LAB 8

DC Separately-Excited Generator

SECTION NUMBER : .....

GROUP NUMBER : .....

GROUP MEMBERS : .....

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LAB 8

No-Load Saturation Characteristic

OBJECTIVE

After completing this exercise, you should be able to demonstrate the operating characteristic of a DC separately-excited generator under no-load saturation condition.

EQUIPMENT REQUIRED

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

NOTE: Though the Multifunction Machine can be used as a separately excited generator, it is inferior to individual generator in characteristics.

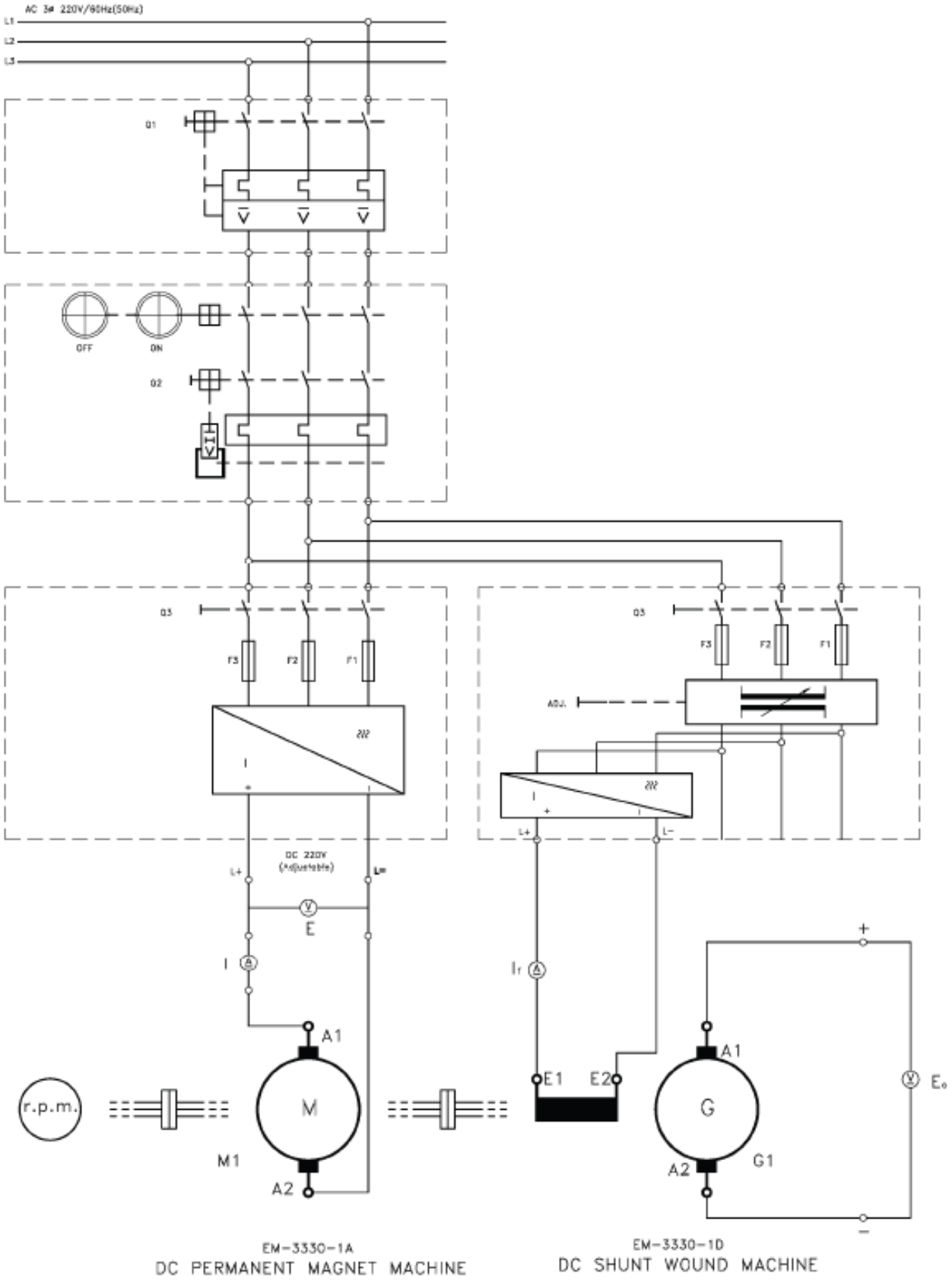

Fig. 9-1-1 Circuit diagram for no-load saturation characteristic test

