TO: Professors J. Hung and V. Nelson
FROM: "The PokeSquad", Justin Wahlers and Demetris Coleman
SECTION: 003 – Tuesday 3:30 p.m.
DATE: September 9, 2016
SUBJECT: Lab 2 and 3 – Developing and Debugging C Programs with Oscilloscope and Logic Analyzer

The objectives of laboratory exercises 2 and 3 were to write and build upon a simple C program, and to utilize the µVision and Waveforms software to execute, analyze, and debug the program. The "counter" program was tested and developed during the second and third laboratory exercises using µVision for compilation and execution and Waveforms as a method of behavioral analysis. The program incremented or decremented two counters, which were visually represented using the PC0 – PC7 output ports. Control of this program consisted of two input switches at PA1 and PA2.

*Testing Procedure and Observations*

With two input switches, there were four states possible for the counter program. These states are specified in Table A. The program behavior was observed and verified using the logic analyzer. Figures 1 and 2 feature the counter behavior in two different states. The two sets of signals, "count1" and "count2", increment/decrement in opposite directions with '0' as a center point.

Signal behavior was also observed using the Waveforms oscilloscope tool. The primary focus of this observation was ensuring the synchronization of the two signals. Scanning the LSB of both signals in the oscilloscope verifies this behavior. The program was modified by merging two assignment statements (one for "count1" and one for "count2") into one statement to create a synchronized change in both outputs. The oscilloscope output shown in Figure 3 features the two outputs.

It can also be noted that the observed delay is approximately 0.44351 seconds, which varies from the 0.49998 seconds observed in the previous week, shown in Figure 4.

*Results*

The count values (range 0 to 9) are correctly incremented or decremented depending on the switches states as specified in Table A.

*Conclusions*

The program behaviors specified in laboratory exercises 2 and 3 were implemented and verified. Specific behaviors exhibited include the synchronized incrementing and decrementing of counts, program state changes triggered by toggling switches, and the continuous, smooth execution of the "counter" program.

One issue found near the conclusion of the third laboratory session was the change in the delay between laboratory exercise 2 and laboratory exercise 3. This discrepancy could be contributed by the addition of additional if/else statements in the program to account for the second counter. The difference was noted earlier in Figures 3 and 4. This error should be fixed in future exercises by modifying the delay function's for loops to have greater or fewer loops.

Table A: Switch Positions and Output Behaviors in each Program State

| | Switches | | Outputs | |
|---|---|---|---|---|
| State | S1 (PA1) | S2 (PA2) | Count1 | Count2 |
| A | Low | Low | Hold | Hold |
| B | Low | High | Hold | Hold |
| C | High | Low | Increment | Decrement |
| D | High | High | Decrement | Increment |

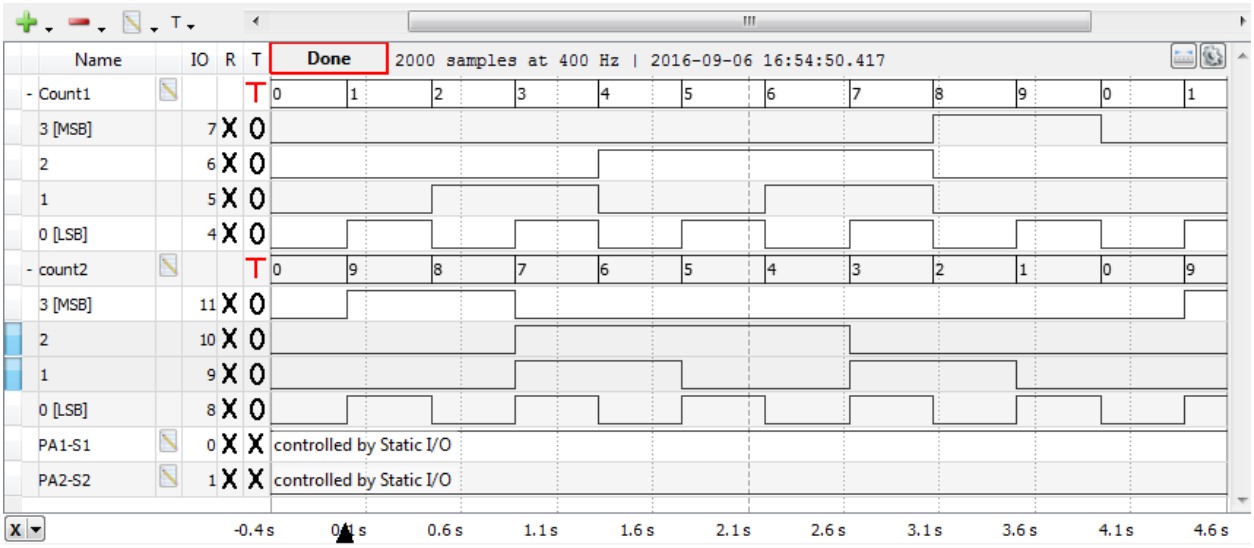


Figure 1: Program Behavior in State C – Count1 is incrementing while Count2 is decrementing.

