



EEE301 - ELECTROMECHANICAL ENERGY CONVERSION
LABORATORY

LAB 7

DC Permanent-Magnet Motor

SECTION NUMBER :

GROUP NUMBER :

GROUP MEMBERS :
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LAB 7

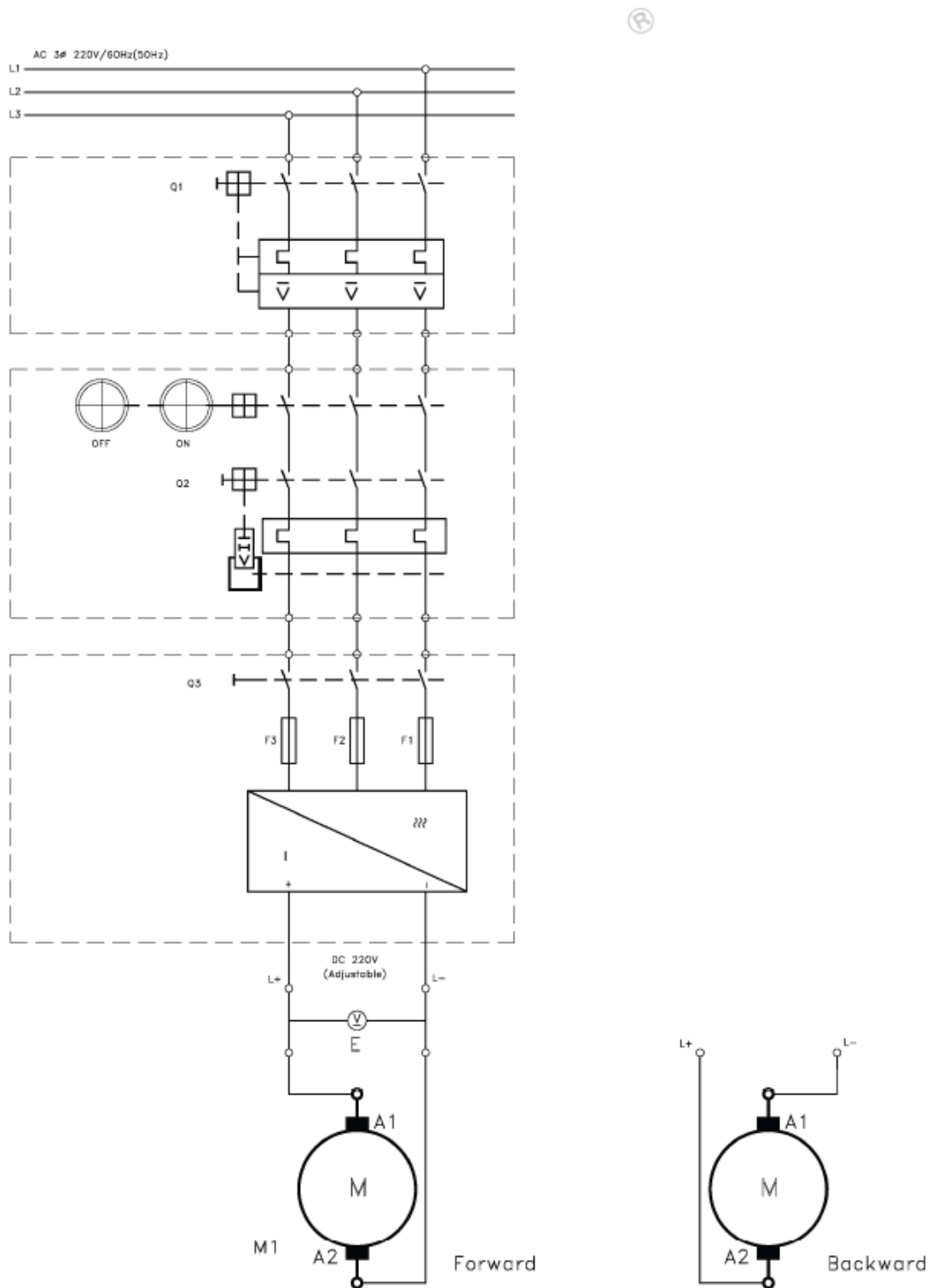
Connection and Motor Direction Control

OBJECTIVE

After completing this exercise, you should be able to demonstrate the connection of a DC permanent-magnet motor and control the direction of rotation of the motor.

