

PLC124 LAB 1.1: WIRING AND TROUBLESHOOTING AN AC SINGLE PHASE MOTOR

Student Name: _____

Student ID: _____

LAB OUTCOMES:

1. Upon completion of this lab procedure, the student should be able to:
1. Wire a single phase, split-phase motor.
2. Reverse the direction of rotation of a split-phase motor.
3. Explain how to vary the speed of a self-excited DC shunt motor.
4. Wire a single phase, capacitor-start motor.
5. Reverse the direction of a capacitor-start motor.
6. Explain the correlation between starting current, running current and load.

LAB PROCESS:

****Extremely Important** – It is important that everyone working in the lab with rotating machinery must wear approved safety glasses, whether you are working on a motor or not.

PART 1:

1. Secure a Machines Training unit, and mount a split-phase motor (See figure 1) to the left side of the training unit. Ask the instructor for help if the machine is too heavy to put into place. If there is a coupling on the motor shaft or not, secure a coupling guard over the unit.
Warning: Do not run a rotating machine with a key stock in the key way.
2. Lock out and tagout the emergency stop pushbutton on the Machines Training Unit.
3. Plug the split-phase motor cable into the corresponding plug on the left side of the Machines Training Unit.

4. Obtain the correct plastic overlay for the external machine connections (left front side) and place it over the banana jacks (See figure 1).

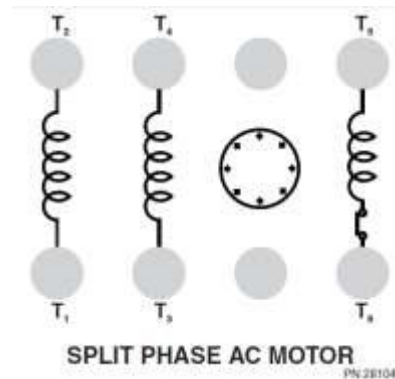


Figure 1: External connector overlay for the Split-phase motor

5. Wire the motor windings together in the split-phase configuration as shown in Figure 2.

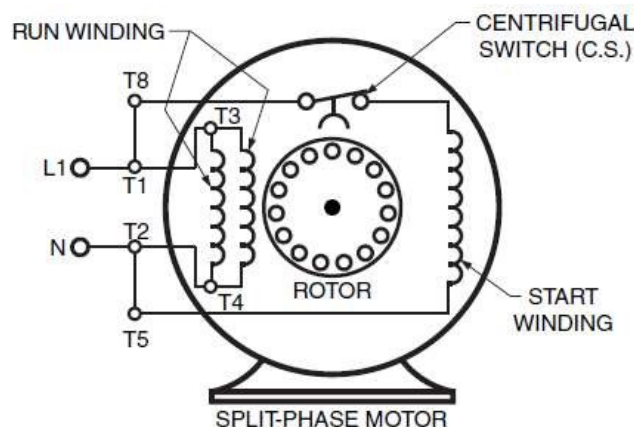


Figure 2: A split-phase motor electrical connections diagram

6. Verify the connections on the Machines Training Unit by reviewing the illustration in Figure 3, which shows the connections between the different banana jacks on the Unit.
7. Notice that the 120VAC power is coming from the 208V three phase power supply, taking one of the three phase hot lines, and a neutral (white) connector, which will give the user 120VAC.
8. Have your Lab Instructor verify your connections.

