

Experiment 1 PLC -- Implementation of Basic Motor Controls

Purpose: To learn the use of the Allen Bradley SLC-5/04 with Relay Ladder Logic (RLL).

Task 1: Design and implement a three-wire start/stop motor control. Enter the design using the Rockwell RSLogix™ software. Verify that the three-wire start/stop motor control works by downloading your design into the Allen-Bradley SLC-5/04 using RSLinx™. Connect the fan motor between O:002/00 and ground. Connect the START button between H0T and I:001/00 and the STOP button between H0T and I:001/01. For this and the remaining tasks, label the contacts and relays in RLL diagram. After your three-wire start/stop motor control is working, get hardcopy of your RLL. Explain your use of either the normally open or normally closed contact on the physical switch and the logical switch in the RLL.

Warning: *Before continuing with the remaining task, plug the SLC-5/04 Power Supply into the GFI equip outlet on the cart. Make sure the lower tank has approximately 8 gallons of treated water in it with no water in the upper tank.*

Task 2: Replace the fan motor with the pump motor. To the design of Task 1 add a Float Switch (FS1) that turns the motor off automatically when the water level in the upper tank reaches a high-water level. Determine whether the switch contact is normally open or normally closed. Leave the switch in its present configuration. Place FS1 between H0T and I:001/02. Verify your design by starting the pump using the START button. Test that the pump stops and stays off when STOP is pressed. Verify that once the top tank fills, the pump motor turns off and remains off when the top tank is drained into the bottom tank. Once your design is working properly, get hardcopy of the RLL. Discuss what changes to the RLL would be required if the switch configuration were changed.

Task 3: To the design of Task 2 add a float switch (FS2) that turns the motor on automatically when the water level in the upper tank reaches a low-water level. Place FS2 between H0T and I:001/03. The pump should remain off until the START button is pressed. The top tank should fill until FS1 is activated. The pump should remain off while you drain the water back into the bottom tank. When the low water line is reached as indicated by FS2, the pump should come on automatically. Whenever the STOP button is pressed the motor should stop and remain off until pressing the START button restarts the automatic operation. Enter your design and download it to the SLC-5/04 or PLC-5/20. Once your design is working properly, get hardcopy of the RLL.

Task 4: To the design of Task 3 add a simulated float switch (FS3) that turns the motor off automatically when the water level in the bottom tank reaches a low-water level. Simulate FS3 with an external normally open switch. Place FS3 between H0T and I:001/04. Enter your design and download it to the SLC-5/04 or PLC-5/20. Once your design is working properly, get hardcopy of the RLL.

Task 5: To the design of Task 4 add simulated Pressure Switch (PS1) and a simulated solenoid (SOL). Use the fan motor used in task 1 to simulate the SOL. Assume SOL is in an air line between the upper tank and an automatic air compressor. Simulate the PS1 by an external switch at I:001/05 and SOL at O:002/01. Assume the PS1 is normally open. The tank should be pressurized only when the water level in the pressure tank reaches the high-water level. Once the PS1 closes then SOL should be de-energized. The upper tank must be refilled and FS1 is activated before this sequence is repeated. Enter your design and download it to the SLC-5/04 or PLC-5/20. Once your design is working properly, get hardcopy of the RLL.

Task 6: To the design of Task 5 add switch so that the system can be controlled automatically (Position A), by hand (Position H), or off (Position O). Enter your design and download it to the SLC-5/04 or PLC-

5/20. Once your design is working properly, get hardcopy of the RLL. Obtain instructors signature by successfully completing task and demonstration to instructor.

Signature Date

Background: One design approach for motor control is to first start with the classic 3-wire motor control. Then in an incremental manner add control components. After each control component is added, the design is checked for proper operation. This is the design methodology used in this laboratory exercise. Task 1 starts with the 3-wire motor control circuit. Then each feature is added and tested.¹

