

Introduction to a Virtual Machine

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Introduction to a Virtual Machine

After viewing this document, the student should be able to:

1. Explain what a virtual machine is, and how to apply it for this course.
2. Explain how their virtual machine works and how to execute the software on their VM
3. Explain what software is required on their VM to actually perform a lab exercise for the course
4. Explain the difference between a virtual and hardware type of simulator
5. How to test a program from a lab exercise on the virtual simulator when it is in Demo mode
6. How to test a program from a lab exercise on the virtual simulator when it is in the Run mode
7. Explain the purpose of a FactoryTalk Activation Server
8. Determine what sequence to start the applications for the virtual simulator in the Run mode
9. Explain how to turn on the virtual simulator, and change the state of the discrete input devices

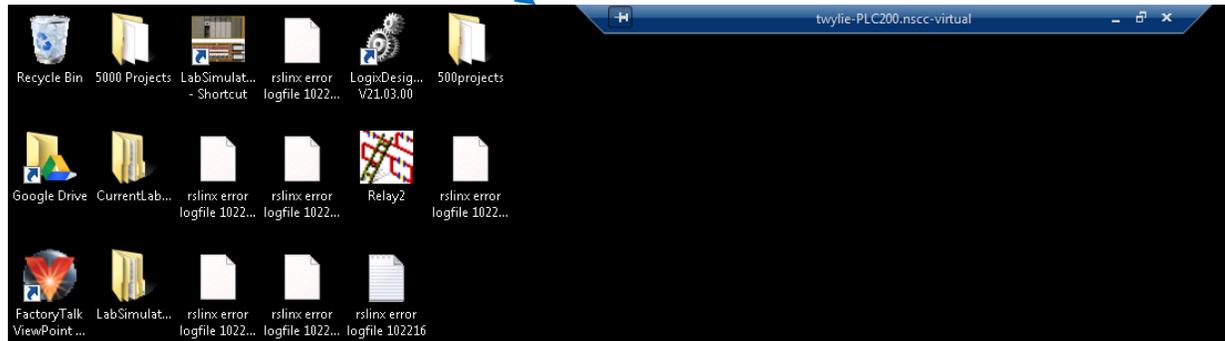
Please Read This

This module will explain to the student how the virtual machine works and the value of it within this course.

Every student will be assigned their own virtual machine when they sign up for any of the NSCC PLC courses. The intent is to have access to all of the software used in the course on a 24/7 basis. Beyond access to the PLC software that is licensed to Northwest State, the students will be able to do most of their labs from this virtual machine, as well as test them on a virtual PLC simulator. The overall intent is to minimize the trips to NSCC, and to accelerate the student learning.

Students are assigned their own virtual machine

The desktop of a Virtual Machine



The purpose of every student getting their own virtual machine assigned to them is that they can have access to all of the PLC software they will be using in the course, without having to come to campus to use it.

Having taught this course for many years, the learning curve for the student is the PLC programming software. The challenge is that it is expensive (cost prohibitive for the student to buy) and it has a restrictive licensing agreement that limits its use to computer systems at the college. So students would have to come to campus, try to get on a computer, and learn the software at limited times.

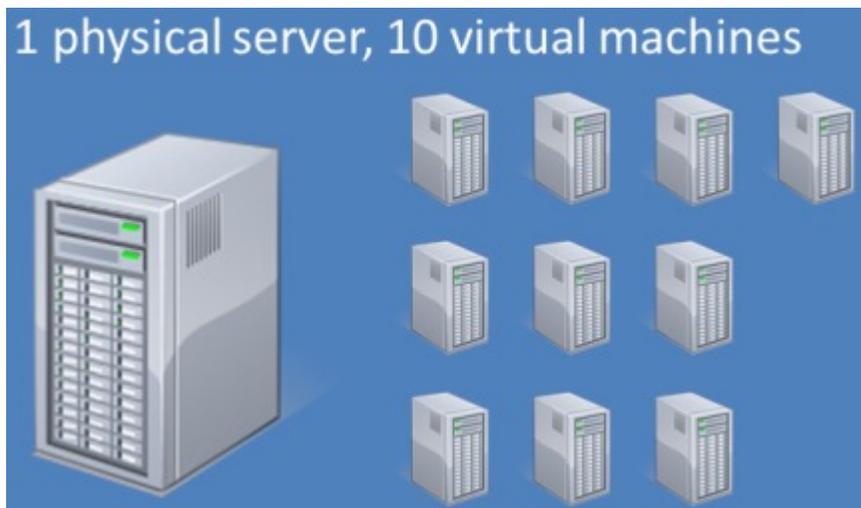
When a student signs up for a PLC or Industrial Computing course, they will be assigned their own virtual machine. They can log into it from any location that has internet access. Though a Macintosh computer should work, it will be easier to use a Windows based computer to connect to the VM and run the PLC software, since the PLC software is only designed for Windows based machines. So students have 24/7 access to the PLC software through the VM, thus they can create their projects (PLC programs) from home, and save their projects to a folder on their desktop. Students can then email the project to themselves, so they do not have to reenter it when they come to the main campus for the lab exercises and the lab tests. Once on campus, they can open their email and save the project to a thumb drive to manipulate it. The other advantage of the NSCC virtual machine system is that the student can actually run their labs on their virtual machine using multiple software applications. This really accelerates student learning in the PLC field.