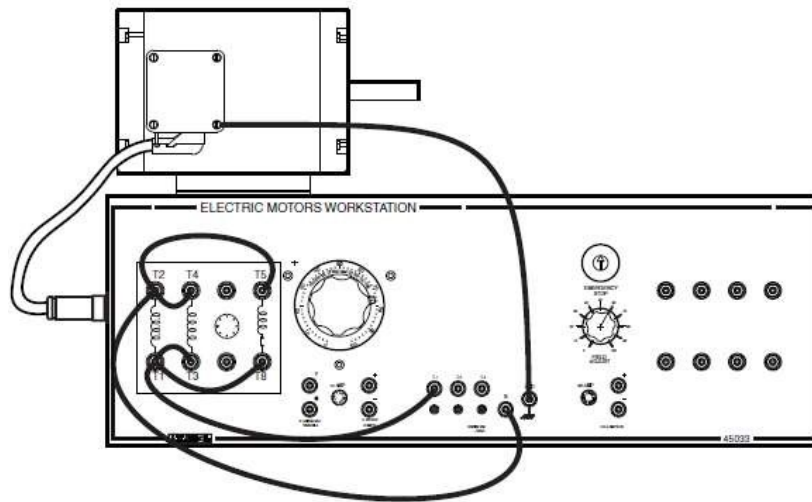


Figure 3: The wiring connections for a Split-phase motor.

9. Reset the Emergency Stop pushbutton and make sure the circuit breaker is on (left side of the Machines Training Unit. Make sure the Machines Training Unit is plugged into a three phase, 208V power source, and the three phase breaker (left side of unit) is turned on.
10. Can you hear the centrifugal switch kick out once the motor gets up to about 70% of full speed?
11. Using a tachometer, verify the speed (RPM) of the shaft at that time.

RPM = _____
12. What is the nameplate voltage for the split-phase motor? _____

Part 2:

1. View the shaft to determine the direction that the motor is running, either from the front or the back of the machine.

What direction is it turning? (CW or CCW) _____
2. Push the Emergency Stop, lockout and tagout the Machines Training Unit.

3. Reverse the start winding with the intent of reversing the direction of rotation of the shaft. Notice the start winding is T5 & T8. Originally they were connect to the run winding by T5 & T2 connected, and T8 & T1 connected. Now change this to: T5 & T1 connected, and T8 & T2 connected (See figure 4).

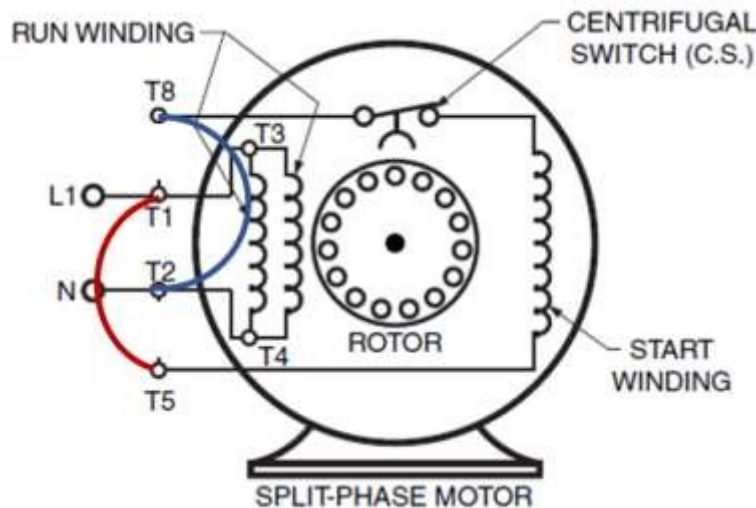


Figure 4: Reversing the start winding to change direction of rotation

4. Reset the Emergency Stop and remove the tagout to energize the motor.
5. Which direction does the motor shaft now turn in (CW or CCW)? _____
6. Push the Emergency Stop and lockout and tagout the Machines Training Unit.

Part 3:

1. Mount a multi-purpose motor (See figure 6) to the left side of the training unit. This unit is called a multi-purpose motor due to a custom build that has two capacitors inside the motor. The unit can be used as a capacitor-start, or capacitor run type of motor. Ask the instructor for help if the machine is too heavy to put into place. If there is a coupling on the motor shaft or not, secure a coupling guard over the unit.

Warning: Do not run a rotating machine with a key stock in the key way.

2. Lock out and tagout the emergency stop pushbutton on the Machines Training Unit.
3. Plug the multi-purpose motor cable into the corresponding plug on the left side of the Machines Training Unit.
4. Obtain the correct plastic overlay for the external machine connections (left front side) and place it over the banana jacks.
5. Wire the motor windings together in capacitor-start configuration as shown in Figure 5.