EQUIPMENT REQUIRED

Qty	Description	Cat. No.
1	DC Permanent-Magnet Machine	EM-3330-1A
1	DC Power Supply Module	EM-3310-1A
1	Three-phase Power Supply Module	EM-3310-1B
1	Three-pole Current Limit Protection Switch Module	EM-3310-2A
1	Digital DCV Meter	EM-3310-3B
1	Laboratory Table	EM-3380-1A
1	Experimental Frame or Experimental Frame	EM-3380-2B EM-3380-2A
1	Connecting Leads Holder	EM-3390-1A
1	Connecting Leads Set	EM-3390-3A
1	Safety Bridging Plugs Set	EM-3390-4A



EM-3330-1A
DC PERMANENT MAGNET MACHINE

Fig. 3-1-1 Circuit diagram for motor direction control

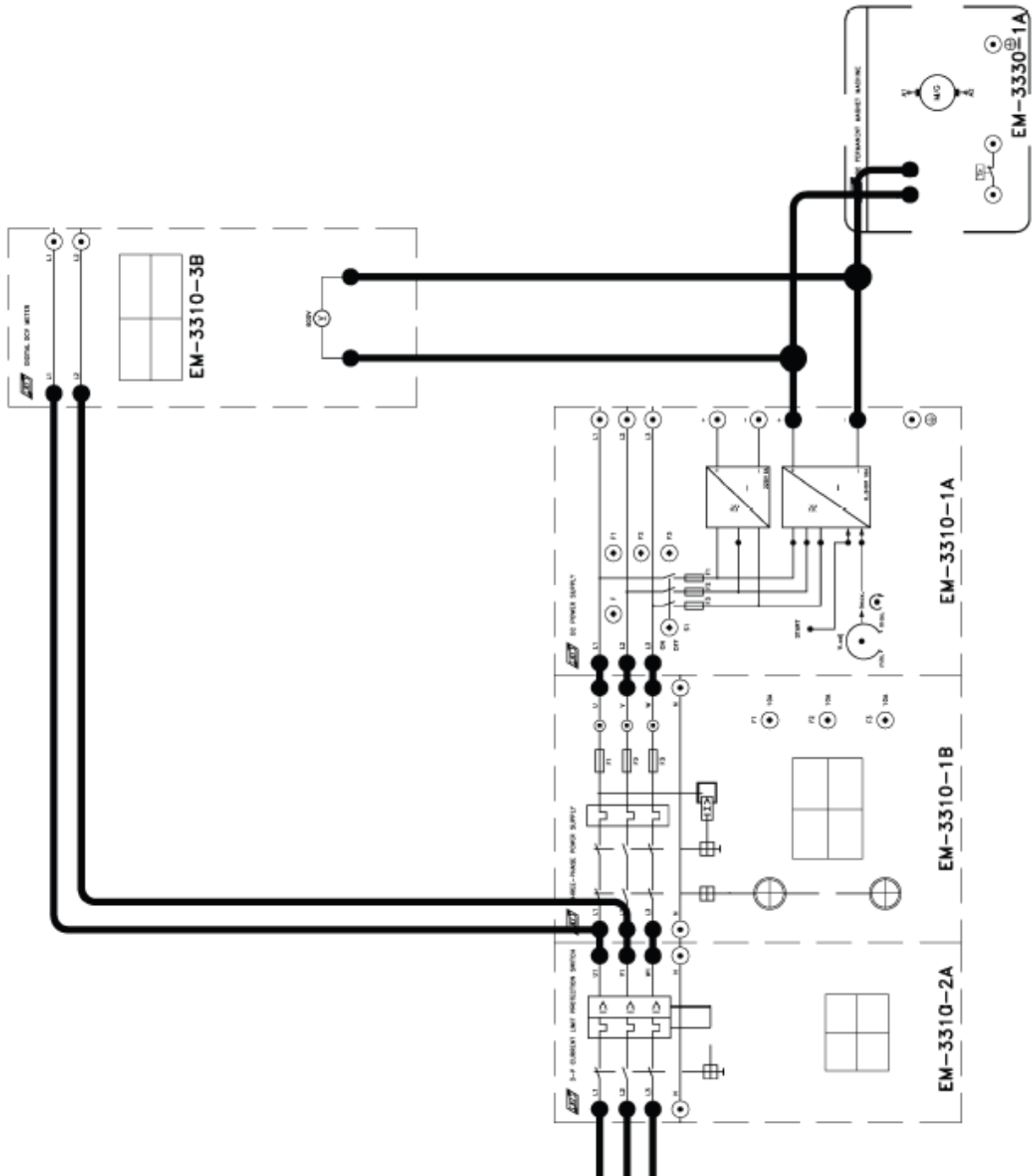


Fig. 3-1-2 Connection diagram for motor direction control

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PROCEDURE

CAUTION: High voltages are present in this laboratory exercise! Do not make or modify any connections with the power on unless otherwise specified! If any danger occurs, immediately press the red EMERGENCY OFF button on the Three-phase Power Supply Module.

