Lab Manual
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Experiment No: 2
Experiment Name: Design of a 4-bit Arithmetic unit.

Introduction:

In this experiment you will construct a 4-bit arithmetic unit which is a part of an ALU. The arithmetic unit will be used to add and subtract two variables 4-bit inputs, A and B, as well as increment, decrement or transfer any of the inputs.

Arithmetic Operations:

Add- Each bit of input A is added with the corresponding bit of input B and the sum appears at the output of each full adder along with any carry out.
Add with carry- Each bit of input A and B are added with the input carry and the sum appears at the output of each full adder along with any carry out.
Subtract- Each bit of input B is subtracted from the corresponding bit of input A and the difference appears at the output of each full adder along with any borrow out.
Subtract with borrow- Each bit of input B is subtracted from A with borrow. The difference and the borrow out appear at the output.
Increment A- Each bit of A is increased by 1 and the result appears at the output of each full adder.
Decrement A- Each bit of A is decreased by 1 and the result appears at the output of each full adder.
Transfer A- Each bit of A appears at the output of each full adder, unmodified.

Select			Input	Output	
S_1	S_0	C_{in}	Y	$D = A + Y + C_{in}$	Microoperation
0	0	0	B	$D = A + B$	Add
0	0	1	B	$D = A + B + 1$	Add with carry
0	1	0	$\overline{B}$	$D = A + \overline{B}$	Subtract with borrow
0	1	1	$\overline{B}$	$D = A + \overline{B} + 1$	Subtract
1	0	0	0	$D = A$	Transfer A
1	0	1	0	$D = A + 1$	Increment A
1	1	0	1	$D = A - 1$	Decrement A
1	1	1	1	$D = A$	Transfer A

Equipment List:

- Trainer board
- IC 7404, 7483 or 74283,74LS153
- Wires for connection.

Function Table:

Complete the function table according to your theoretical knowledge.

S1	S0	Cin	A3	A2	A1	A0	B3	B2	B1	B0	Cout	D3	D2	D1	D0	Microoperation
0	0	0	0	0	0	1	0	0	0	1						Add
0	0	1	0	0	1	1	0	1	0	0						Add with Carry
0	1	0	0	0	1	0	1	1	0	0						Subtract with Borrow
0	1	1	0	1	1	1	0	1	0	0						Subtract
1	0	0	1	0	1	1	0	1	0	0						Transfer A
1	0	1	0	1	0	0	0	0	0	0						Increment A
1	1	0	1	0	1	0	1	0	0	0						Decrement A
1	1	1	1	0	0	1	0	1	1	1						Transfer A

Logic Circuit Diagram:

