

Lab 6 Report

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Contents

1	1-bit Arithmetic Circuit	1
1.1	Full Adder	1
1.2	Operand Logic	2
1.3	1-bit Logic Circuit	2
2	ALU	2
2.1	Arithmetic circuit	2
2.2	Logic Circuit	3
2.3	4-bit ALU	4

1 1-bit Arithmetic Circuit

1.1 Full Adder

C_0	A	B	C_1	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Table 1: Full Adder Truth Table

Sum of Product Equations:

$$C_1 = \sum m(3, 5, 6, 7)$$

$$S = \sum m(1, 2, 4, 7)$$

K-mapping:

C_1	00	01	11	10
0	0	0	1	0
1	0	1	1	1

Table 2: C1 Kmap

S	00	01	11	10
0	0	1	0	1
1	1	0	1	0

Table 3: S Kmap

Kmap Equations:

$$C_1 = AB + C_0B + C_0A$$

$$S = \bar{C}_0\bar{A}B + \bar{C}_0A\bar{B} + C_0\bar{A}\bar{B} + C_0AB$$

1.2 Operand Logic

QuartusFiles/Operand

1.3 1-bit Logic Circuit

S_1	S_0	Operation	Function
0	0	$G = AB$	A AND B
0	1	$G = A + B$	A OR B
1	0	$G = A \oplus B$	A XOR B
1	1	$G = \bar{A}$	NOT A

Table 4: Function Table

2 ALU

2.1 Arithmetic circuit

QuartusFiles/Arithm

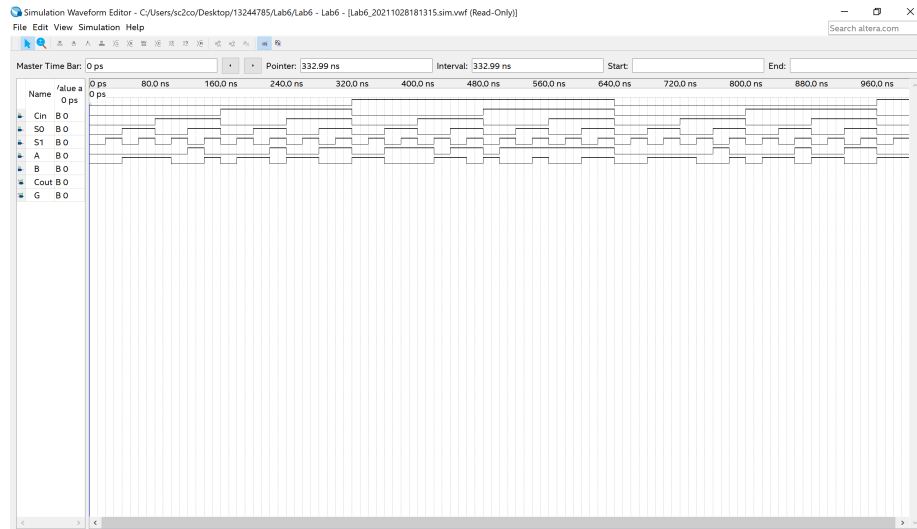


Figure 1: Verification

2.2 Logic Circuit

Operation	S_1	S_0	A	B	G
A AND B	0	0	0	0	0
			0	1	0
			1	0	0
			1	1	1
A OR B	0	1	0	0	0
			0	1	1
			1	0	1
			1	1	1
A XOR B	1	0	0	0	0
			0	1	1
			1	0	1
			1	1	0
NOT A	1	1	0	0	1
			0	1	1
			1	0	0
			1	1	0

