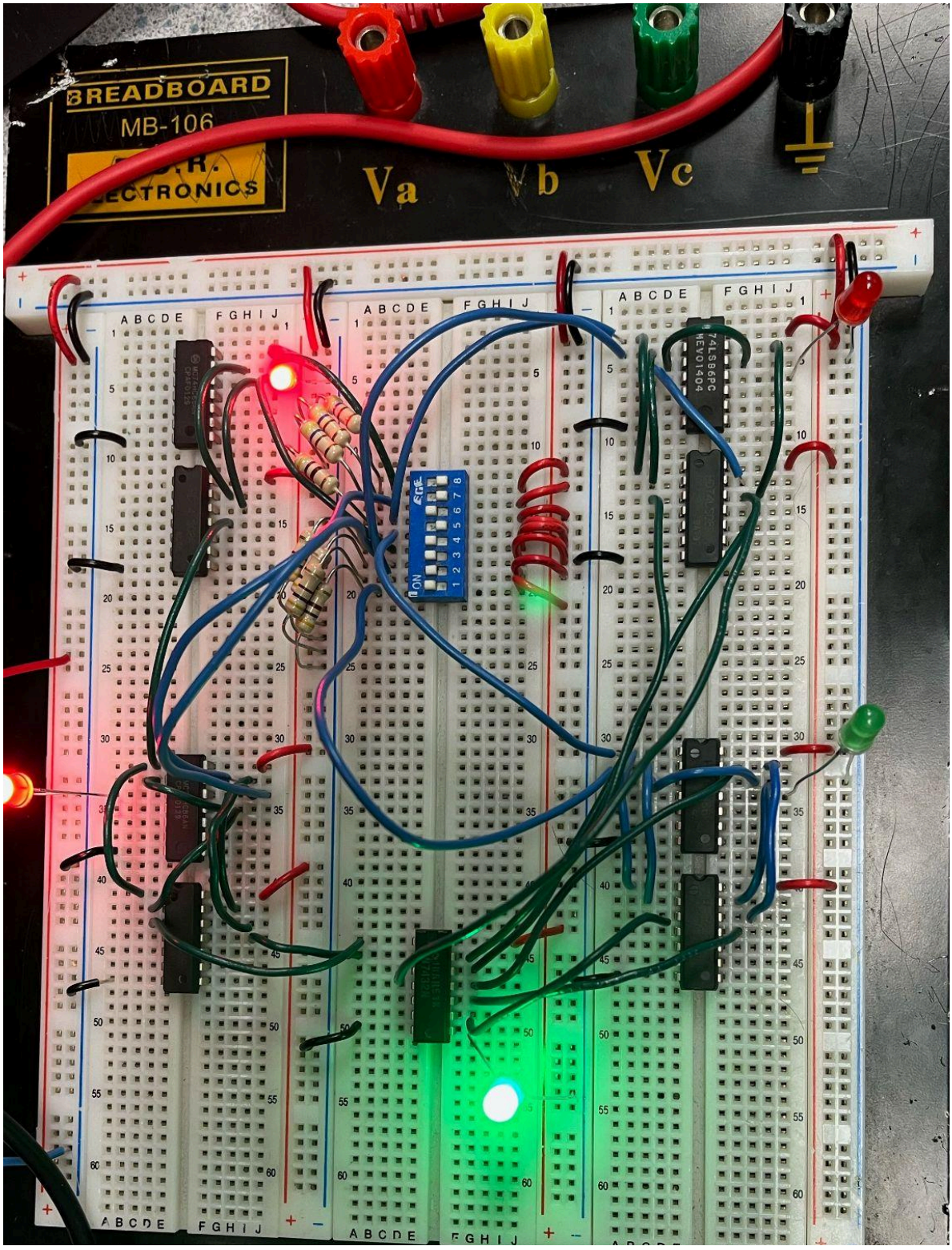
Lab 5- 4 Bit Adder with Full and Half adders



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(10/24/22-10/28/22)

Objectives:

- You will build a 4 bit adder using exclusive gates. You will do it both in Shop and on Multisims. Use LED's for the output.

