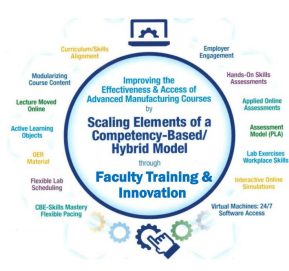# Remote Student Learning using Virtual Machines & Simulations

Presented by:

Tom Wylie, Northwest State CC
Archbold, OH

This PowerPoint/PDF document shows multiple online simulations that the Project PI has created, and implemented into various technical courses, and teach faculty at other college how to do the same. The PLC virtual simulators are built in C#, or can be created in a PLC HMI software, such as Factory Talk View Studio. There are numerous simulations built with Automation Studio, a simulation software created by Famic Corporation from Quebec. This is a very common software used at 2 and 4 year colleges nationally.

If you have an interest in any of these simulations, please reach out to the Project PI, Tom Wylie, at twylie@northweststate.edu

The purpose of the Scaling Elements (NSF) grant is to assist/mentor Faculty to improve their courses by implementing/enhancing elements used in successful competency based instructional models (listed outside the circle in the graphic below).

Curriculum/Skills Alignment

Employer Engagement

Modularizing Course Content

Hands-On Skills Assessments

Lecture Moved Online

Applied Online Assessments

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

Active Learning Objects

Assessment Model (PLA)

OER Material

Lab Exercises Workplace Skills

Flexible Lab Scheduling

Interactive Online Simulations

CBE-Skills Mastery Flexible Pacing

Virtual Machines: 24/7 Software Access

Northwest State Community College

NSF

Purpose of a Virtual Machine (Computer)?

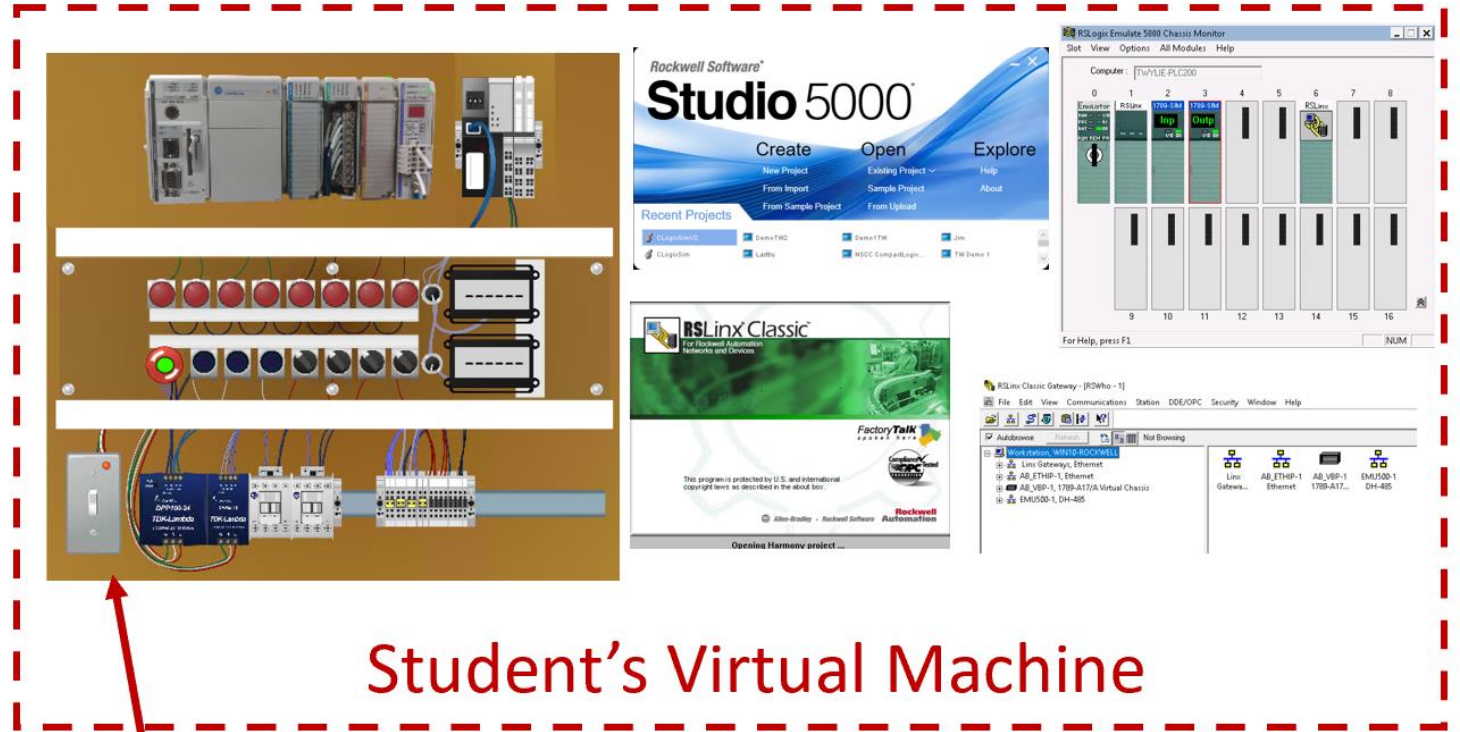- Give students 24/7 access to Proprietary Software
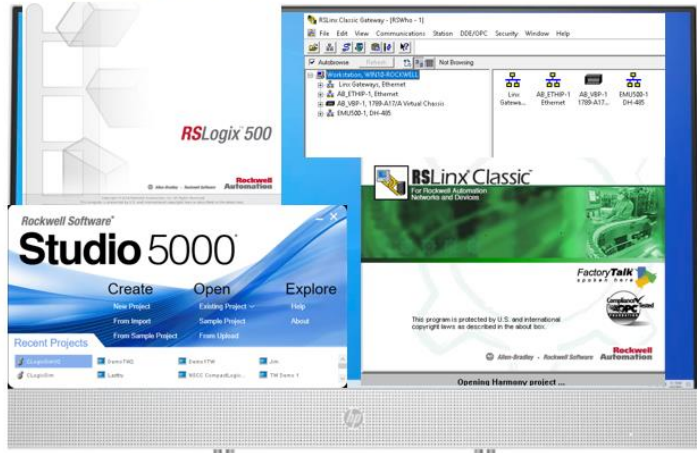- Give students 24/7 access to Online Simulations
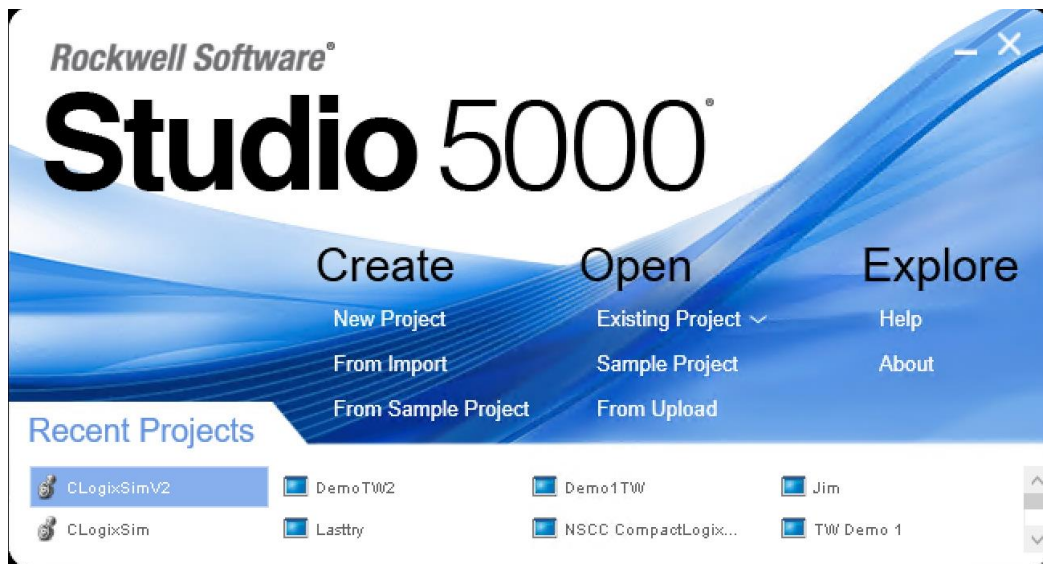
PLC Lab on campus

Computer in PLC Lab

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
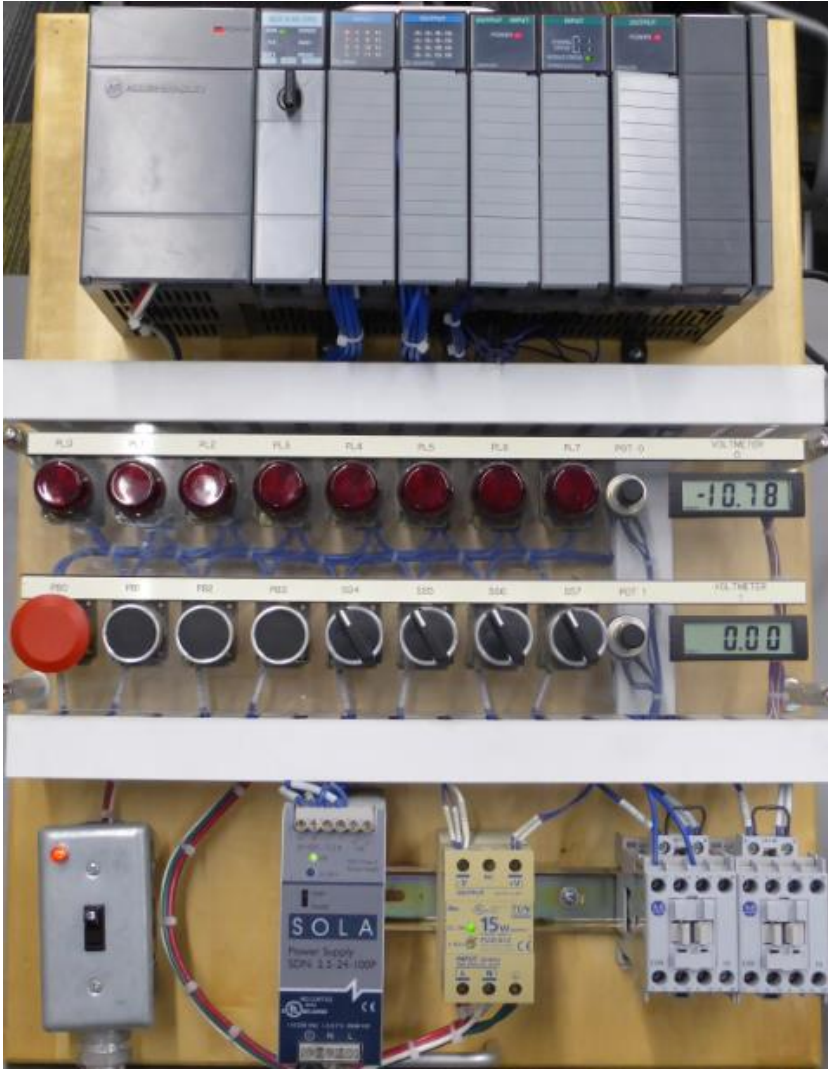
College Firewall