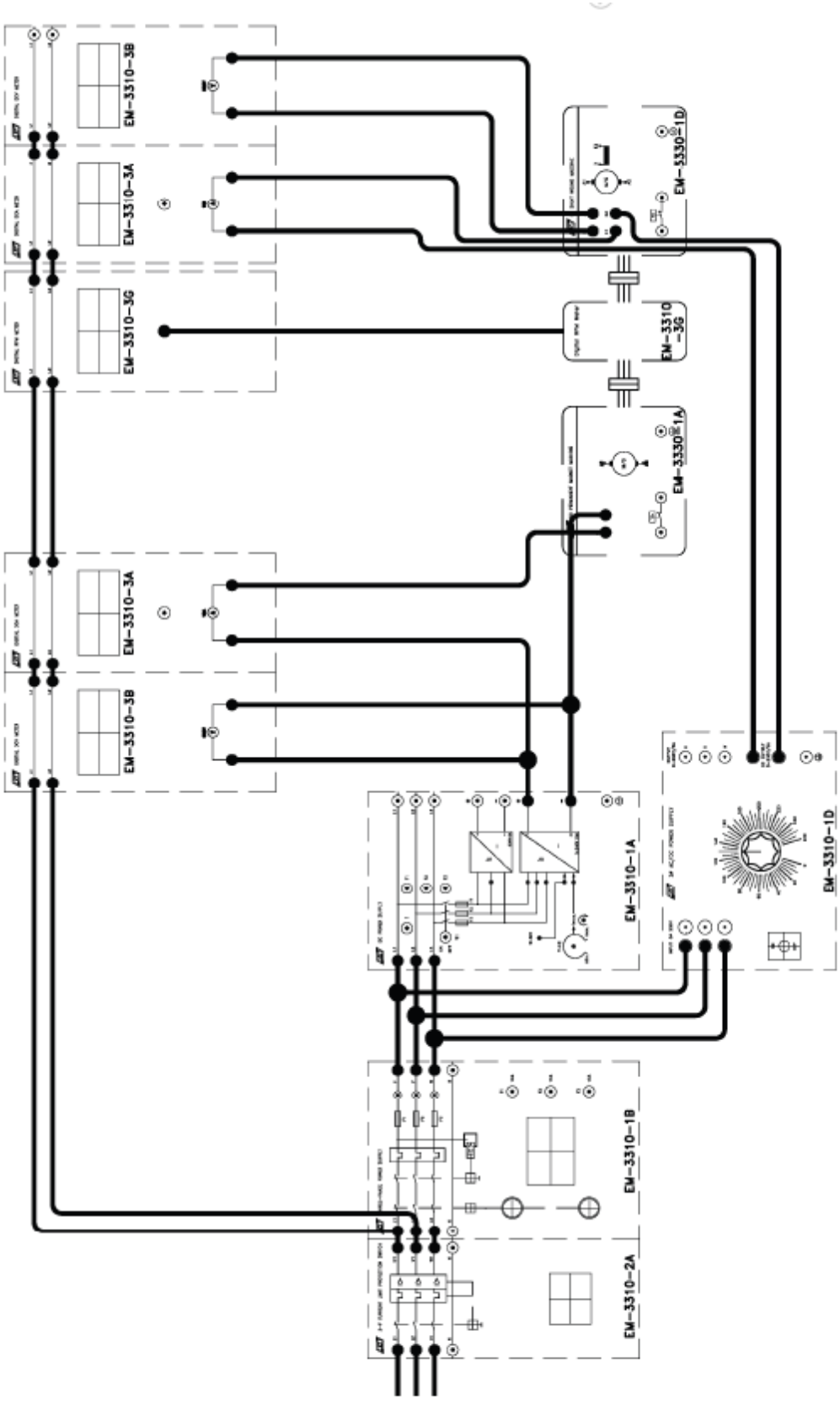

Fig. 9-1-2 Connection diagram for no-load saturation characteristic test

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 (prime mover), DC Shunt Wound Machine, Digital RPM Meter, and 3ϕ AC/DC Power Supply on the Laboratory Table. Mechanically couple the DC Permanent-Magnet (PM) Machine to the DC Shunt Wound Machine and the Digital RPM Meter using Couplings. Securely lock the Machine Bases together using the delta screws. Install Coupling Guards and Shaft End Guard.

   If the developed generator voltage is very small when the prime mover rotates at its rated speed, reverse the connecting leads to A1 and A2 terminals on the panel of the prime mover for building up generator voltage.

