Experiment 1
Combinational Circuits - 1
Part 2

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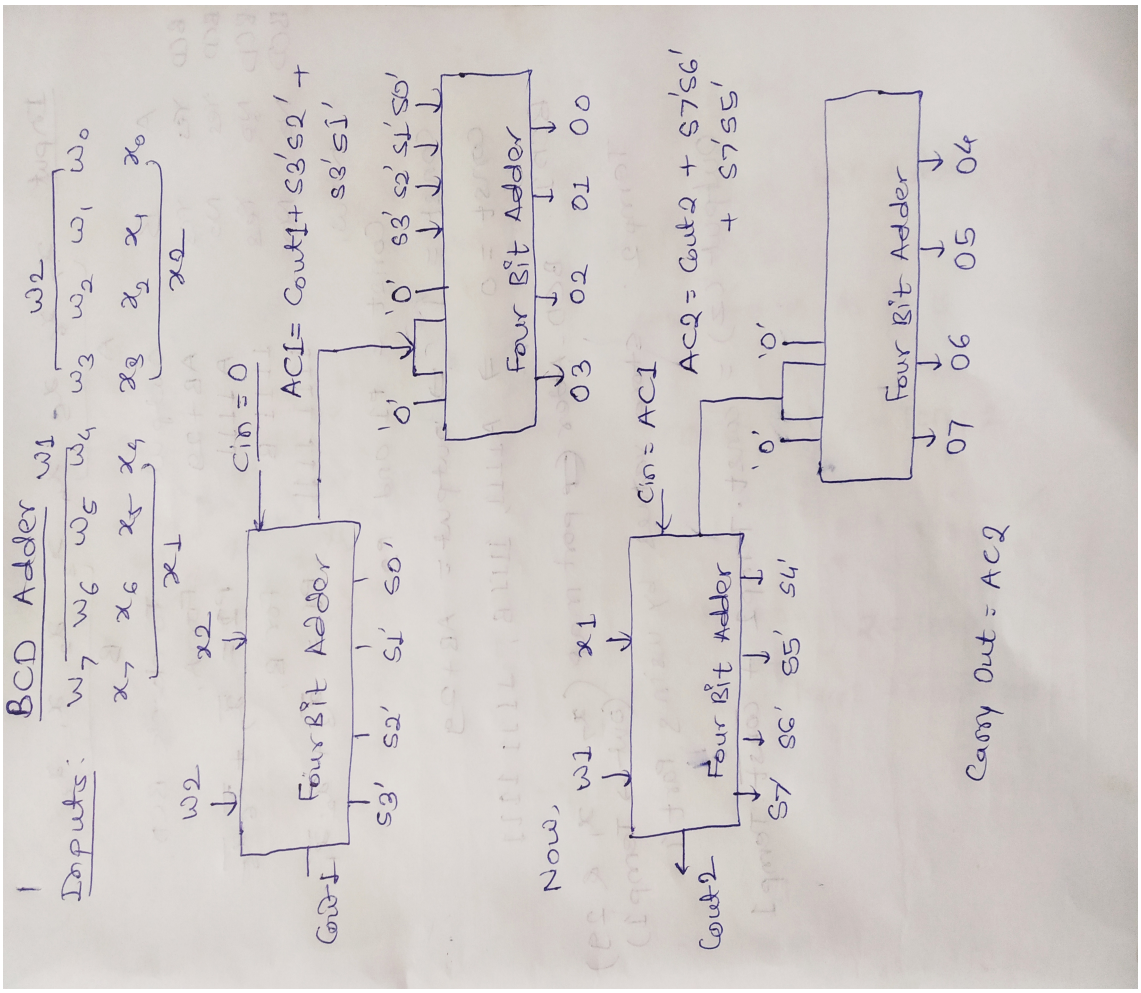
Overview of the experiment

- The purpose of the experiment is to design a a block which adds two 2-digit BCD numbers D1 and D2. The output will be valid a 2-digit BCD number and carry.
- I used Four_Bit_Adder multiple times for Decimal Adjusting which uses simplified K-Map equation to add 6 in non BCD cases.
- The report contains a handmade diagram which describes my approach, some important extracts of VHDL code and the output waveforms.