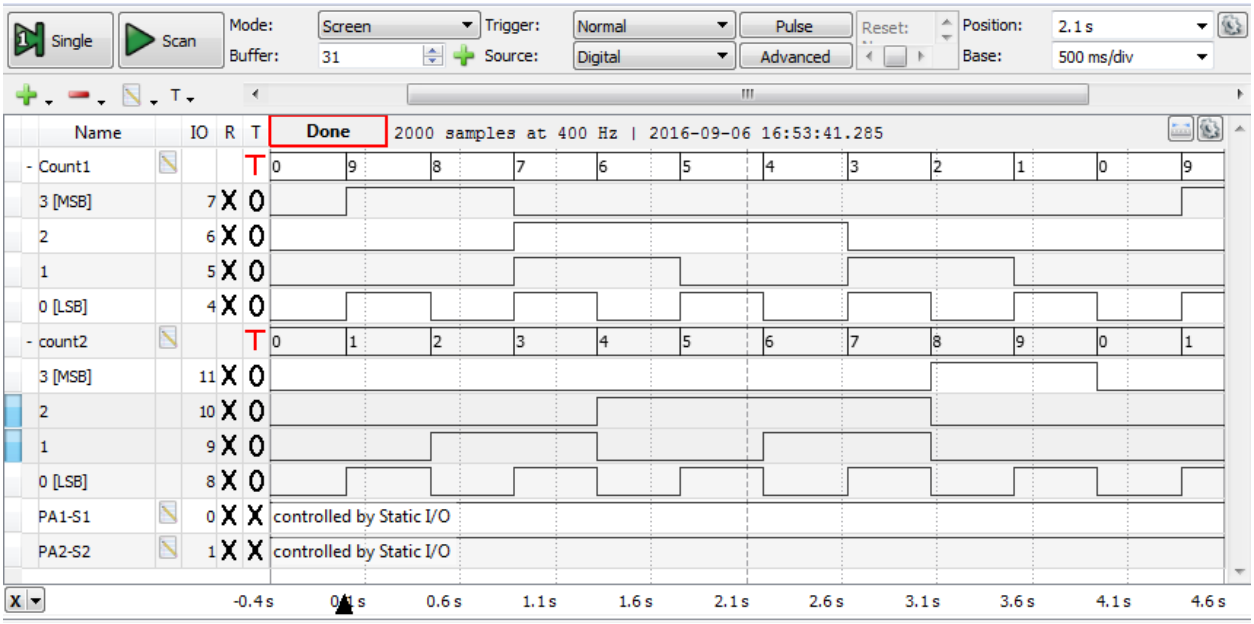


Figure 2: Program Behavior in State D – Count 1 is decrementing while Count2 is incrementing.

