



# Faculty Workshop Session 3

For the NSF Project: “Scaling Elements of a Competency-based/  
Hybrid Instructional Model in Adv. Mfg. Courses”

Presented by:

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([twylie@northweststate.edu](mailto:twylie@northweststate.edu))



# Scaling CBE Elements Faculty Workshop:

1. Session 1: 5/20/22, 1:00 – 3:00pm EDT
2. Session 2: 5/27/22, 1:00 – 3:00pm EDT
- \*3. Session 3: 6/3/22, 1:00 – 3:00pm EDT

Handouts for the Workshop is available at the Project Website:

[https://ate.is/Scaling\\_CBE](https://ate.is/Scaling_CBE)

# Quick Review of Session 2:



1. Types of learning objects
2. Building learning objects for instructional materials
3. Software to capture pictures & video (Snagit & Camtasia Recorder)
4. Software used to build learning objects (PPT & Camtasia)
5. Deploy objects through an LMS



Curriculum/Skills Alignment

Employer Engagement

Modularizing Course Content

Hands-On Skills Assessments

Improving the Effectiveness & Access of Advanced Manufacturing Courses

Applied Online Assessments

by

Lecture Moved Online

Scaling Elements of a Competency-Based/Hybrid Model

Assessment Model (PLA)

Active Learning Objects

through

OER Material

Faculty Training & Innovation

Lab Exercises Workplace Skills

Flexible Lab Scheduling

Interactive Online Simulations

CBE-Skills Mastery Flexible Pacing

Virtual Machines: 24/7 Software Access





# Example of Improving a Technical Course:

1. Terra State CC had an interest in this project
2. Terra won a regional grant that required students get a certification
3. Rockwell ControlLogix Maintainer Certification
4. Formative assessments with feedback used to prepare students
5. 26 PLCII students this semester. The certification was required
6. First 17 students passed the certification on the 1<sup>st</sup> or 2<sup>nd</sup> try



# Workshop Session 3 Topics:

1. Value of using a Learning Management System
2. More info on Learning Object Development
3. What is a virtual machine (VM)?
4. Using the VM to access proprietary software
5. Software to build simulations
6. Using simulations to develop troubleshooting skills
7. Future project activities



# Life is easier if you use an LMS:

1. No more grading of tests; Let the LMS grade them
2. No more making copies of handouts; Post them in the LMS
3. Correspondence with student(s) is logged in the LMS
4. Syllabus is stored in the LMS, with possibly Faculty BIOs
5. All learning activities are stored in the LMS
6. State a communication plan in the Syllabus
7. Lab Safety sheets can be stored in the LMS



# More information on Learning Objects:

1. Videos need Closed Caption to be ADA compliant
  - \* YouTube editor is easiest to update captions
  - \* Some colleges use closed captioning services: 3Play Media
2. Some students have visual impairment (also ADA issue)
  - \* These students may need to use a screen reader
  - \* Each graphic should have Alt Text added to it
  - \* Screen reader will read the Alt Text to the user





# What is a Virtual Machine?

A virtual machine is a virtual computer that is housed on a server in the Information Technology area, with the purpose of allowing the students to get remote access to software that is licensed to the college, such as PLC, CAD, CAM and Automation Studio simulations.

1. Each student that is registered for a tech course will be issued a VM
2. The base machine is 8GB of RAM, 2.5GHz & 126GB Storage Space
3. The college licensed software is loaded into the student VMs
4. Students can access their VM remotely, 24/7
5. Initial investment \$60K for 100 VMs (2016), now \$60K for 300 VMs

# Student Virtual Machine



File Computer View

Control Panel > All Control Panel Items > System

Search Control Panel

Expand

- Manage
- Unpin from Start
- Map network drive...
- Open in new window
- Pin to Quick access
- Disconnect network drive...
- Add a network location
- Delete
- Rename
- Properties

Panel Home

anager

settings

rotection

d system settings

Quick access

- Desktop
- Downloads
- Documents
- Pictures
- This PC
- AS Elect
- IND220
- SouthA

This PC

Network

Devices and drives (1)

Local Disk (C:)

70.9 GB free of 126 GB

## View basic information about your computer

### Windows edition

Windows 10 Enterprise LTSC

© 2018 Microsoft Corporation. All rights reserved.



### System

Processor: Intel(R) Xeon(R) CPU E5-2680 v3 @ 2.50GHz 2.50 GHz

Installed memory (RAM): 8.00 GB (6.86 GB usable)

System type: 64-bit Operating System, x64-based processor

Pen and Touch: Pen and Touch Support with 10 Touch Points

### Computer name, domain, and workgroup settings

Computer name: twylie-ind220

[Change settings](#)

Full computer name: twylie-ind220

Computer description:

Workgroup: WORKGROUP

### Windows activation

Windows is activated [Read the Microsoft Software License Terms](#)

Product ID: 00425-00000-00002-AA195

See also

[Change product key](#)

tate  
y College



# PLC/Industrial Computing Lab

- \*16 desktop computer with RS
- \* Docking for 4 laptops
- \*10 SLC-500 Hdw. Simulators
- \*8 CompactLogix Hdw. Simulators
- \*8 ControlLogix Hdw. Simulators

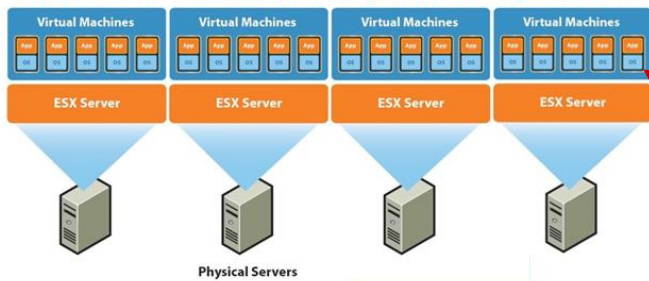


## Factory Talk Activation Server

- 20 Rockwell Classroom Toolkit Activations
- 30 Rockwell Classroom Toolkit Activations

## Factory Talk Activation Server

Each Server: 320 GB RAM, 12-Dual Core processor running 2.5 GHz Each



Student 1  
Virtual  
Machine

Massive Hard-  
drive  
Storage

**NSCC  
Data  
Security  
Firewall**

**THE  
Internet**

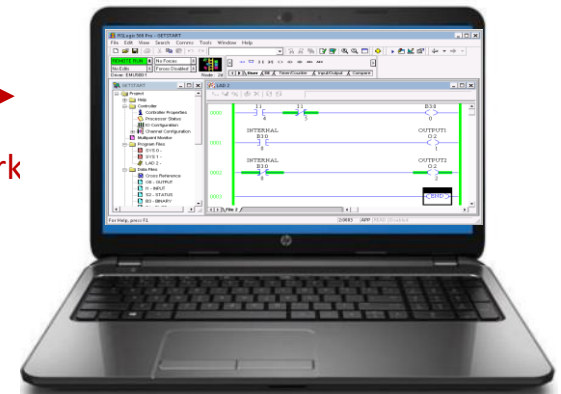
**PHYSICAL**

**VIRTUAL**

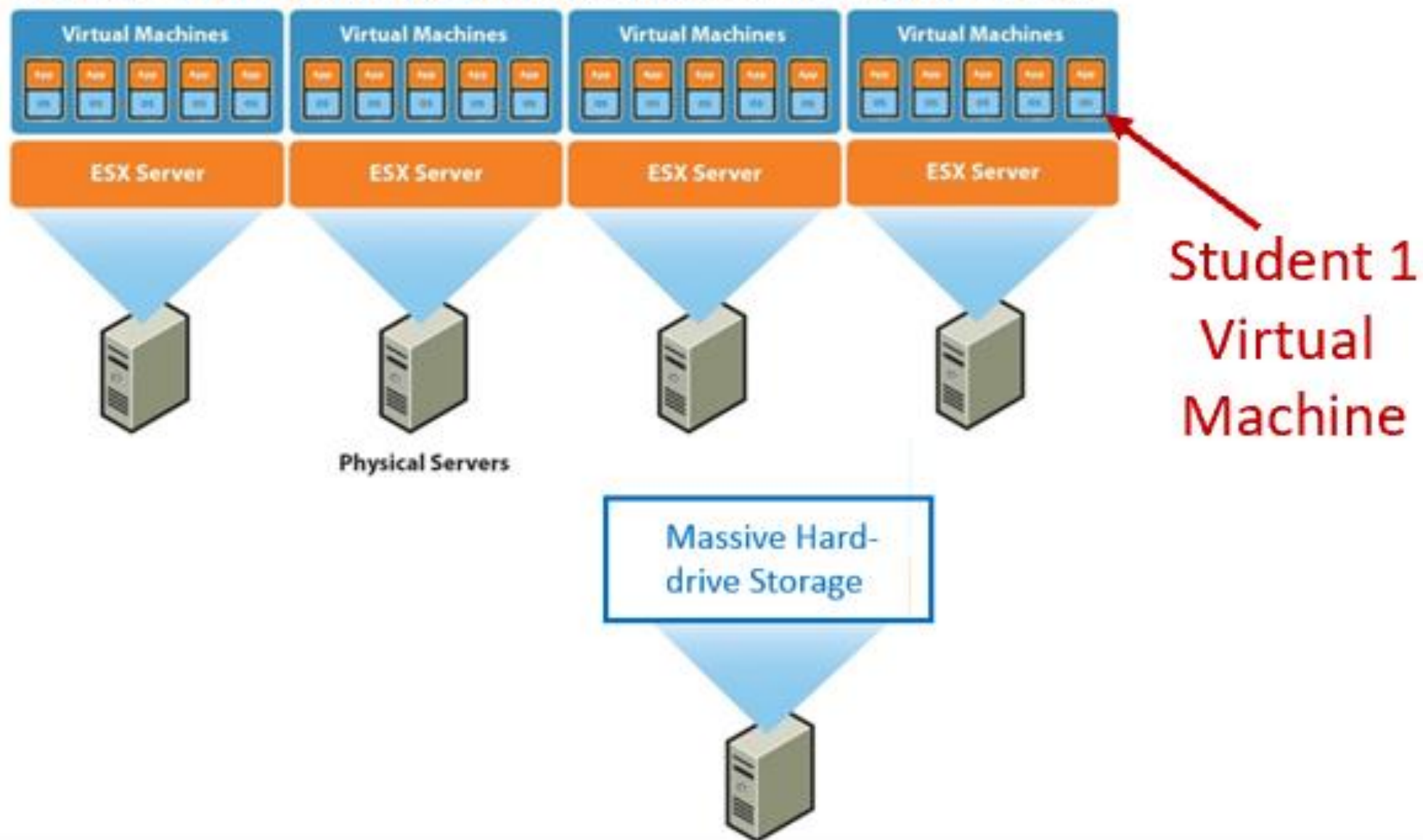
Student enter through the  
[Connect.northweststate.edu](http://Connect.northweststate.edu)  
Portal

Student 1  
WiFi network

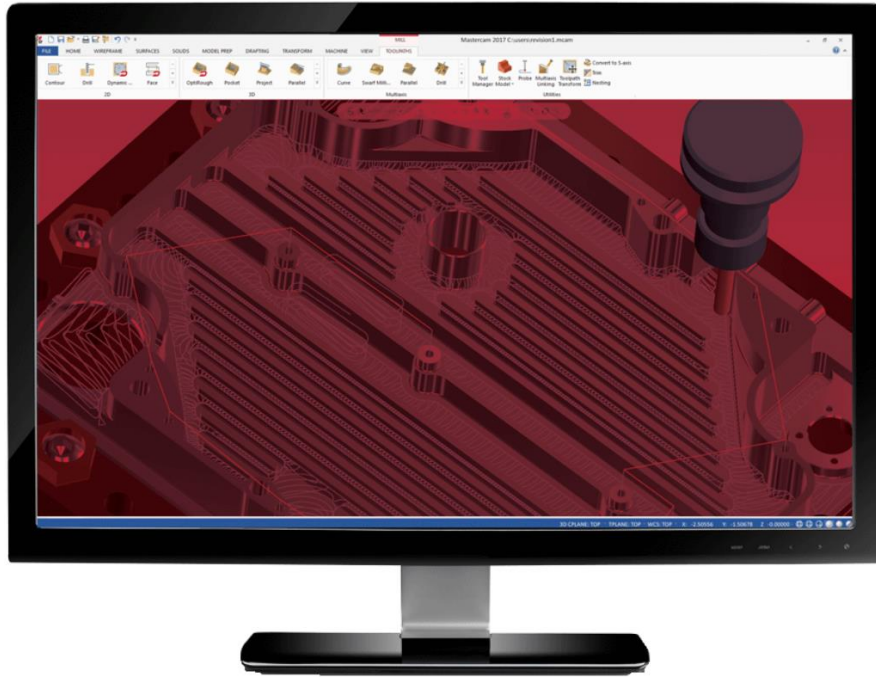
Student 1  
Computer at Home



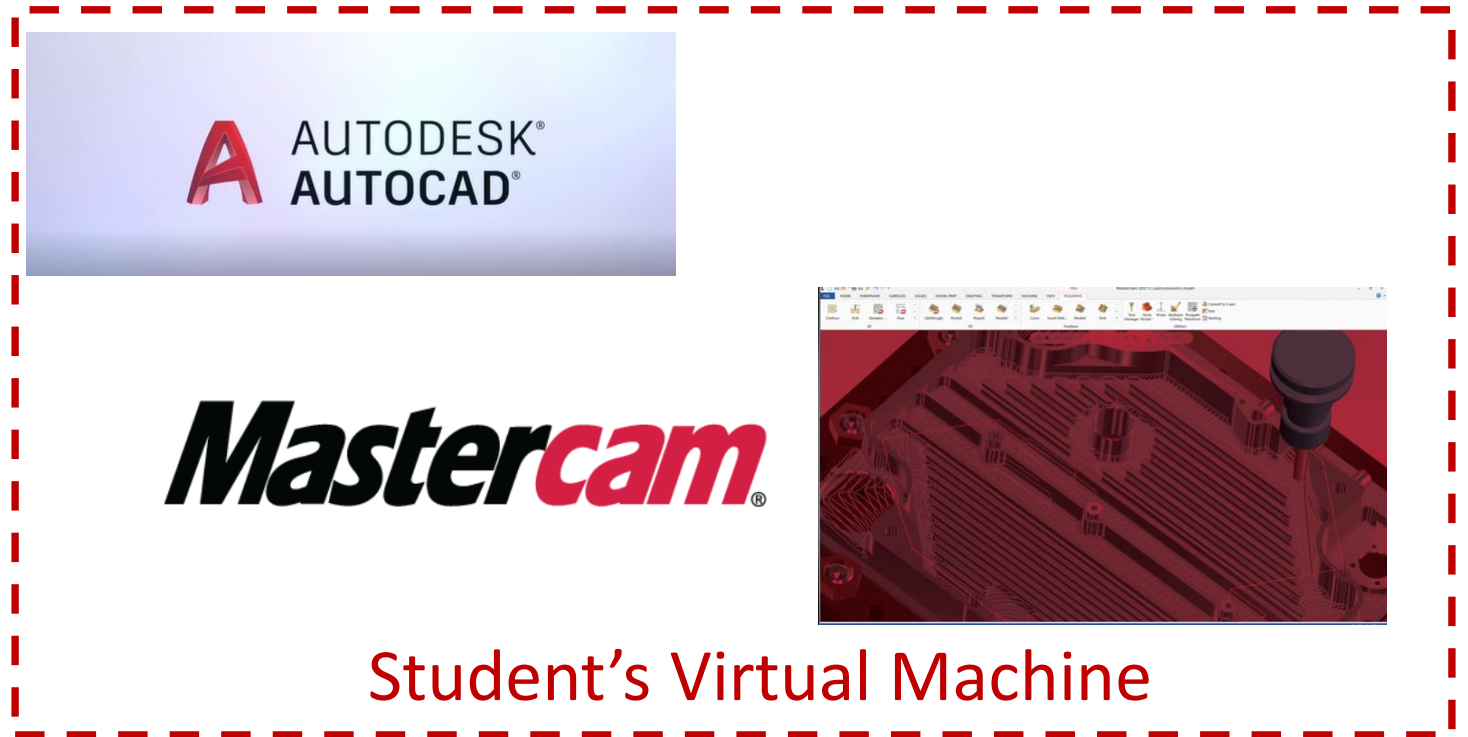
Each Server: 320 GB RAM, 12-Dual Core processor running 2.5 GHz Each



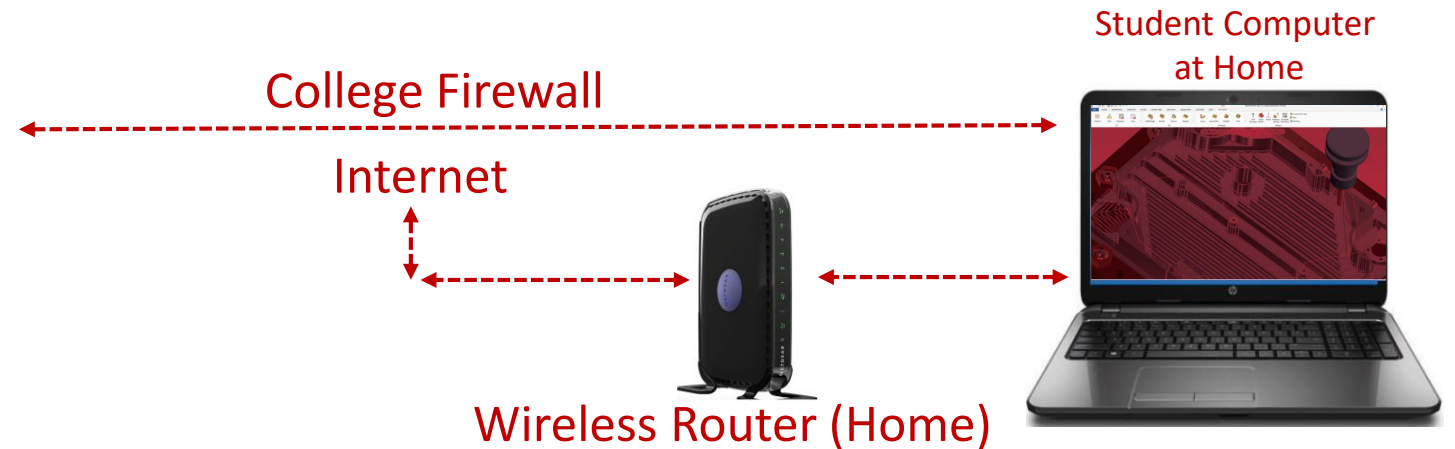
# CAM Lab on campus



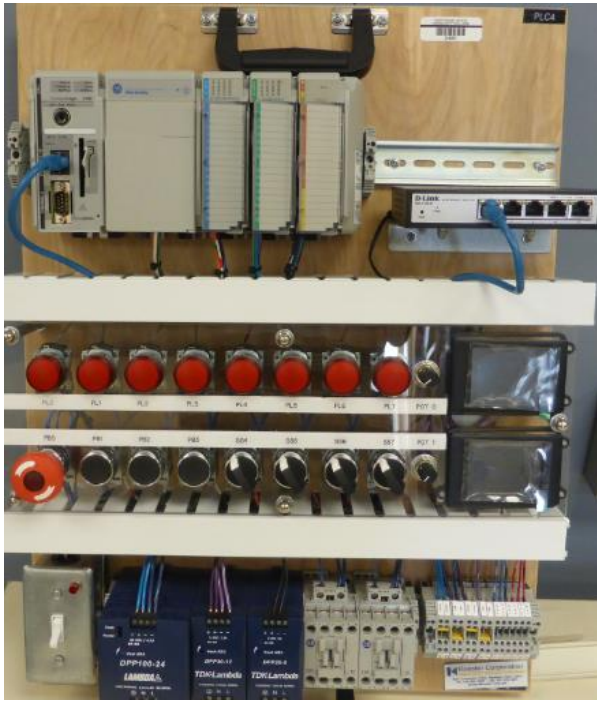
The content of the virtual machine will have all of the same functionality as being in the CAM Lab



Student's Virtual Machine



# PLC Lab on campus



The content of the virtual machine will have all of the same functionality as being in the PLC Lab



