- ECE 3710 -
SIGNED FIXED POINT CALCULATOR

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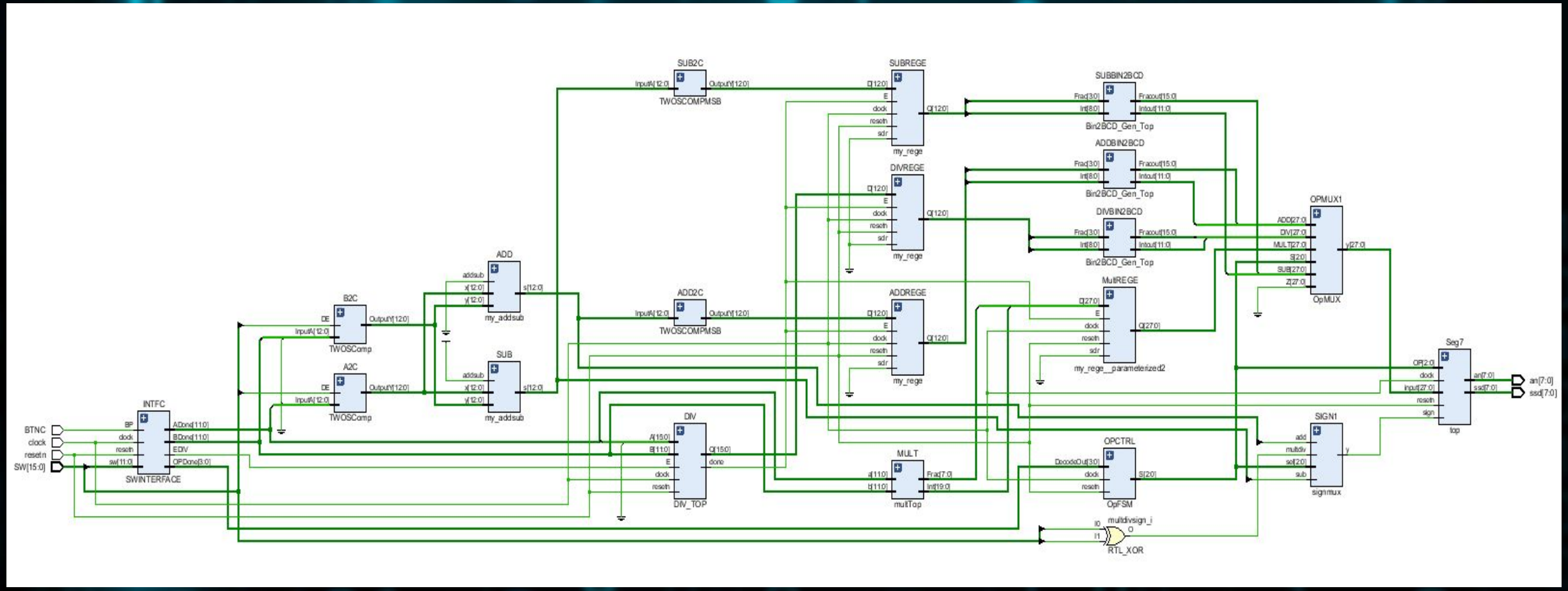
INTRODUCTION

- This calculator will take in a 12-bit, sign and magnitude binary number [12 4], convert it to signed fixed point for the arithmetic operations and provide the user with a signed decimal output.
- Topics in this project include…
  - Calculating signed fixed-point binary
  - Being able to create, simulate, and port map multiple components into VHDL
  - Being able to troubleshoot and see multiple components in timing diagrams for errors.

