8-Bit Calculator With Keyboard Input

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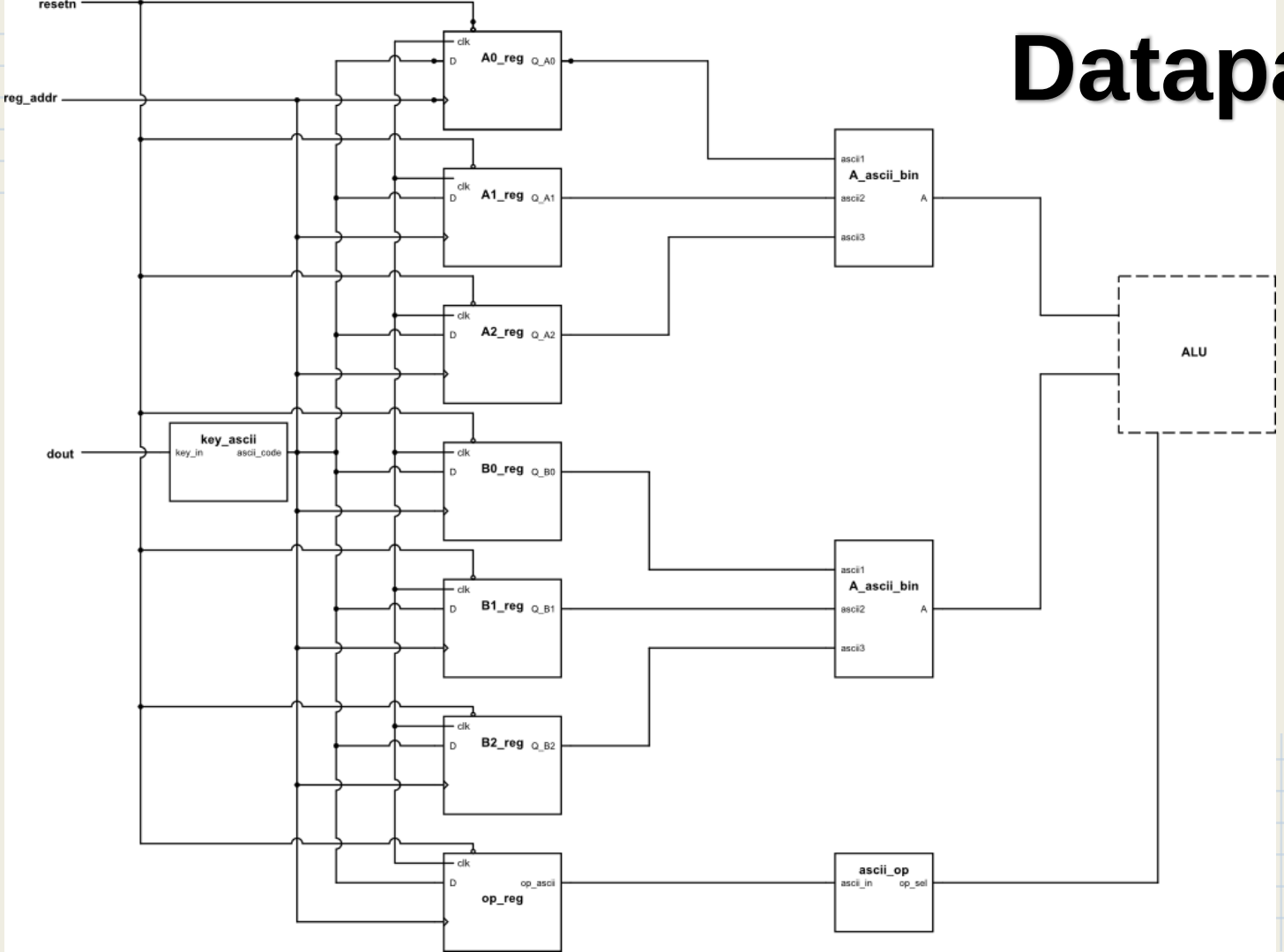
Description

- Constructing a calculator which performs the four basic mathematical operations
  - Addition, subtraction, division (modulus), multiplication
- USB (PS/2 supported) keyboard
- Nexys4 FPGA board will manage the computation
- Nexys4 7 segment display