Approach to the experiment

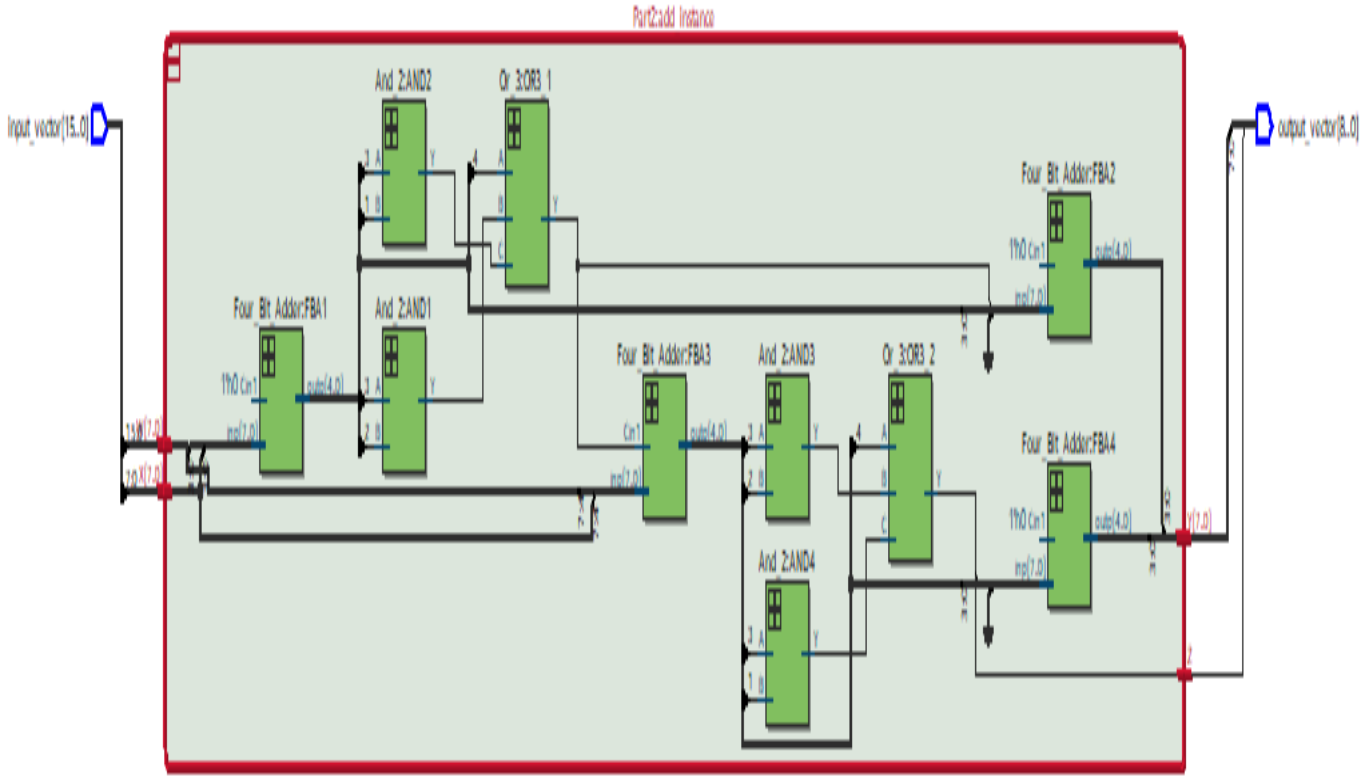
For BCD Adjust, I used K-Map simplification to add 6 to the number if the number is non BCD.
Equations :
For a 4 bit number A3 A2 A1 A0,
P = $\overline{A3} + \overline{A2}*\overline{A1}$
Auxillary Carry(AC) = Cout + S3*S2 + S3*S1
Then, For Decimal Adjust,
Using a Four_Bit_Adder add 0 AC AC 0 and S3 S2 S1 S0 which will give the appropriate output.
The same process will repeat for most significant bytes with Auxillary Carry of previous equation as it's Carry In.



