Expt. No.: 07

Name of Expt.: Design and Analyze 2X2 Barrel Shifter & Crossbar Switch Shifter and 3X3 Barrel Shifter & Crossbar Switch Shifter on MICROWIND 3.0 software.

Objectives:

1.Design a 2x2 barrel shifter circuit using MICROWIND 3.0 software. And To analyze the functionality and performance characteristics of the 2x2 barrel shifter circuit.
2.To design a 2x2 crossbar switch shifter circuit using MICROWIND 3.0 software.
3.To analyze and compare the functionality and performance of the 2x2 barrel shifter and crossbar switch shifter circuits.
4.To design a 3x3 barrel shifter circuit using MICROWIND 3.0 software.
5.To analyze the functionality and performance characteristics of the 3x3 barrel shifter circuit.
6.To design a 3x3 crossbar switch shifter circuit using MICROWIND 3.0 software.
7.To analyze and compare the functionality and performance of the 3x3 barrel shifter and crossbar switch shifter circuits.
8.To evaluate the scalability and efficiency of the barrel shifter and crossbar switch shifter designs as the size increases from 2x2 to 3x3.

Theory:

Barrel Shifter:
A barrel shifter is a digital circuit that can shift a data word by a specified number of bits in one clock cycle. It is commonly used in computer processors and digital signal processing (DSP) applications. The barrel shifter can perform both logical and arithmetic shifts, allowing for efficient bit manipulation operations. The basic structure of a barrel shifter consists of a set of multiplexers that select the appropriate bits from the input data word based on the shift amount. For an n-bit barrel shifter, the number of multiplexers required is n, with each multiplexer selecting one bit from the input data.

Crossbar Switch Shifter: The crossbar switch shifter is an alternative to the traditional barrel shifter, offering a different approach to bit shifting operations. The crossbar switch shifter uses a matrix of switches to connect the input bits to the output bits, allowing for more flexible and efficient shifting operations. In a crossbar switch shifter, the input bits are connected to the output bits through a series of switches. The switches are controlled by the shift amount, allowing the input bits to be routed to the appropriate output positions. This architecture provides a more scalable and modular design compared to the barrel shifter, as the number of switches can be easily increased to accommodate larger data widths. The crossbar switch shifter can perform both logical and arithmetic shifts, similar to the barrel shifter, but with potentially different performance characteristics and design trade-offs.

Comparison of Barrel Shifter and Crossbar Switch Shifter:
The key differences between the barrel shifter and crossbar switch shifter lie in their design, complexity, and performance characteristics. The barrel shifter typically has a simpler and more compact design, with a fixed number of multiplexers. In contrast, the crossbar switch shifter has a more modular and scalable design, with a variable number of switches. The performance of the two circuits can vary depending on factors such as the data width, the shift amount, and the specific implementation details. Generally, the barrel shifter may have a slightly faster shifting

operation due to its more streamlined design, while the crossbar switch shifter may offer more flexibility and potentially better scalability for larger data widths. The choice between the barrel shifter and crossbar switch shifter depends on the specific requirements of the application, such as the required data width, the frequency of shifting operations, and the overall system design constraints.

Required Apparatus:
1. Computer
2. Microwind Software

Circuit Diagram:

