Digital Design and Computer Organization Laboratory

UE19CS206

3rd Semester, Academic Year 2020-21

Date: 18/10/20

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Experiment Number: 6 Week # : 6

Title of the Program:

16 Bit Program Counter

Aim of the Program:

To Design and Implementation of a 16 bit Program Counter

Code (pc.v)

```
// Write code for modules you need here

//module pc (input wire clk, reset, inc, add, sub, input wire [15:0] offset, output wire [15:0] pc);


// Declare wires here

// Instantiate modules here
module fa (input wire i0, i1, cin, output wire sum, cout);
   wire t0, t1, t2;

xor3 _i0 (i0,i1,cin,sum);

and2 _i1 (i0,i1,t0);

and2 _i2 (i1,cin,t1);

and2 _i3 (i0,cin,t2);

or3 _i4 (t0,t1,t2,cout);

endmodule

module addsub (input wire addsub, i0, i1, cin, output wire sumdiff, cout);

wire t;

fa _i0 (i0,t,cin,sumdiff,cout);

xor2 _i1 (i1,addsub,t);

endmodule


```

```
36  module pc_slice (input wire clk, reset, cin, load, inc, sub, offset,
37    output wire cout, pc);
38
39   wire in, inc_;
40
41  invert invert_0 (inc,inc_);
42
43   and2 and2_0 (offset,inc_,t);
44
45  addsub addsub_0 (sub,pc,t,cin,in,cout);
46
47   dfrl dfrl_0 (clk,reset,load,in,pc);
48
49  endmodule
50
51
52
53  module pc_slice0 (input wire clk, reset, cin, load, inc, sub, offset,  output wire cout, pc);
54
55  wire in;
56
57   or2 or2_0 (offset,inc,t);
58
59   addsub addsub_0 (sub,pc,t,cin,in,cout);
60
61  dfrl dfrl_0 (clk,reset,load,in,pc);
62
63  endmodule
64
65
66
67  module pc (input wire clk, reset, inc, add, sub, input wire [15:0] offset, output wire [15:0] pc);
```

```
67  module pc (input wire clk, reset, inc, add, sub, input wire [15:0] offset, output wire [15:0] pc);
68
69   input wire load;
70   input wire [15:0] c;
71
72   or3 or3_0 (inc,add,sub,load);
73
74  pc_slice0
75
76   pc_slice
77
78  pc_slice pc_slice_2 (clk,reset,c[1],load,inc,sub,offset[2],c[2],pc[2]);
79
80  pc_slice pc_slice_3 (clk,reset,c[2],load,inc,sub,offset[3],c[3],pc[3]);
81
82  pc_slice pc_slice_4 (clk,reset,c[3],load,inc,sub,offset[4],c[4],pc[4]);
83
84  pc_slice pc_slice_5 (clk,reset,c[4],load,inc,sub,offset[5],c[5],pc[5]);
85
86  pc_slice pc_slice_6 (clk,reset,c[5],load,inc,sub,offset[6],c[6],pc[6]);
87
88  pc_slice pc_slice_7 (clk,reset,c[6],load,inc,sub,offset[7],c[7],pc[7]);
89
90  pc_slice pc_slice_8 (clk,reset,c[7],load,inc,sub,offset[8],c[8],pc[8]);
91
92  pc_slice pc_slice_9 (clk,reset,c[8],load,inc,sub,offset[9],c[9],pc[9]);
93
94  pc_slice pc_slice_10 (clk,reset,c[9],load,inc,sub,offset[10],c[10],pc[10]);
95
96  pc_slice pc_slice_11 (clk,reset,c[10],load,inc,sub,offset[11],c[11],pc[11]);
97
98  pc_slice pc_slice_12 (clk,reset,c[11],load,inc,sub,offset[12],c[12],pc[12]);
99
100 pc_slice pc_slice_13 (clk,reset,c[12],load,inc,sub,offset[13],c[13],pc[13]);
101
102 pc_slice pc_slice_14 (clk,reset,c[13],load,inc,sub,offset[14],c[14],pc[14]);
103
104 pc_slice pc_slice_15 (clk,reset,c[14],load,inc,sub,offset[15],c[15],pc[15]);
105
106 endmodule
```