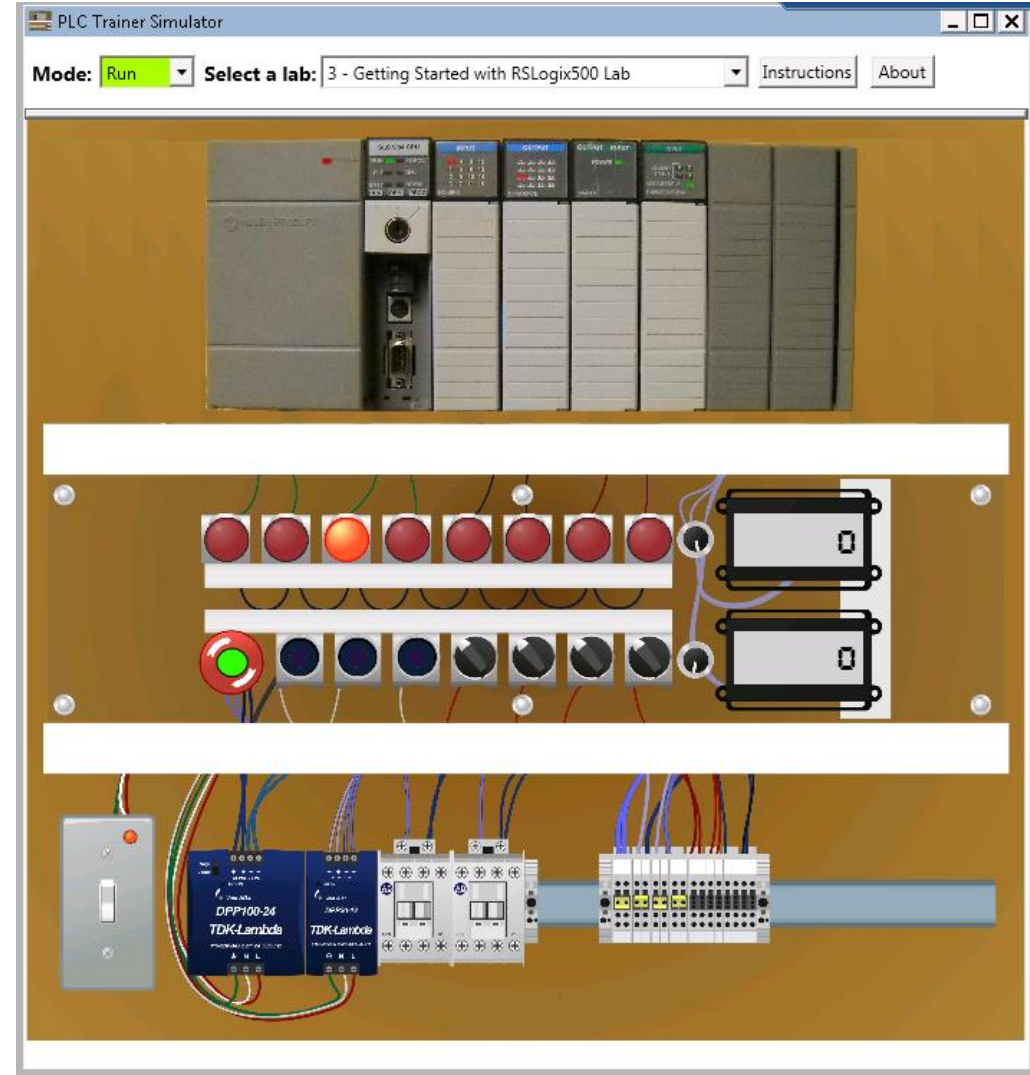Internet

Student Computer at Home

Wireless Router (Home)

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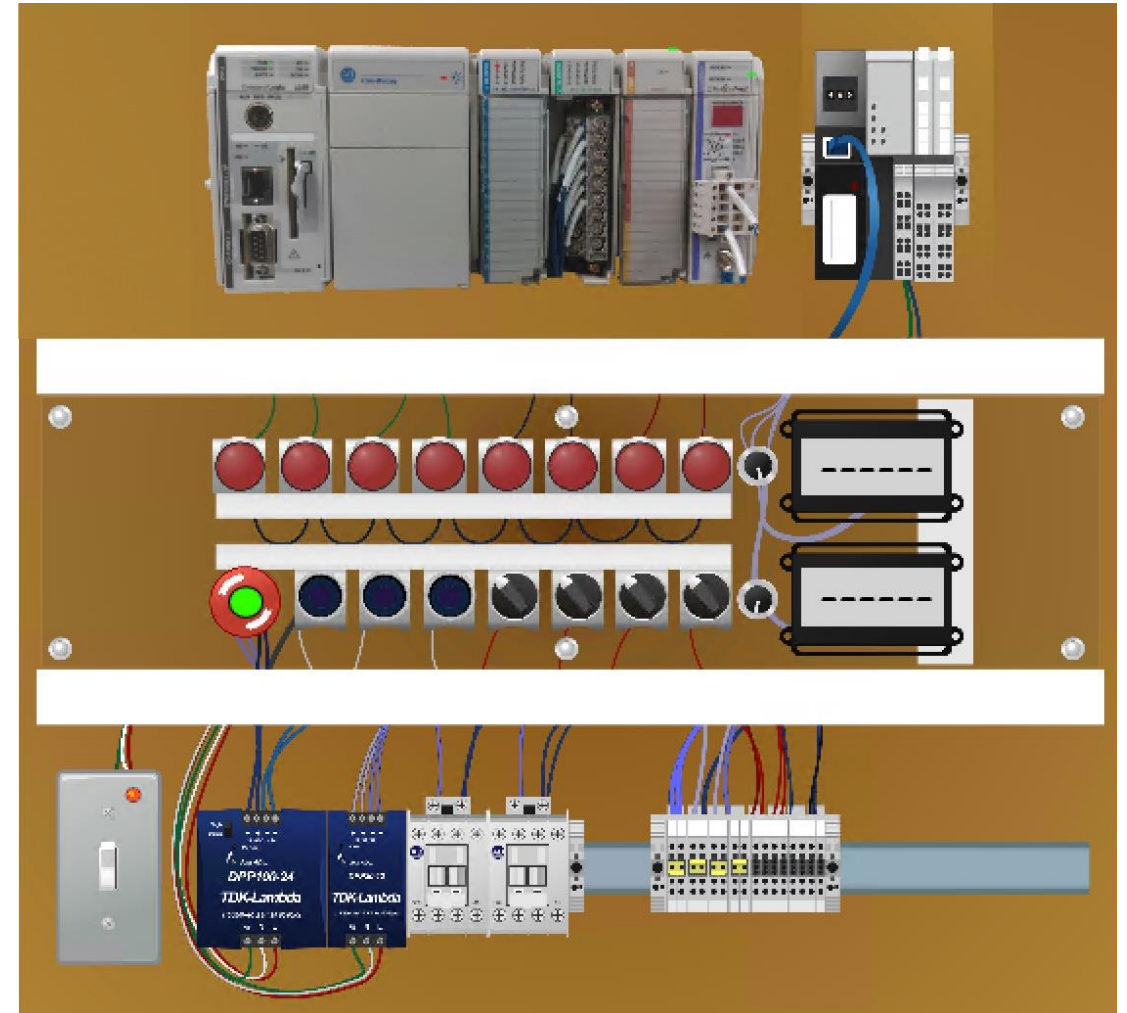
Hardware Simulator