Student's Virtual Machine



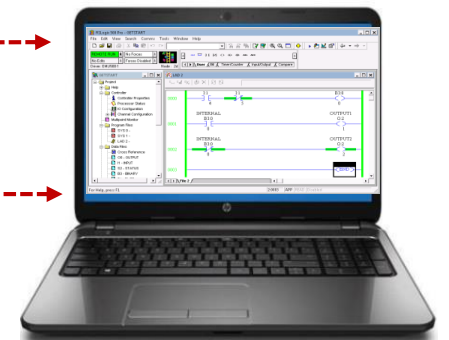
Virtual PLC Simulator

College Firewall

Internet

Student Computer at Home

Wireless Router (Home)



Studio 5000® Logix Emulate™

Slot View Options All Modules Help

Computer: WIN10-ROCKWELL

0	1	2	3	4	5	6	7	8
RS LINX	FTLinx	EMULATOR	1789-SIM		1789-SIM			
RUN I/O OK	RUN I/O OK	RUN REM PR	RUN I/O OK	RUN I/O OK	RUN I/O OK	RUN I/O OK	RUN I/O OK	RUN I/O OK

For Help, press F1

RSLinx Classic Gateway - [RSWho - 2]

File Edit View Communications Station DDE/OPC Security Window Help

Autobrowse Refresh Not Browsing

Workstation, WIN10-ROCKWELL

- Linx Gateways, Ethernet
- AB\_ETHIP-1, Ethernet
- AB\_VBP-1, 1789-A17/A Virtual Chassis
- EMU500-1, DH-485

Linx Gateway...	AB_ETHIP-1 Ethernet
AB_VBP-1 1789-A17...	EMU500-1 DH-485

Logix Designer - FriNite [Emulate 5570 32.11]

FILE EDIT VIEW SEARCH LOGIC COMMUNICATIONS TOOLS WINDOW HELP

Run Mode Controller OK Battery OK I/O OK

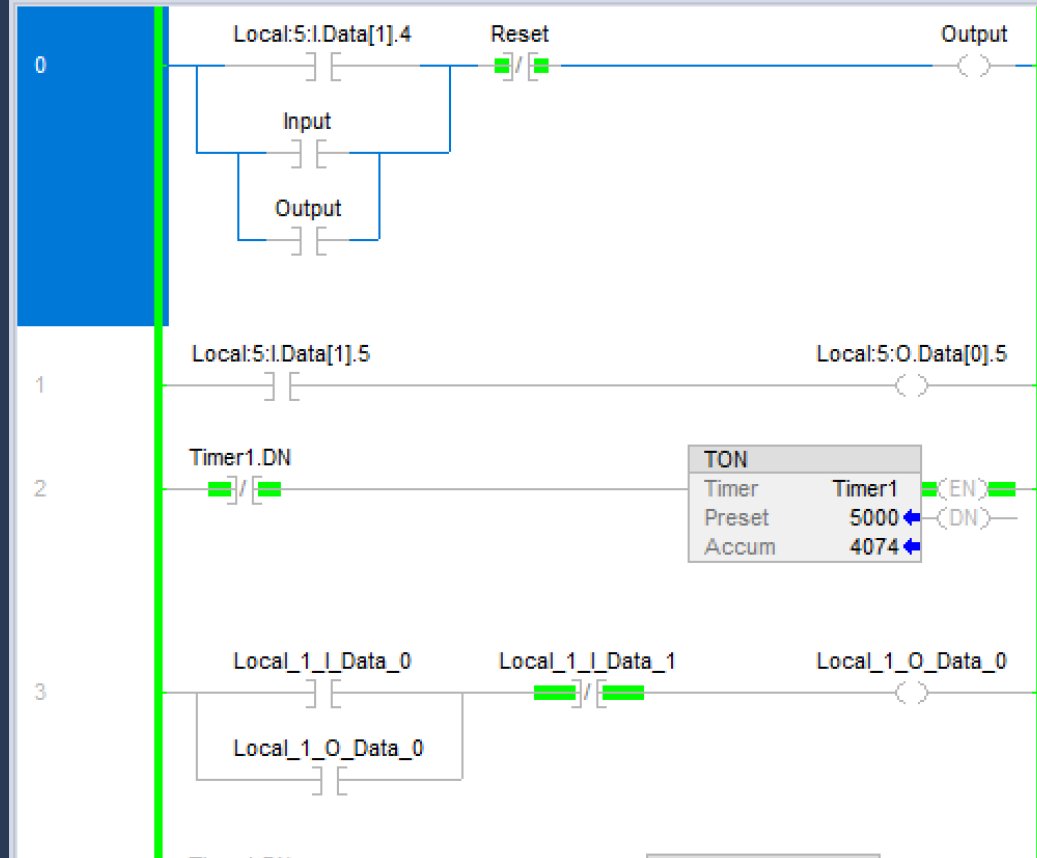
Path: AB\_VBP-1\2\*

Rem Run No Forces No Edits

Controller Organ... MainProgram - MainRoutine

Controller FriNite

- Controller Tags
- Controller Fault Handler
- Power-Up Handler
- Tasks
  - MainTask
    - MainProgram
      - Parameters
      - MainRoutine
- Unscheduled
- Motion Groups
  - Ungrouped Axes
- Assets
- Logical Model
- I/O Configuration
  - 1756 Backplane, 1756
    - [2] Emulate 5570
    - [3] 1756-MODU
    - [5] 1756-MODU





# Interactive Virtual Simulations

Virtual Simulations do not replace hands-on skills development, but it can really complement the hands-on by accelerating the understanding of a technology or circuits.

1. Labs should be created for student learning in a virtual simulation
2. The virtual simulation should align with the hands-on activities
3. The virtual simulation should be housed in the student's virtual machine
4. Students can access their VM and virtual simulations remotely, 24/7
5. Assess the learning process within the virtual simulation





# FESTO AC/DC Training Unit

**DC POWER SOURCE**  
0.5 24 V 1.3 A

**AC POWER SOURCE**  
15 24 V 1 A 60 Hz

**DC RELAY**

**AC RELAY**

**SPST**  
10 A 125 V 50/60 Hz

**SWITCHES**

**SPDT**  
10 A 125 V 50/60 Hz

**DPDT**  
10 A 125 V 50/60 Hz

**NO PUSH BUTTON**  
2 A 30 V =  
3 A 120 V 50/60 Hz

**NC PUSH BUTTON**  
2 A 30 V =  
3 A 120 V 50/60 Hz

**SELECTOR SWITCH**  
3 A 24 V =  
8 A 120 V 50/60 Hz

**SPST KNIFE SWITCH**  
1.2 A 24 V =  
1.2 A 24 V 50/60 Hz  
MAX 24 V

**FUSE**  
0.2 A 250 V 5B

**INDICATOR LIGHTS**  
24 V 2 W  $\varnothing$

**COIL**  
24 V =

**CONTACTS**  
10 A 32 V =  
10 A 125 V 50/60 Hz

**COIL**  
24 V 50/60 Hz

**CONTACTS**  
10 A 32 V =  
10 A 125 V 50/60 Hz

**INDUCTOR**  
1 H  $\pm 15\%$  240 mA 30 V 60 Hz

**TRANSFORMER**  
20 VA 24-24 V 50/60 Hz

**FUSE**  
0.75 A 250 V 5B

**RESISTORS**  
62  $\Omega$   $\pm 5\%$  15 W  
120  $\Omega$   $\pm 5\%$  15 W  
120  $\Omega$   $\pm 5\%$  15 W  
200 k $\Omega$   $\pm 1\%$  0.5 W

**FESTO POTENTIOMETER**  
0-125  $\Omega$  250 mA 12.5 W

**CAPACITOR**  
10  $\mu$ F 50 V 250 mA 50/60 Hz

**DC MOTOR**  
24 V = 50 rpm 30 mA

**BUZZER**  
24 V =

**POWER INPUT**  
120 V 1 A 60 Hz

**FAULTS**  
1 2 3 4 5 6

**TEST CIRCUIT BREAKER**  
0.1 A 250 V 50/60 Hz



# Electrical I, Lab 15



IND120 Lab Exercise 15, 7/16/16  
I AM iSTAR, A DOL funded project

## IND120 Lab 15: Troubleshooting Lab #2

Upon completion of this lab, the student should be able to:

1. Learn the operation of multiple electrical circuits on the ACDC training unit.
2. Explain the purpose of various devices in an electrical circuit.
3. Measure the voltage across a powered load using a DMM.
4. Insert faults into circuits through manual fault switches on the unit.
5. Troubleshoot the electrical circuit that has a fault condition.
6. Use an Ohmmeter to determine how the fault switch affects a circuit device.
7. Return the electrical circuit for full operation.

\*Open the AC/DC Training Unit. Setup the unit on its base, or lay flat on the work table.

**\*Make sure all fault switches are in the “0” position.**

\*Connect the power cord and turn off the power input switch to make sure the unit is not powered.

**\*\*Change the color covers (globes) on the pilot lights to have the following sequence: 1<sup>st</sup> indicator light is green, 2<sup>nd</sup> indicator light is yellow, and the 3<sup>rd</sup> indicator light is r**

12. Turn off all the fault switches to take the circuit back to normal operation.

13. Power off the “Power Input” switch to power off the training unit. Disassemble the circuit.

### Part 2: Wire the following circuit on the AC/DC training system.

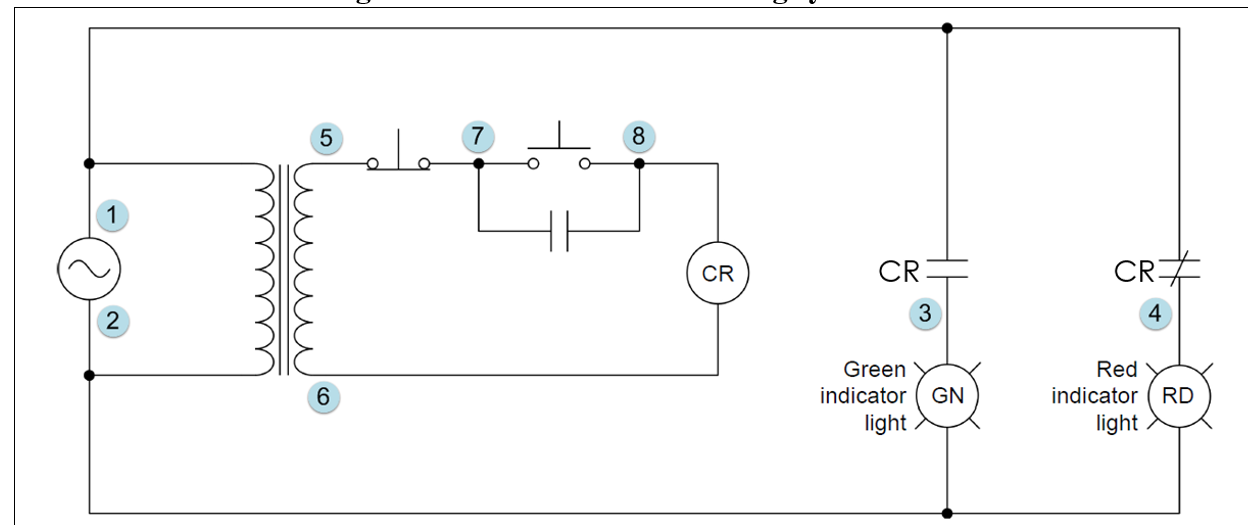


Figure 2. AC circuit 2 for troubleshooting.

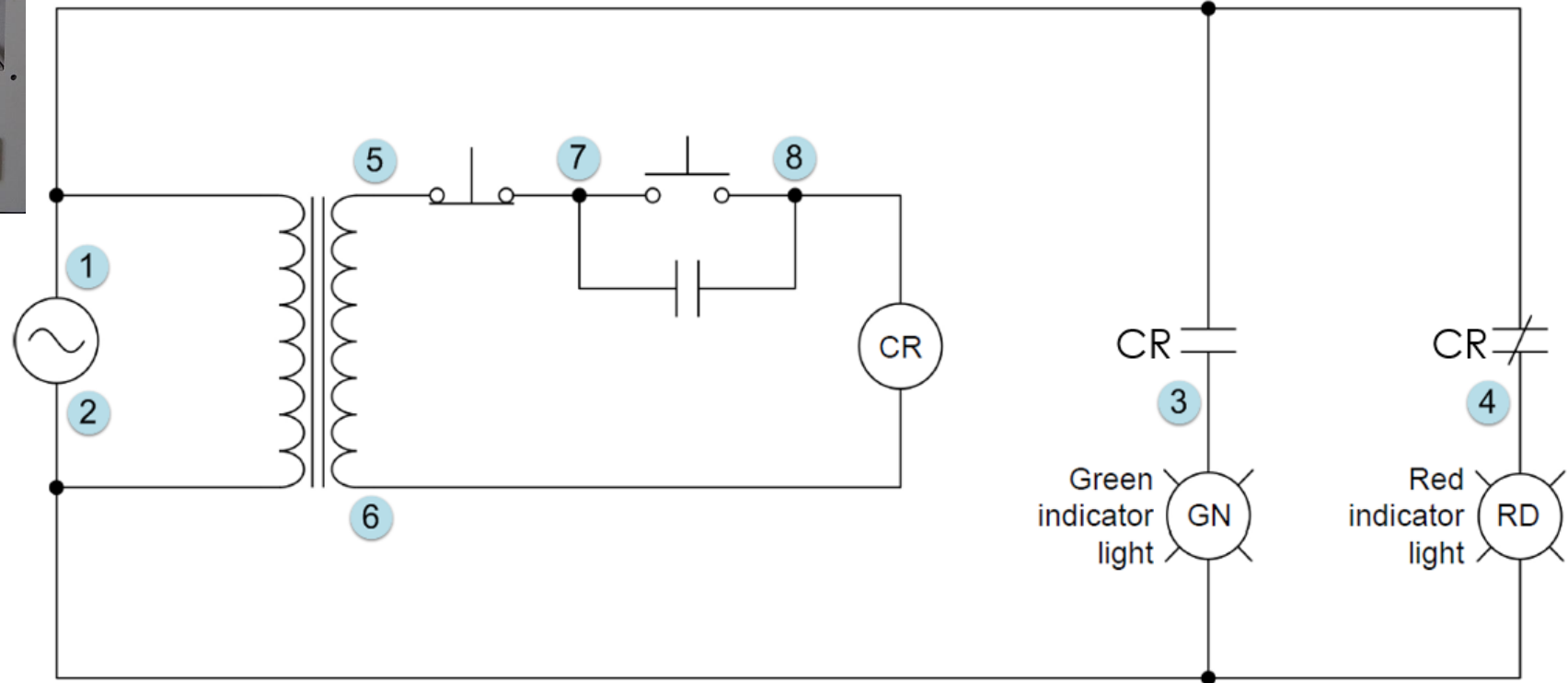
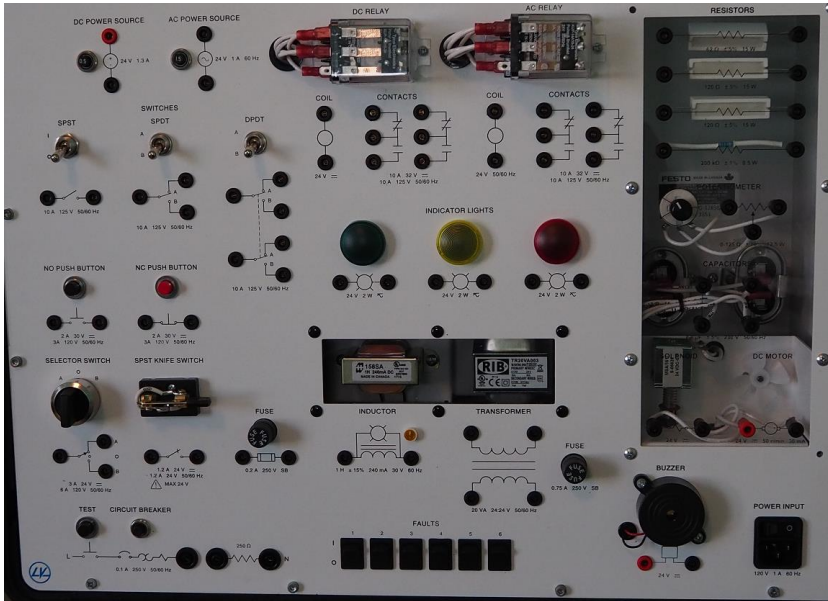
### Testing the Circuit for Part 2:

1. Set all the fault switches to the 0 (or off) position.



# Electrical I, Lab 15, Part 2 Circuit

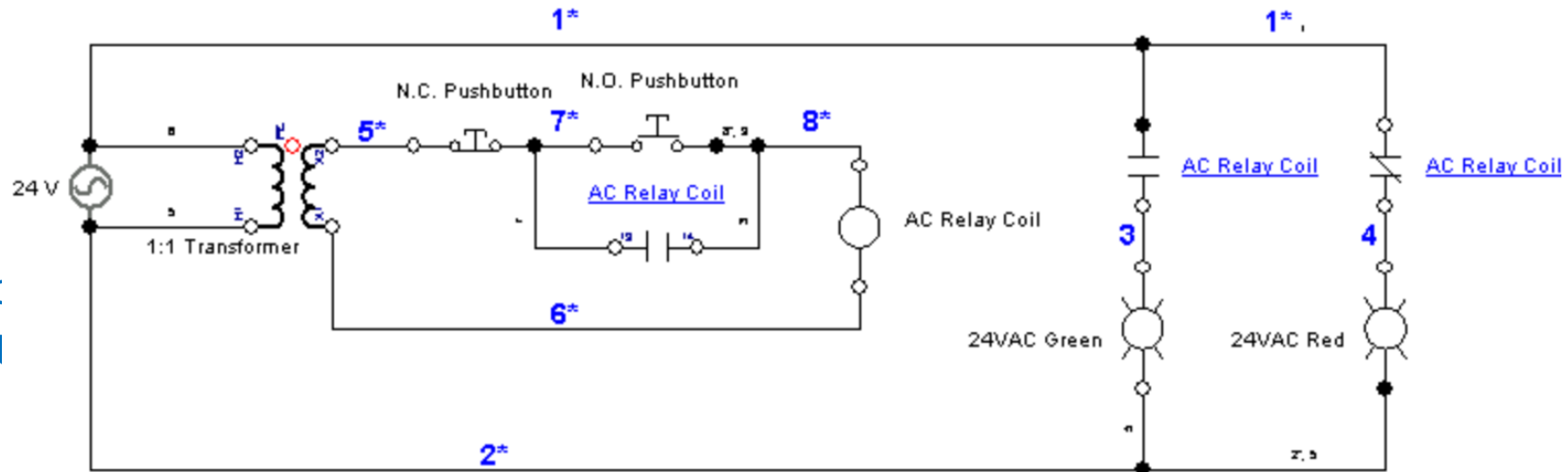
Student connect the circuit on the AC/DC training unit, then test the circuit with a digital multimeter