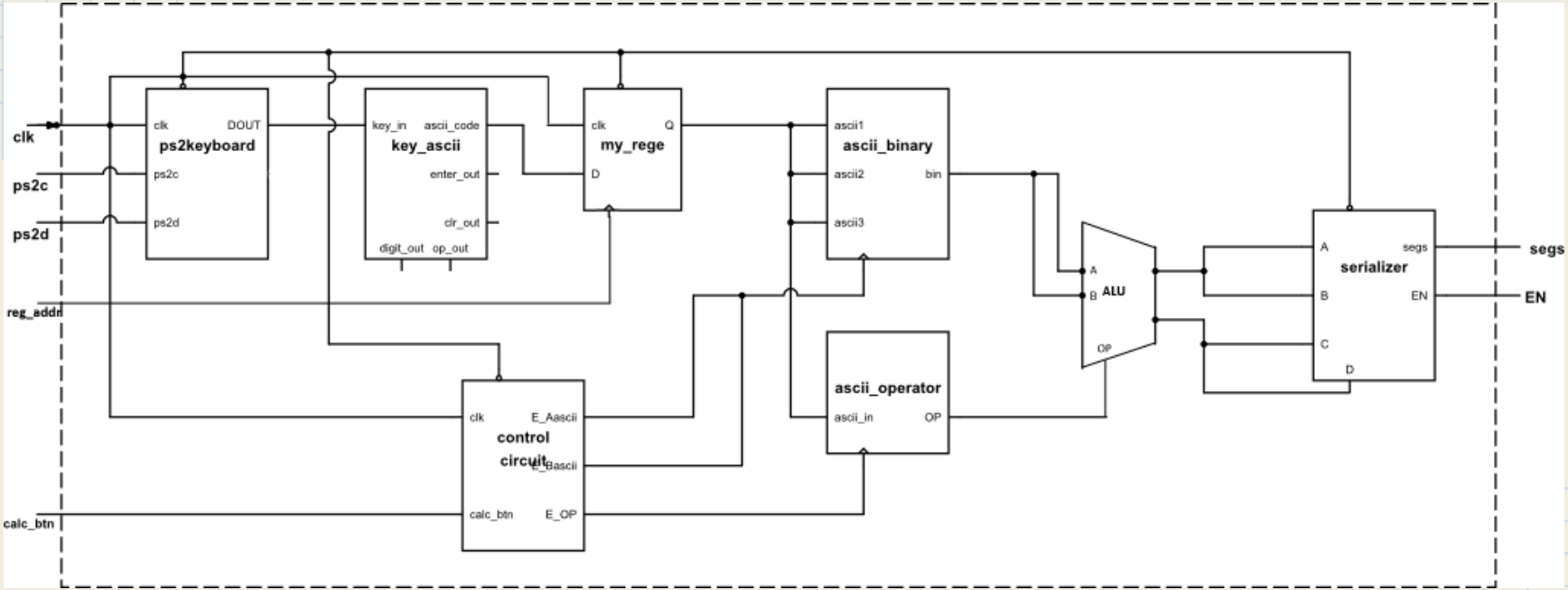
Keyboard - ASCII - Binary

- USB(PS/2) Keyboard
- Keyboard input takes ASCII code - using decoder will pass values into registers
  - A[0-2], B[0-2], OP
- Each register sends to appropriate ASCII to binary conversion register
- Converted bits sent to register that holds binary value
- Binary 8 bit numbers are send to ALU as A and B inputs
  - OP: a 2 bit input

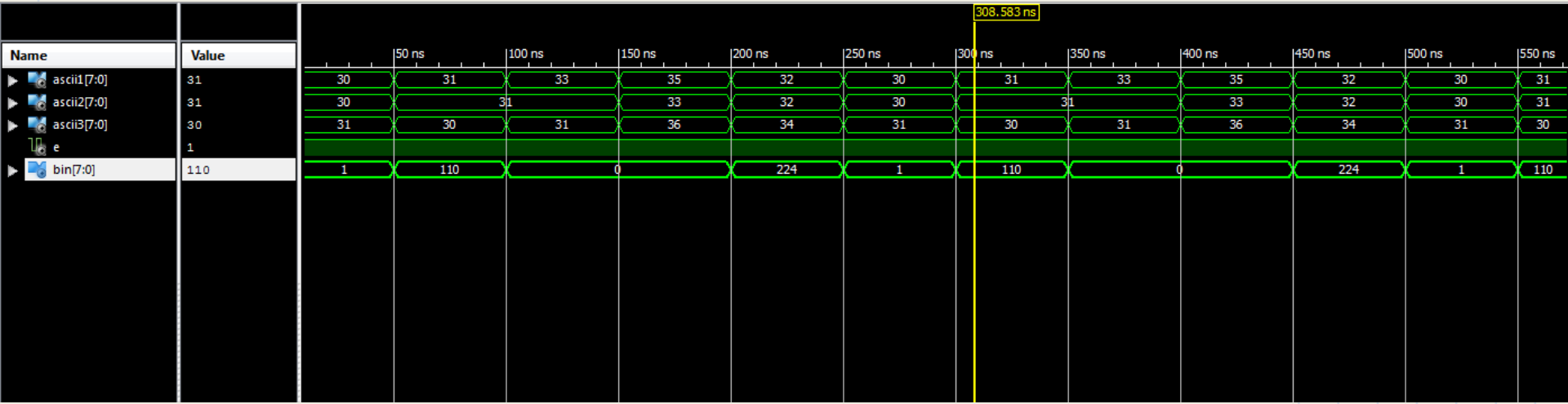
Datapath


resetn
reg_addr
dout
clk
D
A0_reg
Q_A0
A1_reg
Q_A1
A2_reg
Q_A2
B0_reg
Q_B0
B1_reg
Q_B1
B2_reg
Q_B2
op_reg
op_ascii
key_ascii
key_in
ascii_code
ascii1
ascii2
ascii3
A_ascii_bin
A
ascii_op
ascii_in
op_sel
ALU