Design document and VHDL code if relevant

Main Entity :
entity Part3 is
port (W : in std_logic_vector(7 downto 0);
X : in std_logic_vector(7 downto 0);
Y : out std_logic_vector(7 downto 0);
Z : out std_logic);
end entity Part3;
OR3_1 : Or_3 port map (A=¿ AC1, B=¿A1, C=¿A2, Y=¿ O1); –Eqn for calculating Auxillary Carry
Four_Bit_Adder :
component Four_Bit_Adder is
port (inp: in std_logic_vector(7 downto 0);
Cin1 : in std_logic;
outp: out std_logic_vector(4 downto 0));
end component Four_Bit_Adder;

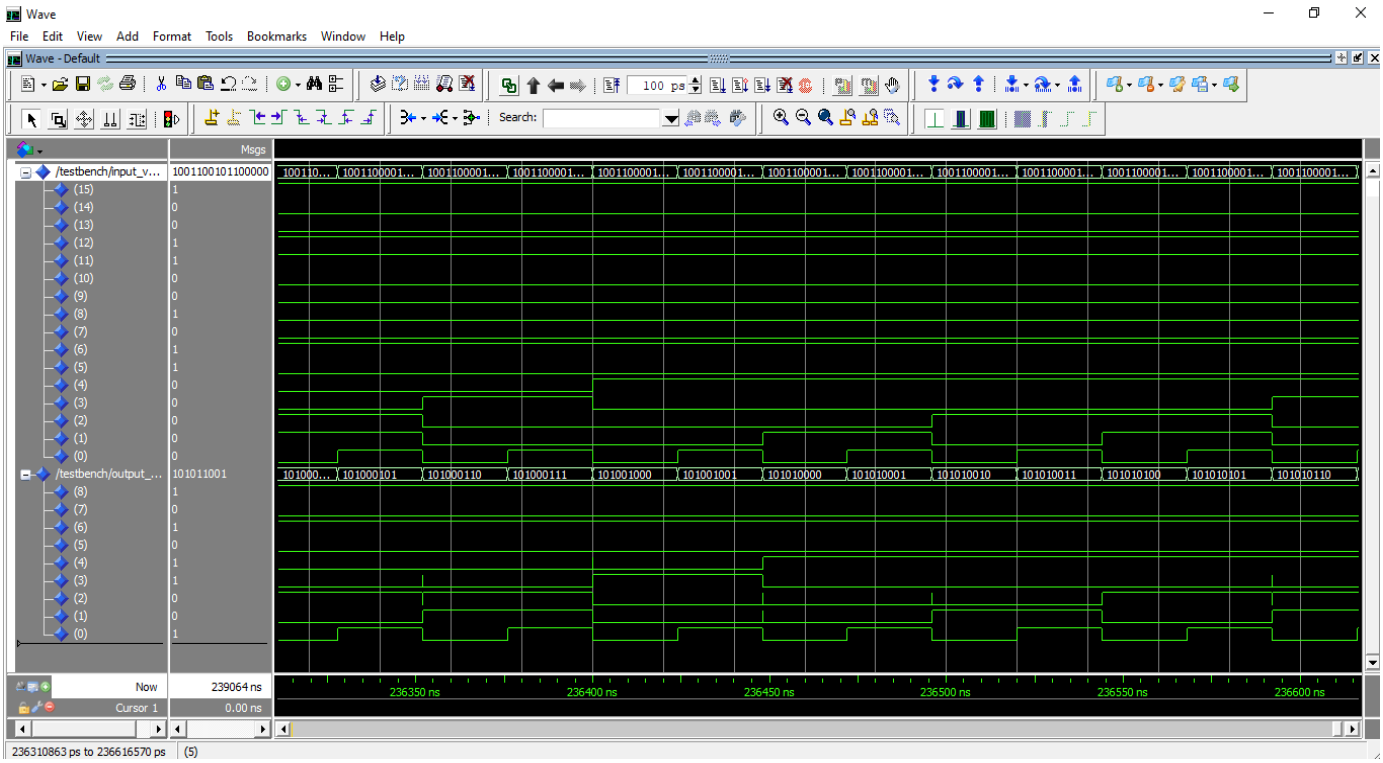
RTL View



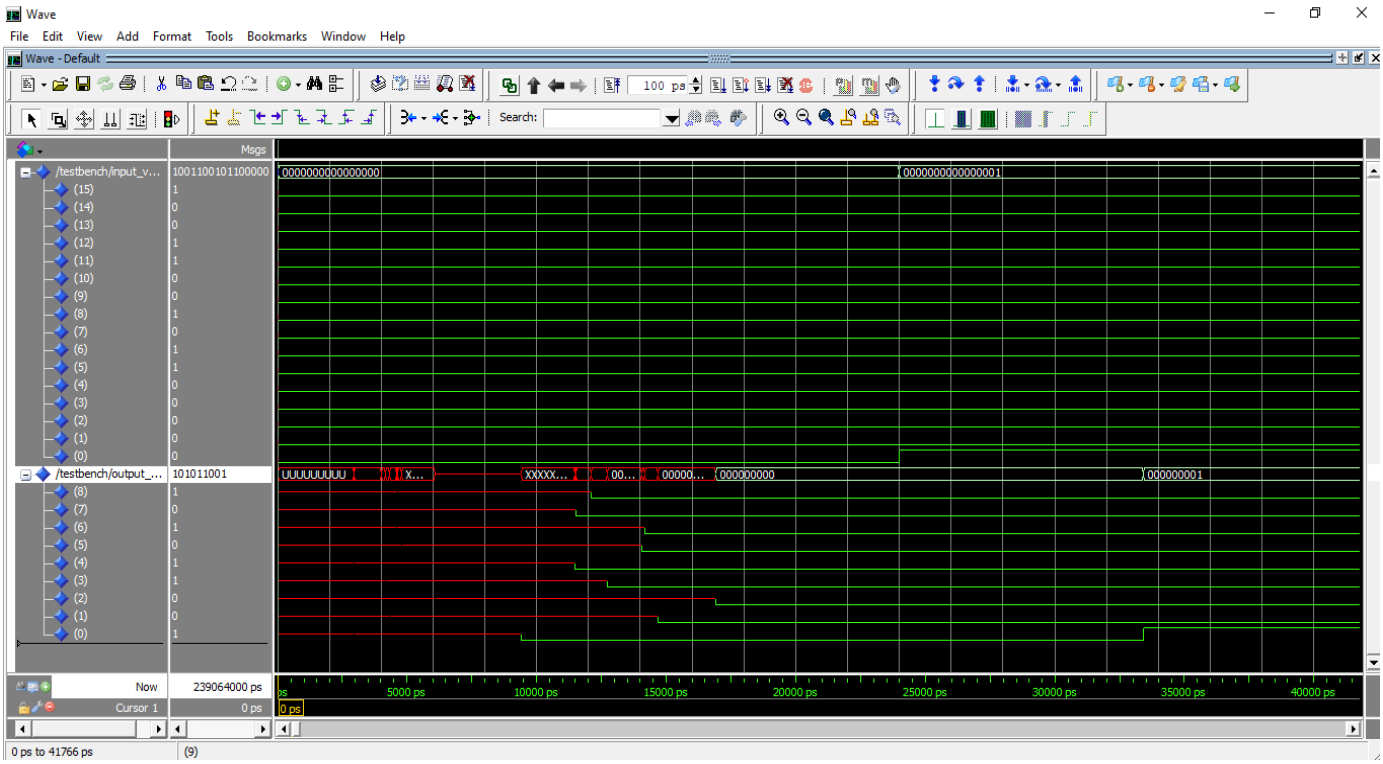
DUT Input/Output Format

W : in std_logic_vector(7 downto 0); –Input1
X : in std_logic_vector(7 downto 0); –Input2
Y : out std_logic_vector(7 downto 0); –Output
Z : out std_logic); –Carry Out
0000000000010110 000010110 111111111 –Input Bits, Output Bits, Mask Bits

