Digital Oscilloscope ECE 241 Milestone #1

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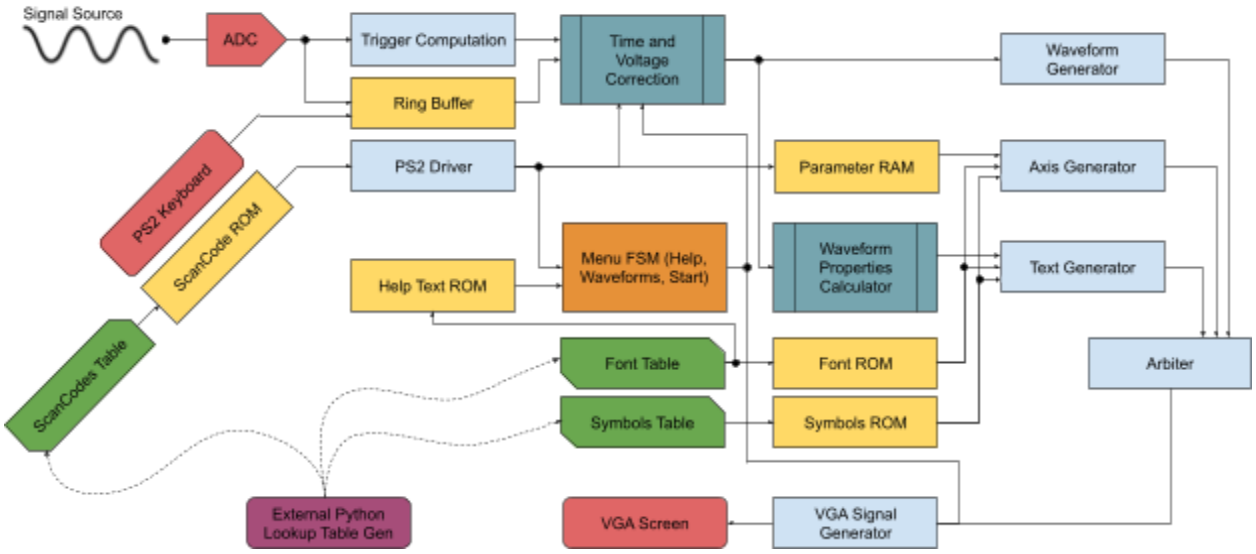
Summary

This week involved the process of setting up the entire pipeline of the project, i.e. writing a VGA driver, PS2 driver, getting a waveform to display on the screen, getting rough calculations of waveform properties to display, and implementing the character display pipeline. This groundwork has set the infrastructure we will use to further develop the features of the FPGAScope, chief of which is getting the ADC to take an analog and place it into the ringbuffer.



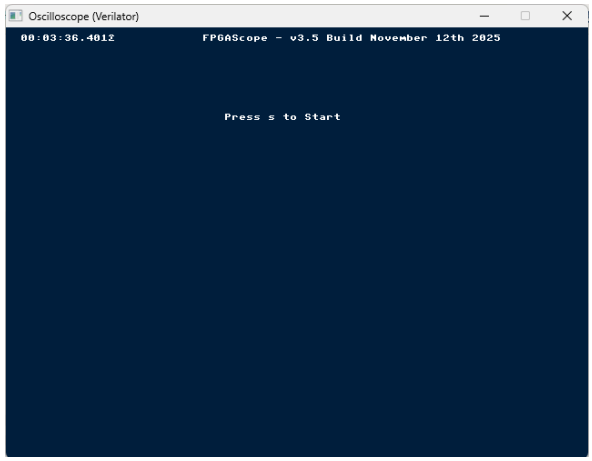
Most of the items above have been completed in some capacity save for the trigger computation and time and voltage correction.