What is a Virtual Machine

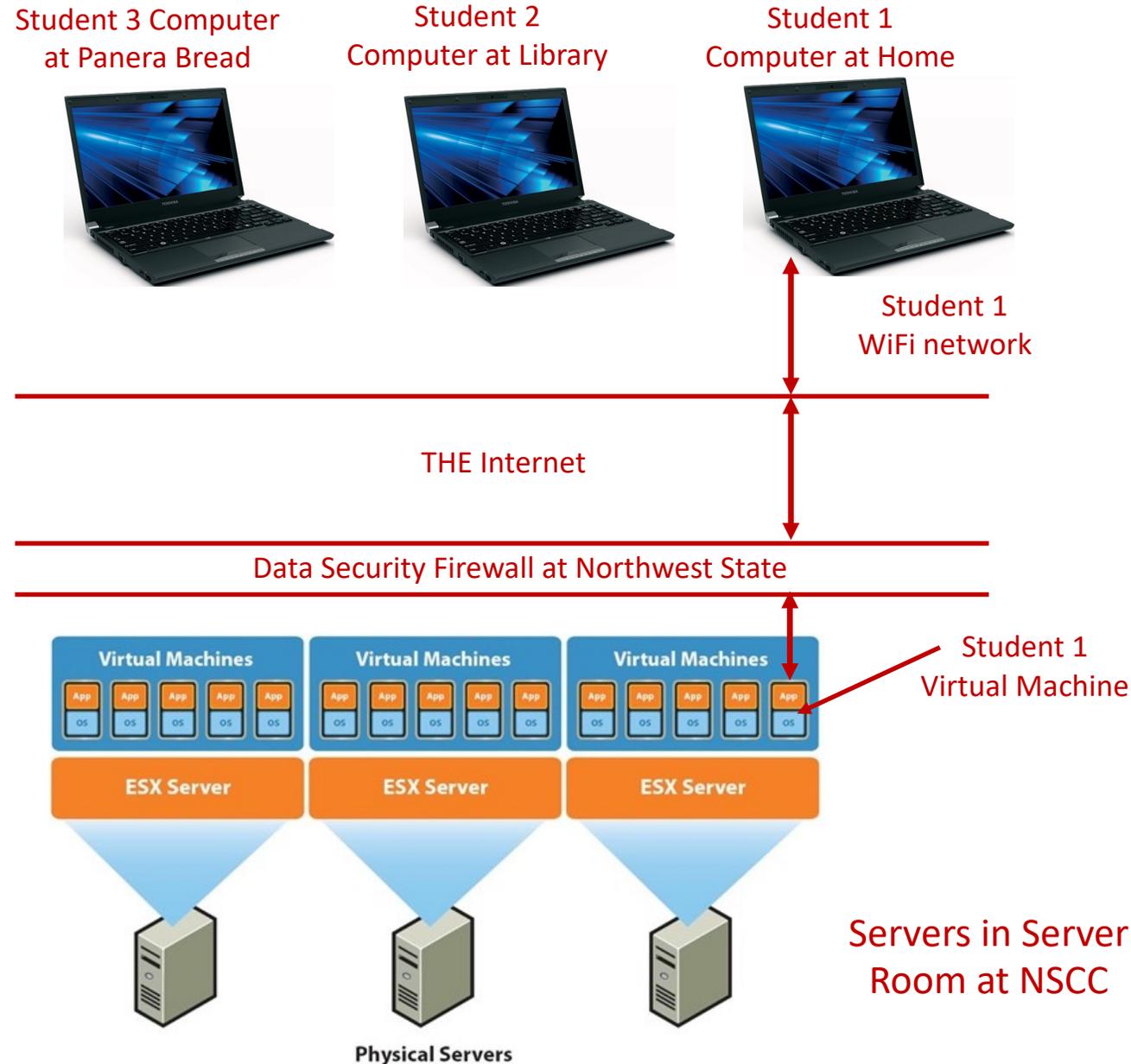


This top illustration shows how computers at an organization is connected to a file server as a way to access software and files that are needed. This is the same way that computer are connected at Northwest State when a student uses them in a computer lab. Networking cable is ran throughout the college and computers are connected by cables to the server through Ethernet switches.

The lower illustration shows the concept of multiple virtual machines located on one physical server. The Computer Technician will create on virtual machine and load all the required software on that virtual machine, then duplicate it 10 times (as in this example). This will create 10 VM, that can be assigned to 10 students. Each student will have a desktop that can be customized to their needs. The students will run their virtual machine just like it is a computer they are in front of.



How the student's computer connects to the VM



This illustration shows how the student's computer connects to the student's virtual machine. The students should have a wired or WiFi connection at home to effectively connect to the VM. Realize that the computer could also be at the public library, an NSCC computer lab or anywhere there is a PC computer with a high speed connection.

The student will have to go the connect.northweststate.edu site and enter their login information. This will connect them to their virtual machine.

The virtual machine is a 16 Gig memory machine for each student. When the student disconnects, this memory is reallocated to the memory pool so another student can use it when they log in. A student has their own desktop and folders where programs can be stored.

PLC Software used in the VM

VM-Master

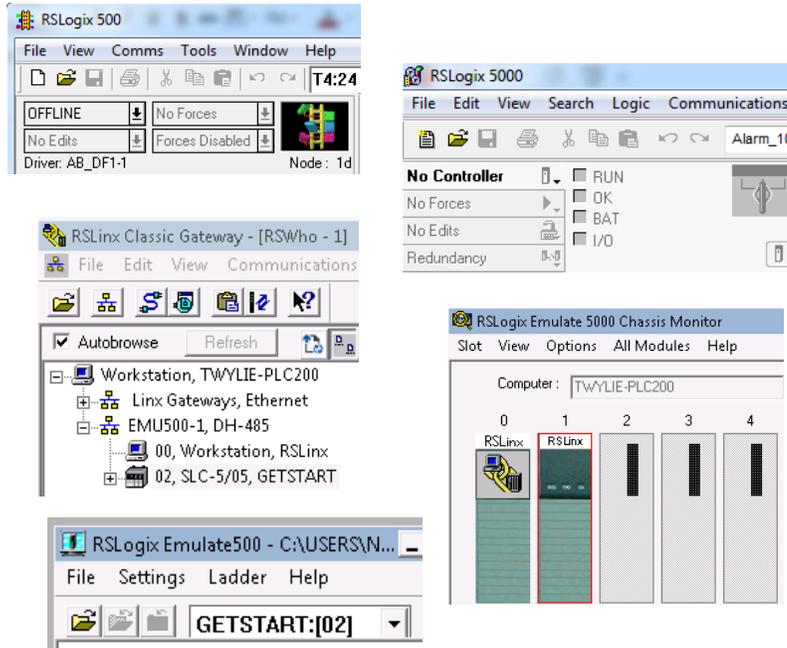
RSLogix500

RSLogix5000

RSLinx

Emulate 500

Emulate 5000



VM-1

RSLogix500

RSLogix5000

RSLinx

Emulate 500

Emulate 5000

VM-2

RSLogix500

RSLogix5000

RSLinx

Emulate 500

Emulate 5000

VM-3

RSLogix500

RSLogix5000

RSLinx

Emulate 500

Emulate 5000

VM-4

RSLogix500

RSLogix5000

RSLinx

Emulate 500

Emulate 5000



The student VMs are loaded with primarily PLC software that is used in this course. The RSLogix500 is the programming software that is used to program and troubleshoot an SLC-500 system.