TABLE

	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]
CASE 1	1	0	0	XXXX	0001

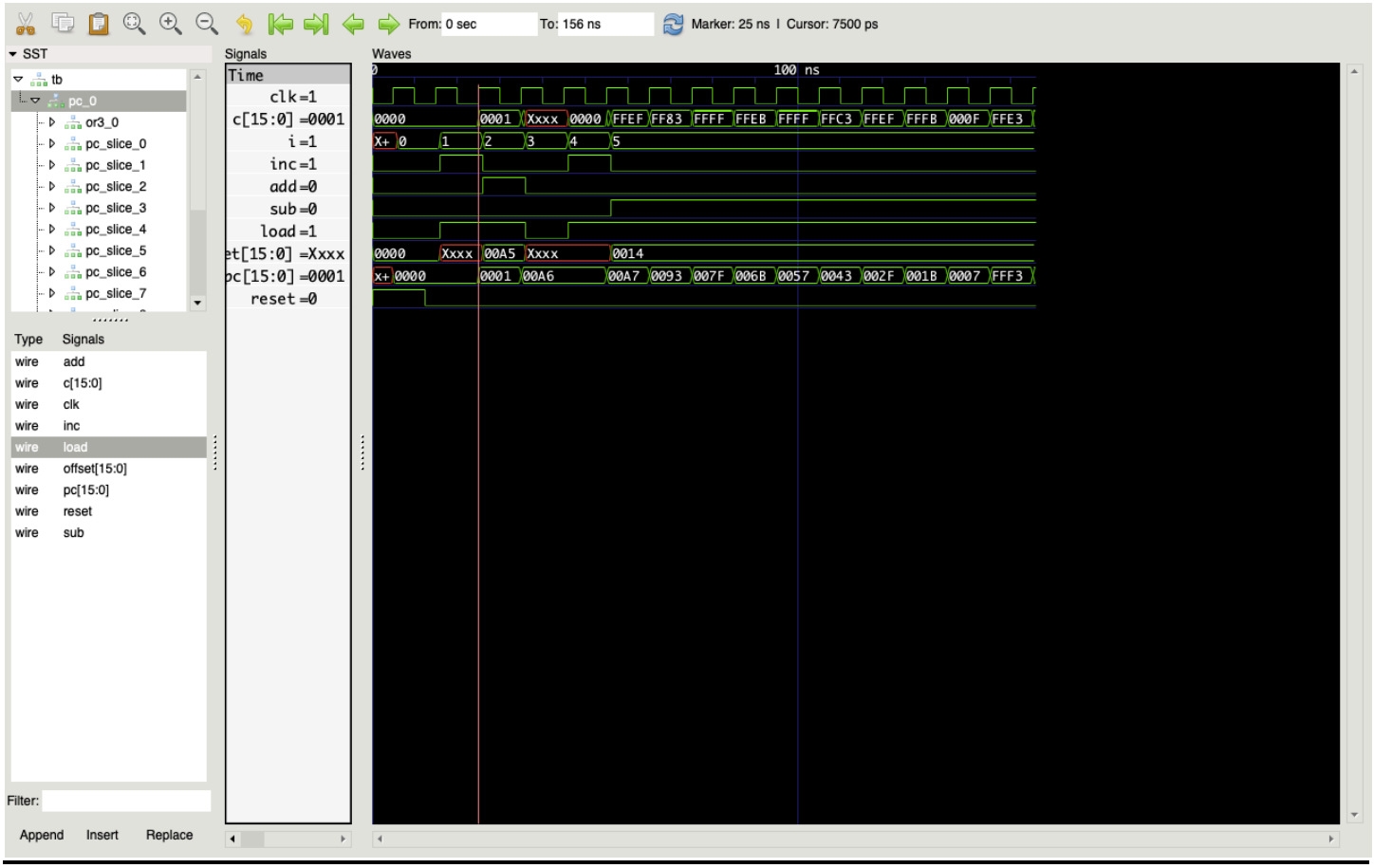
CASE 2	**0**	**1**	**0**	**00A5**	**00A6**
CASE 3	**0**	**0**	**0**	**XXXX**	**00A6**
CASE 4	**1**	**0**	**0**	**XXXX**	**00A7**
CASE 5	**0**	**0**	**1**	**0014**	**Pc-offset =00A7-001 =0093**

