Mini Project 3 Final Report

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System Architecture

The **src/** folder in this directory contains the following files:

- **sine_tb.sv**
- **sine.sv**
- **fsm.sv**
- **memory.sv**

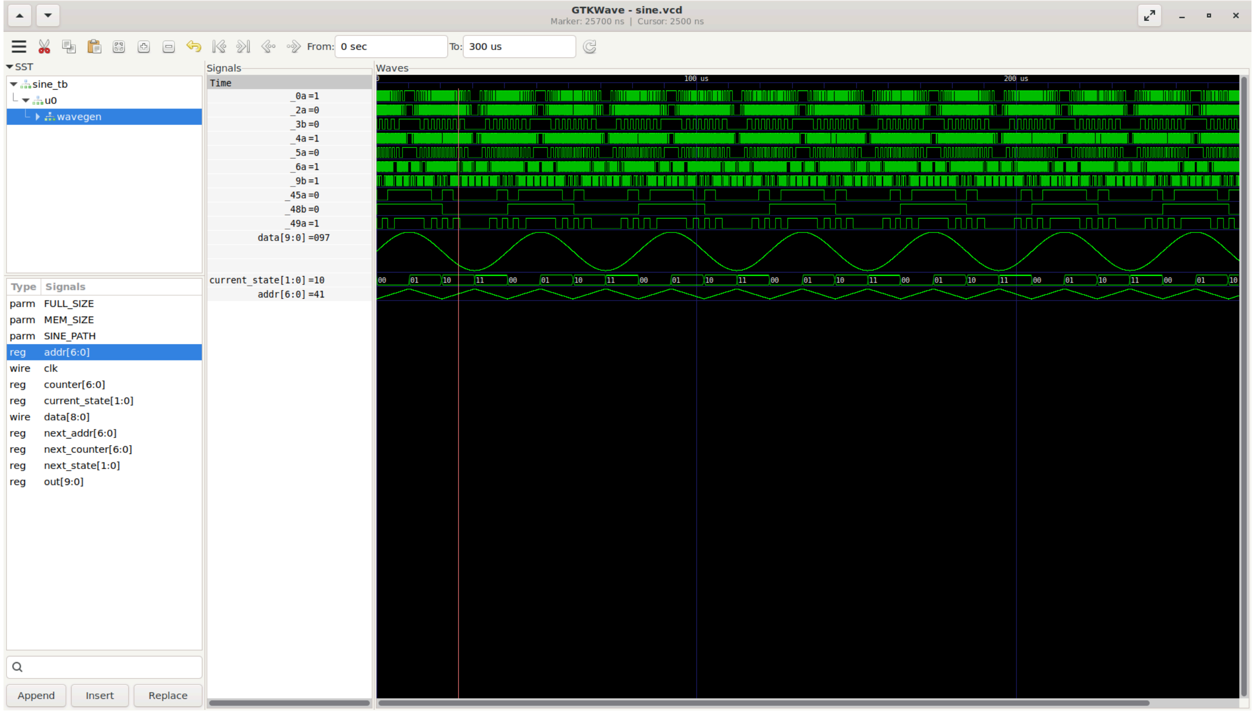
Each file possesses its own module, with **sine** at the highest level and **memory** at the lowest level. **sine_tb** is used to record and view the 10-bit output of the system.

The **sine** module takes a clock input and outputs 10 individual bits of data. The module itself simply contains an instance of the **fsm** module and nothing else. **sine** simply maps the 9-bit datastream output of **fsm** to its 9 individual output bits.

The **fsm** module is the most complex module in the system. **fade** takes in two inputs: memory size, which for this project is 128 bits, and the filepath to a text file containing sine wave samples. **fsm** takes advantage of the symmetry in a sine wave by only using samples from the first quarter of a single cycle. Four states are defined: positive up, positive down, negative down, and negative up. Each state manipulates two parameters: reading the data addresses forward or in reverse, and reading the data values normally or inverted. Together, the four states recreate the full sine wave using only the first quarter. **Fsm** possesses an instance of the **memory** module, which it uses to access data at a certain address within the input text file. **fsm** outputs a 9-bit datastream describing the value of the data at the current address, manipulated according to the state.

The **memory** module is very simple. Given the path to the samples and a certain memory address, **memory** will return the data present at that address.