MAIN COMPONENTS

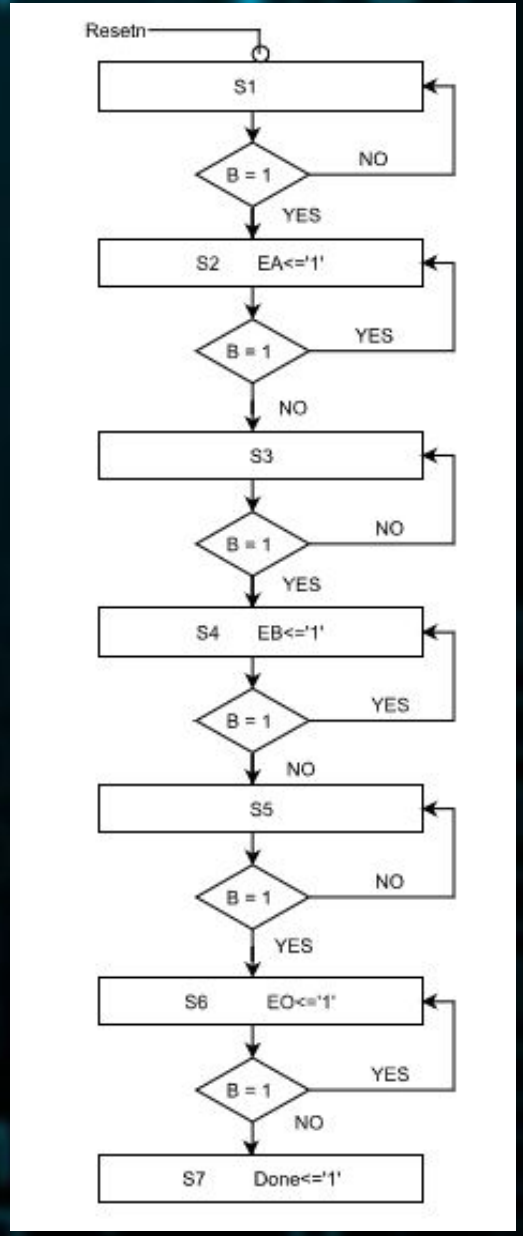
- Input Interface
- Adder/Subtractor
- Multiplier
- Divider
- Bin-to-BCD Converter
- 2’s Complement Converter
- Operation Select FSM
- Seven Segment Display Controller

TOP FILE BLOCK DIAGRAM



INPUT INTERFACE

- Switches 14 and 15 used for sign
- Switches 11 through 0 used for inputs A and B
- Switches 3 through 0 used for operation
- Center button used for loading data
- Inputs A, B, and operation all have their own register enabled by the state machine.



OPERATIONS

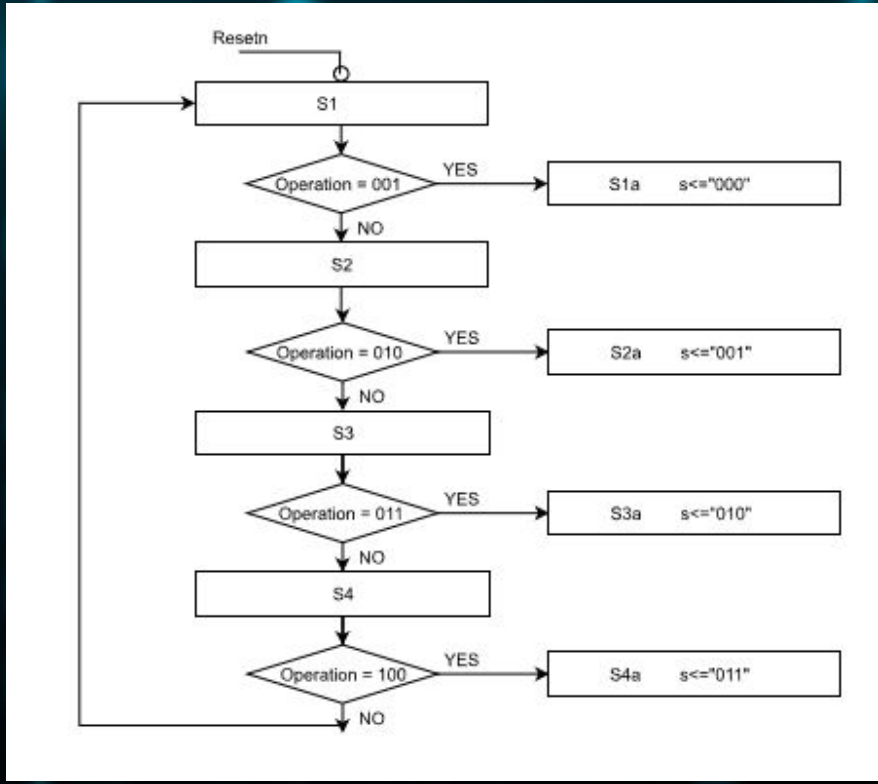
- Addition / Subtraction : 13 bits, 9 integer and 4 fractional
- Multiplication: 12 bit input, 8 integer and 4 fractional. Special Bin-to-BCD
- Division: The iterative divider method was used, and an extra 4 bits were added to the LSB of the numerator for extra precision.

BIN TO BCD

- The method used for the converters is called double-dabble.
- For the fractional numbers you multiply the binary number by 10 and grab the top 4 bits.
- These numbers will all be in BCD form.

OPERATION SELECT FSM

- Responsible for controlling the select line to the MUX that feeds data to the seven segment display. The input to the FSM is the output to the operation register.

