

Experiments for the Lab9500

Part II Registered Logic and State Machines

Part I of the experiments dealt with combinational logic, logic without memory. Now, we will propose experiments dealing with logic requiring memory, namely flip-flops. As before, these examples are meant to suggest some experimentation. No doubt, these may inspire the instructor to invent experimentation to his own liking. EZ-Ware welcomes suggestions for future experiments.

The HDL, ABEL, was a big step forward in simplifying the implementation of logic. Some of the advanced features of ABEL greatly ease the design of logic. However, it may do a disservice to the student to skip over traditional approaches to design and favor the advanced features of an HDL which minimize the need for understanding and creativity on the part of the student. For that reason, for a particular experiment goal, several approaches will be suggested. The instructor is free to pick those which best suits his own needs and philosophy. If time permits, it may be a good idea to include as many of the suggested approaches as possible.

The first experiment is concerned with making a counter. The techniques for designing counters are well-documented in the Chapter 5 of the accompanying e-book. A meat-and-potatoes traditional approach to arbitrary counter design is to construct a present/next state table for the counter states, and use the table to fill in Karnaugh maps for the flip-flop functions used in the counter. This is my favored approach. A similar approach, which makes ABEL do all the work is to use a truth table. In this method, the output is presented as a function of the present input states. No K-maps and reductions are necessary. ABEL does that work behind the scenes. Another approach is to use the state machine function of ABEL, like the truth table approach, ABEL generates the equations internally and does the logic reduction. A fourth approach is what I would call “seat-of-the-pants”. A modulo 16 counter made with T-flip-flops is trivial and takes only one product term per flip-flop. The mod 15 counter desired is close. What is necessary is to suppress the complementing of the LSB flip-flop for just one state resulting in a skipped state and a mod 15 counter. The logic for the all but the LSB would remain unchanged. That’s being creative, something, unfortunately, that doesn’t come natural to many engineers (which is why they end up in management).

Experiments in Part II begin with a “2” and numbered modulo five so that experiments can be added at appropriate places without the need for constant renumbering.