Equipment Utilization Chart

The following equipment is required to perform the exercises in this manual.

Equipment				
Model	**Description**	**1**	**2**	**3**
8131[1]	Workstation	1	1	1
8311[2]	Resistive Load	1	1	1
8331	Capacitive Load		1	
8823	Power Supply	1	1	1
8951-L	Connection Leads	1	1	1
9063-B[3]	Data Acquisition and Control Interface	1	1	1

[1] The Mobile Workstation, Model 8110, and the Workstation, Model 8134, can also be used.
[2] Resistive Load unit with voltage rating corresponding to your local ac power network voltage. Use model variant -00, -01, -02, -05, -06, -07, or -0A.
[3] Model 9063-B consists of the Data Acquisition and Control Interface, Model 9063, with control function set 9069-1.

Glossary of New Terms

balanced three-phase circuit

A balanced, three-phase circuit is a three-phase ac circuit with equal impedances in each of the three load branches. The three phase voltages that power the circuit are equal in amplitude, but are shifted 120° from each other. A balanced, three-phase circuit is thus simply a combination of three single-phase circuits. Therefore, the rules for calculating voltage, current, and power in single-phase circuits also apply to balanced three-phase circuits.

delta configuration

A delta configuration is a type of three-phase circuit connection in which the three branches of the source or load are connected end-to-end to form a continuous (closed) circuit loop. The three line wires are connected to the three junction points of the circuit. There is no point to which a neutral wire can be connected in a delta-connected, three-phase circuit.

line current

The line current in a three-phase circuit is the current measured in any line wire of the circuit. In balanced, delta-connected, three-phase circuits, the line current is $\sqrt{3}$ times higher than the phase current.

line voltage

The line voltage in a three-phase circuit is the voltage measured between any two line wires of the circuit. In balanced, wye-connected, three-phase circuits, the line voltage is $\sqrt{3}$ times higher than the phase voltage.

phase current

The phase current in a three-phase circuit is the current measured in any phase of the circuit (i.e., the current flowing in each element of a three-phase load). In balanced, delta-connected, three-phase circuits, the phase current is $\sqrt{3}$ times lower than the line current.

phase sequence

The phase sequence of a three-phase ac power system is the sequence in which the phase voltages attain the maximum (peak) value. The usual shorthand form of indicating phase sequence is A-B-C, which is the same as the sequences B-C-A and C-A-B. The opposite phase sequence to A-B-C is A-C-B (C-B-A, B-A-C).

phase voltage

The phase voltage in a three-phase circuit is the voltage measured between any line wire and the neutral wire of the circuit. In balanced, wye-connected, three-phase circuits, the phase voltage is $\sqrt{3}$ times lower than the line voltage.

two-wattmeter method

The two-wattmeter method is a method of measuring power in three-phase circuits in which two single-phase power meters are connected across the line wires so that the total power is the algebraic sum of the two power meter readings. When using this method, the two current inputs of the power meters are connected to measure the line current in two of the line wires while the two voltage inputs of the power meters are connected to measure the line voltages between the two line wires connected to the current inputs and the remaining line wire. The two-wattmeter method allows power in three-wire, three-phase power systems to be measured as it uses line voltage and current measurements only.

wye configuration A wye configuration is a type of three-phase circuit connection in which one end of each of the three branches of the source or load are connected together at a common junction point called the neutral. The three line wires are each connected to an individual circuit branch, and a neutral wire can be connected to the neutral point of the circuit. In a balanced three-phase circuit, no current flows in the neutral wire.

Impedance Table for the Load Modules

The following table gives impedance values which can be obtained using either the Resistive Load, Model 8311, the Inductive Load, Model 8321, or the Capacitive Load, Model 8331. Figure 26 shows the load elements and connections. Other parallel combinations can be used to obtain the same impedance values listed.

Table 4. Impedance table for the load modules.

