Matthew Liu Lab Report 6 ECE 2031 L09 3 March 2019

		0 ps	1.28 us	2.56 us	3.84 us	5.12 us	6.4 us	7.68 us	8.96 us	10.24 us	11.52 us	12.8 us	14.08 us	15.36 us	16.64 us	17.92 us	19.2 us
	Name	0 ps J															
@>0	RESETN																
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ig 13	MDR_OUT		0411	X	0004	X 0C12	K 000:	3 X	0C13 X	0005	X 0810 X	0000	X 000C	X		1404	
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76	MW																

**Figure 1.** Simple Computer simulation waveform for edited example.mif (A = (B + C) + D). The waveform's machine code comes from the edited code program example.asm which is assembled with SCASM to create a mif file. The result is then functionally simulated in Quartus with an input waveform file created in the lab.

			0 ps 5.12	2 us	10.24 us	15.36 us	20.48 us	25.6 us	30.72 us	35.84 us	40.96 us	46.08 us	51.2 us	56.32 us	61.44 us	66.56 us	71.68 us
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iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	■ MDR_OUT		0410 0001	30((100)(01	0001#10#1	804 (100)(01)	0001010 180	4 X 1C07 X200	000000000000000000000000000000000000000	1C07 2000	CX1804X4CX 1C	07 🗶 2000 🗶	410 <b>x</b> 7F <b>x</b> 0000,00	x0410\C1x0001	000 2811 00	FFXCTXOFFOX	140F )
<b>i</b> 30	⊞ IR		0000 0410	<u>¥ 1804 ¥</u>	1010 🗶 14	01 🗶 1804 🗶	1010 🗶 1401	X 1804 X 1C	)7 🗶 3401 🗶	1404 🗶 1C07 )	( 3401 ) 1404	4 🗶 1C07 🗶 2	000 🗶 37FE 🎗	2000 ¥ 0C10	¥ 200D ¥ 28	11 🗶 2C12 🗶	140F )
<b>a</b> 47	■ AC		<u> </u>	0001	_X	0000	X	FFFF	X	0000	X	0001	X	FFFF X	0000	X 00FF X	OFOF )
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65	■ MAR_OUT		000 010 000	X004 X0X	010 00	1 004 00	010 001	X 004 X 007	X0X001X0X	004 007 0	001 004	X 007 X00	0 (0 X 3FE X 0 X	000 00 00 000	DX 00D X011	X0X012X0X	00F ¥ 00F ¥
<b>1 1 1 1 1 1 1 1 1 1</b>	MW																

**Figure 2.** Test\_code.mif program file's timing simulation waveform - downloaded from class website. The waveform is created after adding the SUB, JNEG, JPOS, JZERO, OR, XOR, and ADDI instructions to the simple computer as defined by Table 7.1 in the lab. (Note: After compilation of program, reaching state 0F0F is indicative of reaching successful state transitions throughout the program output).



**Figure 3.** Schematic (TOP\_SCOMP.BDF) – part of SCOMP.QPF project, used for the DE2 Cyclone II chip. The schematic includes the SCOMP.BSF symbol created from SCOMP.VHD file which includes all the instructions to the Simple Computer defined by Table 7.1 in the lab. Altpll() device is used for clocking input for SCOMP (notes: measured Max Clock frequency 67.05 MHz, Key[0] push button resets both devices, and clock\_50 is a 50 MHz DE2 clock).



**Figure 4.** Oscilloscope waveform measurement from DE2 board. The waveform simulates the Quartus project including the atpll() and SCOMP device created in the lab. The purpose of this is to measure he frequency of the clock with the oscilloscope to verify what we expect. Note that the measured frequency is 64.18 MHz, which is just slightly lower than the set Max Clock Frequency (65 MHz) set by atpll().

APPENDIX A Lab 7 Designing Simple Computer -- example.mif (edited) A = (B+C) + D

- -- Lab 7 SCOMP Lab, example.asm/mif file
- -- Altera Memory Initialization File (MIF) for Pre-lab
- -- Matthew Liu
- -- ECE2031 L09
- -- 7 March 2019

DEPTH = 1024; WIDTH = 16;

ADDRESS\_RADIX = HEX; DATA\_RADIX = HEX;

CONTENT

## BEGIN

[000..3FF] : 0000; -- Default to NOP

	000 : 0411; Start:	LOAD	В	;Load value stored in B
	001 : 0C12;	ADD	С	;Add value stored in C
	002:0C13;	ADD	D	;Add value stored in D
	003:0810;	STORE	А	;Store/replace value back in A
	004 : 1404; Here:	JUMP	Here	;Loop here forever
	010 : 0000; A:	DW	&H0000	-
	011 : 0004; B:	DW	&H0004	
	012 : 0003; C:	DW	&H0003	
	013 : 0005; D:	DW	&H0005	;New Variable D
ENI	);			