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AutoCAD® Electrical 2021 Fundamentals with NFPA Standards

Learning Guide

1st Edition

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ASCENT - Center for Technical Knowledge®
AutoCAD® Electrical 2021
Fundamentals with NFPA Standards

1st Edition

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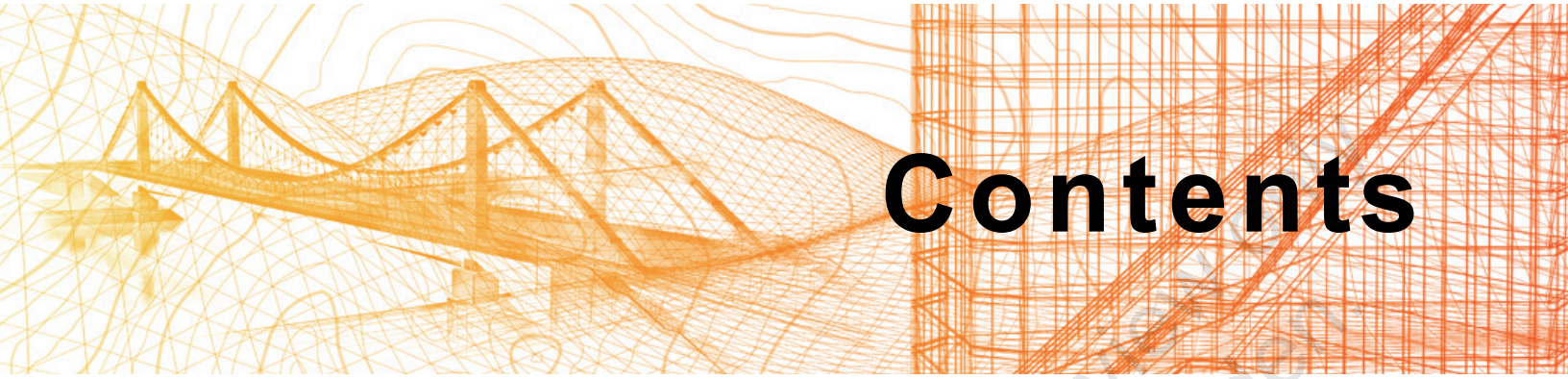

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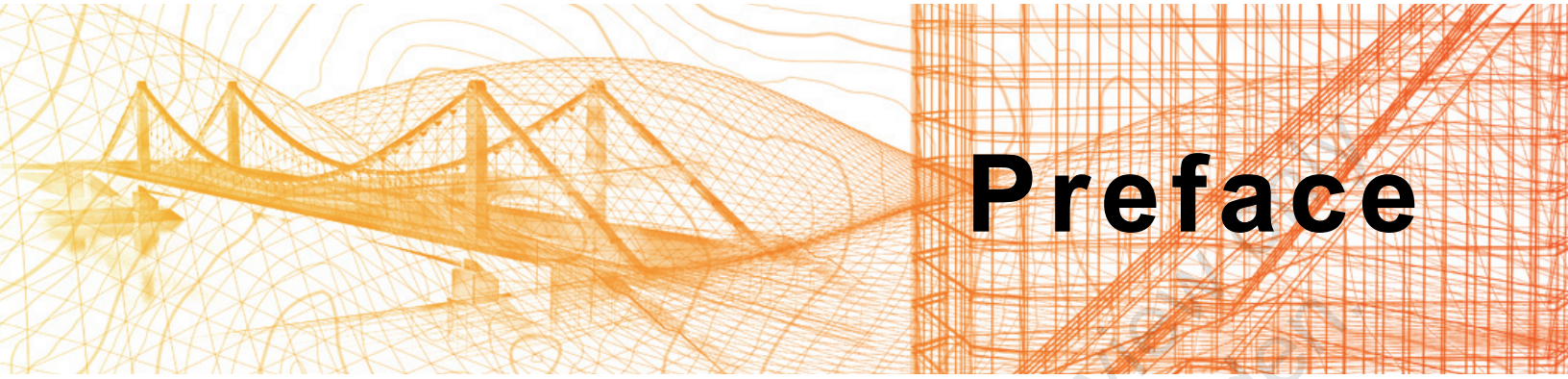

Preface

The *AutoCAD® Electrical 2021: Fundamentals with NFPA Standards* guide is designed for those using AutoCAD® Electrical 2021 with a Windows operating system. This guide is not designed for the AutoCAD for Mac software.

The *AutoCAD® Electrical 2021: Fundamentals with NFPA Standards* guide covers the indispensable core topics for working with the AutoCAD® Electrical software. In this guide, you will learn how to use many of the powerful electrical drawing creation tools in the AutoCAD Electrical software. You will create schematic drawings (ladder logic and point to point), panel drawings, and PLC-I/O circuits using automated commands for symbol insertion, component tagging, wire numbering, and drawing modification. In addition, you are introduced to methods of customizing AutoCAD Electrical symbols, circuits, and databases. Other topics covered include titleblock linking, reporting tools, templates, and project files.

Topics Covered

- Understanding project files
- Creating and editing schematic and panel drawings
- Working with PLC symbols
- Creating custom symbols
- Generating reports

Prerequisites

- Access to the 2021.0 version of the software, to ensure compatibility with this guide. Future software updates that are released by Autodesk may include changes that are not reflected in this guide. The practices and files included with this guide might not be compatible with prior versions (e.g., 2020).

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Note on Software Setup

This guide assumes a standard installation of the Windows version of AutoCAD® Electrical 2021 software using the **NFPA (Inches) Symbol Libraries** and **all** the Manufacturers for the Content Libraries during installation. Lectures and practices use the standard software templates.

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Lead Contributor: Renu Muthoo

Renu uses her instructional design training to develop courseware for AutoCAD and AutoCAD vertical products, Autodesk 3ds Max, Autodesk Showcase and various other Autodesk software products. She has worked with Autodesk products for the past 20 years with a main focus on design visualization software.

Renu holds a bachelor’s degree in Computer Engineering and started her career as a Instructional Designer/Author where she co-authored a number of Autodesk 3ds Max and AutoCAD books, some of which were translated into other languages for a wide audience reach. In her next role as a Technical Specialist at a 3D visualization company, Renu used 3ds Max in real-world scenarios on a daily basis. There, she developed customized 3D web planner solutions to create specialized 3D models with photorealistic texturing and lighting to produce high quality renderings.

Renu Muthoo has been the Lead Contributor for *AutoCAD® Electrical Fundamentals* since 2013

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In This Guide

The following highlights the key features of this guide.

Feature	Description
Practice Files	The Practice Files page includes a link to the practice files and instructions on how to download and install them. The practice files are required to complete the practices in this guide.
Chapters	A chapter consists of the following - Learning Objectives, Instructional Content, Practices, Chapter Review Questions, and Command Summary. • **Learning Objectives** define the skills you can acquire by learning the content provided in the chapter. • **Instructional Content**, which begins right after Learning Objectives, refers to the descriptive and procedural information related to various topics. Each main topic introduces a product feature, discusses various aspects of that feature, and provides step-by-step procedures on how to use that feature. Where relevant, examples, figures, helpful hints, and notes are provided. • **Practice** for a topic follows the instructional content. Practices enable you to use the software to perform a hands-on review of a topic. It is required that you download the practice files (using the link found on the Practice Files page) prior to starting the first practice. • **Chapter Review Questions**, located close to the end of a chapter, enable you to test your knowledge of the key concepts discussed in the chapter. • **Command Summary** concludes a chapter. It contains a list of the software commands that are used throughout the chapter and provides information on where the command can be found in the software.
Appendices	Appendices provide additional information to the main course content. It could be in the form of instructional content, practices, tables, projects, or skills assessment.