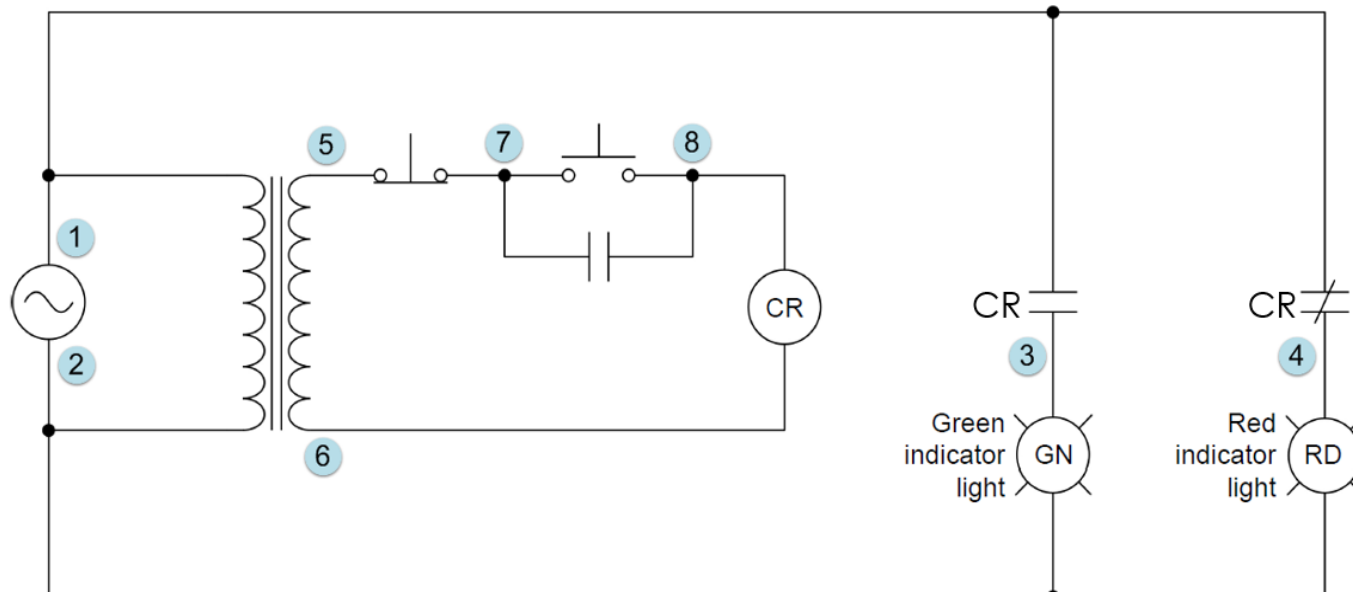
# Electrical I, Lab 15, Part 2 Circuit



Circuit created in Automation Studio within the student virtual machine

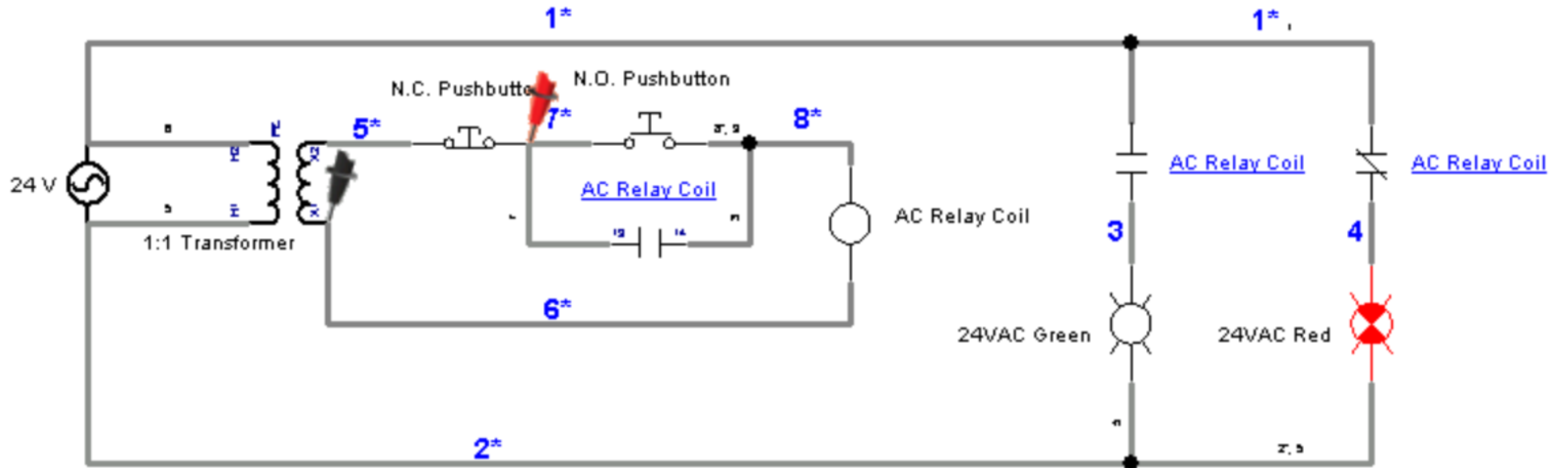


Circuit the student's will connect on the Festo AC/DC training unit





# Same Circuit in Automation Studio



Fault Sw 1

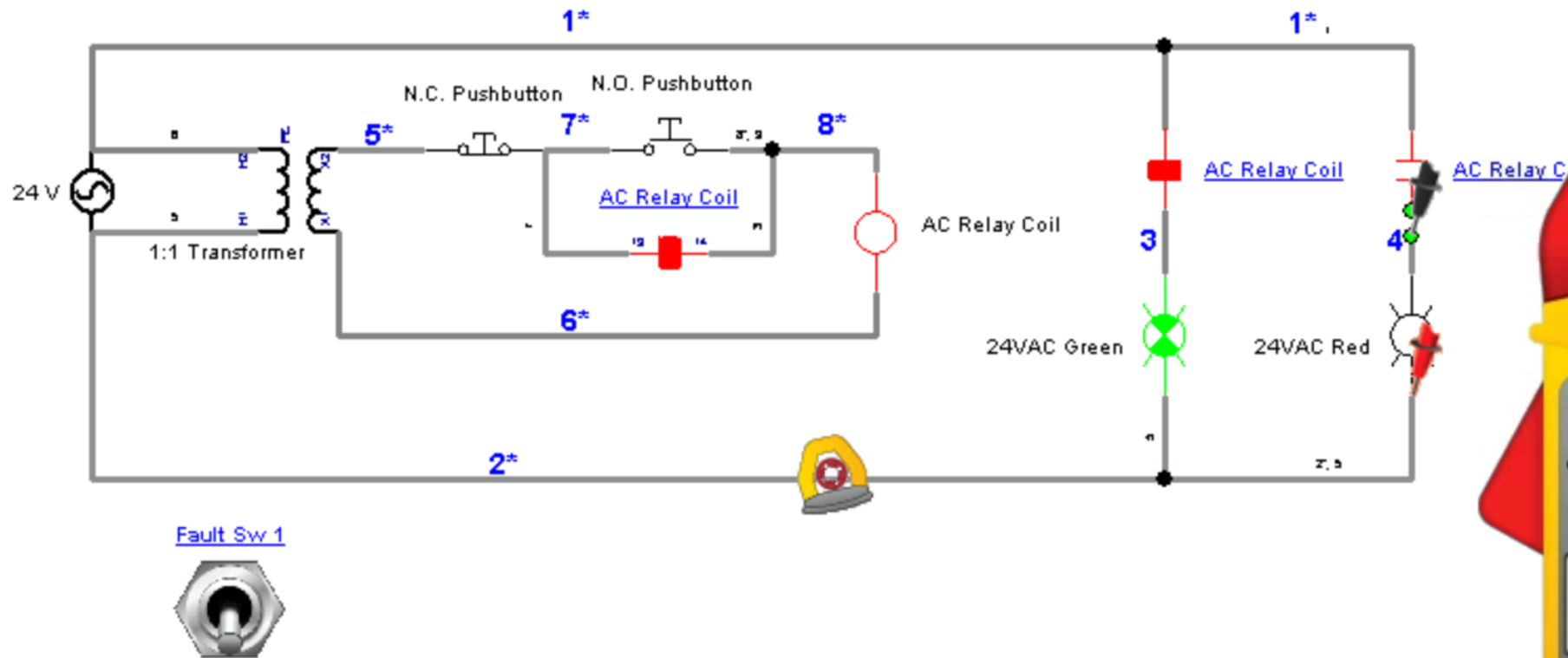


# Same Circuit in Automation Studio

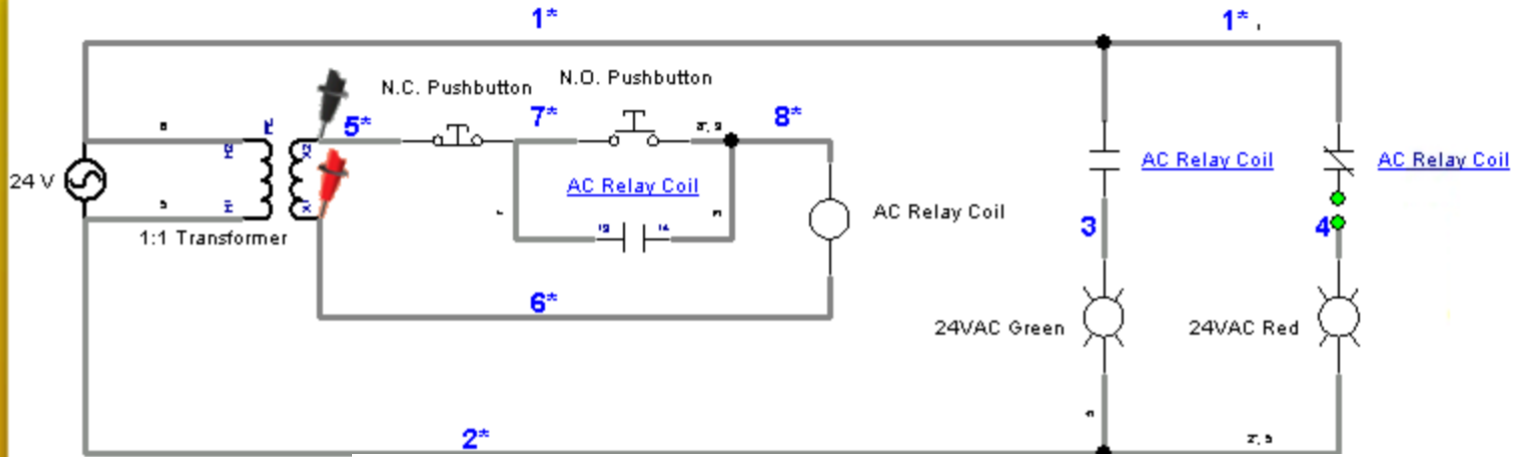
Improving the Effectiveness & Access of Advanced Manufacturing Courses by  
**Scaling Elements of a Competency-Based/Hybrid Model**  
through  
**Faculty Training & Innovation**

Curriculum/Class Alignment  
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QR Material  
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CSE Skills Mastery  
Pusher Pallets

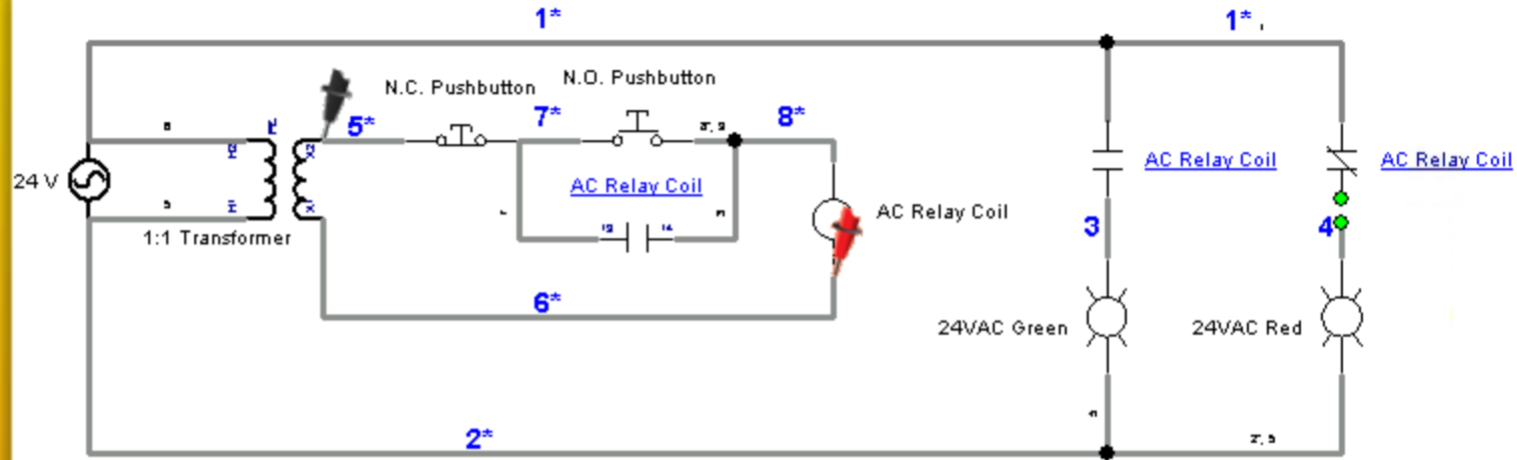
Employer Engagement  
Hands-On Skills Assessments  
Applied Online Assessments  
Assessment Model (PLA)  
Lab Exercises  
Workplace Skills  
Interactive Online Simulations  
Virtual Machines 24/7  
Software Access



# Circuit in Automation Studio with Fault Switch



Fault Sw. 1



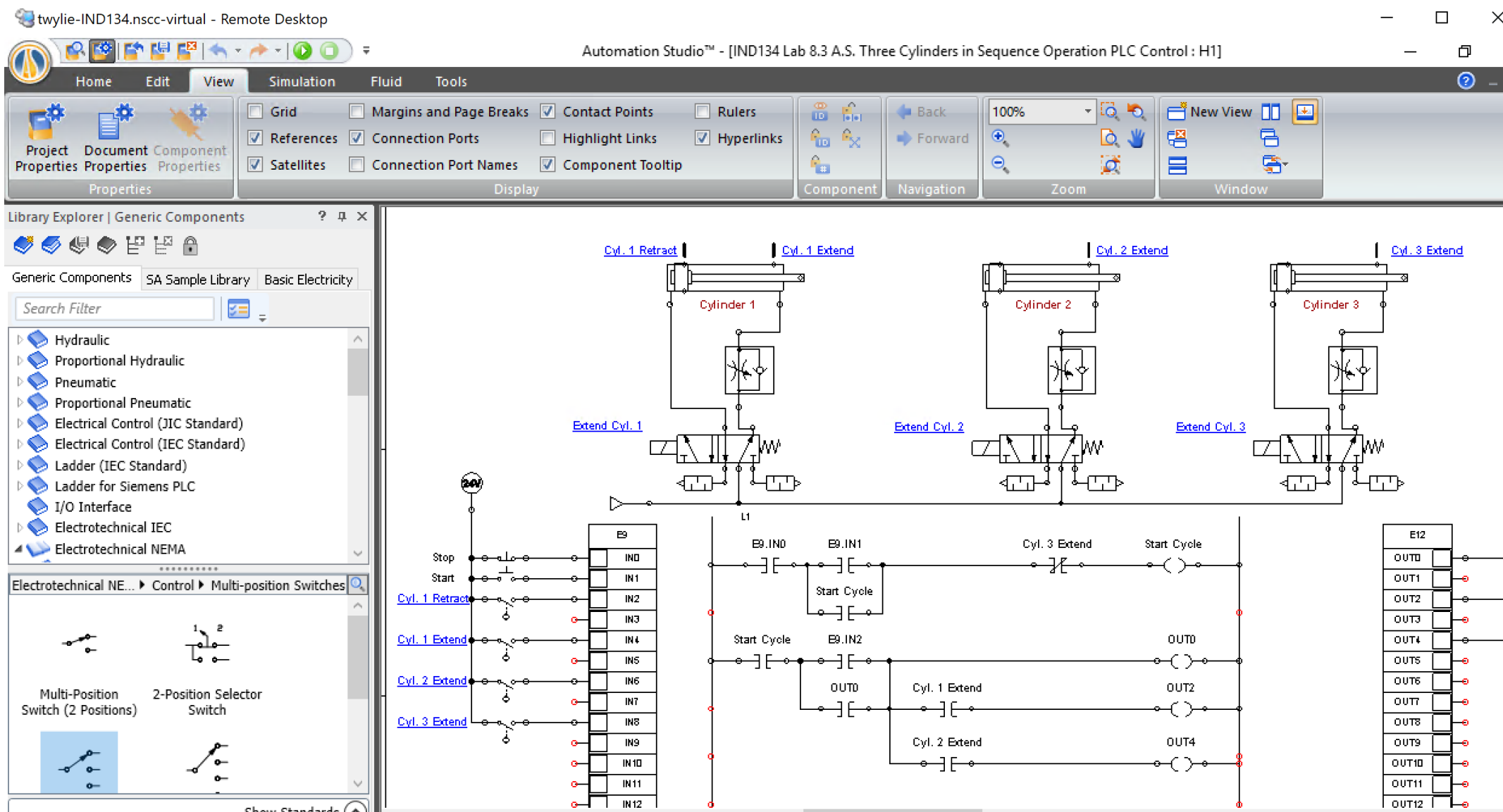
Fault Sw. 1



# Automation Studio by Famic, in Quebec



Simulations can be created by Instructor for students to experience and learn from, or Instructor could create videos using one package for student learning







# Automation Studio by Famic, in Quebec

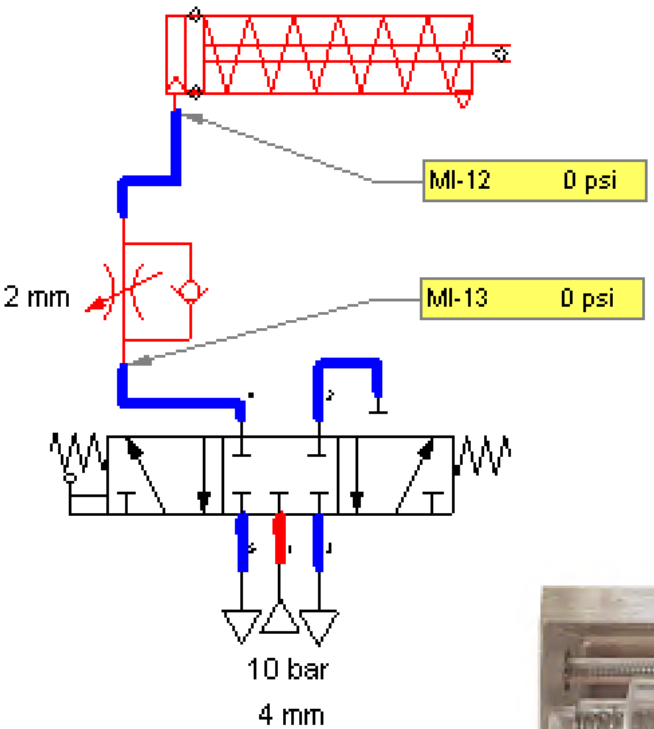
Pictures of the lab hardware can be added on the simulation to better explain a circuit to a student

## 1. What is the cost for a package of Automation Studio?

Here are some prices depending on the type of package and the number of simultaneous users:

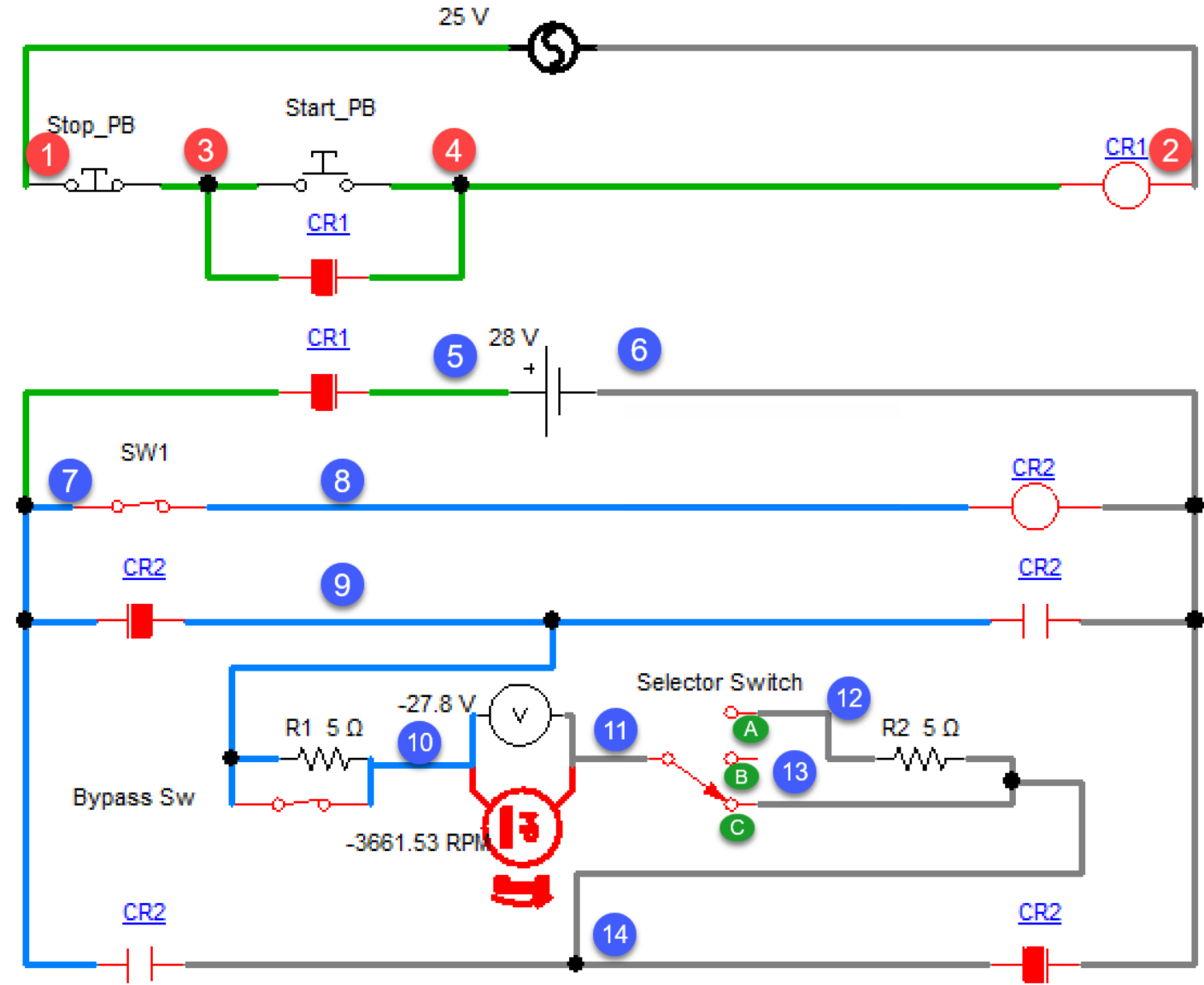
**Price information** (we can provide prices for any quantity)