Output waveform

SCREENSHOT1

CASE1 :PC Increment Operation with no offset

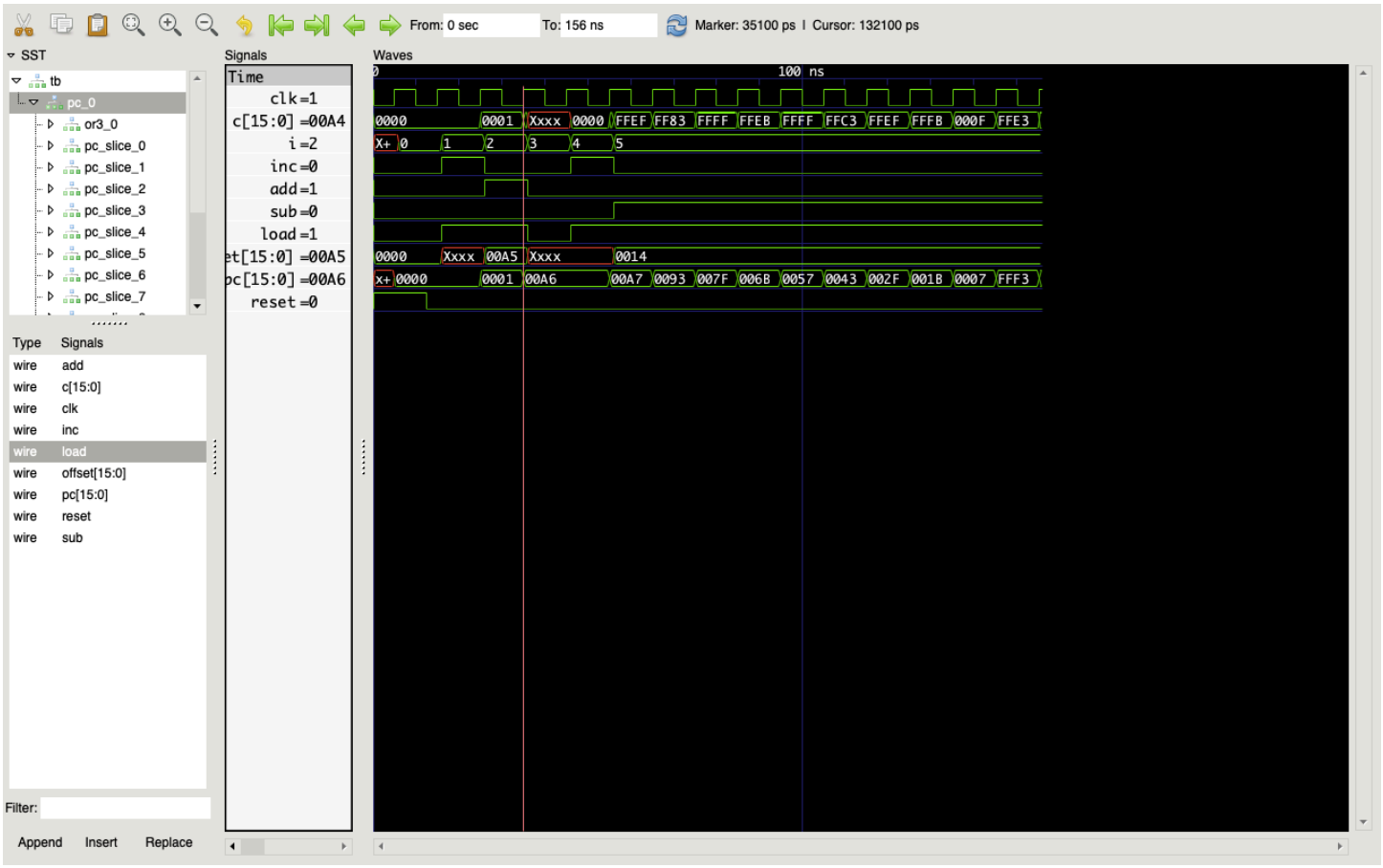
	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]
CASE 1	1	0	0	XXXX	0001