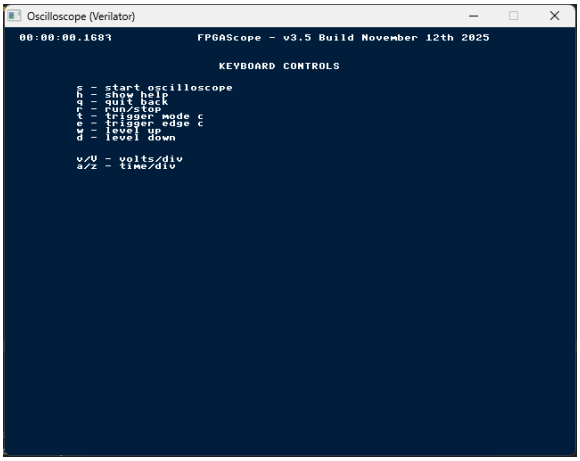
Photos of Progress

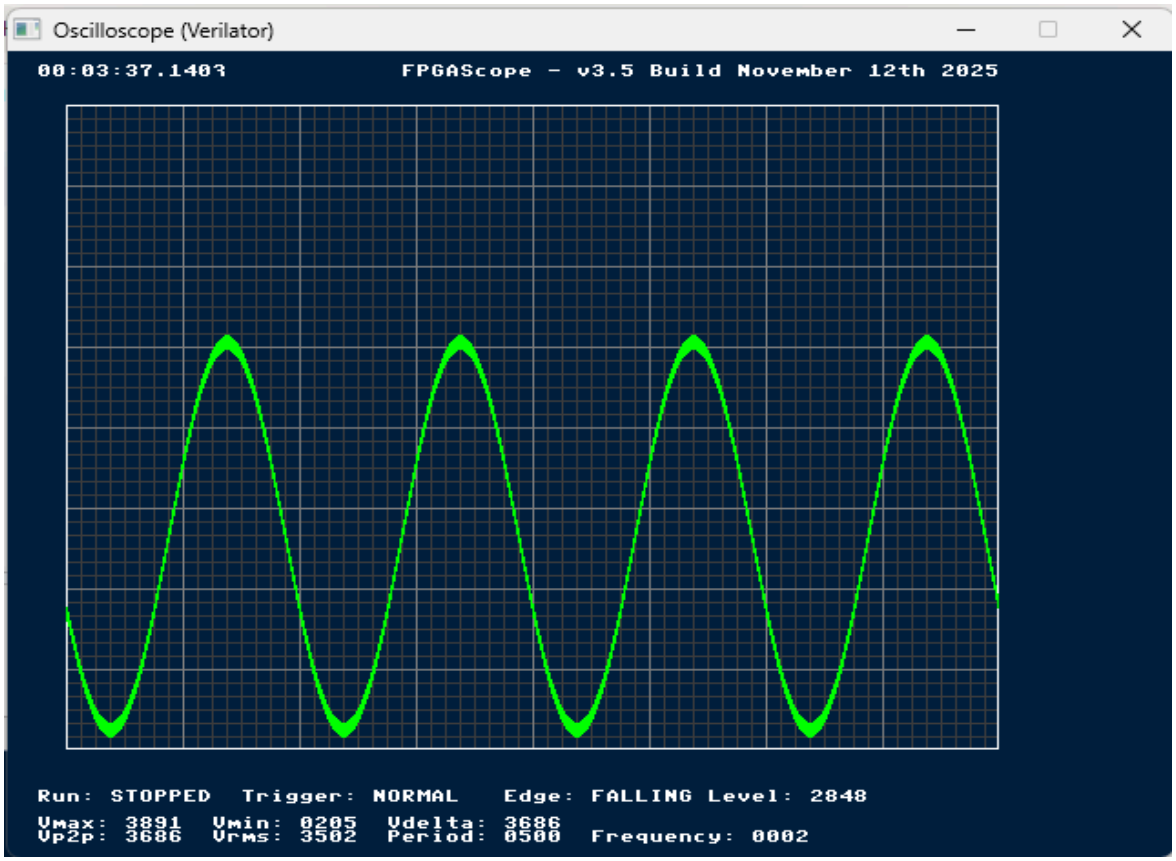
Testbenches

DESim is exceptionally slow at rendering windows, not very useful for quickly debugging UI components and for quickly checking if changes to the waveformGenerator module or ps2Driver module are mirrored correctly.

It was very useful as we could not always come into the lab, wrote our modules asynchronously the majority of times, etc. (and stayed up late writing it, not very convenient to come into the lab at 2AM!). Below is what the Verilator has produced, this is the most recent build.







New Ideas Developed

If there is time before the final project the following ideas might be interesting:

1. There is an issue where if a wave is too steep it will have gaps, the temporary way to fix this is make the line thicker, this reduces accuracy. Interpolation using sin(x)/x.
2. Adding a second channel is quite straightforward as it is multiplying most modules x2 and handling the interconnections. We have used a small amount of resources, so this is feasible to do so. Perhaps even 6-channel is feasible given the 6-pin ADC header.