2. Install the required Modules in the Experimental Frame. Construct the circuit in accordance with the circuit diagram in Fig. 9-1-1 and the connection diagram in Fig. 9-1-2. Have the instructor check your completed circuit.

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

3. Set the V.adj knob on the DC Power Supply Module to the min. position. Set the voltage control knob on the 3ϕ AC/DC Power Supply to the 0 position.

4. Sequentially turn on the Three-pole Current Limit Protection Switch, Three-phase Power Supply, and DC Power Supply Modules.

5. Press the START button on the DC Power Supply Module.

6. Slowly turn the V.adj knob on the DC Power Supply Module to increase the motor voltage E until the prime mover rotates at a speed of the rated value of 2,000 rpm.

Keep this speed through this exercise. **Note:** The armature current I of prime mover must not exceed 130% of the rated current value (2.7Ax1.3=3.51A) and the generator output voltage must not exceed its rated value.

7. Turn on the 3ϕ AC/DC Power Supply.

8. Turn the voltage control knob on the 3ϕ AC/DC Power Supply and set the field current I_f to 0A. Record the generator output voltage E_o in Table 9-1-1.

9. Repeat step 8 for other I_f settings listed in Table 9-1-1. **Note:** The field current values must be increased continuously.

10. Sequentially turn off the 3ϕ AC/DC Power Supply, DC Power Supply, Three-phase Power Supply, and 3-P Current Limit Protection Switch Modules.

11. Using the results of Table 9-1-1, plot the E_o vs I_f curve on the graph of Fig. 9-1-3.

Table 9-1-1 Measured I_f and E_o values

I_f (A)	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.11	0.12
E_o (V)													

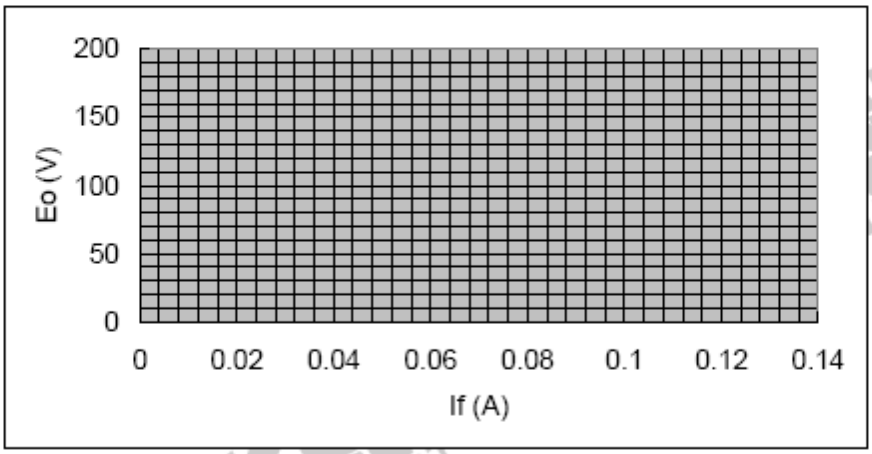

Fig. 9-1-3 The E_o vs I_f curve

Load Characteristic

OBJECTIVE

After completing this exercise, you should be able to demonstrate the operating characteristic of a DC separately-excited generator under load condition.

EQUIPMENT REQUIRED

Qty	Description	Cat. No.
1	DC Permanent-magnet Machine	EM-3330-1A
1	DC Shunt Wound Machine	EM-3330-1D
	or DC Multifunction Machine	EM-3330-1B
1	DC Power Supply Module	EM-3310-1A
1	Three-phase Power Supply Module	EM-3310-1B
1	3ϕ AC/DC Power Supply	EM-3310-1D
1	Three-pole Current Limit Protection Switch Module	EM-3310-2A
1	DC Generator Load Resistor	EM-3310-4H
3	Digital DCA Meter	EM-3310-3A
3	Digital DCV Meter	EM-3310-3B
1	Digital RPM Meter	EM-3310-3G
	or Magnetic Powder Brake Unit	EM-3320-1A
	Brake Controller	EM-3320-1N
1	Laboratory Table	EM-3380-1A
1	Experimental Frame	EM-3380-2B
	or Experimental Frame	EM-3380-2A
1	Connecting Lead Holder	EM-3390-1A
2	Coupling	EM-3390-2A
2	Coupling Guard	EM-3390-2B
1	Shaft End Guard	EM-3390-2C
1	Connecting Leads Set	EM-3390-3A
1	Safety Bridging Plugs Set	EM-3390-4A

NOTE: Though the Multifunction Machine can be used as a separately excited generator, it is inferior to individual generator in characteristics.