Qty	Premium Package (All the modules)	Fluid Power Package (Hydraulic & Pneumatic Electro-HY & Electro-PN)	Hydraulic or Pneumatic or PLC or Electrical package
1	\$1,750.00	\$1,087.00	\$815.00
5	\$4,550.00	\$2,827.00	\$2,119.00
10	\$7,918.00	\$4,914.00	\$3,686.00
20	\$13,604.00	\$8,491.00	\$6,370.00
30	\$18,910.00	\$11,523.00	\$8,542.00
50	\$29,510.00	\$17,643.00	\$12,882.00

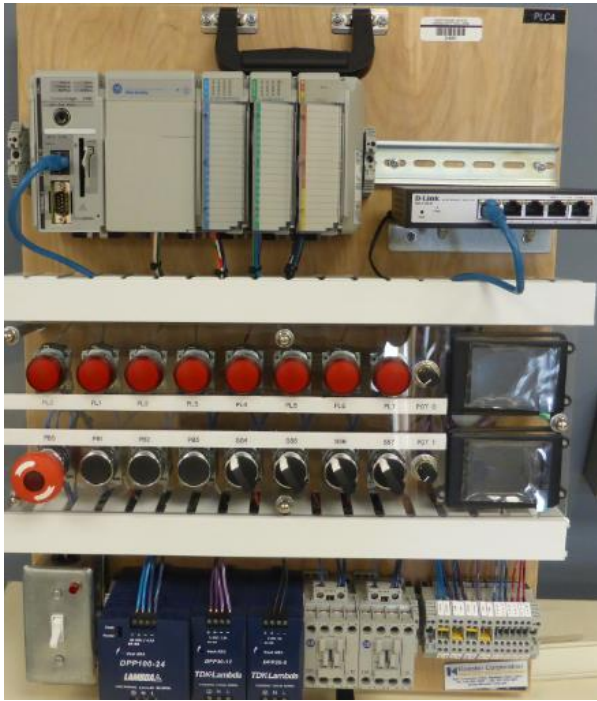




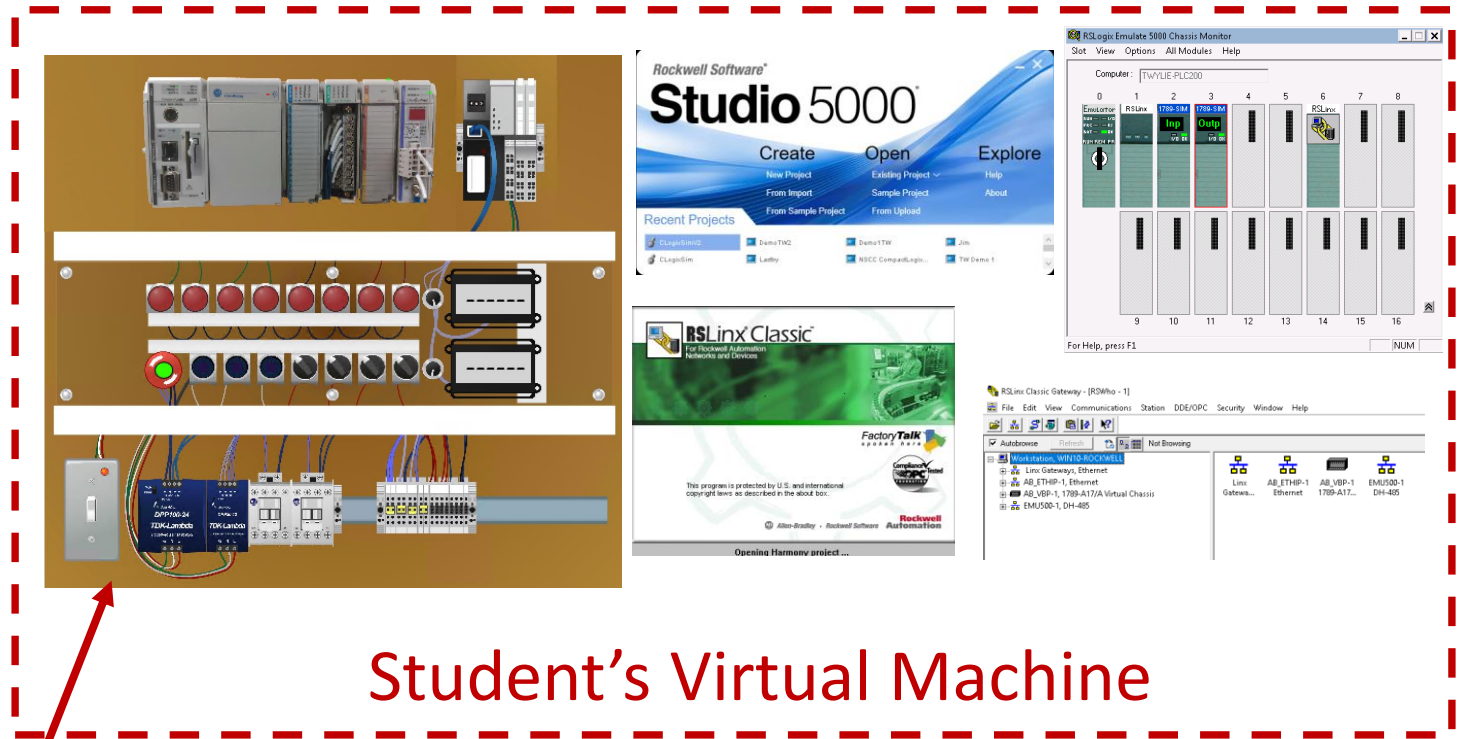
# More Complex Circuit on the AC/DC Training Units



# PLC Lab on campus



The content of the virtual machine will have all of the same functionality as being in the PLC Lab



Student's Virtual Machine



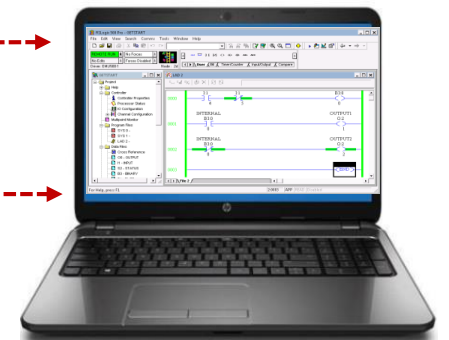
Virtual PLC Simulator

College Firewall

Internet

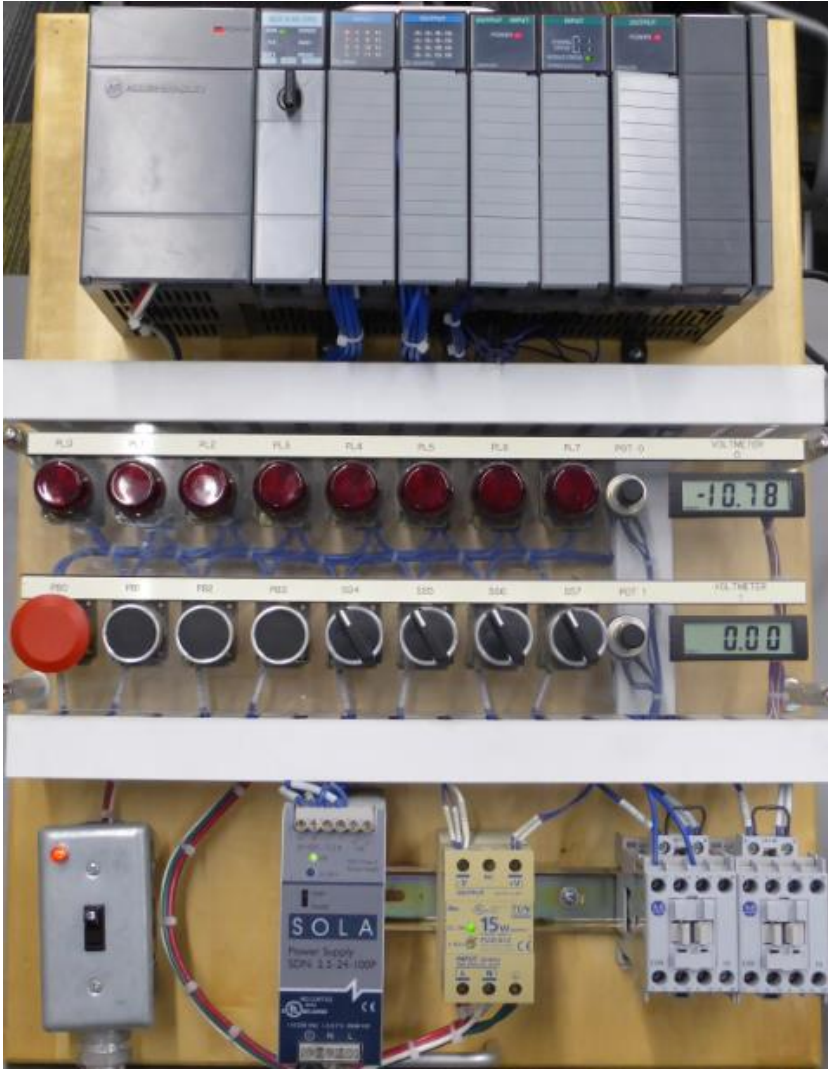
Student Computer at Home

Wireless Router (Home)