Table 5: Expected Outputs

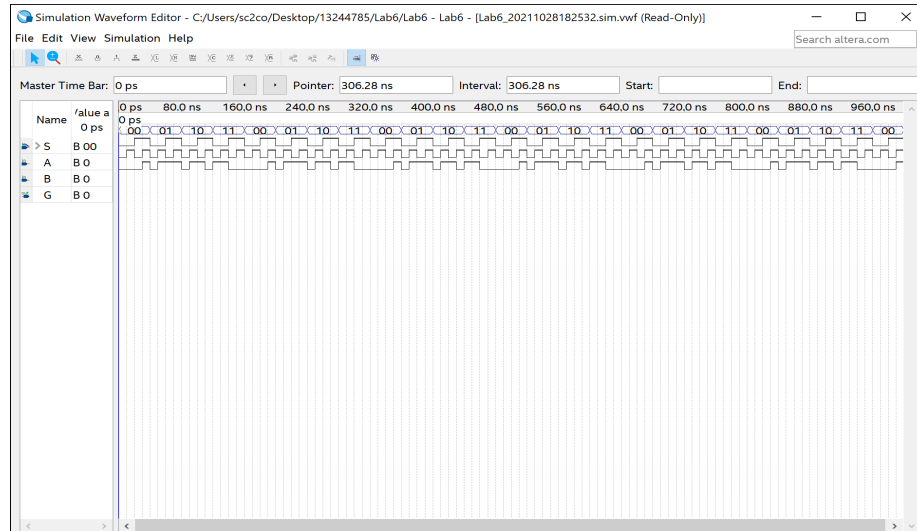


Figure 2: Verification

2.3 4-bit ALU

Description	S_2	S_1	S_0	C_0	C_{in}	A	B	G	C_{out}
Transfer	0	0	0	X	0	0x5	X	0x5	0
Addition	0	0	1	X	0	0x5	0x6	0x11	0
							0xC	0x1	1
Subtraction	0	1	0	X	1	0x5	0x4	0x1	1
							0x6	0xF	0
Increment A	0	0	0	X	1	0x5	X	0x6	0
Decrement A	0	1	1	X	0	0x5	0x3	0x4	1
A AND B	1	X	0	0	X	0x5	0x3	0x1	X
A OR B	1	X	0	1	X	0x5	0x3	0x7	X
A XOR B	1	X	1	0	X	0x5	0x3	0x6	X
NOT A	1	X	1	1	X	0x5	X	0xA	X

Table 6: Functional Table

For the purpose of X I used a random value to check that functionality wasn't affected.

