ATHENS UNIVERSITY
OF ECONOMICS
AND BUSINESS
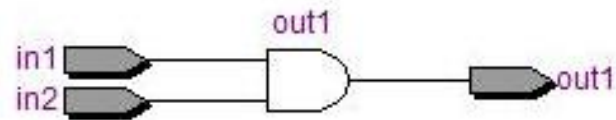
Αρχιτεκτονική Υπολογιστών

ΠΡΩΤΗ ΕΡΓΑΣΙΑ
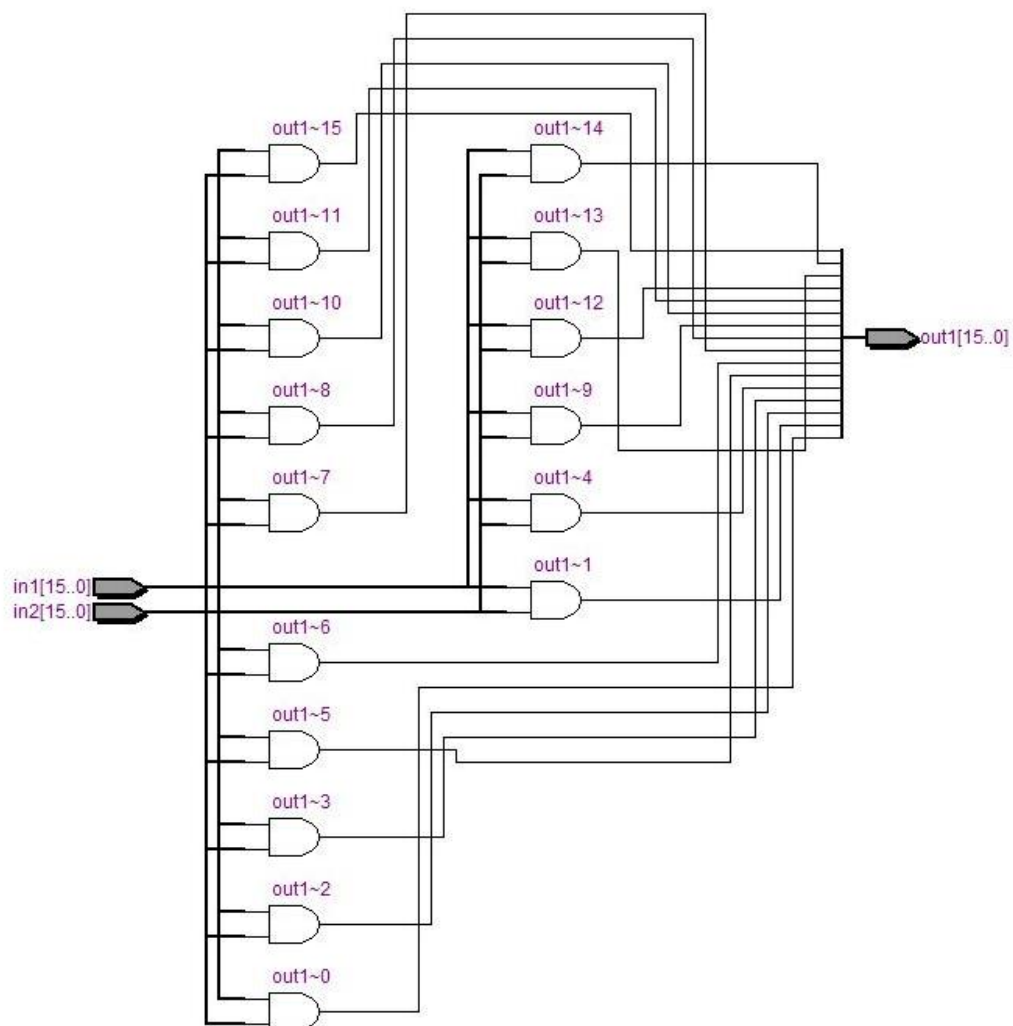
Στεφάνου Δημήτριος 3160245
Σωτηροπούλου Δικαία 3160172
Ομάδα 15

2021

RTLs

AND Gate

AND Gate (16 bits)

NOT Gate (16bits)

in1[15..0] ▷○ out1[15..0]

OR Gate (3 inputs)

in3
in1   out1~1 ▷ out1
in2

OR Gate (16 bits)

out1~13   out1~15
out1~11   out1~14
out1~10   out1~12
out1~9   out1~6
out1~8   out1~5
                 out1~2
in1[15..0]
in2[15..0]
out1~7
out1~4
out1~3
out1~1
out1~0

