

LAB4: Adders and Subtractors**Preparation:****Half-Adder**

1. Design a half-adder circuit using one XOR gate and two NAND gates.

Full-Adder

2. Design a full adder circuit using the two IC's 7486 and 7400.

Parallel Adder

3. The IC type 7483 or 74283 is a 4-bit parallel adder. The pin assignment is shown below. The two 4-bit binary number inputs are A1 through A4 and B1 through B4. The 4-bit sum output is obtained from S1 through S4. C0 is the input carry and C4 is the output carry.

Test the 4-bit binary adder 7483 or 74283 by connecting the two 4-bit inputs to two sets of 4 toggle switches each and the input carry to a separate toggle switch (if you don't have enough toggle switches, then you can fix some of the inputs to either Logic-0 or Logic-1). The five outputs are applied to the LED's. You can also to connect the four sum outputs to the seven segment display used in the previous experiment.

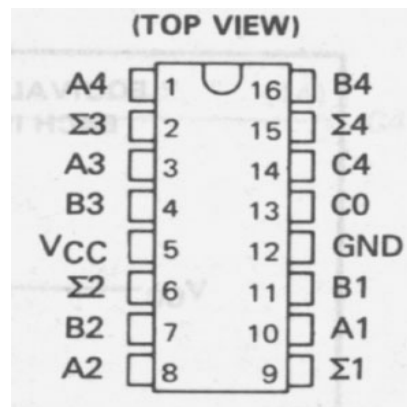
Show that when the input carry is equal to 1, it adds 1 to the output sum.

Adder-Subtractor

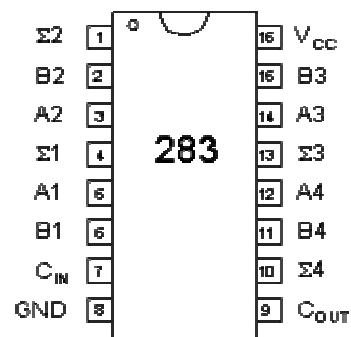
4. The subtraction of two binary numbers can be performed by taking the 2's complement of the subtrahend and adding it to the minuend. The 2's complement can be obtained by taking the 1's complement and adding 1. To perform A-B, we complement the four bits of B and add them to the four inputs of A, and add 1 to the sum using the input carry.

Design an adder-subtractor circuit by using IC 7483 or 74283 and XOR gates, such that when the mode select M=1, the input carry equals to 1 and we perform the subtraction operation (A-B), whereas when the mode select M=0, the input carry is equal to 0 and we perform the addition operation (A+B).

Show that during addition, the output carry is equal to 1 when the sum exceeds 15. Also show that when $A \geq B$ the subtraction operation gives the correct answer, (A-B), and the output carry is equal to 1. But when $A < B$, the subtraction gives the 2's complement of (B-A) and the output carry is equal to 0.



7483



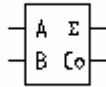
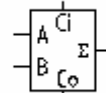
74283

Lab Work:

1. Implement the circuit you designed in Q1 and verify its operation.
2. Implement the circuit you designed in Q2 and verify its operation.
3. Verify the operation of the 4-bit parallel adder (74283) as explained above.
4. Implement the circuit you designed in Q4 and verify its operation.

Questions:

1. Design a comparator circuit that compares between two 4-bit input numbers using 4-bit full adder chip (74283) and 7404 and 7408 IC's.
2. A Half Adder (HA) takes 2 inputs A and B and computes the sum bit S and carry bit Co from them. Show how a FA can be constructed from HA's.

**HA****FA**

3. Implement 1-bit full adder using 4x1 MUX's. Use two 4x1 MUX's for (Ci+1, Si).