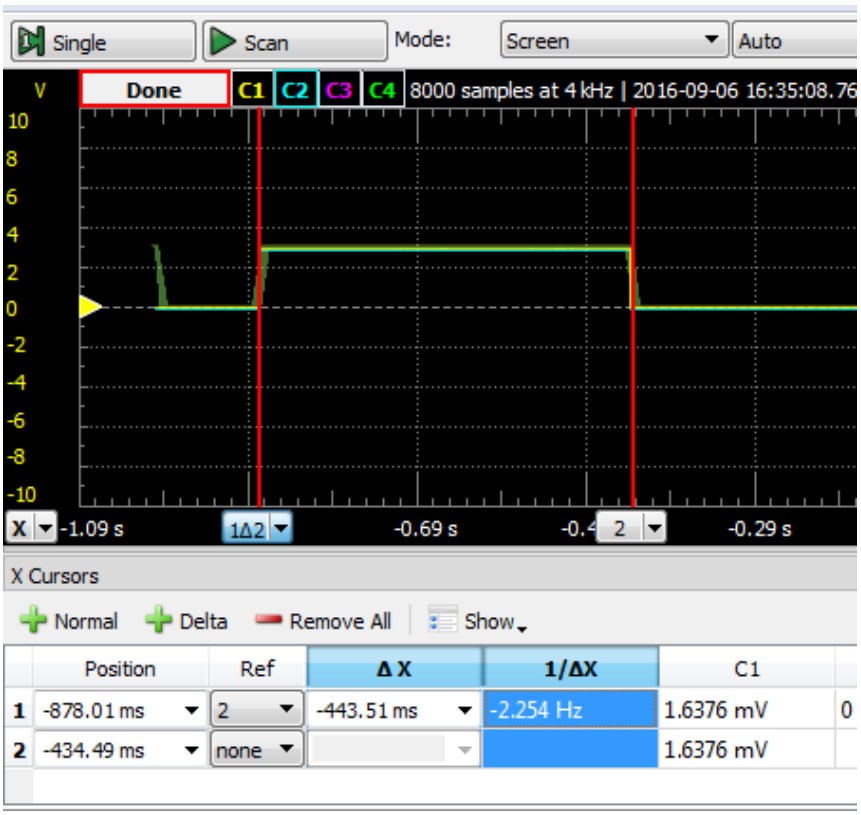


Figure 3: Oscilloscope measurement for the LSB of Count1 and Count2. Note that the two signals are synchronized and appear as one single signal.

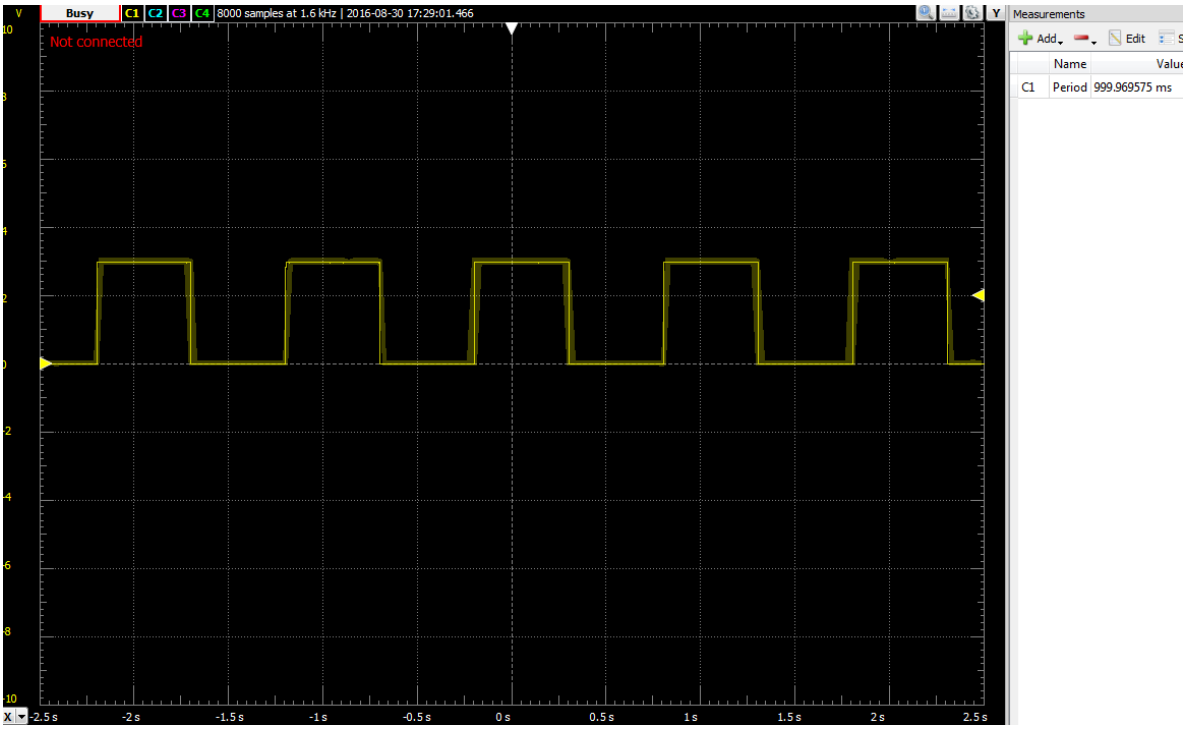


Figure 4: Oscilloscope measurement for a single Count during laboratory exercise 2.