

Lab 2.1: Basic Electrical Concepts in Automation Studio

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

1. Open the simulation file in Automation Studio, and start the simulation
2. Measure the resistance of N.O. and N.C. contacts using a digital multimeter
3. Measure the resistance of a relay coil using a digital multimeter
4. Measure various AC and DC power sources in Automation Studio using a multimeter
5. Explain the operation of a basic relay circuit
6. Explain the operation of a basic relay start/stop/hold-in circuit

*This lab should be performed using Automation Studio, which is a simulation software that will allow the users to experience how an electrical/pneumatic circuit works, prior to performing a similar lab as what the students will do in the hands-on lab.

Part 1: Access the Automation Studio software.

Your Instructor will inform you on how to access the Automation Studio software from the computers at South Ark CC, or what you will have to do to run the software on your personal computer.

Important: All of the Automation Studio simulations will be based on the hands-on activities in the South Ark Advanced Manufacturing Lab. These simulations must be ran on a computer from home, the library, the labs at South Ark CC or anywhere your computer has an internet connection.

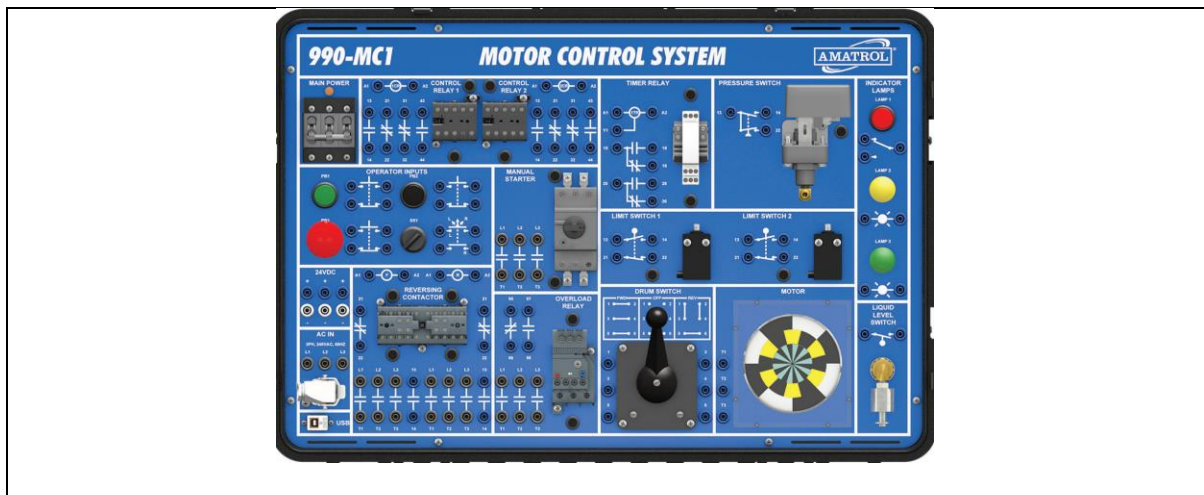


Figure 1. The Amatrol Motor Control Training Unit at South Ark CC.

1. Figure 1 shows the Amatrol Motor Control Training unit that the simulations will be designed around. This is the training unit that will be used by the students in the hardware lab.
2. Open the simulation file named: “PTEC1113 Lab 2_1 Electrical Concepts”. Figure 2 shows how to access the Project Explorer, which will show the 5 documents that make up the simulation. Each document has a circuit on it.

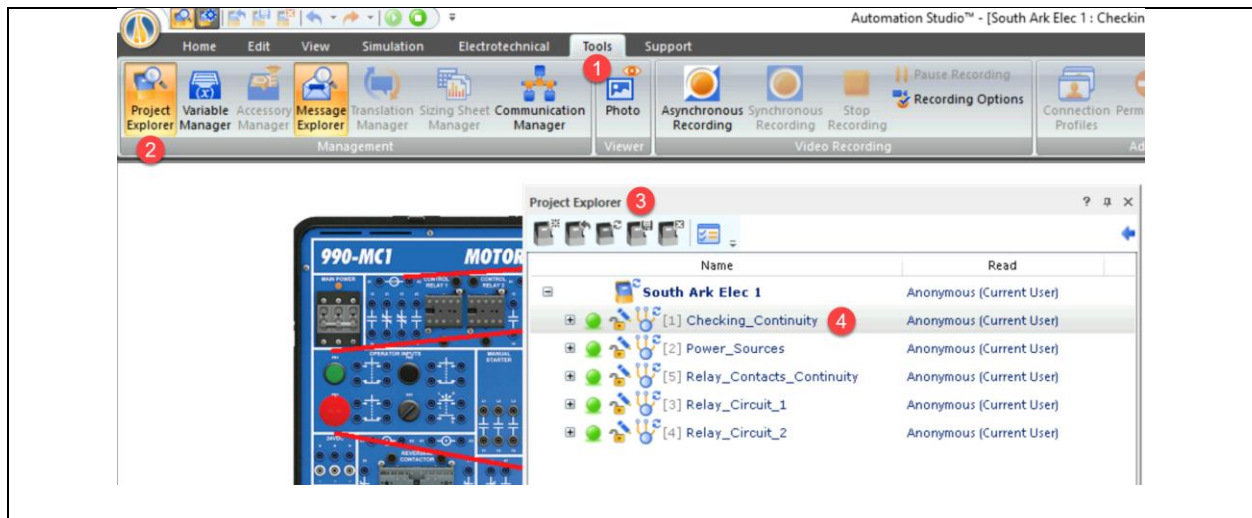


Figure 2. Project Explorer in Automation Studio.

