Signed 5-Bit Calculator

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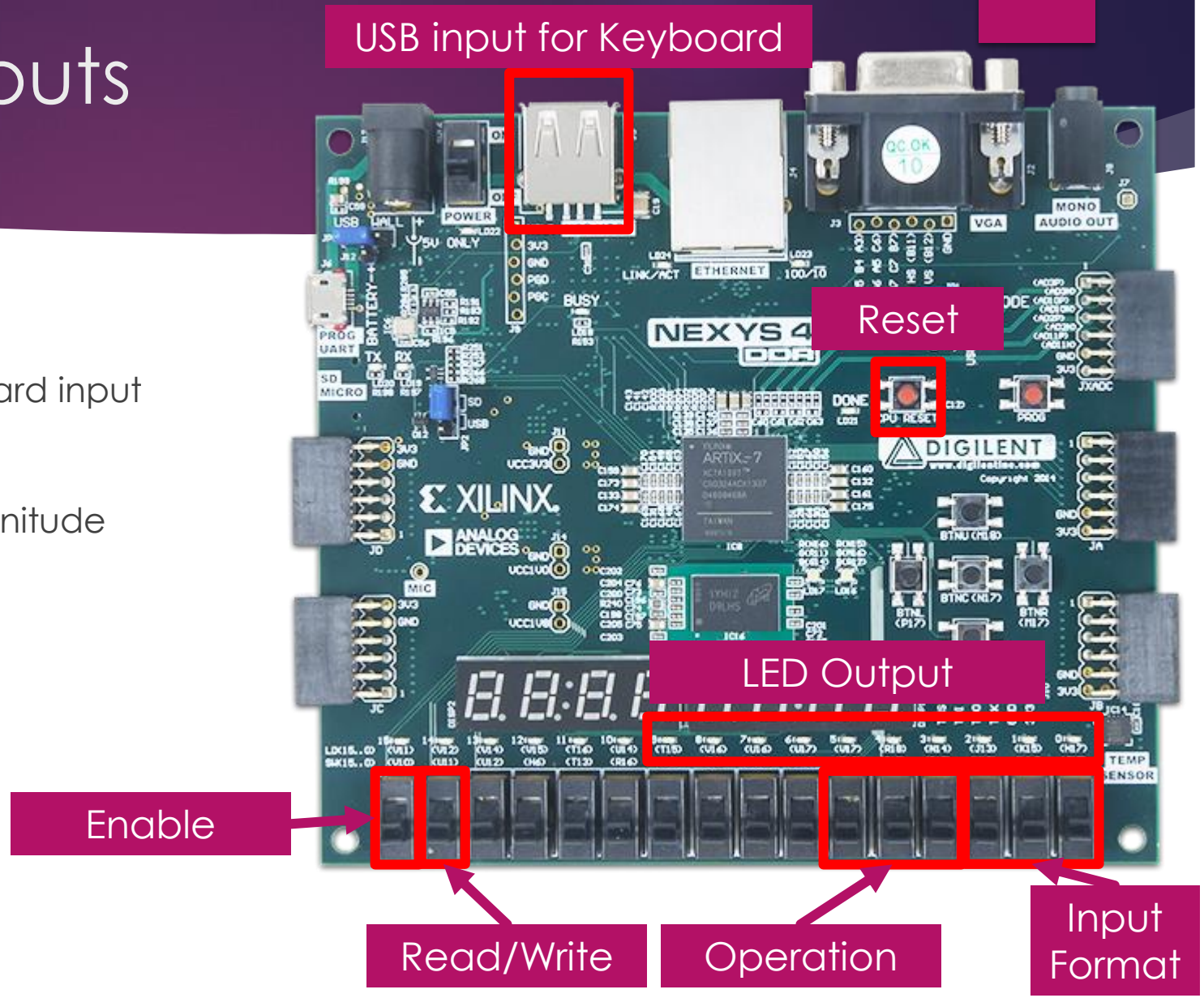
Introduction