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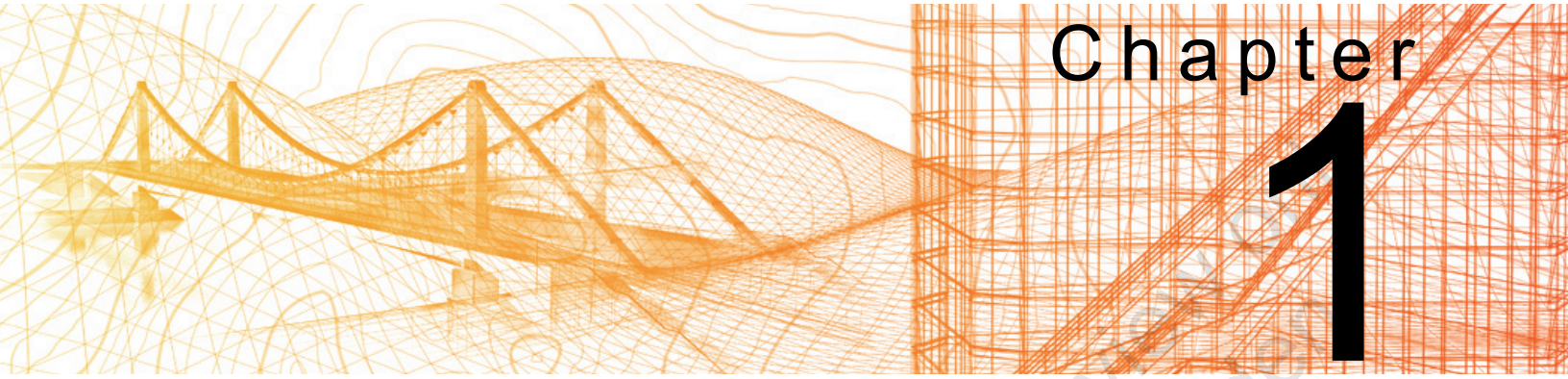

Introduction to AutoCAD Electrical

Understanding the various types of electrical symbols, files, and components used in the AutoCAD® Electrical software is fundamental in the creation of electrical designs. In addition, learning the basic layout of the interface and how to use the working environment increases your designing efficiency.

Learning Objectives in This Chapter

- Identify and navigate the AutoCAD Electrical interface.
- Identify the different types of electrical drawings.
- Identify the various symbols that are used in the AutoCAD Electrical software.
- Recognize the typically used design methodology workflows.

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1.1 What Is AutoCAD Electrical?

The AutoCAD Electrical software is a purpose built controls design tool that is used to automate the creation of electrical schematic and panel drawings. It also tracks component information between drawings and can create reports containing this information.

- Electrical symbols carry the intelligence of AutoCAD Electrical drawings and are the foundation of the functionality in AutoCAD Electrical software.

- Symbols are simply AutoCAD® blocks with attributes. Several standard symbol libraries can be installed with the AutoCAD Electrical software, including NFPA, IEC, IEEE, JIC, JIS, and GB.

- The AutoCAD Electrical software contains all of the standard AutoCAD commands and many automated commands for controls design. Use the AutoCAD Electrical commands when possible rather than the AutoCAD commands. Typically, AutoCAD Electrical commands have additional functionality that helps when designing. For example, the AutoCAD **Erase** command versus the AutoCAD Electrical **Delete Component** command.

  - The **Erase** command erases the component.
  - The **Delete Component** command erases the component, attempts to heal the wires, and updates any references.

Interface

The AutoCAD Electrical interface shown in Figure 1–1, contains three main areas in which to access the AutoCAD Electrical specific commands. The color theme for the interface components has been changed to **Light** and the Drawing Window background color has been changed to white for printing clarity.

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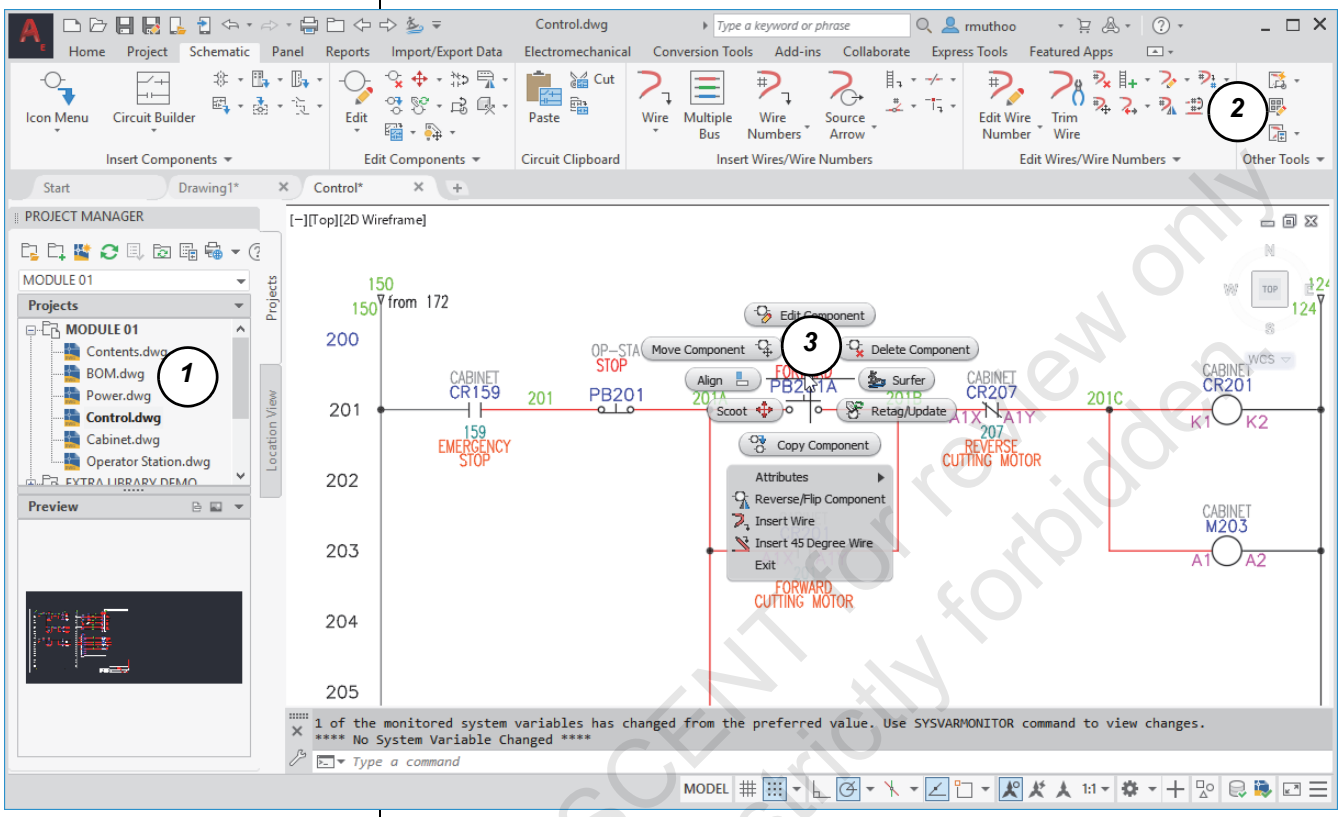

Figure 1–1

1. Project Manager Palette

The Project Manager enables you to access project files, drawing files, and the settings for the active project. It enables you to open, close, activate, and edit project files, as well as update and print drawing files.

