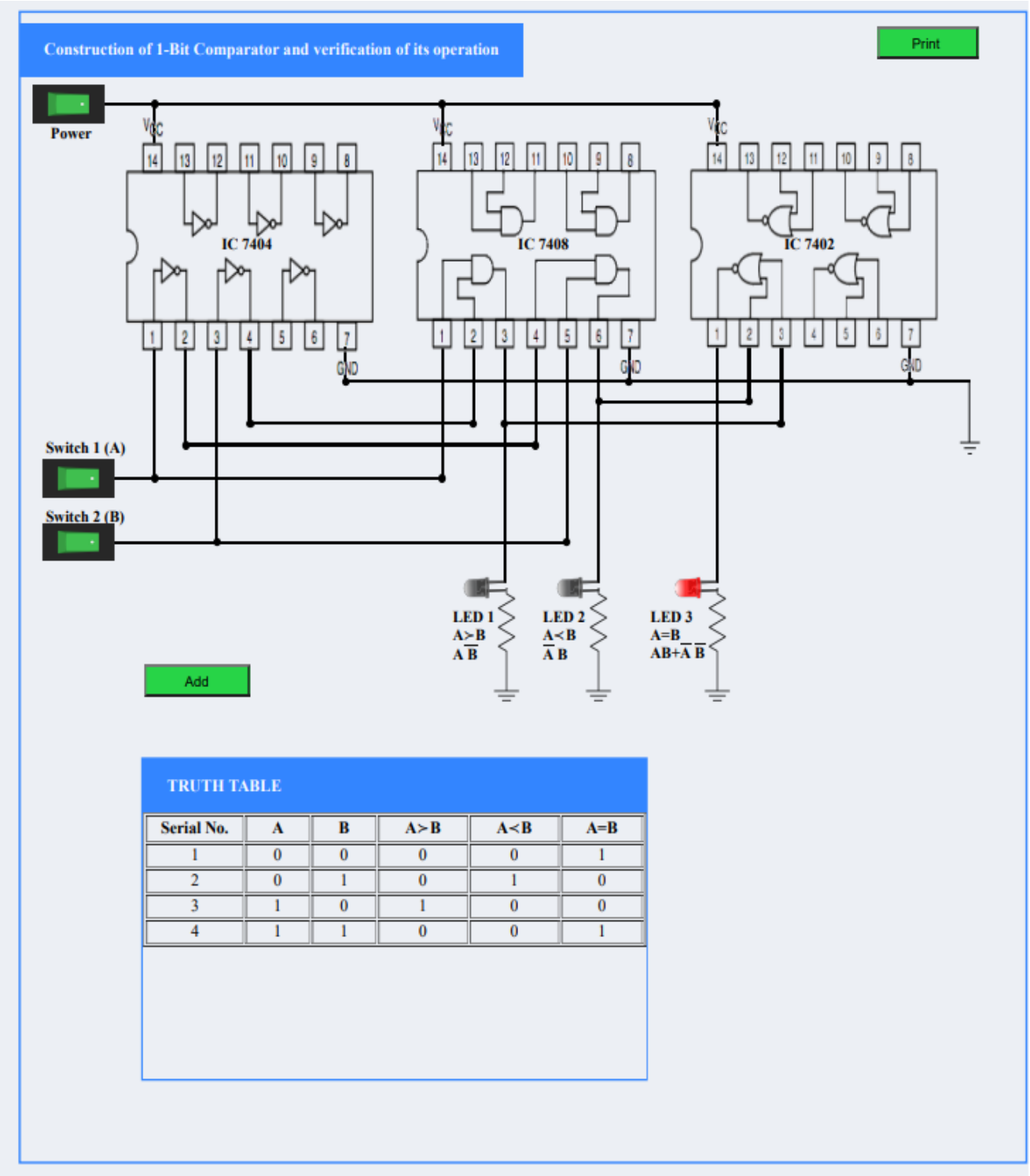


Figure-5: Logic Circuit of 2-Bit Comparator

- **CIRCUIT DIAGRAM:**

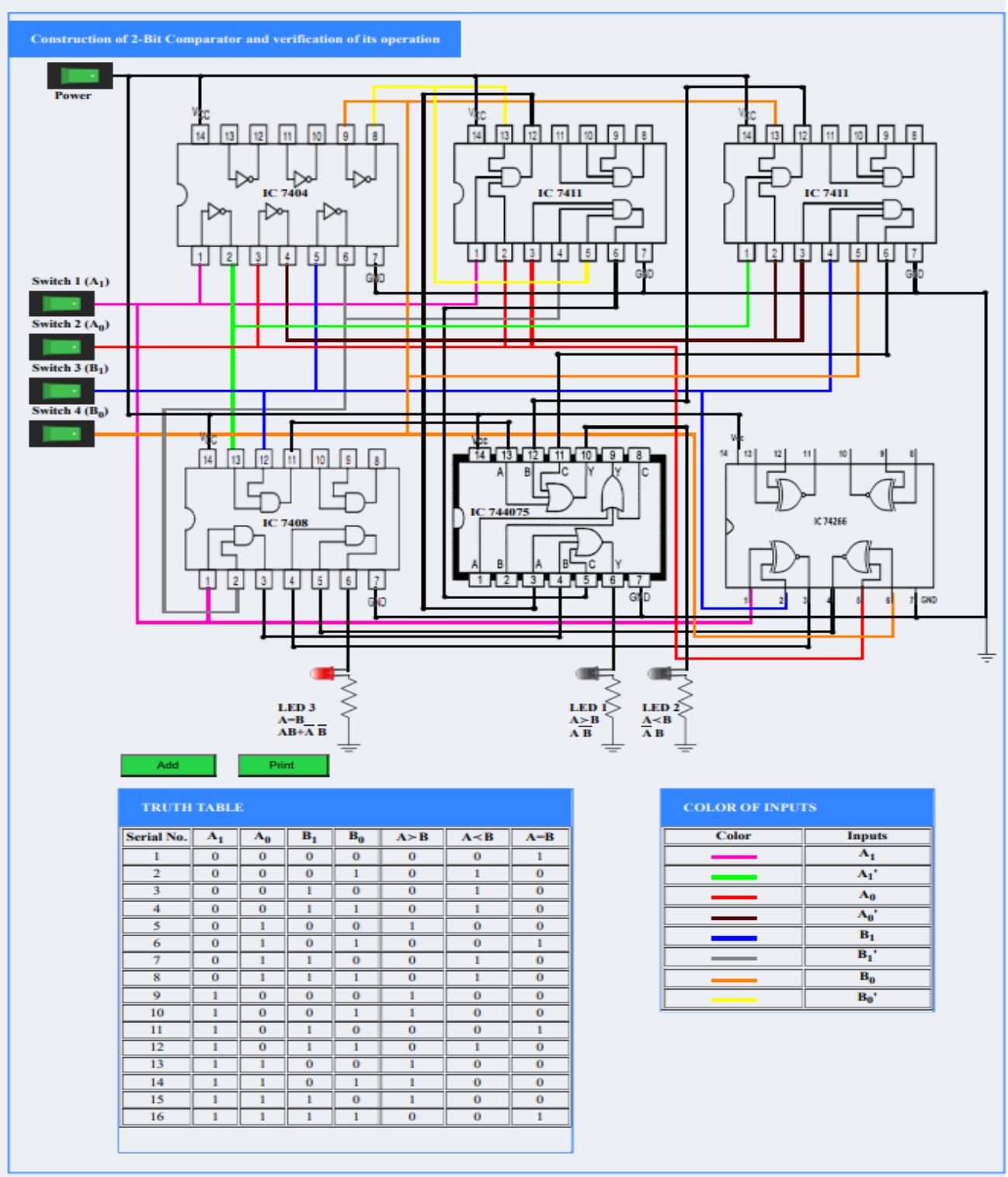
1)1-Bit Magnitude Comparator:



TRUTH TABLE

Serial No.	A	B	A>B	A<B	A=B
1	0	0	0	0	1
2	0	1	0	1	0
3	1	0	1	0	0
4	1	1	0	0	1

2) 2-Bit magnitude Comparator:



TRUTH TABLE

Serial No.	A_1	A_0	B_1	B_0	A>B	A<B	A=B
1	0	0	0	0	0	0	1
