



Reimagining Workforce Training: An Affordable Solution to Train Aspiring Engineers & Technicians

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Agenda

- Find out why Professor Ted Evans chose to reimagine his courses by creating an affordable learning solution
- Demonstrate the steps that were taken to make the course open and affordable for students
- Describe some of the challenges and solutions that were encountered to make the course open and affordable for students
- Q&A

Introduction

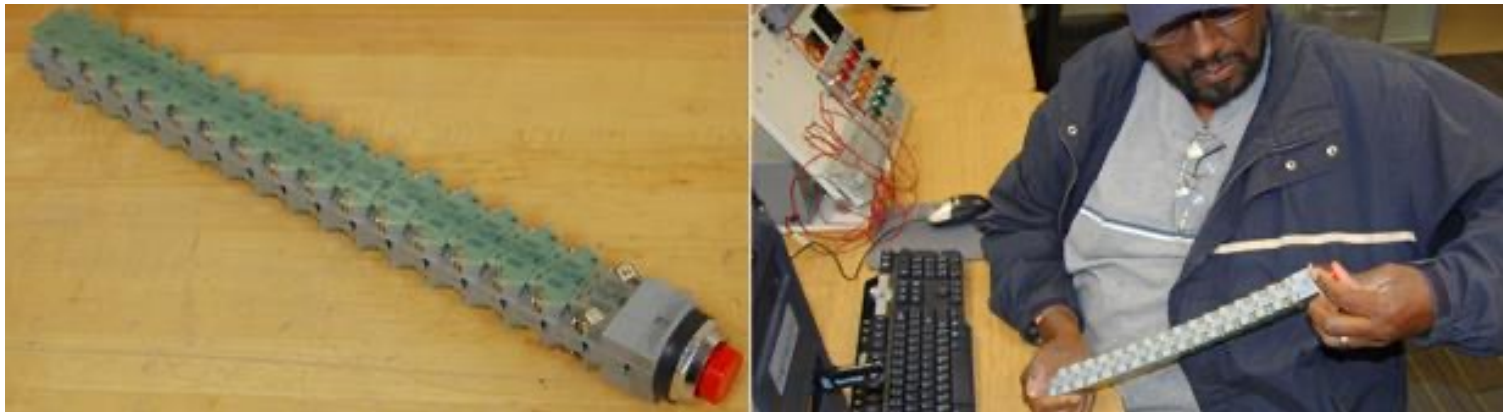


Professor Wm. Ted Evans PhD, PE
University of Toledo, College of Engineering
Engineering Technology Department

- 15 years working in industry prior to becoming a tenure-track professor in Engineering Technology
- 36+ years working as an educator while continuing as an engineer

Reasons for reimagining the course

- Improvements to curriculum over 36-year career
- Response to COVID
- Easy Access – removed barriers to materials
- Affordability – created low-cost option



Steps to make the course open and affordable

Collection of Open CourseWare in Hybrid PLC Mechatronics

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Mechatronics Technology Certificate Program

Preview Online Program: [Hybrid PLC Mechatronics Overview](#)

View Download Materials: [Hybrid PLC Mechatronics Overview](#)

Audience: Instructional designers, Industry training and students

The courses developed in this program use the PLC to train aspiring engineers and technicians. It gives motivation to those who show interest or potentially might show interest in a career in automation. The courses are outlined at the website: hybridplc.org. The courses' texts and videos are free. They will remain so as long as this author is involved. The videos discuss a number of low-cost programming trainers as well as a group of low-cost lab experiments. The recommended approach is a \$189 Siemens PLC, programming software and cable. All that is needed to complete the training station is a computer with Windows 10 Pro, a power supply and a breadboard with some resistors and jumpers and perhaps a voltmeter – common items many may already have.

