

## Course 254: Oscillators

Covers how oscillation is started and maintained. Compares sine-wave oscillators and square-wave switching circuits. Discusses monostable, astable, and bistable flip-flop operation; Schmitt trigger circuits, frequency dividers, ripple counters, propagation delays, and glitches. Describes operation of low-, high-, and band-pass filters; and, how to troubleshooting oscillator components and circuits.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.



### Lesson 1: Introduction to Oscillators

#### Topics

Oscillation; Oscillators and Amplifiers; Classes of Oscillators; LC (Tuned) Circuits; RC (Phase-Shift) Oscillators; Crystal Oscillators; Comparison of Oscillators; Common Oscillator Circuits

#### Objectives

- Describe the conditions needed to start and to sustain oscillation.
- Explain how positive feedback affects oscillation.
- Name three kinds of feedback networks used in oscillators.
- Discuss the advantages and disadvantages of tuned circuits, phase-shift oscillators, and crystal oscillators.
- Describe several common oscillator circuits.

### Lesson 2: Flip-Flops

#### Topics

Square Waves; Switching Circuit; Kinds of Flip-Flops; One-Shots; Integrated Circuit (IC) One-Shots; Astable Flip-Flops (Multivibrators); Frequency of Multivibrators; IC Astable Circuit from One-Shots; Bistable Flip-Flops; IC Bistable Flip-Flops

#### Objectives

- Discuss the differences between sine wave oscillators and square wave switching circuits.
- Explain how rise time and the time constant affect flip-flop circuits.
- Compare the operation of discrete transistor one-shots and IC one-shots.
- Explain how IC pairs of one-shots or IC op amps form an astable multivibrator.
- Describe the operation of bistable flip-flops.

### Lesson 3: Logic Clocks

#### Topics

Combinational Logic; Synchronous Logic; Logic Clock Generation; Negative Resistance Oscillator; Integrated Circuit (IC) Oscillator; Clock Conditioning; Schmitt Trigger Circuit; Frequency Dividers; Multiphase Clocks; Real-World Logic Clocks

#### Objectives

- Compare combinational logic, synchronous logic, and sequential logic.
- Explain how logic clocks are generated.
- Explain how negative resistance enables the UJT relaxation oscillator to be used as a logic clock.
- Discuss the effect of hysteresis on logic clock operation and describe the operation of the Schmitt trigger circuit.
- Describe the operation of ripple counters and other frequency dividers.
- Discuss problems caused by real-world (nonideal) logic clocks.

### Lesson 4: Filters and Waveforms

#### Topics

Filters in Wave Shaping; Simple Filters; RC Low-Pass Filters; RL Low-Pass Filters; High-Pass Filters; Band-Pass Filters; Band-Reject Filters; Active Filters; Time Constants; Universal Time Constant Chart; Differentiators and Integrators; Function Generators

#### Objectives

- Discuss the composition of waveforms and explain how filters change the shapes of waveforms.
- Compare the frequency characteristics of low-pass and high-pass filters and of band-pass and band-reject filters.
- Discuss the calculation of time constants in timing circuits.
- Describe methods of creating and shaping complex waveforms, including the differentiator and integrator circuits.
- Explain briefly how digital waveforms are generated with a microprocessor.

### Lesson 5: Troubleshooting Oscillators

#### Topics

Test Equipment; Troubleshooting Components; Troubleshooting Circuits; Troubleshooting Oscillators; Tracing Oscillator Operation; Troubleshooting Multivibrators; Troubleshooting One-Shots; Troubleshooting Bistable Flip-Flops; Troubleshooting Sequential Logic Circuits; Troubleshooting Clocks; Troubleshooting Frequency Dividers; Troubleshooting Filters

#### Objectives

- Discuss the basic requirements of four kinds of equipment used to test oscillators.
- Describe good general practices in troubleshooting oscillator components and circuits.
- Describe the steps in tracing oscillator circuit operation and selecting test points for monitoring waveforms.
- Discuss the steps in troubleshooting multivibrators, one-shots, and flip-flops.
- Discuss troubleshooting methods for sequential logic circuits, including clocks.
- Discuss troubleshooting methods for frequency dividers and filters.