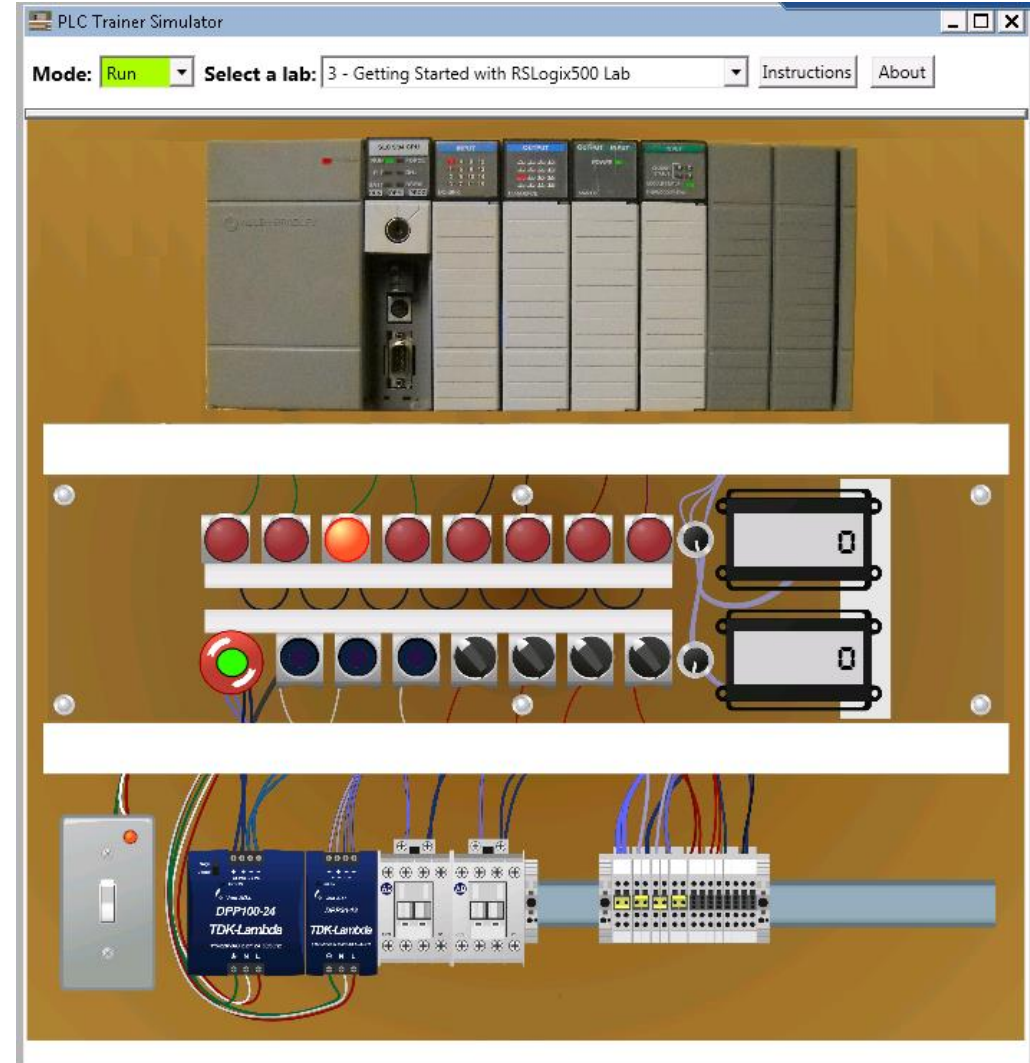


# The Virtual PLC Simulator created to replicate the functionality of the SLC-500 training unit.

## Hardware Simulator



## Virtual Simulator

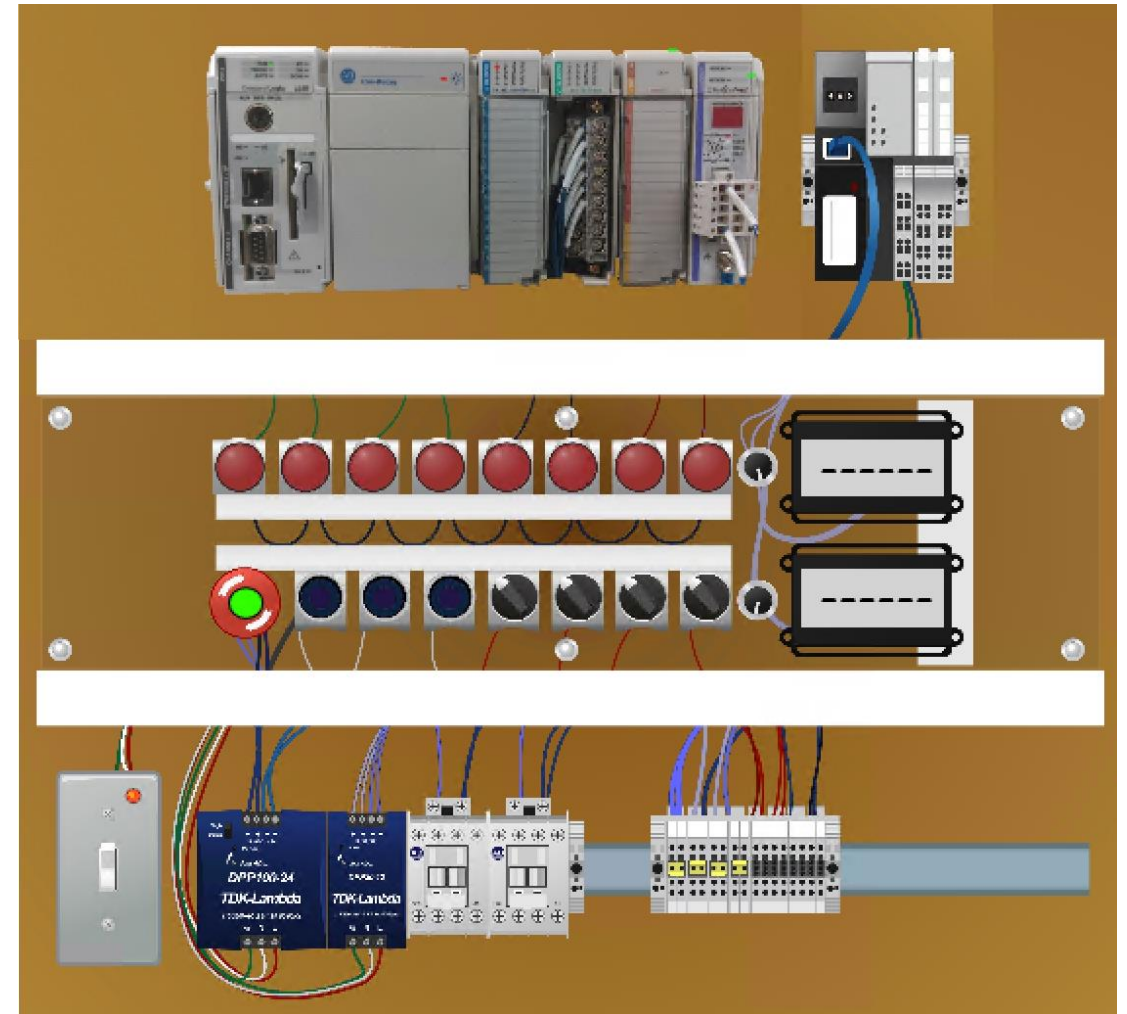


# The Virtual PLC Simulator created to replicate the functionality of the CompactLogix training unit.

## Hardware Simulator



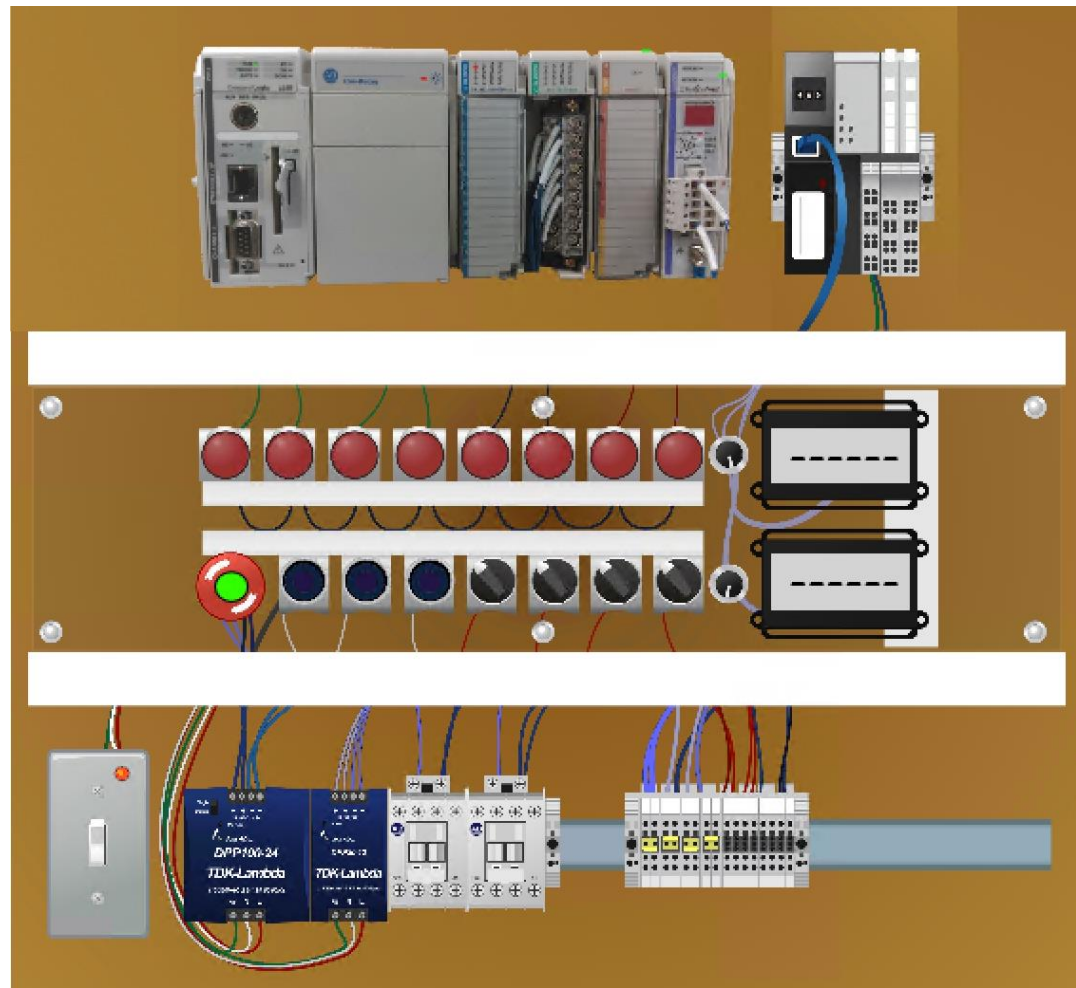
## Virtual Simulator



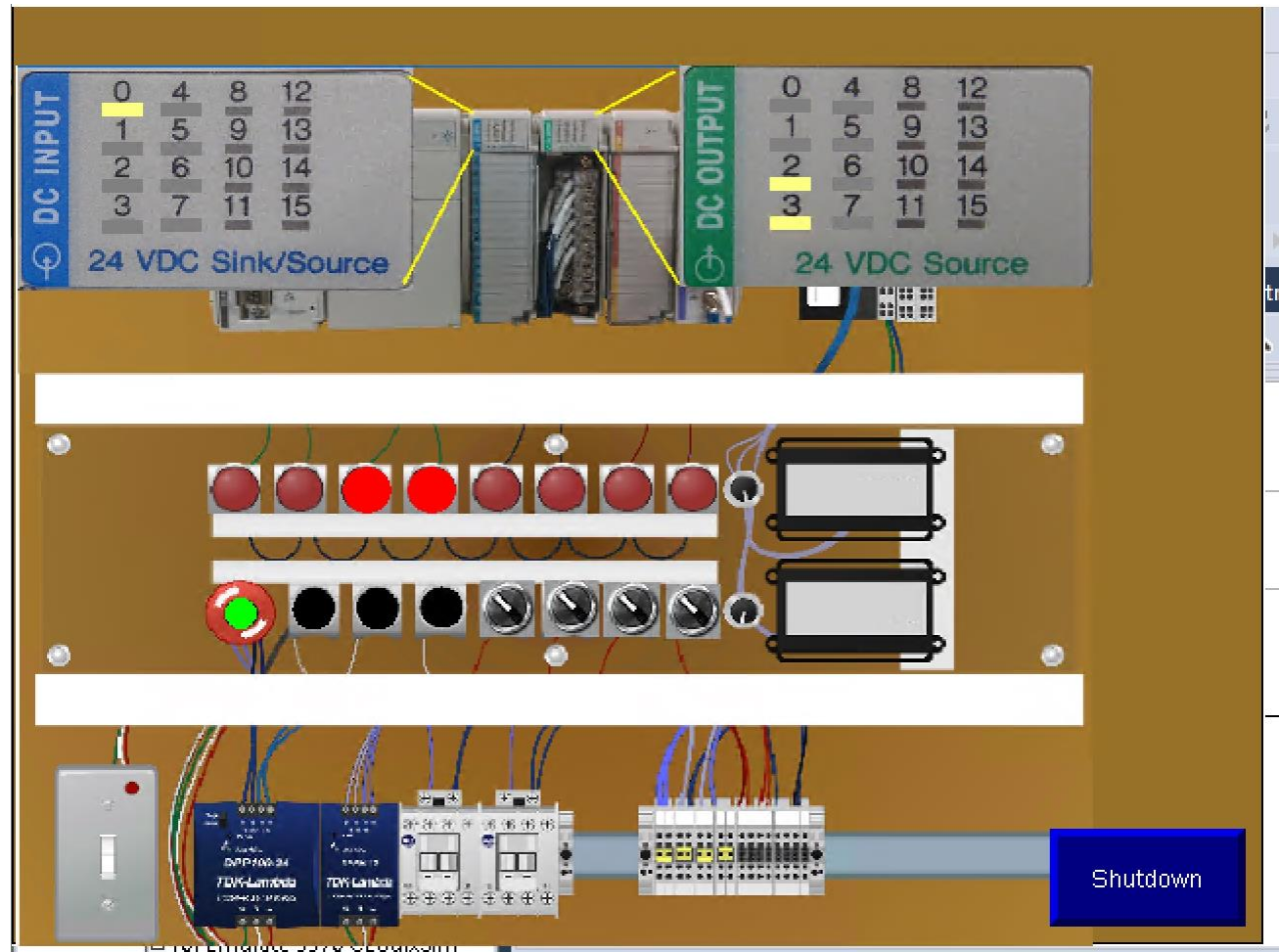


The Virtual PLC Simulator, enhanced with Factory Talk View Studio, which will allow the unit to communicate with the Studio 5000 Emulator with FactoryTalk Linx. This will allow students to run their programs on the simulator that were created in Studio 5000

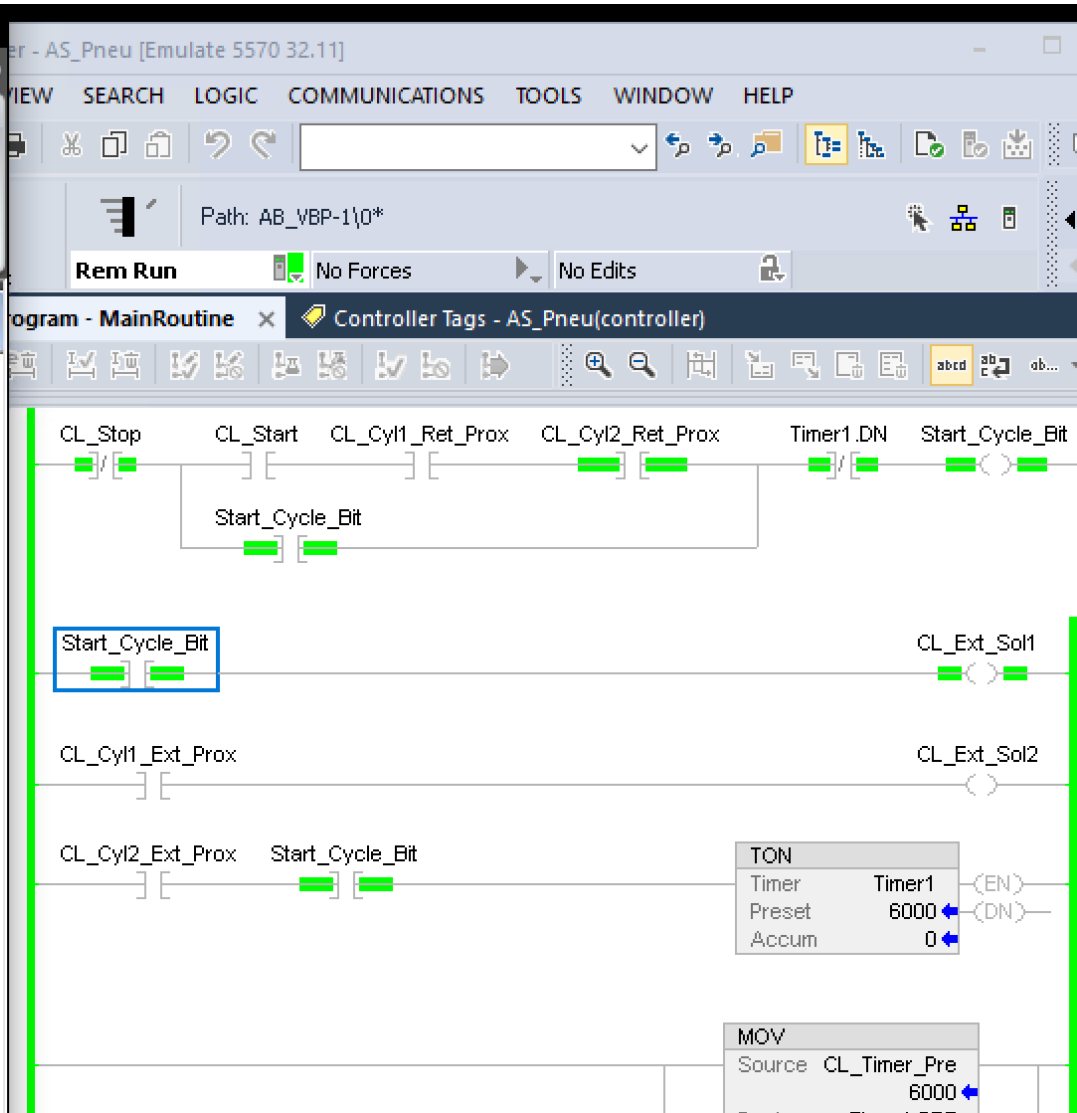
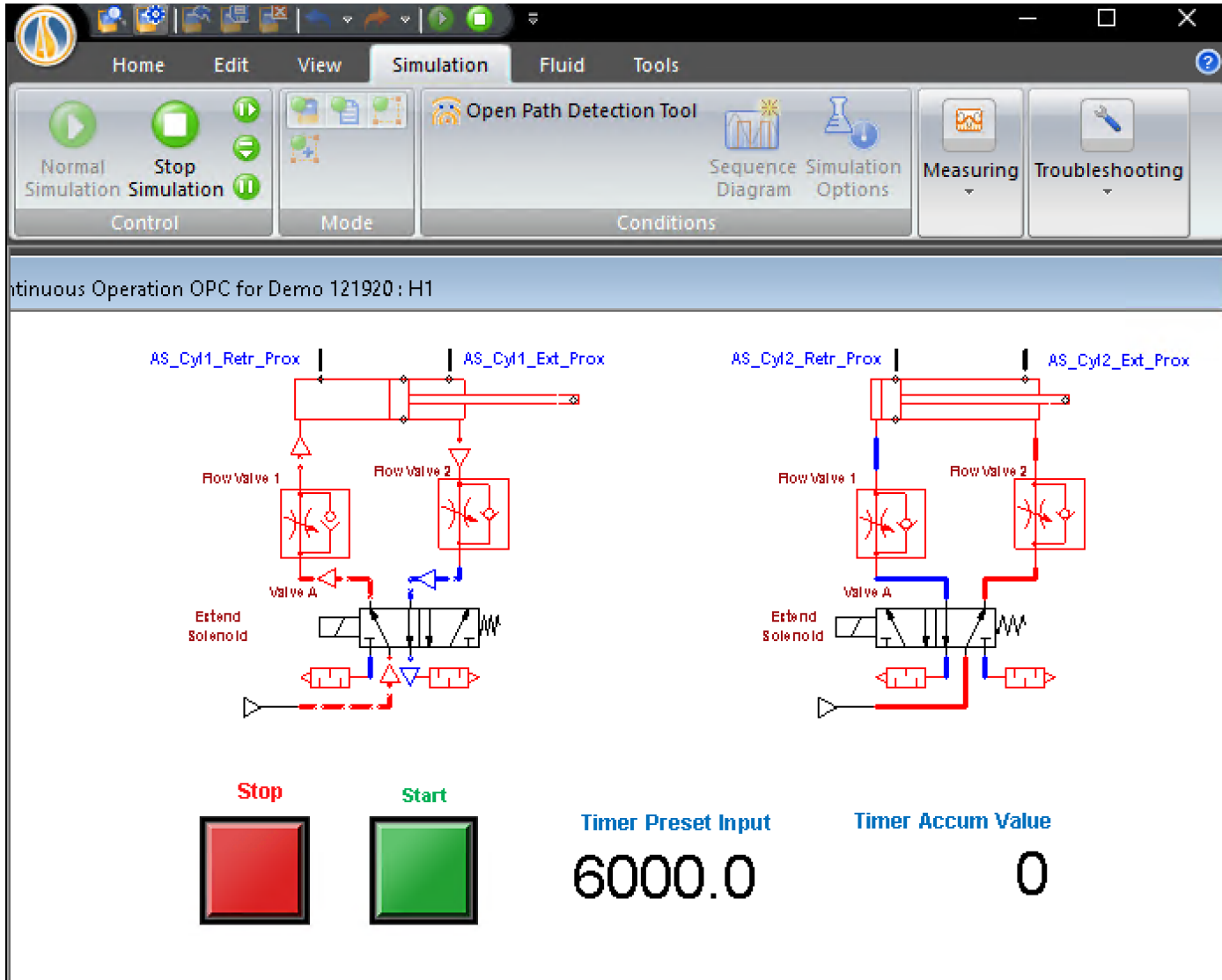
## Virtual Simulator



## Customized Virtual Simulator



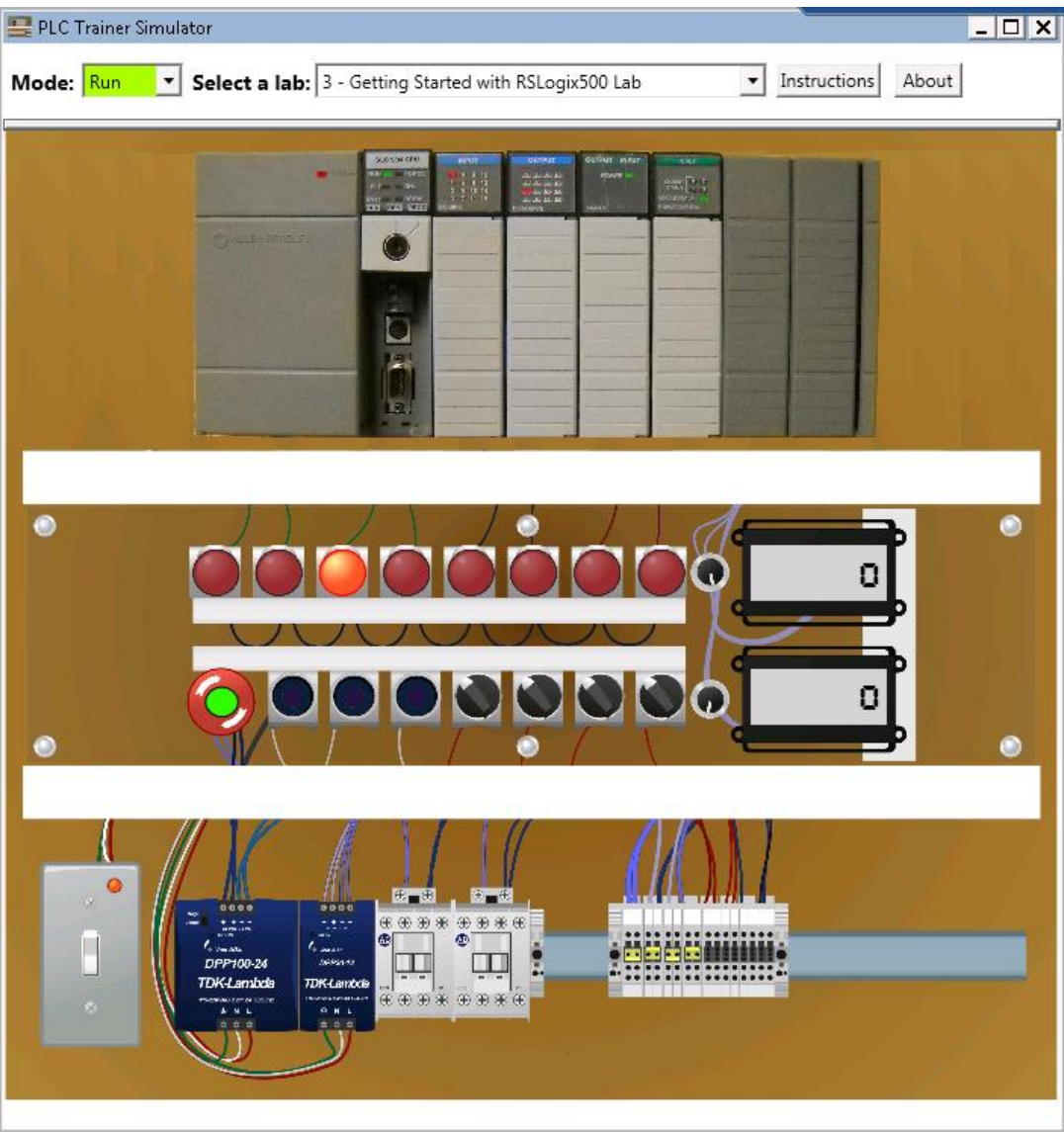
Having a CompactLogix program running in the Studio 5000 Emulator, control a pneumatic circuit in Automation Studio, using OPC communications between the applications. Both Automation Studio and the Rockwell Software are in the same Virtual Machine.





# Virtual Simulator

## Some Information about the Simulation Engine



\*The Engine was built in C# (C-Sharp) Programming Language

\*DEMO mode to show students how a program will work. All 21 PLC I labs are embedded, then can be opened for students to view the program in the lab exercise.

\*RUN mode connects the virtual simulator to the 500 Emulator through the OPC connectivity to RSLinx. Students can run their programs on the simulator that they create in RSLogix500.

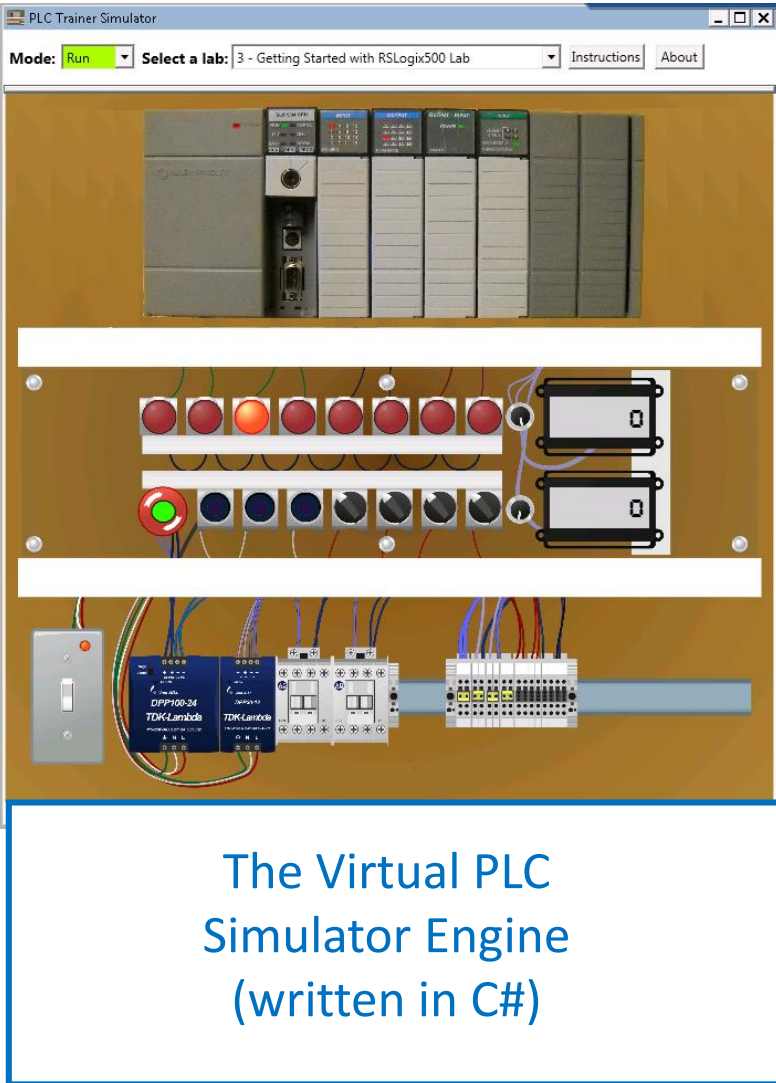
\*The Engine uses OPC technology to communicate with RSLinx

\*The Virtual Simulator is licensed through Creative Commons, and can be downloaded from [Skillscommons.org](https://www.skillscommons.org).