out1[15..0]
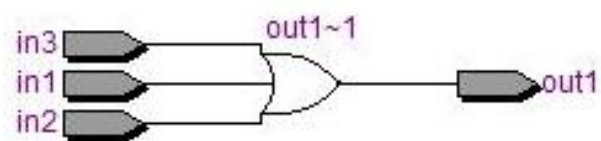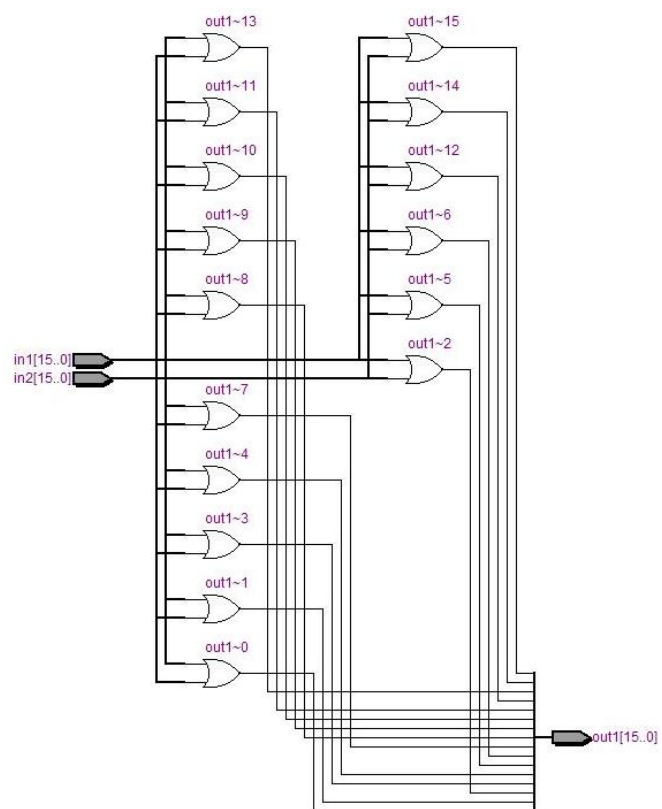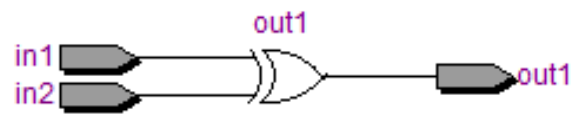
XOR Gate

XOR Gate (3 inputs)

NOT (ALU implementation)

Two's Complement
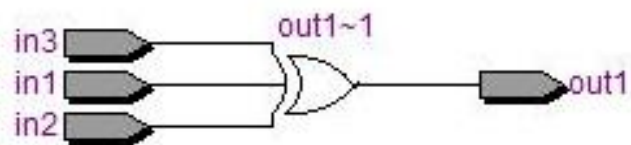
Full Adder (1 bit)

Full Adder (16 bits)

Multiplexer 2 to 1 (16 bits)

Multiplexer 8 to 1

2021

ALU (16 bits)

Waveforms

AND Waveform

AND (16 bit) Waveform)

NOT (16 bit) Waveform

OR (3 inputs) Waveform
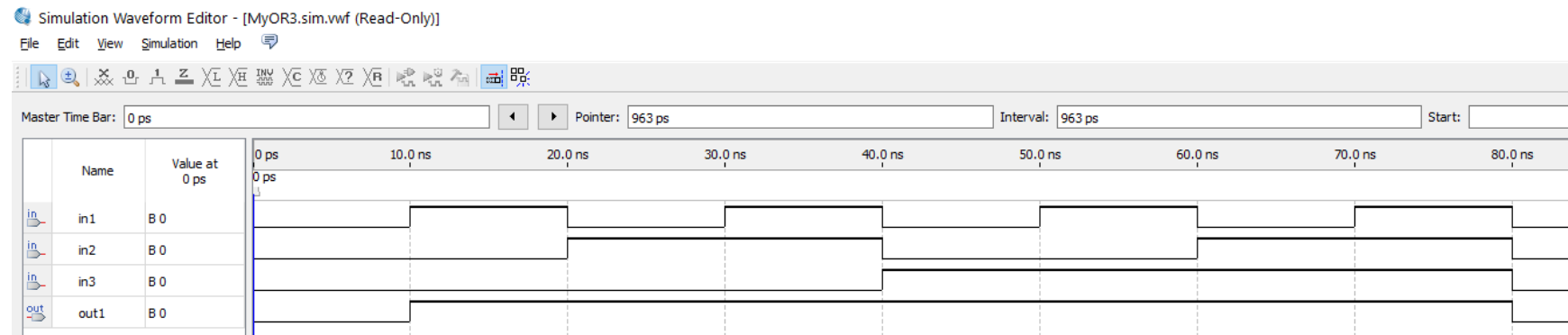
OR (16 bits) Waveform
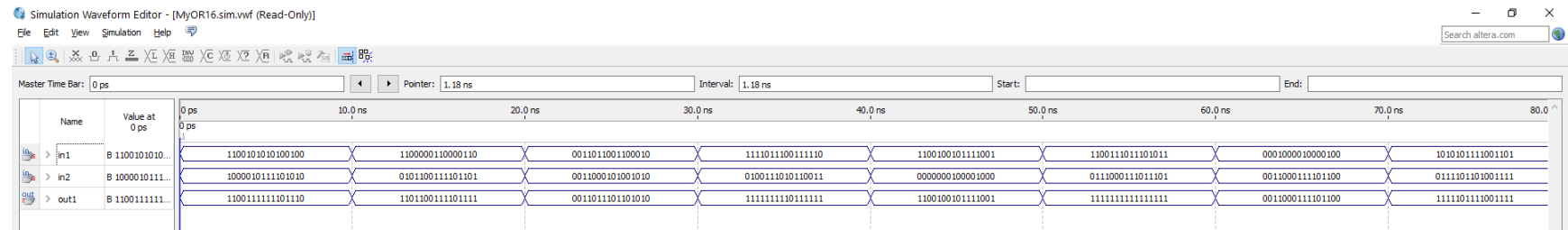
XOR Waveform
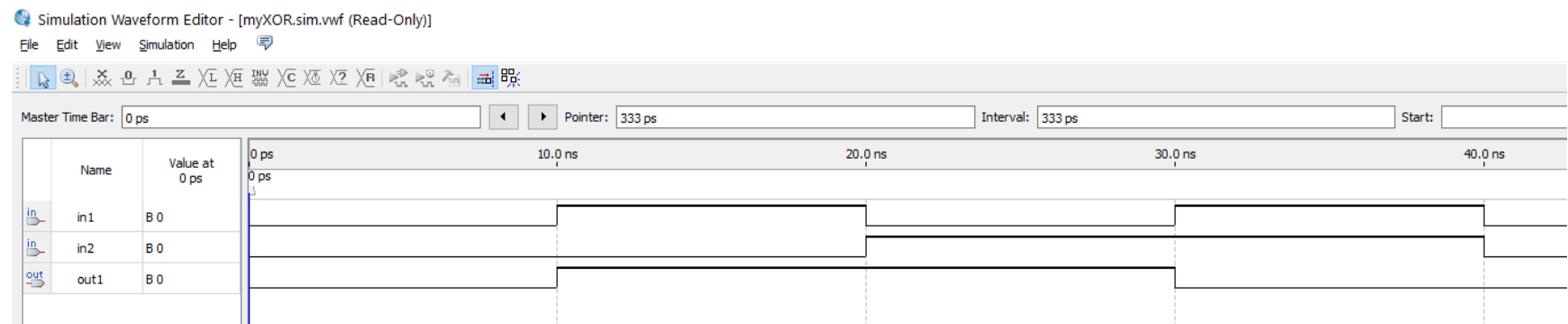
XOR (3 inputs) Waveform

