EE 340L – Experiment 8: 3-Phase Induction Motors

Modules used in this experiment: 3-phase induction motor (see Fig. 1), Four-Quadrant Dynamometer/Power Supply to be used as a mechanical load (see Fig. 2), 3-phase power supply to power the induction motor, and the Data Acquisition and Control Interface for instrumentation/measurements.
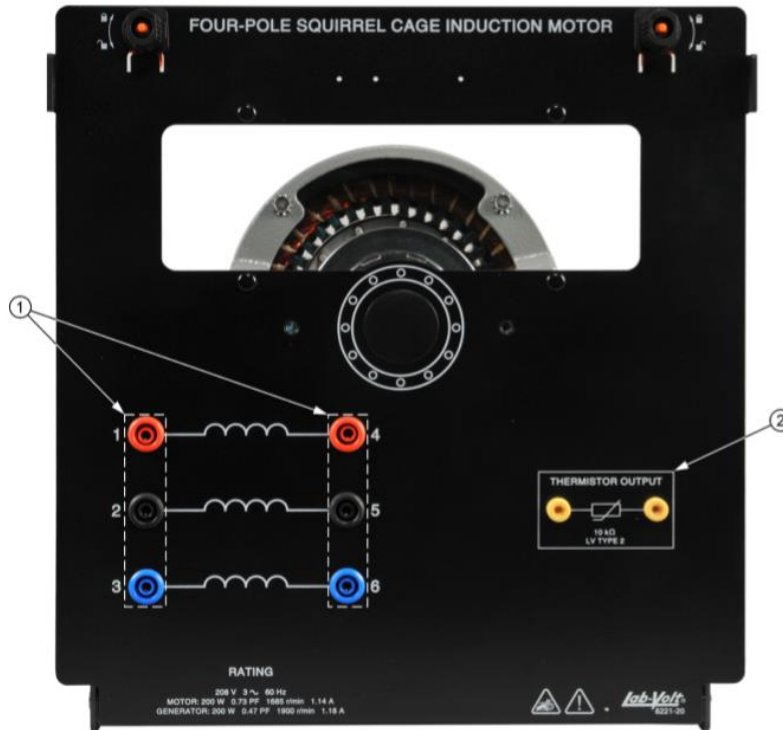

Fig. 1: 3-Phase induction Machine

1. Stator winding terminals:
2. Thermistor Output.
Rated voltage: 120/208 V.
Rated mechanical output power: 200 W,
Rated speed: 1685 rpm
Rated current: 1.14 A
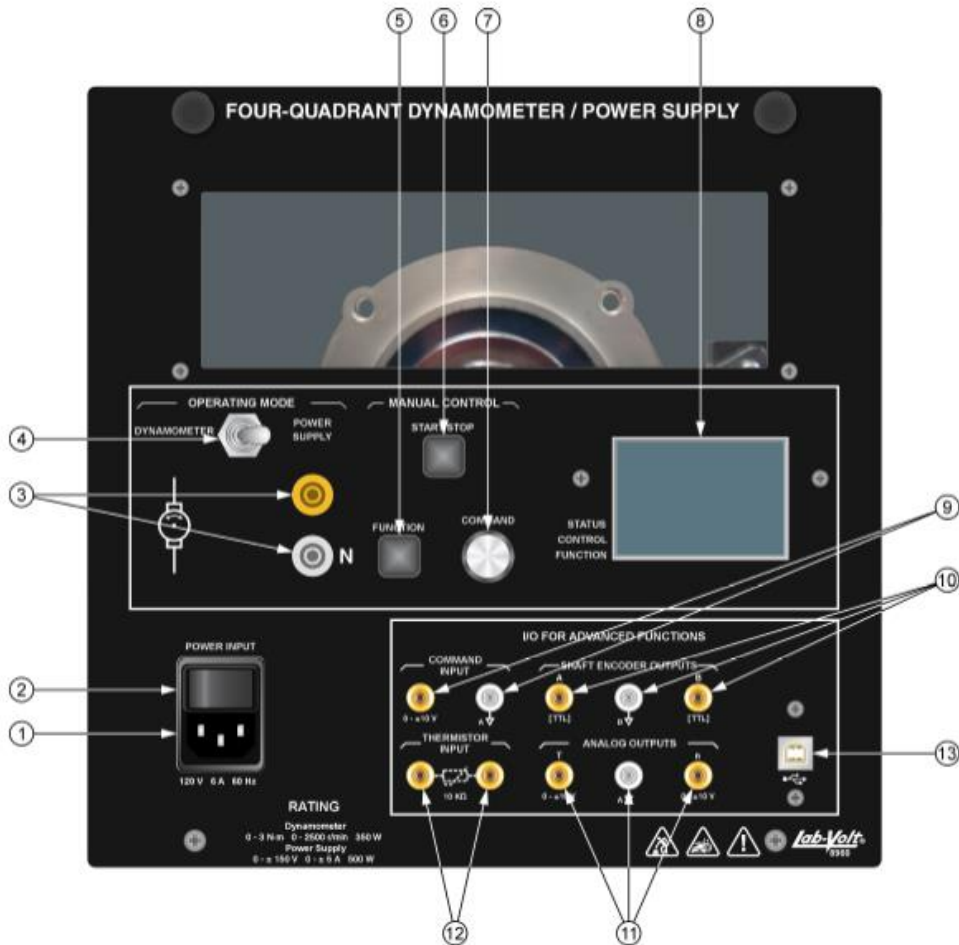Rated power factor: 73% (lag)