Work Assignments

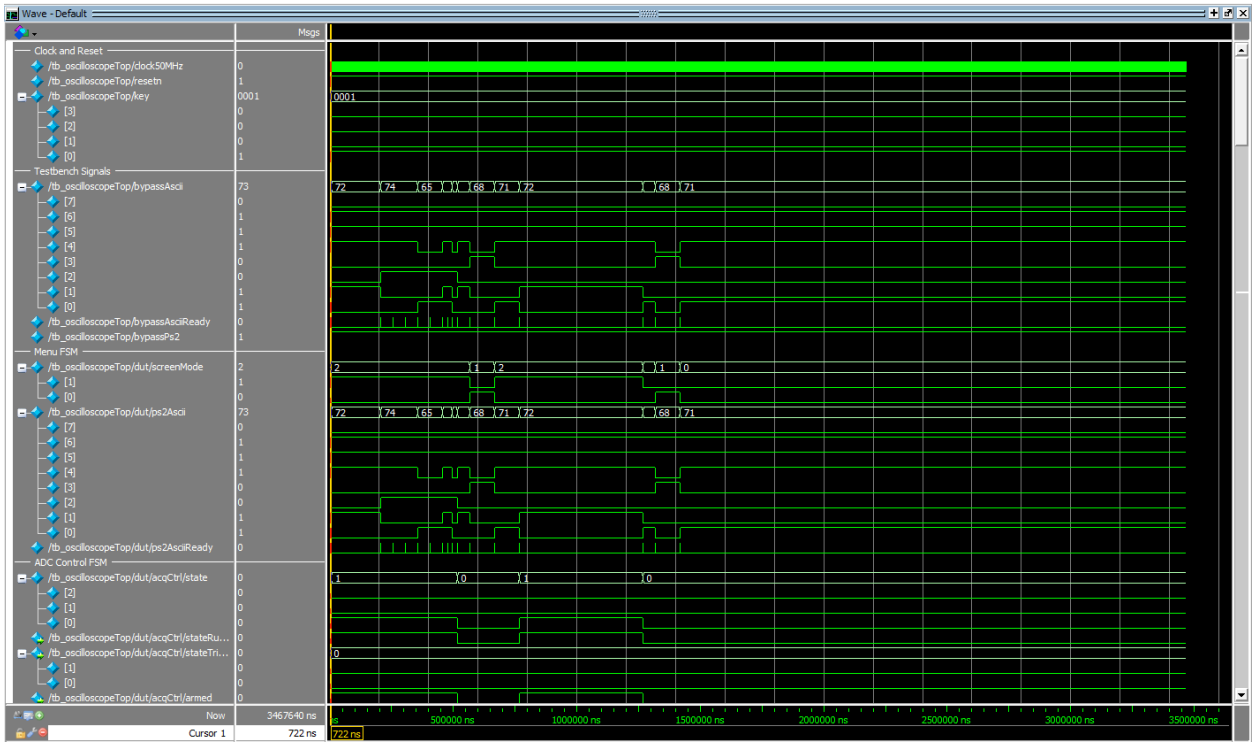
We had aimed to get the below work done in time for the halfway point between Milestone #1 and Milestone #2, hence some parts of the table below are in-progress. Given that during the actually writing of the verilog we discovered that we had to change our timeline slightly some work has been pushed to Milestone #2 and some Milestone #2 has been brought forward to Milestone #1.

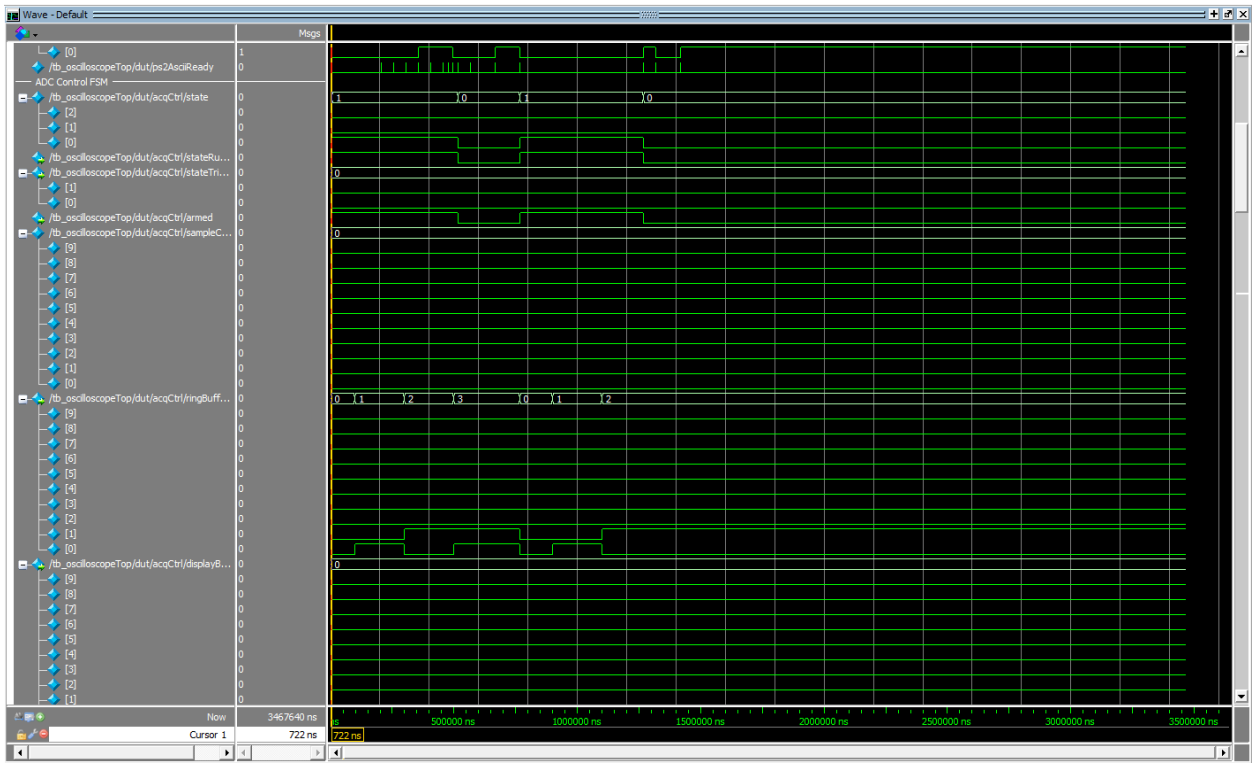
Work labelled DONE is finished. Work labelled IN-PROGRE[SS] is work we aim to finish before the end of the work week.

