LAB 10: 1-BIT FULL ADDER

1. Goals

- Know how to use basic logic gates.
- Build an *Exclusive OR* (XOR) using NAND and OR gates.
- Build a 1-bit full adder using NAND, OR and XOR gates.

2. Exercises

Exercise 1. Build a XOR gate using AND, OR and NOT gates. The symbol and truth table of a XOR gate are shown in Figure 1.

(a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(b)

Figure 1. Symbol (a) and truth table (b) of XOR.

Requirements:

- Test all ICs and equipment.
- Assemble a XOR gate on a breadboard using IC 74LS00 (AND), 74LS32(OR), 74LS04 (NOT), resistors, LEDs, and buttons (or switches).
- Supply 5V/GND power to the circuit.
- Use a function generator and an oscilloscope to define the circuit's activities, i.e., checking circuit's output for all input states.
- Write comments on the experimental results.

Exercise 2. Build a 1-bit full adder using basic logic gates. Figure 2 shows the block diagram of a 1-bit full adder:

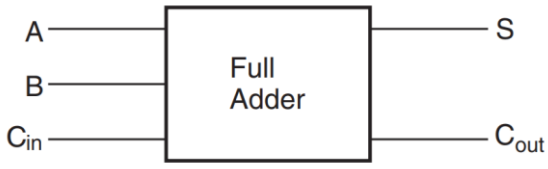
- 3 1-bit inputs: A, B, C_{in}
- 2 1-bit output: S, C_{out}

From the truth table, the Boolean expressions of the SUM and CARRY outputs are:

- $S = \mathrm{A} \oplus \mathrm{B} \oplus C_{in}$
- $C_{out} = \mathrm{A}.\mathrm{B} + \left(C_{in}.(\mathrm{A} \oplus \mathrm{B})\right)$

Requirements:

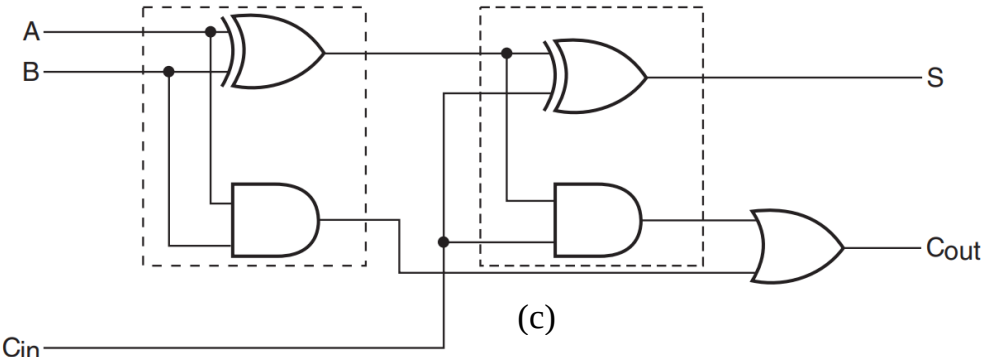
- Test all ICs and equipment.
- Assemble a full adder on a breadboard using the given ICs (74LS00, 74LS32, and 74LS86), resistors, LEDs, and buttons (or switches).
- Supply 5V/GND power to the circuit.
- Use a function generator and an oscilloscope to define the circuit's activities, i.e., checking circuit's output for all input states.
- Write comments on the experimental results.



(a)

A	B	C_{in}	C_{out}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

(b)



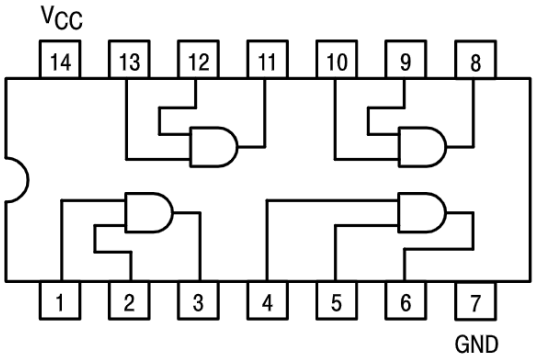
(c)

Figure 2. Block diagram (a), truth table (b) and logic diagram (c) of 1-bit FA.

Components and devices needed for the lab:

Components and Devices	Description	Amount
74LS (or HC) 08/32/04/86	AND/OR/NOT/XOR	2/2/1/1
Resistor	330 Ω/10 kΩ	Few
LED	2V-2.5V, 20mA	5
Switch or Button	3-pin/4-pin	3
Power Supply	Aditeg PS-3030DD	1
Breadboard		1
Connecting Wires		Few
Multimeter/function generator/oscilloscope		1/1/1

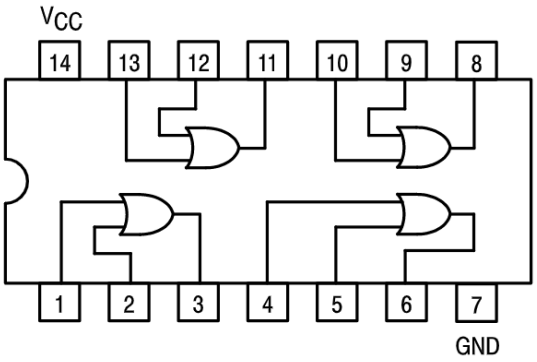
Datasheet of 74LS08 here.



74LS08 Pinout

A	B	A **AND** B
0	0	0
0	1	0
1	0	0
1	1	1

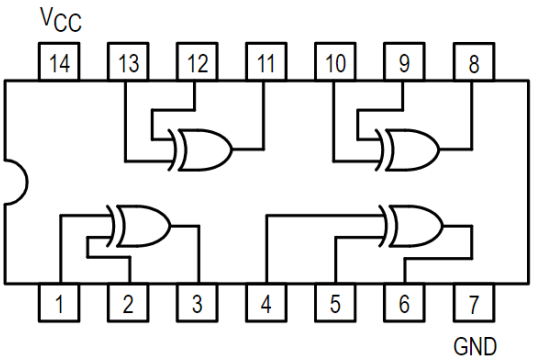
Datasheet of 74LS32 here.



74LS32 Pinout

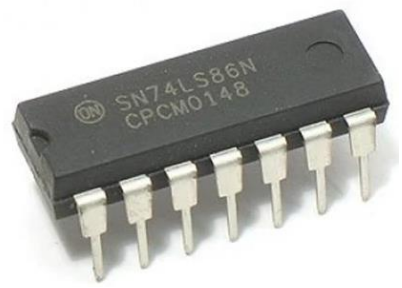
A	B	A **OR** B
0	0	0
0	1	1
1	0	1
1	1	1

Datasheet of 74LS86 here.

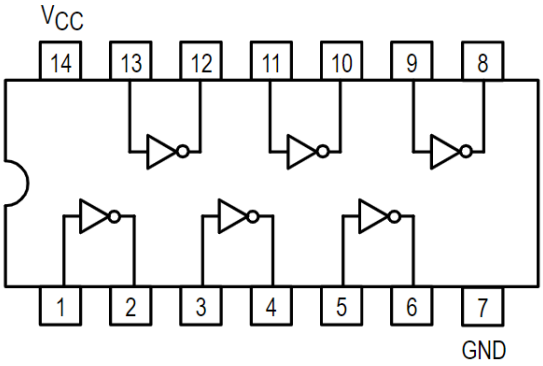


74LS86 Pinout

A	B	A **XOR** B
0	0	0
0	1	1
1	0	1
1	1	0



Datasheet of 74LS04 here.



74LS04 Pinout

A	$\bar{A}$
0	0
0	1
1	1
1	0