Impedance (Ω)			Position of the switches								
120 V 60 Hz	**220 V 50 Hz/60 Hz**	**240 V 50 Hz**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1200	4400	4800	I								
600	2200	2400		I							
300	1100	1200			I						
400	1467	1600	I	I							
240	880	960	I		I						
200	733	800		I	I						
171	629	686	I	I	I						
150	550	600	I			I	I	I			
133	489	533		I		I	I	I			
120	440	480			I		I	I			
109	400	436			I	I	I	I			
100	367	400	I		I	I	I	I			
92	338	369		I	I	I	I	I			
86	314	343	I	I	I	I	I	I			
80	293	320	I			I	I	I	I	I	I
75	275	300		I		I	I	I	I	I	I
71	259	282			I		I	I	I	I	I
67	244	267			I	I	I	I	I	I	I
63	232	253	I		I	I	I	I	I	I	I
60	220	240		I	I	I	I	I	I	I	I
57	210	229	I	I	I	I	I	I	I	I	I

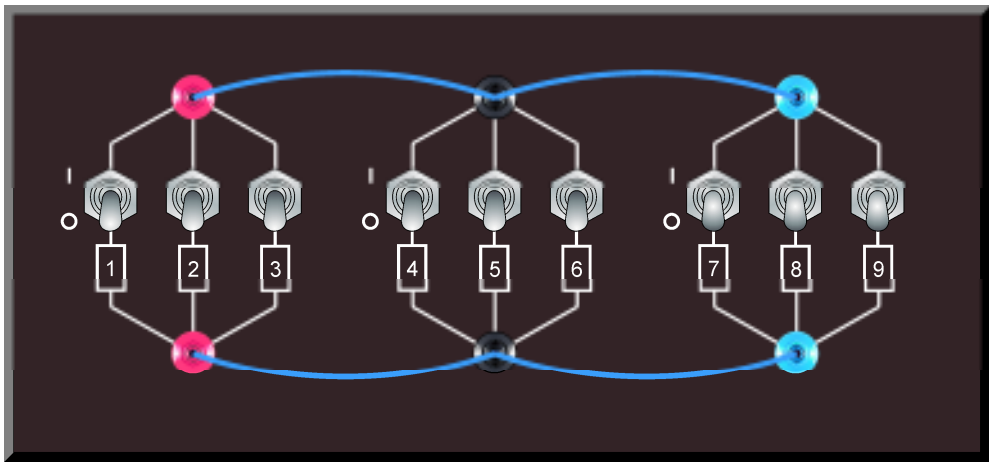


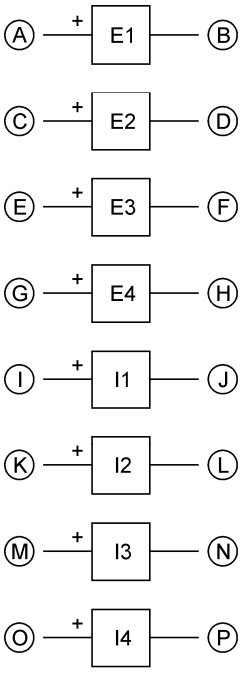
Figure 26. Location of the load elements on the Resistive Load, Inductive Load, and Capacitive Load, Models 8311, 8321, and 8331, respectively.

Circuit Diagram Symbols

Various symbols are used in the circuit diagrams of this manual. Each symbol is a functional representation of a particular electrical device that can be implemented using the equipment. The use of these symbols greatly simplifies the number of interconnections that need to be shown on the circuit diagram, and thus, makes it easier to understand the circuit operation.

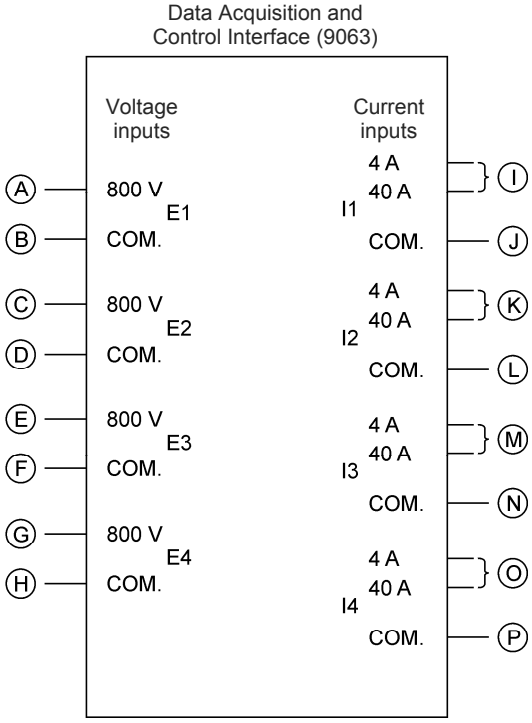
For each symbol other than those of power sources, resistors, inductors, and capacitors, this appendix gives the name of the device which the symbol represents, as well as the equipment and the connections required to properly connect the device to a circuit. Notice that the terminals of each symbol are identified using circled letters. The same circled letters identify the corresponding terminals in the Equipment and Connections diagram. Also notice that the numbers (when present) in the Equipment and Connections diagrams correspond to terminal numbering used on the actual equipment.