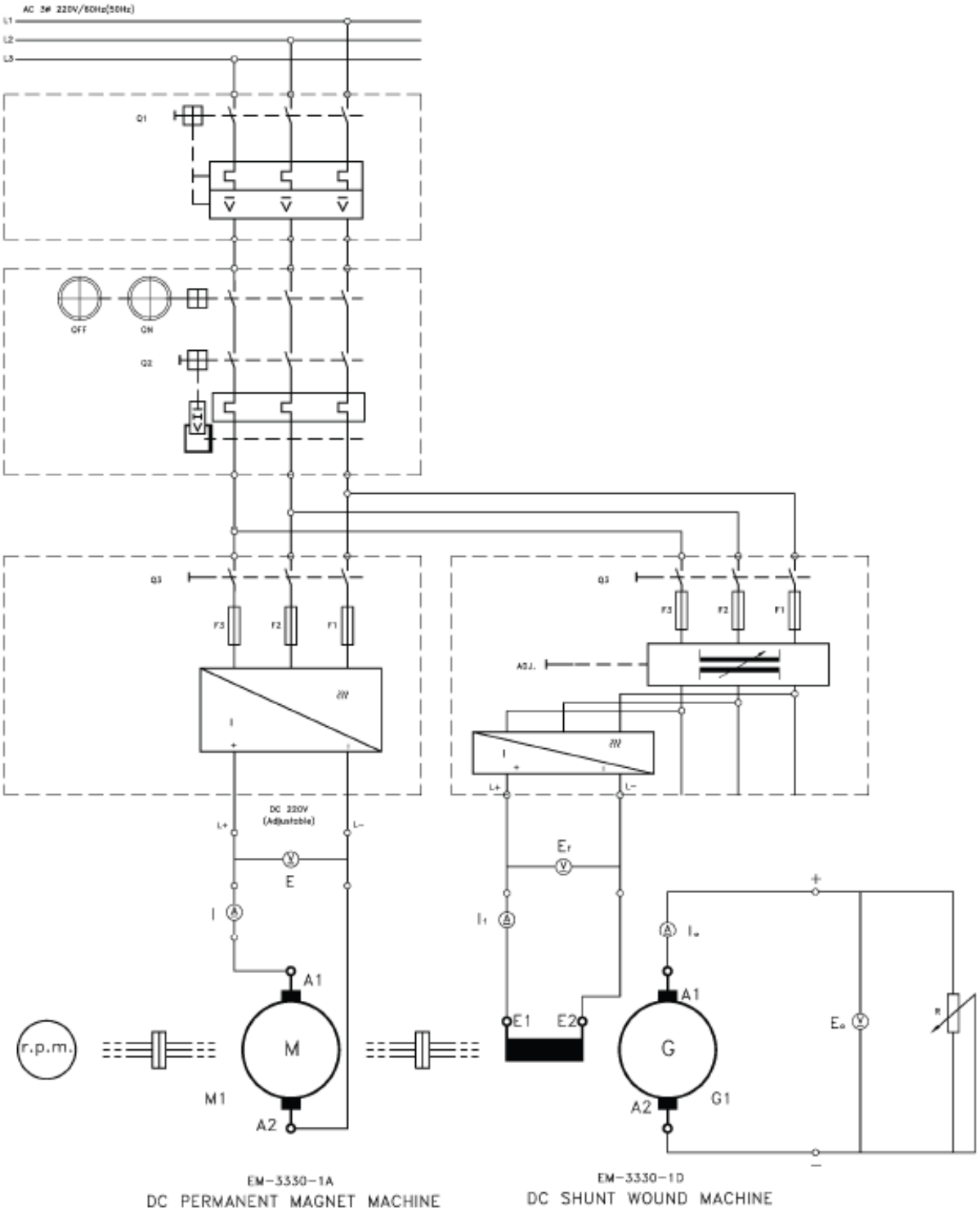

Fig. 9-2-1 Circuit diagram for load characteristic test

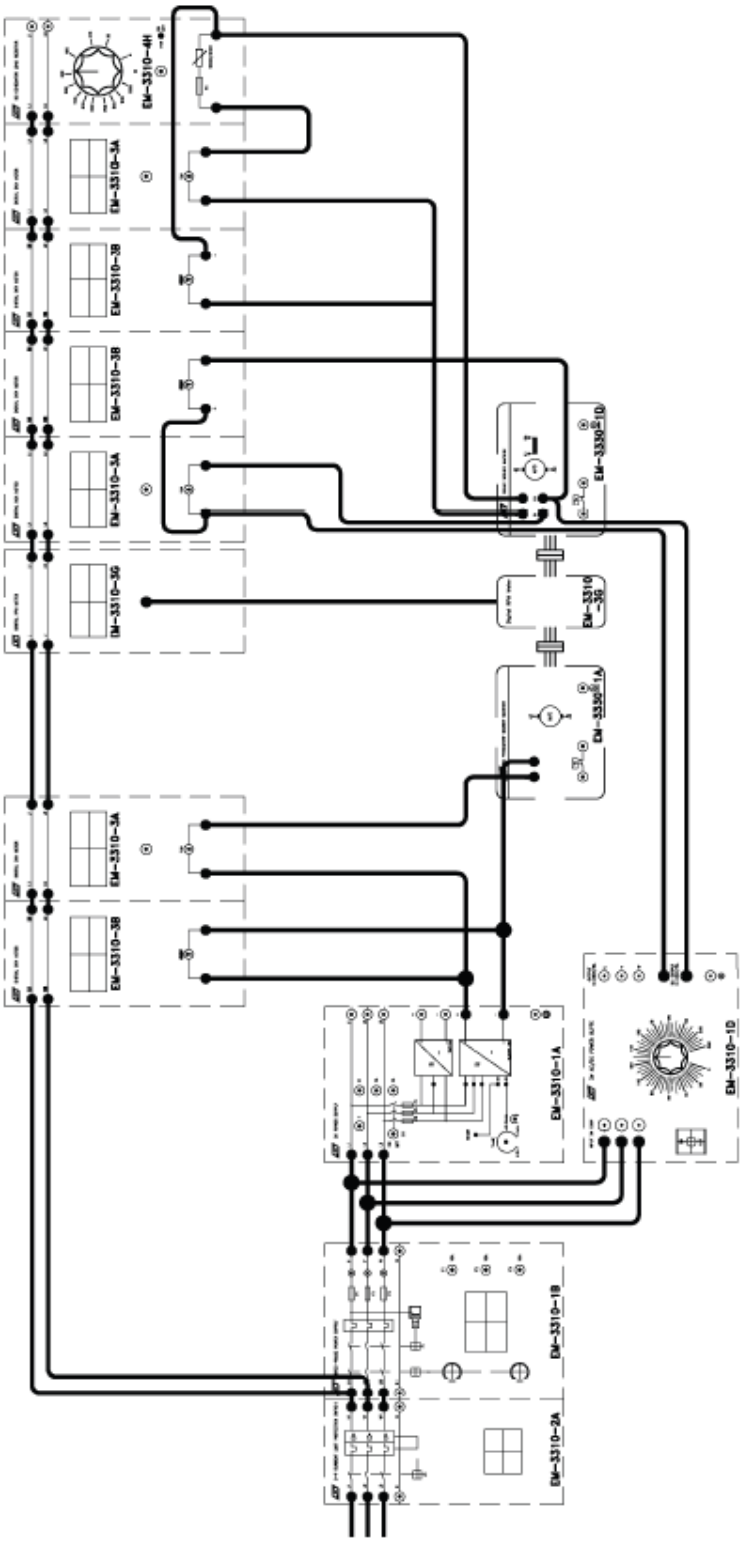

Fig. 9-2-2 Connection diagram for load characteristic test

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 (prime mover), DC Shunt Wound Machine, Digital RPM Meter, and 3ϕ AC/DC Power Supply on the Laboratory Table. Mechanically couple the DC Permanent-Magnet (PM) Machine to the DC Shunt Wound Machine and the Digital RPM Meter using Couplings. Securely lock the Machine Bases together using the delta screws. Install Coupling Guards and Shaft End Guard.

   If the developed generator voltage is very small when the prime mover rotates at its rated speed, reverse the connecting leads to A1 and A2 terminals on the panel of the prime mover for building up generator voltage.

2. Install the required Modules in the Experimental Frame. Construct the circuit in accordance with the circuit diagram in Fig. 9-2-1 and the connection diagram in Fig. 9-2-2. Have the instructor check your completed circuit.

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

3. Set the V.adj knob on the DC Power Supply Module to the min. position. Set the voltage control knob on the 3ϕ AC/DC Power Supply to the 0 position. Set the Ω knob on the DC Generator Load Resistor to the 1000Ω position.

