# **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/10DqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=shar ing

#### 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