3 Binary Adder

In this experiment, the student will become familiar with the operation of a 4-bit binary adder, and will also learn how to cascade two 4-bit binary adders to form an 8-bit binary adder.

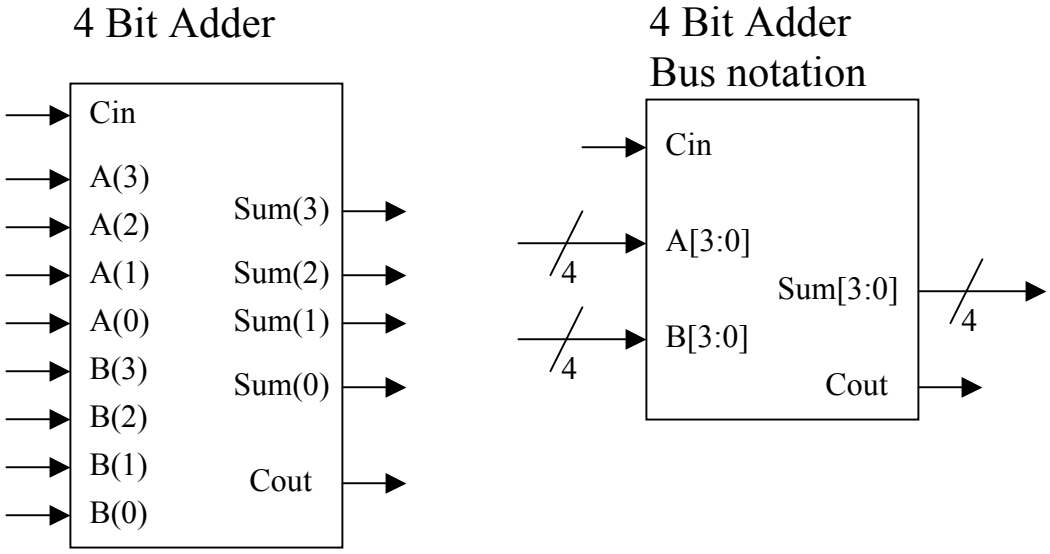
I. 4-Bit Binary adder

The TA will program one of your 22V10 Programmable logic devices so that it implements a 4-bit binary adder function. The pinout for this device is:

- Pin 12 – GND, Pin 24 - Vcc.
- Four bit A input: A(3): pin2, A(2): pin3, A(1): pin4, A(0): pin5
- Four bit B input B(3): pin6, B(2): pin7, B(1): pin8, B(0): pin9
- Carry-In : pin 10
- Four Bit Sum output: Sum(3): pin22, Sum(2): pin21, Sum(1): pin20, Sum(0): pin19
- Carry Out: pin 18

Unused inputs can be left unconnected.

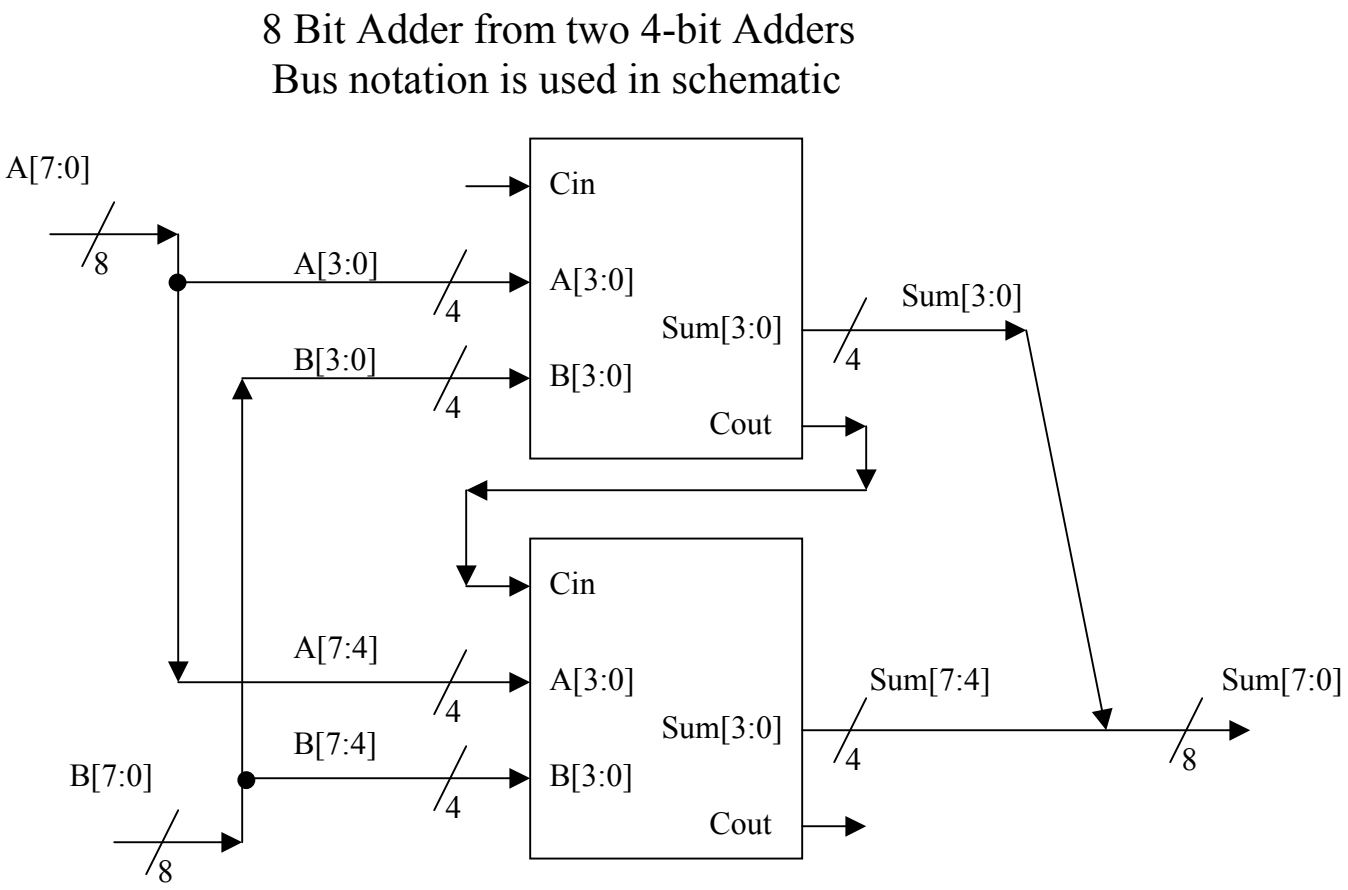
The logic symbol for a 4 bit binary adder is shown below. A(0) is the LSB (least significant bit) of A, A(3) is the MSB (Most Significant Bit) of A.