3. Figure 2 shows the steps to get to the Project Explorer in Automation Studio:
 - a. Choose the Tools tab
 - b. Click on the Project Explorer icon
 - c. The menu for the Project Explorer appears
 - d. Choose the document

As you can see, the Project has 5 documents (circuits) that the user can navigate between.

4. Go to the Checking_Continuity document (marked as “4” on Figure 2)

Part 2: Checking Continuity

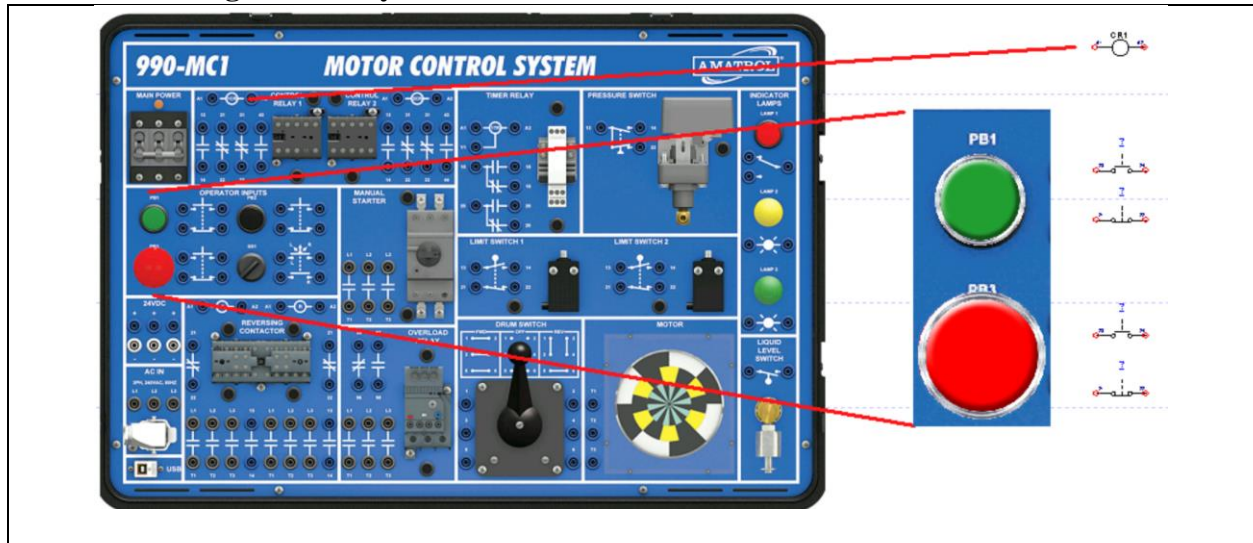


Figure 3. Simulating the Pushbuttons on the Motor Control training unit.

1. Figure 3 shows the Motor Control training unit and the devices that will be simulated:
 - a. Relay coil
 - b. PB1 (green) – Normally-open and normally-closed pushbutton contacts
 - c. PB3 (red) - Normally-open and normally-closed pushbutton contacts

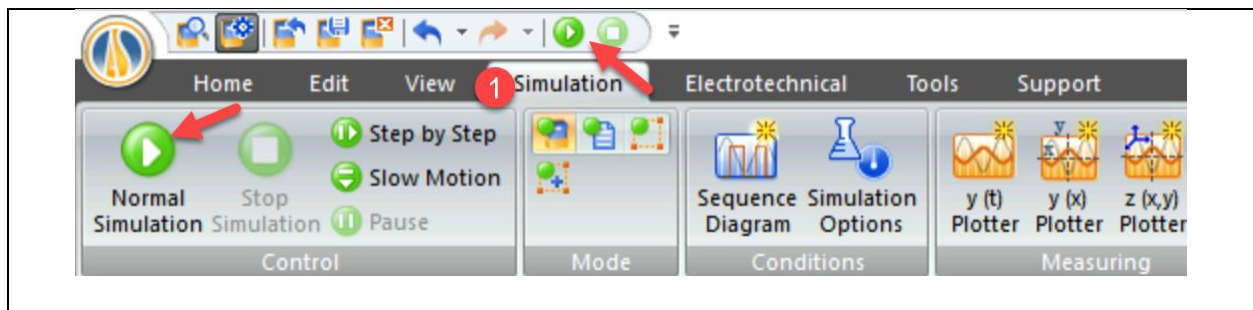


Figure 4. Starting the Simulation in Automation Studio.

2. Figure 4 shows the steps to start the Simulation:
 - a. Click on the Simulation tab
 - b. Click either the green simulation button at the top of the page, or the Normal Simulation button on the left.
3. Start the Simulation. Use the View menu if you have to resize the circuit.

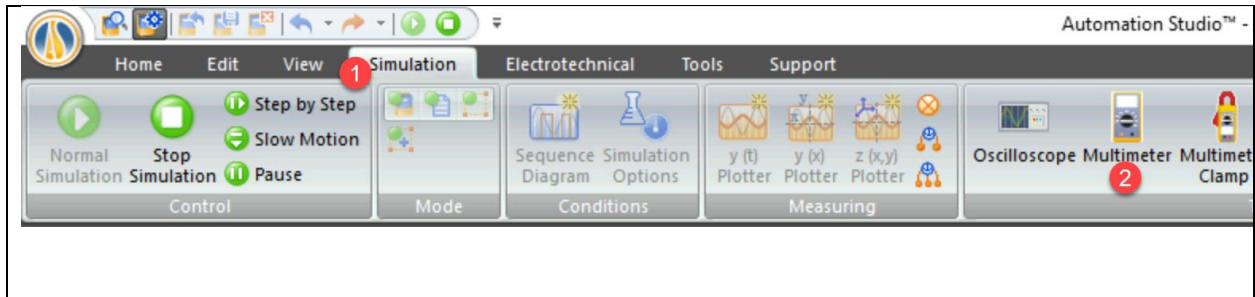


Figure 5. Accessing the Multimeter in Automation Studio.

