Name: <Insert> Course: EE460
ID: <Insert> Section: CA

# Design Assignment #1

## 1. Objective:

Modify the Tristate Bus shown in the figure 1 below. The task is to include 16-bit adder to the design.

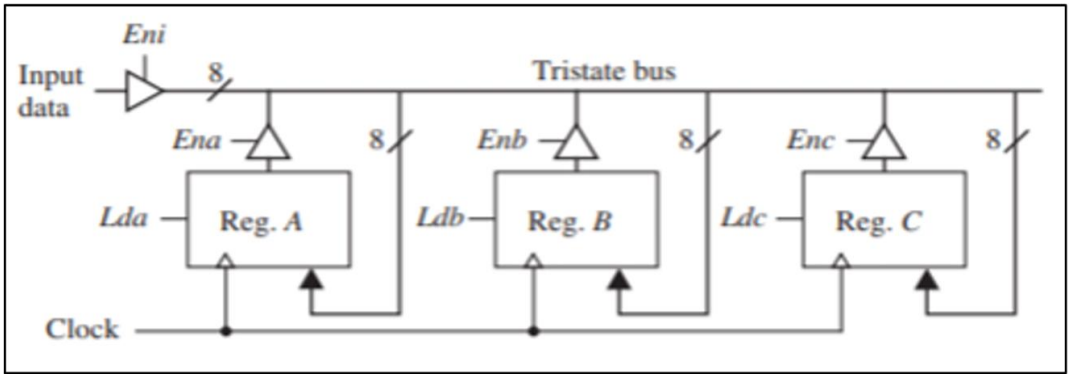


*Figure 1: Given Design for Tristate Bus*

The adder should perform addition on the contents of the 16-bit registers A and B, storing the result in one of the 16-bit registers:

A, B, C or D.

Additionality, I need to incorporate a fourth register D into the design. The following operations must be performed by the Adders:

- A = B + A
- C = B + D
- D = D + C

## 2. Design: Block Diagram:

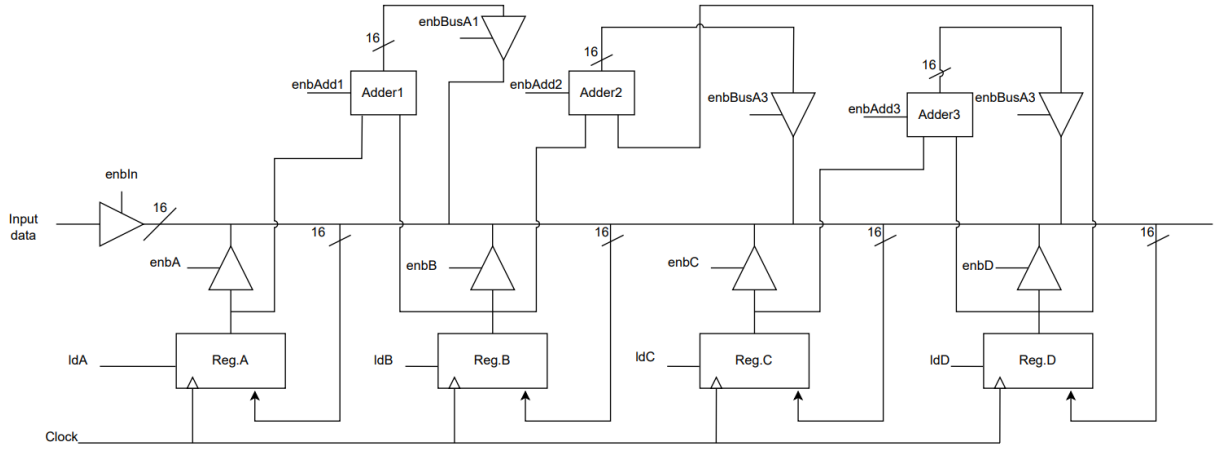


*Figure 2: New implemented design with Adders and Fourth Register*

Now, in this design. I have implemented all of the required objectives. I have added the fourth register Reg. D and also implemented three Adders for each of the adding Operations. The design is for 16-bit registers and adders.