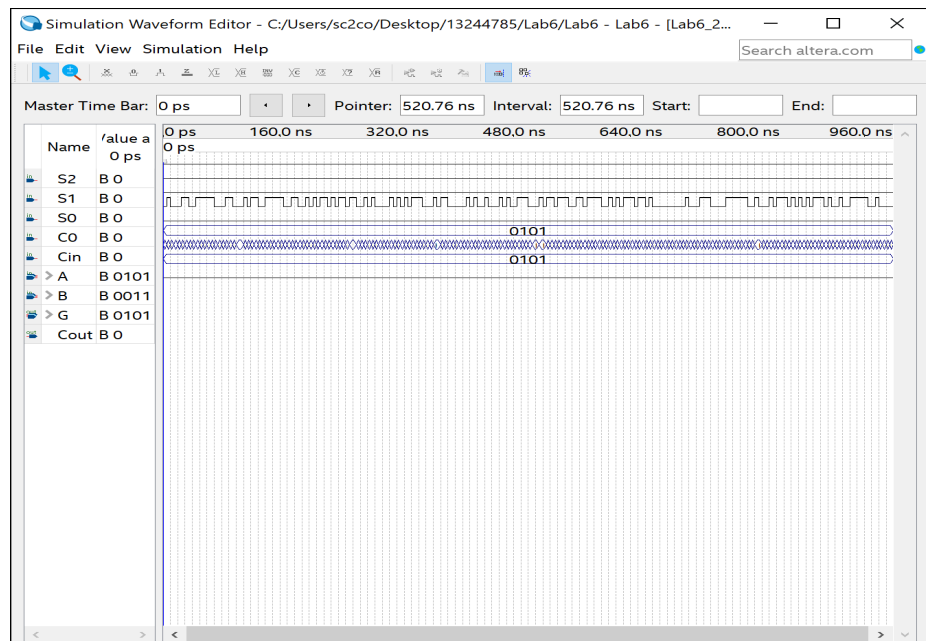


Figure 3: Transfer

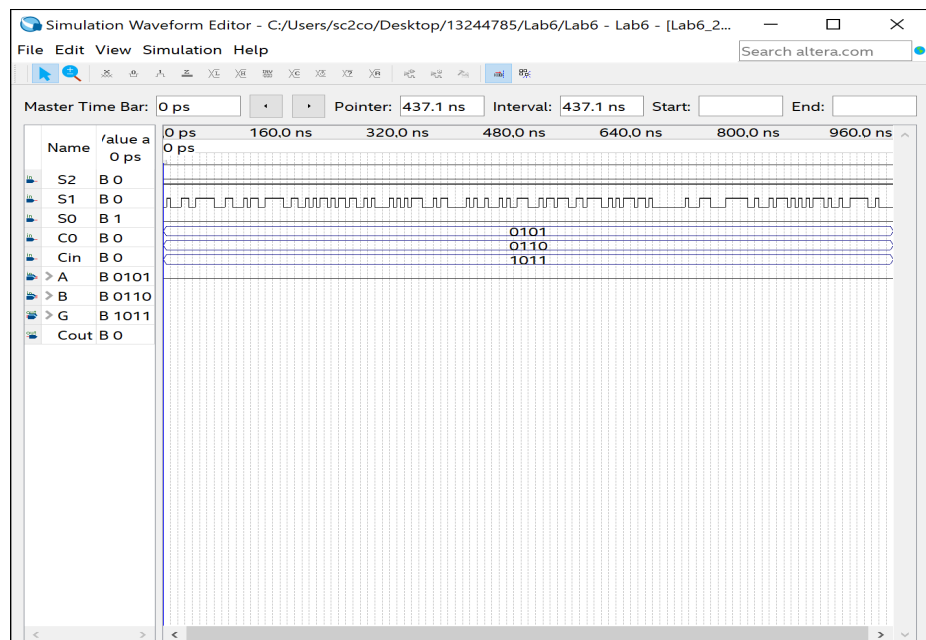


Figure 4: Addition 1