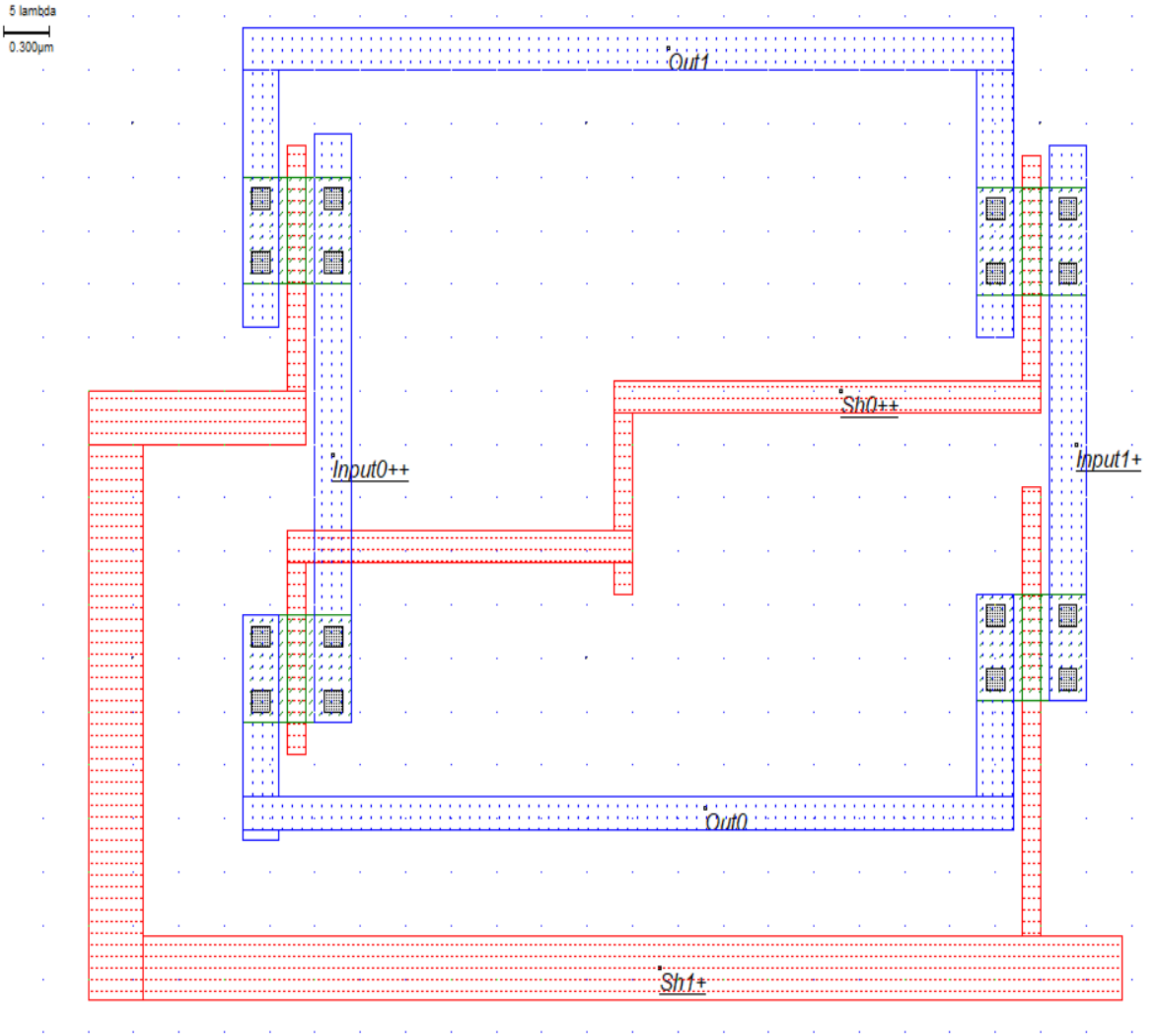

Fig-7.1: 2X2 Barrel Shifter design on MICROWIND 3.0

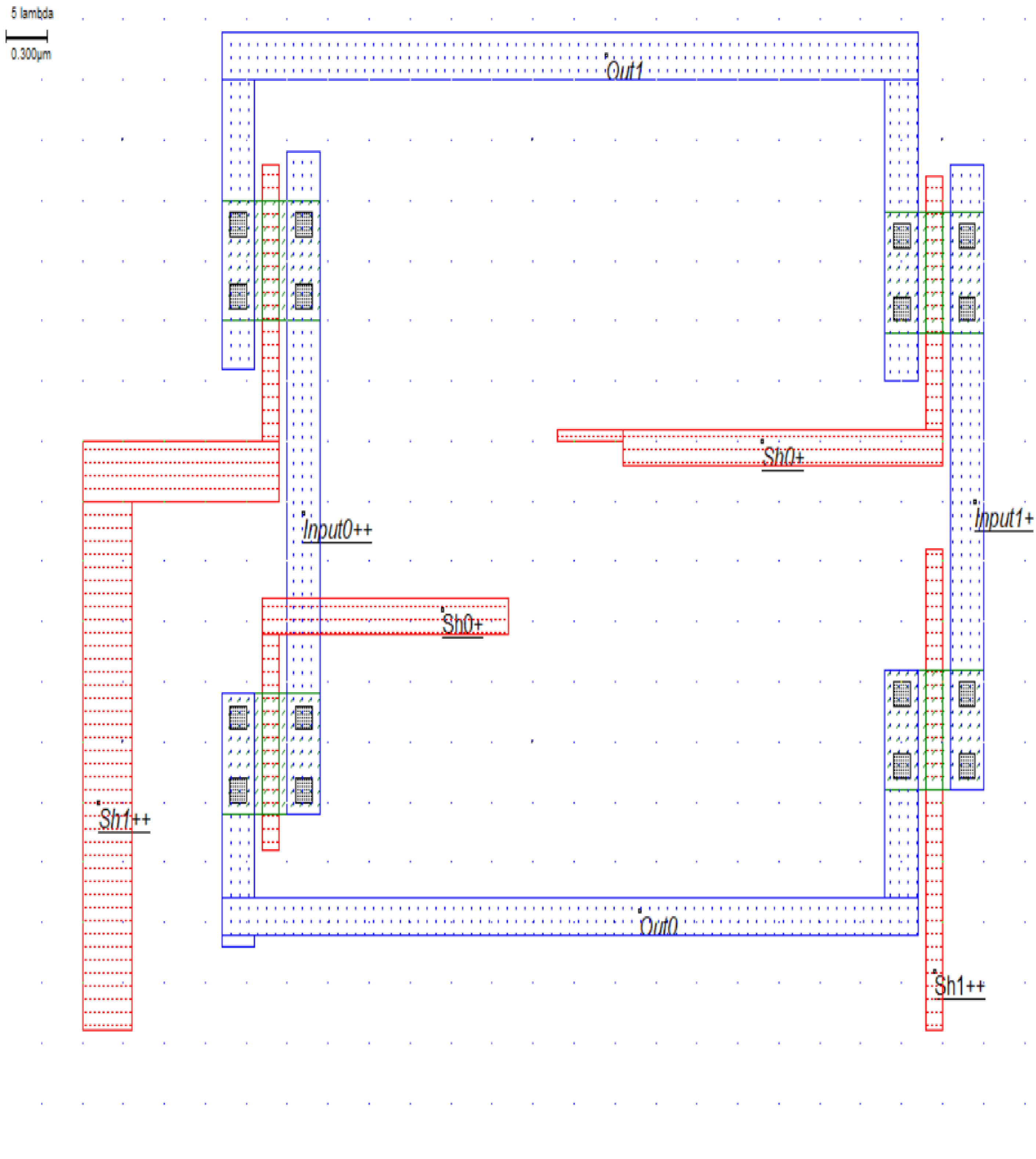

Fig-7.2: 2X2 Crossbar Switch Shifter design on MICROWIND 3.0

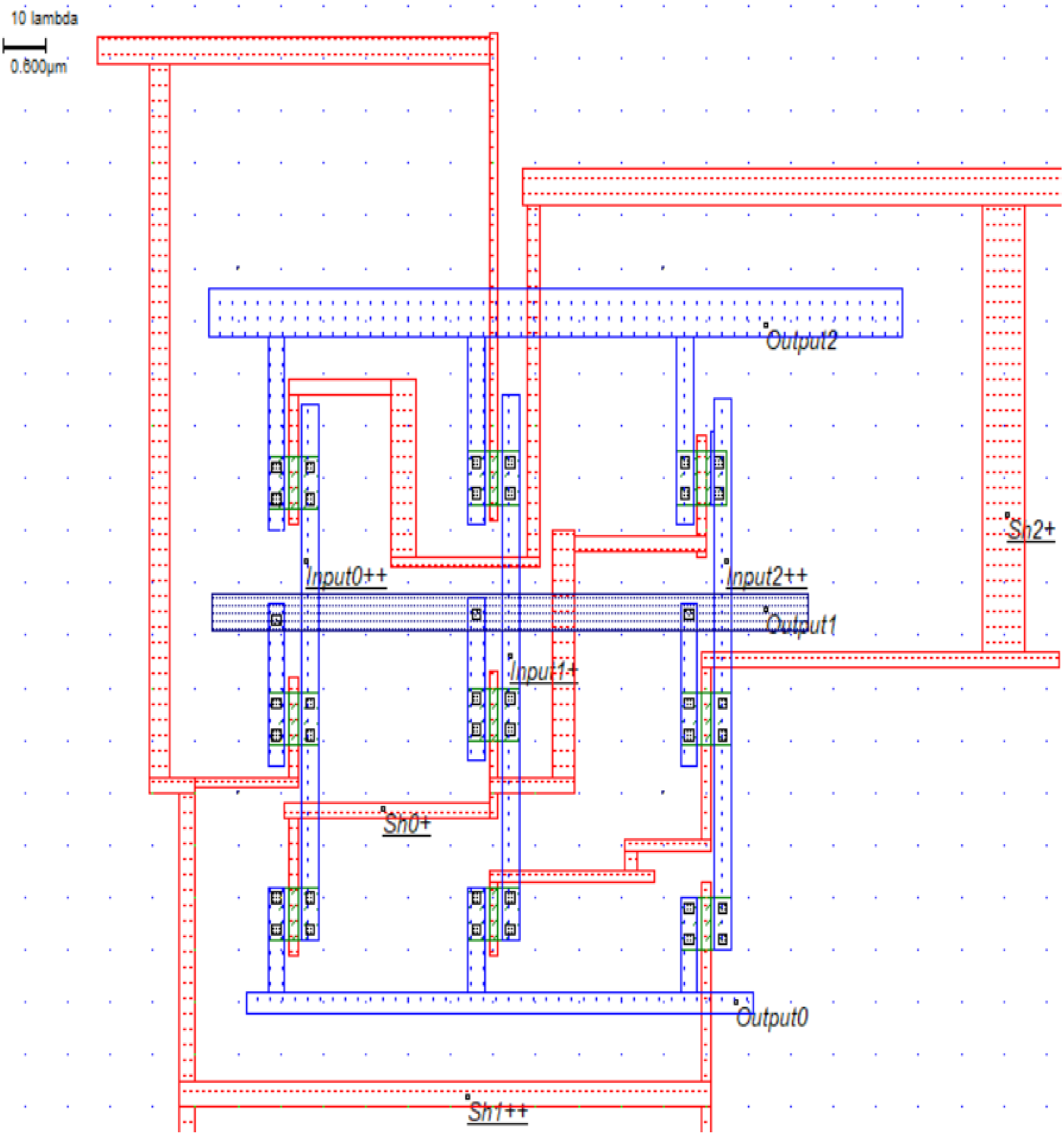

Fig-7.3: 3X3 Barrel Shifter Design on MICROWIND 3.0

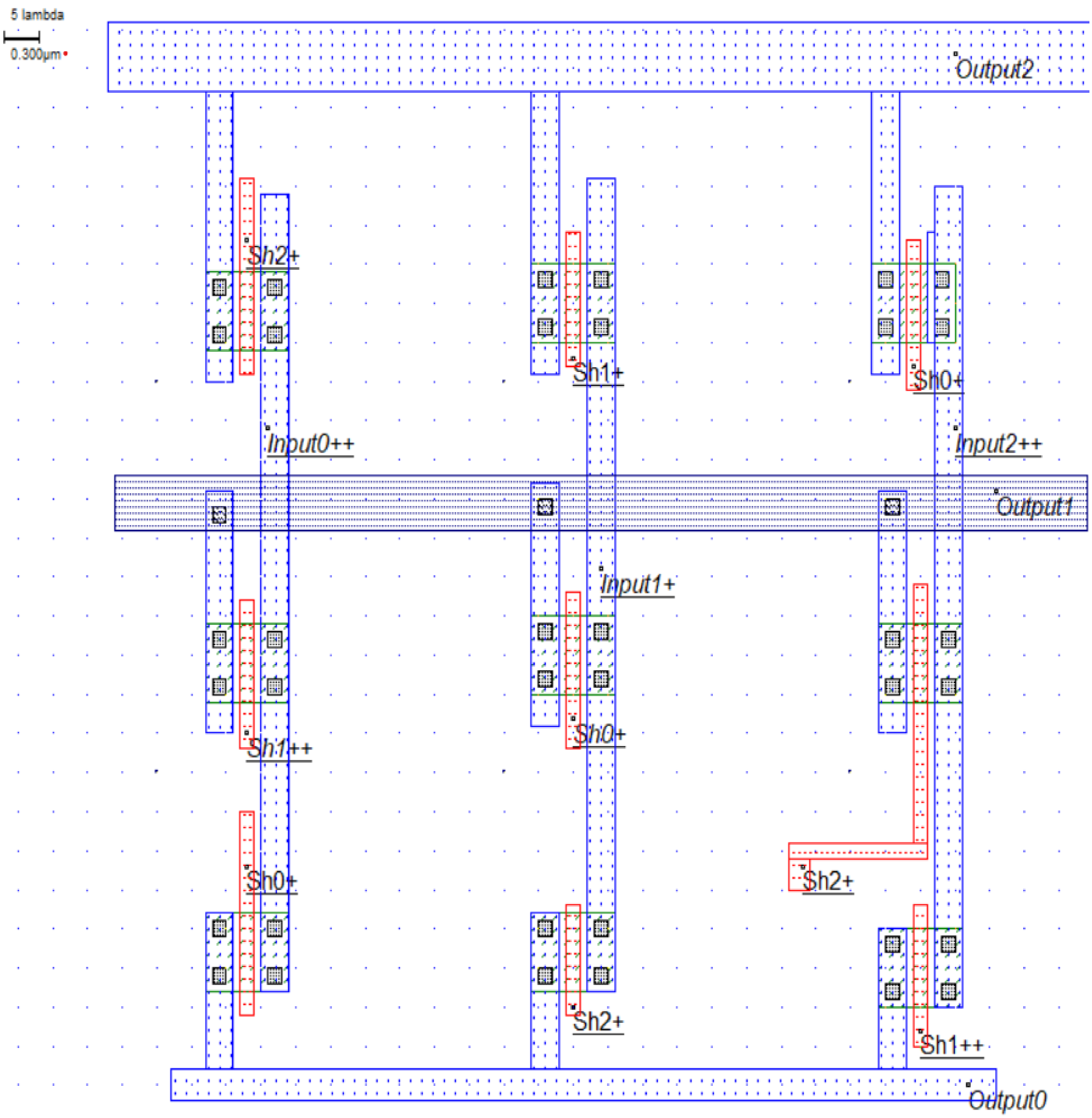

Fig-7.4: 3X3 Crossbar Switch Shifter Design on MICROWIND 3.0

Specification:

For 2X2 Barrel Shifter(1-bit right shift):
5 lambda= 0.300 micrometer; MOS width= 0.600 micrometer, MOS length= 0.120 micrometer

Lebel Name	Input0	Input1	Sh0	Sh1
DC Supply(V)	5.00	0.00	0.00	5.00

For 2X2 Crossbar Switch Shifter(1-bit right shift):
5 lambda = 0.300 micrometer; MOS width= 0.600 micrometer, MOS length= 0.120 micrometer

Lebel Name	Input0	Input1	Sh0	Sh1
DC Supply(V)	5.00	0.00	0.00	5.00

For 3X3 Barrel Shifter(1-bit right shift):
10 lambda=0.600 micrometer; MOS width= 0.600 micrometer, MOS length= 0.120 micrometer