Virtual Simulator

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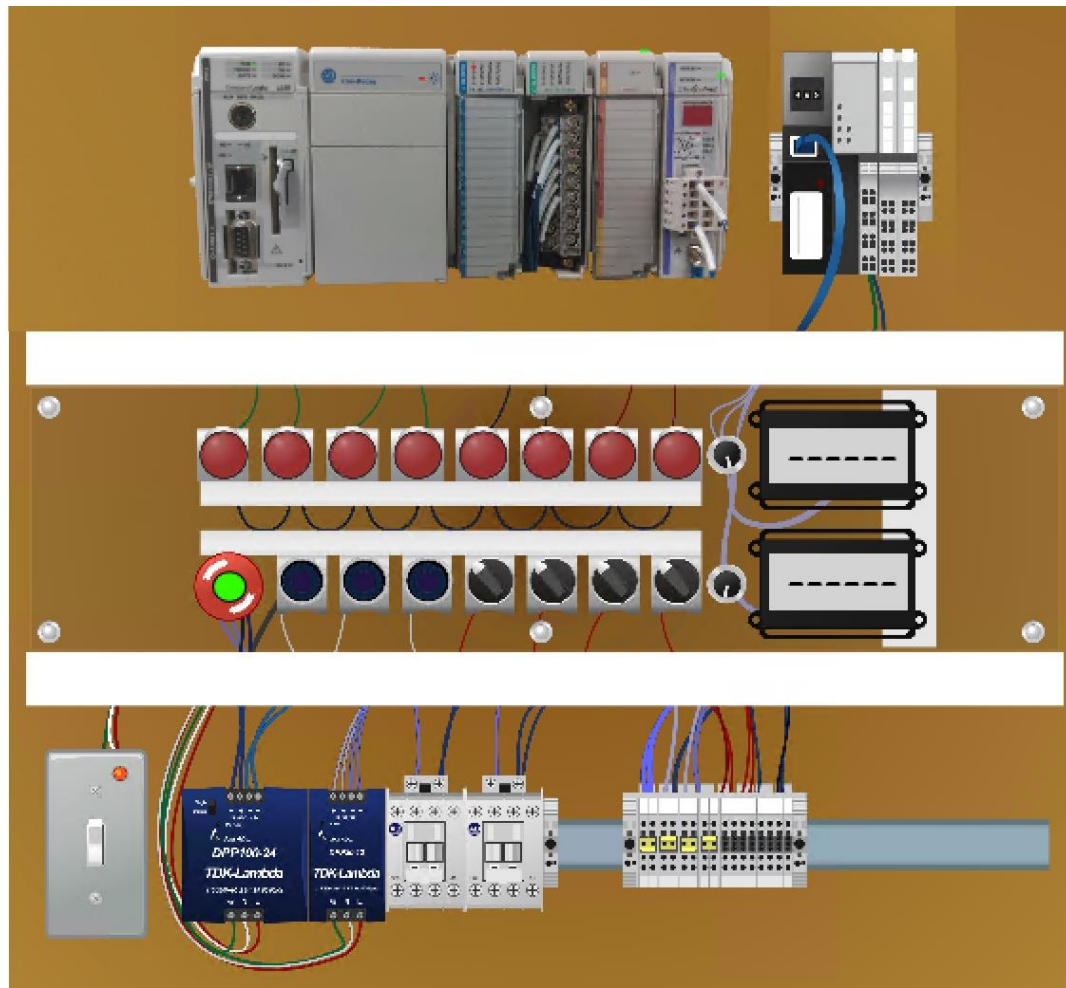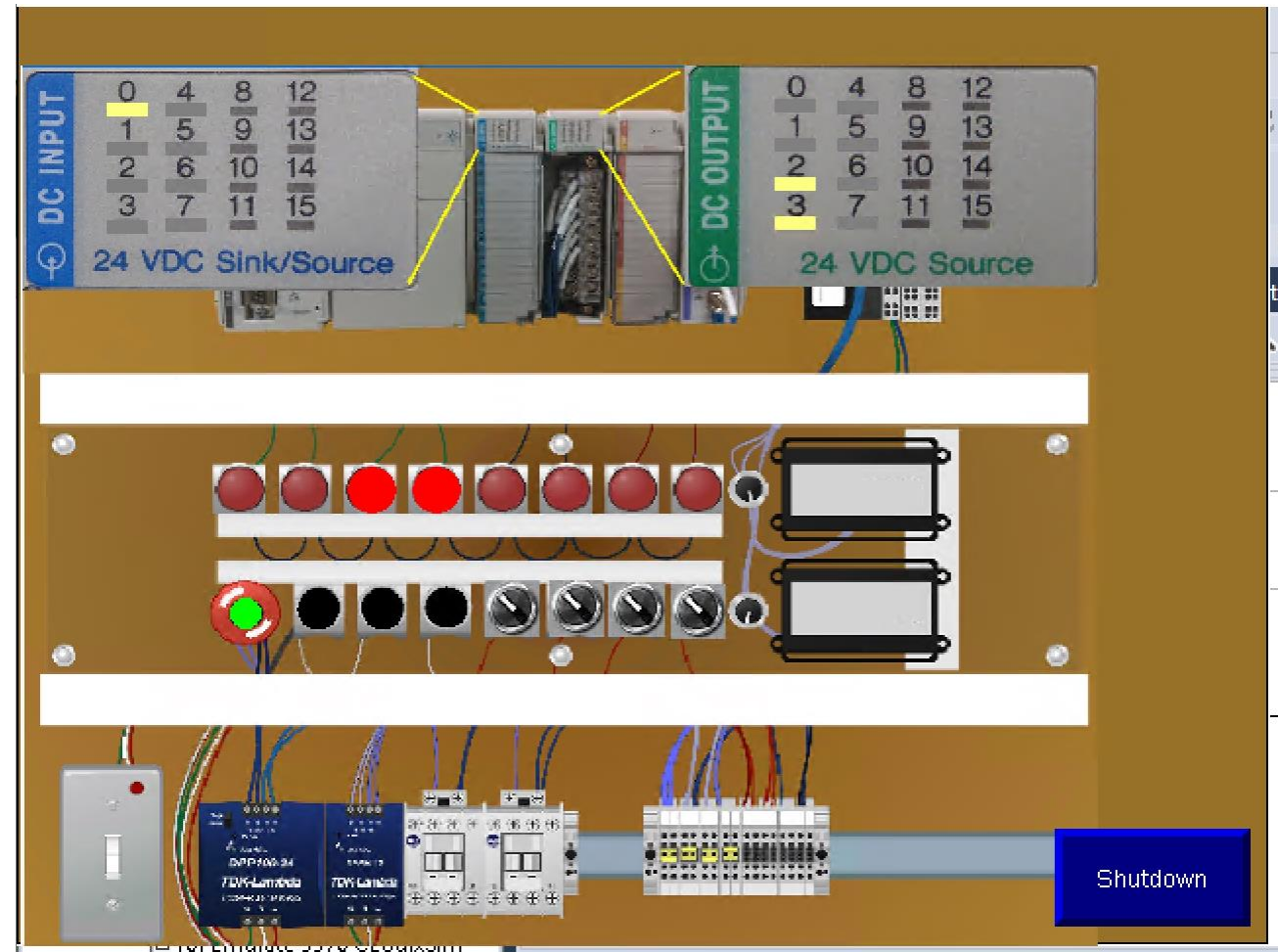
Hardware Simulator