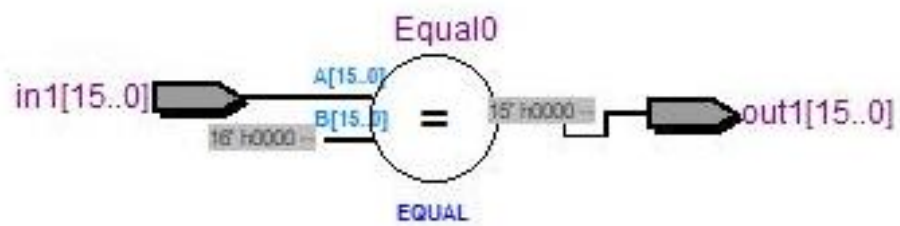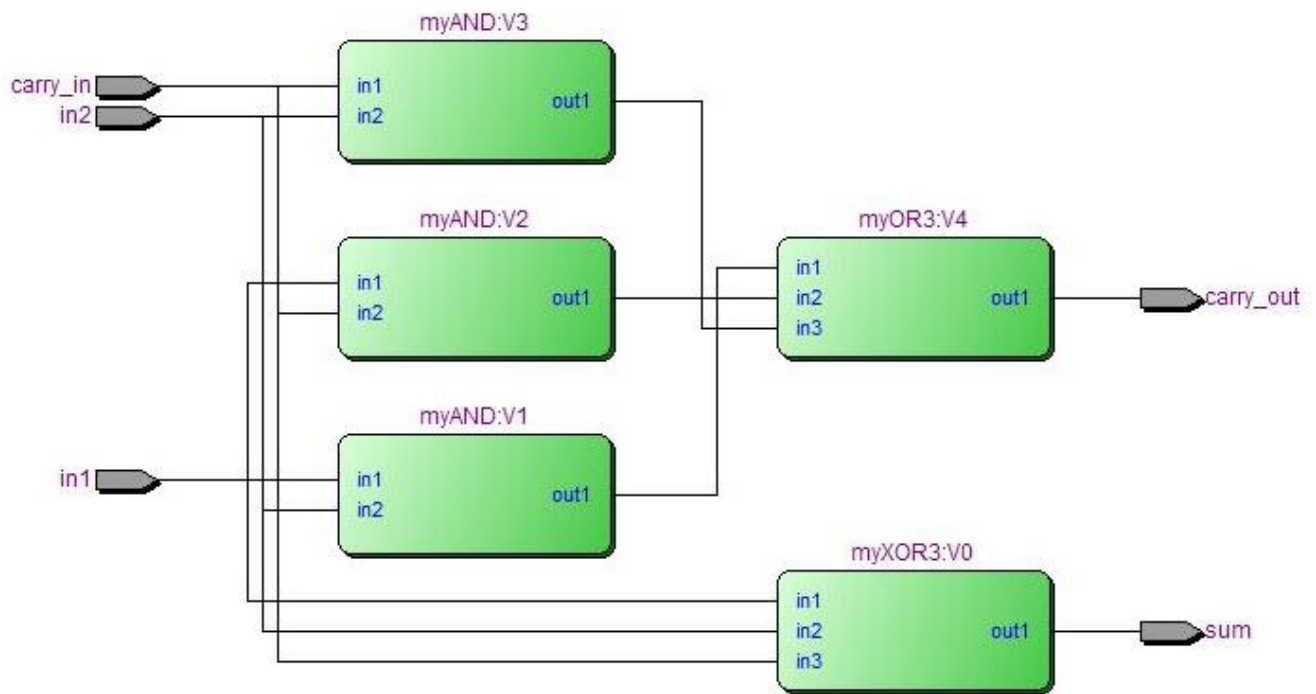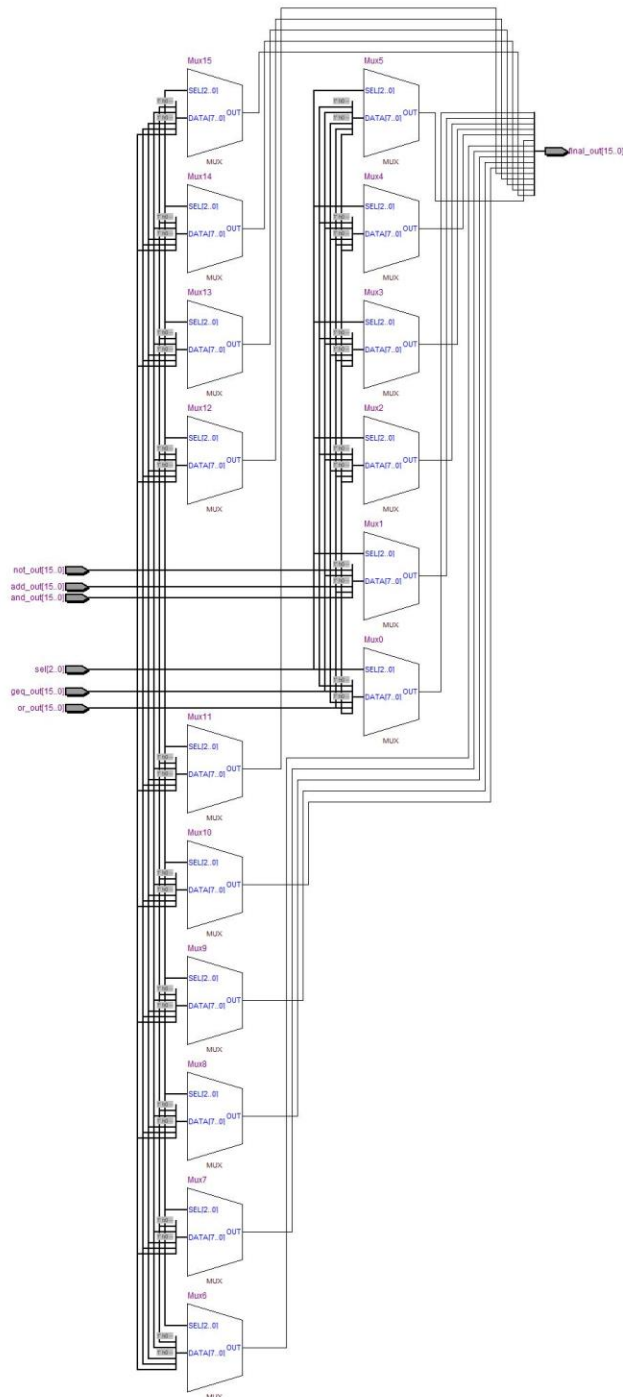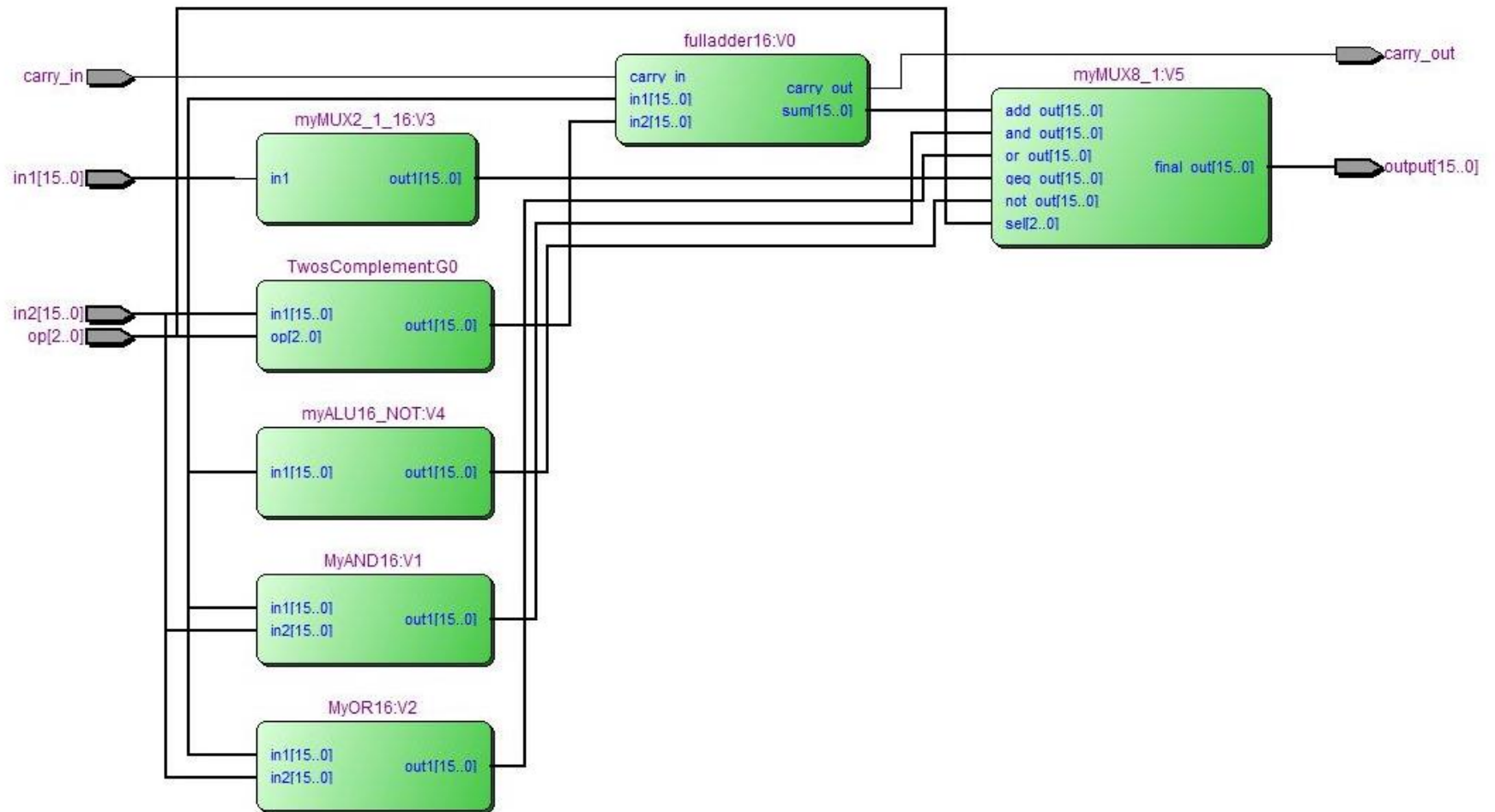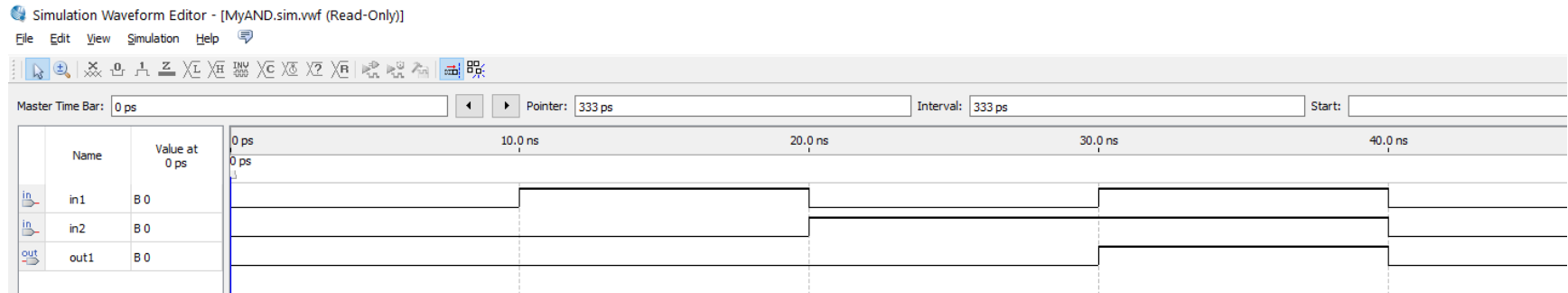