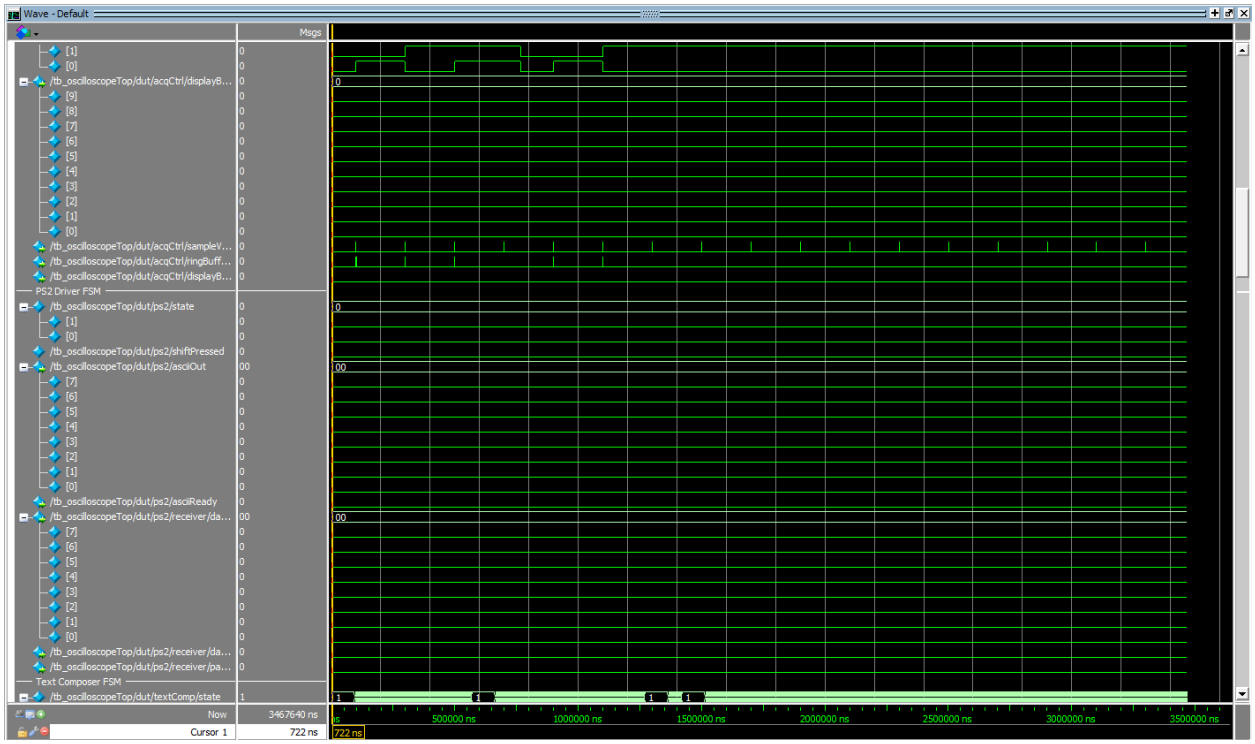
Assignee	Work	Status
Ayan	Verilator Testbench	DONE
	DESim Testbench	DONE
	FakeADC Python Generator and FakeADC.v	DONE
	ScanCodesLUT Python Generator	DONE
	FontLUT Python Generator	DONE
	PS2 (and ScanCodes) and VGA Driver Research	DONE
	State Machines Design	DONE
	ps2Driver.v	DONE
	scancodesROM.v	DONE
	waveformGenerator.v	DONE
	waveformProperties.v	DONE
	menuFSM.v	DONE
	textComposer.v	DONE
	ringBuffer.v	DONE
	oscilloscopeTop.v	IN-PROGRE
	waveformTrigger.v	IN-PROGRE
	timeVoltageCorrection.v	IN-PROGRE
	bridgeAD7928toSPI.v	IN-PROGRE
	Milestone #1 Writeup	DONE
	Draw Cool Logo + Parsing for Display	IN-PROGRE
Rahil	ModelSim Testbenches	DONE