4. Access the Multimeter in Automation Studio as shown in Figure 5:
 - a. Click on the Simulation tab
 - b. Choose the Multimeter (the user can click on the multimeter and drag to move it around).

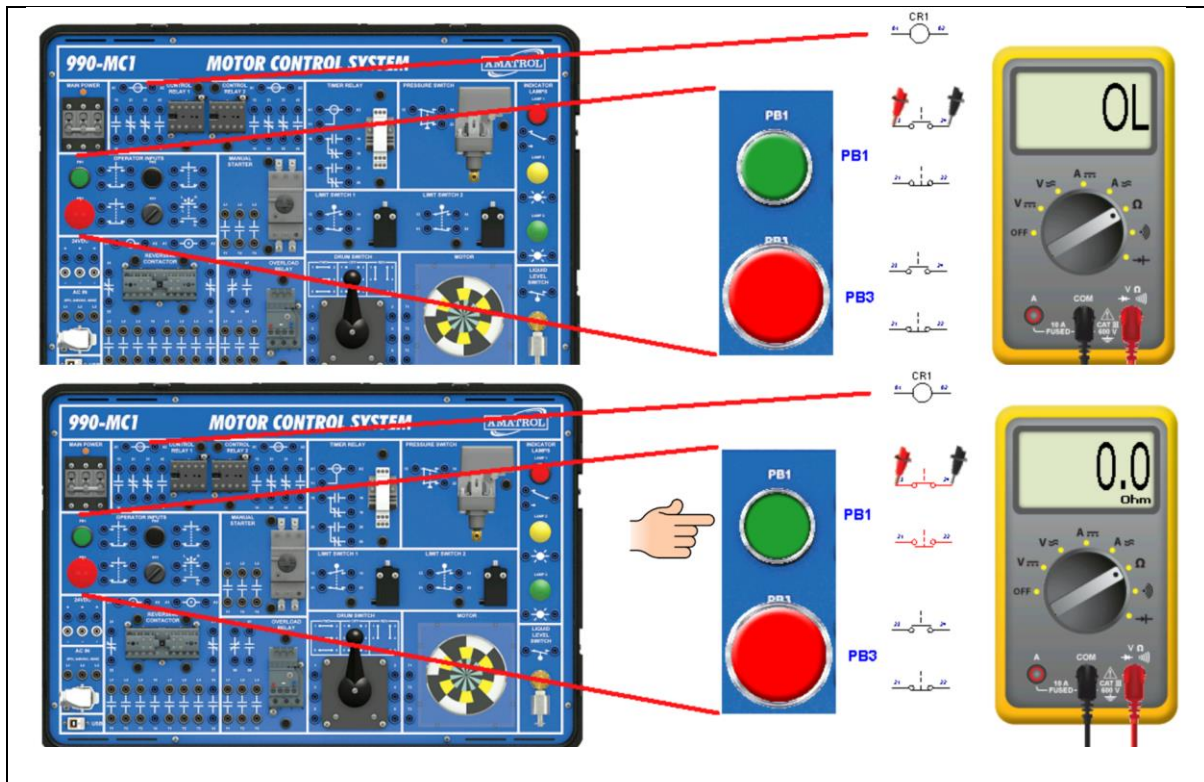


Figure 6. Checking the resistance of a pushbutton.

5. Click on the resistance scale (rotary dial) of the Multimeter, as shown in Figure 6.
6. Measure the resistance of the unactuated N.O. (Normally-Open) contact of PB1 (green)

7. Measure the resistance of the N.O. (Normally-Open) contact of PB1 (green) while actuating the pushbutton _____.
8. Measure the resistance of the unactuated N.C. (Normally-Closed) contact of PB1 (green) _____.
9. Measure the resistance of the N.C. (Normally-Closed) contact of PB1 (green) while actuating the pushbutton _____.

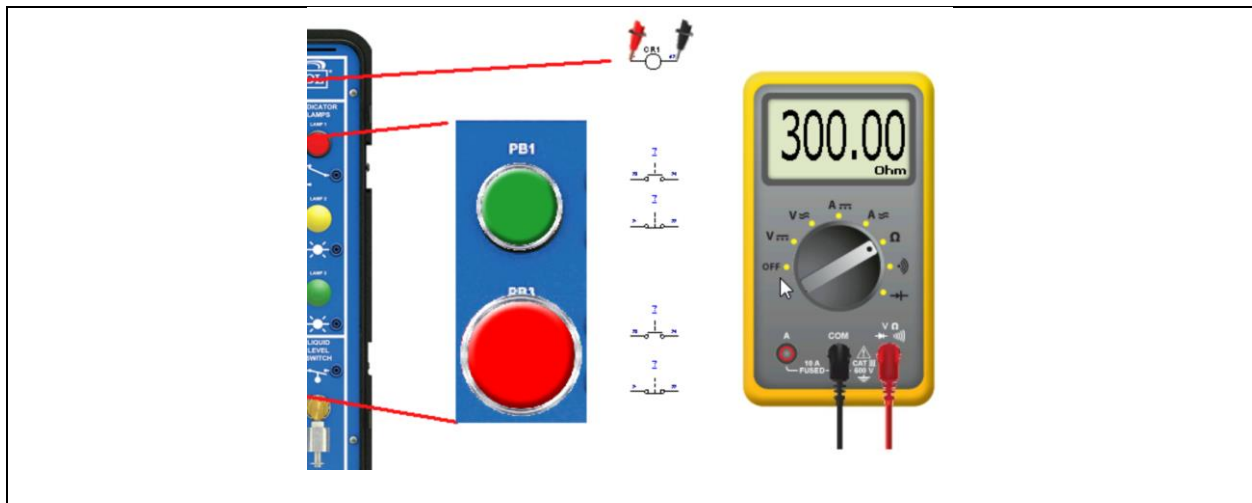


Figure 7. Measuring the relay coil resistance.