Fig. 2: Four-Quadrant Dynamometer/Power Supply

1. Power Input:
2. Main power switch:
3. Power Supply terminals
4. Operating Mode switch:
5. Function push-button:
6. Start/Stop push-button:
7. Command knob:
8. Liquid crystal display (LCD):
9. Command Input:
10. Shaft Encoder Outputs:
11. Analog Outputs
12. Thermistor Input:

1) Stator winding resistance.

Use a multi-meter to measure the resistance of the stator windings. These windings are identical; hence, their resistance value should be the same. Record the value of this resistance below.

Rs = ………….. Ω

2) No-Load Test.

1) Connect the stator windings of the induction motor in Y-connection.

2) Make sure the power supply is turned off. Then connect the motor to the 3-phase power supply and prime mover as shown in Fig. 3 below.

3) Turn the Four-Quadrant Dynamometer/Power Supply on and set the Operating Mode switch to Dynamometer. Then set the Function parameter to CW Constant-Speed Prime Mover/ Brake. Set the Speed parameter to the synchronous speed of the three-phase induction machine, i.e., 1800 rpm.

4) In LVDAC-EMS, start the Metering application. Make the required settings in order to measure the rms values of the phase voltage (E1) and line current (I1). Set two other meters to measure the machine active power, reactive power and power factor from inputs E1 and I1.

5) On the Power Supply, turn the three-phase ac power source on to start the three-phase induction motor. In the Four-Quadrant Dynamometer/Power Supply window, start the CW Constant-Speed Prime Mover/Brake. Adjust the Speed parameter until the torque produced by the three-phase induction motor is as close as possible to 0 N·m. Measure and record the following in the first row of the table below: motor speed, motor current, real power x 3, reactive power x 3.
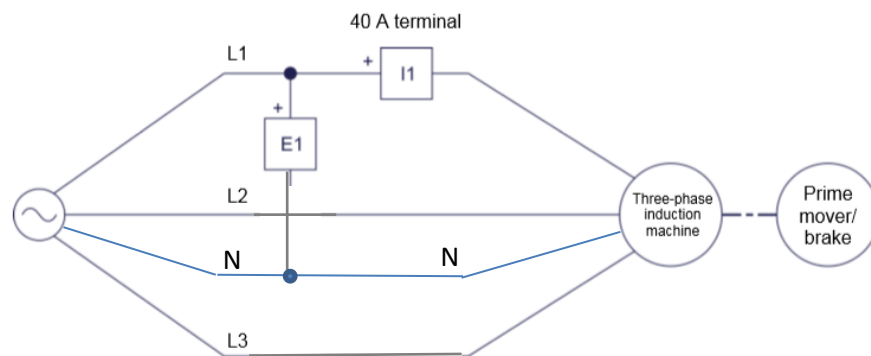

Fig. 3: Induction machine coupled to prime mover/break

3) Load Test (continue from step 6) above)

6) In the Four-Quadrant Dynamometer/Power Supply window, Adjust the Speed parameter until it read 1775 rpm, then record the corresponding parameter values in the second row of the table below. Keep reducing the speed in 25 rpm increments until the table is filled. Turn off the dynamometer, then the power supply to the motor.

Speed (rpm)	Torque (Nm)	Mech. Power (W)	Current (A)	Real Power x 3 (W)	Reactive Power x 3 (VAR)	Power Factor (%)	Efficiency (%)
	0	0					0
1775							
1750							
1725							
1700							
1675							
1650							
1625							
1600							
1575							
1550							

4) Locked Rotor Test:

1) Turn the Four-Quadrant Dynamometer/Power Supply on and set the Operating Mode switch to Dynamometer. Then set the Function parameter to CW Constant-Speed Prime Mover/ Brake. Set the Speed parameter to 0 rpm.
2) Utilize a variable three-phase AC supply (terminals L4, L5 and L6) to power the motor – starting with the minimum voltage possible. Increase the voltage in small increments while monitoring the motor current. When the current reaches 1.2 A, record, the corresponding supply voltage, real and reactive power below, the turn off the power supply to both machines.

I1 = 1.2 A
E1 = ………… V
P = ………… W
Q = …………… VAR

Assignment:

a) Determine the machine electrical parameters (Rs, Xm, Rr, Xs, Xr). Assume motor Cage Design D (i.e., Xs = Xr).
b) Plot the (partial) torque-speed curve of the motor.
c) Plot the (partial) efficiency-speed curve of the motor.
d) Plot the (partial) current-speed curve of the motor.
e) Plot the (partial) power factor – speed curve of the motor.