Description

This project implements scrolling, writable text across the four 7-segment displays on the Basys 3, with variable scrolling speed. The text has a maximum length of 10 characters. This is a total of 70 bits, as the characters are decoded using ASCII codes, which are normally 8 bits, but since the MSB of all letters A-Z in ASCII is zero, it is omitted. The circuit begins in write state. When the “write” switch is turned on, the code (taken from the leftmost 7 switches) is decoded and the character is added to the sequence. If the code is invalid, an empty character (space) is entered. After writing a character, the circuit enters a state which waits for the “write” switch to go low again, to avoid writing multiple characters at the same time. If more than 10 characters are entered, the first ones will be overwritten by the new ones. If the “start” switch is turned on, the current text will begin scrolling across the four displays. It starts the scrolling sequence with the display completely blank, and the first letters scroll in from the right side. After all characters have disappeared off the left side, the circuit enters its wait state. This state waits for 3 ticks of the scroll clock before returning to the scroll state. The displays are blank during the wait state. The scrolling and waiting process continues infinitely until the reset switch is turned on, at which point the display and text are reset and the circuit enters its write state once again.

Code

ScrollingText.sv

SevenSegmentDecoder.sv

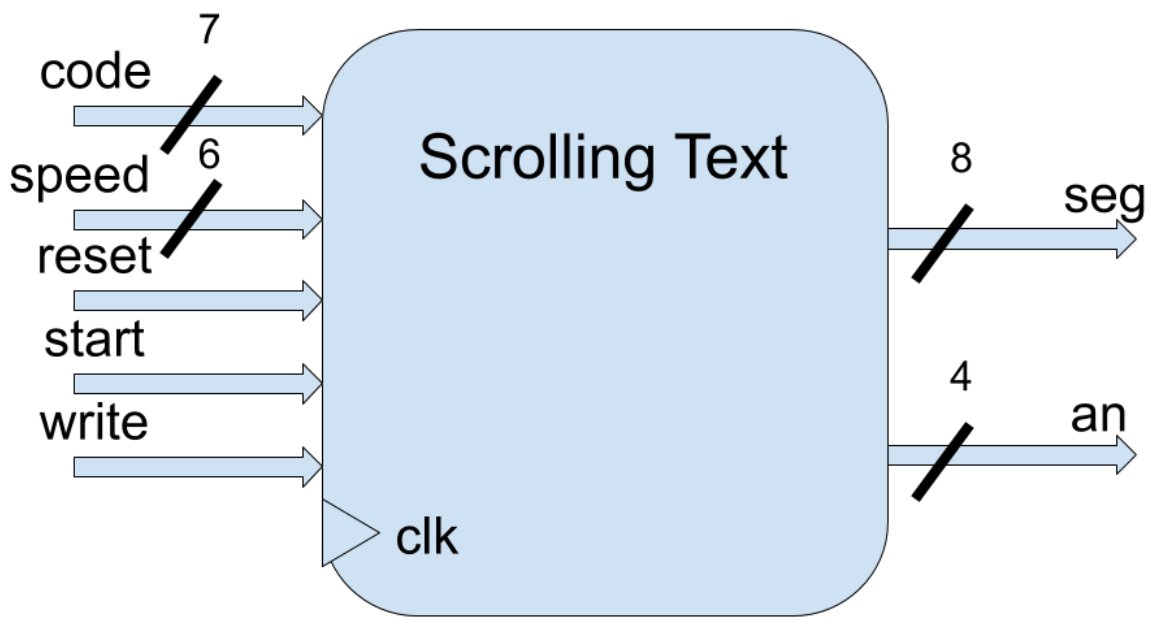
ClockDivider.sv

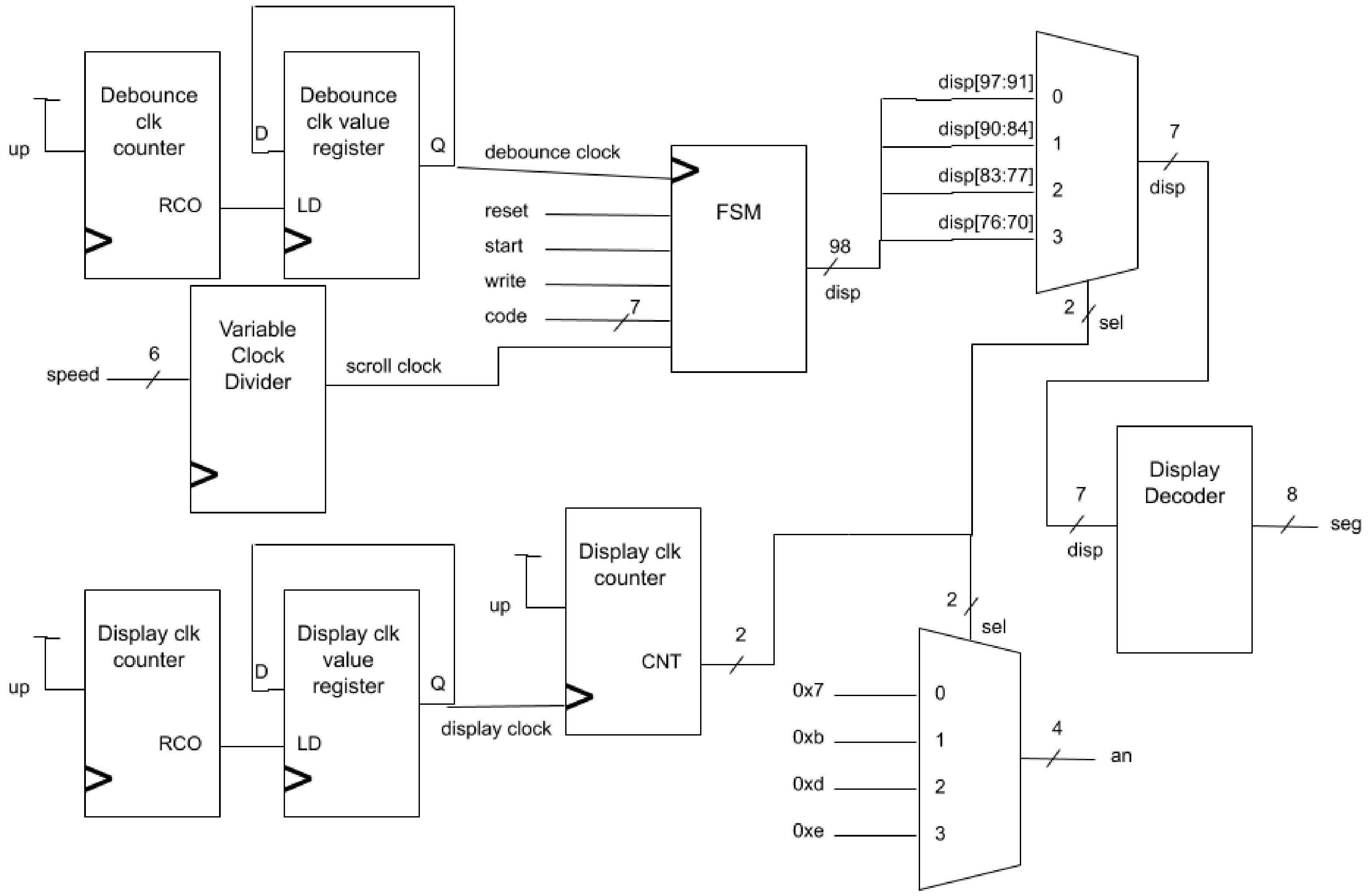
VariableClockDivider.sv

ScrollingTextConstraints.xdc

ScrollingText_tb.sv

Black Box Diagrams (high and lower level)