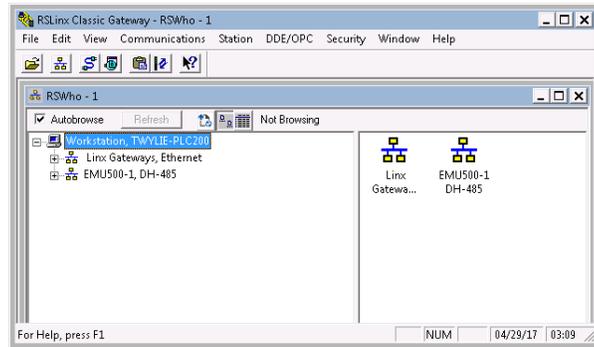
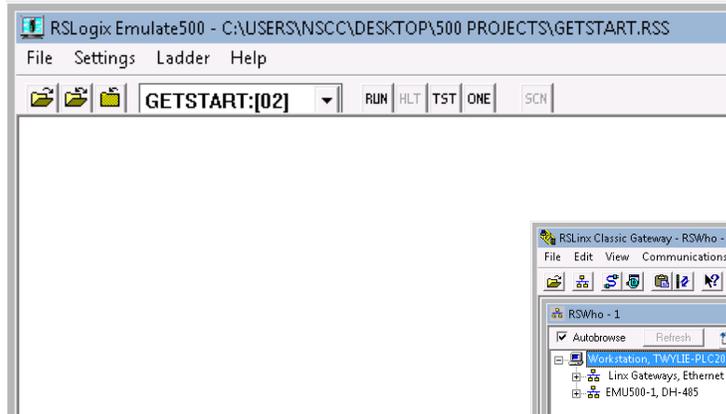
RSLogix Emulate 500 software is used to replace a hardware processor. It will scan the program and run based on the instructions in the ladder logic. The project that is created with RSLogix500 will be opened with the emulator and put into the Run mode.

RSLinx is used to communicate between the emulator and RSLogix500, so the student can download to it, upload from it, and go online to it.

An original VM is created by the NSCC IT department, then replicated numerous times, then these individual VMs will be assigned to students registered for the PLC courses.

Realize that when the student connect to their VM, then opens up one of the software packages, the software will go out to a FactoryTalk Activation Server to get an activation for each software application. If it cannot get an activation, the software will not run. The FactoryTalk Activation Server is run inside the firewall at NSCC.

Creating and Testing an RSLogix500 Project in a VM



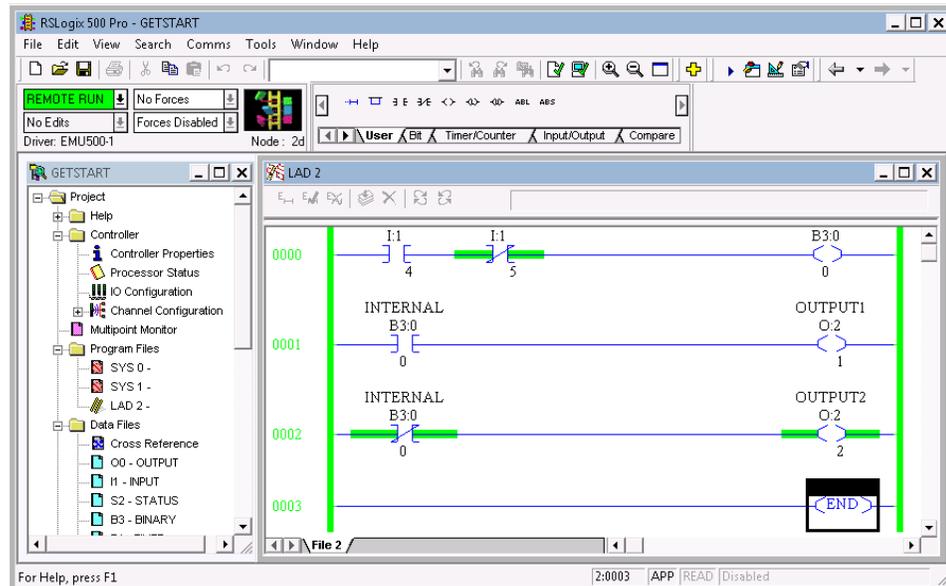
The neat thing about having your own VM is that you can do pretty much all of your lab exercises from home, or any place that has high speed wired or wireless internet.

The project is created in RSLogix500.

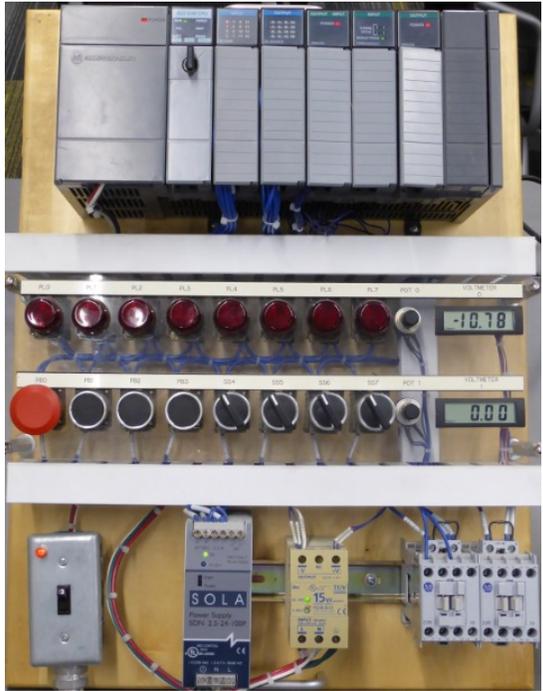
The RSLogix500 project is loaded into the RSLogix Emulate500 software, given a station number and put into the Run mode.

A driver is created in RSLinx, that will be used to connect the emulator together with RSLogix500.