1. Place the DC Permanent-Magnet (PM) Machine on the Laboratory Table and install the required Modules in the Experimental Frame. Construct the circuit in accordance with the circuit diagram in Fig. 3-1-1 and the connection diagram in Fig. 3-1-2. Have the instructor check your completed circuit.
2. Set the V.adj knob on the DC Power Supply Module to the min. position.
3. Sequentially turn on the 3-P Current Limit Protection Switch, Three-phase Power Supply, and DC Power Supply Modules.
4. Press the START button on the DC Power Supply Module.
5. On the DC Power Supply Module, slowly turn the V.adj knob to increase the motor voltage E . Observe and record the direction of rotation of the PM motor. **Note:** The motor voltage must not exceed the rated value of 180 Vdc.

The direction of rotation = _____

6. Slowly return the V.adj knob on the DC Power Supply Module to the min. position.
7. Sequentially turn off the DC Power Supply, Three-phase Power Supply, and 3-P Current Limit Protection Switch Modules.
8. Reverse the connecting leads to A1 and A2 terminals on the panel of the DC Permanent-magnet Machine.
9. Set the V.adj knob on the DC Power Supply Module to the min. position.



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10. Sequentially turn on the 3-P Current Limit Protection Switch, Three-phase Power Supply, and DC Power Supply Modules.
11. Press the START button on the DC Power Supply Module.
12. Slowly turn the V.adj knob on the DC Power Supply Module to increase the motor voltage E. Observe and record the direction of rotation of the PM motor. **Note:** The motor voltage must not exceed the rated value of 180 Vdc.

The direction of rotation = _____

13. Slowly return the V.adj knob on the DC Power Supply Module to the min. position.
14. Sequentially turn off the DC Power Supply, Three-phase Power Supply, and 3-P Current Limit Protection Switch Modules.



Torque-Speed Characteristic

OBJECTIVE

After completing this exercise, you should be able to demonstrate the torque-speed characteristic of DC permanent-magnet motor.

EQUIPMENT REQUIRED

Qty	Description	Cat. No.
1	DC Permanent-Magnet Machine	EM-3330-1A
1	Magnetic Powder Brake Unit	EM-3320-1A
1	Brake Controller	EM-3320-1N
1	DC Power Supply Module	EM-3310-1A
1	Three-phase Power Supply Module	EM-3310-1B
1	Three-pole Current Limit Protection Switch Module	EM-3310-2A
1	Digital DCA Meter	EM-3310-3A
1	Digital DCV Meter	EM-3310-3B
1	Coupling	EM-3390-2A
1	Coupling Guard	EM-3390-2B
1	Shaft End Guard	EM-3390-2C
1	Laboratory Table	EM-3380-1A
1	Experimental Frame	EM-3380-2B
	or Experimental Frame	EM-3380-2A
1	Connecting Leads Holder	EM-3390-1A
1	Connecting Leads Set	EM-3390-3A
1	Safety Bridging Plugs Set	EM-3390-4A

