

Allen Bradley PLC and HMI Troubleshooting for Maintenance Techs and Manufacturing Engineers

When your automation breaks down, often the cause is something simple, such as a misaligned sensor or a broken wire. The real challenge though, is identifying which sensor or which wire needs repaired. This class teaches you how to use Allen Bradley software to troubleshoot your machines, giving you the ability to see the whole picture of what is going on in your automation, so that you can quickly and confidently make repairs when needed, reducing downtime and maintenance costs.

Software covered:

- Studio 5000
- Factory Talk View ME
- RSlinx Classic

Applies to machines with:

- Compact Logix PLCs
- Control Logix PLCs
- PanelView Plus HMIs



Duration: 24 Hours (6, 4-hour sections)

1) Section 1: Going online, introduction to basic programming instructions

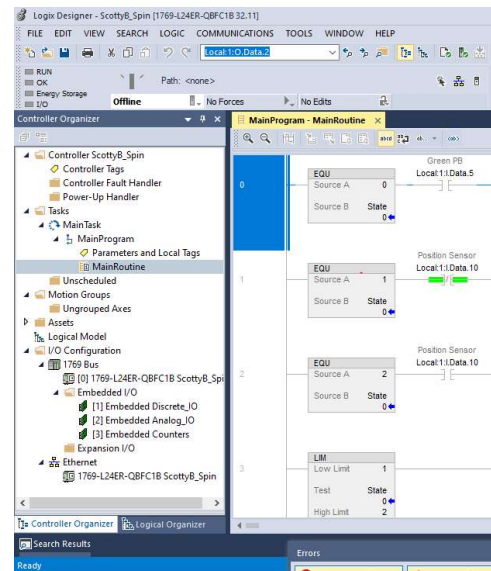
In section 1 students will learn how to connect a programming laptop to a PLC using several different methods. Next, they will then learn how ladder logic is used to create programs, and how the most common programming instructions work.

- a. Uploading/Downloading PLC programs
 - i. How to determine which piece of software and programming cables to use
 - ii. How to use RSlinx to set up communication drivers
 - iii. How to go online with a PLC and upload and download programs
- b. Introduction to Common PLC Instructions in Studio 5000
 - i. Bit instructions
 - ii. Timer and counter instructions
 - iii. Compare instructions
 - iv. Math instructions
 - v. Move and logical instructions

2) Section 2: Navigating Studio 5000, creating first PLC programs

In section 2 the class will study the purpose and function of various windows and tool bars in Studio 5000. Next, they will apply what they learned to create several simple programs.

- a. Navigating Studio 5000 Software
 - i. Overview of the Controller Organizer
 1. Controller and Local tags
 2. Tasks, Programs and Routines
 3. I/O Configuration
 4. Ethernet Devices
 - ii. Overview each tool bar
 1. Standard tool bar
 2. Security tool bar
 3. Controller Overview
 4. Language element
 5. Path Bar
 - iii. Overview of Ladder Window
 1. Rungs and Rails overview
 2. Edit Rung Comments
- 3) Write new PLC programs
 - a. Latching light program
 - b. Delay light on program
 - c. Push button press counting program
- 4) Introduction to state logic programs
 - a. Run Dial Program
 - b. Index Dial Program



5) Section 3: Hardware overview and PLC Troubleshoot tools

During Section 3, students will learn about PLC hardware. The class will focus primarily on information that can aid in trouble shooting. The next lesson will include reading and modifying PLC programs, which control a marble sorting machine that is built into the PLC trainer. Each program gradually increases in complexity and introduces new concepts. Finally, the class will learn about various tools and techniques that can be used to pinpoint issues in broken down automation