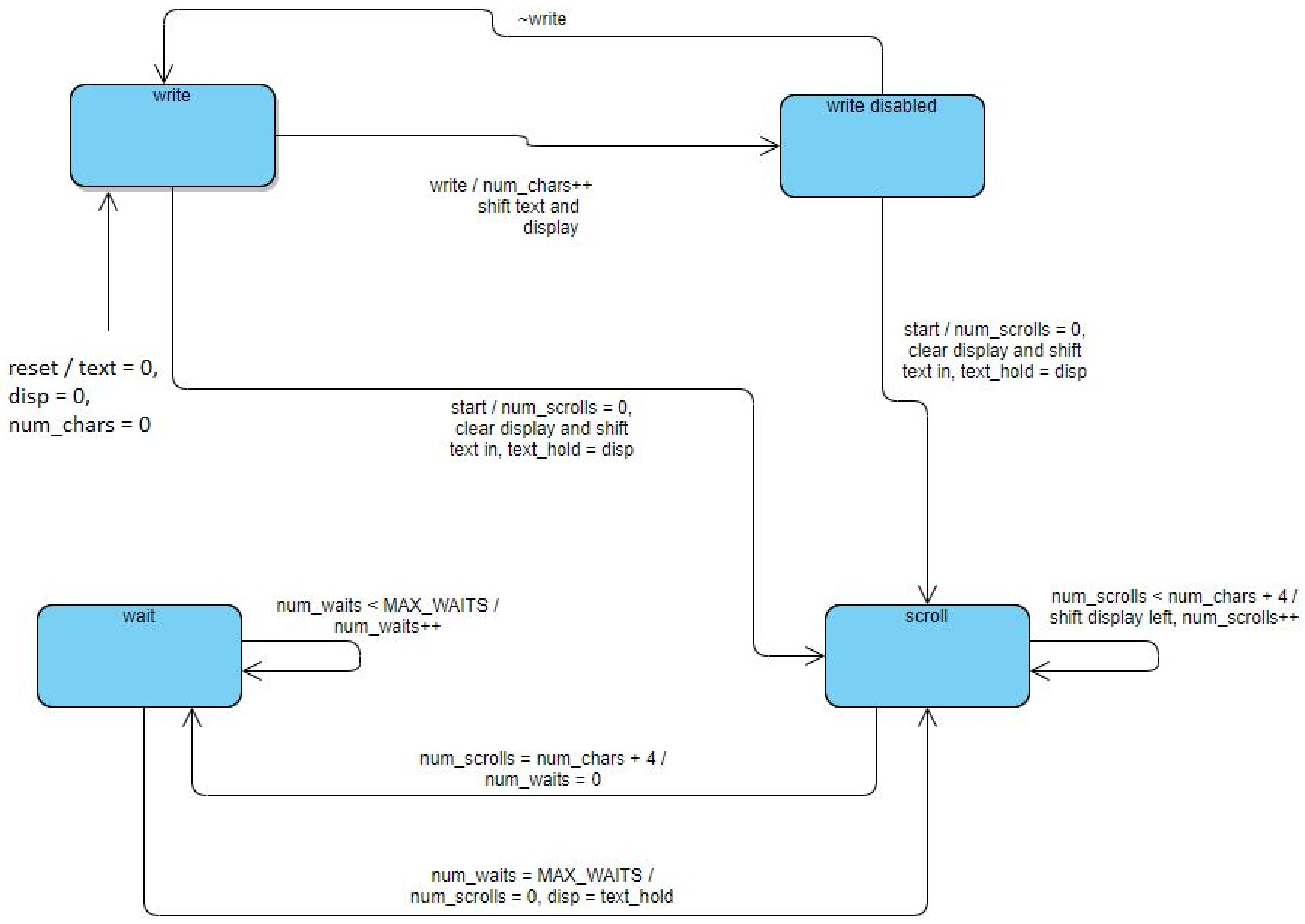




BBD Notes

- Debounce & display clock counters count to values that will produce a frequency appropriate for debouncing switches & displaying 4 separate characters on the four 7-segment displays
- Reset is asynchronous, start and write are not.
- All counters only count up continuously and overflow to zero upon reaching their terminal value.

State Diagram


~write
write
write disabled
write / num_chars++
shift text and
display
start / num_scrolls = 0,
clear display and shift
text in, text_hold = disp
reset / text = 0,
disp = 0,
num_chars = 0
start / num_scrolls = 0,
clear display and shift
text in, text_hold = disp
wait
num_waits < MAX_WAITS /
num_waits++
scroll
num_scrolls < num_chars + 4 /
shift display left, num_scrolls++
num_scrolls = num_chars + 4 /
num_waits = 0
num_waits = MAX_WAITS /
num_scrolls = 0, disp = text_hold