Courses In This Program

Chapter 1 Introduction to PLCs

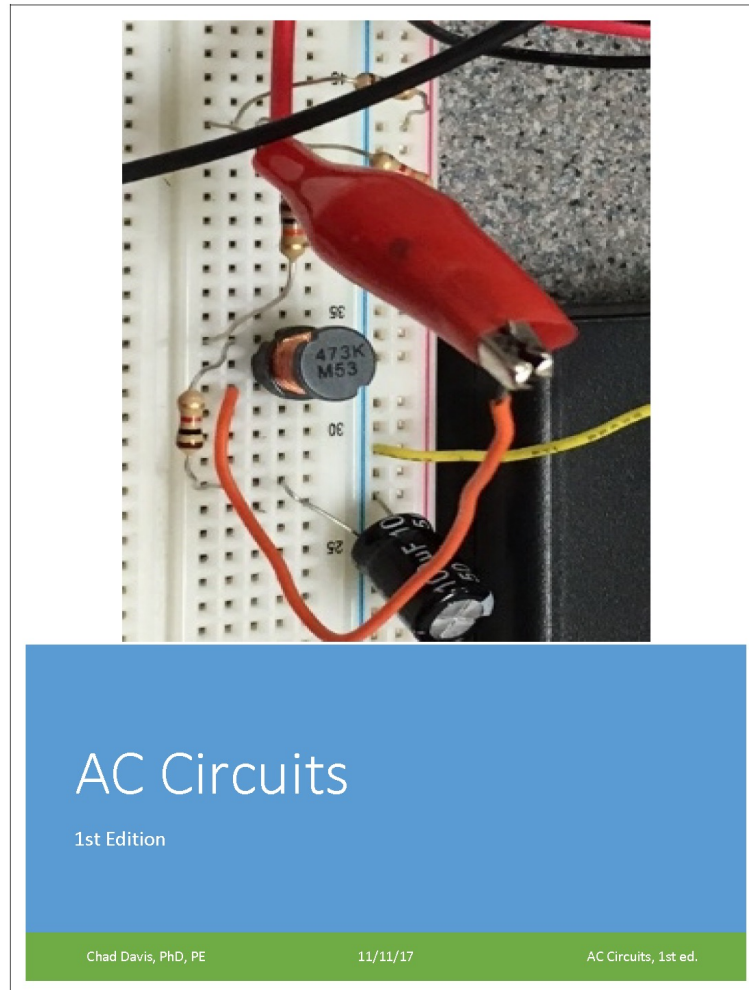


Programmable logic controllers (PLCs) were introduced to industry between 1968 and 1970 as a way to replace large expensive panels of relays, timers, and counters. Automotive manufacturers were looking for ways to simplify start up of new car lines after model changeovers each year and save money in the cost of manufacturing installations. This statement starts the text introducing PLCs and the study of how they are used to automate processes. The Hybrid Text is complemented by the Hybrid Lab Text and together they form a good study of the use of PLCs as well as instrumentation to automate a machine or complete process. The YouTube videos were recorded primarily during the covid time period with the assumption that the course(s) may necessarily be taught remotely for a number of years. Accompanying YouTube Video (38:27): PLC Series Chapter 1 – Introduction.

Preview Online Course Materials: [Hybrid PLC Mechatronics – Chapter 1 Introduction to PLCs](#)
[Hybrid PLC Mechatronics – Chapter 1 Introduction to PLCs Video](#)

View & Download Materials: [Hybrid PLC Mechatronics – Chapter 1 Introduction to PLCs](#)