The user can then go Online to the emulator with RSLogix500 to test the program within the project. The user can right click on an address in the program and toggle the bit, which is the same

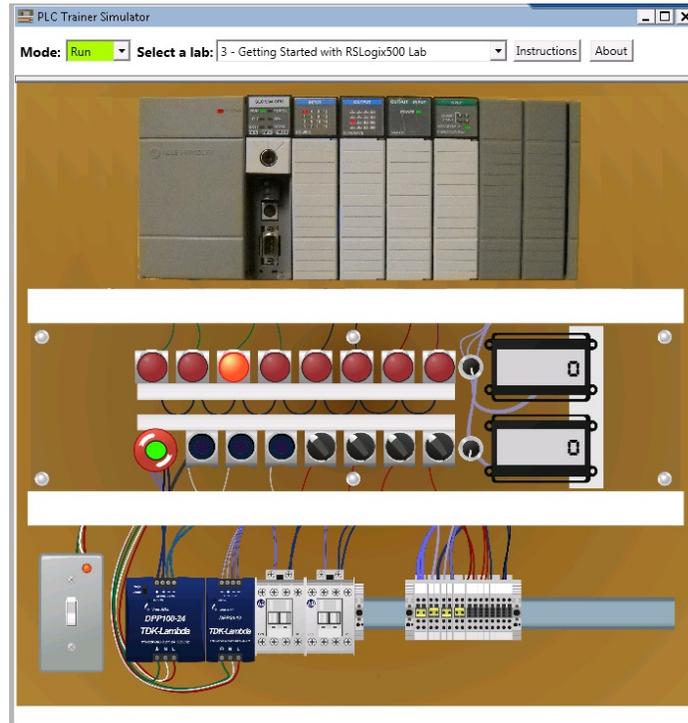


Hardware versus Virtual Simulators



SLC-500 Hardware Simulator
found in the PLC training room

Virtual SLC-500 Simulator
found in the student VM



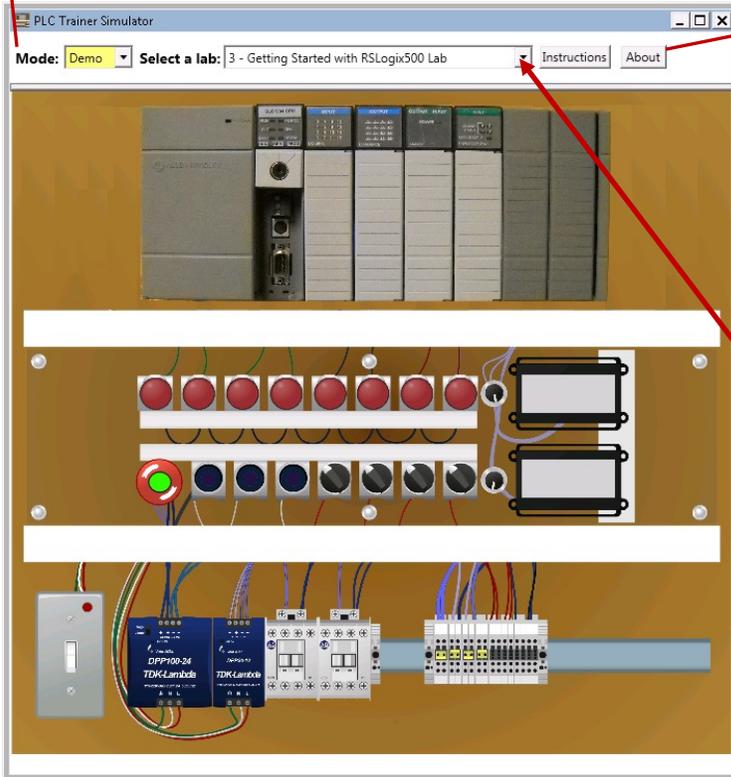
It is important to understand the difference between the PLC hardware simulator and the PLC virtual simulator. The hardware simulator is an actual PLC with discrete inputs and outputs (pushbuttons & pilot lights), and analog I/O devices (potentiometers and analog displays). The students will physically connect this unit to a PLC to actual hands-on tasks, similar to what is required in an industrial environment.

The virtual PLC simulator is found in the virtual machine, and will look very similar to the hardware simulator. This is a fully functioning simulator with pushbuttons, selector switches and pilot lights.

The virtual PLC simulator has two modes: Demo mode and Run mode. In demo mode, the devices will simulate the running of each of the lab exercise programs so the student will know how it will operate. When in Run mode, the student will be able to actually run their program on the virtual simulator.

Running the Virtual Simulator in the Demo mode

Mode: **Demo** Select a lab: 3 - Getting Started with RSLogix500 Lab Instructions About



Click the pull-down menu to choose which lab to run

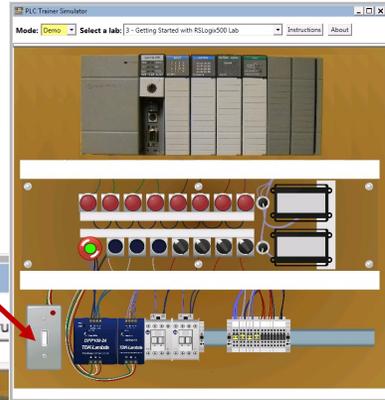
- 3 - Getting Started with RSLogix500 Lab
- 3 - Getting Started with RSLogix500 Lab
- 4 - Relay Instructions Lab
- 5 - On-delay Timer Lab 1
- 6 - On-delay Timer Lab 2
- 7 - Counter Instructions Lab
- 8 - Off-delay Timer Lab
- 9 - Timer Cascading Lab
- 10 - Data Comparison Lab 1
- 11 - Data Comparison Lab 2
- 12 - TONMOV Lab
- 13 - Micrologix Wiring Lab
- 14 - Search Lab
- 15 - Force Lab
- 16 - CompactLogix Hardware Lab
- 17 - Getting Started with RSLogix5000 Lab
- 18 - Relay Instructions Lab
- 19 - Timer Instructions Lab
- 20 - Troubleshooting Lab
- 21 - Sequencer Output Lab

When the virtual simulator is put into the Demo mode (upper left of the display), the user can choose which project to run. The PLC programs used in each lab is programmed in the virtual simulator. The user will select a lab from the pull down menu at the top (middle) of the simulator object.

The Demo mode will allow the student to interact with the virtual simulator to see how the program in a lab exercise will work. The student will click the buttons or selector switch to actually see how the program will control the pilot lights based on the condition of an input.

Running the Virtual Simulator in the Demo mode cont.