Materials List:

- Multisim
- 5v DC Power Supply
- 7486 Quad 2-input XOR Gate
- 7402 Quad 2-input NOR Gate
- 7408 Quad 2-input AND Gate
- 1 by 8 Dip-switch Array
- 470 Ω Resistor (8)

Procedure:

1. To make a four-bit adder we first needed it to start out with a half-bit adder which can be shown in figure 1-1

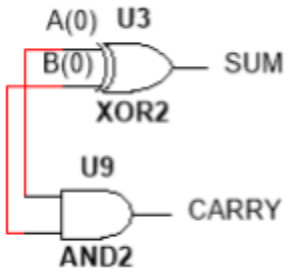


Figure 1-1: Half-bit adder

2. Now that we had the first digit as the half-bit, we needed to have the second bit be a full adder connected to the half-adder which can be shown in figure 1-2.

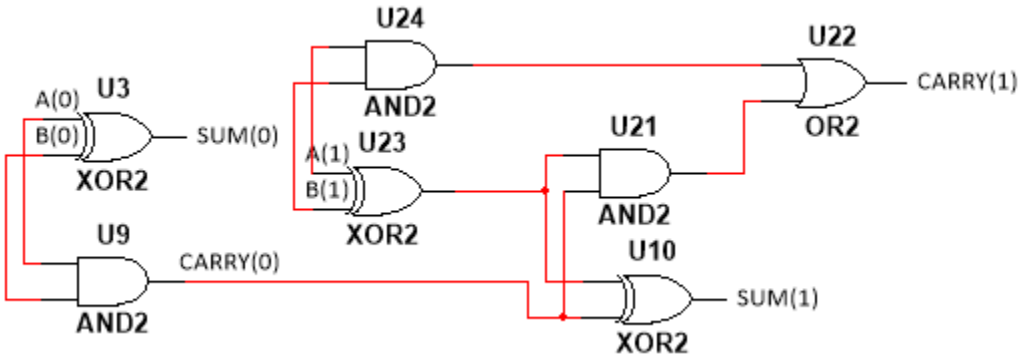


Figure 1-2: 2 bit adder with a Half adder and Full adder

3. With this information we were able to make the four-bit adder using one half-bit adder and three full-bit adders which can be shown in Figure 1-3. The input on each bit can be shown as the As and Bs, the carry out can be shown as the Cs, and the summations can be shown as the Σs. On our protoboard we used dip-switches for the inputs.

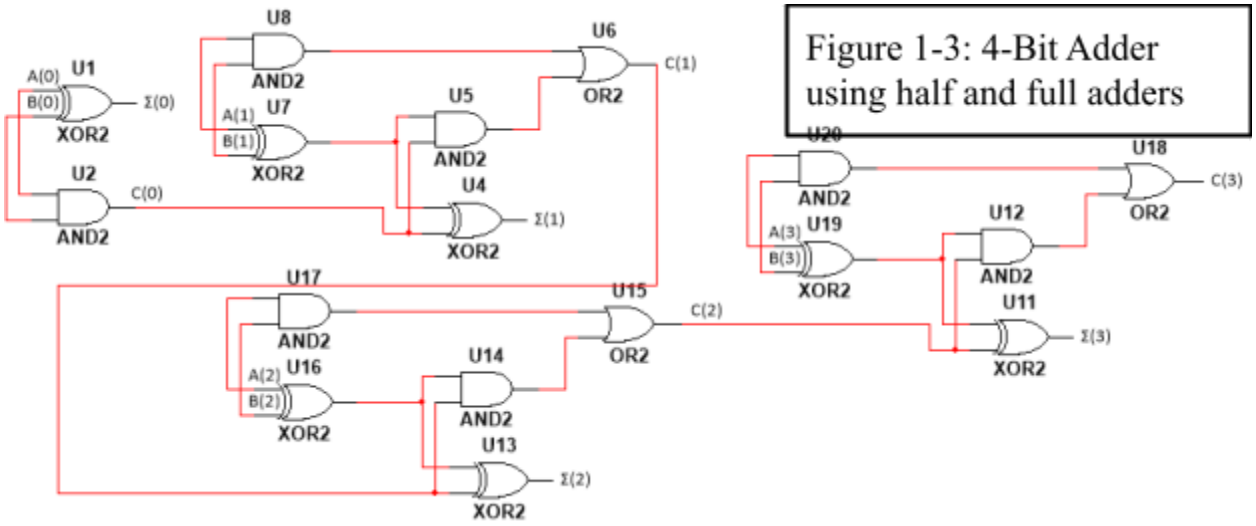


Figure 1-3: 4-Bit Adder using half and full adders

4. We then decided to add 11+1 which would be 1011_2+0001_2 in binary and figure 1-4 can show that we got 12 or 1100_2 in binary as the A inputs are the 1101 and the B inputs are the 0001.