2. Ribbon

In the AutoCAD Electrical software, you use the ribbon to access the commands. The ribbon consists of a series of tabs and panels that contain a variety of tools grouped by function.

3. Right-click Marking Menus

The AutoCAD Electrical interface contains context sensitive right-click marking menus. When you right-click on different objects, the menus that open contain commands specific to the selected object. These menus are very effective when editing or adding the electrical drawings.

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Hint: Interface Color Theme

You can set the color theme for your interface components to be **Light** or **Dark** (default) in the Options dialog box, as shown in Figure 1–2.

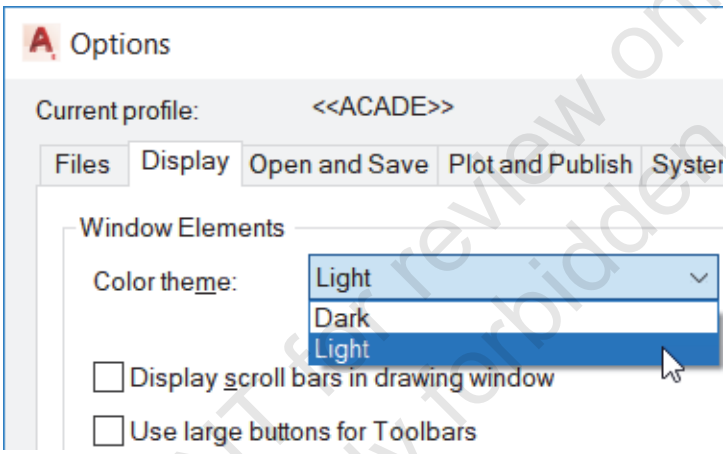

Figure 1–2

Start Tab

When you launch the software or if you click in the *Start* tab while working in an active drawing, the initial Start window displays, as shown in Figure 1–3.

- By default, the *Start* tab is always available as the first tab in the *File Tabs* bar.
- You can click it to display the initial Start window anytime.
- You can switch between multiple open drawings and the *Start* tab by selecting the required tab.
- You can use <Ctrl> +<Home> to jump from an active drawing to the *Start* tab.
- The Start window contains two content frames: *Learn* and *Create*, as shown in Figure 1–3.
  - The *Learn* frame enables you access to online training resources, videos, and tips to help you learn the software.
  - The *Create* frame enables you to create and open drawings, and access recently used files. It also enables you to connect to Autodesk® online.

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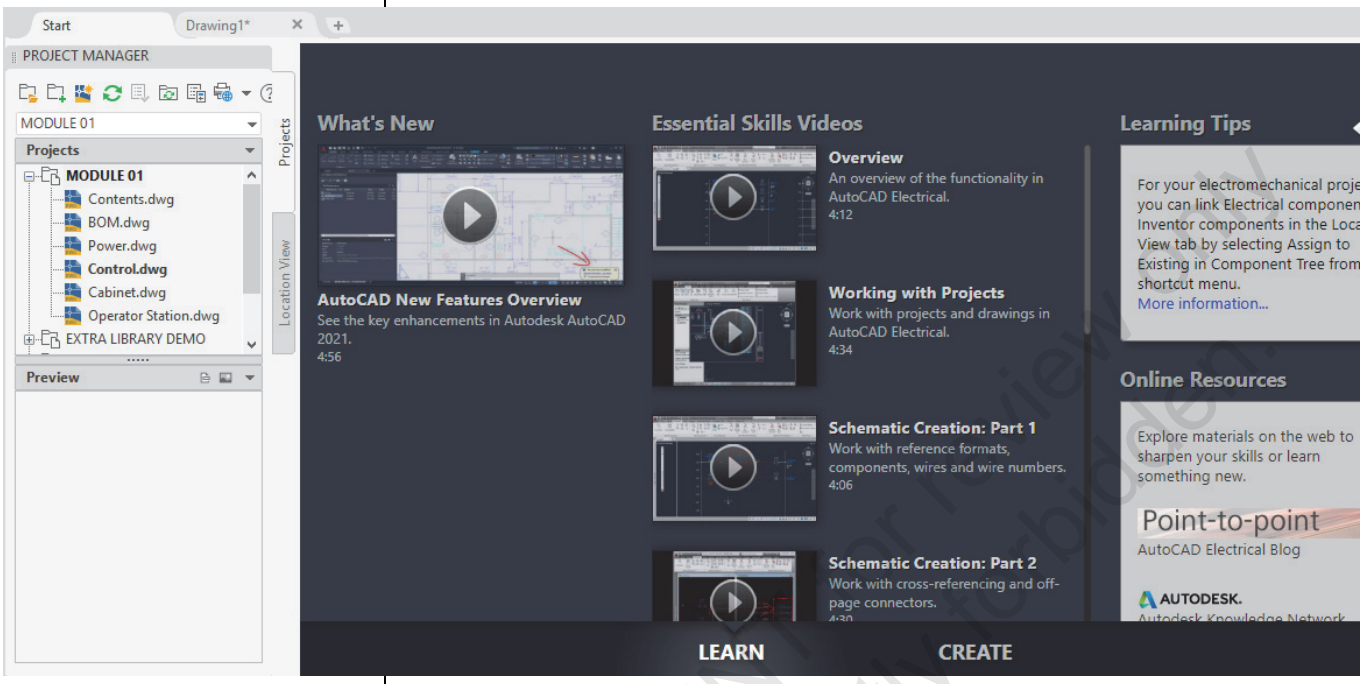

Figure 1–3

Electrical Help

AutoCAD Electrical Help files can be accessed by expanding (Help) in the Infocenter Bar and selecting **Electrical Help Topics**, as shown in Figure 1–4.

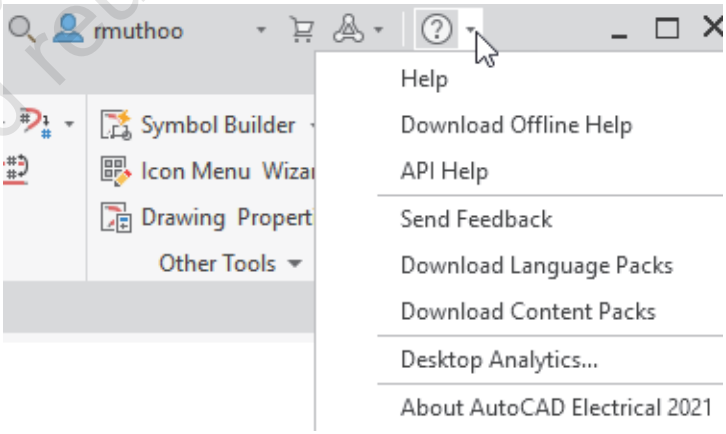

Figure 1–4

- You can also press <F1> to open the AutoCAD Electrical Help system.
- When hovering over a tool (tooltip displayed) or when a command is active, pressing <F1> opens the Help that is specific for that command.