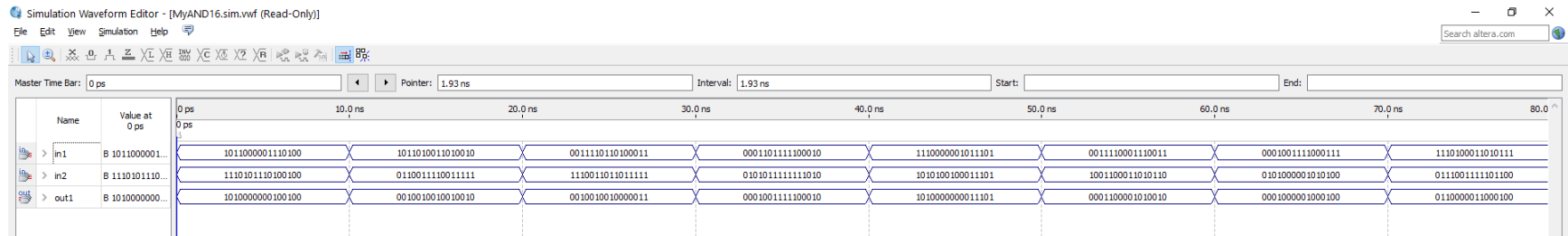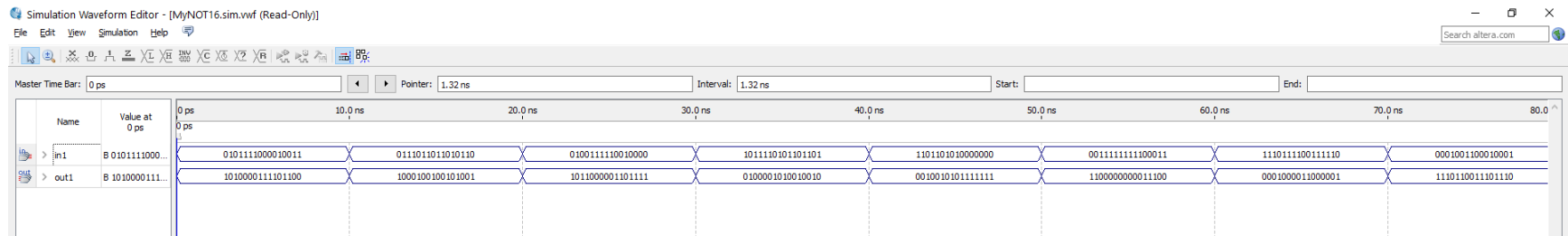Simulation Waveform Editor - [MyXOR3.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help