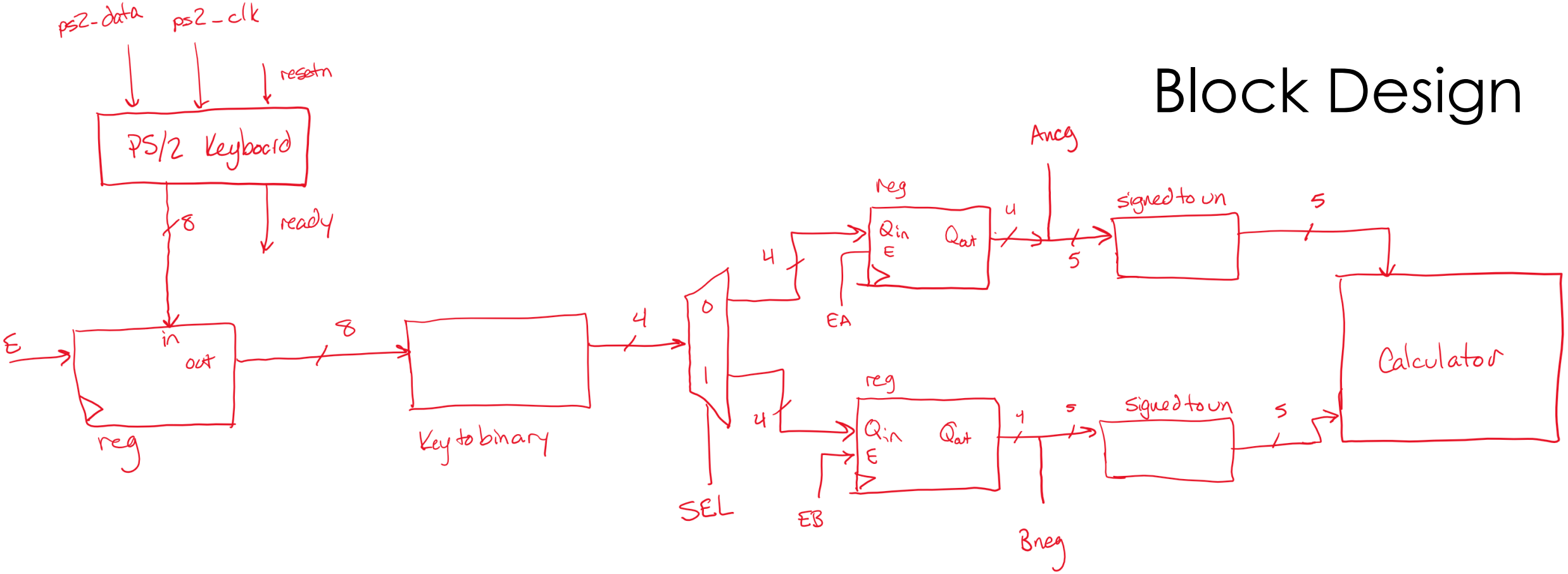
- Signed 5-bit input calculator that outputs a signed 10-bit value
- Capable of 5 functions
  - Addition (+)
  - Subtraction (-)
  - Multiplication (*)
  - Division (÷)
  - Modulo (%)

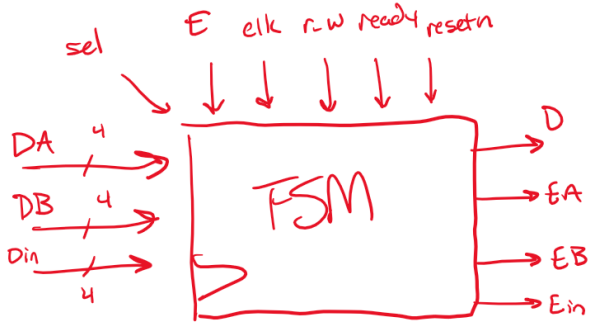
Inputs and Outputs

- Inputs
  - Switches and a PS/2 keyboard input
- Outputs
  - LED output in sign and magnitude