2	0	0	0	1	0	1	0
3	0	0	1	0	0	1	0
4	0	0	1	1	0	1	0
5	0	1	0	0	1	0	0
6	0	1	0	1	0	0	1
7	0	1	1	0	0	1	0
8	0	1	1	1	0	1	0
9	1	0	0	0	1	0	0
10	1	0	0	1	1	0	0
11	1	0	1	0	0	0	1
12	1	0	1	1	0	1	0
13	1	1	0	0	1	0	0
14	1	1	0	1	1	0	0
15	1	1	1	0	1	0	0
16	1	1	1	1	0	0	1

COLOR OF INPUTS

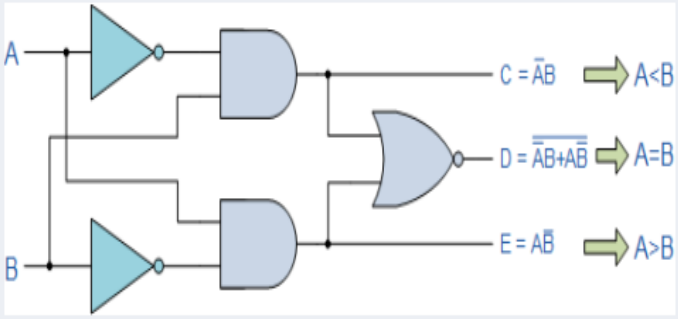
Color	Inputs
	A_1
	A_1'
	A_0
	A_0'
	B_1
	B_1'
	B_0
	B_0'