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1.2 Drawing Files

The AutoCAD Electrical software uses DWG files. They can be opened and modified in the different software, such as:

- AutoCAD software
- AutoCAD® WS software
- AutoCAD LT® software
- DWG TrueView™ and Design Review software
- Any software that supports DWG files

The AutoCAD Electrical software contains different types of drawing files. These include schematic drawings, panel drawings, and reference drawings.

Schematic Drawings

Schematic drawings (as shown in Figure 1–5) contain ladder logic documentation. This includes schematic symbols, wires, reports, and any other documentation that is required for the design.

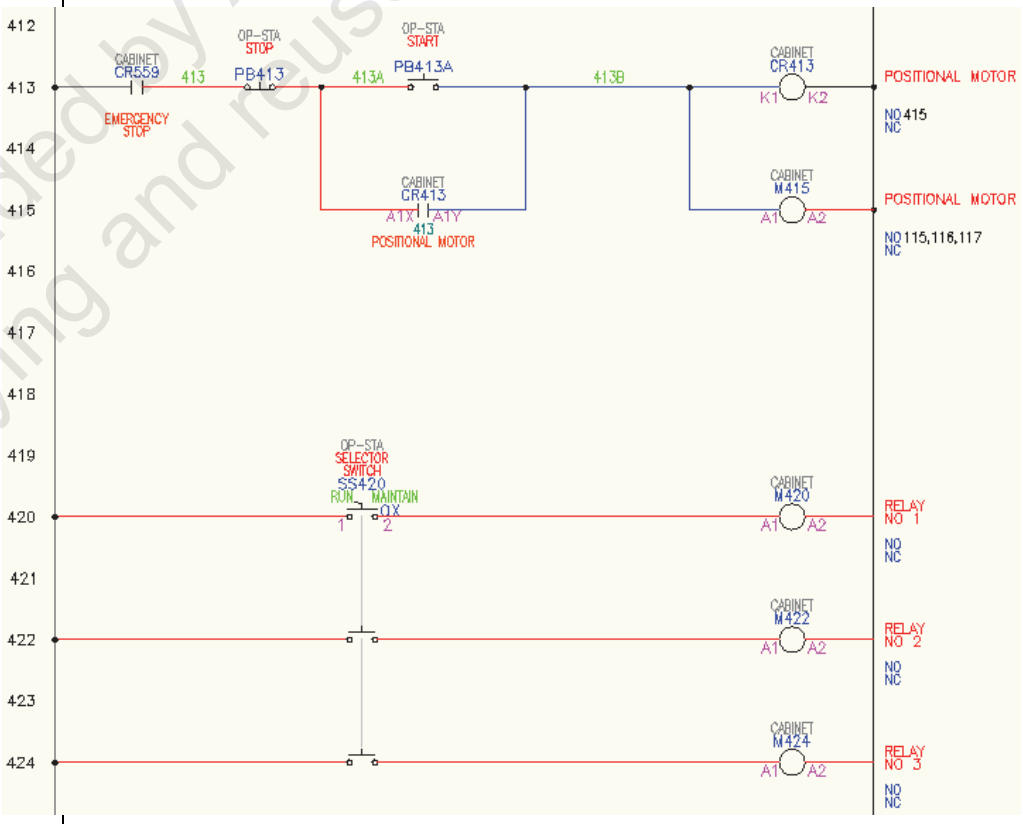

Figure 1–5

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Panel Drawings

Panel drawings (as shown in Figure 1–6) are used to document the physical location of components in the panel. They can contain footprints for components, nameplates, balloons, and reports.

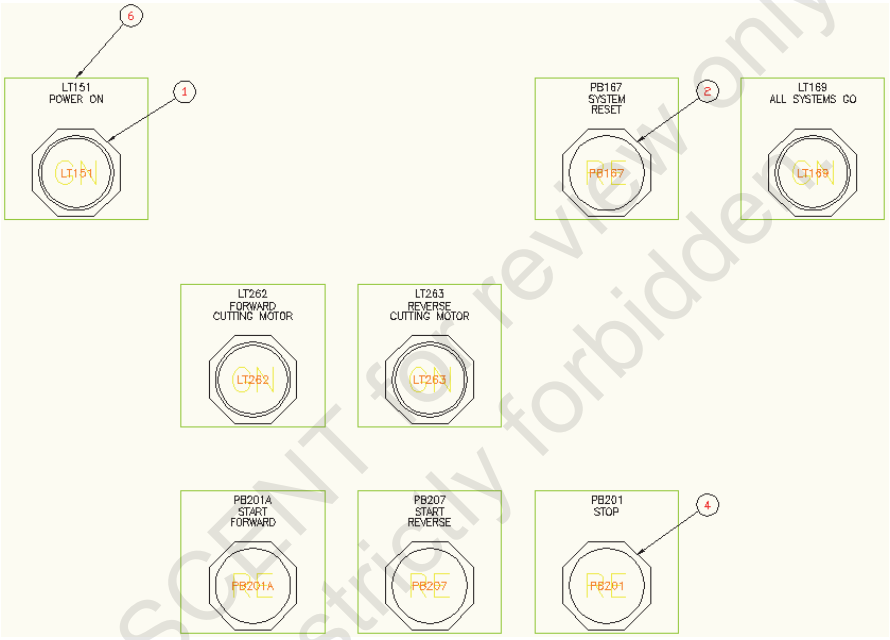
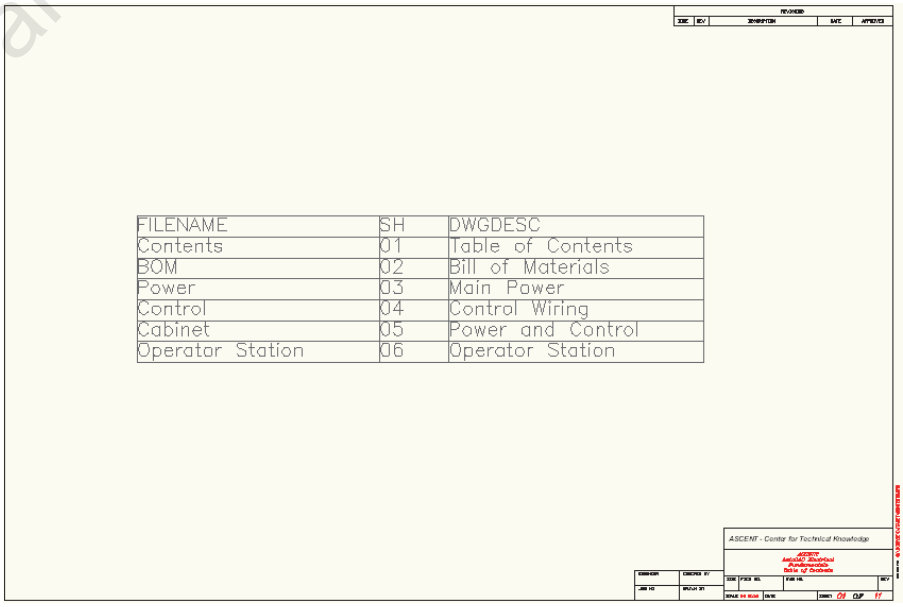


Figure 1–6

Reference Drawings

Reference drawings (as shown in Figure 1–7) are drawings used to document designs, including table of contents or customer drawings. Reference drawings are included in the project but not in the tagging, cross-referencing, or reporting processes.