Click on the power switch
To power the virtual simulator



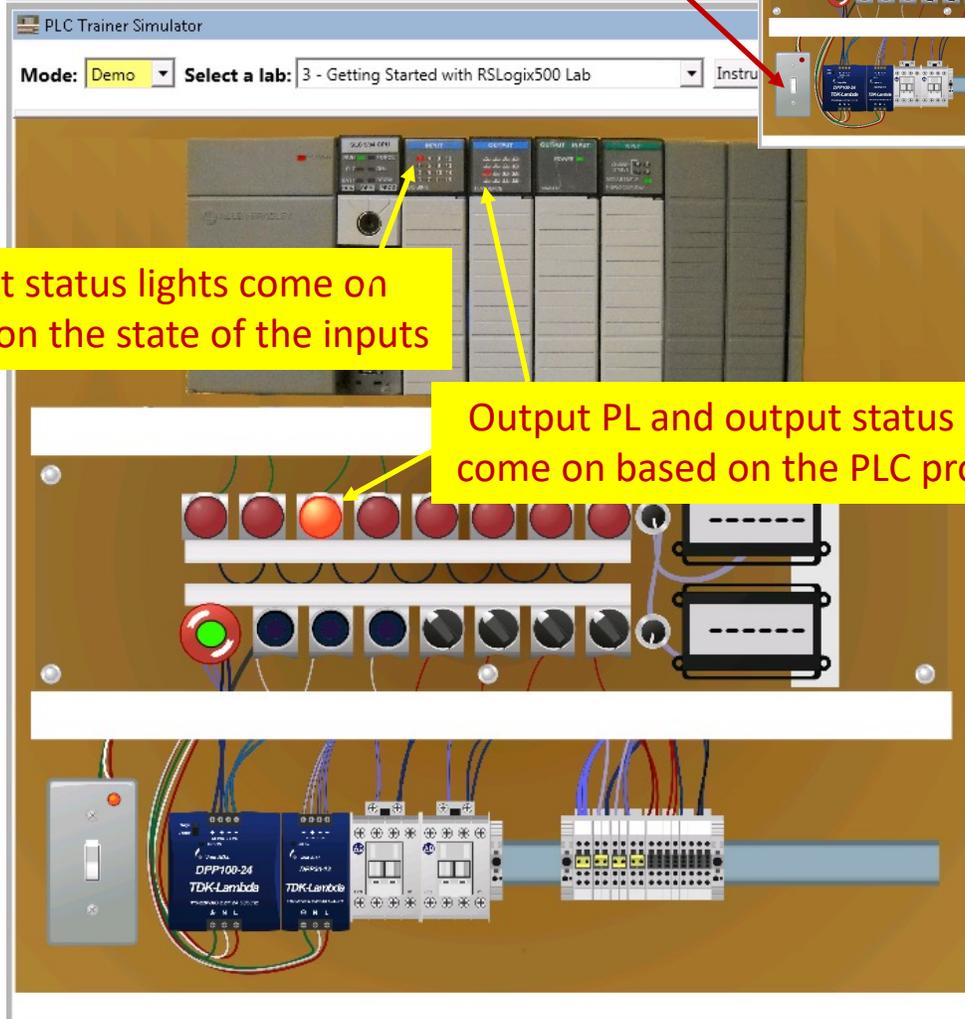
To power the virtual simulator, the user should move the mouse pointer to the power switch in the lower left corner of the simulator and left click it. This will power the unit.

Notice that the small power light turns on that is located on the switch plate of the power switch.

Also, the input indicator lights come on based on the status of the inputs. Notice that the stop pushbutton is wired normally closed, so input 0 status light on the input module is on.

Also notice that the status light for output 2 in module slot 2 is on (which is turned on by the PLC program), so it turns on the corresponding output pilot light.

Once again, this virtual simulator is setup to run the same as the hardware simulator found in the PLC lab.



Input status lights come on based on the state of the inputs

Output PL and output status lights come on based on the PLC program

Running the Virtual Simulator in the Demo mode cont.

The image shows a side-by-side view of two software windows. The left window is the 'PLC Trainer Simulator' in 'Demo' mode, displaying a virtual PLC rack with various modules and a terminal block. A yellow arrow points to the 'Instructions' button in the top right corner of the simulator window. A yellow callout box with red text says: 'To open up the lab exercise to view the instruction and the program, click on the Instructions button'. The right window is an Adobe Acrobat Reader DC showing a PDF document titled 'PLC200_Lab03_SLC-500 Getting Started with RSLogix500 Lab.pdf'. The document contains the following objectives and procedure:

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

1. Execute the RSLogix500 software
2. Create a new project and configure the I/O
3. Enter a 3 rung program with basic relay instructions
4. Explain the operation of the XIC, XIO and OTE instructions
5. Download a program to the SLC-500 processor and go online
6. Change the mode of the processor with RSLogix500
7. Monitor the bits in the I/O image tables

Procedure:
1. Key in the following program with the following steps as specified in the following sequence.

The PDF also displays a ladder logic diagram with three rungs:

- Rung 0000: SELSW4 I1 (NO) in series with SELSW5 I1 (NC) leading to INTERNAL B3 (NO) coil.
- Rung 0001: INTERNAL B3 (NO) leading to OUTPUT1 O2 (NO) coil.
- Rung 0002: INTERNAL B3 (NO) leading to OUTPUT2 O2 (NO) coil.

Steps to Execute RSLogix, create a project and configure the I/O:

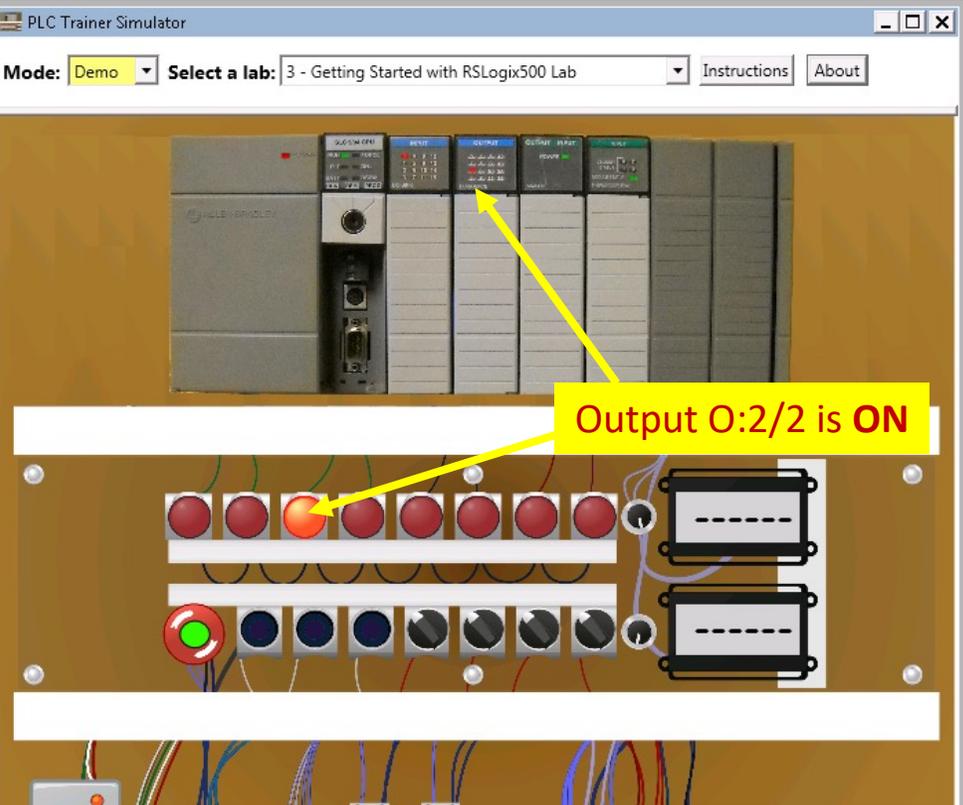
To view the lab exercise and the PLC program that the virtual simulator will demo, first make sure you select the correct lab (top middle). In this case, it is the "Getting Started with RSLogix500 Lab". Then click on the Instructions button, which will open the lab exercise in a PDF format. The user can resize this document so the simulator and PDF is shown side-by-side as shown in this graphic.

Running the Virtual Simulator in the Demo mode cont.

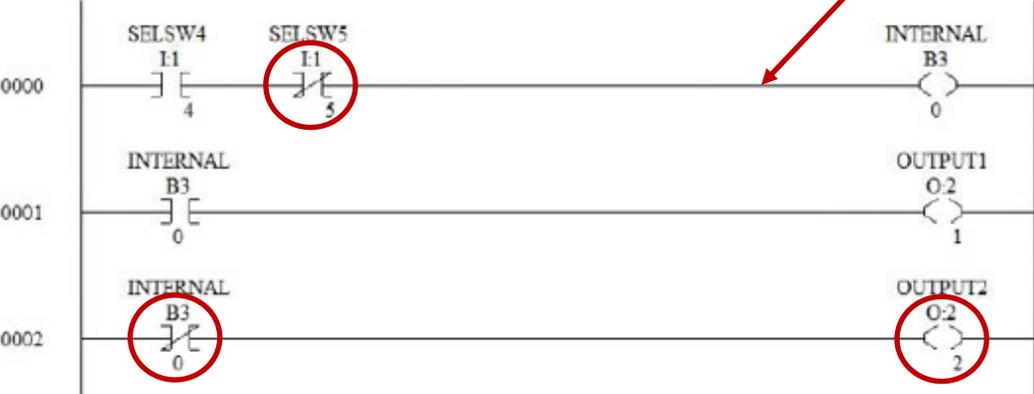
This illustration shows the PLC program that is in Lab 3. The instructions that will allow power flow is circled in red. In this example, with SELSW4 and SELSW5 both off, then OUTPUT2 (O:2/2) is on.

To change the state of a pushbutton or selector switch, simply left click on it with the mouse pointer.

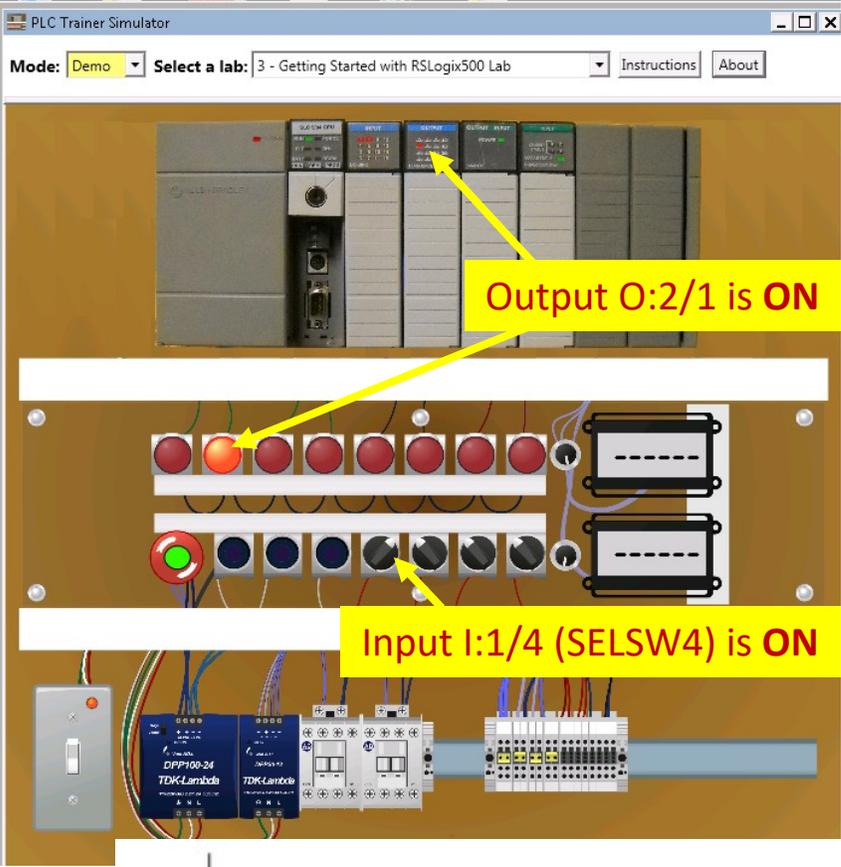
Notice the output status light on the output module is on, which will turn on the corresponding output pilot light.



The PLC program that is used in the Getting Started Lab



Running the Virtual Simulator in the Demo mode cont.