## 3. Operations:

The following waveform represents all of the three operations, a detail of each operation will follow:

*Figure 3: All operations waveform*

### 3.1. Operation: A = B + A

- For this operation, we needed to enable the following signals in order to achieve this operation. First, we are loading different data on A, B, C and D registers. That's just pre preparation for the addition function so we can verify the addition process.
- Now, to enable the operation we need to enable the adder by giving 1 to it (enbAdd1 = 1). Also, we need to enable the tristate buffer in front of adder for the data of the adder to go into tristate Bus. We need this to grab the data onto the register A (EnbBusA1 = 1).
- So, to take output data of the Adder we need to enable reg A to store the data. So, we enable it (ldA = 1).
- This is the complete operation for the A = B + A. Here A = 79 and B = 15. So, we got A = 94.

*Figure 4: Operation A = B + A*

### 3.2. Operation C = B + D

- Now, to enable this operation we need to enable the adder by giving 1 to it (enbAdd2 = 1). Since this is the second adder. I named it such so. Also, we need to enable the tristate buffer in front of adder for the data of the adder to go into tristate Bus. We need this to grab the data onto the register C (EnbBusA2 = 1).
- So, to take output data of the Adder we need to enable reg C to store the data. So, we enable it (ldC = 1).
- This is the complete operation for the C = B + D.
- Here B = 63 and D = 40. So, we got C = 103.


*Figure 5: Operation C = B + D*

### 3.3.Operation D = C + D

- Now, to enable this operation we need to enable the adder by giving 1 to it (enbAdd3 = 1). Since this is the second adder. I named it such so.
- Also, we need to enable the tristate buffer in front of adder for the data of the adder to go into tristate Bus. We need this to grab the data onto the register D (EnbBusA3 = 1).
- So, to take output data of the Adder we need to enable reg D to store the data. So, we enable it (ldD = 1).
- This is the complete operation for the D = C + D.
- Here C = 103 from previous operation and D = 40. So, we got C = 143.

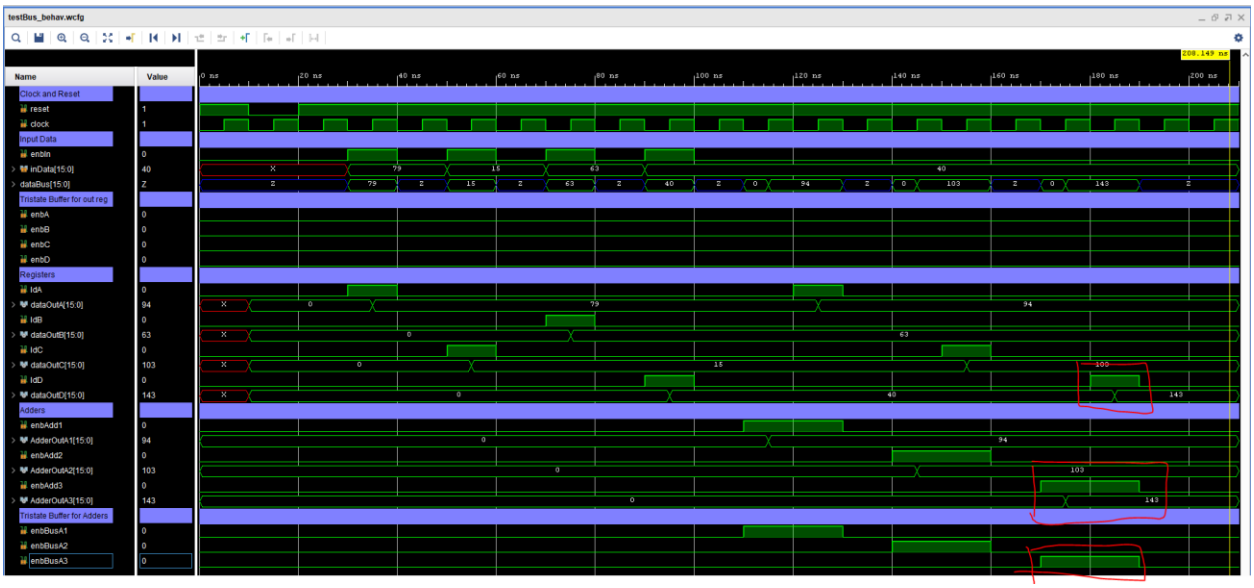


*Figure 6: Operation D = C + D*

## 4. Conclusion:

All three operations required by the task are completed and verified. The operations are working as intended.