Master Time Bar: 0 ps   Pointer: 444 ps   Interval: 444 ps   Start:

Name	Value at 0 ps								
		0 ps	10.0 ns	20.0 ns	30.0 ns	40.0 ns	50.0 ns	60.0 ns	70.0 ns	80.0 ns
in1	B 0								
in2	B 0								
in3	B 0								
out1	B 0								
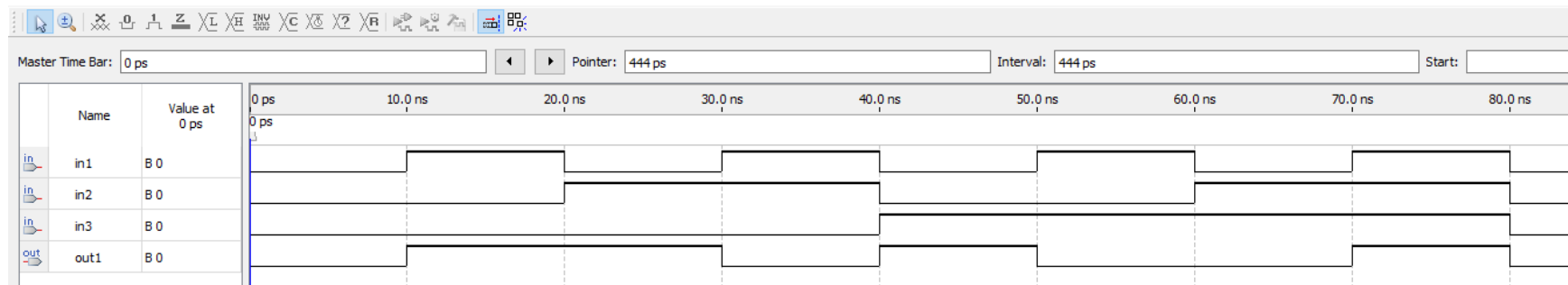
NOT (ALU implementation) Waveform