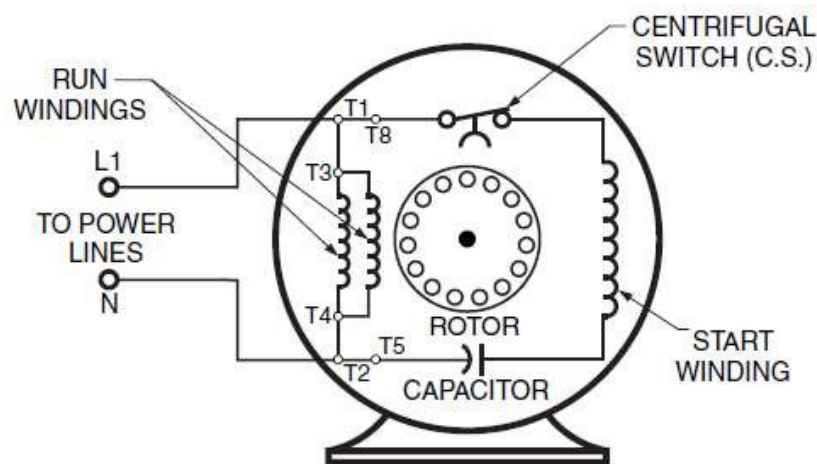


Figure 5: A capacitor-start motor electrical connections diagram

6. Verify the connections on the Machines Training Unit by reviewing the illustration in Figure 6, which shows the connections between the different banana jacks on the Unit.

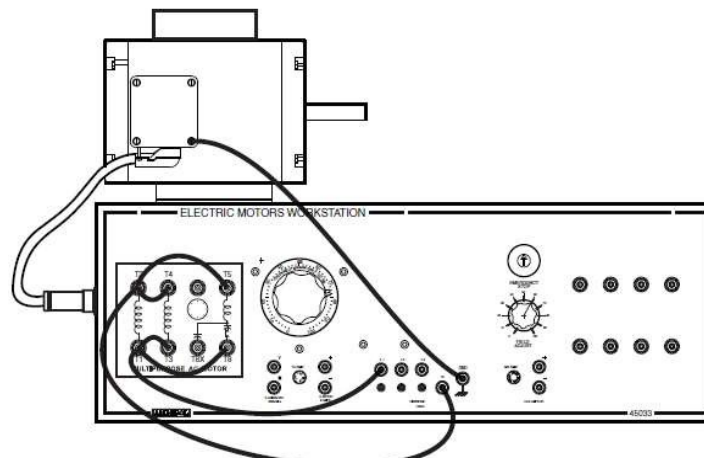


Figure 6: The wiring connections for a capacitor-start motor

7. Make sure the three phase breaker is off when doing these connections.
8. Have your Lab Instructor verify your connections.
9. Reset the Emergency Stop, remove the tagout and turn on the three phase breaker to energize the motor.
10. Does the motor start running? _____

Part 4:

1. Remove the coupling guard from the motor base, and mount the prony brake in its place.
2. Couple the prony brake to the motor.
3. Make sure there is $\frac{1}{4}$ inch of water inside the Brake Drum of the prony brake to cool the drum as the tightening of the cloth band to load the motor will create friction and heat.
4. Secure an AC voltmeter to go across the feed line to the motor (figure 11).
5. Secure a clip-on ammeter and attach around a power lead feeding the motor (figure 11).