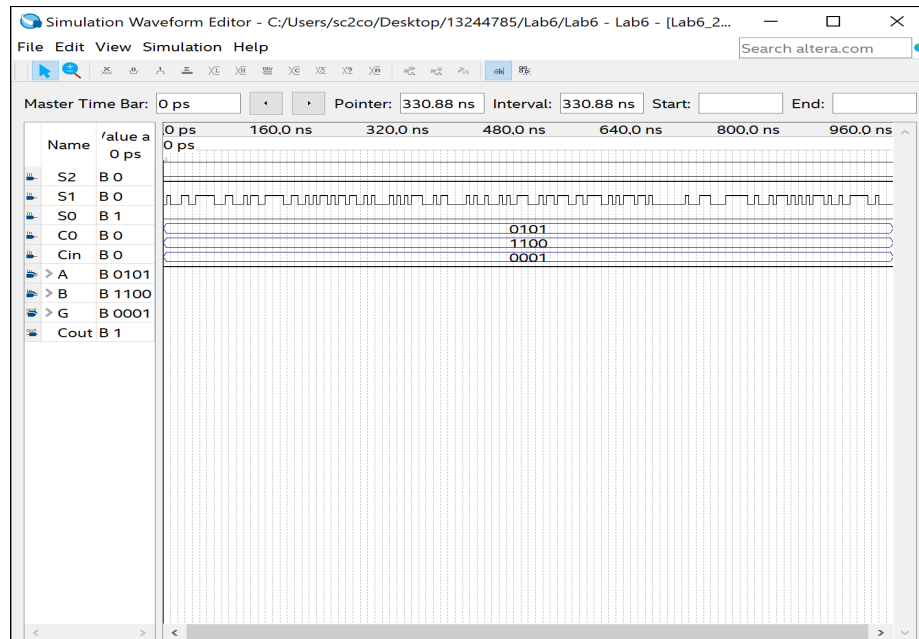


Figure 5: Addition 2

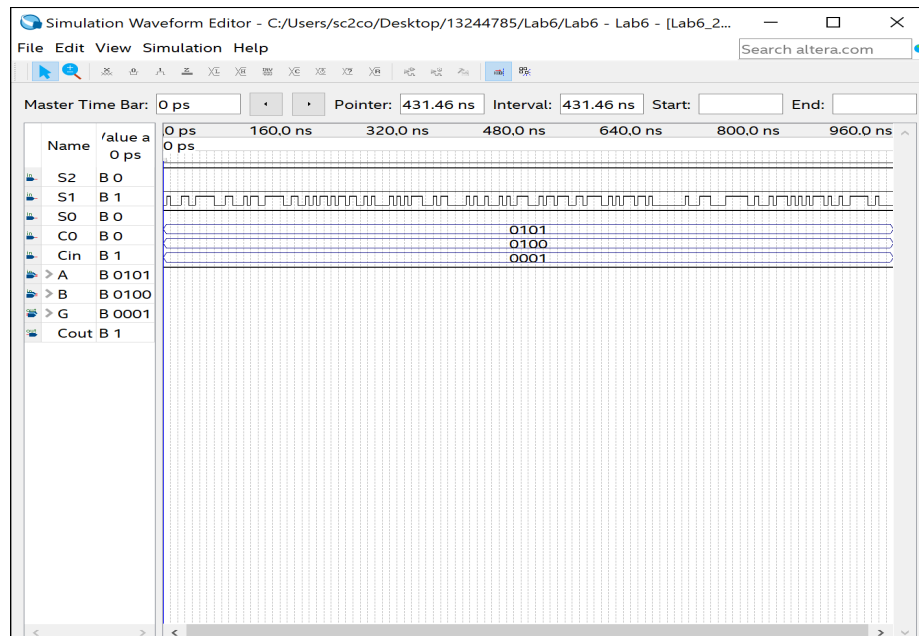


Figure 6: Subtraction 1

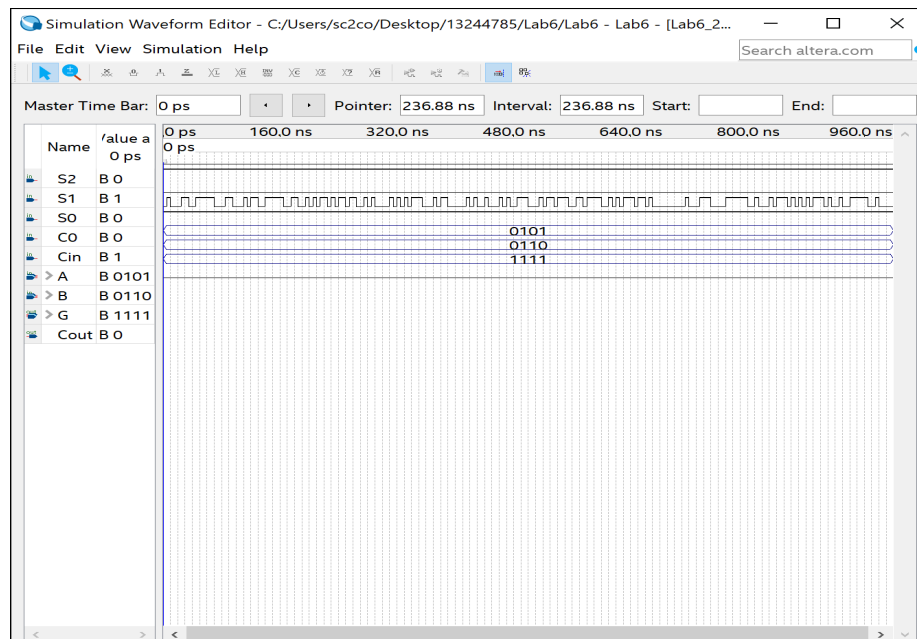