Simulation Waveform Editor - [MyALU16_NOT.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help

Master Time Bar: 0 ps   Pointer: 987 ps   Interval: 987 ps   Start: End:

Name	Value at 0 ps	0 ps	10.0 ns	20.0 ns	30.0 ns	40.0 ns	50.0 ns	60.0 ns	70.0 ns	80.0
in1	B 1100001111...	1100001111101000	0000000000000000	0010100100010011	1000011111001110	0101110101111101	1110001000101100	0011100110000010	0000000100000001
out1	B 0000000000...	0000000000000000	0000000000000001			0000000000000000			
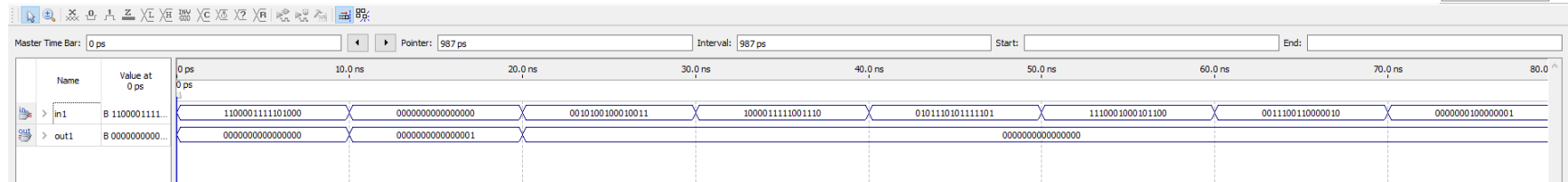
Two's Complement