GTKWave Demonstration



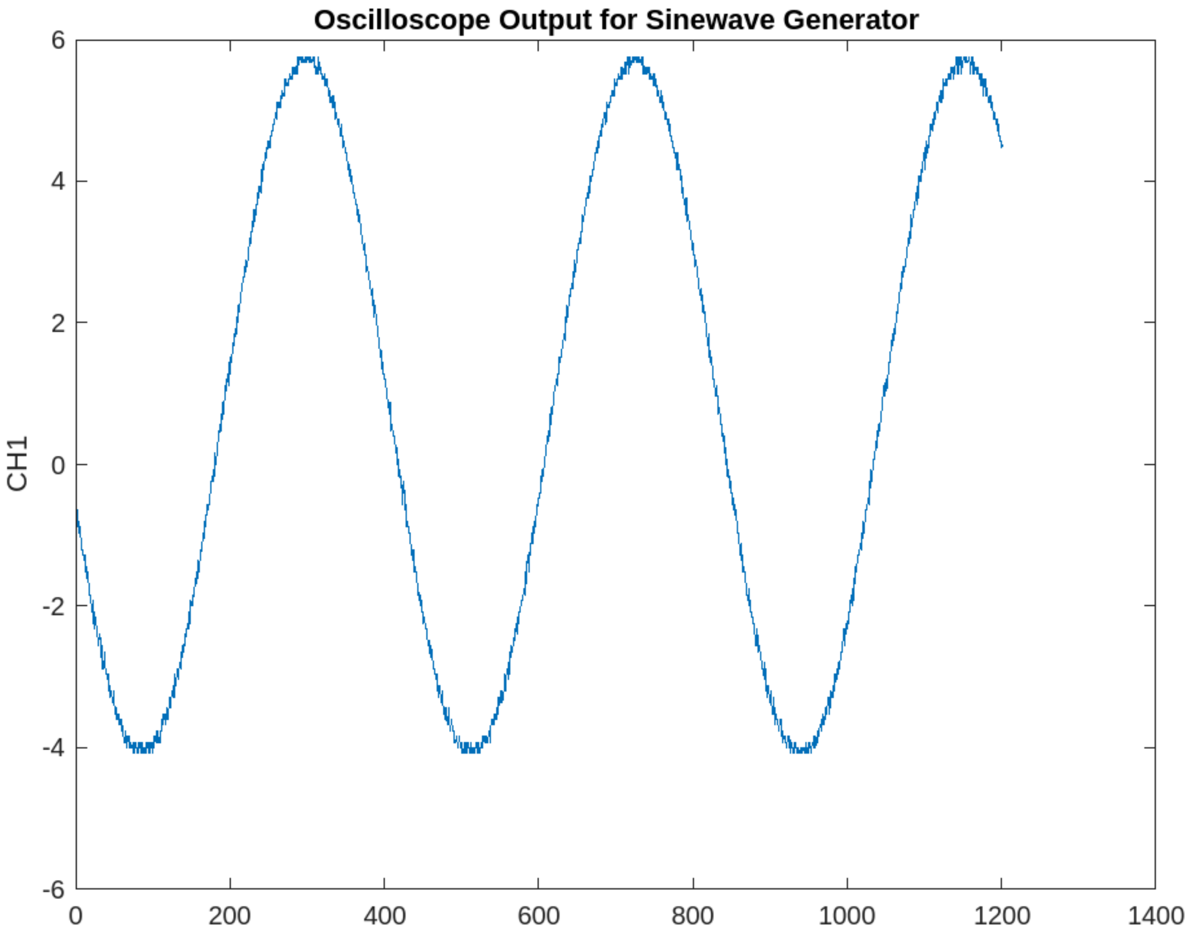
Type	Signals
parm	FULL_SIZE
parm	MEM_SIZE
parm	SINE_PATH
reg	addr[6:0]
wire	clk
reg	counter[6:0]
reg	current_state[1:0]
wire	data[8:0]
reg	next_addr[6:0]
reg	next_counter[6:0]
reg	next_state[1:0]
reg	out[9:0]

```
Time
       _0a =1
       _2a =0
       _3b =0
       _4a =1
       _5a =0
       _6a =1
       _9b =1
      _45a =0
      _48b =0
      _49a =1
   data[9:0] =097


current_state[1:0] =10
   addr[6:0] =41
```

This is a screenshot of the GTKWave-generated representation of the complete sine wave produced by my system in a single second. **data[9:0]** shows the output sine wave, while the variables above **data[9:0]** show each individual bit. Below, **current_state[1:0]** shows the FSM state alternating between four options with the sine wave. Also, **addr[6:0]** shows how the second and fourth states access the memory in reverse order.

Oscilloscope Output



This is a screenshot of the outputted oscilloscope data, plotted in MATLAB. The data clearly shows a full sine wave cycling as a function of time.