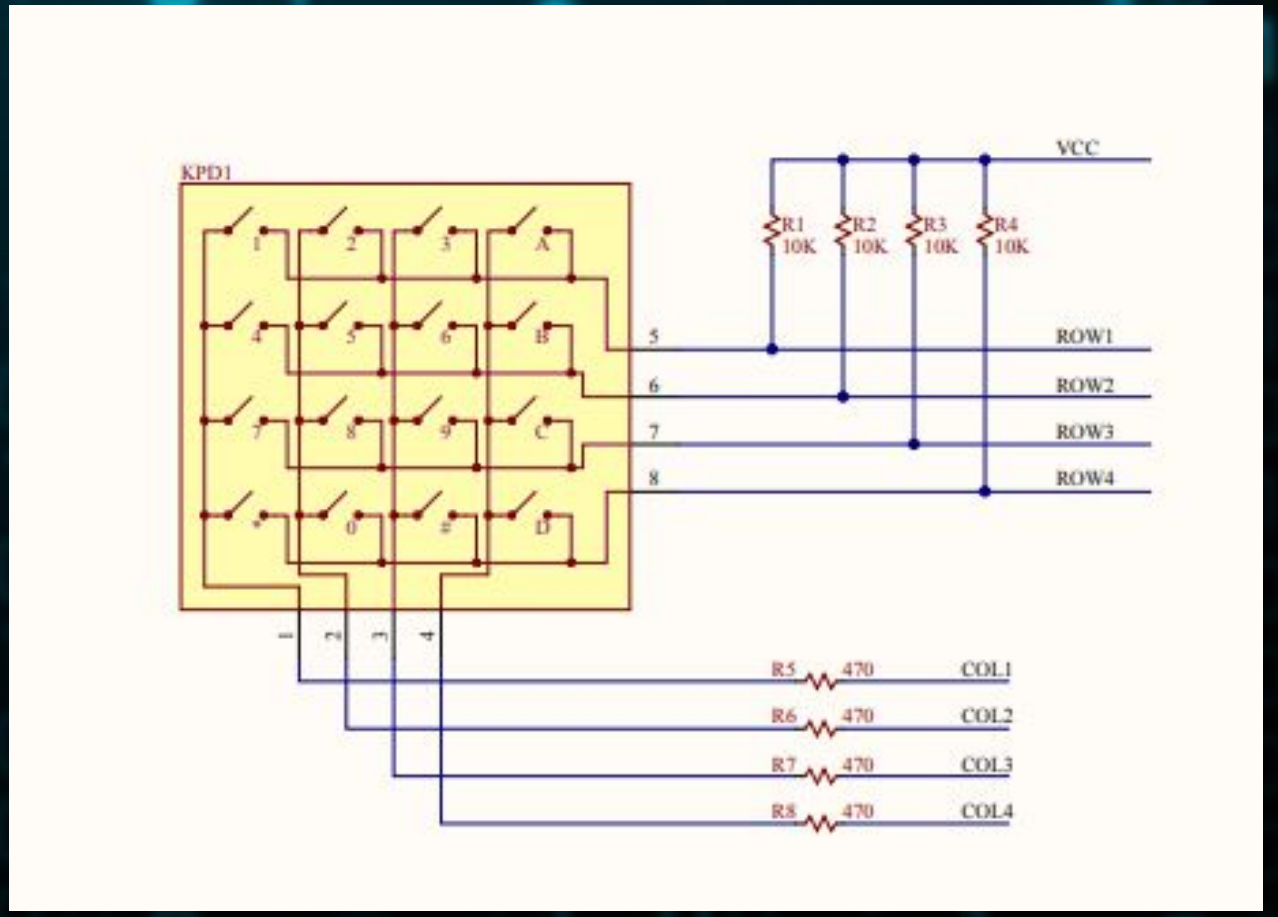


SEVEN SEGMENT DISPLAY CONTROLLER

- Separate decoder hooked up to output of Bin-to-BCD component split into groups of 4
- Outputs of decoders hooked up to a display control
  - Controls when group of segments turns on
- Decimal point is controlled by concatenating a bit to the MSB of the normal 6 down to 0 signal
  - Makes the signal 7 down to 0, or 8 bits
  - Because decimal point changes places based on operation, an if statement is used to turn on the 5th displays decimal point or the 3rd display's
- Modified decoder was made for the sign display

ADDITIONAL IDEAS

- Keypad Interface
- Have the inputs appear as they are entered



THANKYOU!

Any Questions?

DEMO

1. 30.0625 + 50.375 = 80.4375
2. -1.4375 - 10.6875 = -12.125
3. -127.5 * -100.5625 = 12821.7188
4. -28.9375 / 15.875 = -1.8228