Lebel Name	Input0	Input1	Input2	Sh0	Sh1	Sh2
DC Supply(V)	5.00	0.00	5.00	0.00	5.00	0.00

For 3X3 Crossbar Switch Shifter(1-bit right shift):
5 lambda=0.300 micrometer; MOS width= 0.600 micrometer, MOS length= 0.120 micrometer

Lebel Name	Input0	Input1	Input2	Sh0	Sh1	Sh2
DC Supply(V)	5.00	0.00	5.00	0.00	5.00	0.00

Output Wave-Shape:

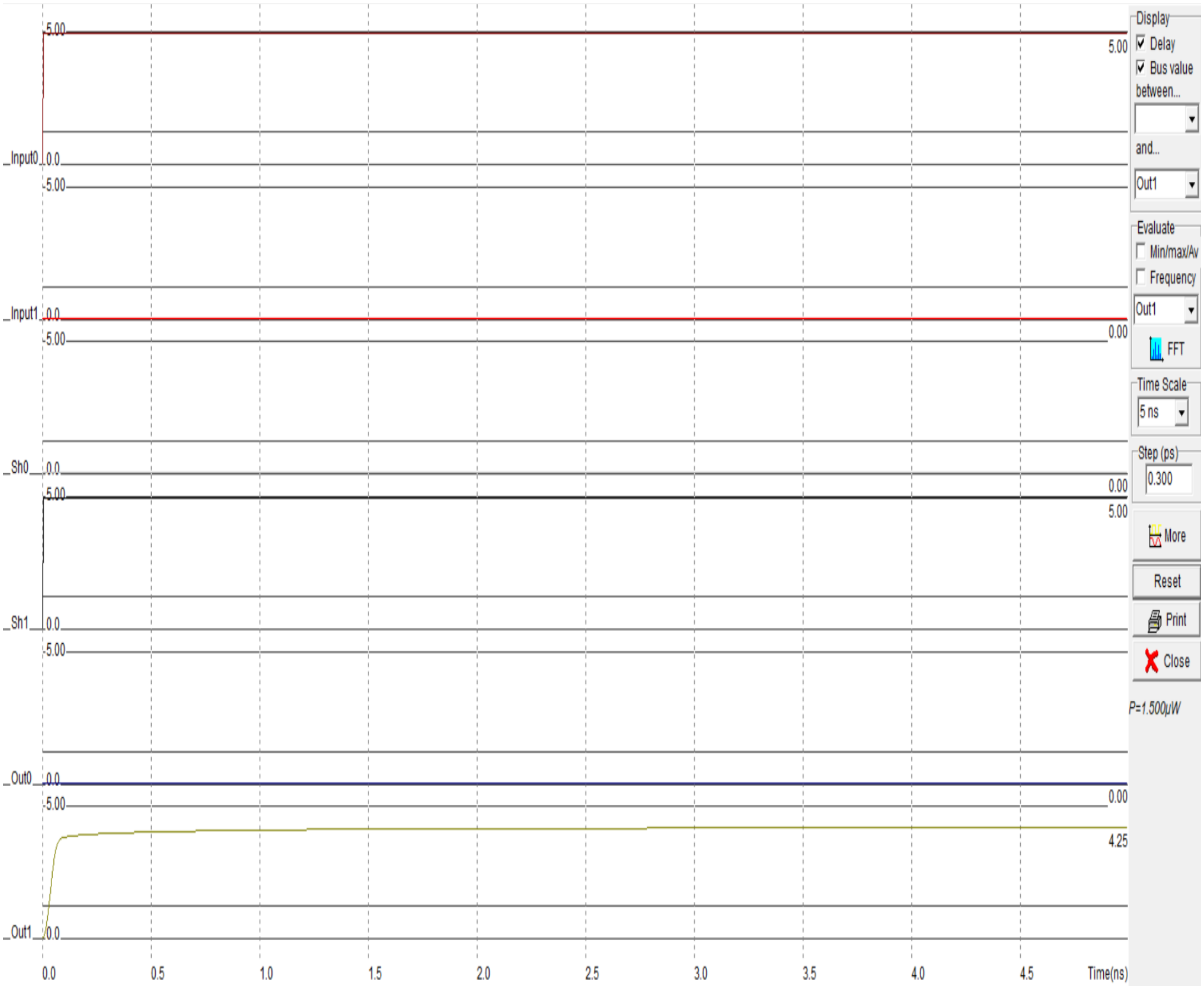

Fig-7.5: Output Wave-shape of 2X2 Barrel Shifter(1-bit right shift)