Top-Level

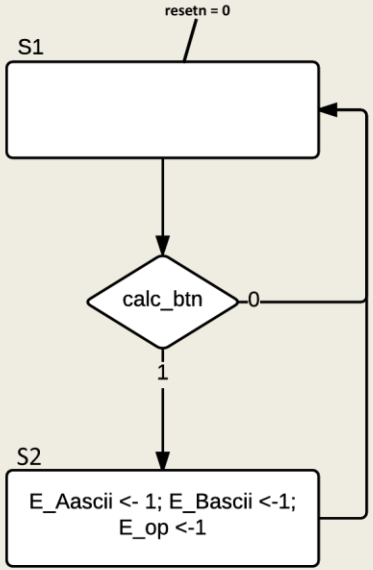

clk
ps2c
ps2d
reg_addr
calc_btn
clk
DOUT
ps2keyboard
ps2c
ps2d
key_in
ascii_code
key_ascii
enter_out
clr_out
digit_out
op_out
clk
Q
my_rege
D
ascii1
ascii_binary
ascii2
bin
ascii3
A
B
ALU
OP
ascii_operator
ascii_in
OP
clk
E_Aascii
control
circuit
E_Bascii
calc_btn
E_OP
A
segs
serializer
B
EN
C
D
segs
EN

ASCII to Binary Simulation



Control Circuit

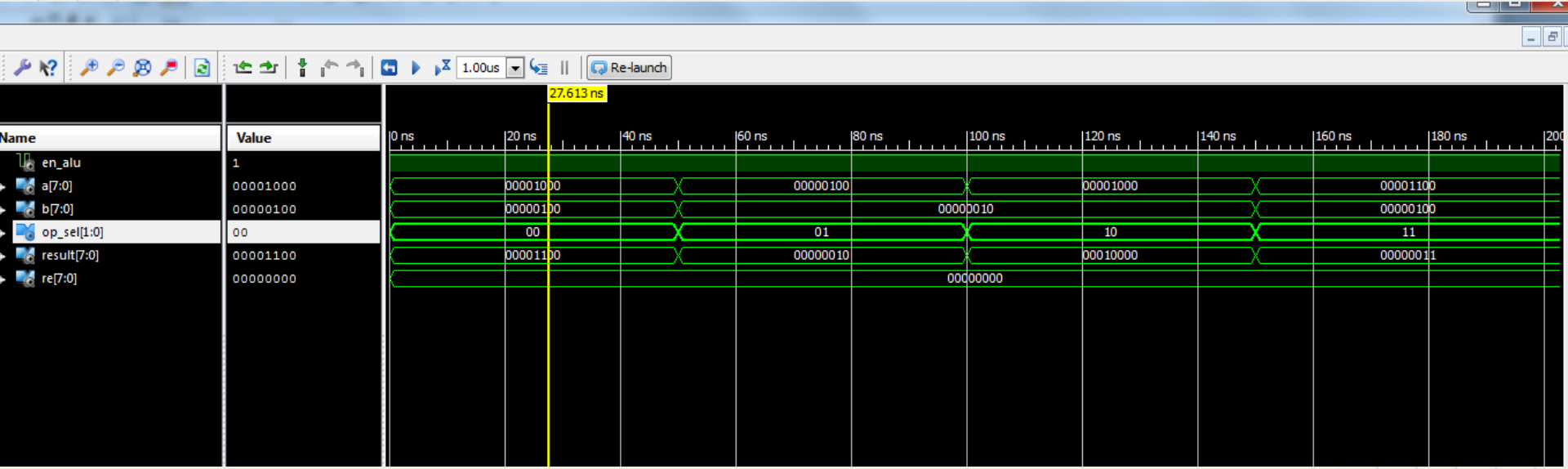
- Calc_btn triggers whether the values are ready to be put into registers.
- Control Circuit waits for the first keys to be pressed which will indicate it's A value and enable the A ascii to binary register.
- Second calc button press will enable the operator ascii to binary register.
- The third will enable the B value for ascii to binary register.



Calculations

- Using VHDL provided libraries
  - use IEEE.STD_LOGIC_1164.ALL
  - use IEEE.STD_LOGIC_ARITH.ALL
  - use IEEE.STD_LOGIC_UNSIGNED.ALL
- 8 bit inputs and outputs with a 2 bit selector for operation
- Division
  - 8 bit by 8 bit divider with 8 bit quotient and remainder
- Remainder set to 0 for all but division
- Sends to assigned register to hold value

ALU Simulation



7 Segment

- Using a serializer to display results
- The result of the calculation is displayed as the Hexadecimal value on the two leftmost displays
- The remainder is displayed on the two rightmost displays as the remainder’s Hexadecimal representation