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
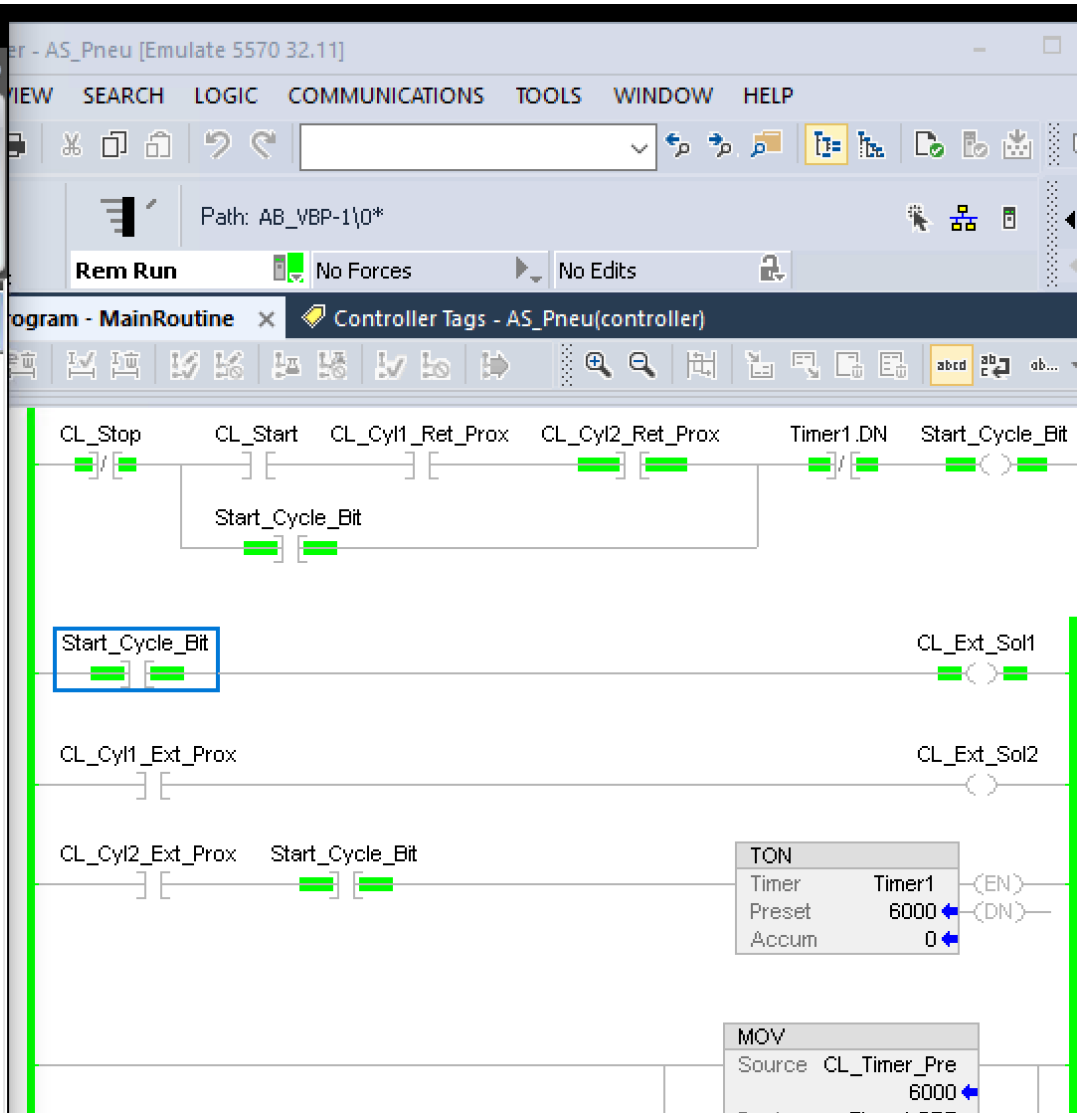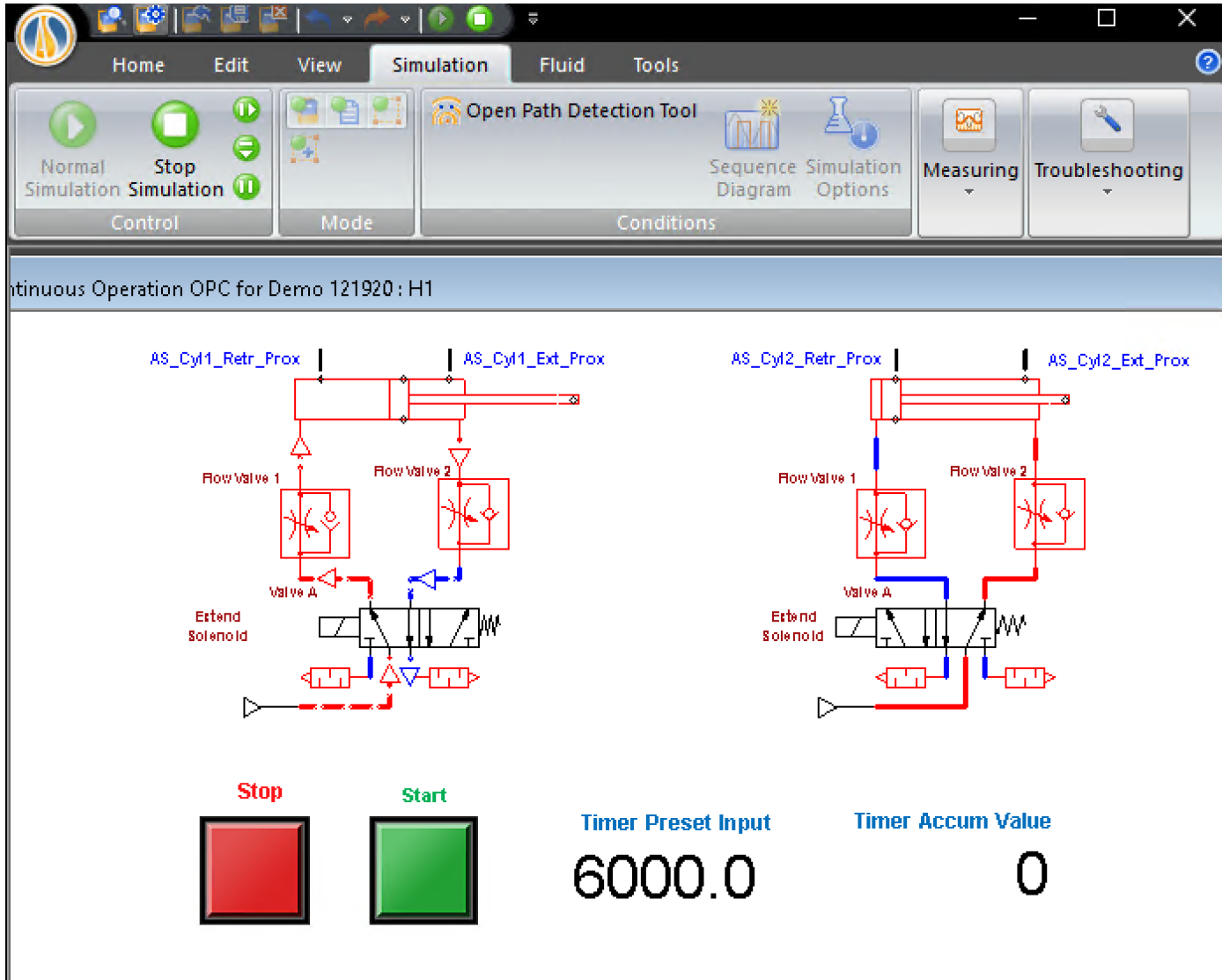
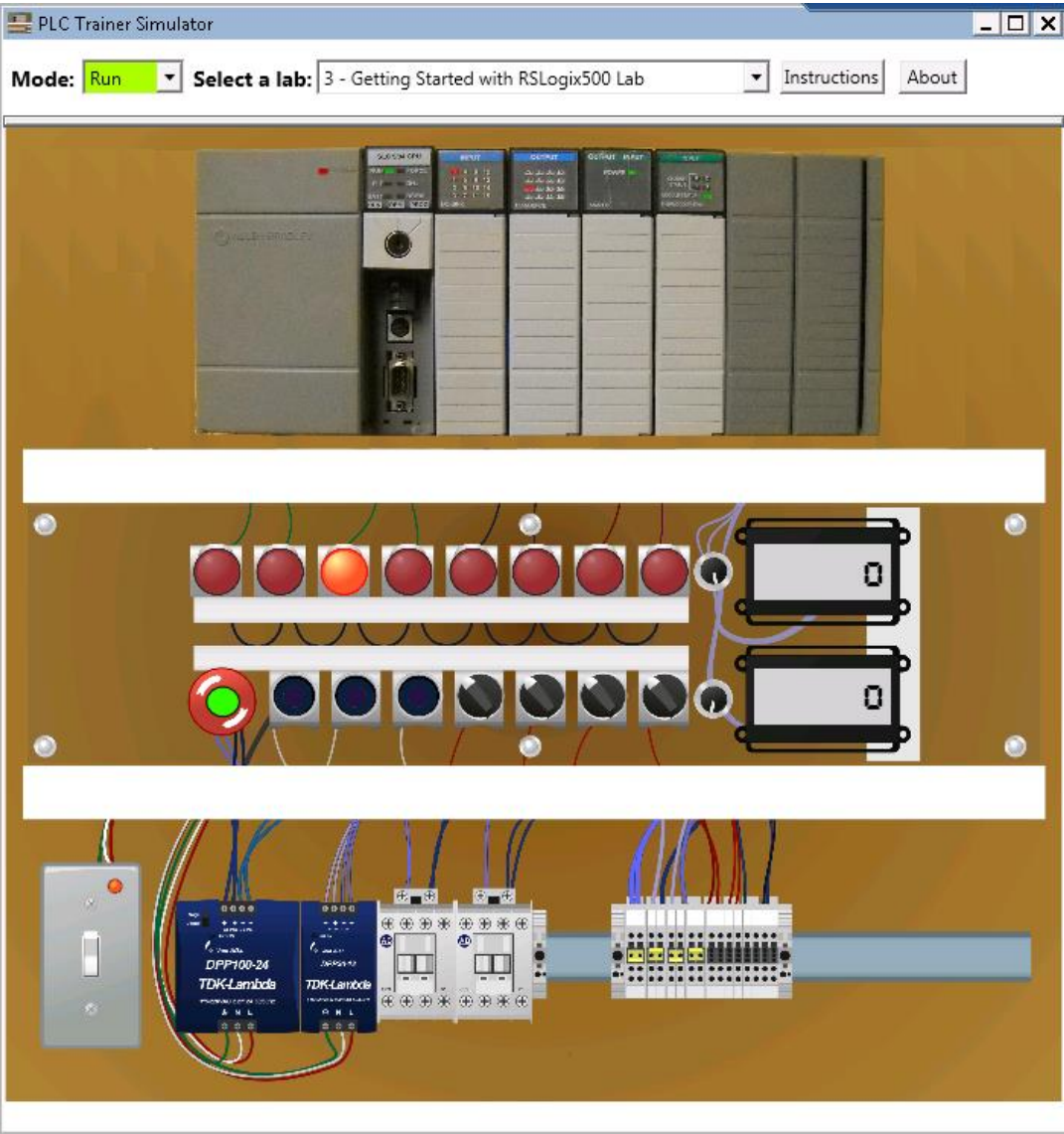## Virtual Simulator

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.
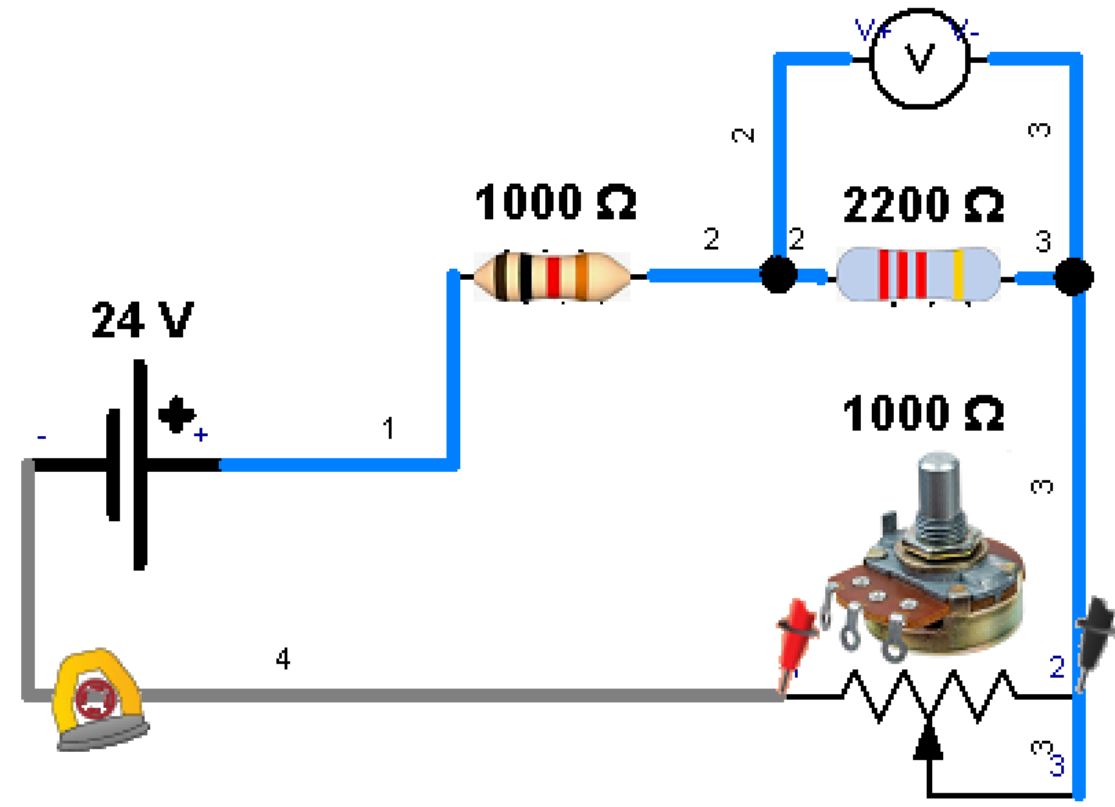
*The Engine uses OPC technology to communicate with RSLinx