10. Move the multimeter probes to the coil as shown in Figure 7.
11. Measure the resistance of the coil in ohms _____.

Part 3: Measuring Power Sources:

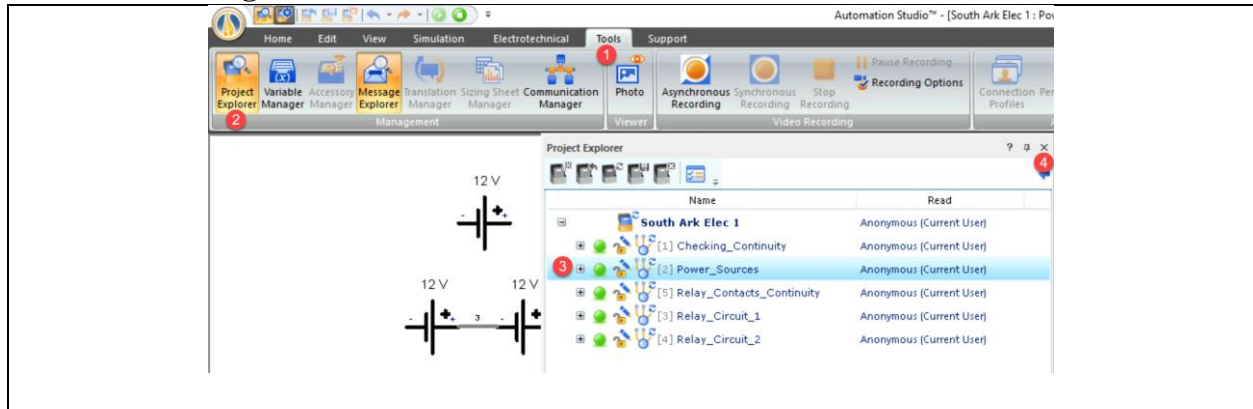


Figure 8. Moving to the Power Sources document.

1. Navigate to the Power_Sources document in the project as shown in Figure 8.
 - a. Tools tab
 - b. Project Explorer icon
 - c. Double click on the Power_Sources document

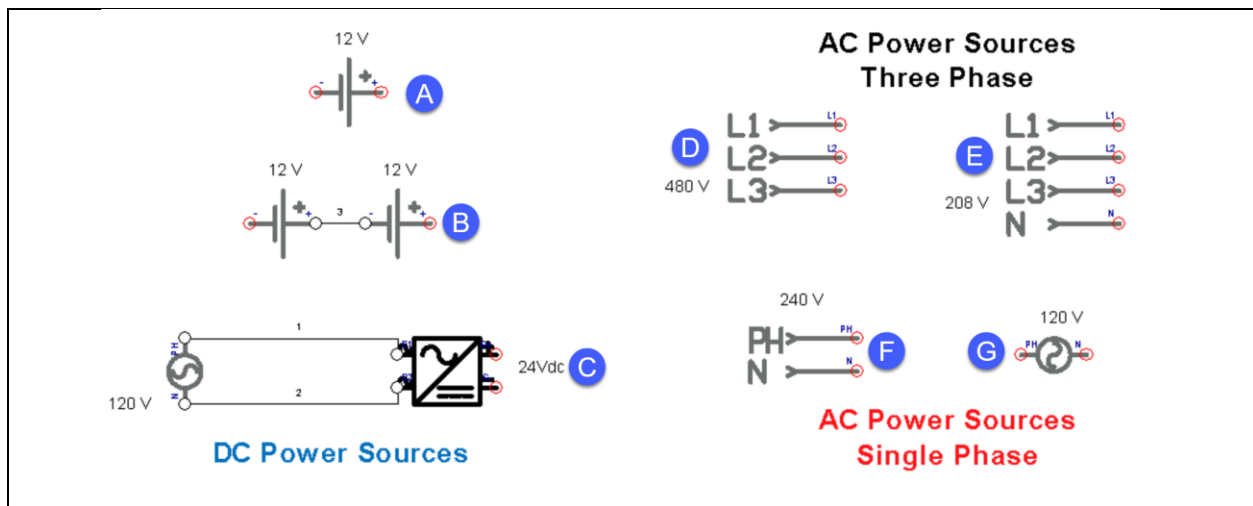


Figure 9. The Power Sources document.

2. Figure 9 shows the various DC & AC power sources. Use the Multimeter to measure the following DC voltages:
 - A. 12 Vdc battery _____
 - B. 24 Vdc battery (two batteries in series aiding) _____
 - C. 24Vdc power supply _____

3. Use the Multimeter to measure the following AC voltages:
 - D. 3 phase 480 (measure between any of the 3 leads _____)
 - E. 3 phase 208 (measure between any of the L1, L2 & L3 leads _____)
 - F. Single phase 120 _____
 - G. Single phase 120 _____

Part 4: Measuring Continuity on Relay Contacts.