Simulation Waveform Editor - [TwosComplement.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help

Master Time Bar: 0 ps   Pointer: 141 ps   Interval: 141 ps   Start: 0 ps   End: 0 ps

Name	Value at 0 ps	0 ps	10.0 ns	20.0 ns	30.0 ns	40.0 ns	50.0 ns	60.0 ns	70.0 ns	80.0
in1	S -23109	-23109	-14786	24611	-12858	24721	-2779	5487	-29099
op	B 011				011				
out1	S 23109	23109	14786	-24611	12858	-24721	2779	-5487	29099
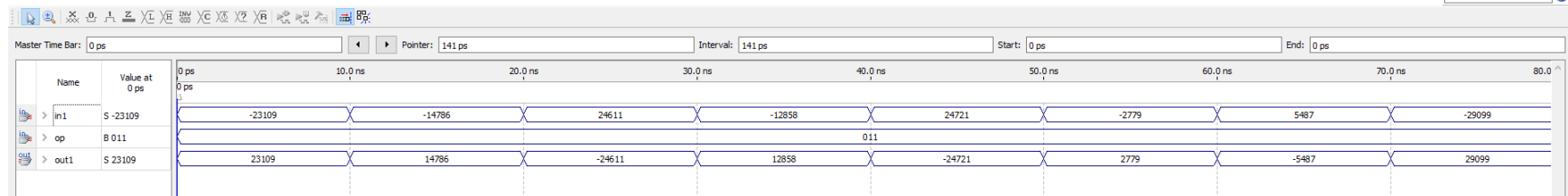
Multiplexer 2 to 1 (16 bit)

Simulation Waveform Editor - [MyMUX2_1_16.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help

Master Time Bar: 0 ps   ◀ ▶   Pointer: 37 ps   Interval:

	Name	Value at 0 ps	0 ps	10.0 ns	20.0 ns
in	in1	B 0			
out	out1	B 1111111111...	1111111111111111	0000000000000000	

Full Adder (1 bit) Waveform

Simulation Waveform Editor - [FullAdder.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help

Master Time Bar: 0 ps   ◀ ▶   Pointer: 74 ps   Interval: 74 ps   Start:

	Name	Value at 0 ps	0 ps	10.0 ns	20.0 ns	30.0 ns	40.0 ns	50.0 ns	60.0 ns	70.0 ns	80.0 ns
in	in1	B 0									
in	in2	B 0									
in	carry_in	B 0									
out	sum	B 0									
out	carry_out	B 0									

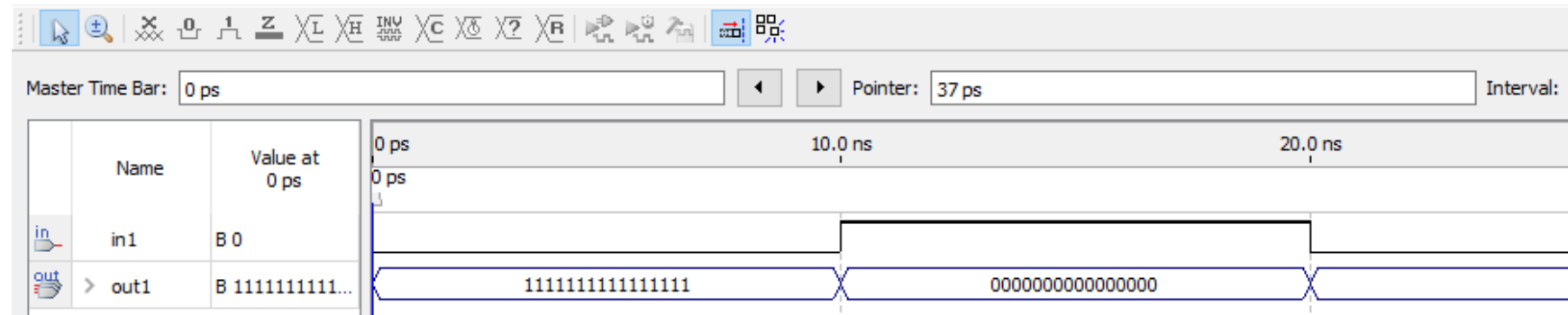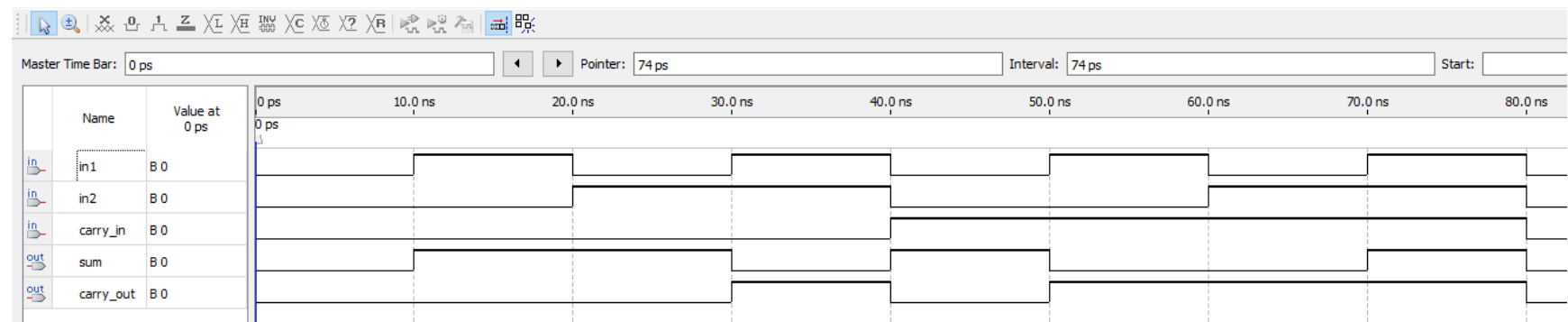## Full Adder (16 bit) Waveform