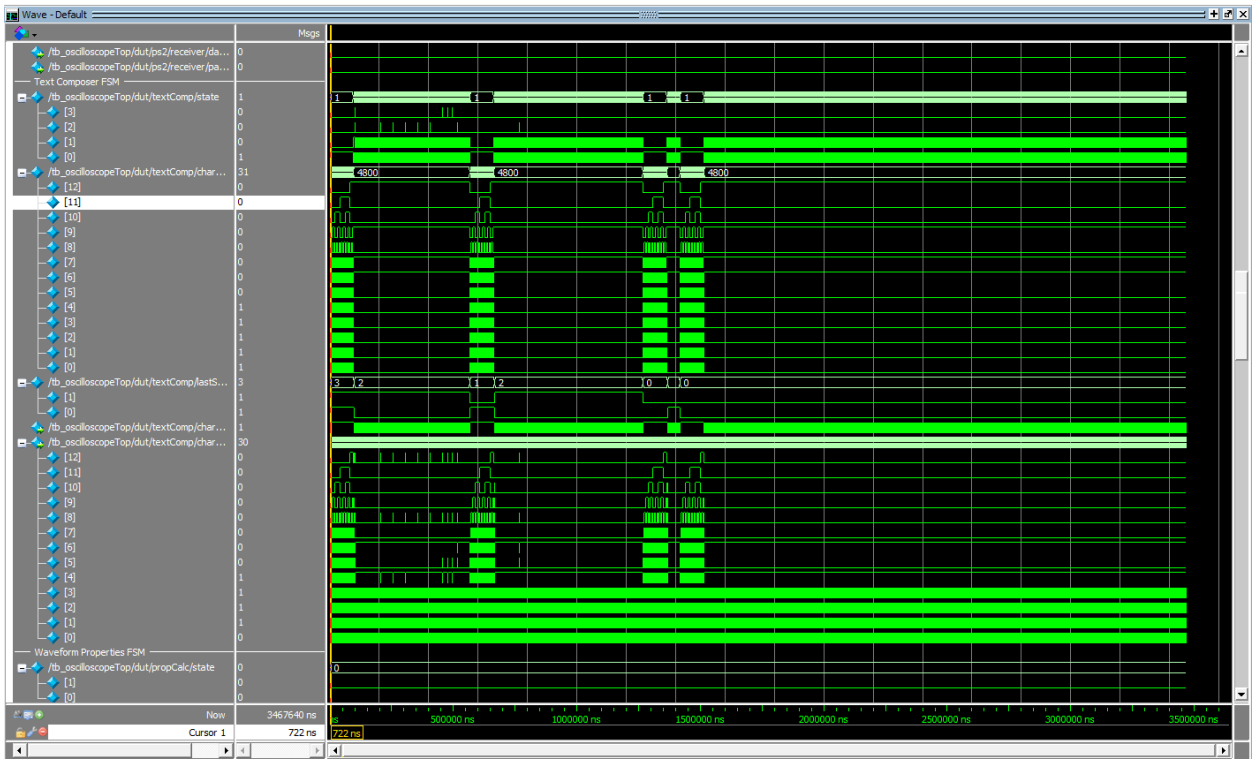
	vgaDriver.v	DONE
	fontROM.v	DONE
	parameterRAM.v	DONE
	characterRAM.v	DONE
	textGenerator.v	DONE
	axisGenerator.v	DONE
	pixelArbiter.v	DONE
	displayBuffer.v	DONE
	clockCounter.v	DONE
	controlADC.v	IN-PROGRE
	Milestone #1 Writeup	DONE
	Draw Cool Logo + Parsing for Display	IN-PROGRE