*The Virtual Simulator is licensed through Creative Commons, and can be downloaded from Skillscommons.org.
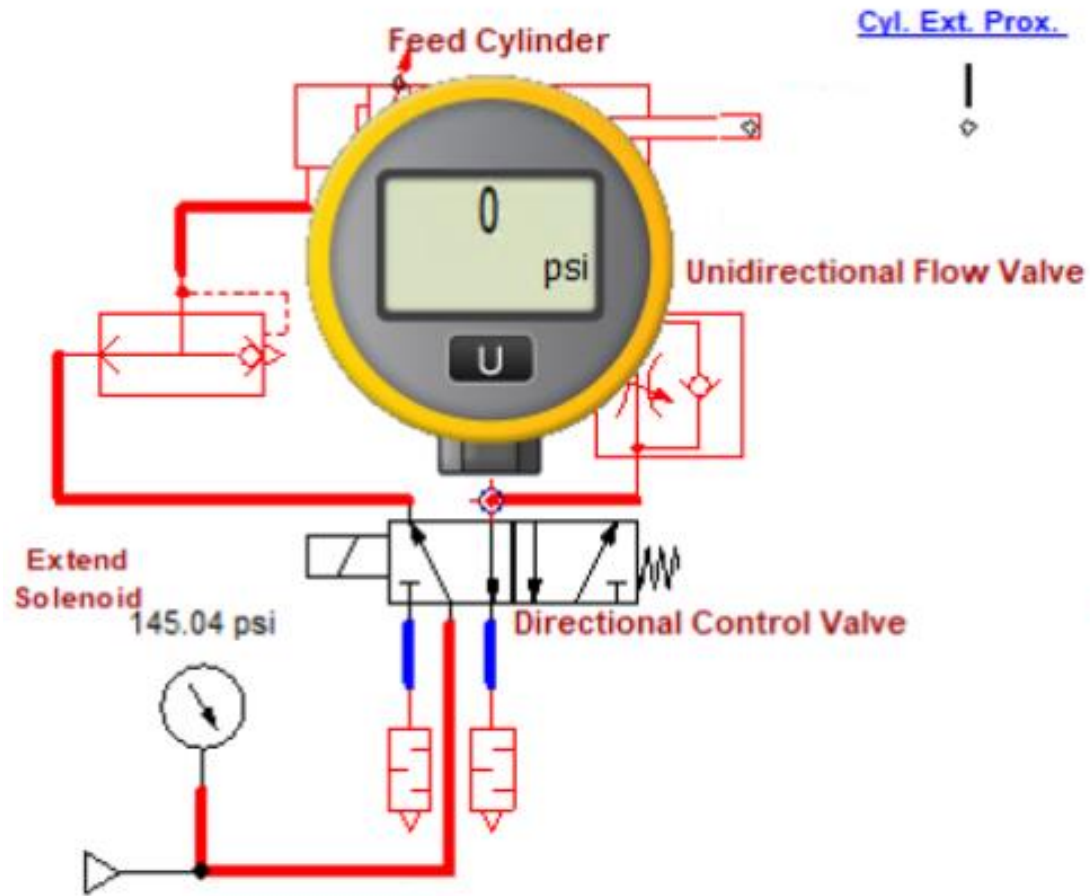
Simulation in Automation Studio for basic electrical course. Multi-meter or clamp-on ammeter can be used for testing the circuit.
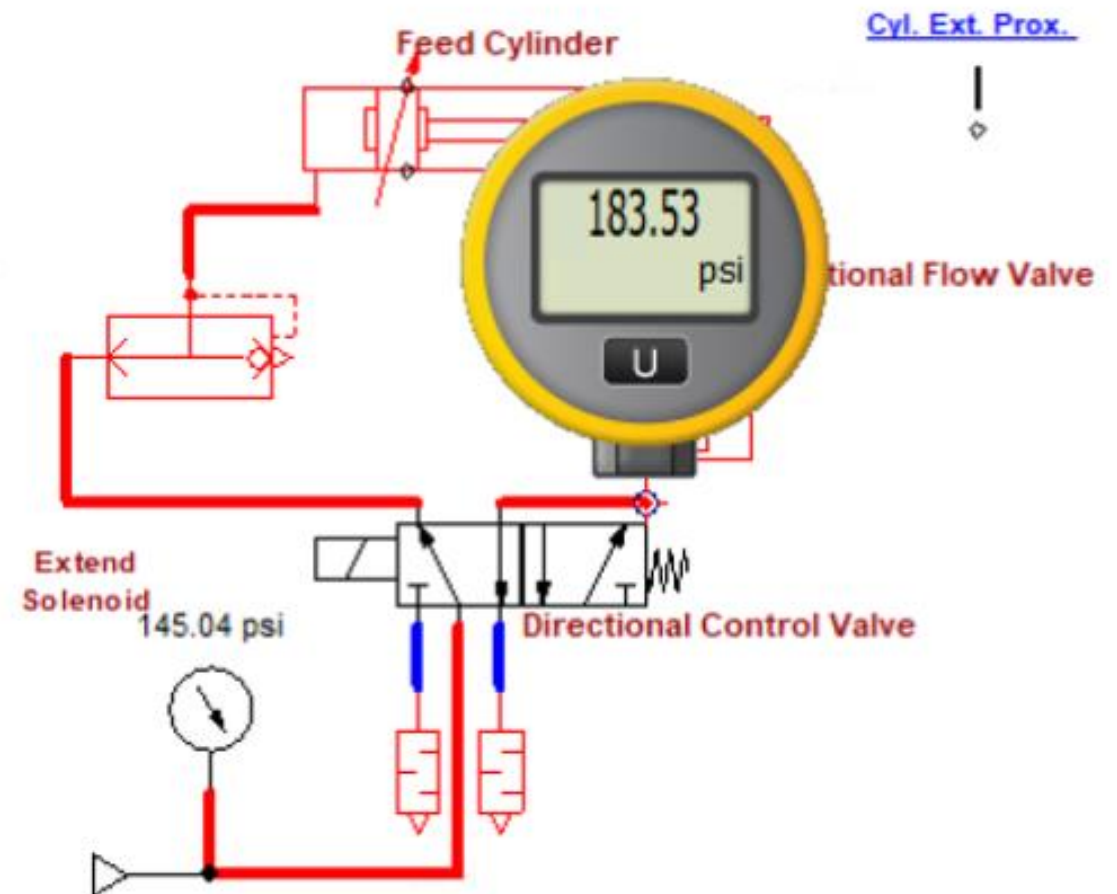
RMS Voltage 14.3 V

1000 Ω

2200 Ω

24 V

1000 Ω

-3.19 v

7 mA

Simulation in Automation Studio for basic pneumatic circuit operation and troubleshooting