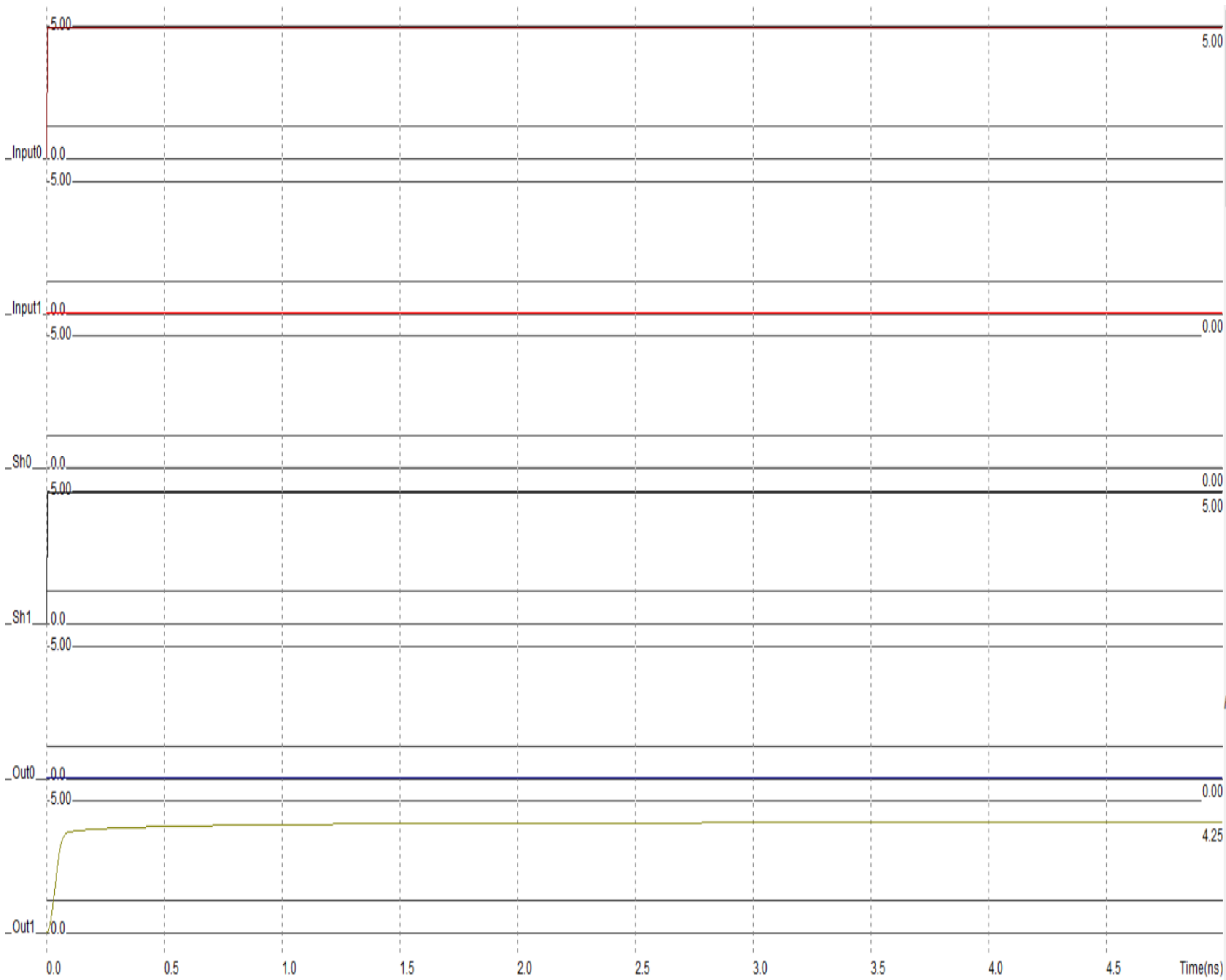

Fig-7.6: Output Wave-shape of 2X2 Crossbar Switch Shifter(1-bit right shift)