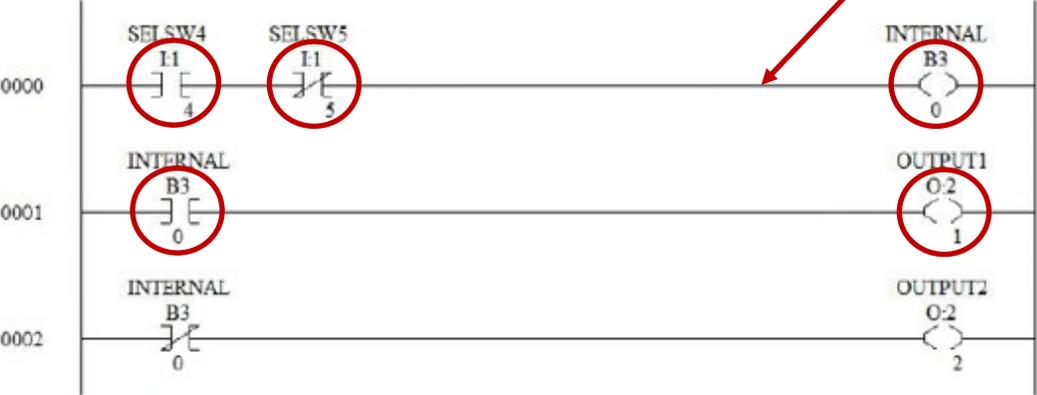


This illustration shows the PLC program that is in Lab 3. The instructions that will allow power flow is circled in red. In this example, with SELSW4 is "ON" and SELSW5 both off, then OUTPUT1 (O:2/1) is on.

To change the state of a pushbutton or selector switch, simply left click on it with the mouse pointer.

Notice the output status light on the output module is on, which will turn on the corresponding output pilot light.

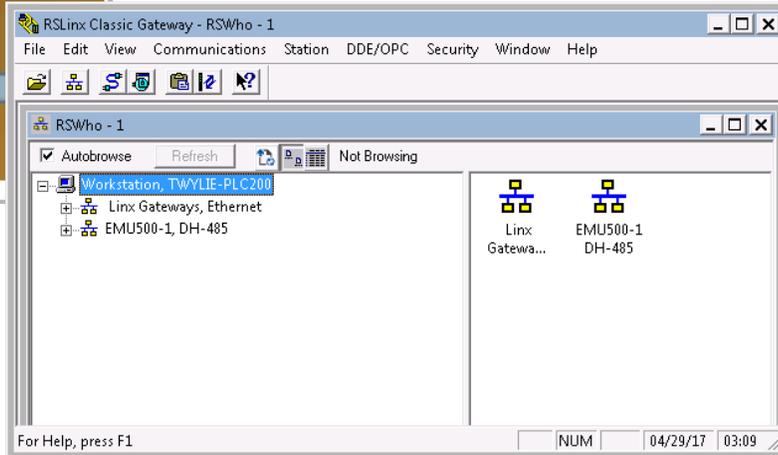
The PLC program that is used in the Getting Started Lab



Running the Virtual Simulator in the Run mode



SLC-500 Simulator



RSLinx Application

Emulator Application



RSLogix500 Project named GETSTART

Project Name	Date/Time	Application
15_1025_playing around	10/25/2015 7:47 PM	Microsoft Excel W...
GETSTART	4/12/2017 3:43 AM	RSLogix 500 SLC P...
Lab05	10/24/2016 10:37 ...	RSLogix 500 SLC P...
LAB05_BAK005	10/21/2016 5:23 PM	RSLogix 500 SLC P...

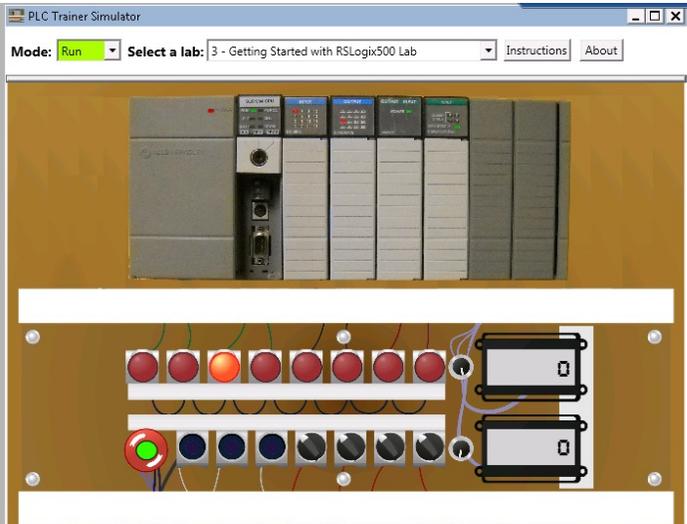
This illustration shows all the applications within the virtual machine to simulate the operation of the SLC-500 training unit that is found in the PLC lab (E101).

The project that was created with RSLogix500 will be stored in a folder on the desktop of the VM. This project will need to be opened up with the RSLogix500 Emulate500 application, and put into the Run mode. The Emulator software will emulate a processor and scan the PLC ladder logic program, just like an actual processor.

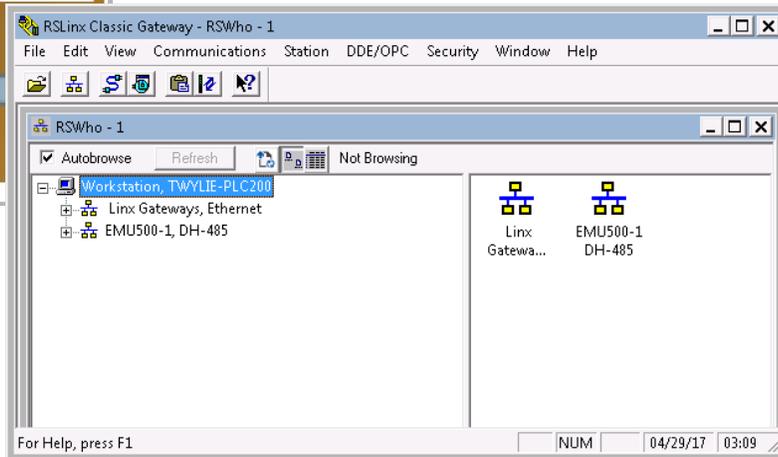
An RSLinx driver must be setup to communicate with the Emulator. Notice that the name of the driver in the RSLinx RSWho window is EMU500-1. This is an emulator driver.

The SLC-500 Simulator is an interactive application that has computer programming that will transport data between the Simulator and the program in the Emulator via an OPC link in RSLinx. OPC is a way of sending data between applications. Kind of complicated but it really works well. See your instructor if you have trouble with your connections.

Running the Virtual Simulator in the Run mode cont.