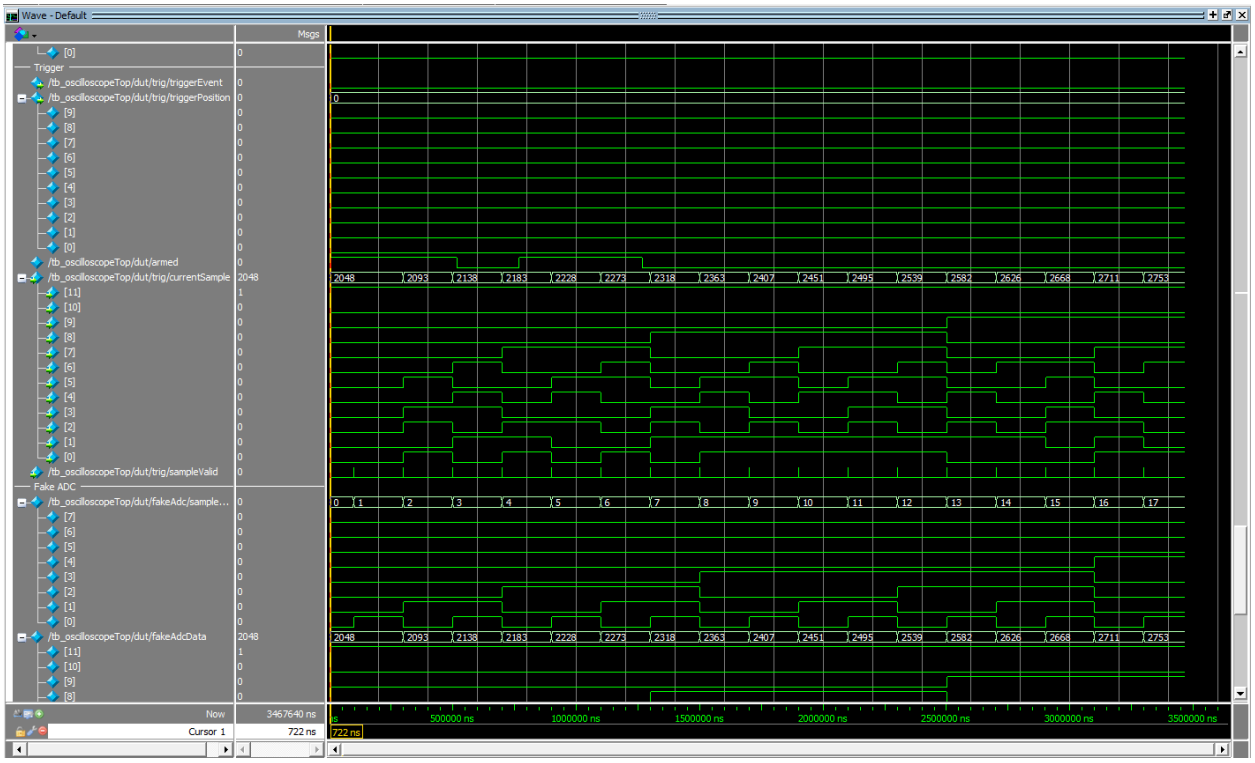
ModelSim Testing of Statemachines

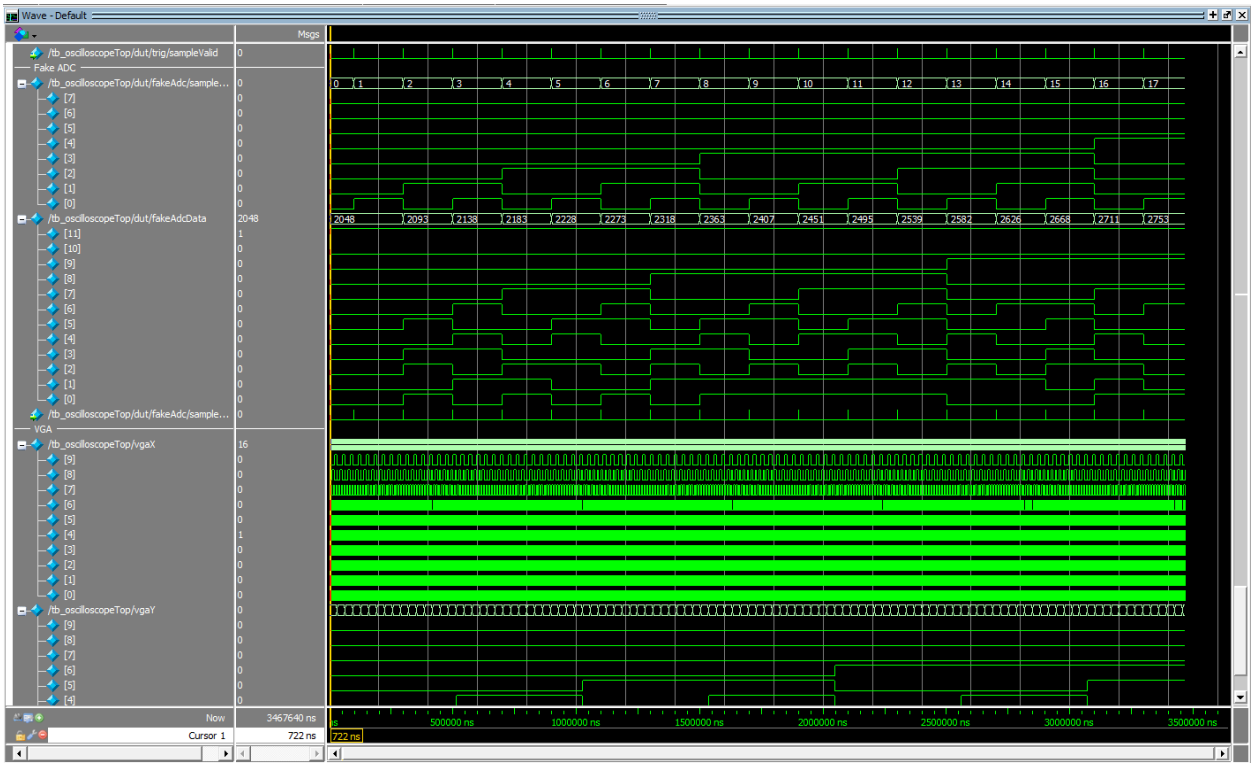


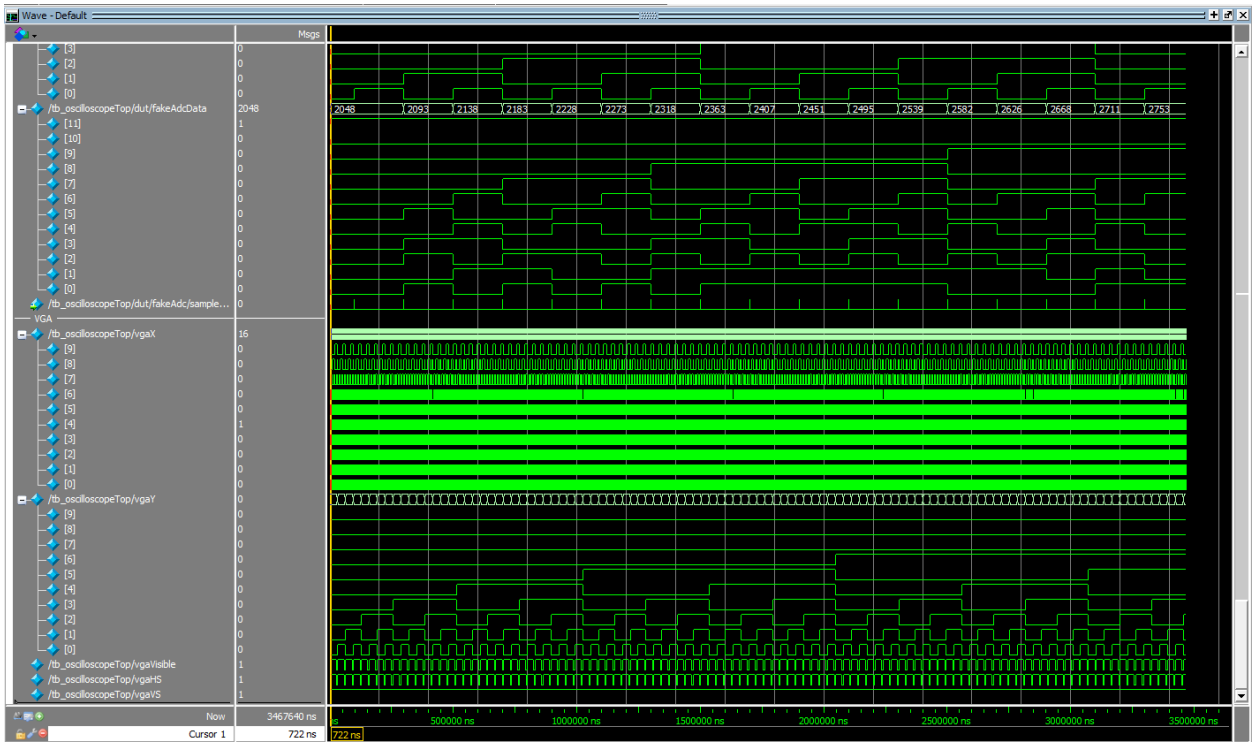



Wave - Default
Msgs
/tb_oscilloscopeTop/dut/acqCtrl/displayB...
/tb_oscilloscopeTop/dut/acqCtrl/sampleV...
/tb_oscilloscopeTop/dut/acqCtrl/ringBuff...
/tb_oscilloscopeTop/dut/acqCtrl/displayB...
PS2 Driver FSM
/tb_oscilloscopeTop/dut/ps2/state
/tb_oscilloscopeTop/dut/ps2/shiftPressed
/tb_oscilloscopeTop/dut/ps2/asciiOut
/tb_oscilloscopeTop/dut/ps2/asciiReady
/tb_oscilloscopeTop/dut/ps2/receiver/da...
/tb_oscilloscopeTop/dut/ps2/receiver/pa...
Text Composer FSM
/tb_oscilloscopeTop/dut/textComp/state