Symbol

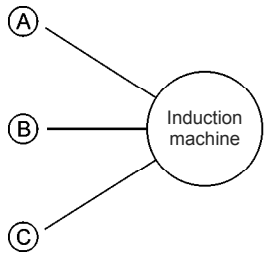
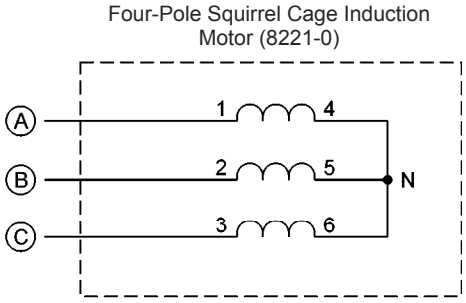
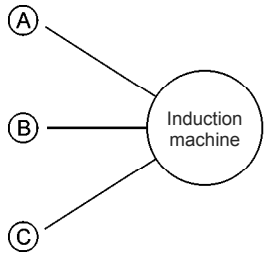
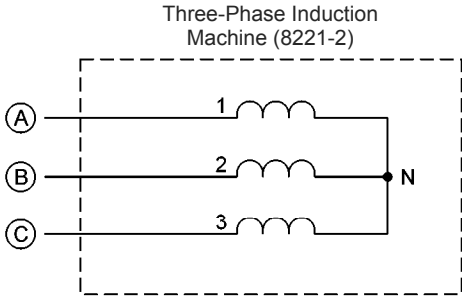
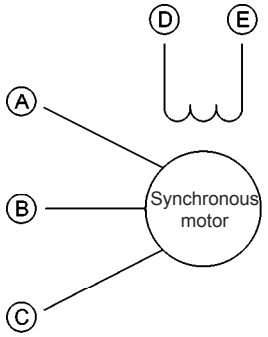
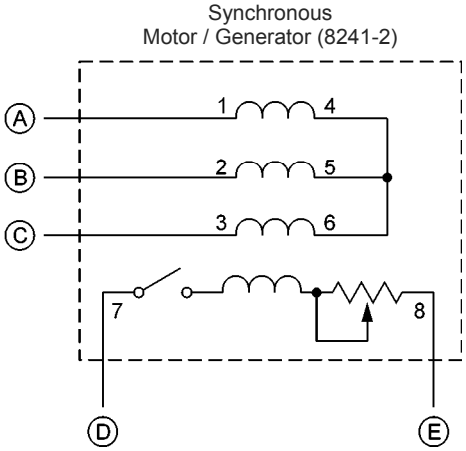


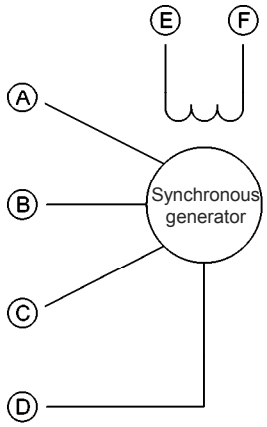
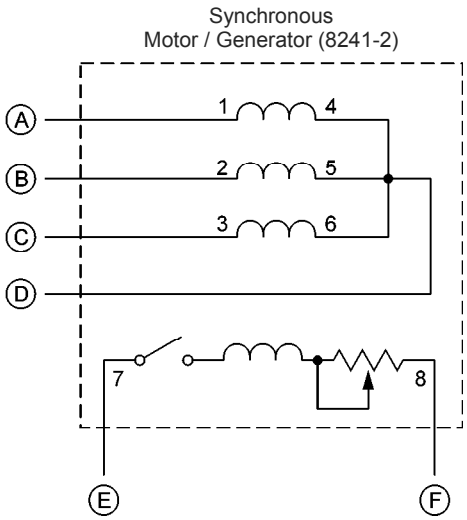
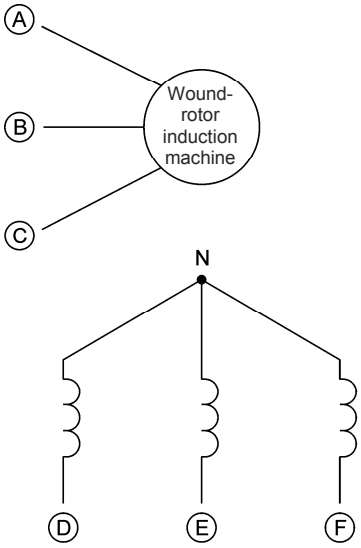
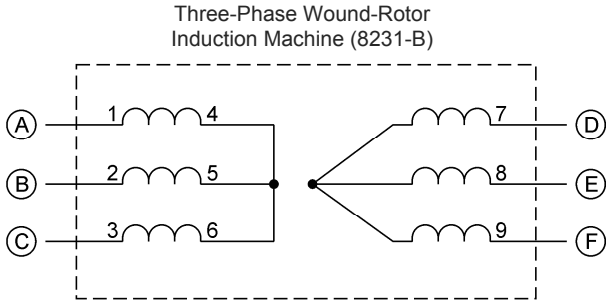
Isolated voltage and current measurement inputs