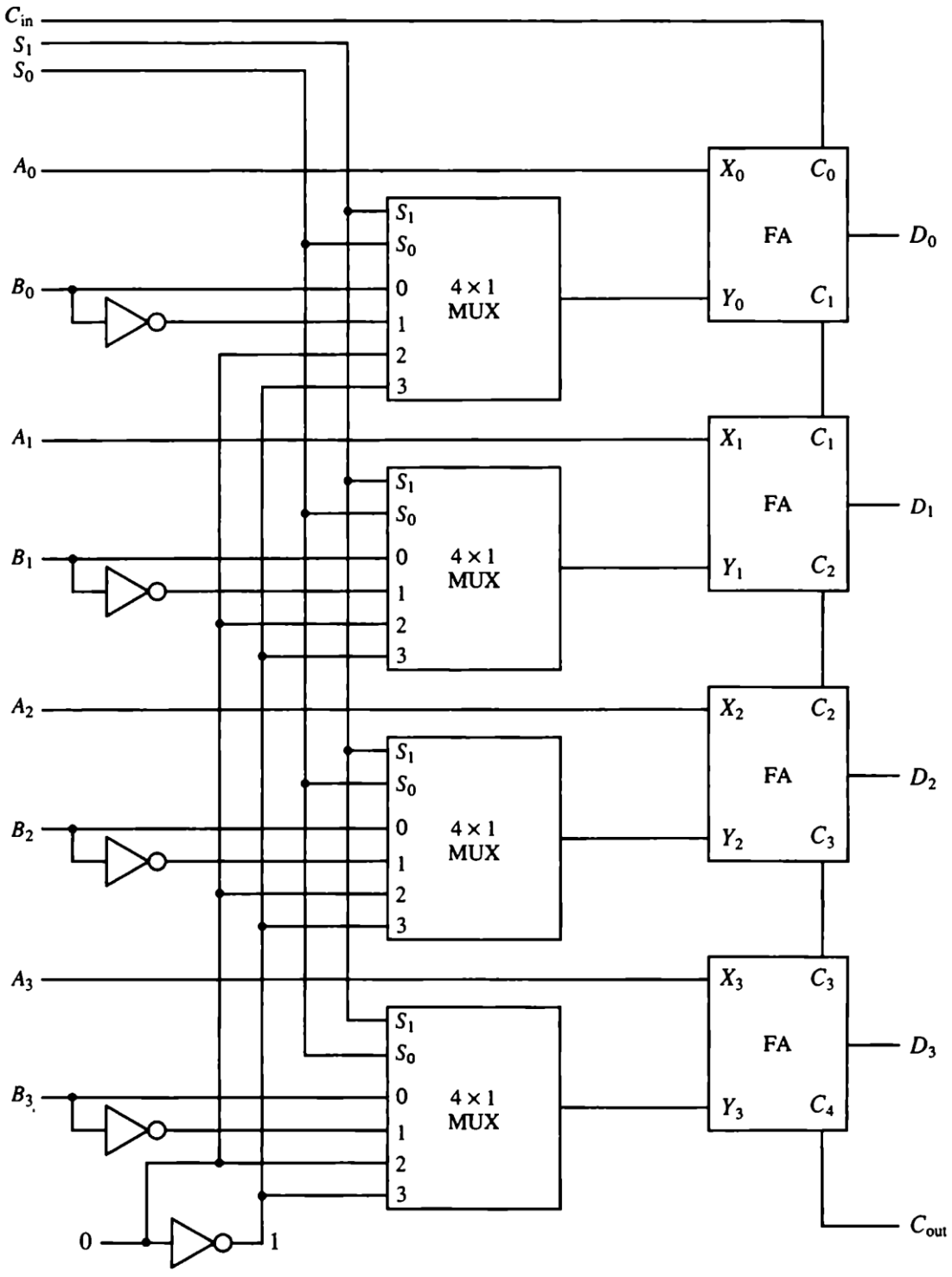


Fig: 4-bit Arithmetic unit Logic Circuit Diagram

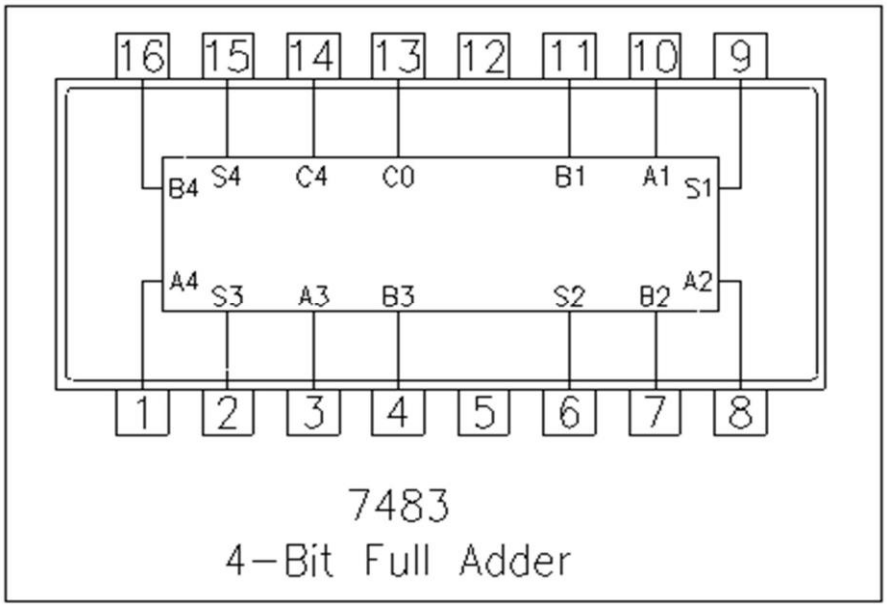
Procedure:

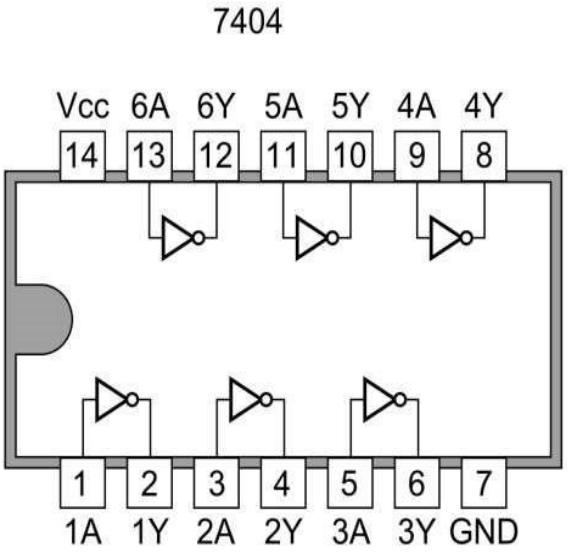
1) Place the ICs on the trainer board.
2) Connect V_{cc} and ground to the respective pins of IC.
3) Connect the inputs with the switches and the outputs with LEDs.
4) Apply various combinations of inputs and observe the outputs.
5) Verify the experimental outputs with the Function Table.

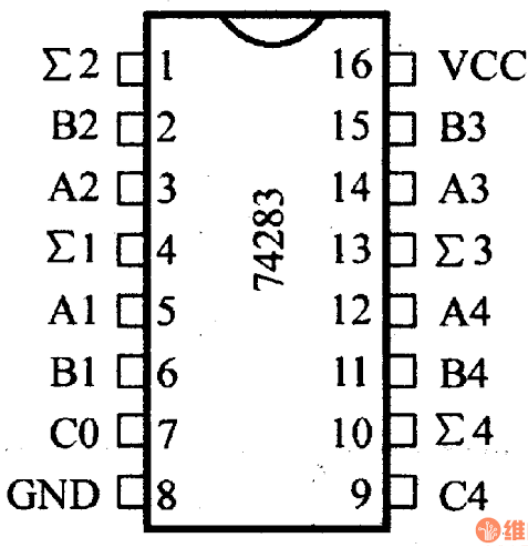
Assignment:

1) Prepare the lab report.
2) Implement the circuit in Logisim. Take a screenshot along with table in Logisim and include it in your lab report.

Pin configuration of ICs:

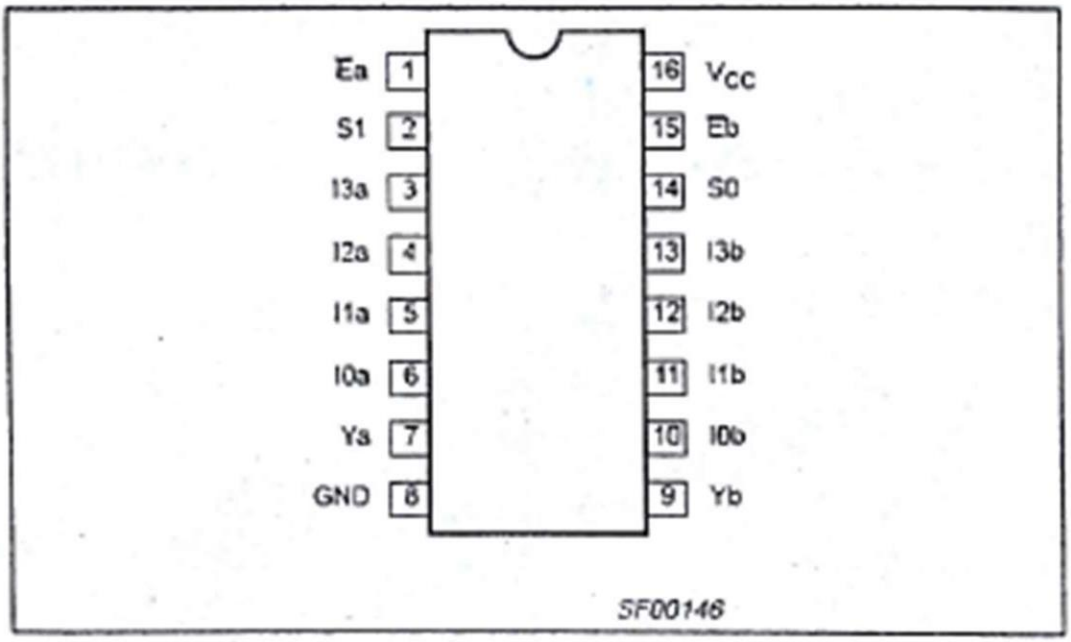






EEE336/CSE232 LAB
Dual 4x1 Multiplexer 74F153
Data Sheet

PIN CONFIGURATION



INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

PINS	DESCRIPTION
I0a – I3a	Port A data inputs
I0b – I3b	Port B data inputs
S0, S1	Common Select inputs
Ea	Port A Enable input (active Low)
Eb	Port B Enable input (active Low)
Ya, Yb	Port A, B data outputs