

PLC123 LAB 2.2: WIRING AND TESTING A DC SHUNT MOTOR

Student Name: _____

Student ID: _____

LAB OUTCOMES:

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

1. Wire a self-excited DC shunt motor.
2. Reverse the direction of rotation of a self-excited DC shunt motor.
3. Vary the speed of a self-excited DC shunt motor.
4. Wire a separately-excited DC shunt motor.
5. Reverse the direction of rotation of a self-excited DC shunt motor.
6. Explain the correlation field and armature winding voltage and motor speed.

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.

Secure a Machines Training unit, and mount a DC machine 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.

Part 1:

1. Lock out and tagout the emergency stop pushbutton on the Machines Training Unit.
2. Plug the DC motor cable into the corresponding plug on the left side of the Machines Training Unit.

3. Obtain the correct plastic overlay for the external machine connections (left front side) and place it over the banana jacks.
4. Wire the motor windings together in the self-excited configuration as shown in Figure 1.

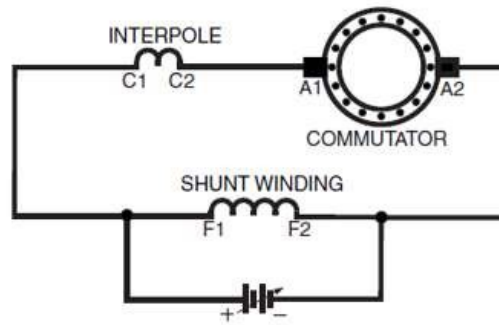


Figure 1: A self-excited DC shunt motor diagram

5. Verify the connections on the Machines Training Unit by reviewing the illustration in Figure 2, which shows the connections between the different banana jacks on the Unit.

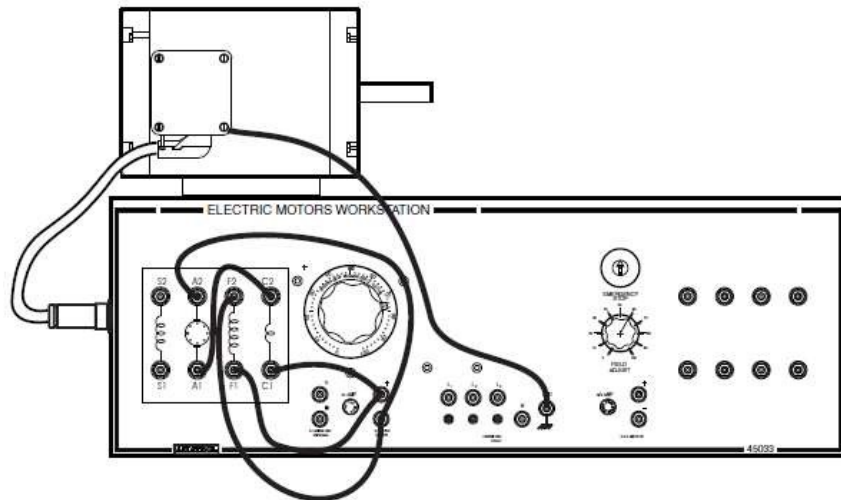


Figure 2: The wiring connections for a self-excited DC shunt motor

6. Make sure the Variac, which controls the variable DC voltages is rotated fully CCW (0 volts).

7. Have your Lab Instructor verify your connections.
8. Connect a DC voltmeter across the variable DC power source.
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. With the unit powered up, gradually start turning the variac up (CW) to increase voltage on the circuit.

At what voltage does the motor start turning? _____

11. Using a tachometer, verify the speed (RPM) of the shaft at that time.

RPM = _____

12. What is the nameplate voltage for the DC motor? _____
(make sure you do not exceed this voltage with the applied DC voltage).

13. Turn up the variac to go to 50% of nameplate voltage on the circuit.

What is the measured RPM? _____

14. Turn up the variac to go to 75% of nameplate voltage on the circuit.

What is the measured RPM? _____

15. Turn up the variac to go to 100% of nameplate voltage on the circuit.

What is the measured RPM? _____

16. Reduce the DC supply voltage to 50% of nameplate voltage.

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 field (shunt) winding with the intent of reversing the direction of rotation of the shaft (see Figure 3).