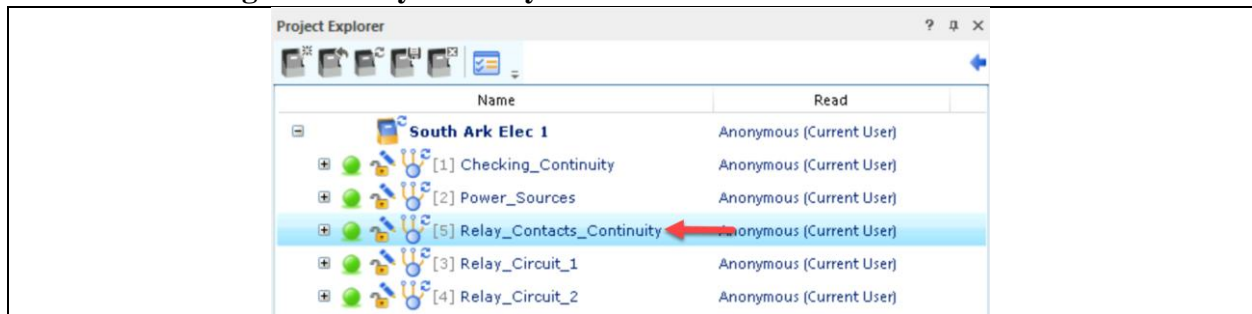


Figure 10. Navigating to the Relay_Contacts_Continuity document.

1. Navigate to the Power_Sources document in the project as shown in Figure 10.
 - a. Tools tab
 - b. Project Explorer icon
 - c. Double click on the Relay_Contacts_Continuity document

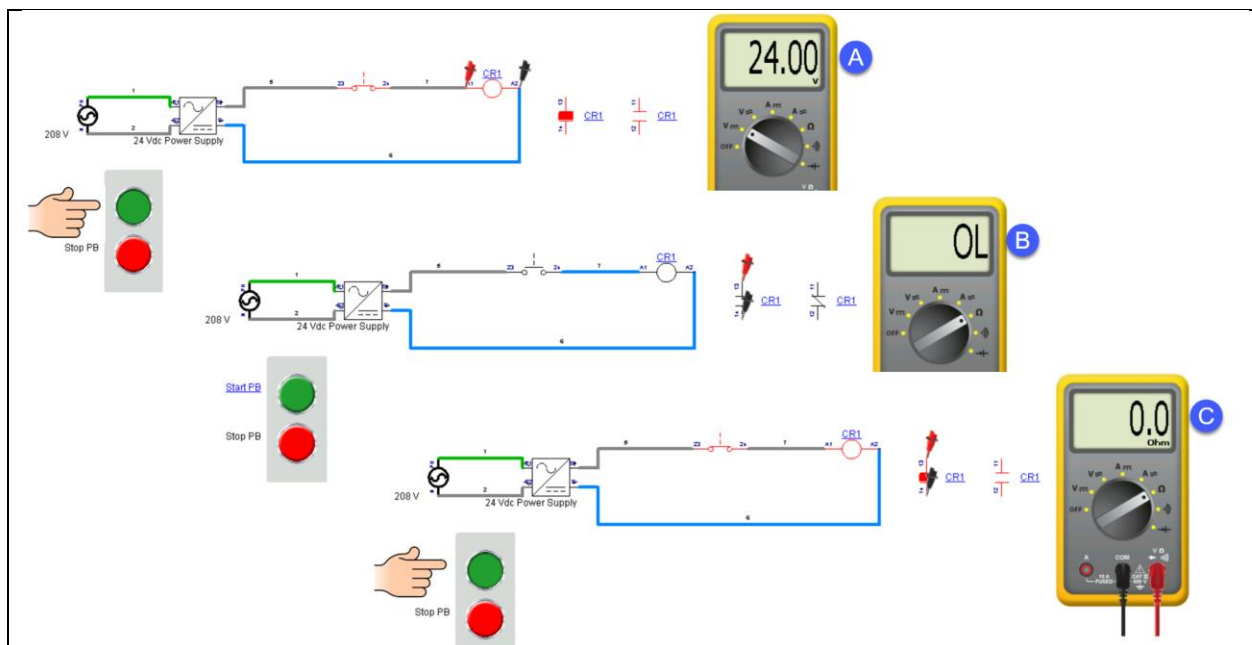


Figure 11. Measuring voltage and resistance in a circuit.

2. Measure the DC volts across the relay coil (CR1) with the pushbutton actuated (as shown in Figure 11-A) _____.
3. Measure the resistance of the N.O. contact on the CR1 relay with the StartPB (green) not actuated (as shown in Figure 11-B) _____.
4. Measure the resistance of the N.O. contact on the CR1 relay with the StartPB actuated (as shown in Figure 11-C) _____.
5. Measure the resistance of the N.C. contact on the CR1 relay with the StartPB (green) not actuated _____.
6. Measure the resistance of the N.C. contact on the CR1 relay with the StartPB (green) actuated _____.

Part 5: Learning how a Relay Works.

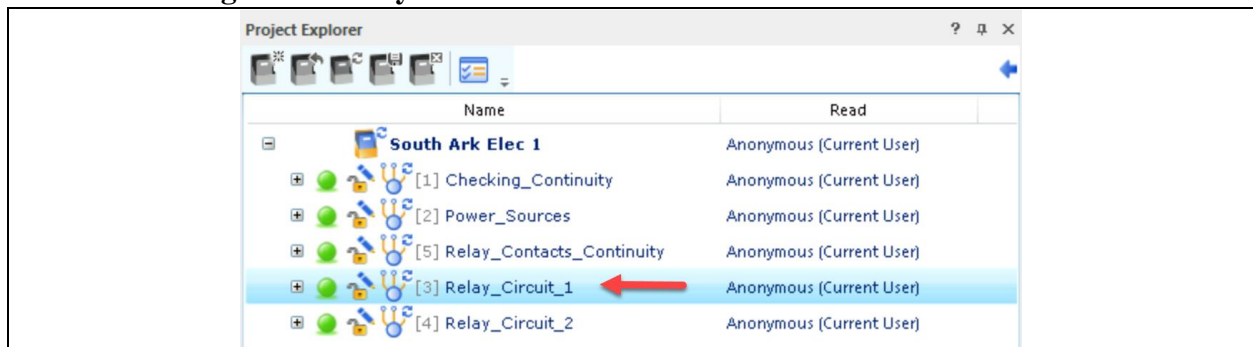


Figure 12. Navigating to the Relay_Circuit_1 document.