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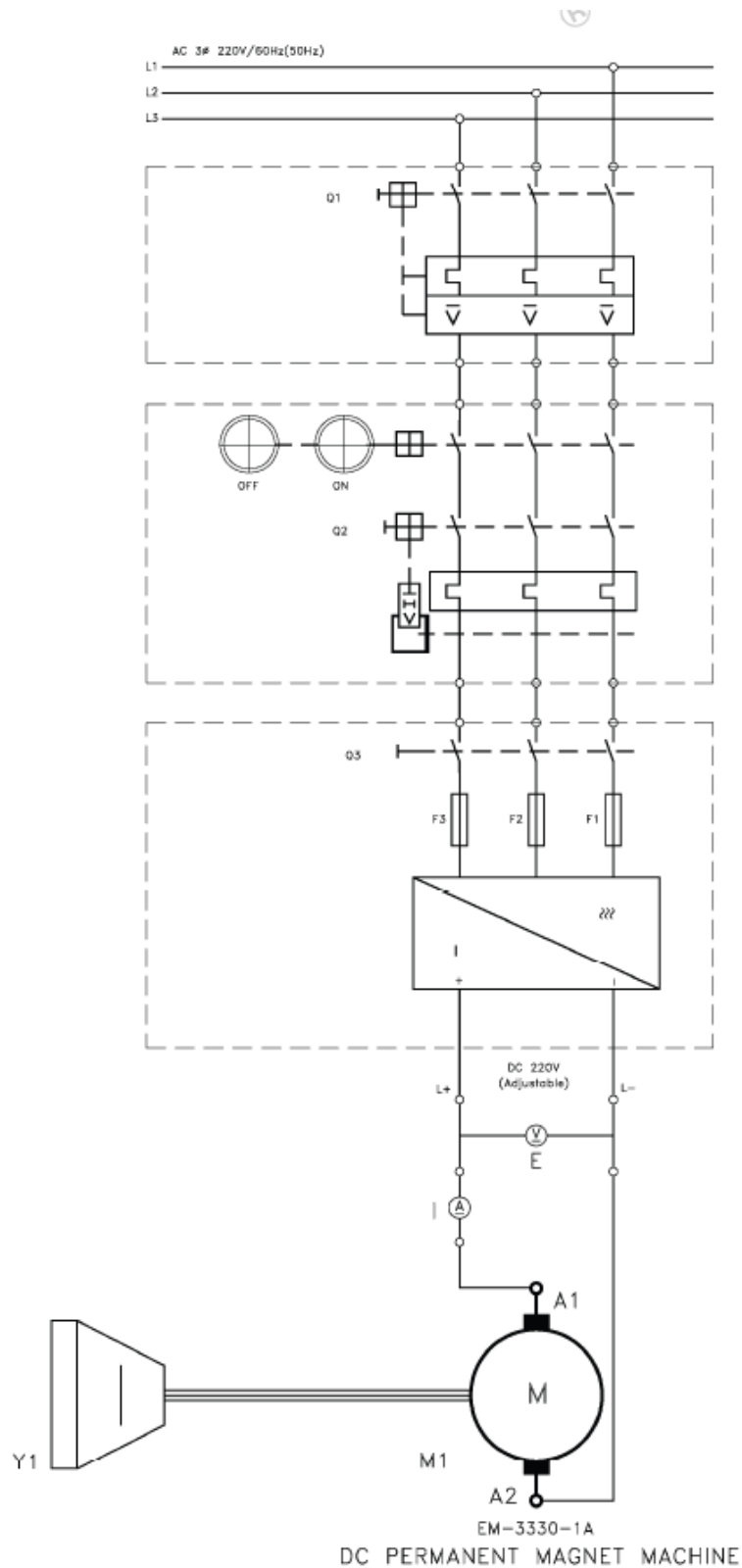