FILENAME	SH	DWGDESC
Contents	01	Table of Contents
BOM	02	Bill of Materials
Power	03	Main Power
Control	04	Control Wiring
Cabinet	05	Power and Control
Operator Station	06	Operator Station

Figure 1–7

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1.3 Electrical Components and Wires

The AutoCAD Electrical software uses symbols to represent components and lines to represent wires. It contains several commands for inserting and maintaining them.

Schematic Symbols

Schematic symbols, including push buttons, relays, and switches (as shown in Figure 1–8) are used to represent components in the electrical logic drawings of the system.

- Schematic symbols are AutoCAD blocks with attributes.
- The AutoCAD Electrical software contains several different libraries of symbols that support different standards, including NFPA, IEC, IEEE, JIC, JIS, and GB, among others.

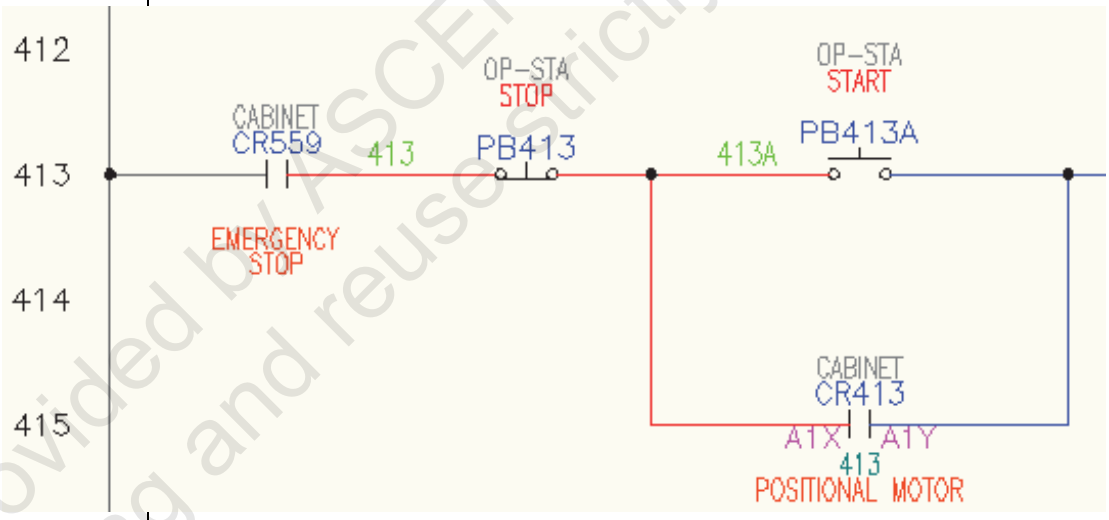

Figure 1–8

- The **Symbol Builder** utility can be used to create custom symbols.

PLC Modules

The AutoCAD Electrical software contains a library of PLC modules from different manufacturers, and display in a schematic drawing, as shown in Figure 1–9.

- The PLC library can be customized to add manufacturers or modules.
- The modules are AutoCAD blocks with attributes.

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- The software contains automated commands for inserting the modules into a drawing.

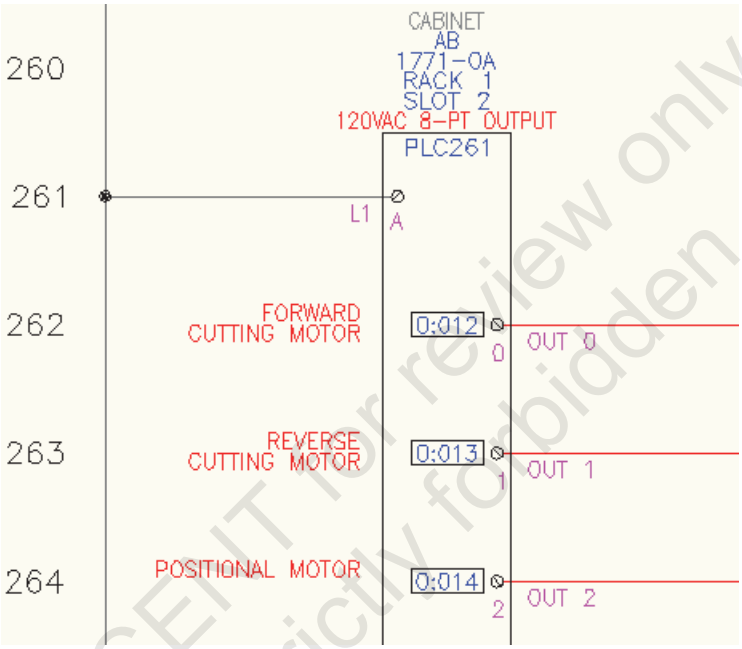

Figure 1–9

Panel Footprints

Panel footprints are used to represent components in the design, and schematic symbols are used to document the electrical logic of the system. The AutoCAD Electrical software contains a library of panel footprints based on manufacturer information, and display in a panel drawing, as shown in Figure 1–10. The library is customizable to enable you to add new footprints.

Figure 1–10

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Wires

Wires are an integral part of any electrical design, as shown in Figure 1–11. The AutoCAD Electrical software contains automated commands for inserting, trimming, and numbering wires, which are AutoCAD line objects on special layers.

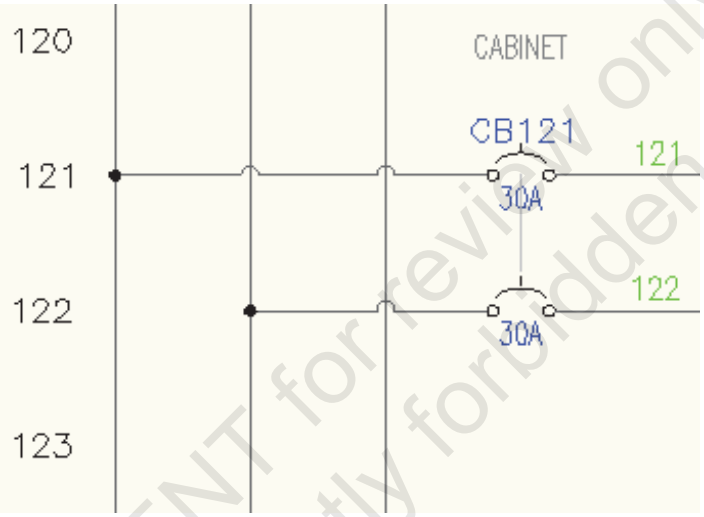

Figure 1–11

Cable Markers

Wires can be linked to create cables using cable marker symbols, as shown in Figure 1–12. Cable markers carry information about the cable manufacturer, color, and other attributes. The AutoCAD Electrical software contains commands for inserting, deleting, and modifying cable markers, and for creating reports containing information about the cables.