- **CALCULATIONS:**

- **Verification of truth table of one-bit comparator:**

Instructions

Verification of truth table of one bit Comparator



1

1

0

1

0

Check

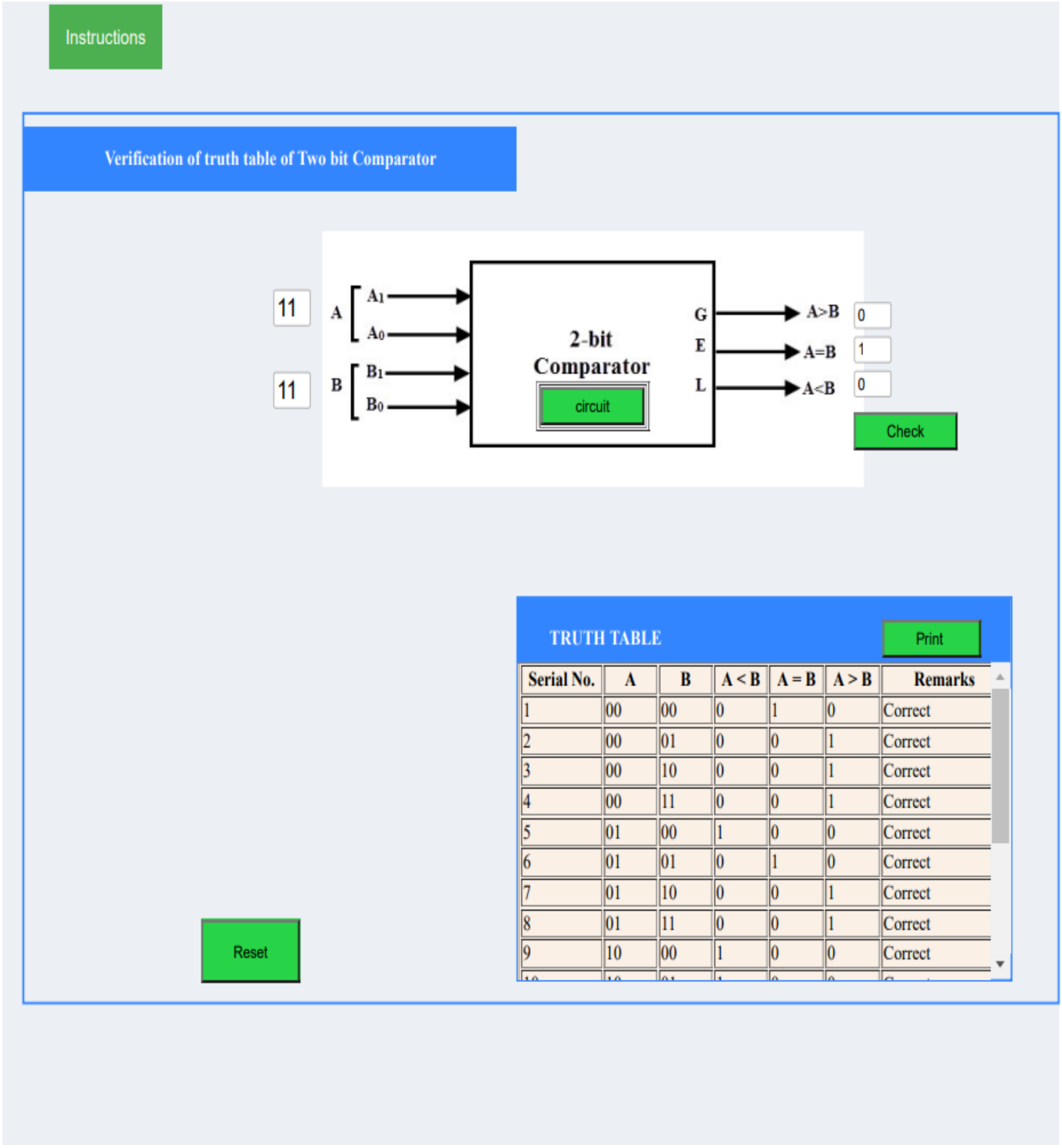
TRUTH TABLE

Print

Serial No.	A	B	A < B	A = B	A > B	Remarks
1	0	0	0	1	0	Correct
2	0	1	1	0	0	Correct
3	1	0	0	0	1	Correct
4	1	1	0	1	0	Correct
5	1	1	0	1	0	Correct

Reset

- **Verification of truth table of two-bit comparator:**



Serial No.	A	B	A < B	A = B	A > B	Remarks
1	00	00	0	1	0	Correct
2	00	01	0	0	1	Correct
3	00	10	0	0	1	Correct
4	00	11	0	0	1	Correct
5	01	00	1	0	0	Correct
6	01	01	0	1	0	Correct
7	01	10	0	0	1	Correct
8	01	11	0	0	1	Correct
9	10	00	1	0	0	Correct

- **RESULT:**
  - Verified the truth table of one-bit comparator.
  - Verified the truth table of two-bit comparator.

- **PRECAUTIONS:**

• All the connections should be made properly as per the circuit diagram.

• Connections should be tight and easy to inspect.

• Power supply should be 5v.

• Keep the switch turned off while making connections.