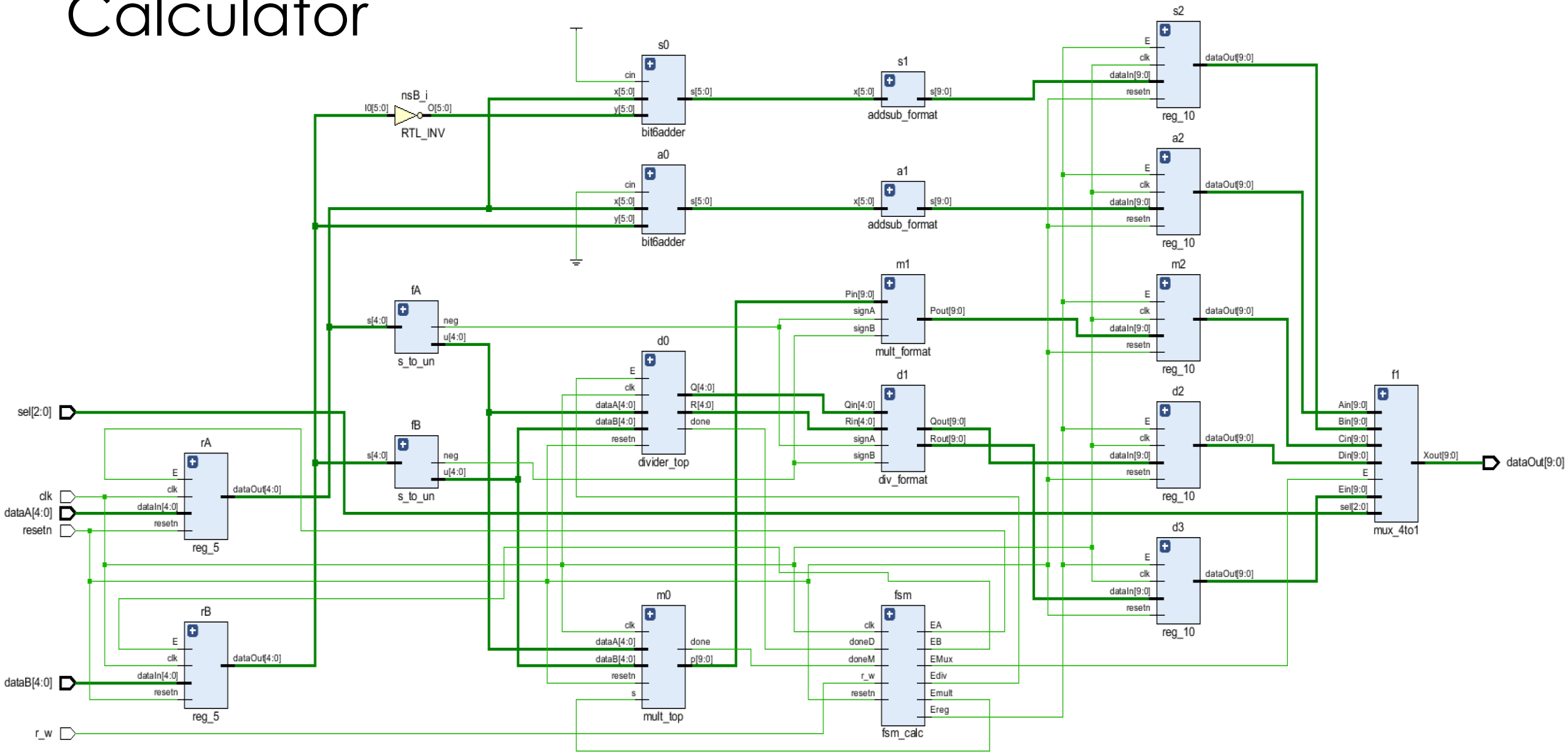


Block Design

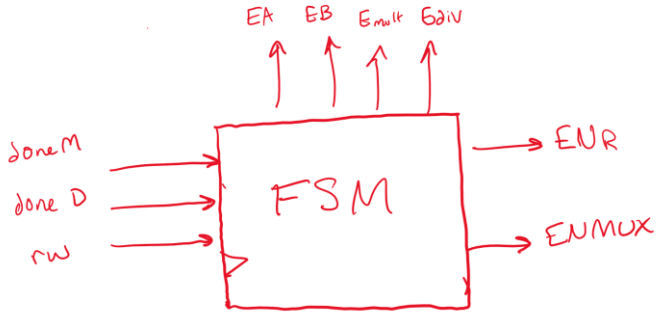


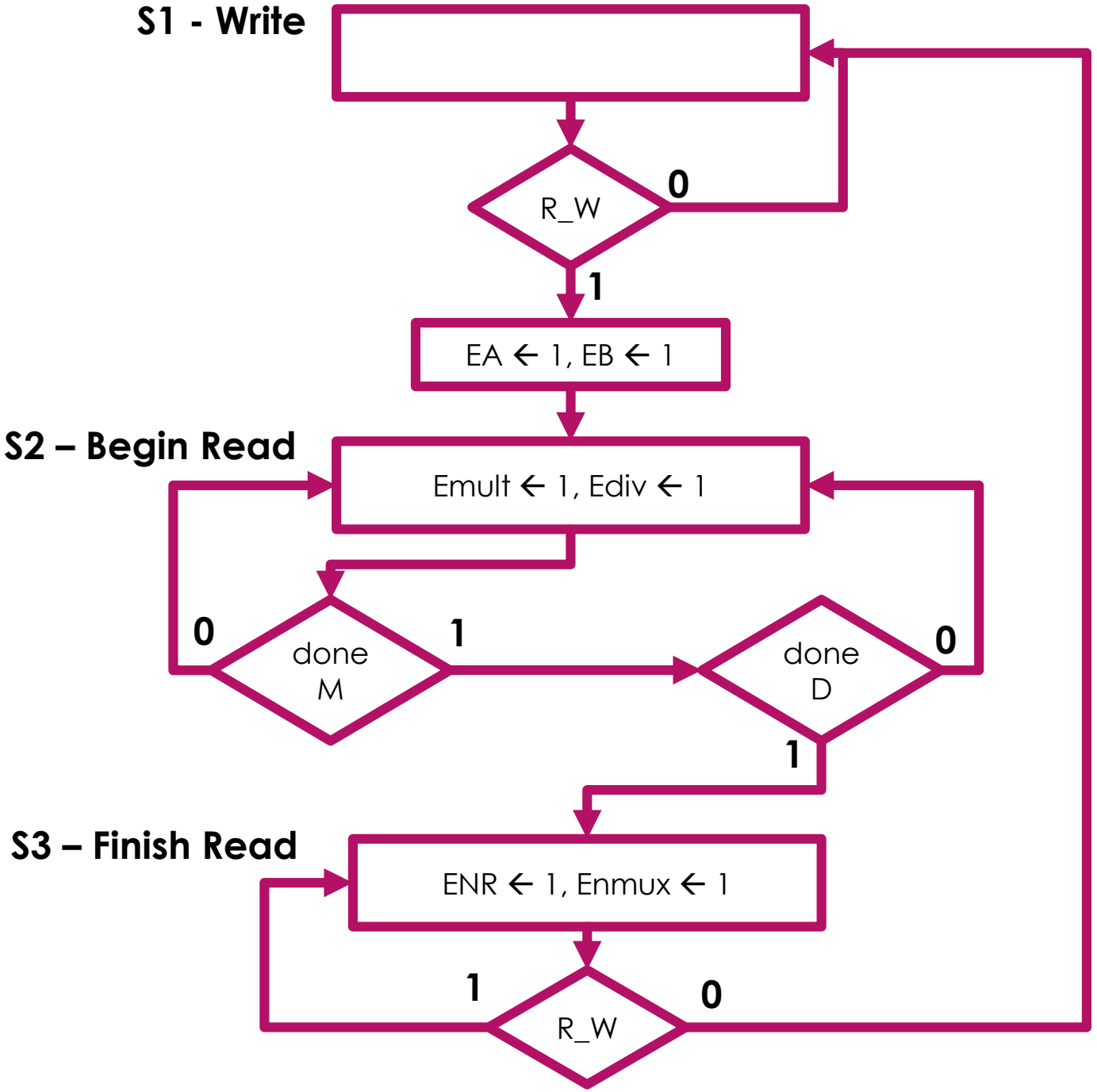


Calculator

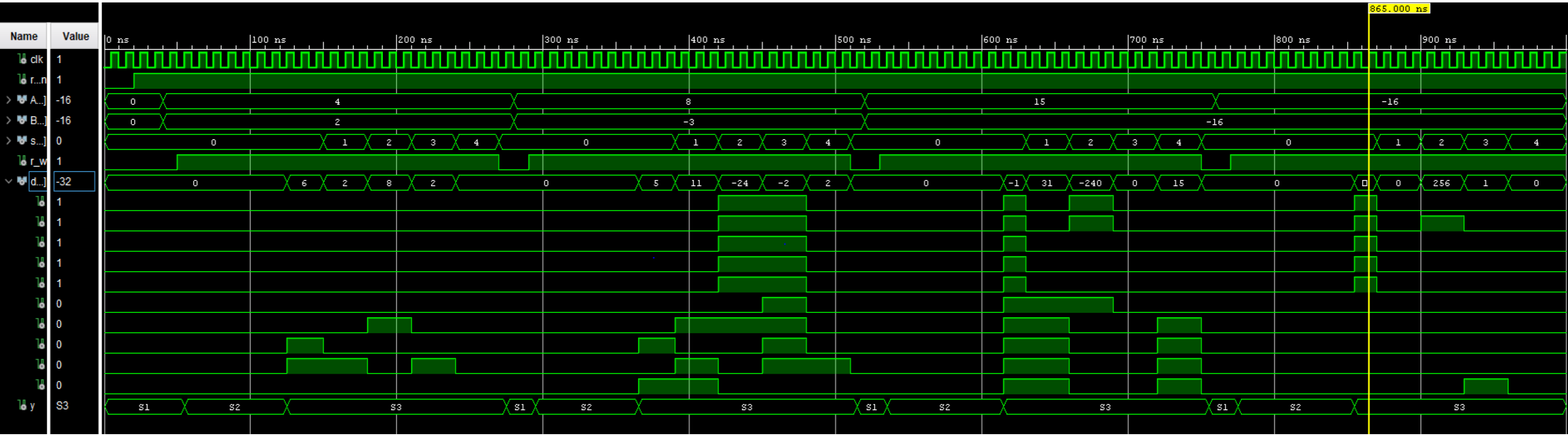

sel[2:0]
clk
dataA[4:0]
resetn
dataB[4:0]
r_w
rA
rB
reg_5
reg_5
fA
fB
s_to_un
s_to_un
nsB_i
I0[5:0]
O[5:0]
RTL_INV
s0
bit6adder
a0
bit6adder
s1
addsub_format
a1
addsub_format
d0
divider_top
d1
div_format
m0
mult_top
m1
mult_format