RTL Simulation



Gate-level Simulation



Krypton board

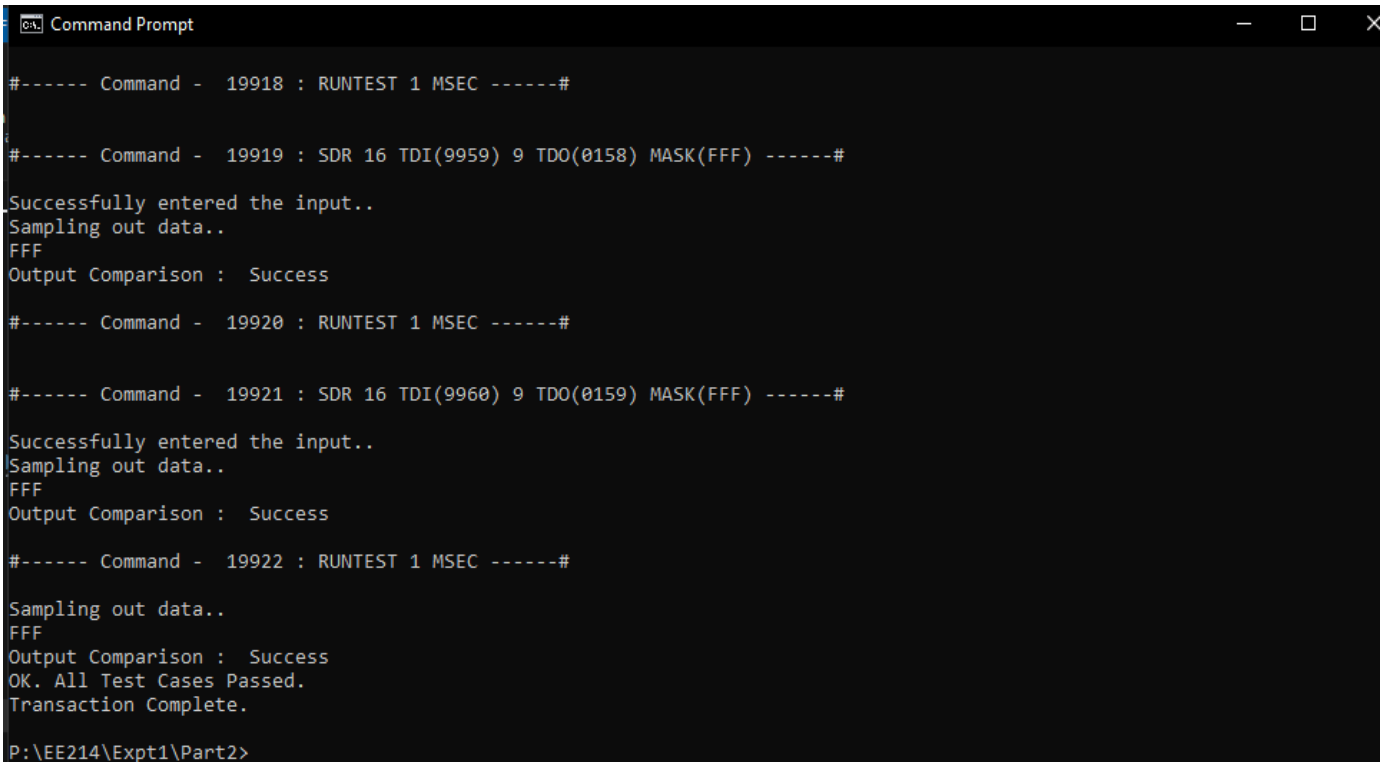
Not Applicable

Observations

Not Applicable

Tiva C

After generating all 9961 testcases in in.txt, Tiva-C compiled outputs in output.txt.
Image attahced below shows the successful compilation.



References

EE 309 : Microprocessors by Prof. Dinesh Sharma Video Lectures for understanding the logic and design of BCD.