1. Navigate to the Power_Sources document in the project as shown in Figure 12.
 - a. Tools tab
 - b. Project Explorer icon
 - c. Double click on the Relay_Circuit_1 document

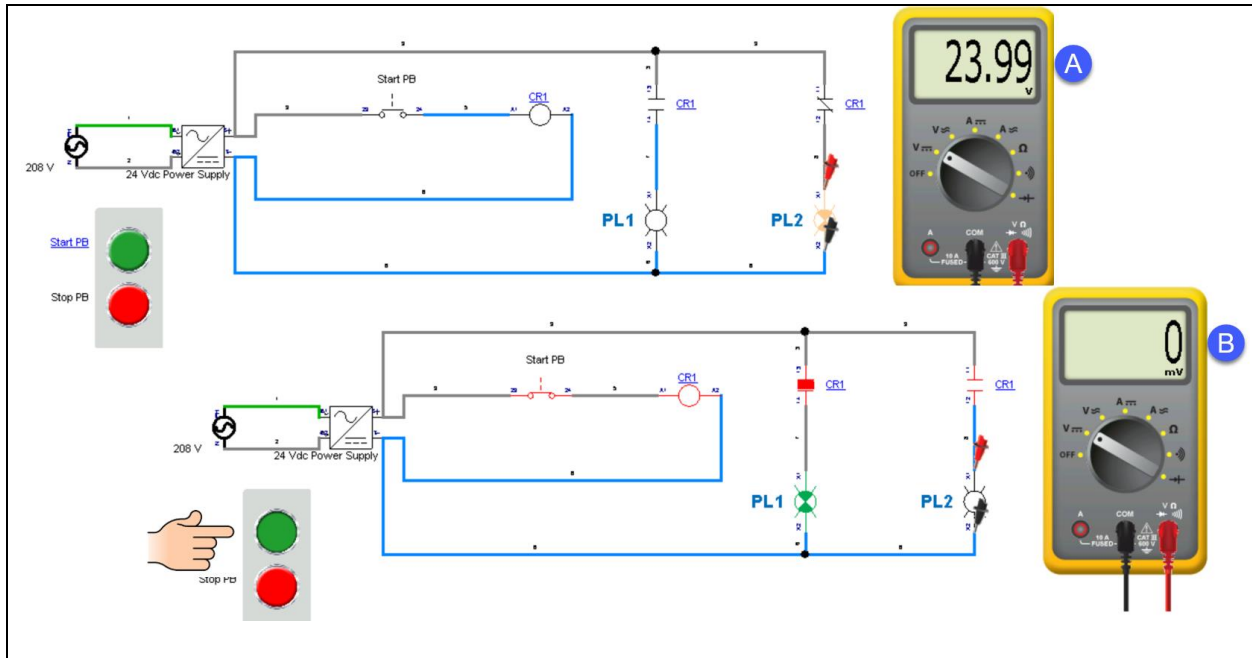


Figure 13. Measuring the voltage drop across a pilot light.

2. Figure 13 shows how to measure the voltage across a pilot light of a relay circuit that is using the contacts to turn on/off pilot lights.
3. Measure the voltage across PL2 (as shown in Figure 13-A) if the StartPB is not actuated _____.
4. Measure the voltage across PL2 (as shown in Figure 13-B) if the StartPB is actuated _____.
5. Measure the voltage across PL1 (first pilot light) if the StartPB is not actuated _____.
6. Measure the voltage across PL1 (first pilot light) if the StartPB is actuated _____.

Part 6: Relay in a Start/Stop Circuit.

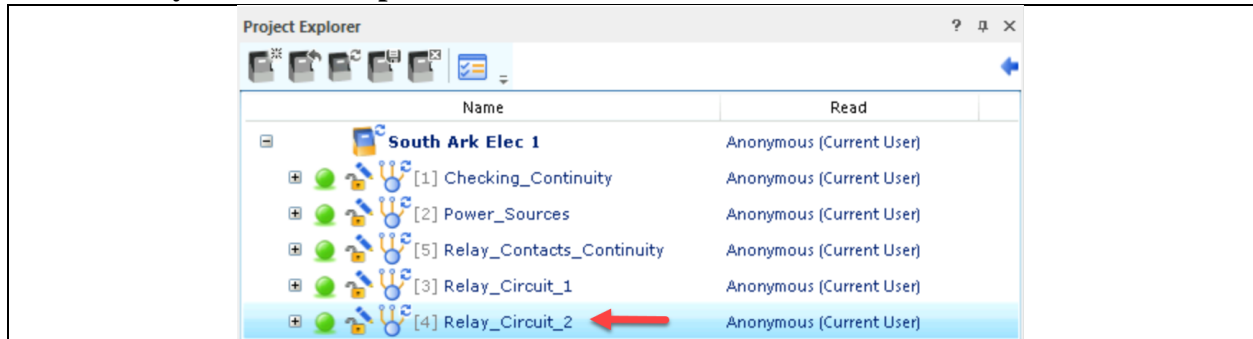


Figure 14. Navigating to the Relay_Circuit_2 document.