Equipment and Connections

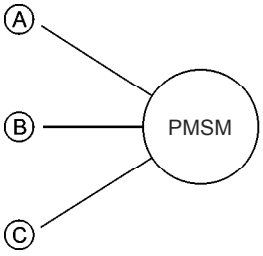


When a current at inputs I1, I2, I3, or I4 exceeds 4 A (either permanently or momentarily), use the corresponding 40 A input terminal and set the Range parameter of the corresponding input to High in the Data Acquisition and Control Settings window of LVDAC-EMS.

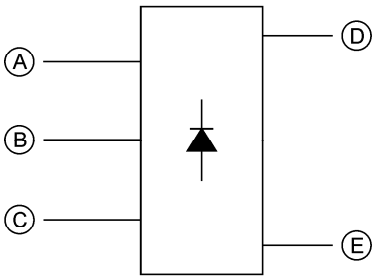
Symbol	Equipment and Connections
 Three-phase induction machine	
 Three-phase induction machine	
 Three-phase synchronous motor	

Symbol	Equipment and Connections
 Three-phase synchronous generator	
 Three-phase wound-rotor induction machine	

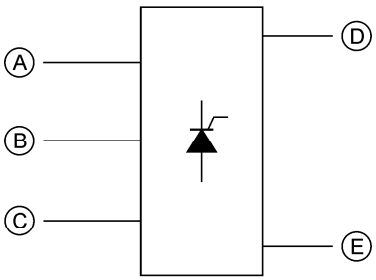
Symbol



Permanent Magnet
Synchronous Machine

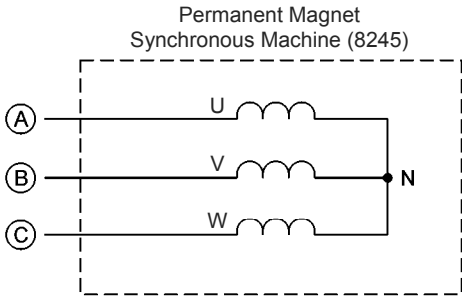


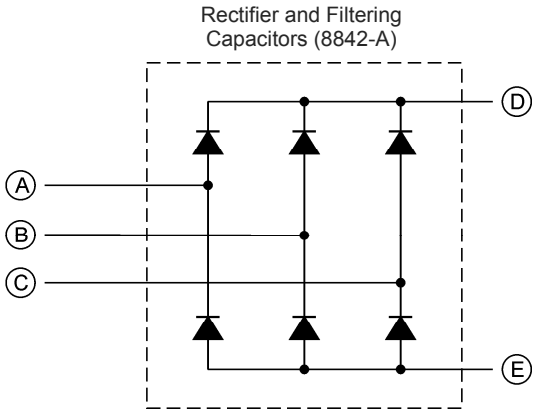
Power diode three-phase
full-wave rectifier

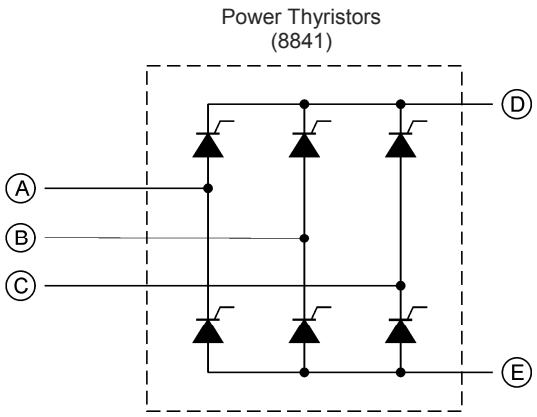


Power thyristor
three-phase bridge

Equipment and Connections







Symbol	Equipment and Connections