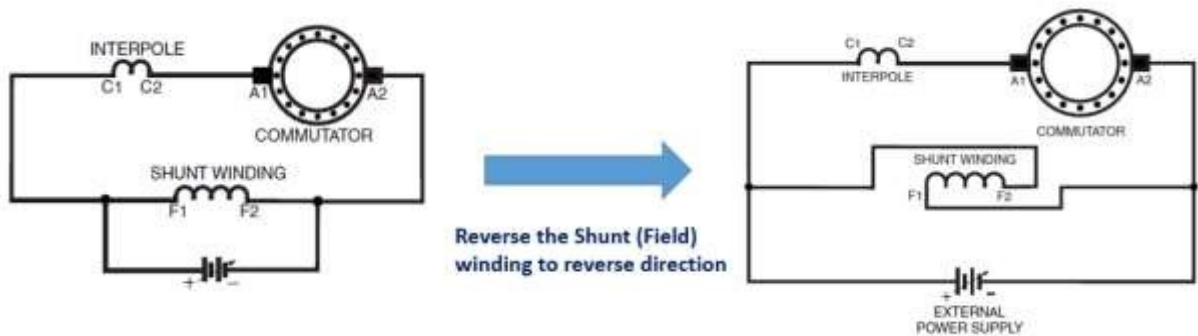


Figure 3: Reversing the Shunt (field) winding to change direction of rotation

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.
7. Change the wiring back to the original circuit (see Figure 4.)

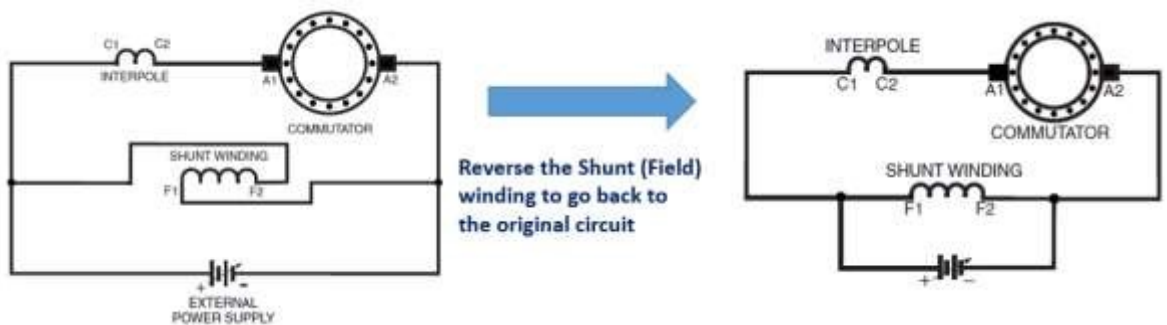


Figure 4: Returning the circuit to the original circuit/direction of rotation

8. Reset the Emergency Stop and remove the tagout to energize the Motor Training Unit.

9. Which direction does the shaft now turn (CW or CCW)? _____

Part 3:

1. Push the Emergency Stop pushbutton, lockout and tagout the Machines Training Unit.
2. Reverse the armature winding (specified as commutator in the diagram) as shown in Figure 5.

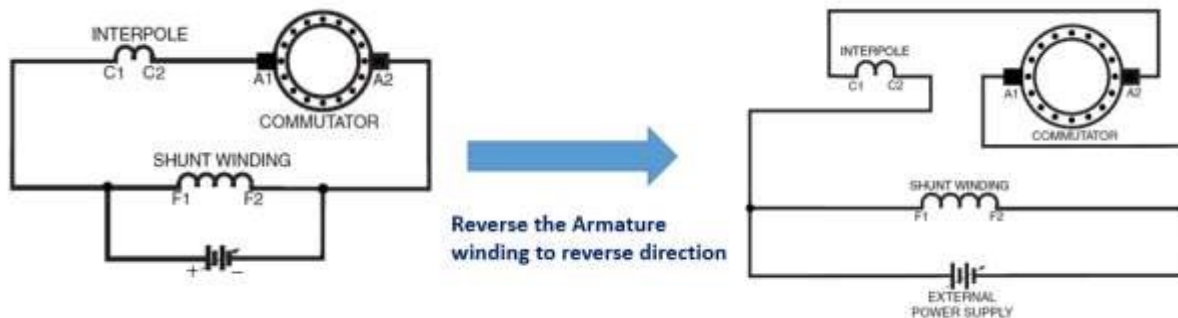


Figure 5: Reversing the Armature winding to change direction of rotation

3. Reset the Emergency Stop and remove the tagout to energize the motor.
4. Which direction does the shaft now turn (CW or CCW)? _____

Part 4:

1. Push the Emergency Stop pushbutton, lockout and tagout the Machines Training Unit.
2. Reverse the polarity of the power coming to the circuit from the variable DC power supply.
3. Reset the Emergency Stop and remove the tagout to energize the motor.
4. Which direction does the shaft now turn (CW or CCW)? _____
5. From the sequence of tasks from above, which of the following changes the direction of rotation?
 - a. Reversing the field (shunt) winding (__changes direction, __does not change direction)
 - b. Reversing the armature winding (__changes direction, __does not change direction)
 - c. Reversing the polarity of DC power (__changes direction, __does not change direction)

6. Push the Emergency Stop, lockout and tagout the Machines Training Unit.

Part 5:

1. Unwire the previous circuit, and reconnect the wires into the following connections to be a separately-excited DC shunt motor, as shown in Figure 6. Notice that two DC power supplies is now needed.