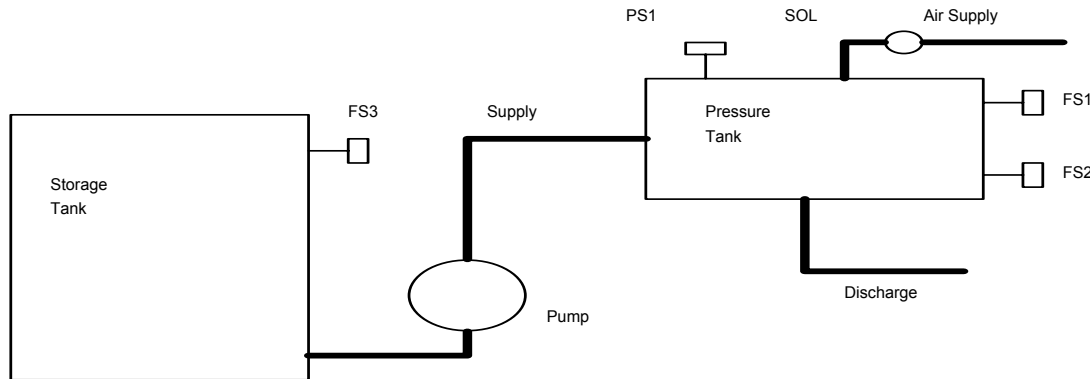


Figure 1 Arrangement of Control Components

Figure 1 is the system to be used for tasks 1 through 6. The control panel has the approximate layout of figure 2.

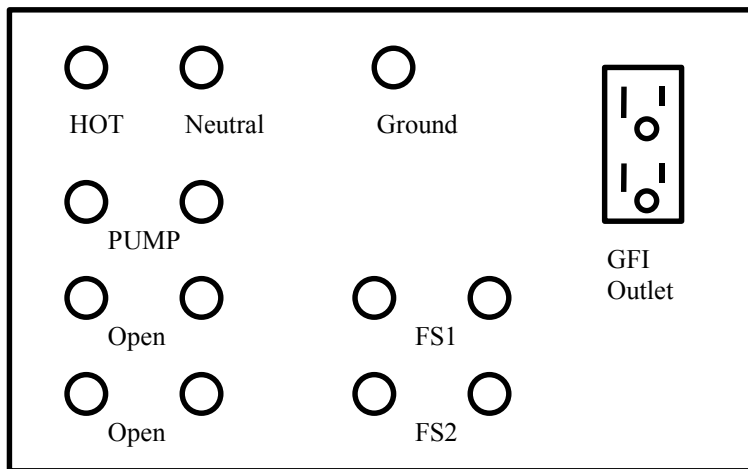


Figure 2 Control Panel Layouts

Rule of Thumb: The normal assumption is that if wiring to a switch fails is most likely to fail in an open circuit mode. Therefore when wiring a 3-wire start/stop the start switch should be normally open. If the wire to the start switch fails, then pressing the start switch will not be sensed as closed which would place 120 VAC at the input module and the system will not start. In a similar manner the stop switch should be normally closed. Therefore if the wiring from the stop switch fails the system will automatically stop.

¹ McIntyre and Losee, Industrial Motor Control Fundamentals, 4th edition, Mc-Graw-Hill Publishing 1990.

SLC 500 Interface

The SLC 5/04 systems have been placed in a metal cabinet, pictorially shown below. The connection to the Input and Output modules are made from the front panel. The power switch, fuses, and power sources connections are on the back of the cabinet.

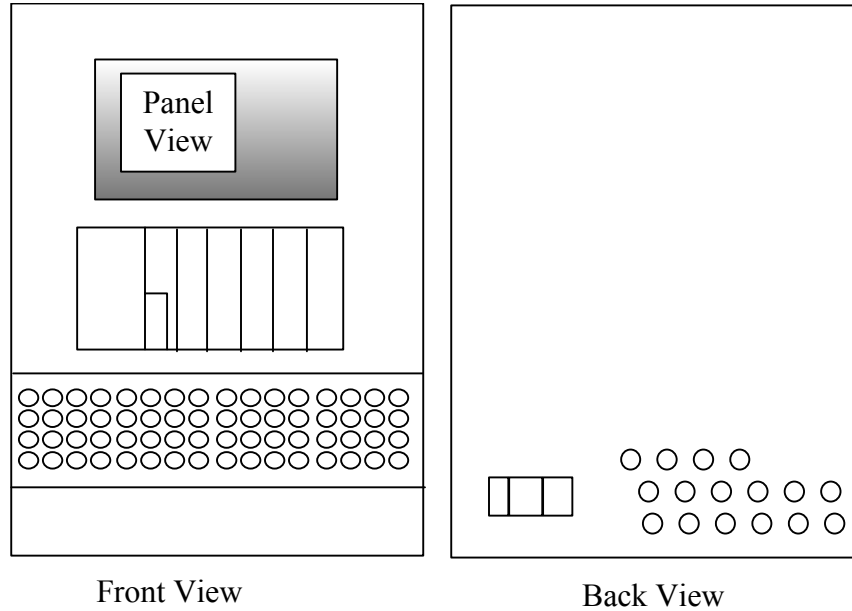


Figure 3 SLC 500 System

The front panel connections are grouped for each module from left to right. The right most module is the AC input module 1746-IA16 with the addressable nodes and the AC common or neutral. Note the addressable nodes are numbered from left to right and in decimal. The input connections are black and the AC commons are white. The address for the nodes is I:001/n where n varies from 0 to 15.