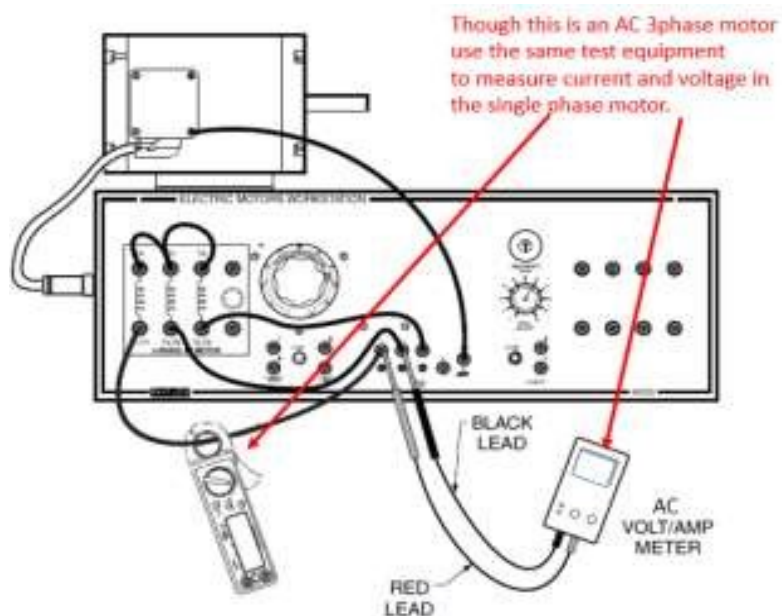


Figure 7: Test equipment to measure loading effect

6. Make sure there is electrical tape and a strip of reflective tape (1/16-in x 1-inch on the motor shaft) so the digital tachometer can be used to measure the RPM of the motor as it is loaded
7. Make sure your safety glasses are on, and notify the instructor to check your setup and reset the emergency stop pushbutton.
8. Remove the tagout and turn on the main power circuit breaker. The motor should accelerate.
9. Start loading the motor in 4 ounce increments starting at 4 ounces. Record the terminal voltage, the line current, and the rpm, so you can compare them as the motor is loaded. Fill this information into the chart.

MEASURED PERMANENT-CAPACITOR AC MOTOR PERFORMANCE CHARACTERISTICS TABLE										
LOAD (oz.)	4	8	12	16	20	24	28	32	36	40
INPUT CURRENT (amps)										
INPUT VOLTAGE (volts)										
SPEED (RPM)										

10. Reduce the load back to 0 ounces, and push the emergency stop pushbutton, then turn off the three phase circuit breaker. Press the Emergency Stop pushbutton, turn off the three phase breaker, and unplug the Machines Training Unit. Disassemble the circuit, and return the multi-purpose motor to its storage area.

Questions:

1. True or False? A capacitor start motor will have a higher starting torque than a split-phase motor.
2. What are the two ways to change the direction of rotation of a capacitor-start motor?
 - a. Reverse the start winding in reference to the run winding
 - b. Reverse the incoming voltage leads
 - c. Reverse the connections on the centrifugal switch
 - d. Reverse the connections on the capacitor
3. True or False? A permanent capacitor run motor does not usually use a centrifugal switch.

4. What are the lead identifiers for the start winding on most split-phase motors?
 - a. S1 & S2
 - b. T5 & T8
 - c. T1 & T4
 - d. T2 & T3
5. True or False? The centrifugal switch in a split phase AC motor is Normally Closed.
6. The purpose of the centrifugal switch in a split phase motor is to:
 - a. Remove the start winding from the circuit when the motor gets up to approximately 70% of full speed.
 - b. Pulls in a phase to help start a motor
 - c. Sends an alarm if the motor is turning
 - d. Removes the run winding on start up
7. When a split-phase motor starts getting more load put on it, what happens to line current?
 - a. Line current goes down
 - b. Line current goes up
 - c. Line current is not affected by load
8. What occurs if a centrifugal switch fails and does not open on a split-phase motor?
 - a. Motor will get real hot
 - b. Cannot happen. The centrifugal switch cannot fail.
 - c. The motor will operate normally

The outcomes of this exercise (listed on page 1) specifies the skills that the Student must demonstrate to the Instructor. Once the Instructor is satisfied with the demonstration of Knowledge & Skills by the individual student, they will sign this document (for the student), then enter a 100% into the Hands-On Lab grade in Sakai.

I verify that this student has completed all of the requirements of this Hands-On Assessment:

Student Name: _____

Faculty Signature: _____ Date: _____

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