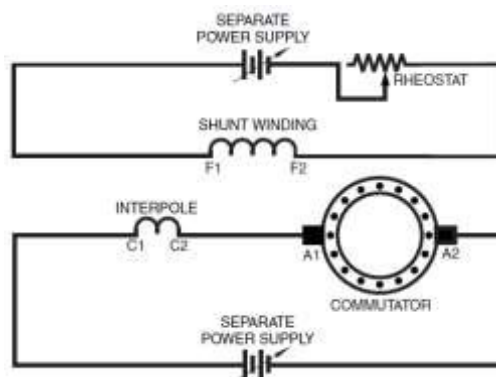


Figure 6: A separately-excited DC shunt motor diagram

2. Verify the connections on the Machines Training Unit by reviewing the illustration in Figure 7, which shows the connections between the different banana jacks on the Unit.

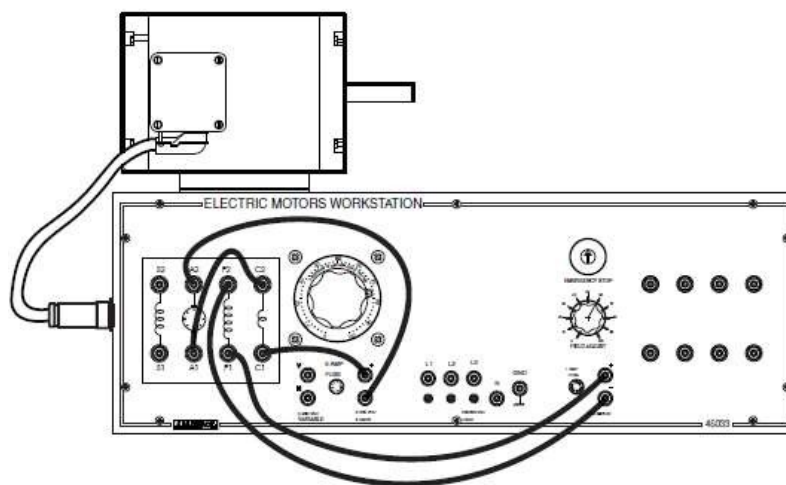


Figure 7: The wiring connections for a separately-excited DC shunt motor

3. Reset the Emergency Stop and remove the tagout to energize the motor.
4. Adjust the variac to change the voltage on the armature winding to be nameplate voltage.
5. Does the motor start running? _____
6. Start adjusting the field rheostat from full CCW to about 25% of circular rotation in the CW direction.

What happens to the speed of the motor? _____

7. Dial the selector switch of the digital meter on the Machines Training Unit to view the Field current.

What is this value? _____

8. Rotate the Field Rheostat to 50% of circular rotation in the CW direction.

What happens to the motor speed? _____

9. What happens to the field current, does it go up or down? _____
10. Explain the relationship between the field current, and the speed of a DC shunt motor.

11. Press the Emergency Stop pushbutton, turn off the three phase breaker, and unplug the Machines Training Unit. Disassemble the circuit, and return the DC machine to its storage area.

Questions:

1. True or False? A separately-excited DC shunt motor requires two different DC power supplies to control the speed and torque of the motor.
2. What are the two ways to change the direction of rotation of a self-excited DC shunt motor?
 - a. Reverse the field winding in reference to the armature winding
 - b. Reverse the polarity of the incoming DC voltage

- c. Reverse the armature winding in reference to the field winding
 - d. Reverse the interpole winding
3. True or False? Another name for the field winding is the shunt winding.
4. Which winding in a DC machine should measure the highest resistance with an ohmmeter?
- a. Armature winding
 - b. Field winding
 - c. Interpole winding
 - d. Series winding
5. True or False? One major advantage that DC motors had for many years over AC motors (until advancements in VFD technology) is the torque characteristics of the DC motor.
6. As a DC shunt motor is loaded more (increased load) mechanically (with a prony brake), what happens to the Armature current?
- a. Armature current goes down
 - b. Armature current goes up
 - c. Armature current is not affected by load
 - d. The armature winding is not used in a DC shunt motor
7. The device in the DC motor that the brushes connect to is called a(n):
- a. Rotor
 - b. Commutator
 - c. Interpole
 - d. Series winding
8. If the field current goes down in a separately-excited DC shunt motor, how is the motor speed affected?
- a. Motor speed goes up
 - b. Motor speed goes down
 - c. Motor speed is not affected by the field current
 - d. Field current must remain constant in a DC shunt motor or the speed will become unstable

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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