1. Navigate to the Power_Sources document in the project as shown in Figure 14.
 - a. Tools tab
 - b. Project Explorer icon
 - c. Double click on the Relay_Circuit_2 document

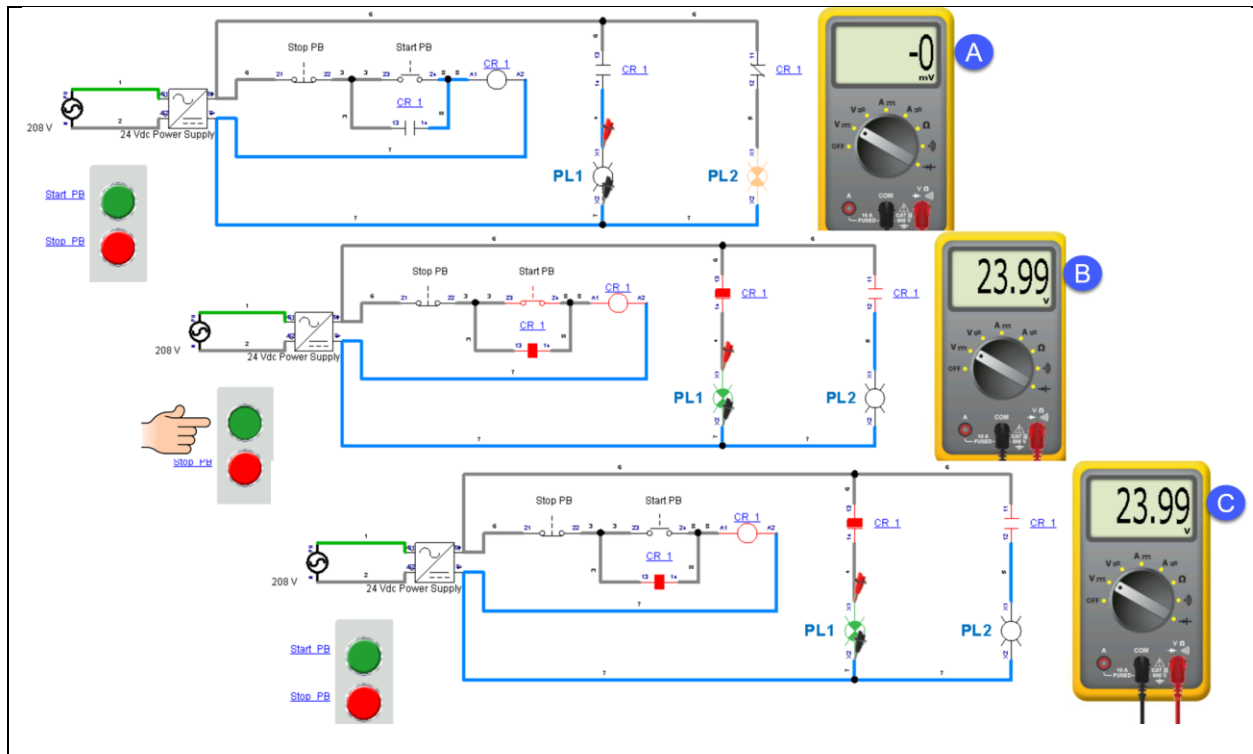


Figure 15. Measuring the voltage drop across pilot lights.

2. Figure 15 shows the relay in a start and stop pushbutton configuration with a hold-in contact, which is a normally-open contact in parallel with the start button. The purpose in the hold-in contact is to hold in the relay after the start pushbutton is released.
3. Actuate the Start_PB as shown in Figure 15-B. The relay should actuate.
4. Release the Start_PB as shown in Figure 15-C. The relay should remain actuated.
5. Actuate the Stop_PB (red). Does the relay release (shut off)? _____