The next group is the AC output module 1746-OA16 with two separate AC hot connections. The address for the nodes is O:002/n where n varies from 0 to 15. The output connections are white and the separate AC hot connectors are black.

The next group is the DC input module 1746-ID8 with two separate DC common connections. The address for the nodes is I:003/n where n varies from 0 to 8. The input connections are red and the DC commons are white.

The next group is the DC output module 1746-OD32 with two separate DC common connection pairs and two separate positive voltage connection pairs. The address for the nodes is O:004/n where n varies from 0 to 31. The output connections are blue for the first 16 nodes and yellow for the last 16 nodes, and the DC commons are white and the positive supply nodes are red.

The last group is the analog input module 1746-AD4 with two separate DC common connection pairs. The address for the nodes is I:005/n where n varies from 0 to 3. Consult the SLC 500 system to determine the color.

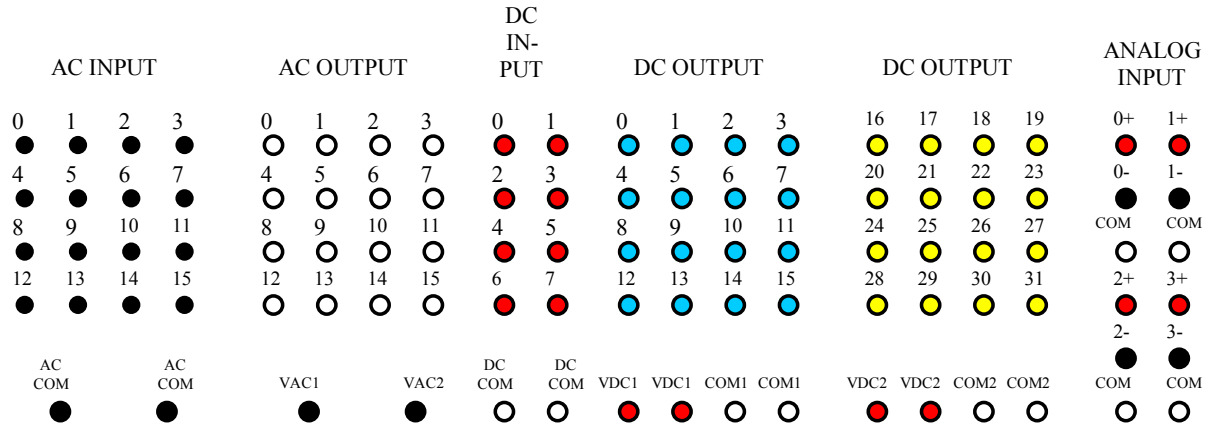


Figure 4 Front Panel Connects

The back panel has access to the sources and controls the power to the system. The power switch is on the right side of the chassis when facing the front of the system. The fuses are 5 AMP SBG.

When facing the system from the back, the right most three (black) connectors are connected to 120 VAC. The next group of three (white) connectors are connected to the system neutral. The next group of three (red) connectors are bussed together. In the future they will be connected to the positive voltage of an internal 5 volt supply. The next group of three (black) connectors are bussed together. In the future they will be connected to the negative voltage of an internal 5 volt supply. The next two (red and white) connectors are for future use. The last two (green) connects are connected to the system ground

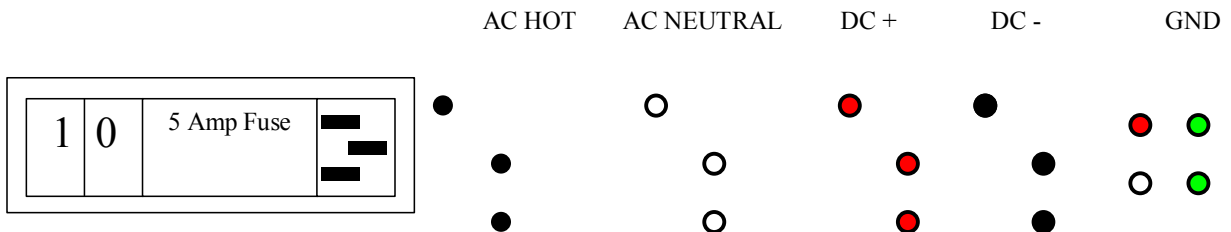


Figure 5 Back Panel Connections