Fig. 3-2-1 Circuit diagram for torque-speed characteristic test

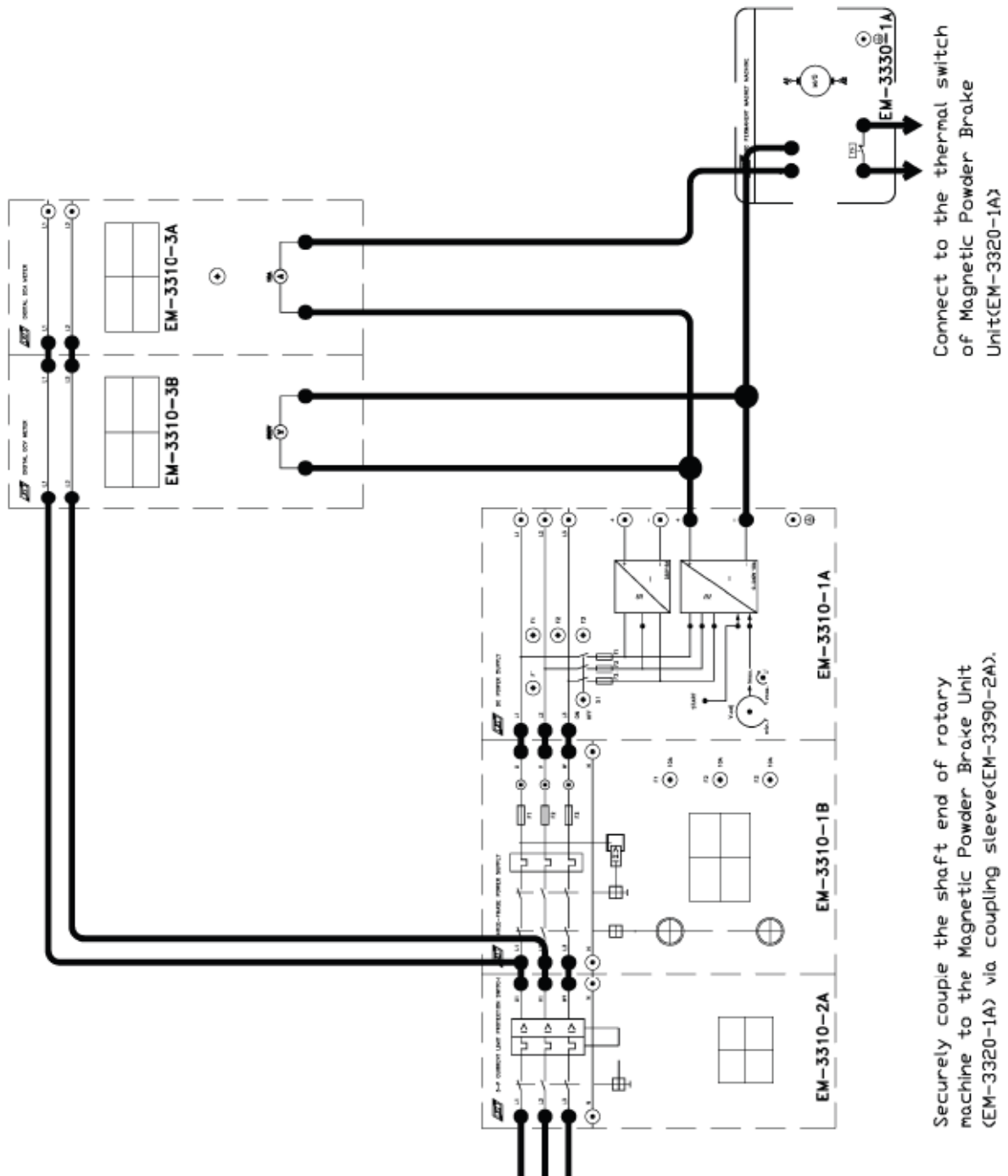


Fig. 3-2-2 Connection diagram for torque-speed characteristic test



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PROCEDURE

CAUTION: High voltages are present in this laboratory exercise! Do not make or modify any connections with the power on unless otherwise specified! If any danger occurs, immediately press the red EMERGENCY OFF button on the Three-phase Power Supply Module.

1. Place the DC Permanent-magnet Machine, Magnetic Powder Brake Unit and Brake Controller on the Laboratory Table. Mechanically couple the DC Permanent-magnet Machine to the Magnetic Powder Brake Unit using a Coupling. Securely lock the Machine Bases together using delta screws. Install the Coupling Guard and the Shaft End Guard. Connect the Brake Controller to the Magnetic Powder Brake Unit using the supplied cable.

Complete this laboratory exercise as quickly as possible to avoid the rise in temperature under load condition.

2. Install the required Modules in the Experimental Frame. Construct the circuit in accordance with the circuit diagram in Fig. 3-2-1 and the connection diagram in Fig. 3-2-2. Have the instructor check your completed circuit. **Note:** The thermal switches of Permanent-magnet Machine and Magnetic Powder Brake Unit must be connected together.

Make yourself familiar with the operation of Brake Controller by referring to the EM-3320 Operation Manual.

Before using the Brake Controller and Magnetic Powder Brake Unit, you must first calibrate the torque display of Brake Controller to 0 kg-m by adjusting the zero adj knob located on the rear panel of Magnetic Powder Brake Unit with the power on.

3. Set the V.adj knob on the DC Power Supply Module to the min. position. Sequentially turn on the Brake Controller, Magnetic Powder Brake Unit, 3-P Current Limit Protection Switch, Three-phase Power Supply, and DC Power Supply Modules.
4. Press the START button on the DC Power Supply Module.