fsm
fsm_calc
s2
a2
m2
d2
d3
reg_10
reg_10
reg_10
reg_10
reg_10
f1
mux_4to1
dataOut[9:0]

Calculator


EA
EB
Emult
Ediv
doneM
done D
rw
FSM
ENR
ENMUX


S1 - Write
R_W
0
1
EA ← 1, EB ← 1
S2 – Begin Read
Emult ← 1, Ediv ← 1
0
done M
1
done D
0
1
S3 – Finish Read
ENR ← 1, Enmux ← 1
1
R_W
0

Calculator


Name
Value
clk
1
r...n
1
A...]
-16
B...]
-16
s...]
0
r_w
1
d...]
-32
y
S3
865.000 ns
0 ns
100 ns
200 ns
300 ns
400 ns
500 ns
600 ns
700 ns
800 ns
900 ns
S1
S2
S3

Keys

Switch	Function
SW(0)	Negates A
SW(1)	Negates B
SW(2)	Selects digit for input
SW(3 to 5)	Selects Operation
SW(14)	Toggles Read/Write
SW(15)	Enables Calculator

SW(5 downto 3)	Function
000	Addition
001	Subtraction
010	Multiplication
011	Division
100	Modulo

Improvements

- Implementation of 7-segment display
- Reduce usage of switches on Nexys board
- Expand capacity of the calculator