Lab 7: Adder/Subtractor

Action Items

- Design an adder/subtractor module and implement it on the demo board.
- The adder/subtractor has the following input and output ports:

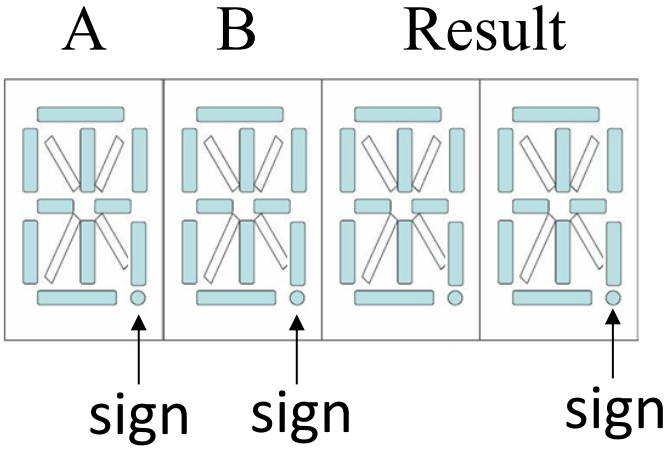
```
input clk, reset, add, sub;
input  [3:0] COLUMN;
output [3:0] ROW, DIGIT;
output [8:0] DISPLAY;
```

Behavior (1/3)

- The adder/subtratcor takes two 4-bit 2's complement numbers A and B (whose ranges are -8 ~ 7 in decimal) and calculates the result of A+B or A-B, depending on which button (the add button or the sub button) is pushed.
- If the add button is pushed, the adder/subtractor performs the addition. If the sub button is pushed, the subtraction is performed. At any time, only one or none of the two buttons is pushed.

Behavior (2/3)

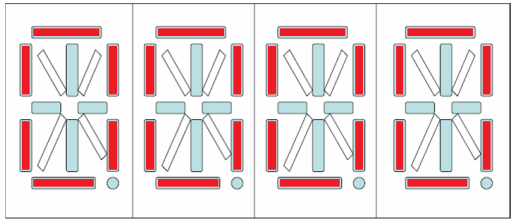
- Your design should show the decimal values of A and B on the two leftmost seven-segment display, and the decimal value of the result on the two rightmost seven-segment displays. In addition, the dot segment should light up when the number being displayed is a negative number.



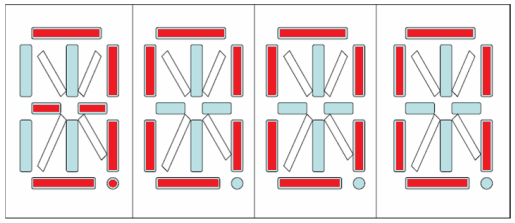
Behavior (3/3)

- Use the 4x4 keyboard to set up the values of A and B by pressing two keys sequentially. The keys 0 ~ 7 represent the decimal numbers 0 ~ 7, respectively, and the keys 8 ~ F stand for the decimal numbers -8 ~ -1, respectively.
- Once the add or sub button is pushed, the result has to be updated and displayed accordingly. To respecify the values of A and B, the reset needs to be triggered at least once.
- Use a debouncer to filter out bouncing pulses for the keyboard and each pushbutton used in this lab.

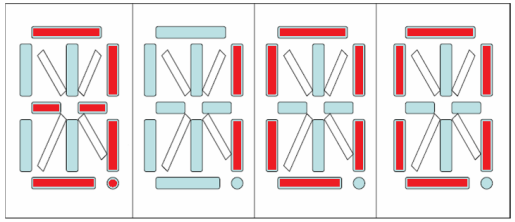
Example Operations



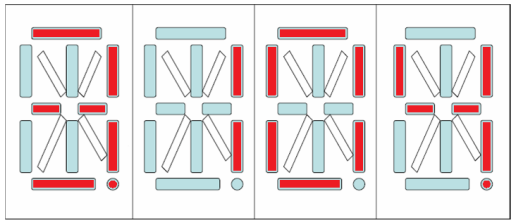
press RESET



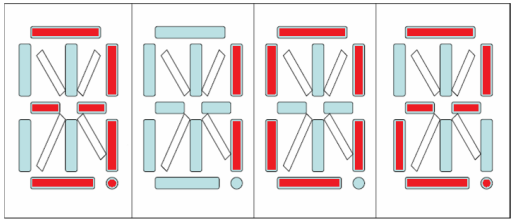
press D



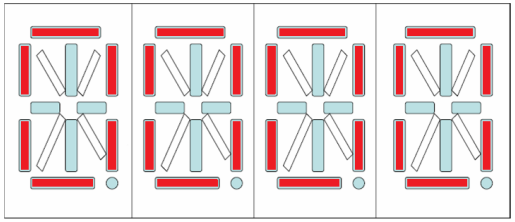
press 1



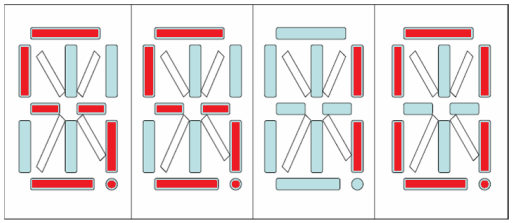
press sub



press add



press RESET



press B,
press B,
and press add

Block Diagram