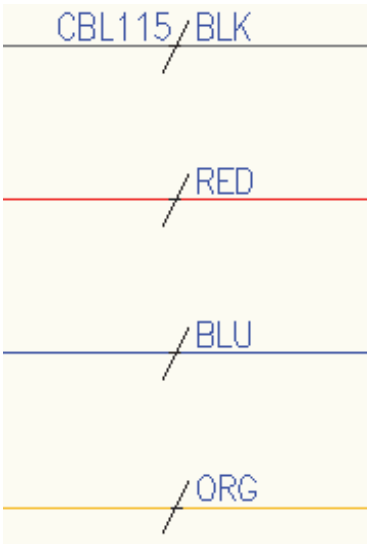

Figure 1–12

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1.4 Design Methodologies

The AutoCAD Electrical software is a flexible and customizable system. A typical workflow includes:

1. Creating a new project file or copying an existing project file.
2. Configuring the settings for the project.
3. Building the schematic drawings.
4. Building panel drawings based on components in the schematic drawings.
5. Creating reports from the panel or schematic drawings.

The AutoCAD Electrical software enables you to have variations of the workflow. You can create panel drawings first, and then create schematic drawings based on components in the panel. Both workflows can be used: schematic to panel or panel to schematic.

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Practice 1a

Introduction Overview

Practice Objective

- Open electrical drawings and investigate the information for the symbols.

In this practice, you will open a schematic drawing (as shown in Figure 1–13) and use the right-click marking menus to see the information attached to the symbols. You will then open a panel drawing and edit a panel footprint to see its attached information.

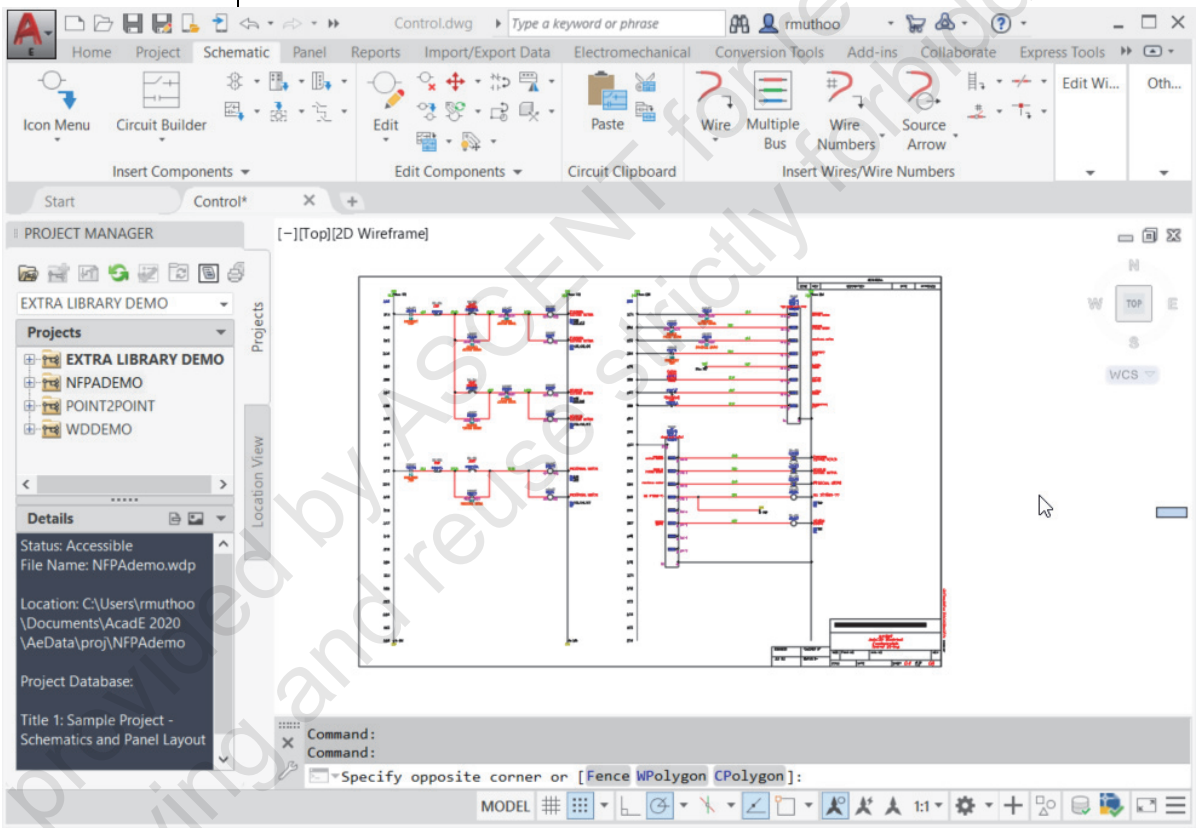

Figure 1–13

1. In your practice files folder, in the *Module 01* folder, open **Control.dwg**. (Use the AutoCAD **Open** command.)
2. Zoom to different areas of the drawing to investigate the different symbols. This is a schematic drawing containing two motor control circuits and two PLCs.
3. Zoom to the top half of the ladder on the right side of the drawing. This is the input PLC for this design.
4. Zoom to the lower half of the ladder on the right side of the drawing. This is the output PLC for this design.

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5. Zoom to the top portion of the ladder on the left side of the drawing.

6. Right-click on the relay coil symbol labeled **CR201** to display the Marking Menu. Select **Edit Component**, as shown in Figure 1–14. The Insert / Edit Component dialog box opens, as shown in Figure 1–15. The data attached to the symbol includes its component tag, manufacturer, descriptions, and pin numbers.