SLC-500 Simulator



RSLinx Application

Emulator Application



RSLogix500 Project named GETSTART

Project Name	Date/Time	Application
15_1025_playing around	10/25/2015 7:47 PM	Microsoft Excel W...
GETSTART	4/12/2017 3:43 AM	RSLogix 500 SLC P...
Lab05	10/24/2016 10:37 ...	RSLogix 500 SLC P...
LAB05_BAK005	10/21/2016 5:23 PM	RSLogix 500 SLC P...

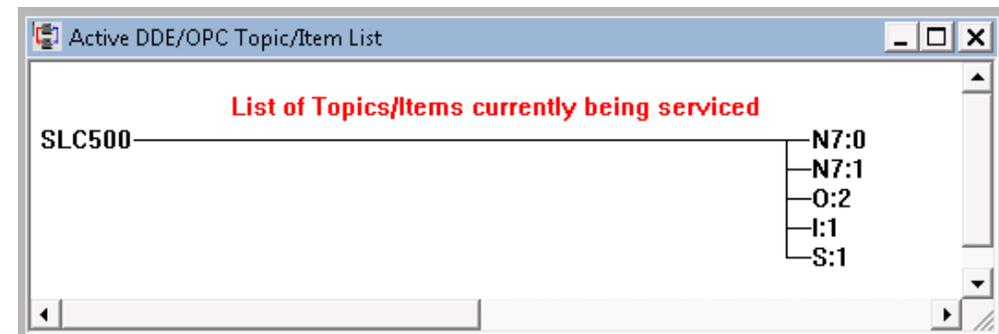
It is important to start the components up in the proper order. Open the RSLogix500 project with RSLogix Emulate500 (assign it station address 2). Put the Emulator in the Run mode.

Next, open the RSLinx application and setup a driver for the Emulator.

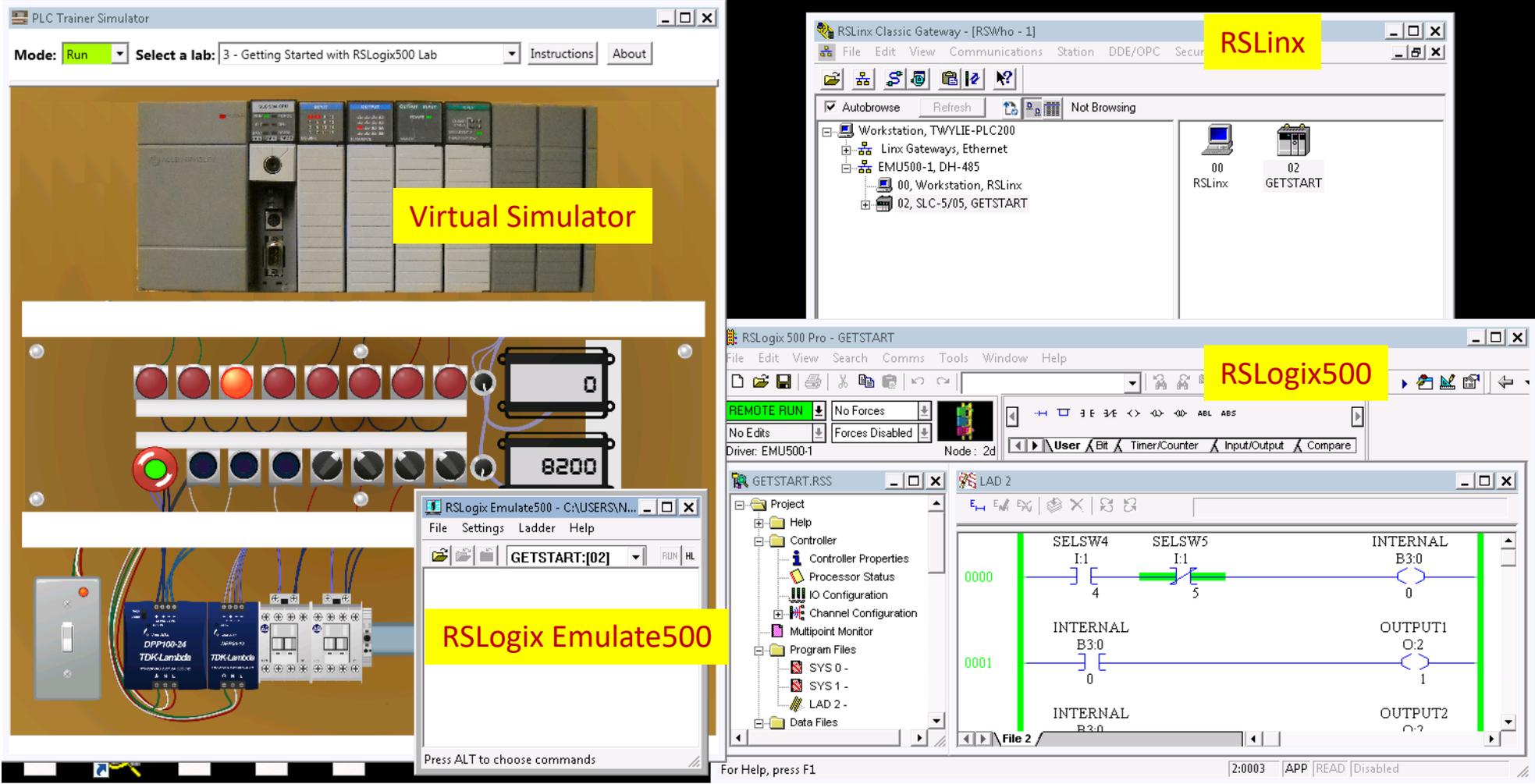
Last, start the SLC-500 simulator application, and make sure it is in the Run Mode (upper left).

The software that was created within the SLC-500 Simulator automatically creates the OPC item for RSLinx. The lower graphic will show the data that will be access through the OPC item named SLC500.

The data flow within the OPC Item



Running the Virtual Simulator in the Run mode cont.



This illustration shows the applications in the VM required to have a student key in a program, and run it on the virtual simulator. The project is created in RSLogix500 and saved to a folder on the desktop of the VM. This project is opened with RSLogix Emulate500 and given a station address of "2". An emulator driver is created in RSLinx, with the computer given a station number "0", and in this case it was named RSLinx. The last application started is the virtual simulator. Turn it on, and it should interact with the program. The user can then go Online to the Emulator with RSLogix500 as shown above.

This Concludes this Instructional Document

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