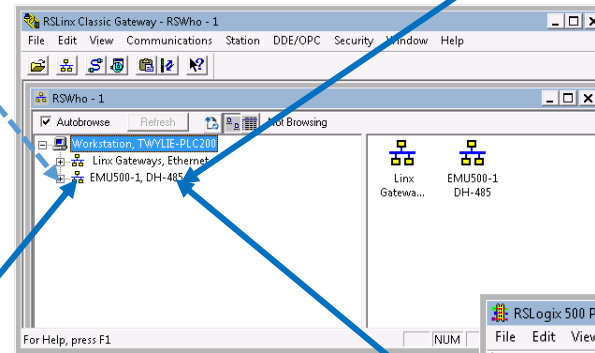


# How the Virtual PLC Simulator works in RUN mode

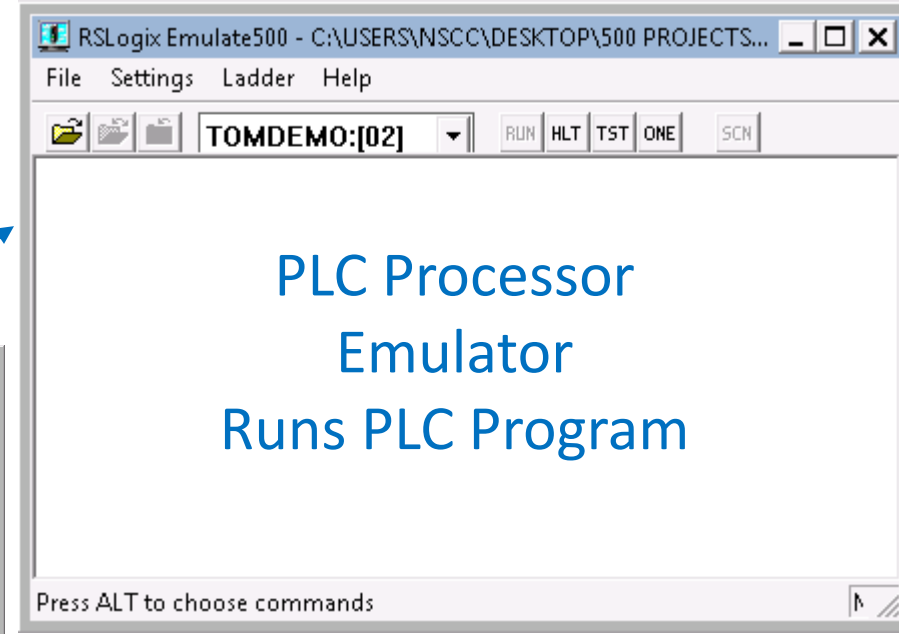
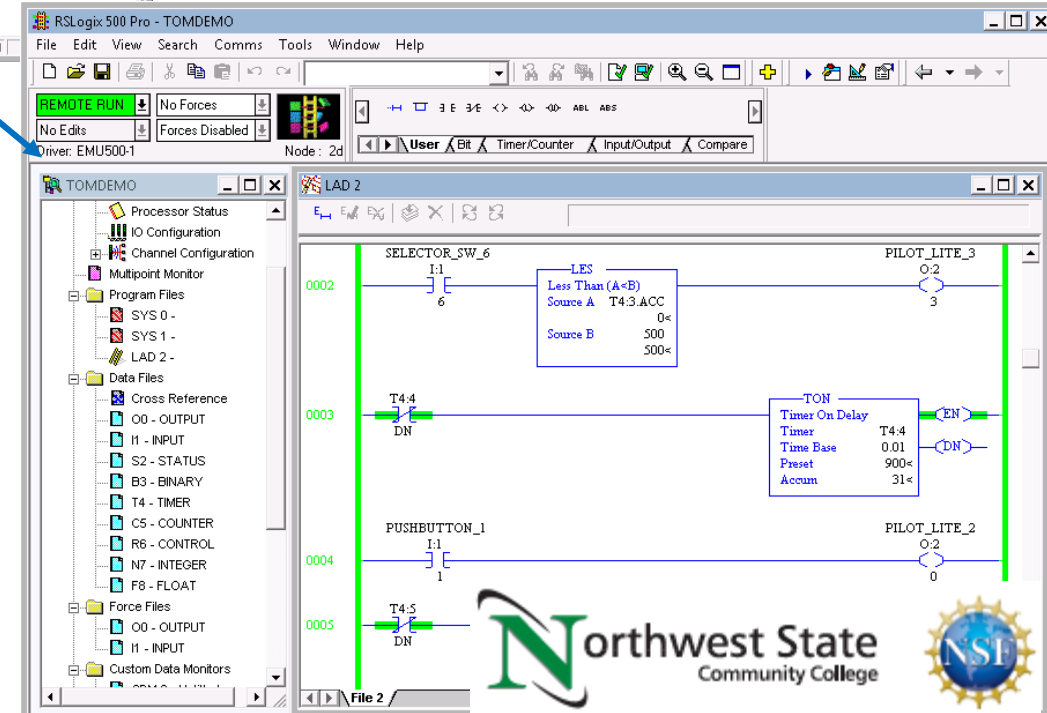
## Virtual Simulator



The Emulate500 Driver in RSLinx



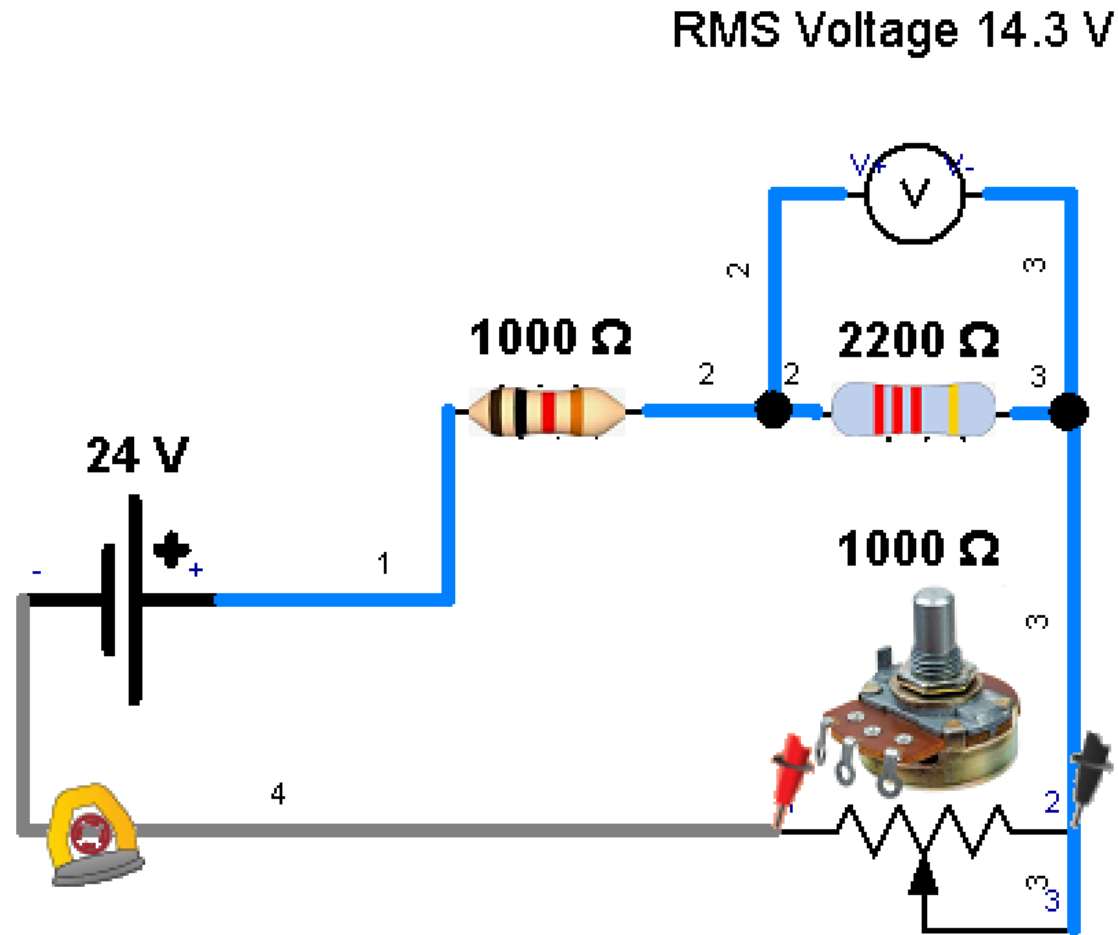
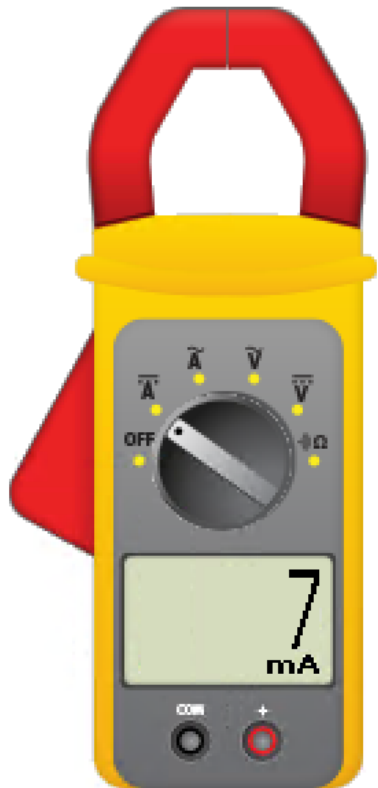
Data Communication With OPC Technology



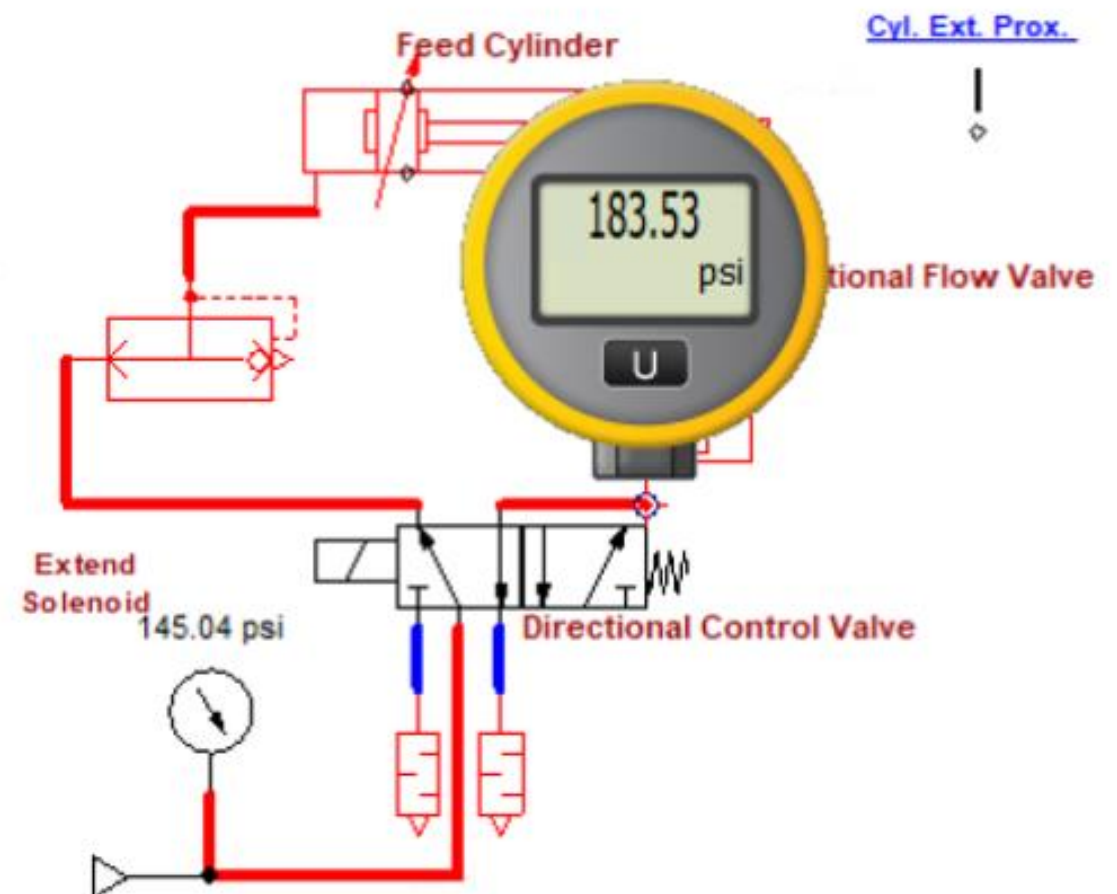
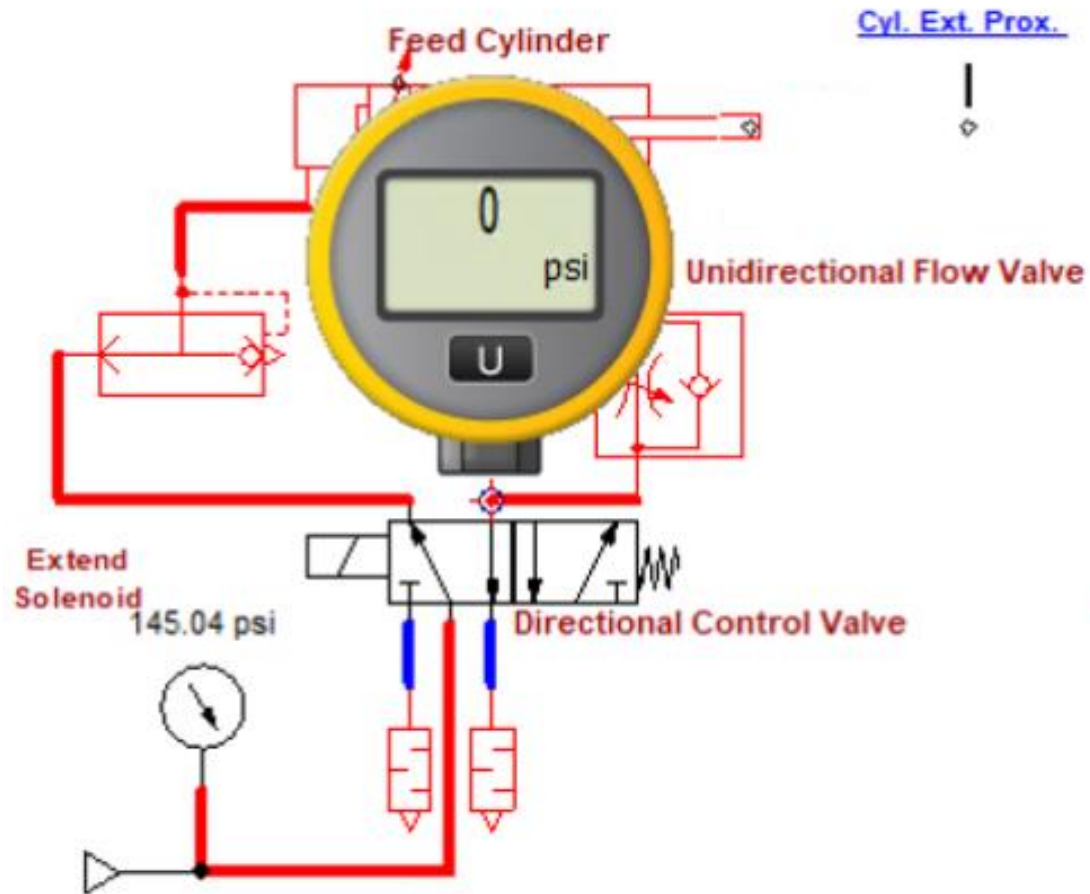
PLC Processor Emulator  
Runs PLC Program



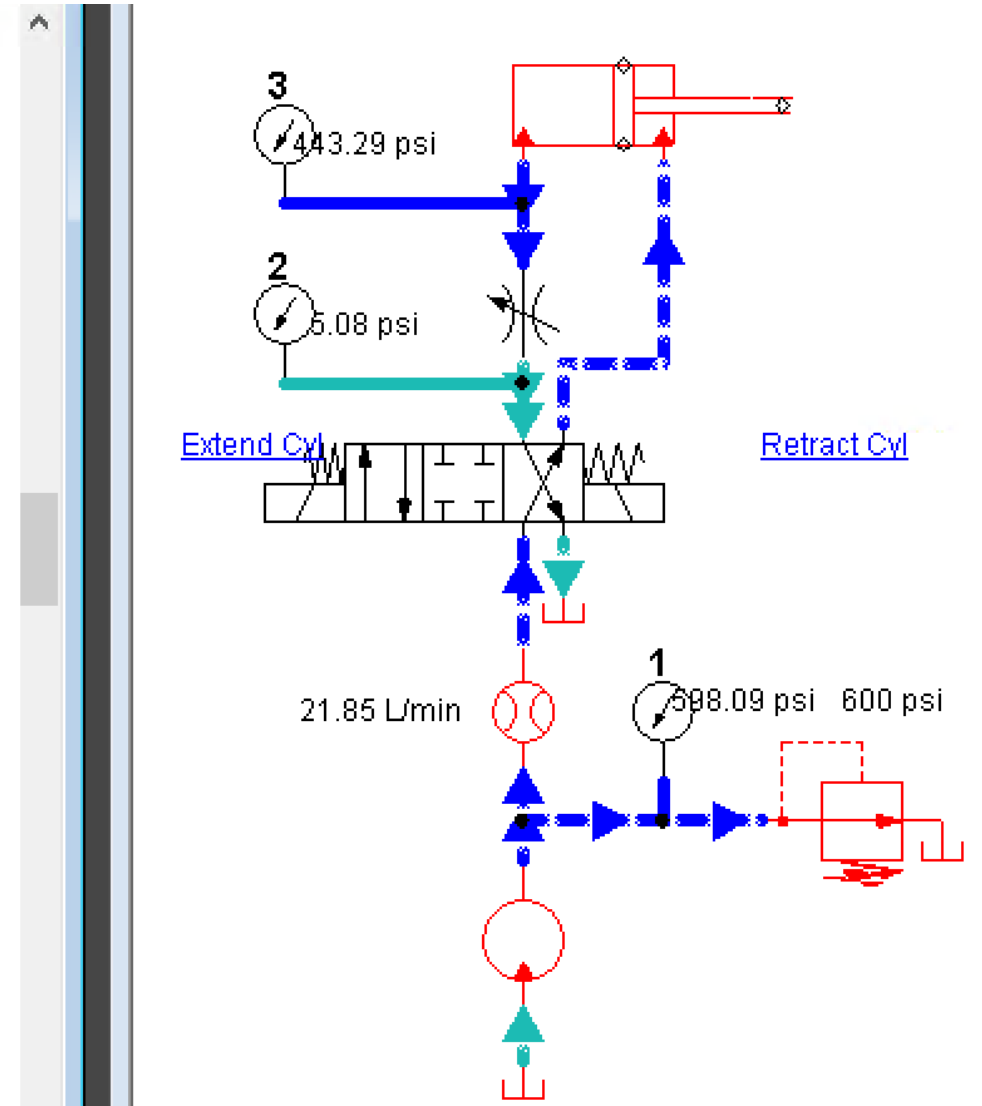
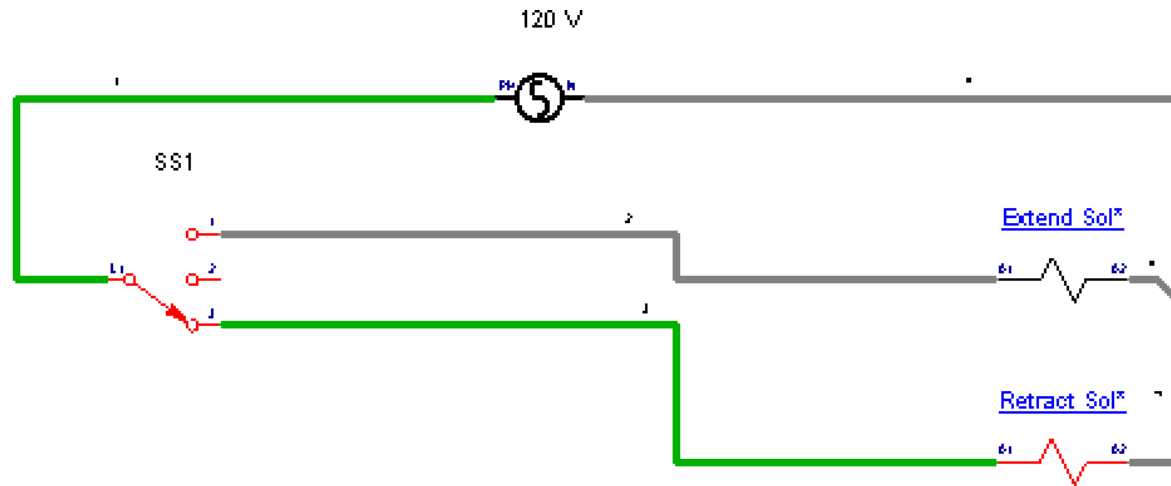
Simulation in Automation Studio for basic electrical course. Multi-meter or clamp-on ammeter can be used for testing the circuit.