Figure 7: Subtraction 2

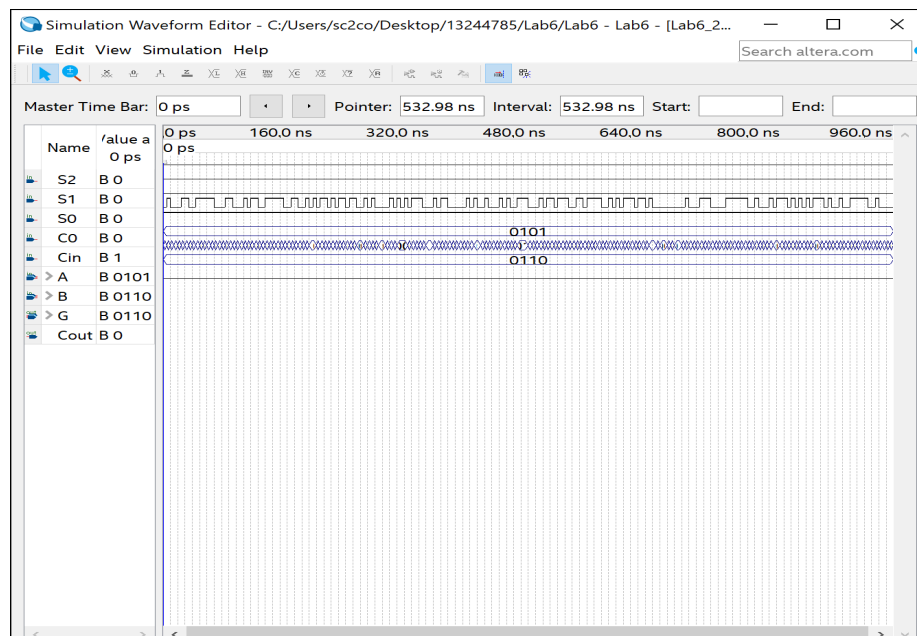


Figure 8: Increment

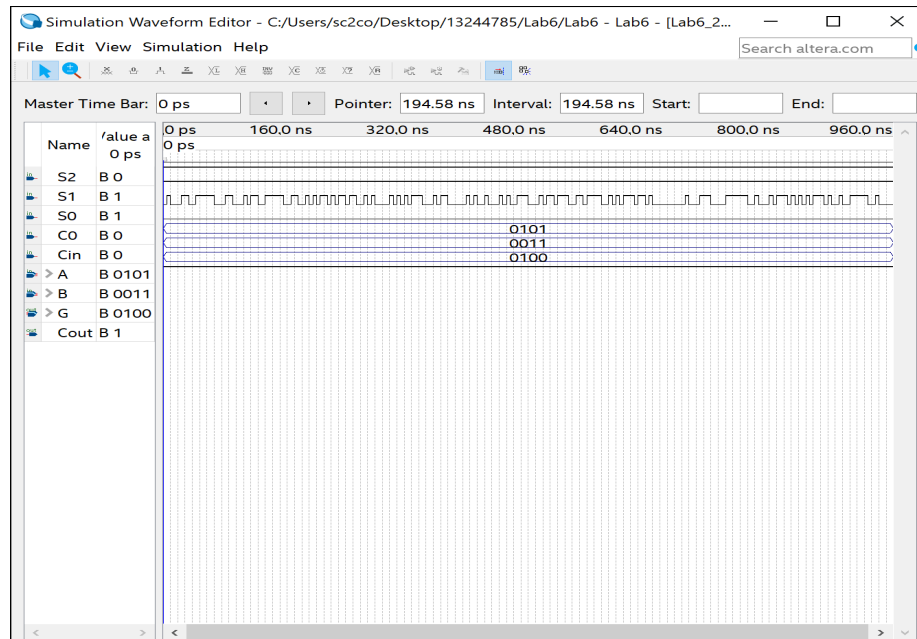