A. Connect the 4 bit Sum output of the adder to LEDs. Connect COUT output to an LED. Connect the two 4 bit inputs A[3:0], B[3:0] to switch inputs. Use a wire connection to either GND or VCC for the CIN input as appropriate for testing.
B. Fill in Table #1 in the lab data sheet for your circuit.

II. 8 Bit Binary adder

A. Connect two of the 4-bit binary adder chips to form an 8-bit adder. Use the diagram below to guide you (the carry out of the first 4-bit adder becomes the carry-in of the 2nd four-bit adder).



Tie Cin to GND. Tie 8 switch inputs to the A input (bits 7 down to 0). Use connections to +5 v/ GND for the B inputs.

B. Verify the operation of the 8 bit adder by applying the test inputs below (values are in DECIMAL). Fill in Table #2 of the lab data sheet.

a) 56 + 23	b) 75 + (-22)	c) -53 + (-42)	d) -65 + (-80)

Two's complement overflow could be a problem for some of the above additions. Which ones overflow the 8-bit range for two's complement?

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1. Fill in the following table (Table #1) for the operation of the 4-bit adder.

Cin	A3	A2	A1	A0	B3	B2	B1	B0	S3	S2	S1	S0	Co
0	0	0	1	0	0	1	0	1					
0	0	1	1	0	1	0	0	0					
0	0	1	1	0	1	1	1	0					
0	1	1	0	0	0	1	1	1					
1	0	0	1	0	0	1	0	1					
1	0	1	1	0	1	0	0	0					
1	0	1	1	0	1	1	1	0					
1	1	1	0	0	0	1	1	1					
0	0	0	0	0	0	0	0	0					
1	1	1	1	1	1	1	1	1					

2. Perform the binary addition operations in section III – 8 bit additions

Examples:

Decimal	Binary
36	00100100
(+) 15	00001111
51	00110011

Decimal	Binary
53	00110101
(-) 19	11101101
34	00100010

Fill in the following values:

Decimal	Binary
56	
(+) 23	

Decimal	Binary
75	
+(-22)	

Decimal	Binary
-53	
(+) (-42)	

Decimal	Binary
-65	
+(-80)	

Lab Data Sheet TA CHECKOFF_____

4-Bit Binary Adder (Table 1)

Cin	A3	A2	A1	A0	B3	B2	B1	B0	S3	S2	S1	S0	Co
0	0	0	1	0	0	1	0	1					
0	0	1	1	0	1	0	0	0					
0	0	1	1	0	1	1	1	0					
0	1	1	0	0	0	1	1	1					
1	0	0	1	0	0	1	0	1					
1	0	1	1	0	1	0	0	0					
1	0	1	1	0	1	1	1	0					
1	1	1	0	0	0	1	1	1					
0	0	0	0	0	0	0	0	0					
1	1	1	1	1	1	1	1	1					

8-Bit Adder (Table 2):

	Binary								
Decimal	CO	MSB 7	6	5	4	3	2	1	LSB 0
56	X								
23	X								
75	X								
-22	X								
-53	X								
-42	X								
-65	X								
-80	X								