Now
3467640 ns
Cursor 1
722 ns
500000 ns
1000000 ns
1500000 ns
2000000 ns
2500000 ns
3000000 ns
3500000 ns

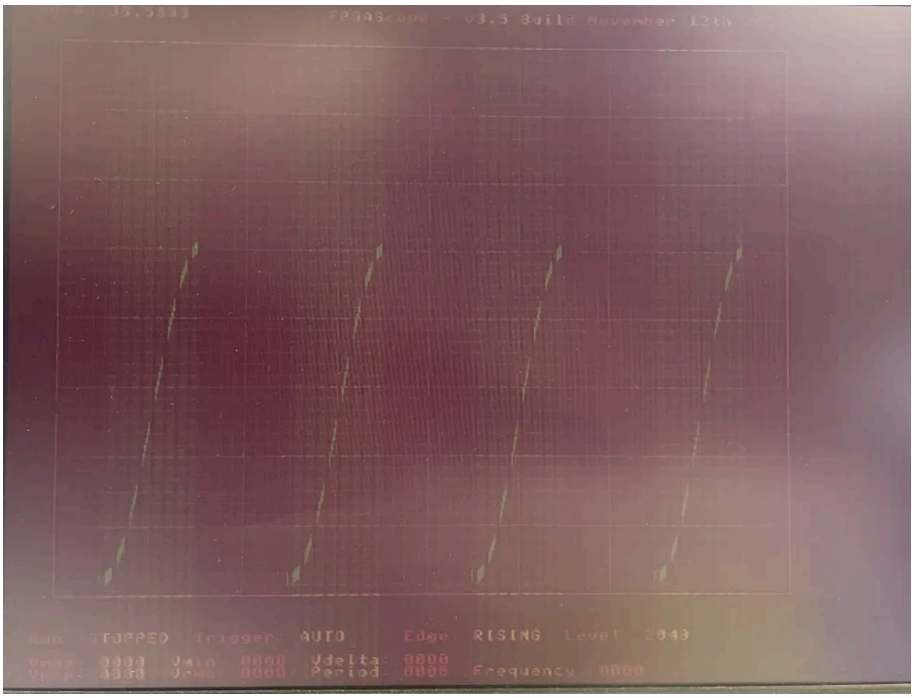

Wave - Default
Msgs
/tb_oscilloscopeTop/dut/ps2/receiver/da...
/tb_oscilloscopeTop/dut/ps2/receiver/pa...
Text Composer FSM
/tb_oscilloscopeTop/dut/textComp/state
/tb_oscilloscopeTop/dut/textComp/char...
/tb_oscilloscopeTop/dut/textComp/lastS...
/tb_oscilloscopeTop/dut/textComp/char...
/tb_oscilloscopeTop/dut/textComp/char...
Waveform Properties FSM
/tb_oscilloscopeTop/dut/propCalc/state
Now
3467640 ns
Cursor 1
722 ns
500000 ns
1000000 ns
1500000 ns
2000000 ns
2500000 ns
3000000 ns
3500000 ns