a. Hardware Overview

i. Allen Bradley PLC Families

ii. I/O Overview

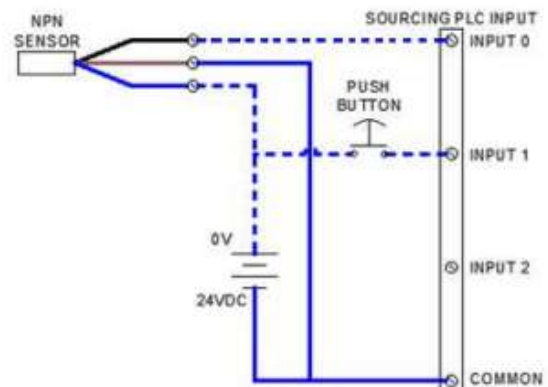
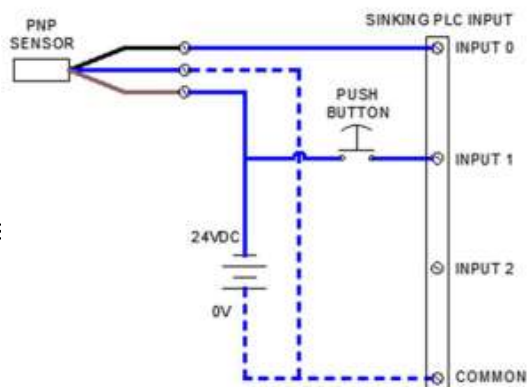
1. Wiring
2. Sinking Vs Sourcing
3. Normal Vs High Speed
4. Digital vs Analog iii)
 - iii. Hardware terminology
 - iv. Troubleshoot / setup analog sensors

b. Reading and modifying PLC programs

- i. Marble Sorting Program Level 1
- ii. Marble Sorting Program Level 2
- iii. Marble Sorting Program Level 3

c. Troubleshooting Techniques

- i. Forcing Inputs and Outputs
- ii. Cross Referencing Tags
- iii. Watching Tags
- iv. Trending
- v. Clearing Major PLC faults



3) Section 4: PLC Troubleshoot scenarios

Students will use all the skills gained in the prior sections to identify the causes of various break downs in a marble sorting machine that is built into the PLC trainer. For each scenario a different toggle switch is flipped on the trainer that causes it to malfunction. The students then are required to go online with the PLC using studio 5000 and use the trouble shooting tools taught earlier in the class to determine the cause of the malfunction. Each of the 10 scenarios are listed below.

- a) You are called to repair the marble sorting machine. Prior to this, another technician replaced the left actuator because it had a bad air leak. Afterwards an alarm pops up on the HMI stating, "Left actuator failed to extend". The alarm will not clear. You can see that the left actuator is in the extended position. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- b) You are called to repair the marble sorting machine. Prior to this, the machine was running well for some time, and there have not been any repairs done to it recently. An alarm pops up on the HMI stating "Right actuator failed to retract". The alarm can be cleared, but it comes back on as soon as the machine is restarted. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- c) You are called to repair the marble sorting machine. Prior to this, another technician replaced the sensor 202PRX because it was damaged. It seems to run fine except that all the steel marbles now go into the right bin and the plastic marbles go into the left bin. There are no alarm messages. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- d) You are called to repair the marble sorting machine. Prior to this, the machine was running fine, and there have not been any repairs done to it recently. The operator tells you that the machine suddenly stopped and now refuses to start. There are no alarms displayed on the HMI. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- e) You are called to repair the marble sorting machine. Prior to this, the machine was running fine, and there have not been any repairs done to it recently. The operator tells you that the machine just suddenly stopped. An alarm on the HMI states, "Left actuator failed to retract". The alarm will clear, but reappears when the machine is restarted. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.



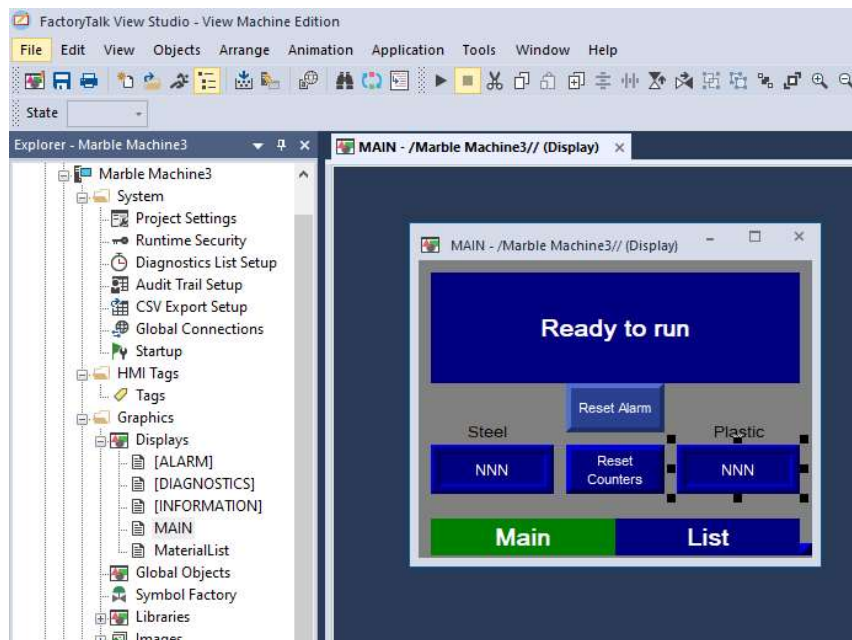
- f) You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The machine appears to run fine for a few cycles, but randomly the dial will fail to index. When this happens, the machine completes the rest of its cycle, and no alarms appear on the HMI. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- g) You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The machine refuses to start and there are no alarms on the HMI. You notice that a red light is flashing on the PLC. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- h) You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. When the start button is pressed, the dial rotates continuously for a few moments, then stops in a random position between indexes. An alarm on the HMI states, "Dial failed to index". Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- i) You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. When you start the machine, all the marbles go into the right bin, regardless if they are steel or plastic. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- j) You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. An alarm pops up on the HMI stating, "Right actuator failed to Retract". The alarm can be cleared, but comes back up as soon as the machine is restated. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class