Open Textbook



The Relay

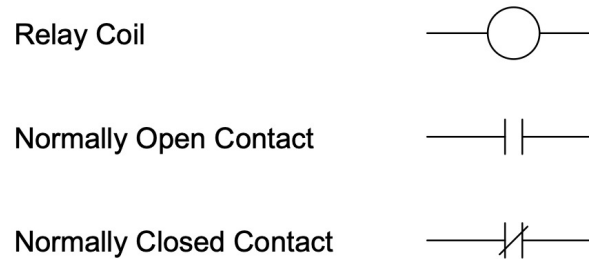
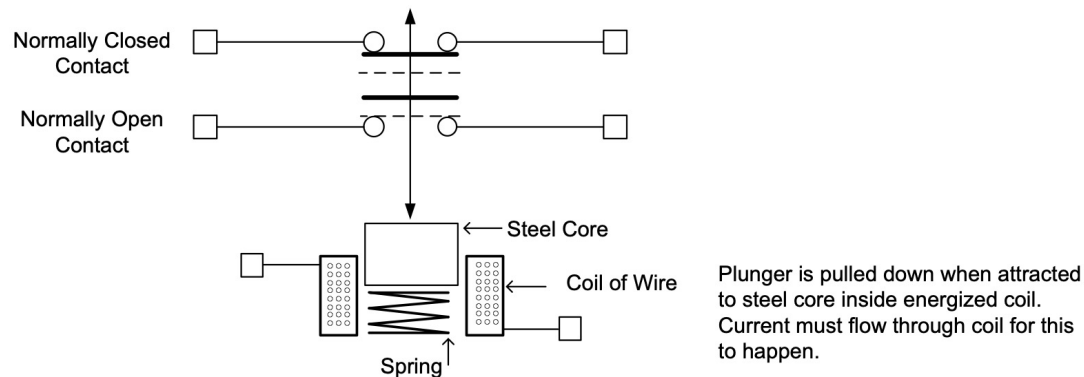
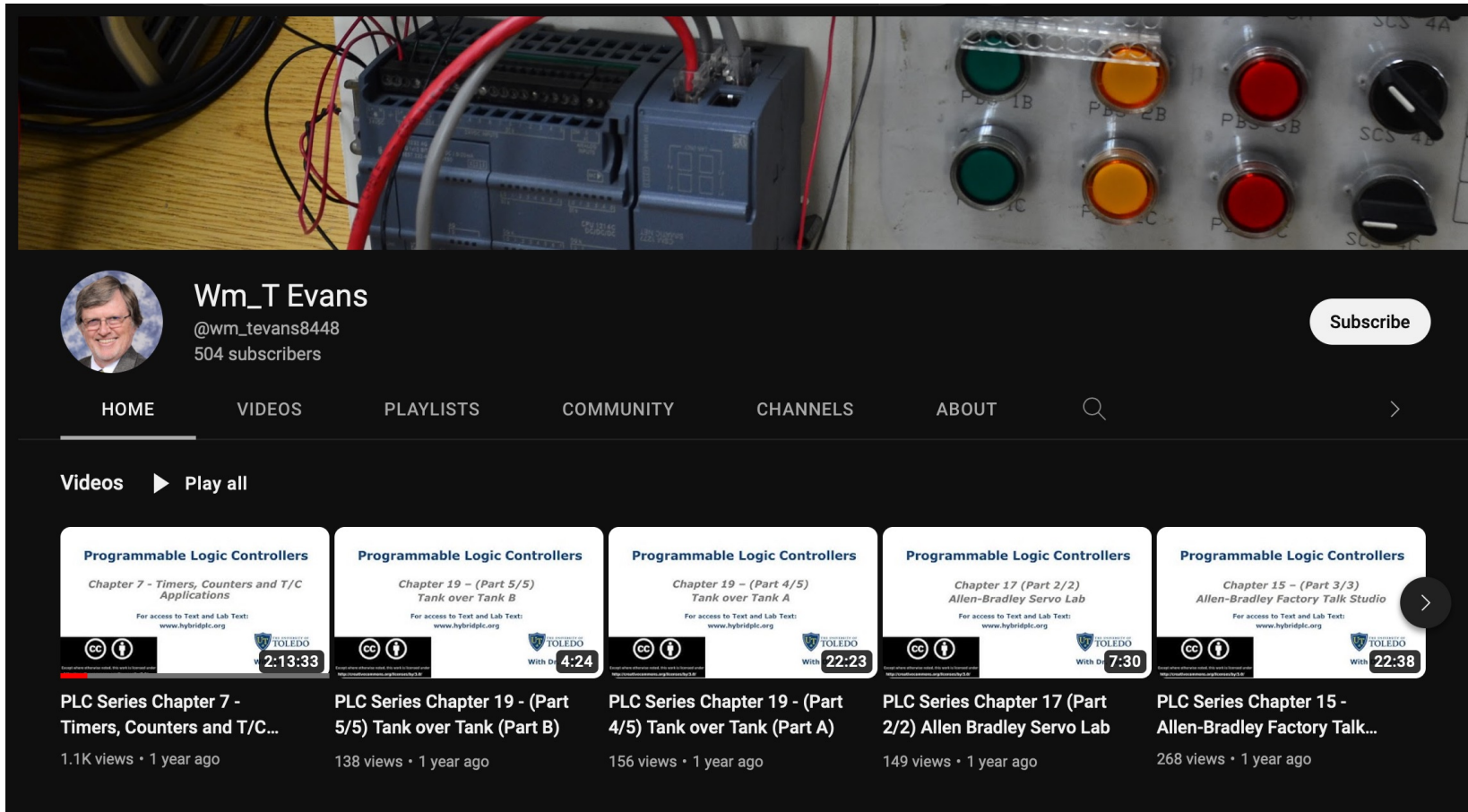


Fig. 2-6 Symbols for Components of the Relay

Fig. 2-7 shows the contact arrangement in the relaxed mode for the solid line contacts. The dashed line contacts show the contact arrangement in the energized mode when current is flowing sufficiently through the coil to attract the plunger to contact the steel core inside the coil.



Video Tutorials



The image shows a screenshot of a YouTube channel page for Wm_T Evans. At the top is a video player showing a close-up of a PLC rack with various modules and a control panel with several indicator lights (green, yellow, red) and knobs. Below the video player is the channel header for Wm_T Evans, including a profile picture, name, handle (@wm_tevans8448), and subscriber count (504). A navigation menu includes links for HOME, VIDEOS, PLAYLISTS, COMMUNITY, CHANNELS, and ABOUT, along with a search icon. Below the menu is a "Videos" section with a "Play all" button. Five video thumbnails are displayed, each for a PLC tutorial. Each thumbnail includes the title, chapter information, a "With Dr." badge, a video duration, and view statistics.