Wave - Default
Msgs
Trigger
/tb_oscilloscopeTop/dut/trig/triggerEvent
/tb_oscilloscopeTop/dut/trig/triggerPosition
/tb_oscilloscopeTop/dut/armed
/tb_oscilloscopeTop/dut/trig/currentSample
/tb_oscilloscopeTop/dut/trig/sampleValid
Fake ADC
/tb_oscilloscopeTop/dut/fakeAdc/sample...
/tb_oscilloscopeTop/dut/fakeAdcData
2048 2093 2138 2183 2228 2273 2318 2363 2407 2451 2495 2539 2582 2626 2668 2711 2753
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Now
3467640 ns
Cursor 1
722 ns
500000 ns
1000000 ns
1500000 ns
2000000 ns
2500000 ns
3000000 ns
3500000 ns

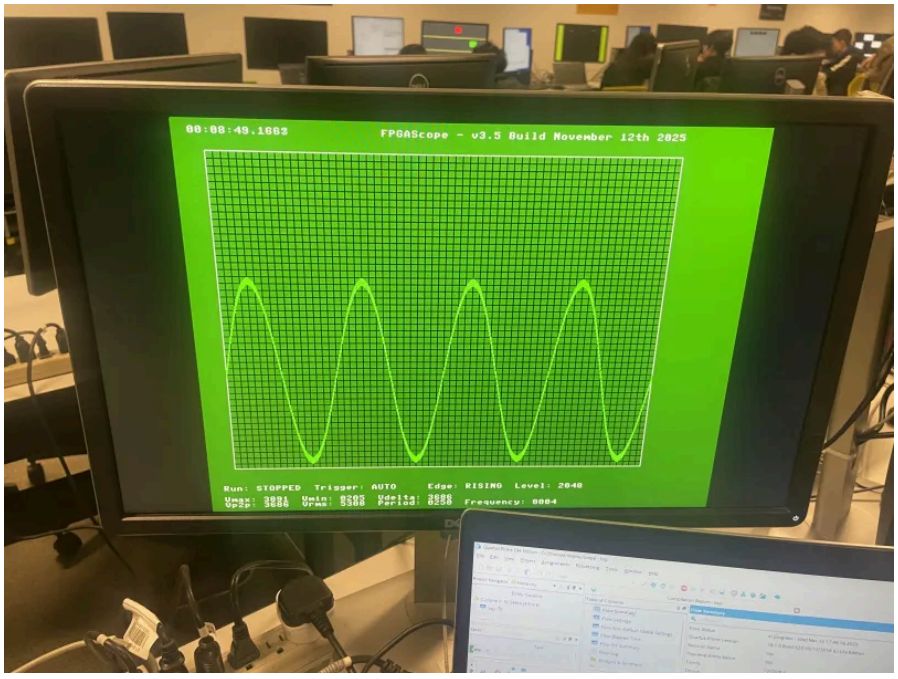

Wave - Default
Msgs
/tb_oscilloscopeTop/dut/trig/sampleValid
Fake ADC
/tb_oscilloscopeTop/dut/fakeAdc/sample...
/tb_oscilloscopeTop/dut/fakeAdcData
VGA
/tb_oscilloscopeTop/vgaX
/tb_oscilloscopeTop/vgaY
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
2048 2093 2138 2183 2228 2273 2318 2363 2407 2451 2495 2539 2582 2626 2668 2711 2753
Now
3467640 ns
Cursor 1
722 ns
500000 ns
1000000 ns
1500000 ns
2000000 ns
2500000 ns
3000000 ns
3500000 ns


Wave - Default
Msgs
/tb_oscilloscopeTop/dut/fakeAdcData
2048
2093
2138
2183
2228
2273
2318
2363
2407
2451
2495
2539
2582
2626
2668
2711
2753
/tb_oscilloscopeTop/dut/fakeAdc/sample...
VGA
/tb_oscilloscopeTop/vgaX
/tb_oscilloscopeTop/vgaY
/tb_oscilloscopeTop/vgaVisible
/tb_oscilloscopeTop/vgaHS
/tb_oscilloscopeTop/vgaVS
Now
3467640 ns
Cursor 1
722 ns
500000 ns
1000000 ns
1500000 ns
2000000 ns
2500000 ns
3000000 ns
3500000 ns

Spooky Bugs



This display bug happened as my code handles only 4-bit color in an effort to reduce displayBuffer.v size. The vga screen expects a 8-bit color for each RGB. This fix was to add extra bits to the end of the color value when passing to VGA.



This display bug happened when the green and blue connections wires were flipped due to a typo.