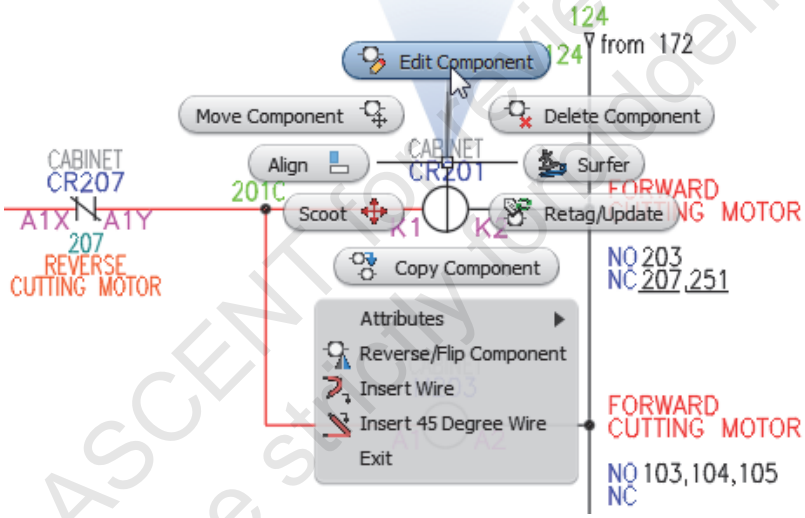

Figure 1–14

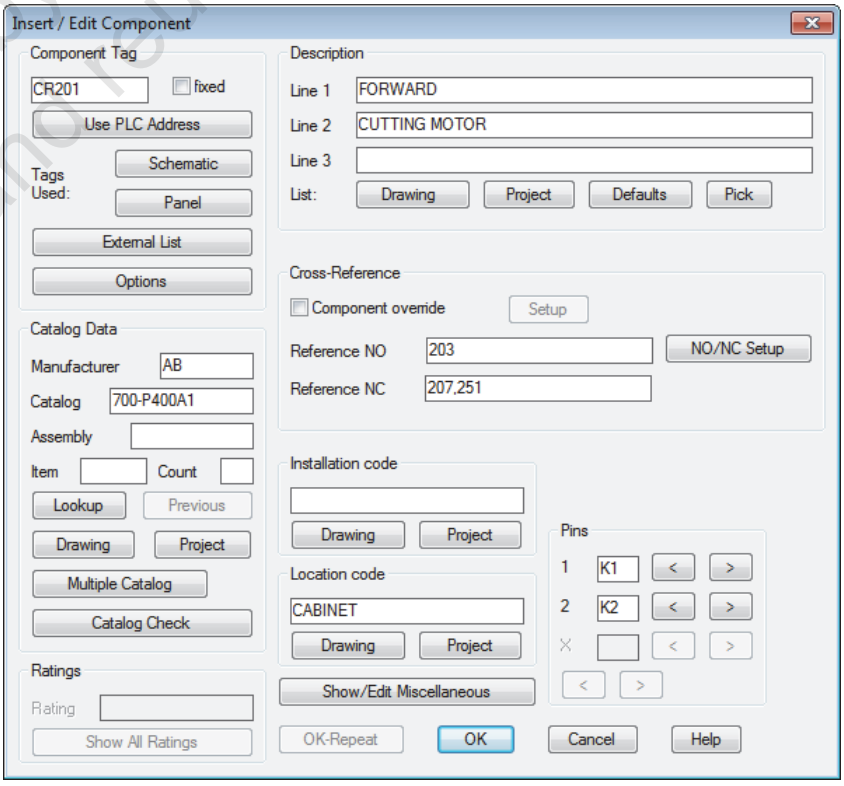

Figure 1–15

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7. Click **Cancel** to close the dialog box.

8. Right-click on the push button symbol labeled **PB201A** and select **Edit Component** from its Marking Menu, as shown in Figure 1–16. The Insert / Edit Component dialog box opens, as shown in Figure 1–17. The same data fields are available, but they contain values pertaining to the push button.

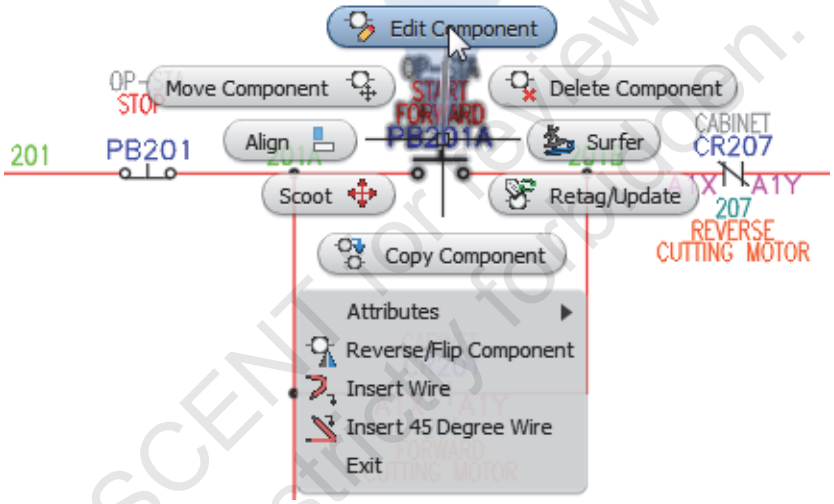

Figure 1–16

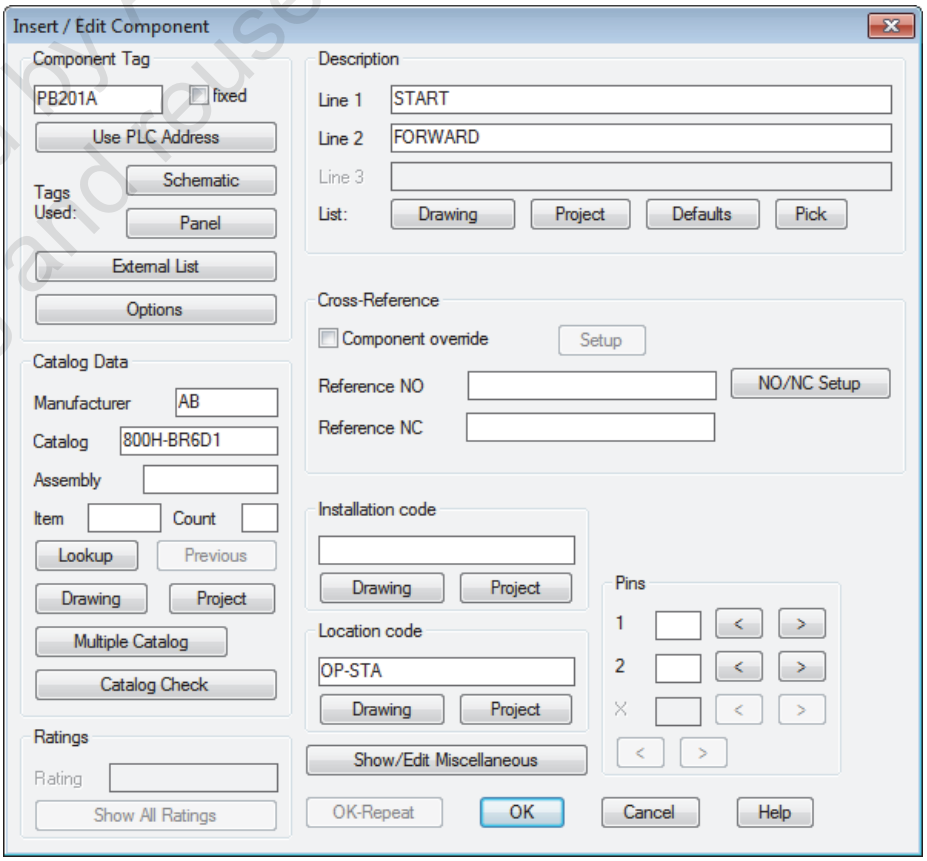

Figure 1–17

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9. Click **Cancel** to close the dialog box.

10. Close **Control.dwg**. When prompted to save changes, click **No**.

11. In your practice files folder, in the *Module 01* folder, open **Operator Station.dwg**. The drawing represents the operator panel drawing and a bill of materials for the panel drawings.

12. Zoom in to the three push buttons near the middle of the panel, as shown in Figure 1–18. They are labeled **PB201A**, **PB207**, and **PB201**.

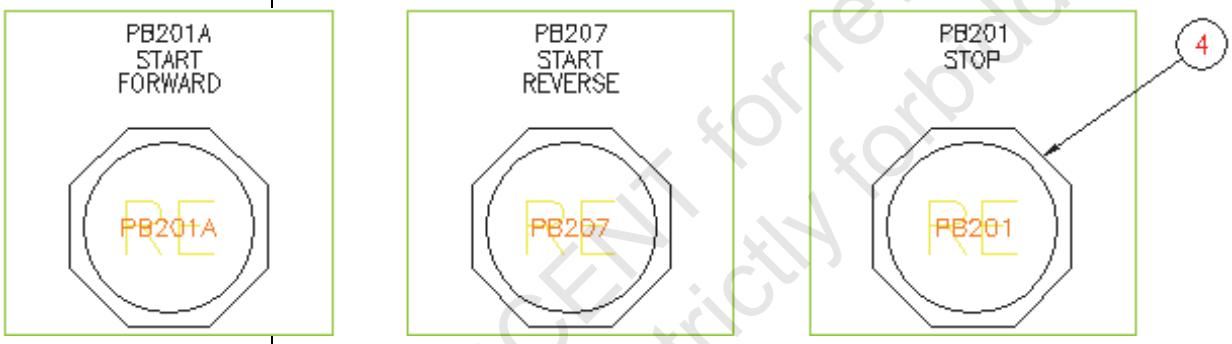

Figure 1–18

13. Right-click on the push button on the left, labeled **PB201A** and select **Edit Footprint**, as shown in Figure 1–19. (Right-click on the octagonal shape and not on the outside green square.)