Figure 9: Decrement

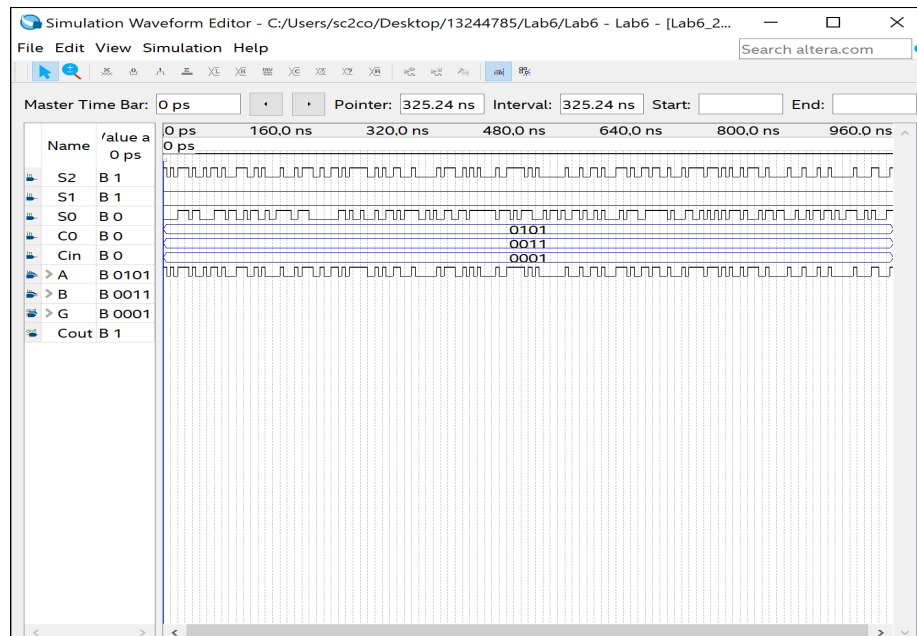


Figure 10: AB

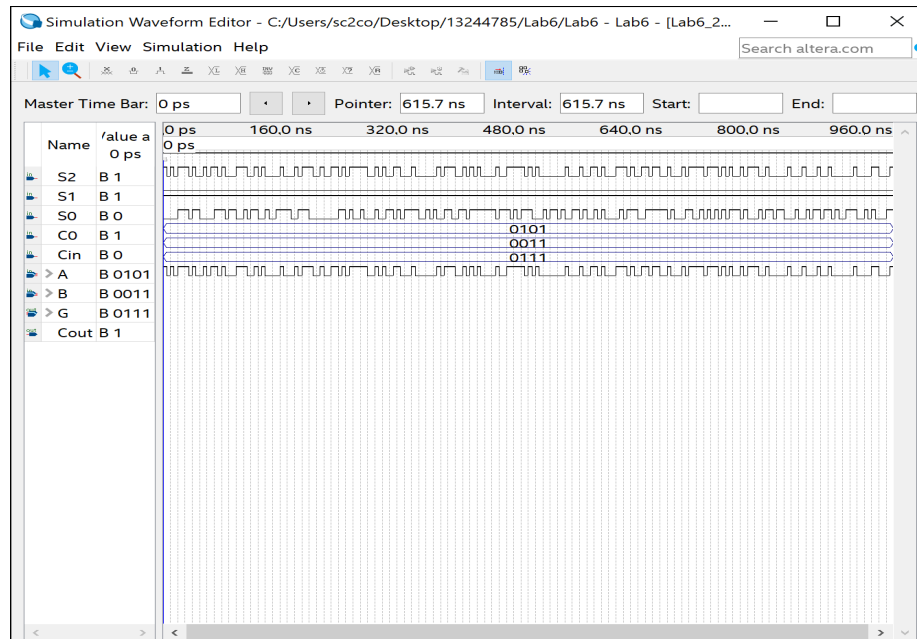