Video Title	Duration	Views	Time Ago
PLC Series Chapter 7 - Timers, Counters and T/C...	2:13:33	1.1K	1 year ago
PLC Series Chapter 19 - (Part 5/5) Tank over Tank (Part B)	4:24	138	1 year ago
PLC Series Chapter 19 - (Part 4/5) Tank over Tank (Part A)	22:23	156	1 year ago
PLC Series Chapter 17 (Part 2/2) Allen Bradley Servo Lab	7:30	149	1 year ago
PLC Series Chapter 15 - Allen-Bradley Factory Talk...	22:38	268	1 year ago

Lab Assignments

Chapter 1 Hot Dog Counter

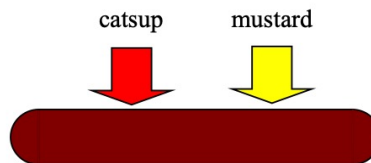
Fred and Rudy are making hot dogs at the ballpark. Fred dispenses mustard and Rudy dispenses catsup. A hot dog is not sold without each Fred and Rudy putting both mustard and catsup on the dog. As each pushes the button for their ingredient, a signal is fed to the PLC for the action. Either button may be pushed first. Design a program to count the total number of hot dogs made. Inputs should be wired to contacts and labeled as mustard and catsup. A display is kept in the PLC showing up-to-date counts of hot dogs made by Fred and Rudy.

To complete the lab, enter the program shown later in the lab into the PLC and wire the two inputs.

Watch the count accumulate in the counter as the two buttons are pressed in any order. Get a listing from the listing software on the programming software package. The documented listing of the program may be used as the final lab report.

Wire the PLC to the inputs for this lab and to inputs or outputs for other labs per the diagram on the next page.

The next page shows the layout of the PLC on the trainer and the PLC wiring schematic. To wire the two inputs, wire through the two pushbuttons selected so that 24 volts is at the terminals of I/0 and I/1 when the two buttons are pushed.



Enter the following 4 rung program in both Siemens TIA Portal and A-B RSLogix 5000.

Low-Cost PLC



The recommended approach is a \$189 Siemens PLC, programming software and cable

All that is needed to complete the training station is

- a computer with Windows 10 Pro
- a power supply
- a breadboard with some resistors and jumpers
- perhaps a voltmeter

Challenges & Solutions

**Industry needs more people
in automation than the
United States can produce**



Challenges & Solutions

Annual salaries can range from \$100K to \$150K in a few years!

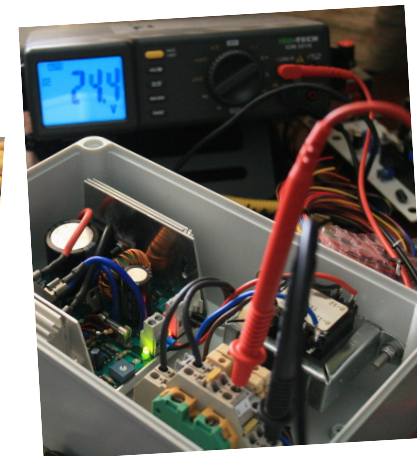
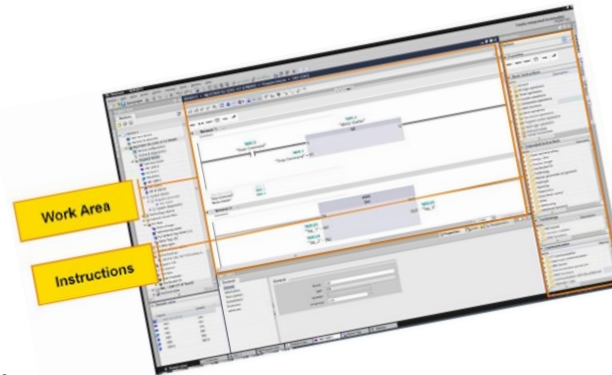


Challenges & Solutions

The Cost

The cost of the program is minimal:

- Many of the labs have little or no cost after the initial investment of \$189.
This includes a PLC, a software programming package and an ethernet cable.
- If one has a 24 V DC power supply great. If not, then a \$20 power supply can be purchased through Amazon. This is all that is required for the Siemens PLC.



Questions



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Questions?

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