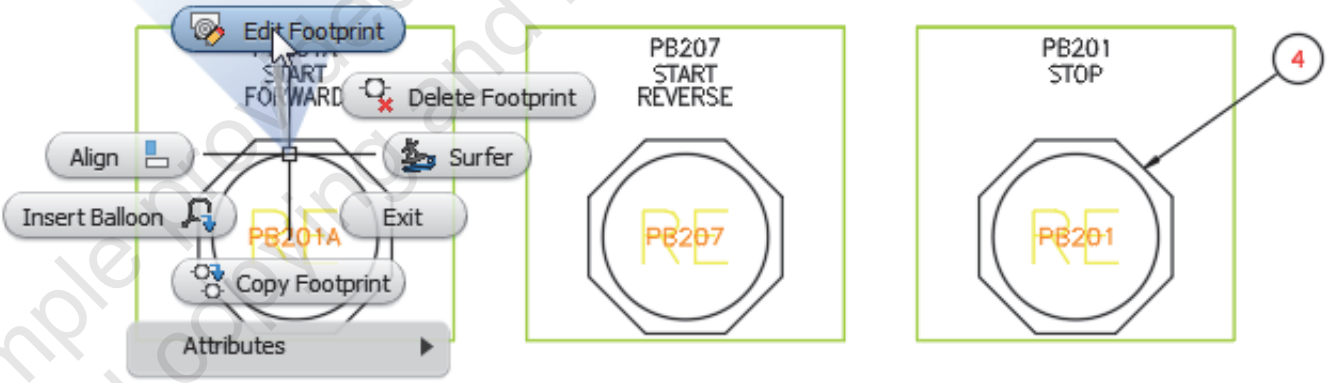

Figure 1–19

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14. The Panel Layout – Component Insert/Edit dialog box opens, as shown in Figure 1–20. The panel footprint symbol represents the push button that was edited in the schematic drawing.

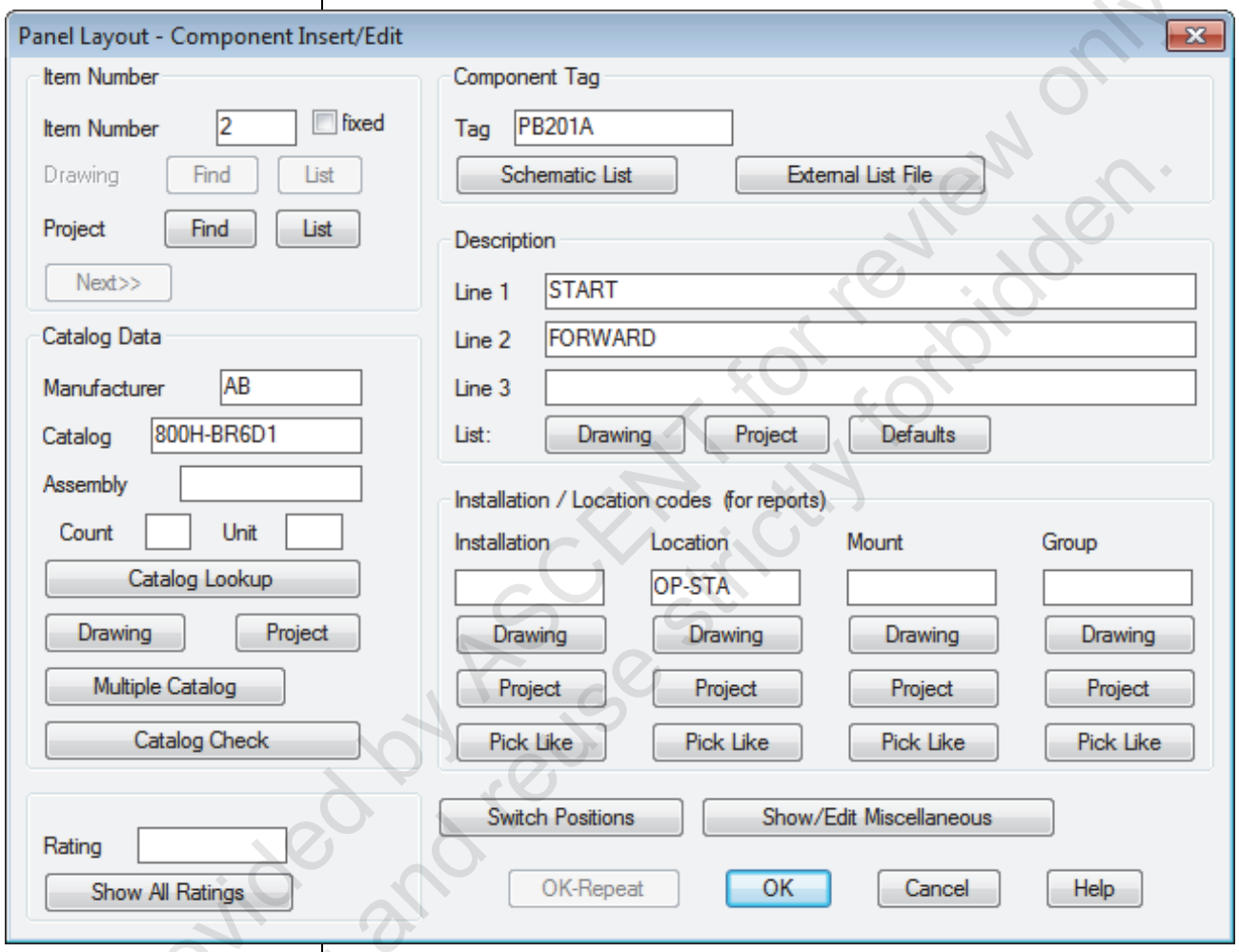

Figure 1–20

15. Click **Cancel** to close the dialog box.

16. Close **Operator Station.dwg**. When prompted to save changes, click **No**.

17. If time permits, open and investigate the other drawings in the *Module 01* folder, in your practice files folder. **Contents.dwg** contains a list of the drawings that are part of the project. **BOM.dwg** contains the bill of materials report for the project. **Power.dwg** contains the schematic symbols for the power circuit for the project. **Cabinet.dwg** contains the panel footprints for the cabinet components in the project.

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Chapter Review Questions

1. How do you access the AutoCAD Electrical commands? (Select all that apply.)
   a. Project Manager Palette
   b. Ribbon
   c. Status Bar
   d. Right-click Marking Menu
2. How do you access the AutoCAD Electrical Help system?
   a. Application Menu>Help
   b. Help>Electrical Help Topics in the Infocenter Bar
   c. Status Bar>Help
   d. Press <F2>
3. The AutoCAD Electrical symbols are composed of what object type(s)?
   a. Blocks and fields
   b. Lines and fields
   c. Blocks with attributes
   d. Lines and attributes
4. There are automated commands for creating and managing wires made of line objects.
   a. True
   b. False

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