Figure 11: $A + B$

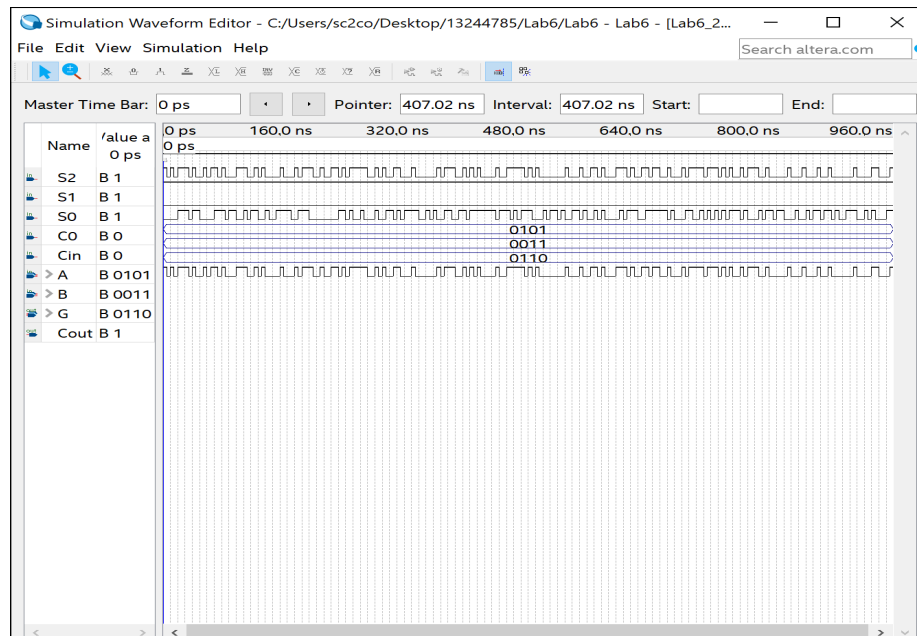


Figure 12: $A \oplus B$

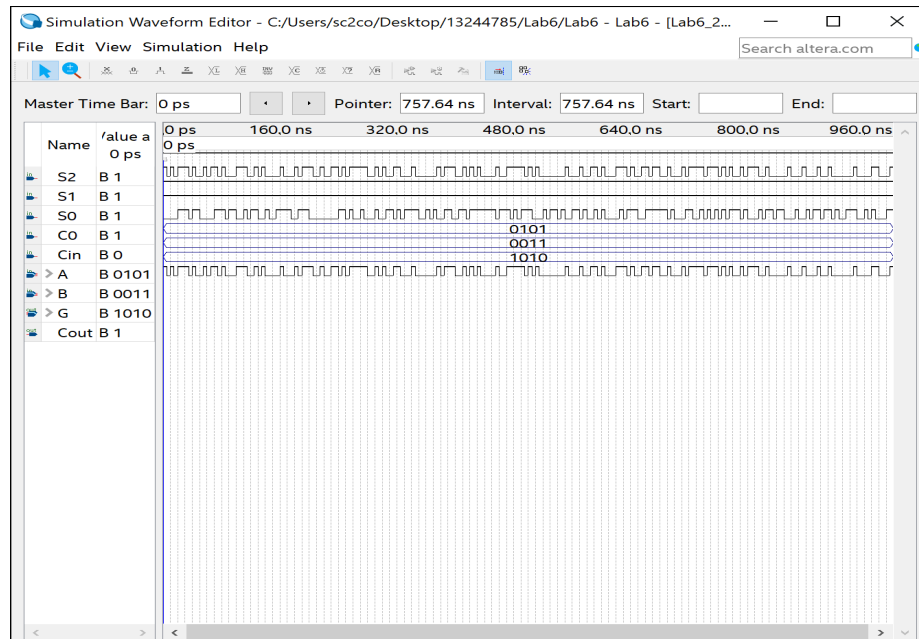


Figure 13: \bar{A}