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5. Slowly turn the V.adj knob on the DC Power Supply Module to increase the motor voltage E up to the rated value of the DC PM motor, 180 Vdc.
6. Manipulate the Brake Controller to operate in Mode\Closed Loop\Constant Torque mode and set the output torque to 0 kg-m. If the Controller doesn't operate normally, reboot it by pressing the RESET button. If the rotor is locked by a heavy brake torque, release the braking by pressing the ESC or BACK button.
7. Record the values of the motor speed N (obtained from the Brake Controller), the motor current I (obtained from the Digital DCA Meter), and the motor voltage E (obtained from the Digital DCV Meter) in Table 3-2-1.
8. Manipulate the Brake Controller to release the braking. That is to say, release the braking by pressing the ESC or BACK button on the Brake Controller.
9. Repeat steps 6 through 8 for other torque settings listed in Table 3-2-1. **Note:** The motor current must not exceed 130% of the rated value, $2.7\text{A} \times 1.3 = 3.51\text{A}$.
10. Slowly return the V.adj knob on the DC Power Supply Module to the min. position.
11. Sequentially turn off the DC Power Supply, Three-phase Power Supply, and 3-P Current Limit Protection Switch Modules, Magnetic Powder Brake Unit and Brake Controller.
12. Using the results of Table 3-2-1, plot the N vs T curve on the graph of Fig. 3-2-3.
13. Using the results of Table 3-2-1, plot the I vs T curve on the graph of Fig. 3-2-4.

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Table 3-2-1 Measured values of I, E, and N

T (kg-m)	0	0.05	0.1	0.15	0.2	0.25
I (A)						
E (V)						
N (rpm)						

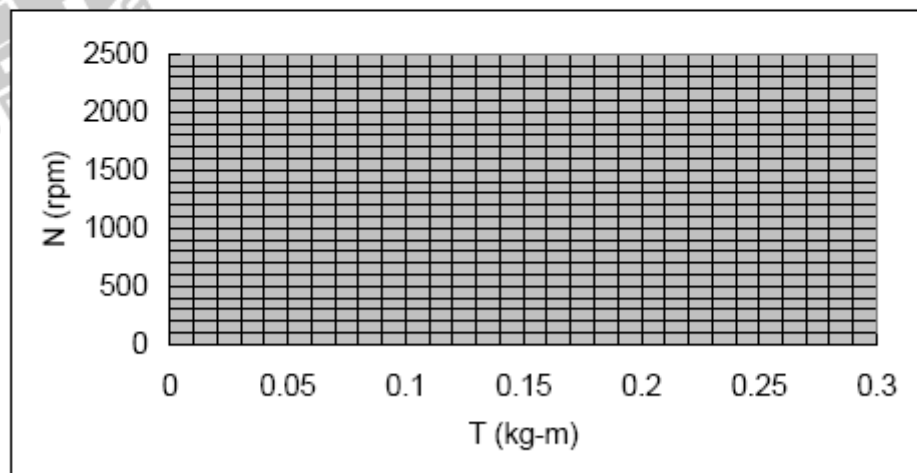


Fig. 3-2-3 The N vs T curve

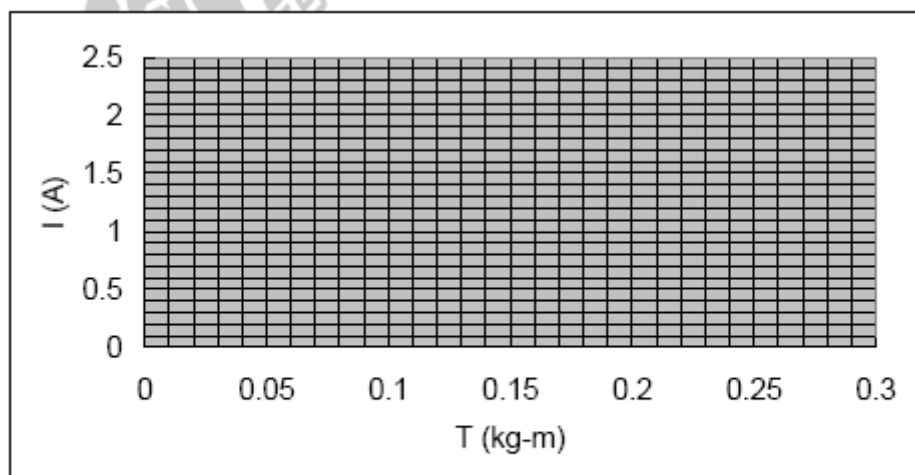


Fig. 3-2-4 The I vs T curve



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