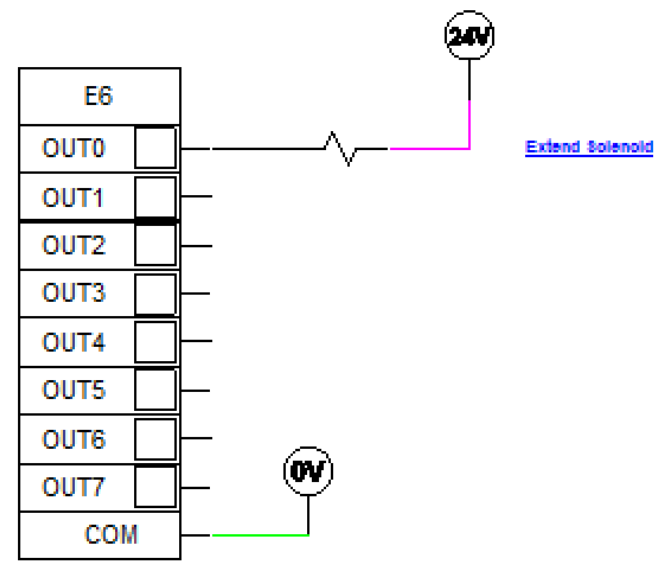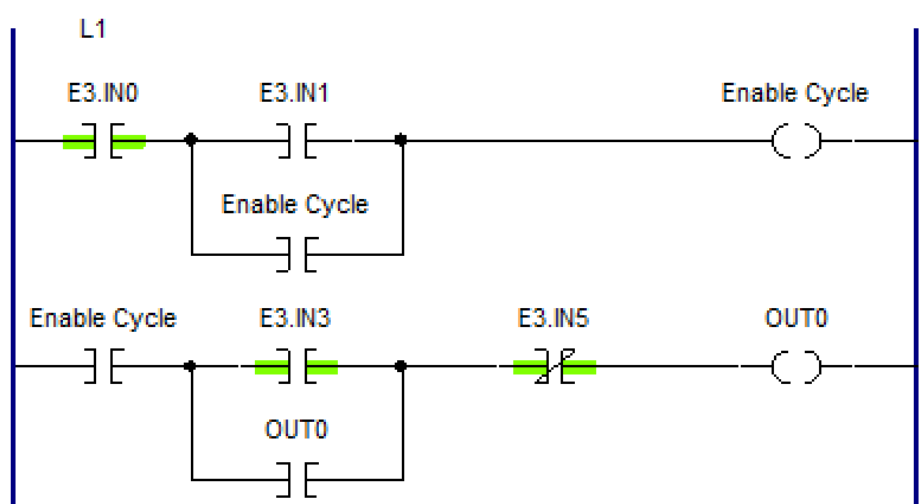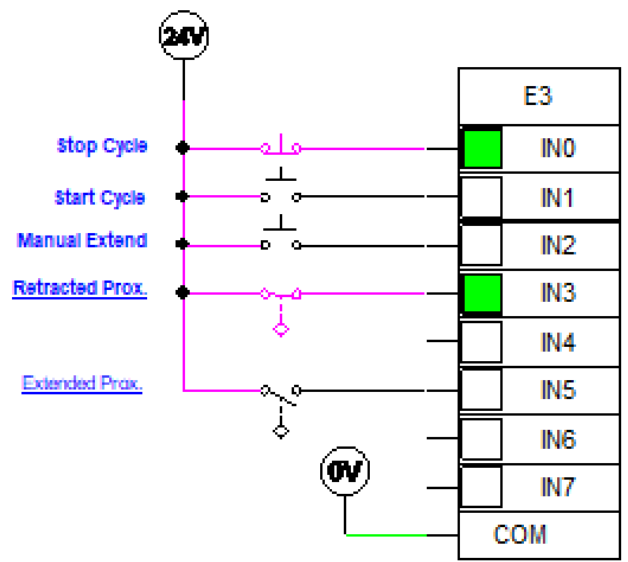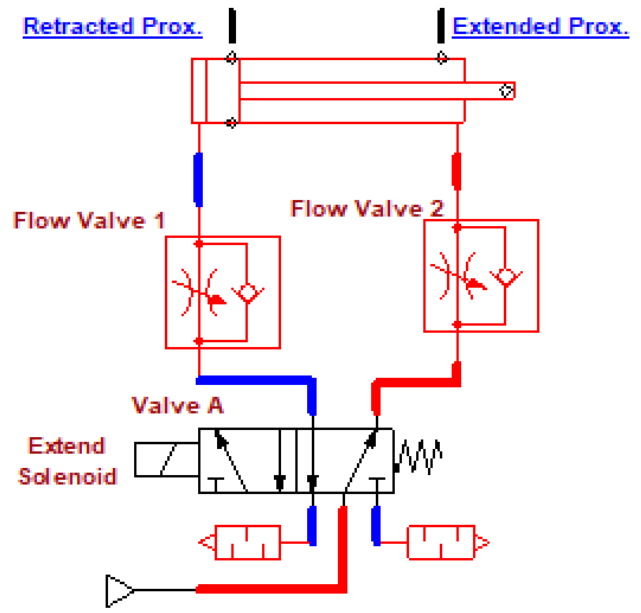# Simulation in Automation Studio for basic pneumatic circuit controlled by an electrical circuit
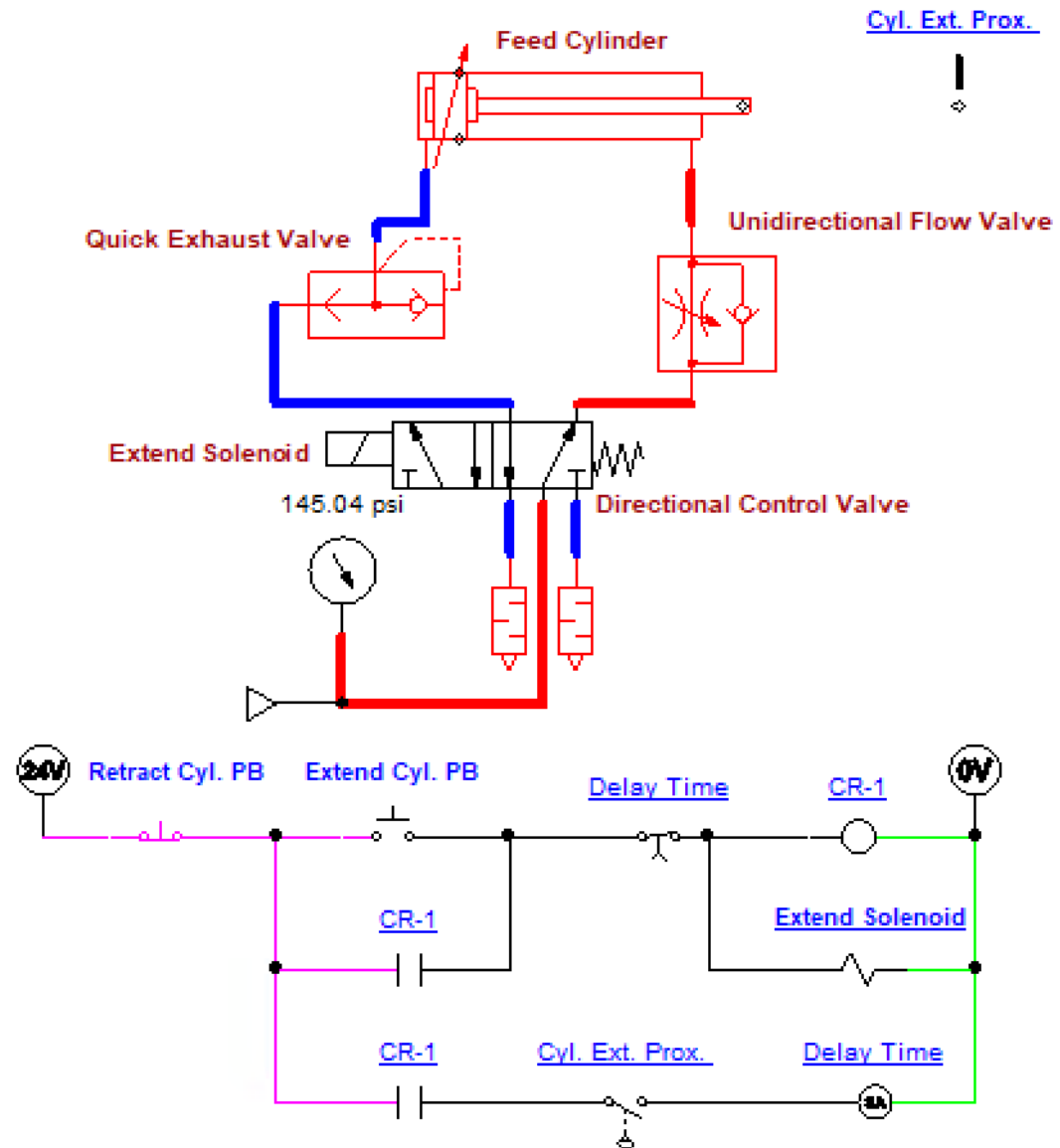
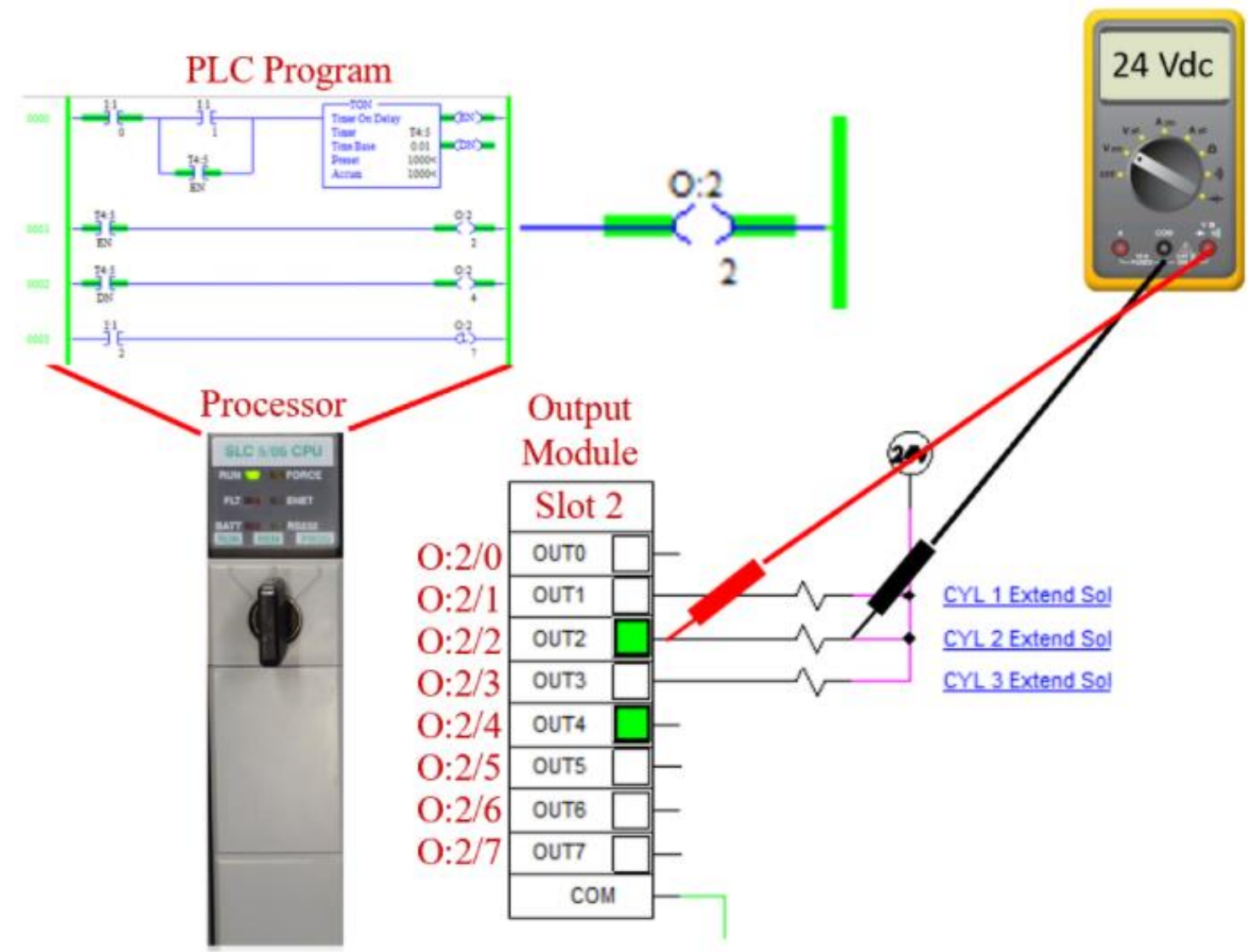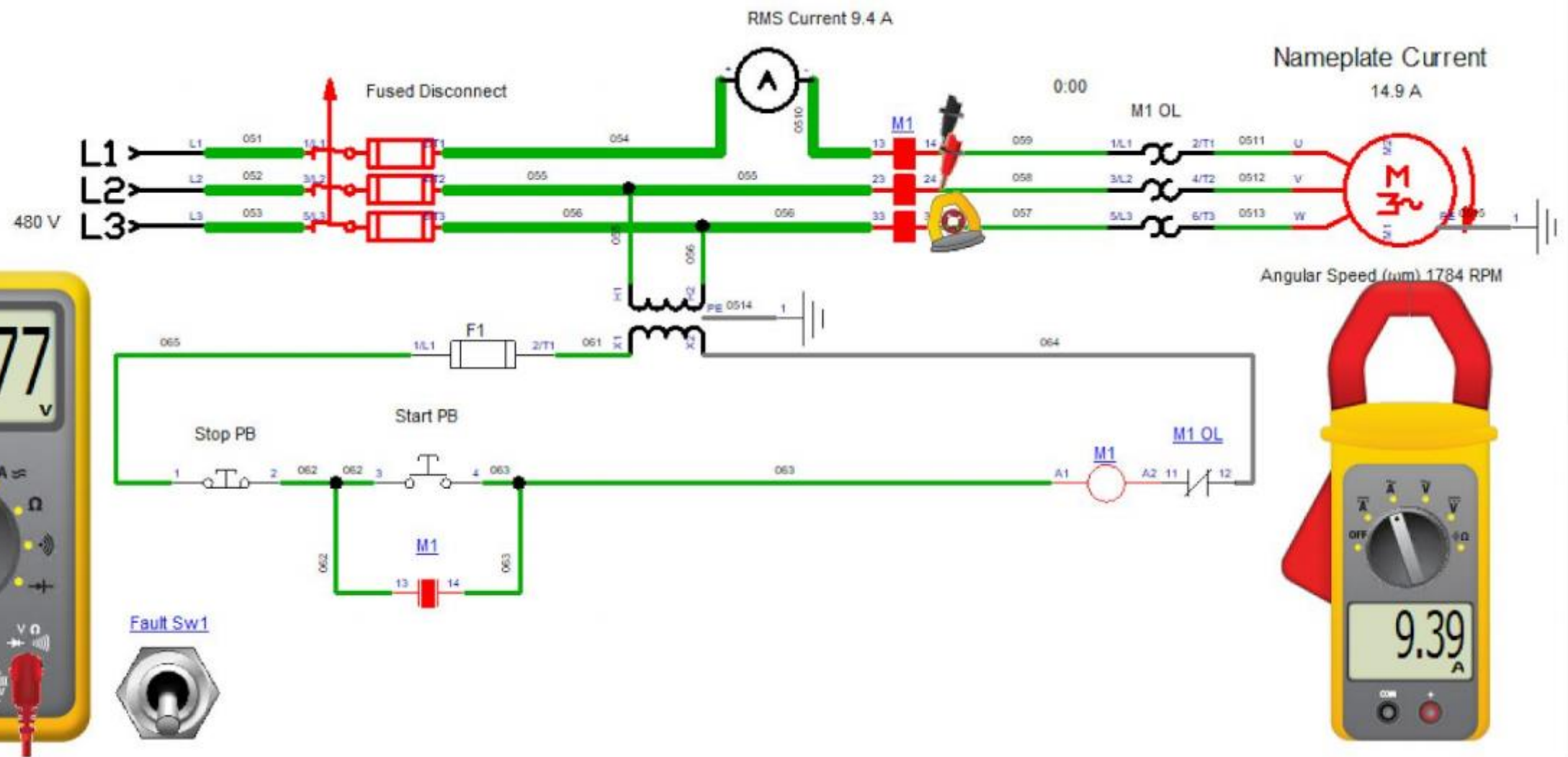# Simulation in Automation Studio for basic pneumatic circuit controlled by a PLC circuit