4. Sequentially turn on the 3-P Current Limit Protection Switch, Three-phase Power Supply, and DC Power Supply Modules.

5. Press the START button on the DC Power Supply Module.

6. Slowly turn the V.adj knob on the DC Power Supply Module to increase the motor

voltage and observe the speed of the prime mover until the prime mover rotates at its rated speed of 2,000 rpm. Maintain this speed through the exercise. **Note:** The armature current of prime mover must not exceed 130% of the rated current value (2.7A x 1.3=3.51A) and the output voltage of DC generator must not exceed its rated value.

7. Turn on the 3ϕ AC/DC Power Supply. Turn the voltage control knob on the 3ϕ AC/DC Power Supply and set the field current I_f to 0.1A. Maintain this I_f value. Turn the Ω knob on the DC Generator Load Resistor and set the armature current I_a to 0A. Record the values of I_a, I_f, and E_o in Table 9-2-1. Calculate P_o using the equation $P_o = I_a \times E_o$. If the generator rotor is locked by a heavy load, decrease the load and terminate the experiment.

8. Repeat step 6 for other I_a settings listed in Table 9-2-1.

9. Sequentially turn off the 3ϕ AC/DC Power Supply, DC Power Supply, Three-phase Power Supply, and 3-P Current Limit Protection Switch Modules.

10. Using the results of Table 9-2-1, plot the E_o vs I_a curve on the graph of Fig. 9-2-3.

11. Using the results of Table 9-2-1, plot the P_o vs I_a curve on the graph of Fig. 9-2-4.

Table 9-2-1 Measured E_o and calculated P_o

I_f (A)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
I_a (A)	0	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7
E_o (V)																
P_o (W)																

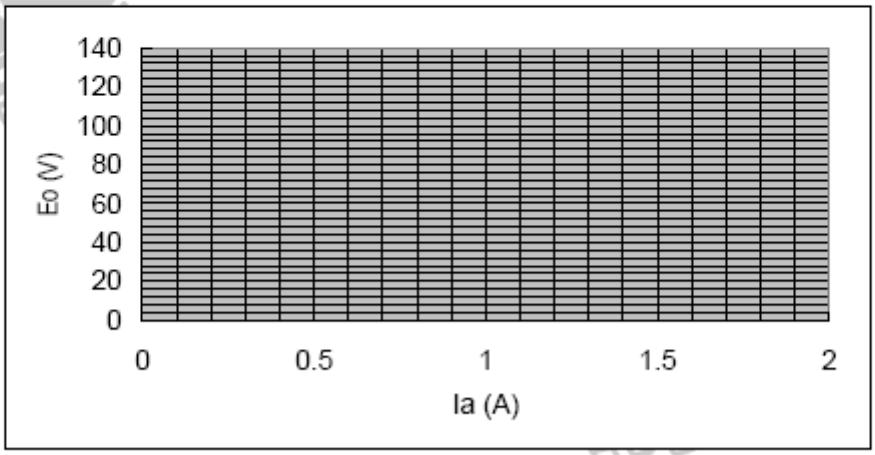

Fig. 9-2-3 The E_o vs I_a curve

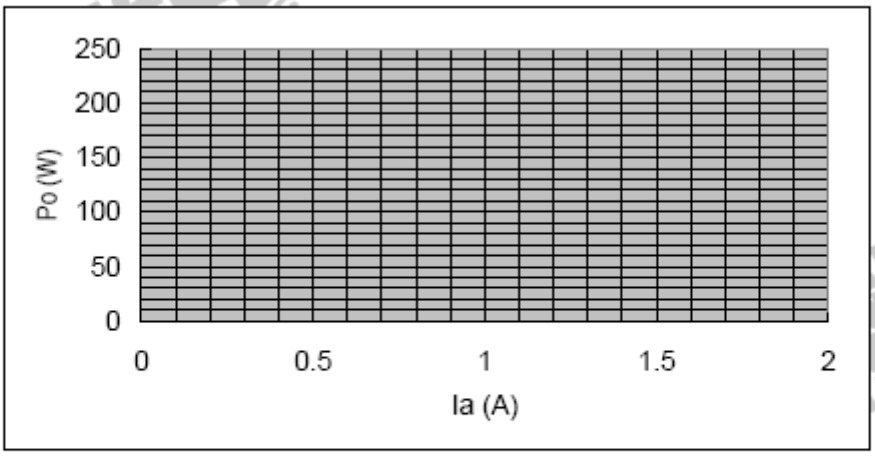

Fig. 9-2-4 The P_o vs I_a curve