SCREENSHOT2

CASE 2 :Add Offset to PC

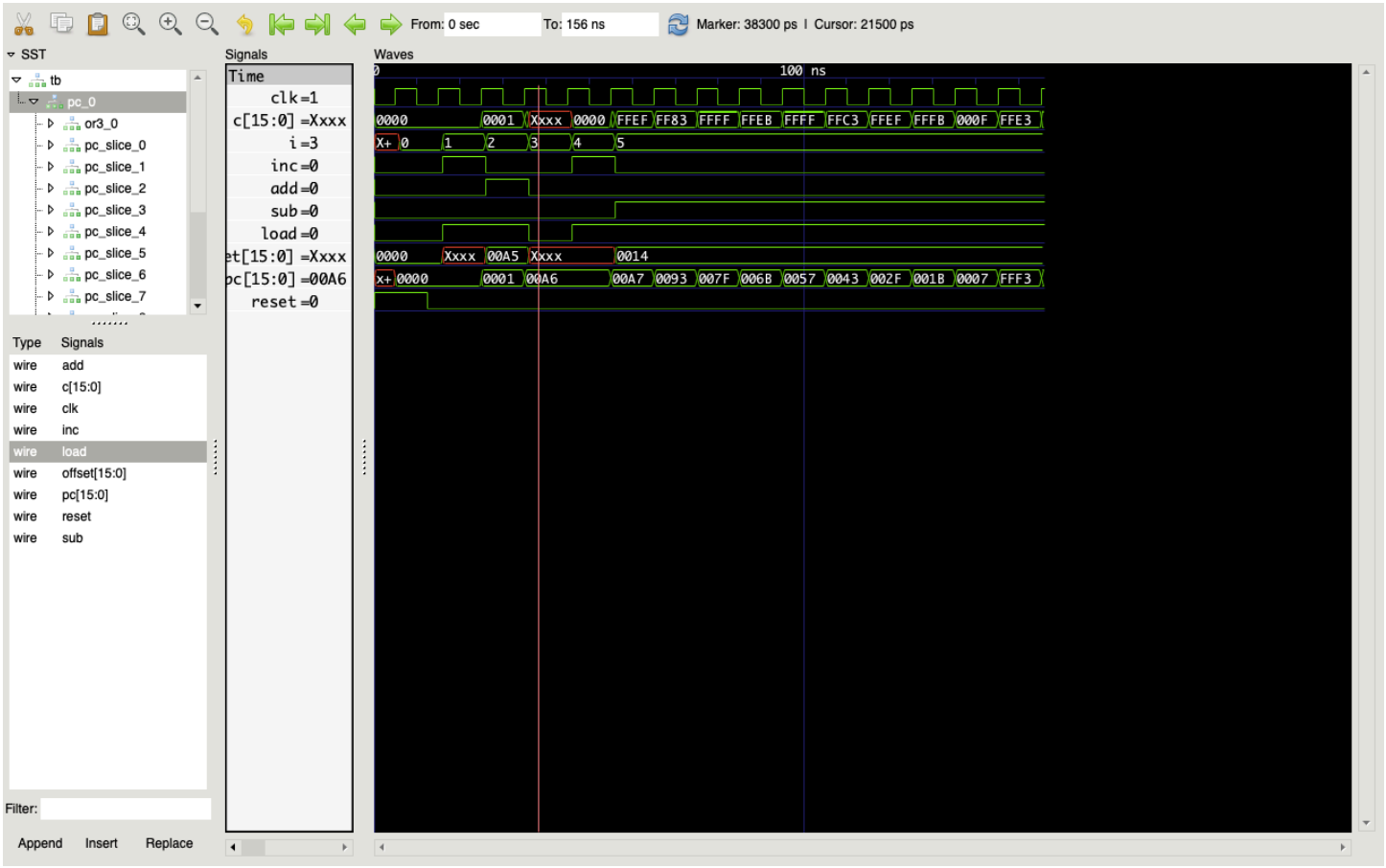
	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]
CASE 2	0	1	0	00A5	00A6