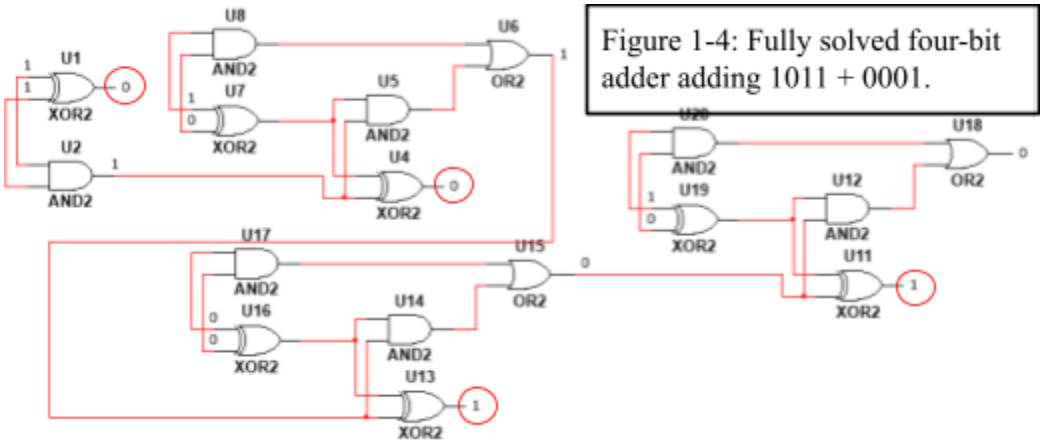


Figure 1-4: Fully solved four-bit adder adding 1011 + 0001.

Discussion:

Symptom: Our circuit was not properly adding numbers.

Troubleshooting: We checked the IC chips and the voltages at inputs and outputs to make sure that our chips were functioning normally. We then checked all wires to make sure they were properly secured to the board.

Solutions: We found a loose wire switch near one of the dip switches

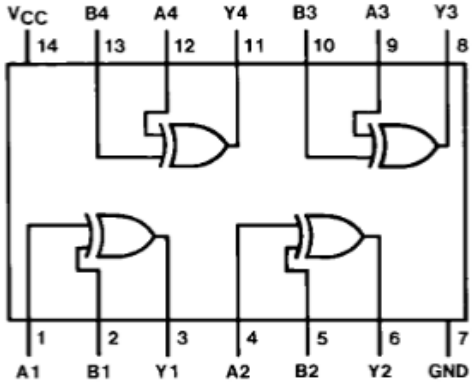
Conclusion:

- Using one half adder and three full adders, you can make a 4-bit adder.
- The last adder (last full adder) will hold the MSD, and the half-adder will hold the LSD.
- The half adder gives you a sum, which is the LSD, and a C_{out}, which is then put into the C_{in} on a full adder
- The half-adder is made from one XOR gate that creates the summation output, and an AND gate that creates the carry out.

- A full-adder consists of an XOR gate connected to the inputs followed by an XOR on the output connected to the carry out of the last adder that creates the summation output. There is also an AND gate across the two inputs and another one connected to the output of the first XOR gate and the carry out of the last adder, both of which are ORed together to make the carry out.

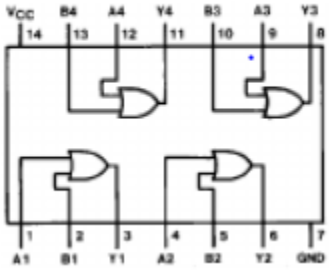
Datasheets:

☐ **7486 Datasheet XOR**



☐ **7432 Datasheet OR**

Connection Diagram



Function Table

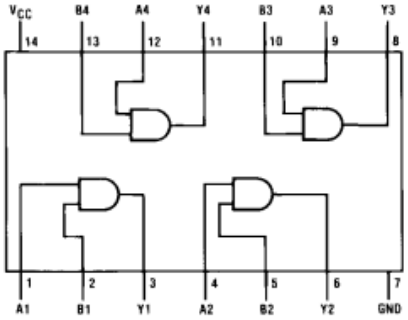
Y = A + B

Inputs		Output
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	H

H = HIGH Logic Level
L = LOW Logic Level

☐ **7408 Datasheet AND**

Connection Diagram



Function Table

$Y = AB$

Inputs		Output
A	B	Y
L	L	L
L	H	L
H	L	L
H	H	H

H = HIGH Logic Level
L = LOW Logic Level