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1.0 Objectives

The objective of this report is to study the 74151 and 74153 integrated circuits, their pin diagrams, and their functionalities. Additionally, the report aims to design and implement a digital logic circuit for the function F(A,B,C) = ∑m(1, 3, 4, 6) using both a 4-input MUX and a 2-to-1 MUX along with necessary basic gates. The report will cover the following key points:

1.Familiarize with the pin diagrams of the 74151 and 74153 integrated circuits, understanding their functions and usage in digital systems.

2.Design a digital logic circuit using a 4-input MUX and basic gates to implement the Boolean function F(A,B,C) = ∑m(1, 3, 4, 6). Provide a step-by-step explanation of the circuit design process.

3.Construct a truth table to represent the function F(A,B,C) = ∑m(1, 3, 4, 6) and derive the corresponding input expressions.

2.0 Components

1. Logisim Software
2. AND gate .(74LS08)
3. OR gate . (74LS32)
4. NOT gate. (74LS04)
5. IC 74151 & IC 74153

3.0 Theory

3.1 Definition and Mechanism of Multiplexer (MUX)

A multiplexer (MUX) is a digital electronic device that allows multiple input signals to be transmitted onto a single output line based on control signals. It is often represented as an N-to-1 device, where N represents the number of data inputs and 1 represents the output. The primary function of a multiplexer is to select one of the input lines and pass its data to the output, determined by the select inputs. The mechanism of a MUX can be understood using its basic building blocks - data inputs, select inputs, and output.

Data Inputs: These are the individual lines that carry binary data. The number of data inputs corresponds to the number of select inputs, i.e., for an N-to-1 MUX, there are N data inputs.
Select Inputs: These control the data inputs' selection and determine which input data will be propagated to the output. The number of select inputs is usually log2(N) for an N-to-1 MUX.
Output: The output of the multiplexer is connected to a single line that carries the selected data from one of the input lines based on the select inputs.

3.2 2-to-1 MUX

A 2-to-1 MUX is one of the simplest types of multiplexers and consists of two data inputs (D0 and D1), one output (Y), and one select input (S). The select input (S) determines which data input is passed to the output.

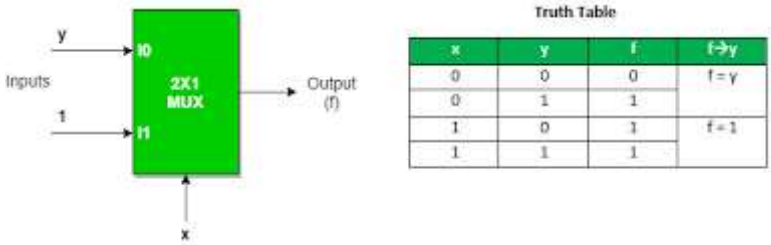


Figure 3.2.1: 2-to-1 MUX and Its Truth Table:

3.3 4-to-1 MUX

A 4-to-1 MUX is a more complex multiplexer with four data inputs (D0, D1, D2, and D3), one output (Y), and two select inputs (S0 and S1). The two select inputs allow the MUX to choose one of the four data inputs to route to the output.