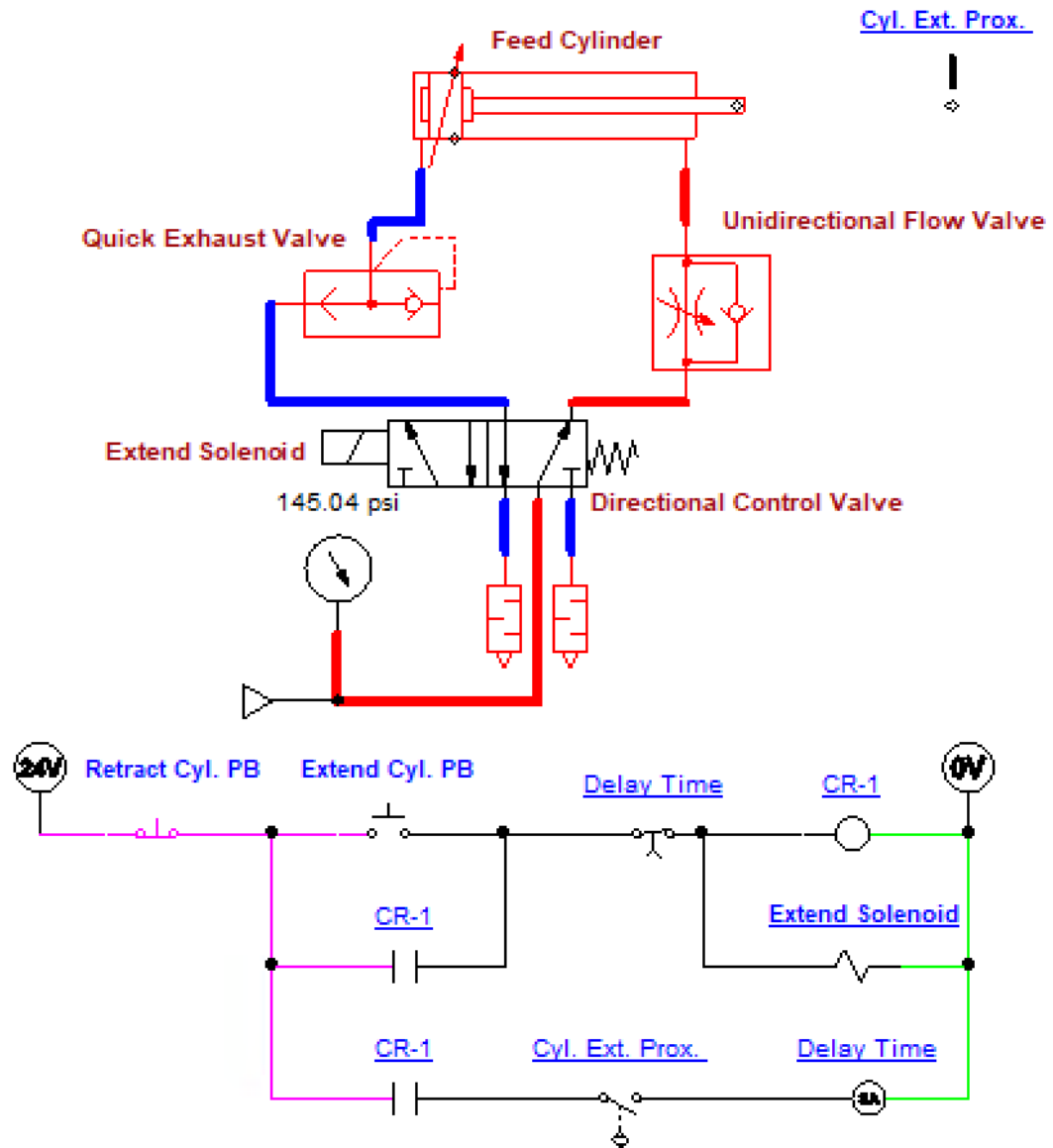
# Simulation in Automation Studio for basic pneumatic circuit operation and troubleshooting



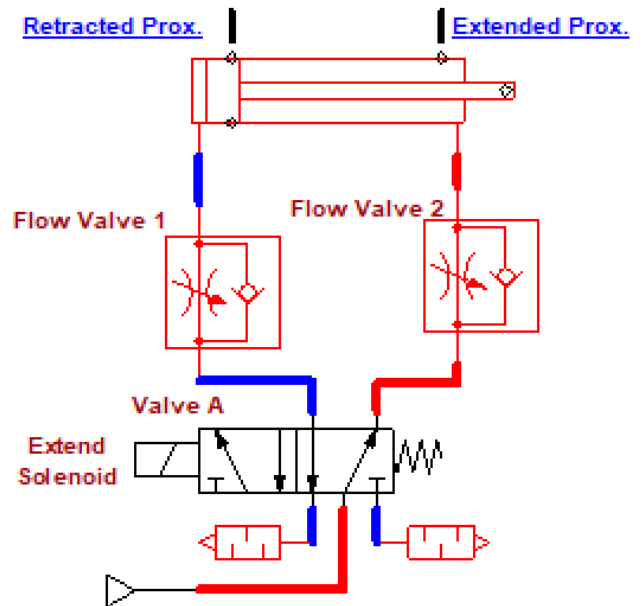
# Simulation in Automation Studio electrical controlled hydraulic circuit



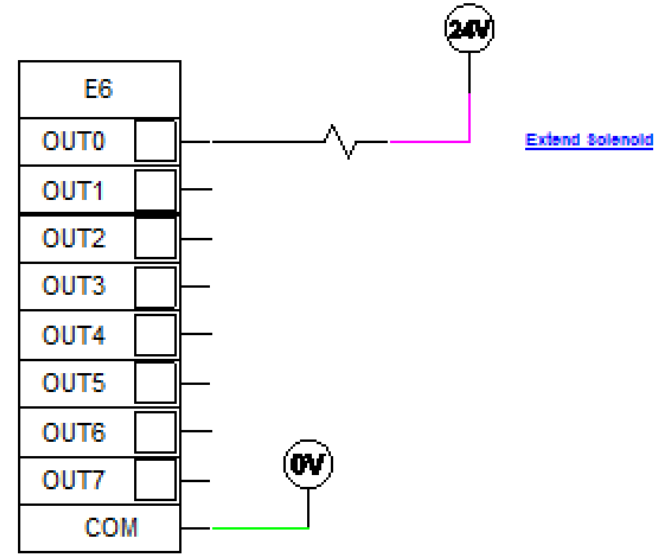
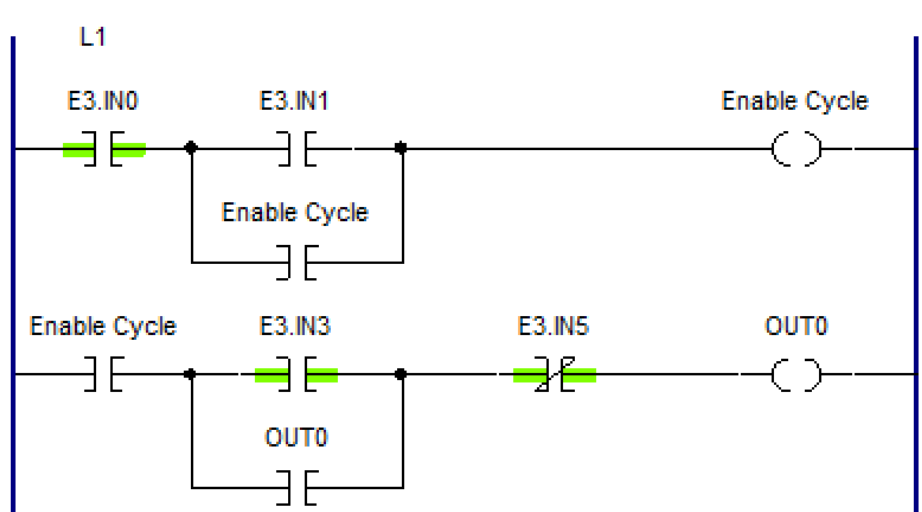
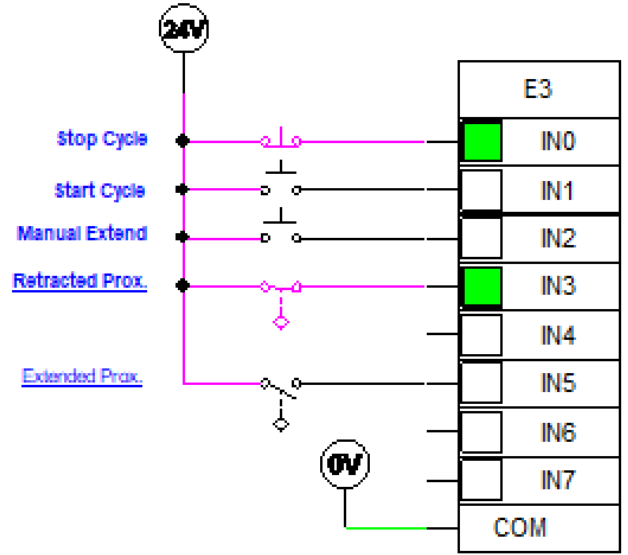
# Simulation in Automation Studio for basic pneumatic circuit controlled by an electrical circuit



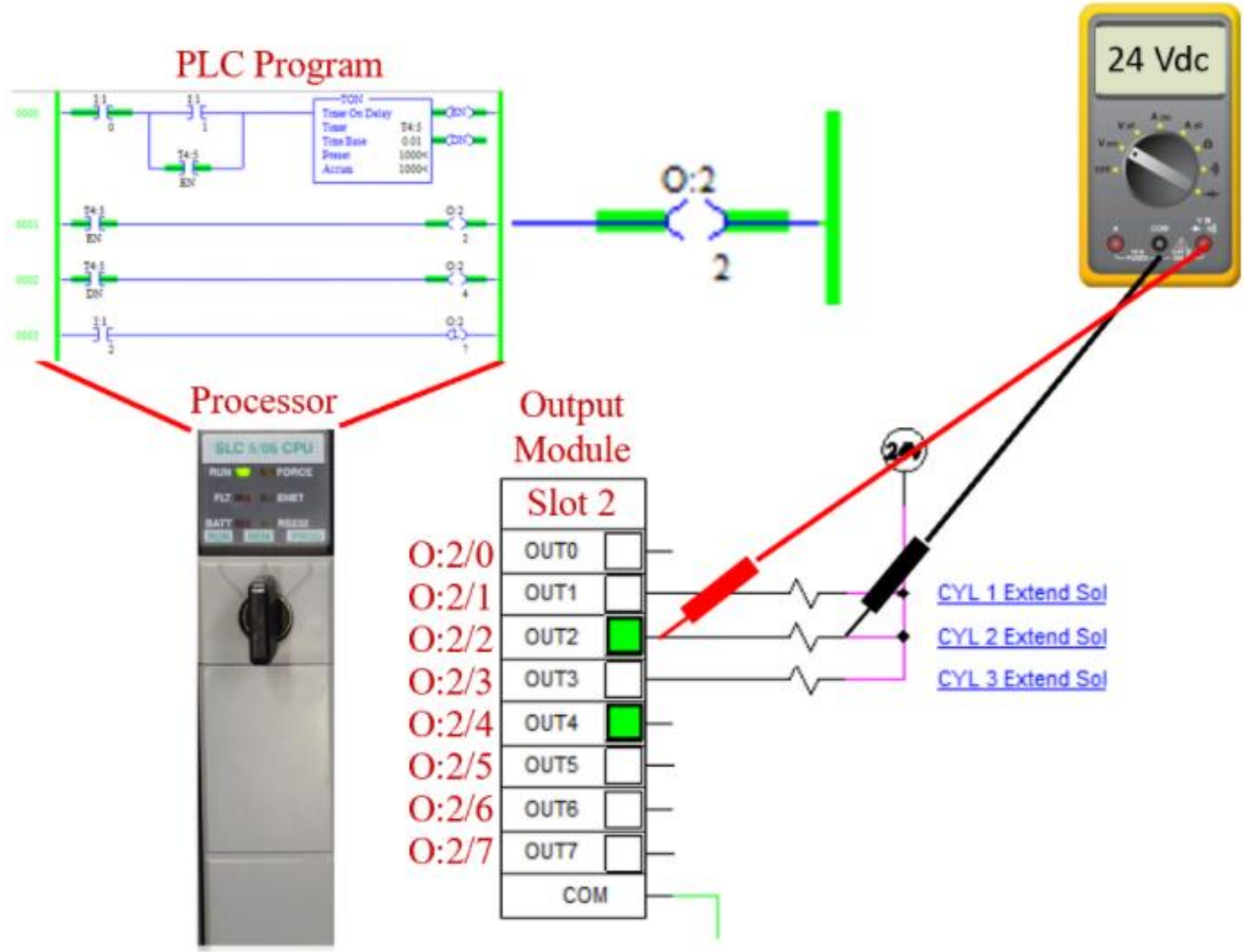
# Simulation in Automation Studio for basic pneumatic circuit controlled by a PLC circuit



Lab 6:3

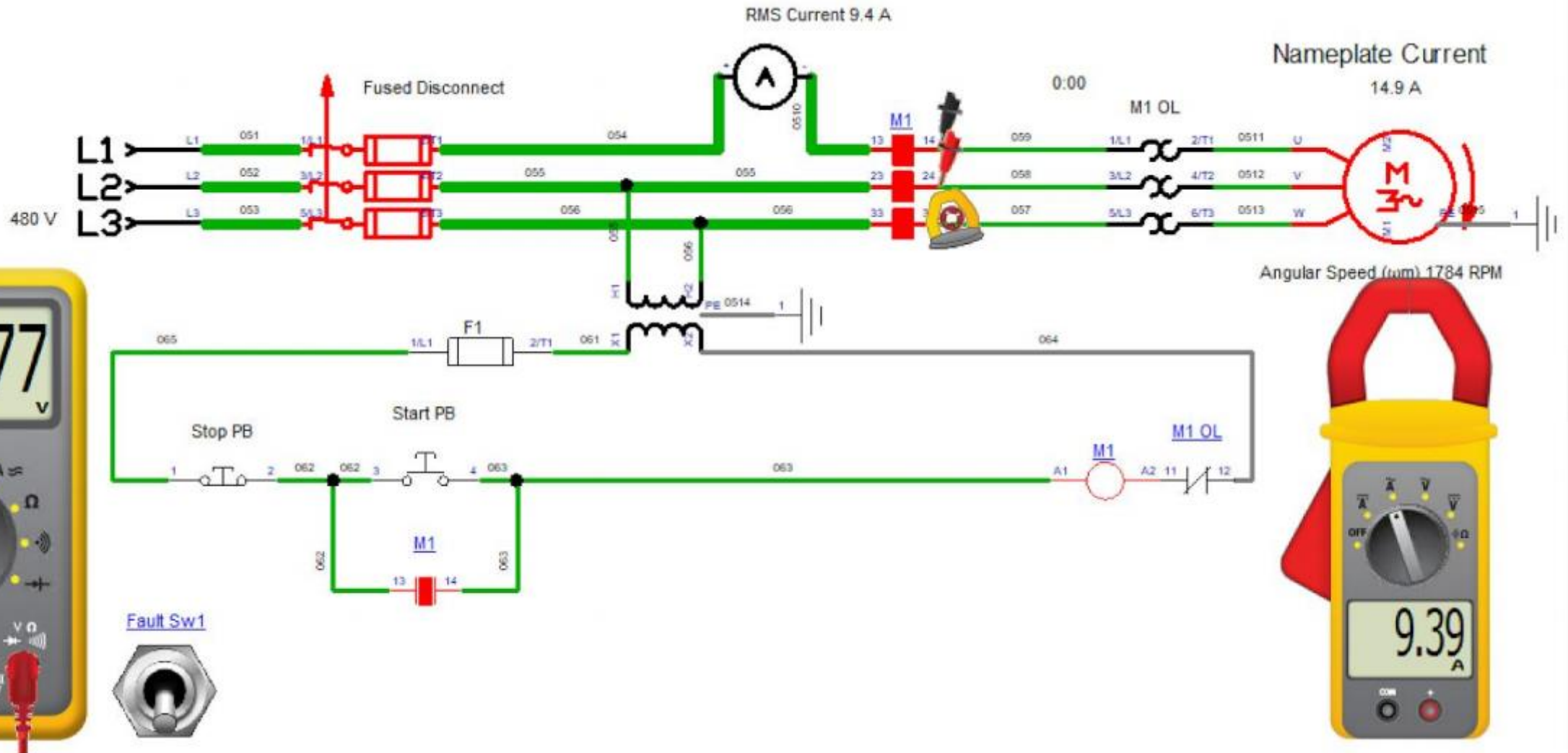


# Visual objects created in PowerPoint of the simulation circuit, used to create test questions or illustrations



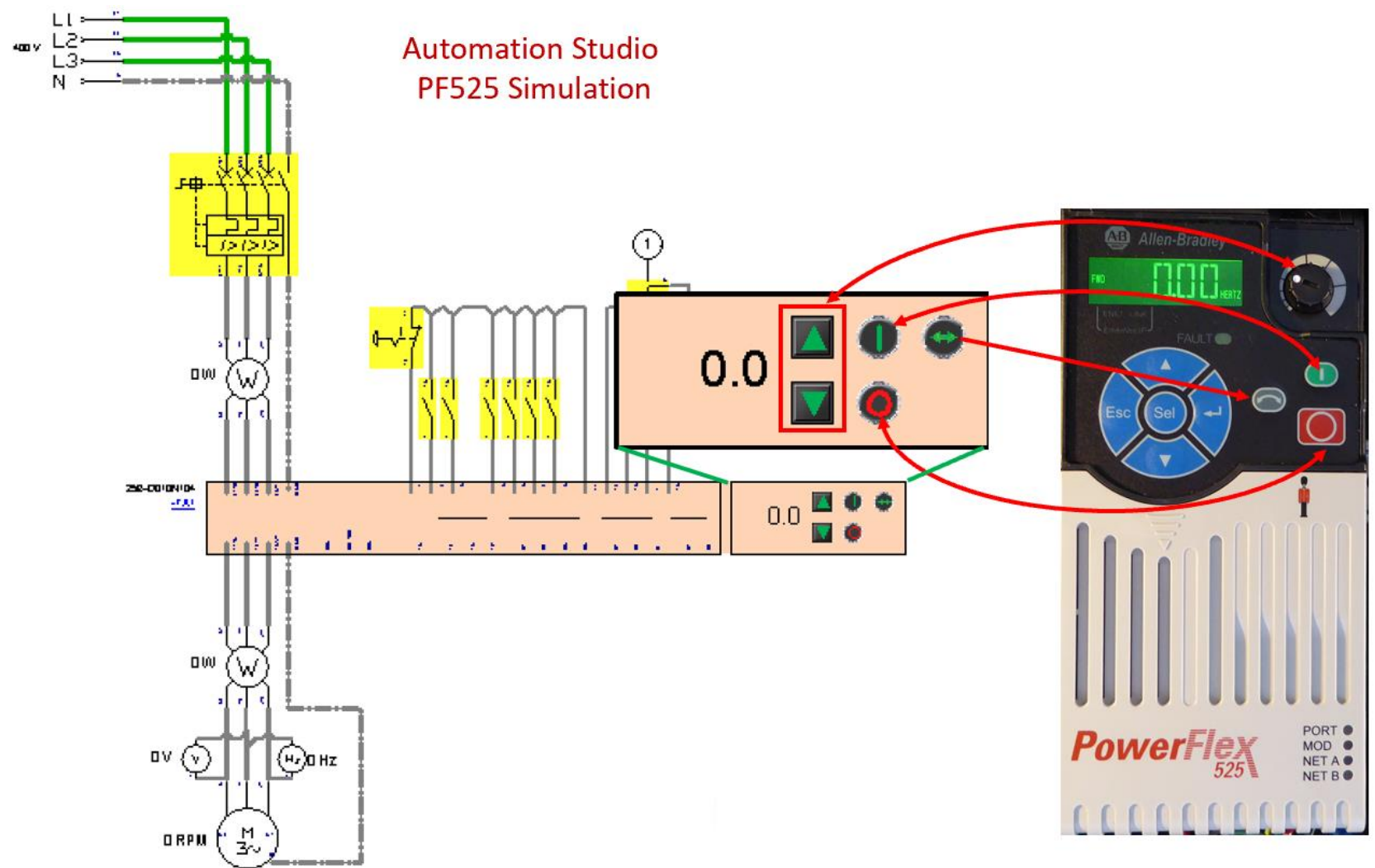


Simulation in Automation Studio of a motor branch circuit.  
Students see how the control circuit and power circuit works.  
Fault switch is used to open a power line for student troubleshooting.