SCREENSHOT 3

CASE 3 :No change in PC

	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]
CASE 3	0	0	0	XXXX	00A6

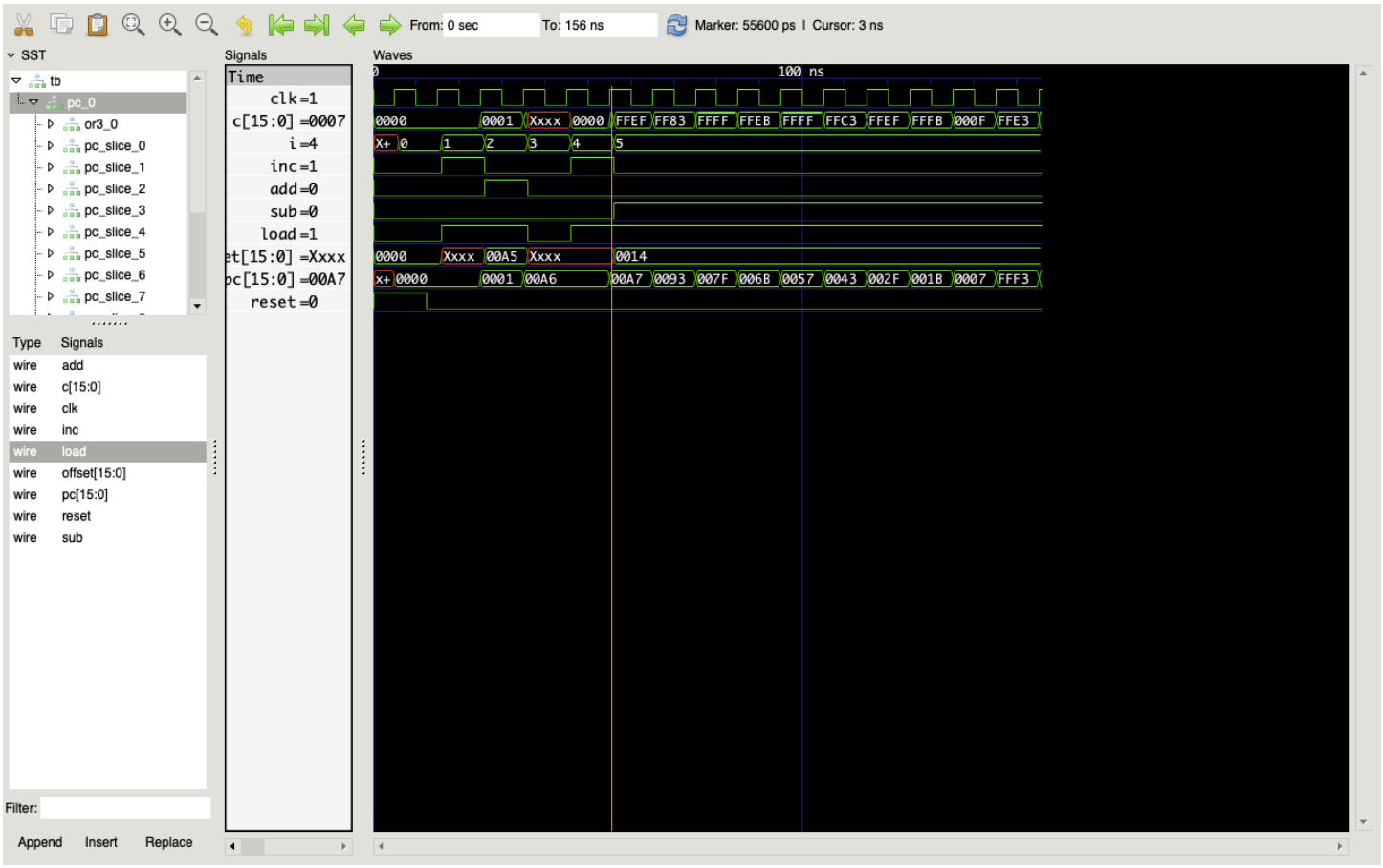


SCREENSHOT 4

CASE 4 :Auto increment current value of PC

	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]

CASE 4	1	0	0	XXXX	00A7



SCREENSHOT 5

CASE 5 :Subtract offset contents from PC

	inc	add	sub	offset [15:0]	output
	Bit 18	Bit 17	Bit 16	Bit 15 to Bit0	pc[15:0]
CASE 5	0	0	1	0014	Pc-offset

					=00A7-001 =0093