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.
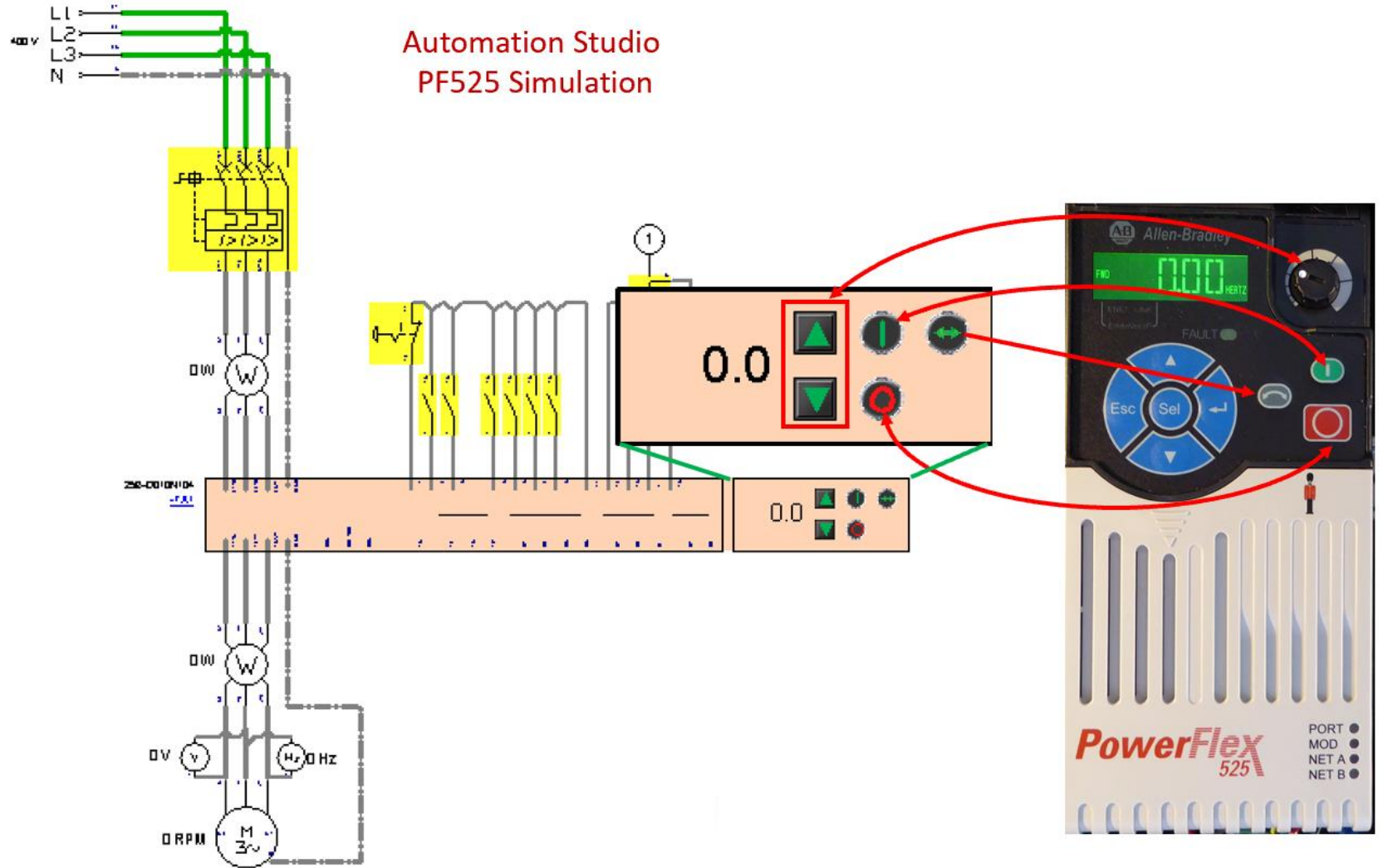
Automation Studio
PF525 Simulation

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.
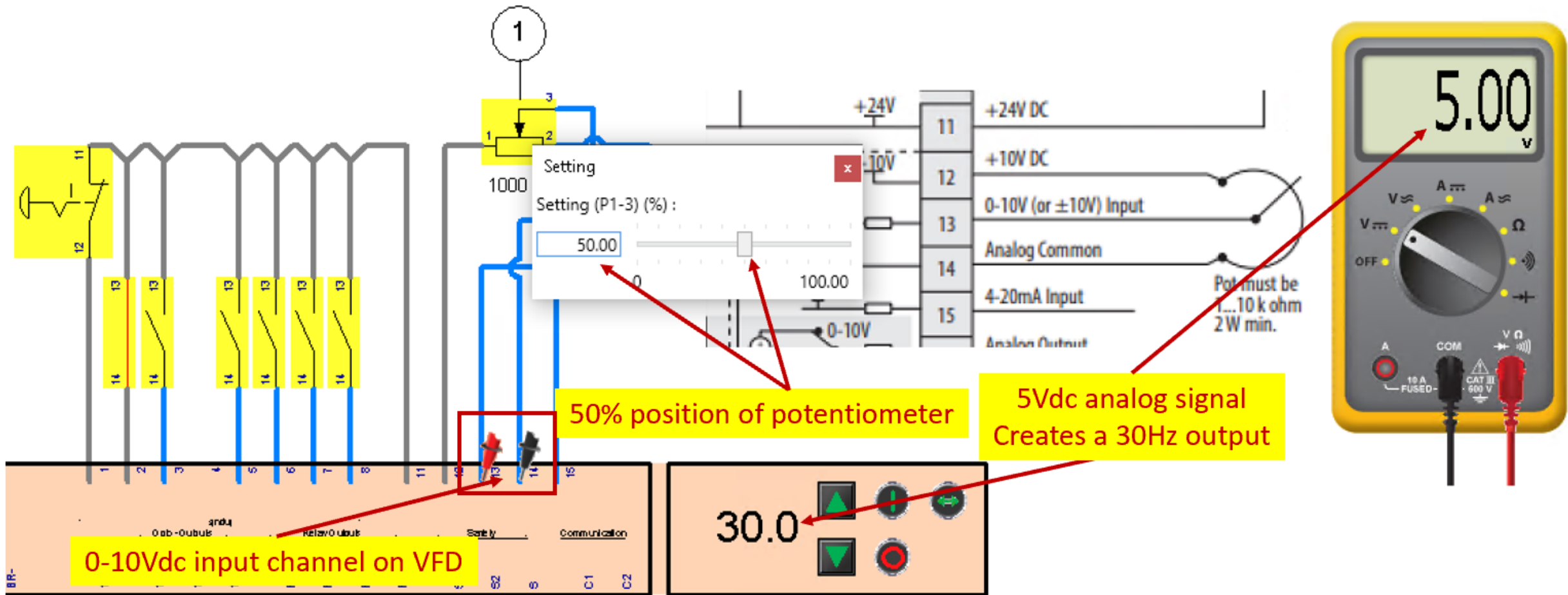
Setting

Setting (P1-3) (%) :

50.00

0   100.00

+24V

+24V DC

+10V DC

0-10V (or ±10V) Input

Analog Common

4-20mA Input

Pot must be 1...10 k ohm 2 W min.