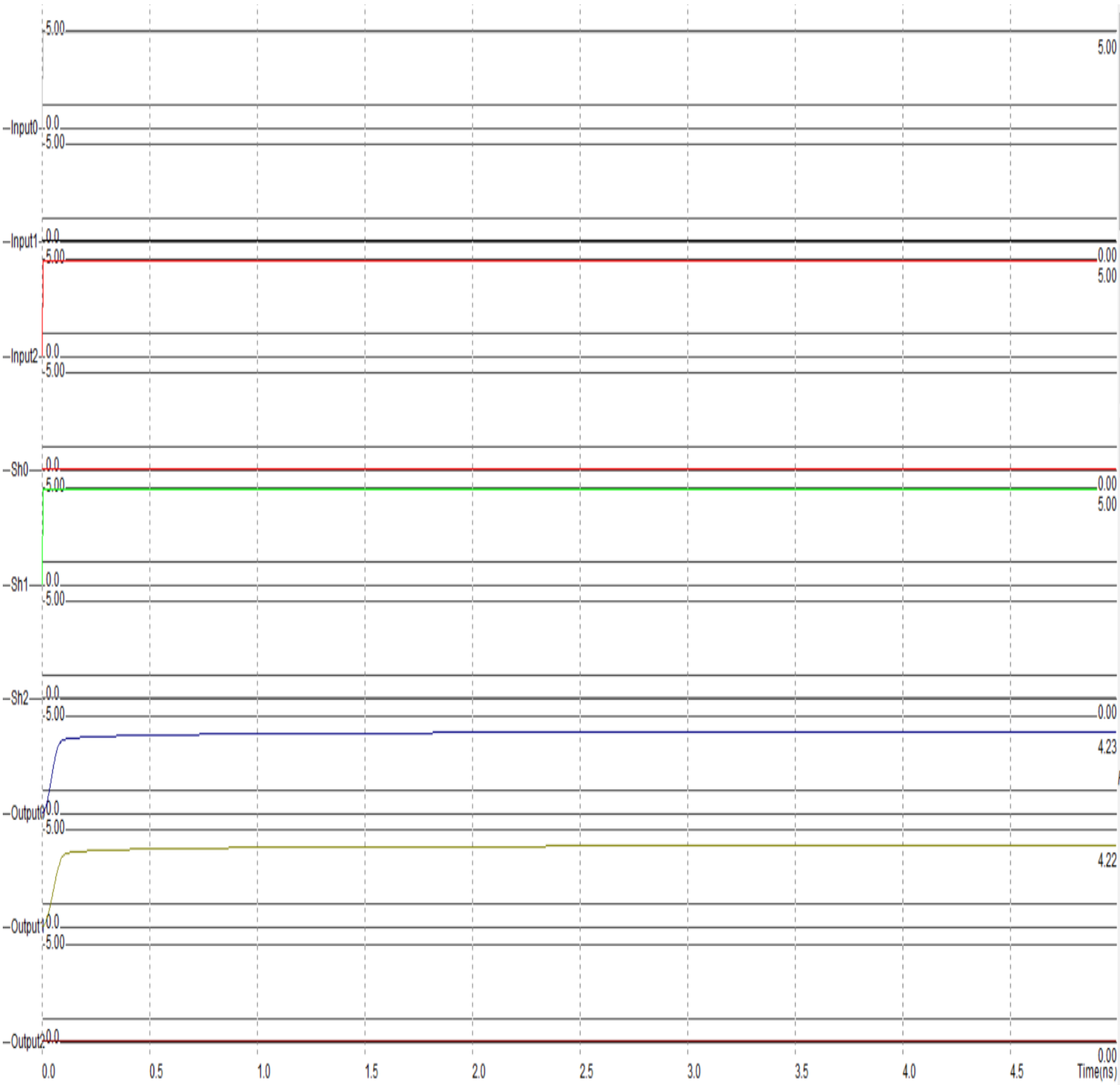

Fig-7.7: Output Wave-shape of 3X3 Barrel Shifter(1-bit right shift)

