Unit 3.3: Synchronous Counters

Content Area: **Science**
Course(s): **Digital Electro**
Time Period: **Semester 2**
Length: **3 weeks**
Status: **Published**

Standards

TEC.9-12.	Technology products and systems impact every aspect of the world in which we live.
TEC.9-12.8.1.12.A.4	Create a personalized digital portfolio that contains a resume, exemplary projects and activities reflecting personal and academic interests, achievements, and career aspirations.
TEC.9-12.8.2.12.B	Design: Critical Thinking, Problem Solving, and Decision Making
TEC.9-12.8.2.12.G	The Designed World

Enduring Understandings

Understandings

Students will understand that …

1. Synchronous counters, also called parallel counters, are characterized by an external signal clocking all flip-flops simultaneously.
2. Synchronous counters can be implemented using small scale integrated (SSI) and medium scale integrated (MSI) logic gates.
3. Synchronous counters can be implemented with either D or J/K flip-flops.
4. Up counters, down counters, and modulus counters all can be implemented using the synchronous counter method.

Essential Questions

Students will keep considering …

1. How can D flip-flops or J/K flip-flops be arranged in order to create a desired synchronous clock signal?
2. How would you use a design process to create synchronous counters using small scale integration (SSI) and medium scale integration (MSI)?
3. Why is it important to have a counter/start at specific values?
4. How can a synchronous counter be designed to start and stop/repeat a count at the desired values?

Knowledge and Skills

Knowledge

Students will …

1. Recognize synchronous counters.
2. Recognize small scale integration (SSI) logic gates.
3. Recognize medium scale integration (MSI) logic gates.
4. Arrange synchronous counters to count up or down over specified ranges.

Skills

Students will ...

1. Describe the advantages and disadvantage of counters designed using the synchronous counter method.
2. Analyze and design up, down, and modulus synchronous counters using discrete D and J/K flip-flops.
3. Analyze and design up, down, and modulus synchronous counters using medium scale integrated (MSI) circuit counters.
4. Describe where a count starts and where a count stops/repeats on a modulus synchronous counter.
5. Use Circuit Design Software (CDS) and Digital Logic Board (DLB) to simulate and prototype SSI and MSI synchronous counters.

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing

Resources

Technology Resources

- National Instruments Multiim circuit design and simulation software
- Microsoft Office Applications

Electronics Resources

- Electronics Trainers (power supply, function generator, breadboard)
- Electronics hand tools (diagonal cutters, needle-nosed pliers, wire strippers, etc.)
- Digital Multimeters
- Digital Transistor-Transistor Logic (TTL) integrated circuits
- TTL Chip Checker
- Dual Channel Oscilloscope
- Digital/Analog Function Generator