Analog Output

50% position of potentiometer

5Vdc analog signal Creates a 30Hz output

0-10Vdc input channel on VFD

30.0

5.00

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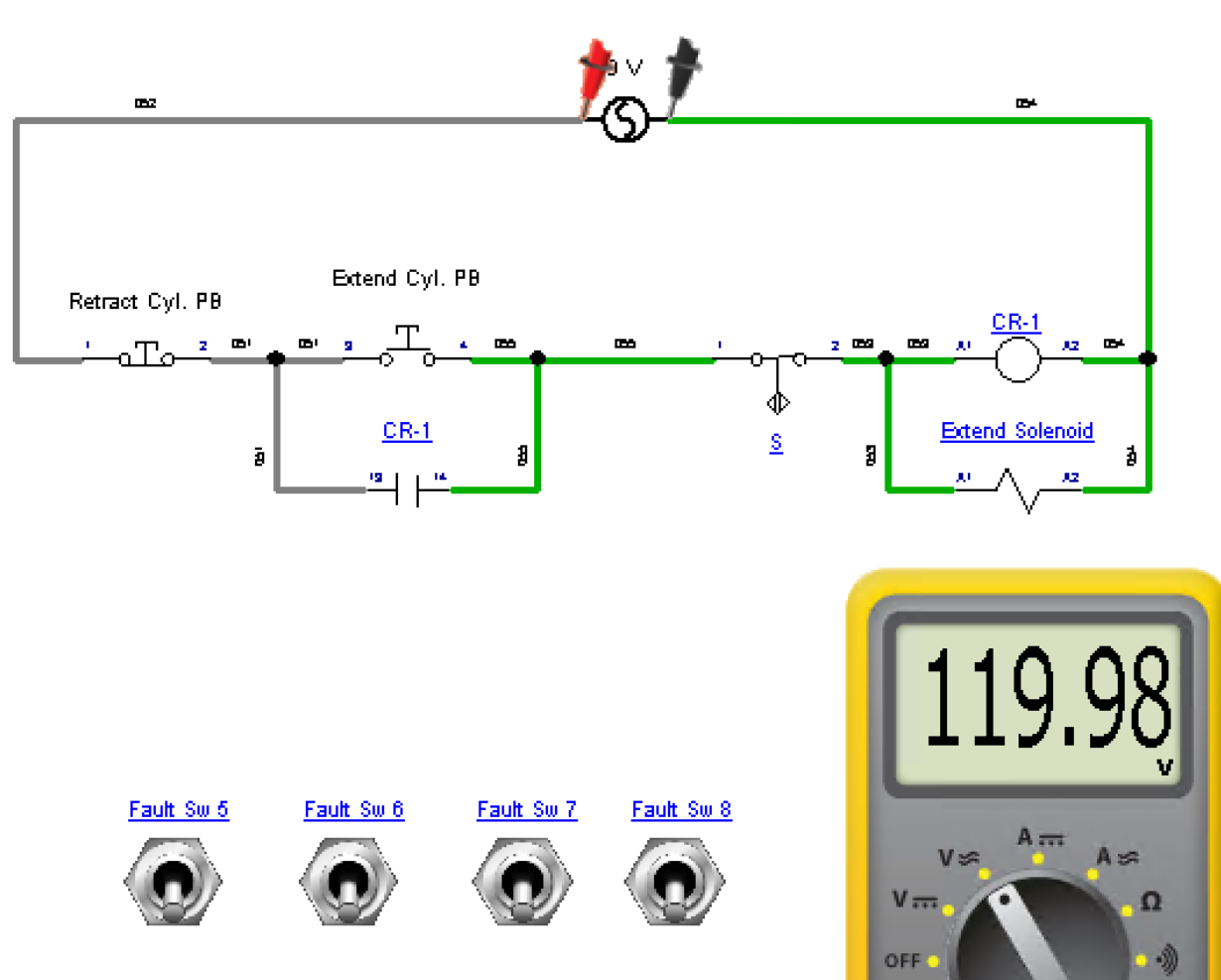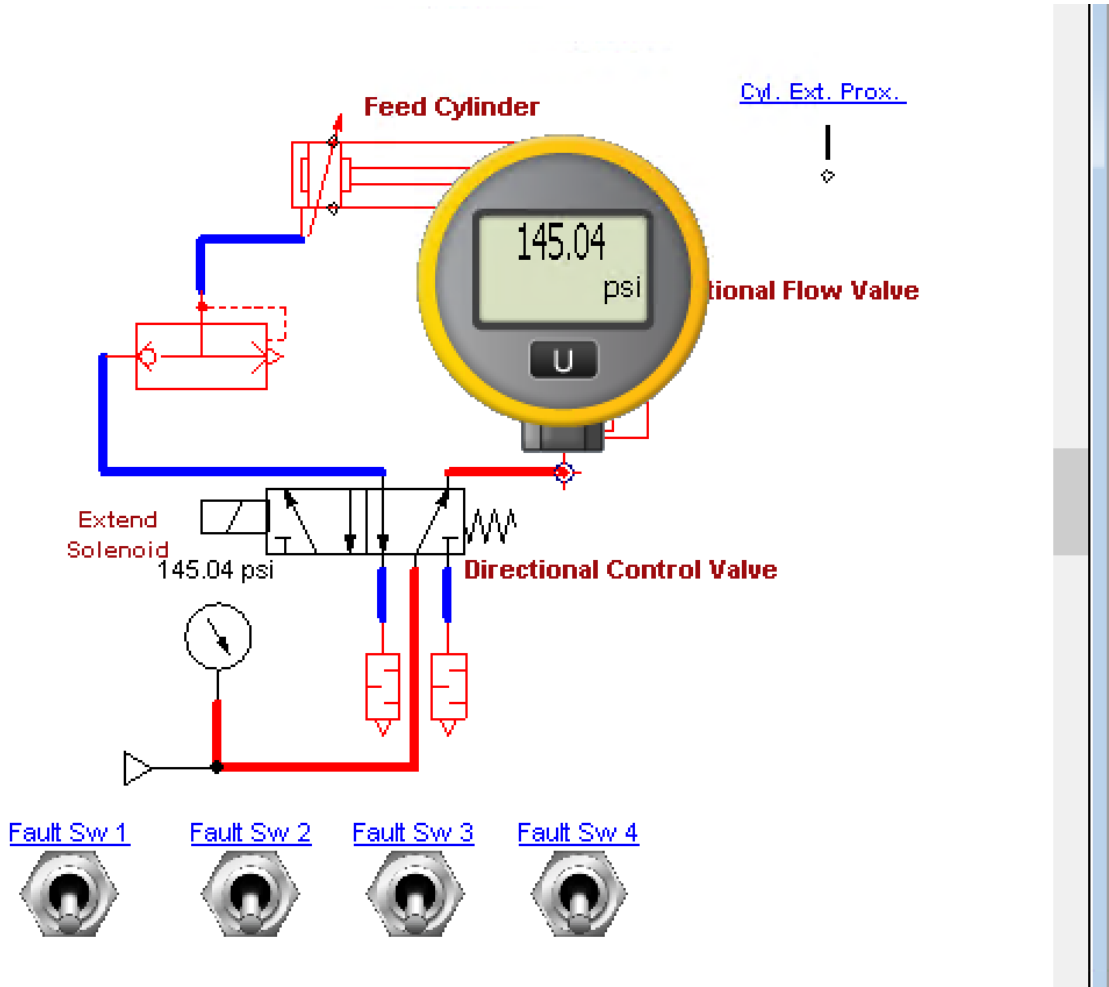
Simulation in Automation Studio of an electrical circuit, controlling a pneumatic circuit. Faults are inserted for student troubleshooting. This document is for the Instructor to reference what fault is inserted. All components and lines can have a fault inserted by the instructor, and assigned to a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

Broken Wire Fault Sw5

Blocked Line Fault Sw2

Feed Cylinder

Cyl. Ext. Prox.

Quick Exhaust Valve

Unidirectional Flow Valve

Extend Solenoid

145.04 psi

Directional Control Valve

Dir. Valve Jammed Fault Sw1

Blocked Line Fault Sw3

Blocked Silencer Fault Sw4

Fault Sw 1 Fault Sw 2 Fault Sw 3 Fault Sw 4

120 V

Retract Cyl. PB

Extend Cyl. PB

CR-1

CR-1

S

Extend Solenoid

Broken Wire Fault Sw8

Broken Wire Fault Sw7

Open Coil Fault Sw6

Fault Sw 5 Fault Sw 6 Fault Sw 7 Fault Sw 8

The End of the Presentation