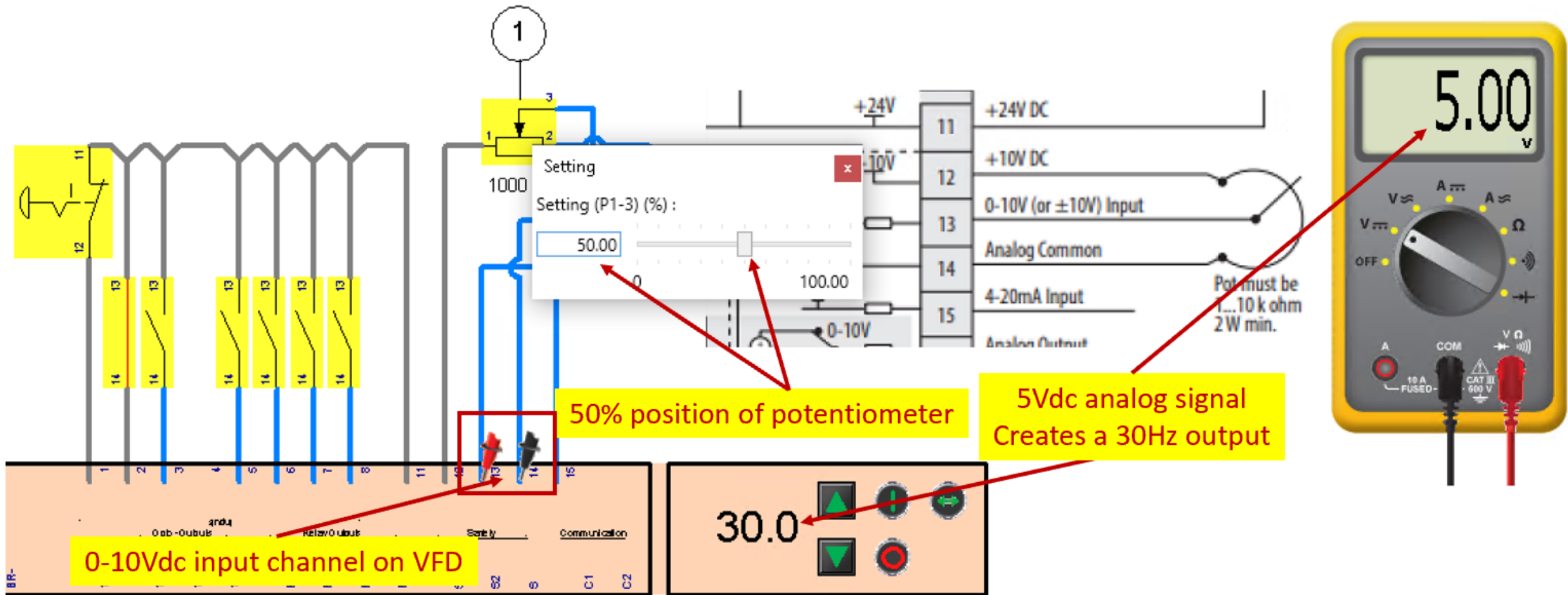




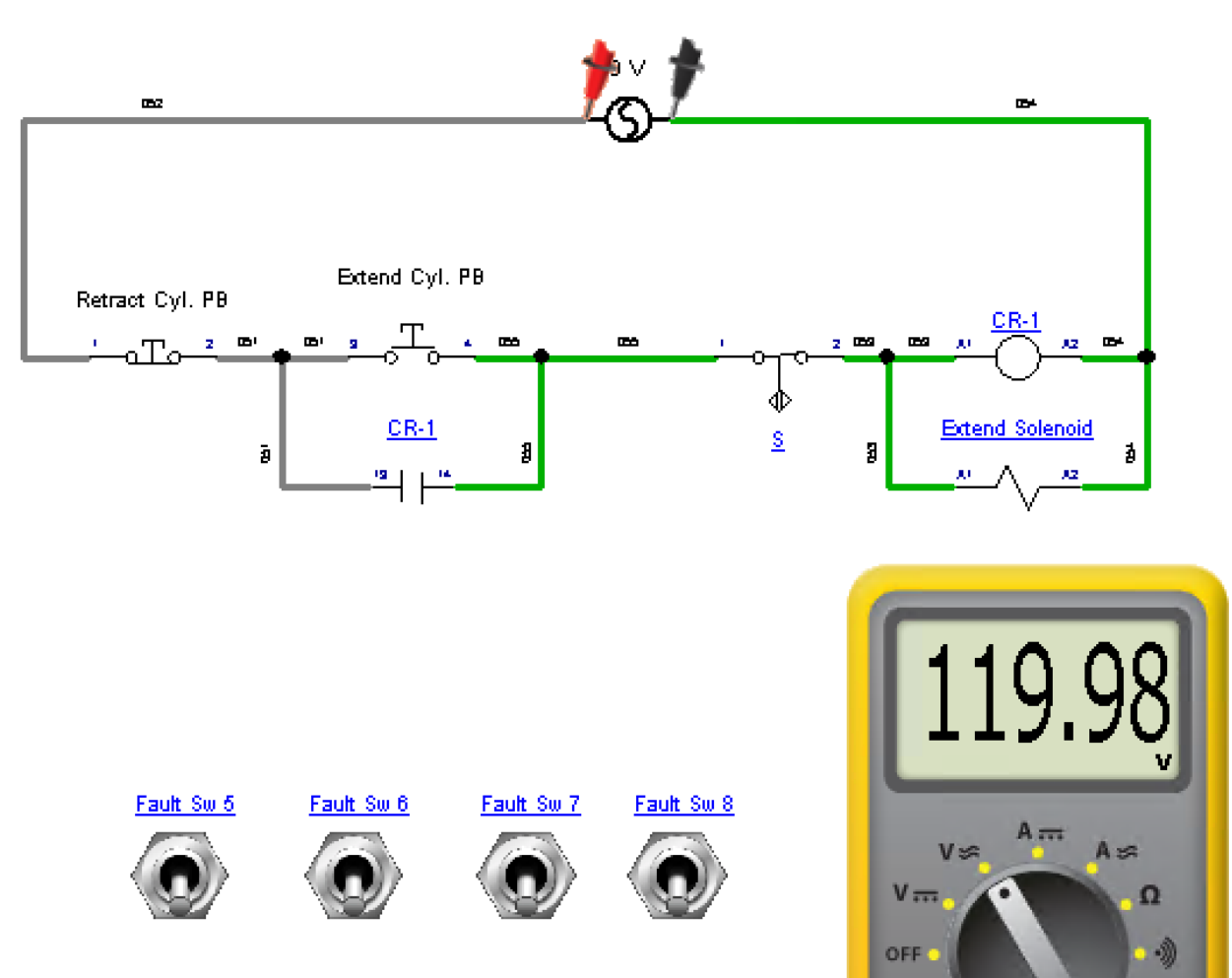
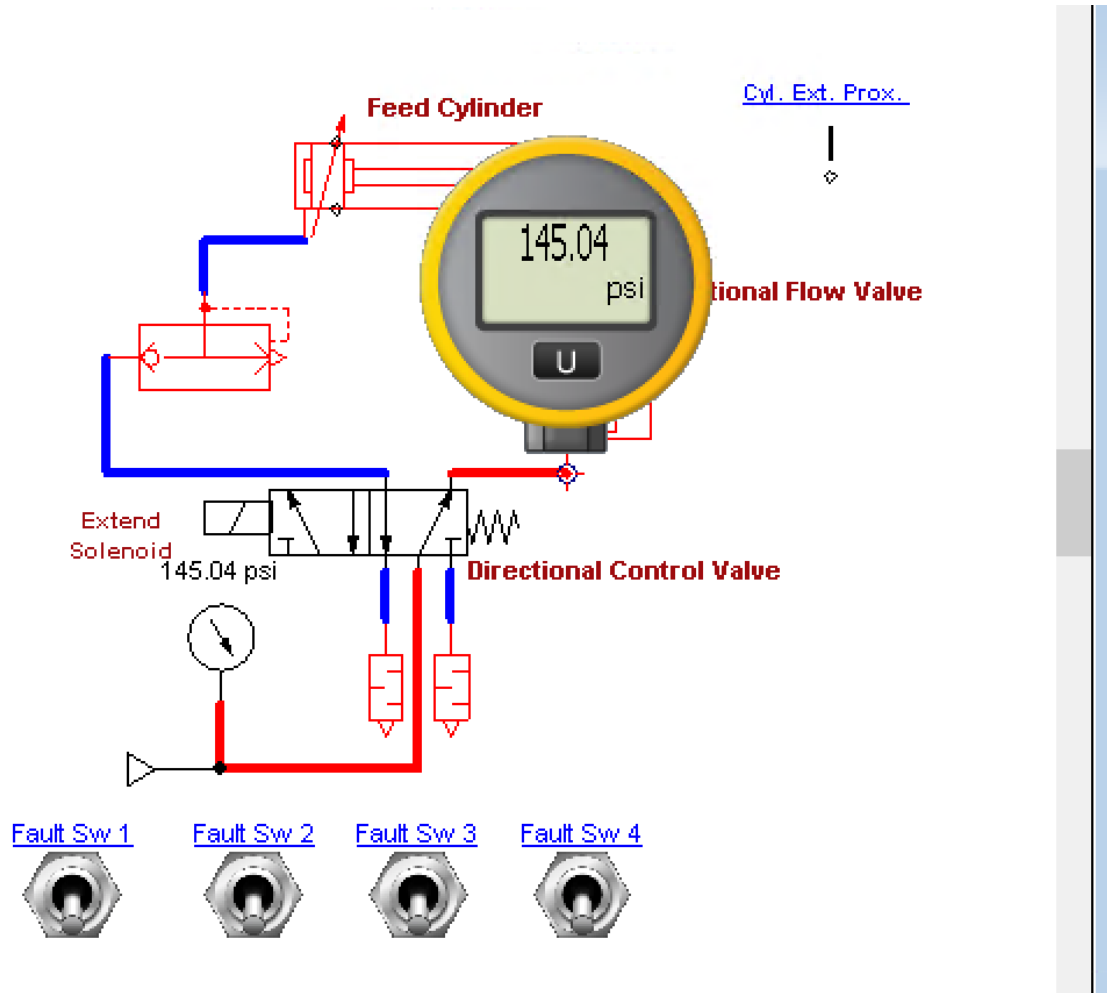
Simulation in Automation Studio for VFD operation. This simulation is using an AB PowerFlex 525. Students see how changing the frequency changes the motor speed, output voltage and power consumption.



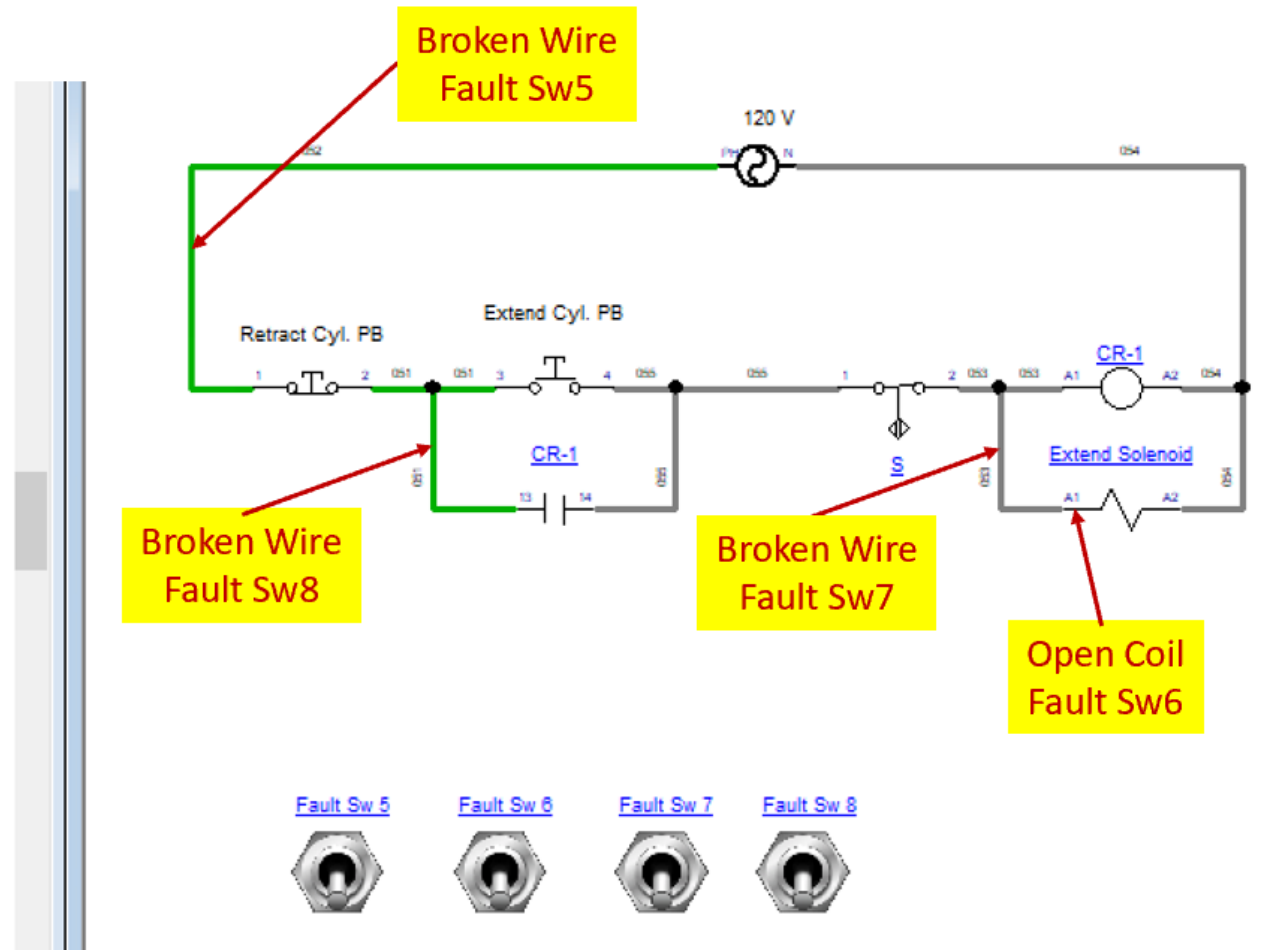
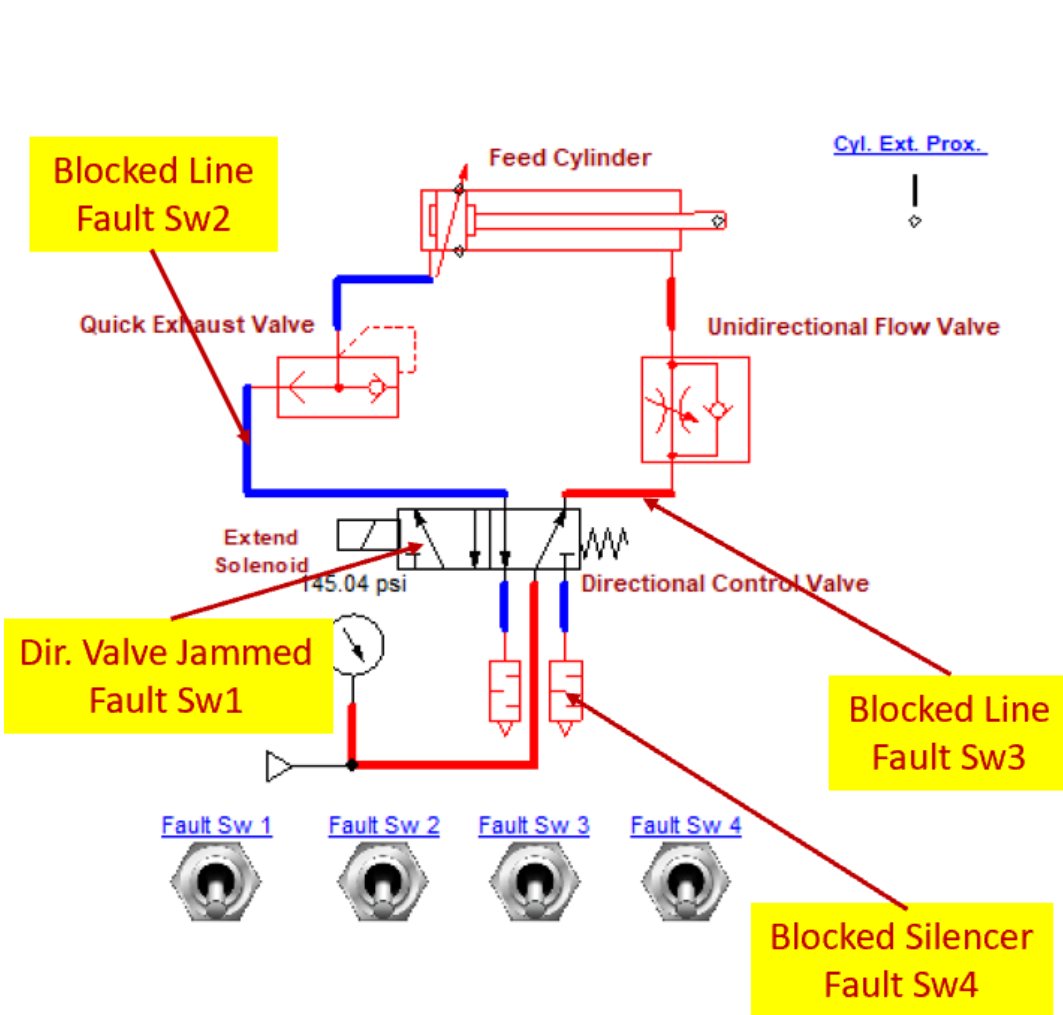
Simulation in Automation Studio for VFD operation. This simulation is using an AB PowerFlex 525. Students see how changing the external potentiometer, changes the output frequency of the drive.



Simulation in Automation Studio of an electrical circuit, controlling a pneumatic circuit. Faults are inserted for student troubleshooting. This slide show a virtual pressure gauge, and a multi-meter used to troubleshoot the pneumatic and electrical circuits where faults can be inserted from the fault switches.



Simulation in Automation Studio of an electrical circuit, controlling a pneumatic circuit. Faults are inserted for student troubleshooting. This document is for the Instructor to reference what fault is inserted. All components and lines can have a fault inserted by the instructor, and assigned to a fault switch.





# Future Scaling CBE Elements Project Activities:

1. More faculty workshops throughout the year
2. Specialized workshops: Using Automation Studio
3. Technical Course Conversion process training
4. Networked Improvement Community activity: Theme: Ways to implement troubleshooting skills development into curriculum



# Questions for the Workshop Participants:

1. What types of future training would you attend if offered?

\* Automation Studio, Building Assessments?

2. Have you identified a possible change in one of your courses due to attending this workshop?



If you are interested in applying any of the elements into courses at your college, please email me and I will setup a time to do a Zoom session, to help you build a development and implementation plan.



# The End of the Presentation

Please email the presenter with  
Any questions you may have, as  
well as any feedback on the session  
([twylie@northweststate.edu](mailto:twylie@northweststate.edu))