6) Section 5: HMI Programing and Troubleshooting

During Section 3, students will learn about Panelview Plus HMIs. The class will cover how to download and upload programs to and from an HMI as well as how to diagnose and correct various issues. Finally the class will go over how edit and create elements within a HMI program.

- a. Troubleshooting
 - i. Find configuration screen
 - ii. Trouble shoot coms
 - iii. Set date and time
 - iv. Screen Savor
- b. Install New HMI
 - i. Finding firmware on Allen Bradley's website
 - ii. Installing firmware in a new HMI
 - iii. Download HMI program into a new HMI via ethernet
 - iv. Download HMI program into a new HMI via thumb drive
- c. Programming
 - i. Link HMI elements to PLC tags
 - ii. Edit HMI elements
 - iii. Create new HMI elements



Section 6: Advance PLC and HMI troubleshooting scenarios

- 7) Students will use all the skills gained in the prior sections to identify the causes of various break downs in a marble sorting machine that is built into the PLC trainer. For each scenario a different toggle switch is flipped on the trainer that causes it to malfunction. The students then are required to use Studio 5000 and factory talk View ME to diagnose the issue in each scenario. Each of the scenarios are listed below.
- a. You are called to repair the marble sorting machine. The HMI screen is cracked. The screen is still readable, but the touchscreen no longer works. You do not have a replacement screen. Setup the HMI to work with a computer mouse so the machine can be used while you wait for a replacement screen.
 - b. You are called to repair the marble sorting machine. Prior to this, the machine was running fine, and there have not been any repairs done to it recently. The marble machine will run for a few seconds and then stop and display a vague alarm message. Use Factory Talk View ME to identify what is triggering the alarm and causing the machine to stop.
 - c. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The HMI screen has failed. The screen is dark, but the computer behind it still works. Use factory talk view to pull the program out of the HMI and then install it in a new HMI.
 - d. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The marble machine will run fine for a few minutes then stop randomly for no reason. No alarm is displayed on the HMI. Use Studio 5000 and the trending tool to identify the issue.
 - e. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The left actuator no longer works because the output on the PLC has failed. Confirm the output no longer works, then wire the actuator to a different output and update the PLC program to use the new output.



- f. You are called to repair the marble sorting machine. The machine will stop and say that the right actuator failed to retract. You observe the actuator does in fact retract when it is supposed to. The operator tells you that this issue started to happen occasionally a few weeks ago but is happening more and more often now. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- g. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The machine will stop and say that the right actuator failed to retract. You observe the actuator does in fact retract when it is supposed to. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- h. You are called to repair the marble sorting machine. Prior to this, a sensor was wired incorrectly and input 4 on the PLC was damaged. Wire the sensor into a new input and update the PLC program.
- i. You are called to repair the marble sorting machine. The machine will stop and say that the left actuator failed to extend. You observe the actuator does in fact extend when it is supposed to, but there is a marble stuck inside. The operator tells you that this issue started to happen occasionally a few weeks ago but is happening more and more often now. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- j. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The machine refuses to start and there are no alarms on the HMI. You notice that a red light is flashing on the PLC. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.
- k. You are called to repair the marble sorting machine. Prior to this, the machine was running well, and there have not been any repairs done to it recently. The dial will sometimes index partway causing the marbles to drop in the wrong locations. Determine the cause of the malfunction using the trouble shooting tools taught earlier in the class.