Simulation Waveform Editor - [FullAdder16.sim.vwf (Read-Only)]

File   Edit   View   Simulation   Help   Search altera.com

Master Time Bar: 0 ps   ◀ ▶   Pointer: 235 ps   Interval: 235 ps   Start: End:

	Name	Value at 0 ps	0 ps	10.0 ns	20.0 ns	30.0 ns	40.0 ns	50.0 ns	60.0 ns	70.0 ns	80.0
in	in1	B 1010100010...	1010100010110000	0111001101000110	0010000001111010	0101000001000011	1011001101000101	1110101111000110	0101100100000100	0011111100010010
in	in2	B 1011110011...	1011110011110101	1111101000010101	0010111110001110	1100011001110011	1000010011011011	0010000110110101	1010110011110101	0001001100010100
in	carry_in	B 0									
out	sum	B 0110010110...	0110010110100101	0110110101011011	0101000000001000	0001011010110110	0011100000100000	0000110101111011	0000010111111001	0101001000100110
out	carry_out	B 1									

ALU ADD Waveform

Name	Value at 0 ps							
in1	S -5460	-5460	-15007	21121	-1371	-30902	-4917	8391	32767
in2	S 10027	10027	18005	-23194	-1813	26069	17875	-10563	2675
carry_in	B 0								
op	B 010	010							
output	S 4567	4567	2998	-2073	-3184	-4833	12958	-2172	-30094
carry_out	B 0								

ALU SUB Waveform

Name	Value at 0 ps							
in1	S -5460	-5460	-15007	21121	-1371	-30902	-4917	8391	32767
in2	S 10027	10027	18005	-23194	-1813	26069	17875	-10563	2675
carry_in	B 0								
op	B 011	011							
output	S -15487	-15487	32524	-21221	442	8565	-22792	18954	30092
carry_out	B 0								

ALU AND Waveform

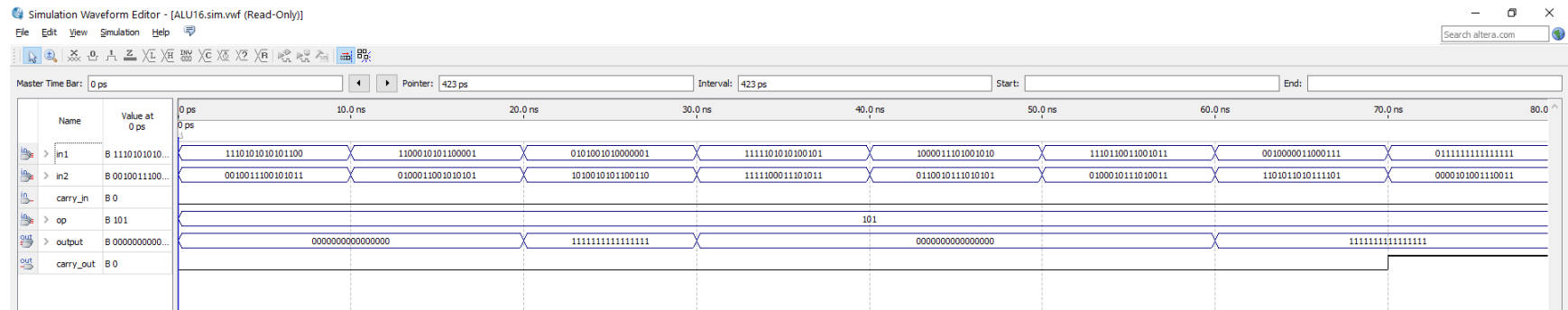| Name	Value at 0 ps							
in1	B 1110101010...	1110101010101100	1100010101100001	0101001010000001	1111101010100101	1000011101001010	1110110011001011	0010000011000111	0111111111111111
in2	B 0010011100...	0010011100101011	0100011001010101	1010010101100110	1111100011101011	0110010111010101	0100010111010011	1101011010111101	0000101001110011
carry_in	B 0								
op	B 000	000							
output	B 0010001000...	0010001000101000	0100010001000001	0000000000000000	1111100010100001	0000010101000000	0100010011000011	0000000010000101	0000101001110011
carry_out	B 0								

ALU OR Waveform

ALU GEQ Waveform

ALU NOT Waveform