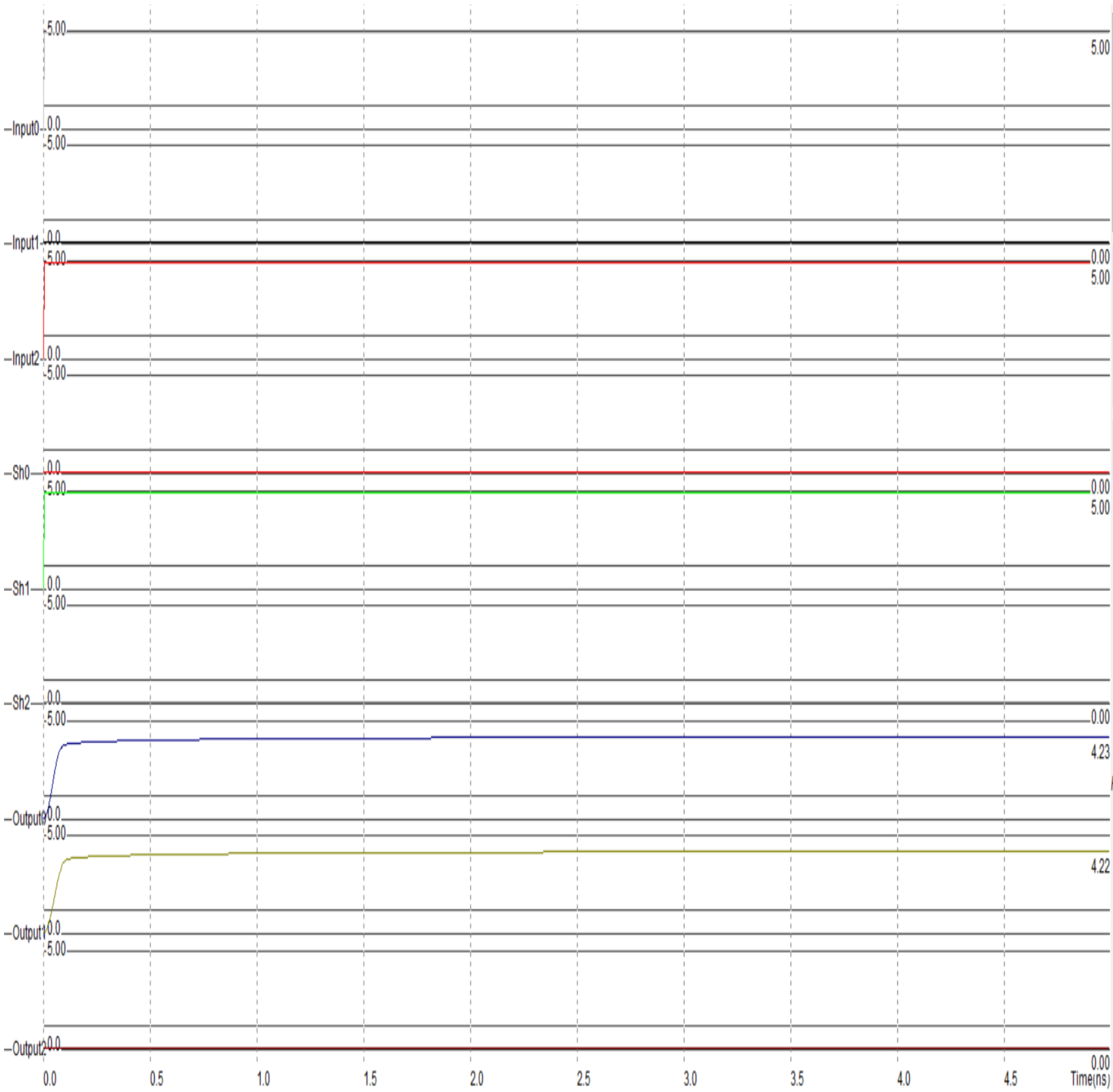

Fig-7.7: Output Wave-shape of 3X3 Crossbar Switch Shifter(1-bit right shift)

Discussion:

In the 2x2 barrel shifter and crossbar switch shifter experiments, the observed output voltages during the 1-bit right shifting operation did not match the expected values. For the 2x2 barrel shifter, when the input was set to Input_0 = 5.00 V and Input_1 = 0.00 V, the expected output for Output_1 was 5.00 V. However, the observed value was 4.25 V, which is lower than the expected value. This mismatch between the expected and observed output voltages can be attributed to the voltage drop and signal attenuation that occurs within the digital circuit. In a real-world implementation, the digital logic gates and interconnections in the barrel shifter circuit introduce some resistance and capacitance, which can lead to voltage drops and signal degradation. Additionally, the MICROWIND 3.0 software may not perfectly model the behavior of the digital circuits, and there could be some discrepancies between the simulated and actual circuit performance.

Similar observations were made in the 1-bit shifting at 3x3 barrel shifter and crossbar switch shifter experiments. When the input was set to Input_0 = 5.00 V, Input_1 = 0.00 V, and Input_2 = 5.00 V, the expected output for Output_0 and Output_1 was 5.00 V. However, the observed values were 4.23 V and 4.22 V, respectively, which are lower than the expected values. The reasons for this mismatch are the same as those discussed for the 2x2 shifter circuits. The voltage drops and signal attenuation within the digital logic gates and interconnections, as well as potential limitations in the MICROWIND 3.0 software's modeling accuracy, can contribute to the observed discrepancies between the expected and actual output voltages.

It is important to note that these voltage discrepancies are relatively small and may not have a significant impact on the overall functionality of the barrel shifter and crossbar switch shifter circuits. In real-world applications, the digital logic circuits are designed to operate reliably within a certain voltage range, and the observed voltage drops may be within the acceptable tolerance levels.

Conclusion:

In this experiment, we successfully designed and analyzed both the 2x2 and 3x3 barrel shifters and crossbar switch shifters using MICROWIND 3.0 software. The implementation of these digital circuits demonstrated the effectiveness of shifter designs in data routing and manipulation within integrated circuits.The 2x2 barrel shifter and crossbar switch shifter were evaluated for their functionality and performance metrics, including propagation delay, power consumption, and area efficiency. The results indicated that both designs met the expected operational criteria, showcasing the ability to shift and route data effectively with minimal delay. The crossbar switch shifter, in particular, exhibited superior flexibility in connecting multiple inputs to outputs, making it a valuable component in larger digital systems. Similarly, the 3x3 barrel shifter and crossbar switch shifter were analyzed, revealing an increase in complexity and performance capabilities. The 3x3 designs maintained efficient data handling while accommodating a larger set of inputs and outputs. The analysis highlighted the trade-offs between increased functionality and resource utilization, emphasizing the importance of optimizing designs for specific applications. Overall, the experiments conducted in this lab provided valuable insights into the design principles and operational characteristics of barrel shifters and crossbar switch shifters. The use of MICROWIND 3.0 facilitated a comprehensive understanding of the circuit behavior, allowing for effective simulation and analysis. Future work could explore further optimizations and the integration of these shifters into larger digital systems, as well as the potential for implementing advanced features such as error correction and adaptive routing.