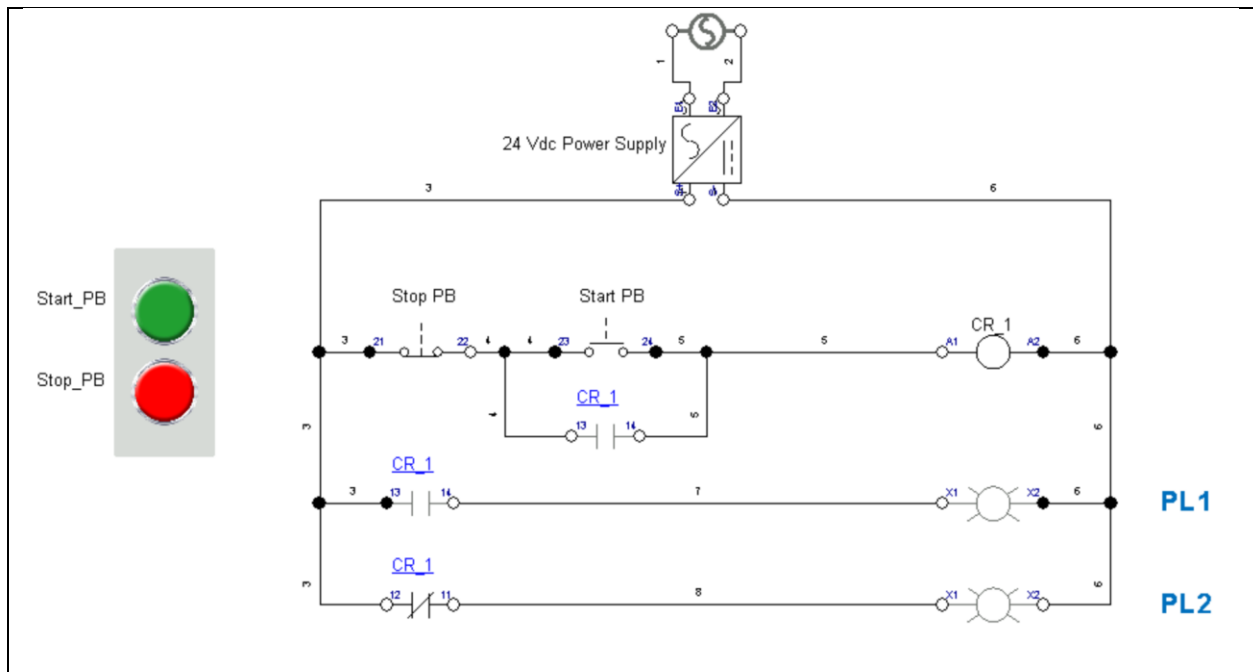


Figure 16. The circuit from Figure 15 drawn a different way.

6. Figure 16 shows the circuit from Figure 16 redrawn in a format more common in industry. This is sometime termed a ladder circuit, since it looks like the rungs of a ladder. The operation is the same.

Questions:

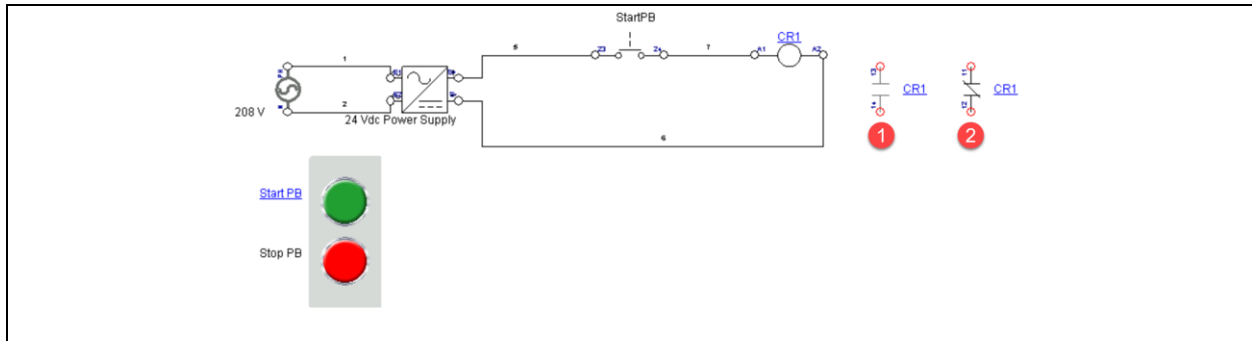


Figure 17. Relay circuit.

1. If the StartPB was not actuated in Figure 17, what should the resistance be across the CR1 contact marked with a “1”?
 - a. OL
 - b. 0 Ohms
 - c. 150 Ohms
 - d. Cannot determine with the information given

2. If the StartPB was actuated in Figure 17, what should the resistance be across the CR1 contact marked with a “2”?
 - a. OL
 - b. 0 Ohms
 - c. 150 Ohms
 - d. Cannot determine with the information given

3. What would be the voltage rating on the coil of the circuit in Figure 17?
 - a. 24 Vac
 - b. 24 Vdc
 - c. 120 Vac
 - d. 208 Vac

4. What would the resistance of the relay coil typically be in Figure 17 if it was removed from the circuit and measured with the Multimeter?
 - a. 0 ohms
 - b. OL
 - c. 150 ohms

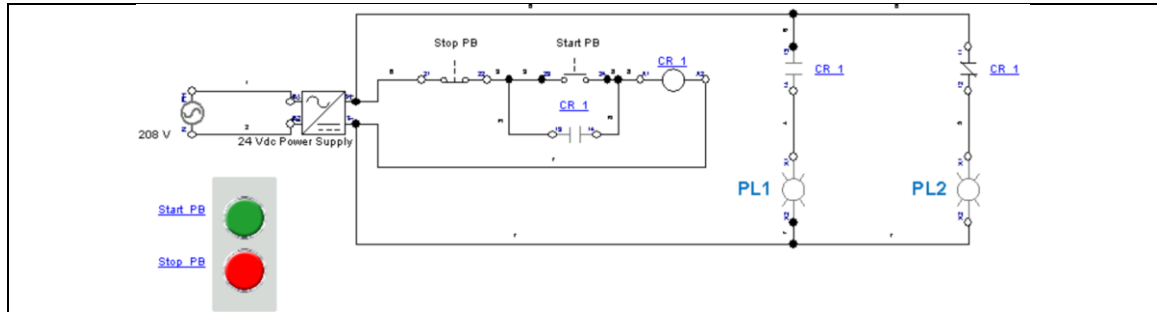


Figure 18. Relay in a start/stop circuit.

5. What should be the voltage measured across PL1 if the CR_1 coil is not energized in Figure 18?
 - a. 0 V
 - b. 24 Vac
 - c. 24 Vdc
 - d. 208 Vac

6. What should be the voltage measured across PL2 if the CR_1 coil is not energized in Figure 18?
 - a. 0 V
 - b. 24 Vac
 - c. 24 Vdc
 - d. 208 Vac

7. What should be the voltage measured across PL1 if the CR_1 coil is energized in Figure 18?
 - a. 0 V
 - b. 24 Vdc
 - c. 24 Vac
 - d. 208 Vac

8. What should be the voltage measured across PL2 if the CR_1 coil is energized in Figure 18?
 - a. 0 V
 - b. 24 Vdc
 - c. 24 Vac
 - d. 208 Vac



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