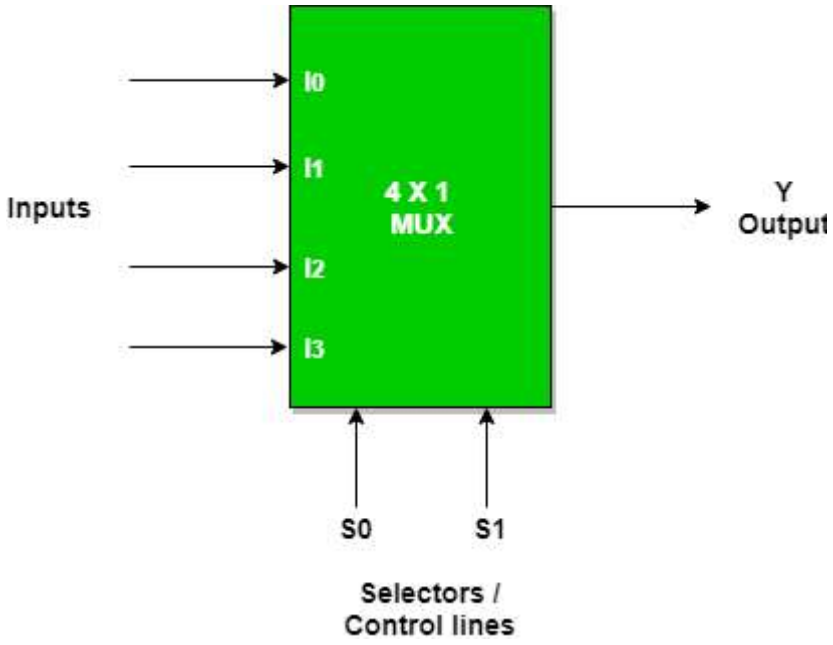


Figure 3.3.1: 4-to-1 MUX and Its Truth Table:

4.0 Problem/Design Solve Procedure

4.1: pin diagram of 74151

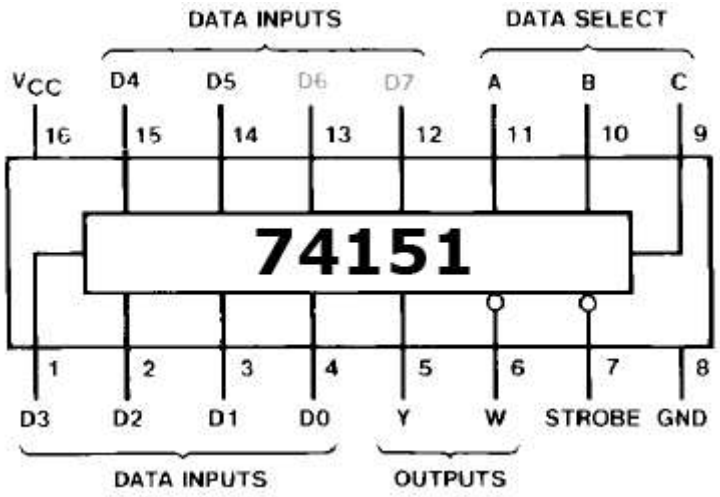


Figure 4.1.1 : Pin diagram of 74151

4.2: pin diagram of 74153

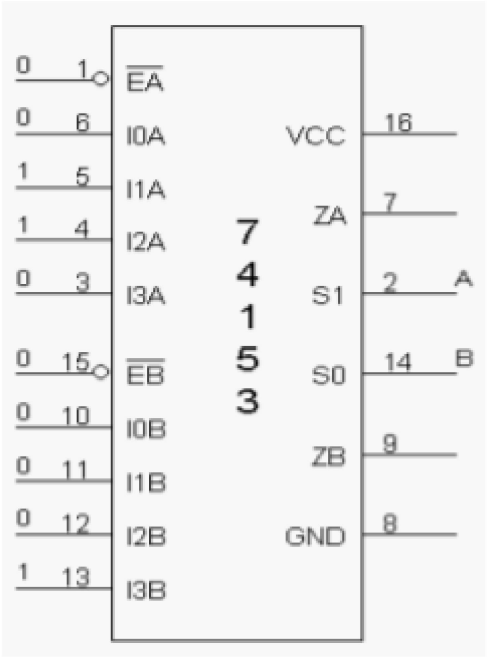


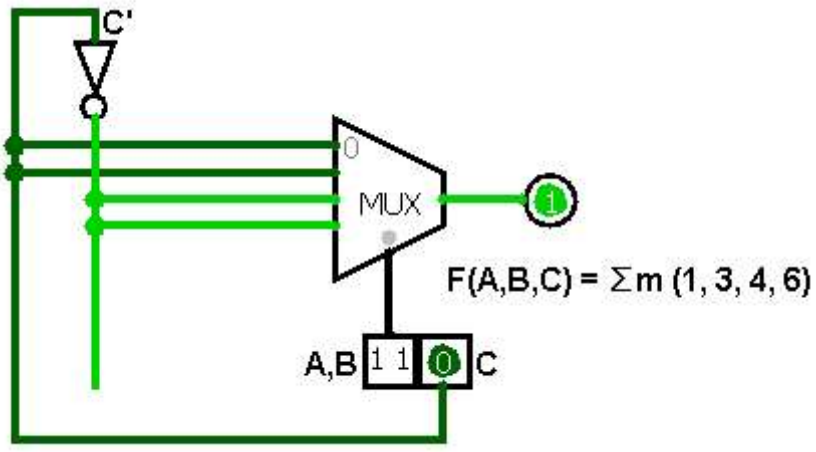
Figure 4.2.1 : Pin diagram of 74153

4.3: F(A,B,C) = ∑m (1, 3, 4, 6) using 4-to-1 MUX

Truth table for **F(A,B,C) = ∑m (1, 3, 4, 6) :**

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Circuit diagram of **F(A,B,C) = ∑m (1, 3, 4, 6) using 4-to-1 MUX:**

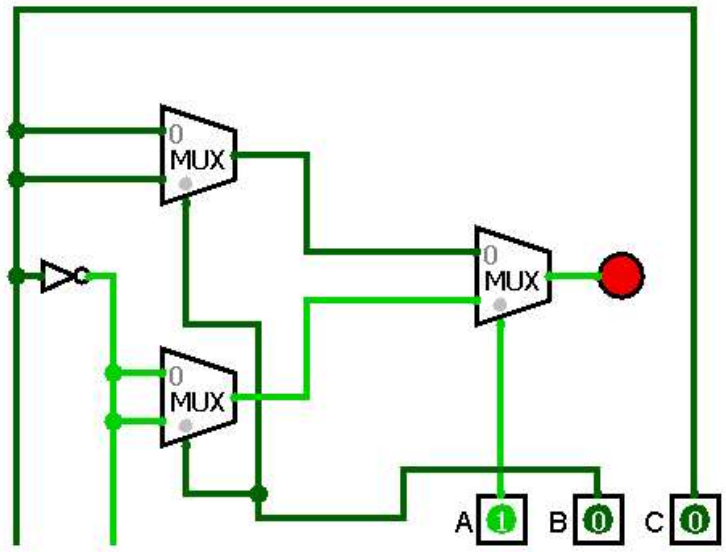


4.4: F(A,B,C) = ∑m (1, 3, 4, 6) using 2-to-1 MUX

Truth table for **F(A,B,C) = ∑m (1, 3, 4, 6) :**

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Circuit diagram of **F(A,B,C) = ∑m (1, 3, 4, 6) using 2-to-1 MUX:**



5.0 Discussion

5.1 What I learnt throughout this experiment

The experiment involving the study of multiplexers (MUX) has provided valuable insights into the functioning and practical applications of these digital devices. Through the experiment, we have accomplished the following outcomes:
Understanding of MUX Mechanism: By studying the 2-to-1 MUX and 4-to-1 MUX, we now have a clear grasp of how these devices operate and select the desired data inputs based on control signals. We have observed that MUX acts as a digital switch, enabling data routing and selection.

1. Truth Tables Interpretation: The truth tables of the 2-to-1 MUX and 4-to-1 MUX have been thoroughly analyzed. We have observed how the control inputs determine the selection of data inputs and their forwarding to the output. This knowledge is essential for designing and analyzing more complex digital circuits.

2. Practical Implementation: The experiment involved the practical implementation of the 2-to-1 MUX and 4-to-1 MUX using appropriate electronic components. This hands-on experience has enhanced our understanding of real-world applications and challenges in using MUX in various electronic systems.

3. Data Selection Techniques: Through the experiment, we have learned the effectiveness of using MUX for data selection and routing in digital circuits. This knowledge is crucial for optimizing the performance and efficiency of complex systems that deal with multiple data inputs.

5.3 The advantages and disadvantages of using MUX

Advantages:

1. Space and Component Efficiency
2. Flexibility
3. Reduced Signal Delay
4. Lower Power Consumption

Disadvantages:

1. Signal Propagation Delay
2. Complexity in Large Multiplexers.
3. Limited Data Input Capacity