Equipment Utilization Chart

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

Equipment							
Model	**Description**	**1**	**2**	**3**	**4**	**5**	**6**
8134[(1)]	Workstation	1	1	1	1	1	1
8216[(2)]	Wind Turbine Generator/Controller	1					
8311[(3)]	Resistive Load	1	1	1	1	2[(4)]	1
8353	Transformer	1	1	1	1	1	1
8946-2	Multimeter	1					
8951-L	Connection Leads	1	1	1	1	1	1
8960-C[(5)]	Four-Quadrant Dynamometer/Power Supply	1	1	1	1	1	1
8990	Host Computer	1	1	1	1	1	1
9063-B[(6)]	Data Acquisition and Control Interface	1	1	1	1	1	1
30004-2	24 V AC Power Supply	1	1	1	1	1	1

(1) Workstation model 8110 can also be used.
(2) This model is optional.
(3) Resistive Load unit with low (120 V) voltage rating. Use model variant -00, -01, -02, or -0A.
(4) The second Resistive Load is optional as it is only required to perform an optional section of this exercise.
(5) Model 8960-C consists of the Four-Quadrant Dynamometer/Power Supply, Model 8960-2, with functions 8968-1 and 8968-2.
(6) Model 9063-B consists of the Data Acquisition and Control Interface, Model 9063, with function 9069-1.

Glossary of New Terms

autotransformer An autotransformer is a special type of power transformer in which only one winding serves as both the primary and the secondary windings, instead of two separate windings as in conventional power transformers. Because of this, autotransformers are smaller, lighter, and cheaper than conventional transformers for the same power rating. Autotransformers, however, do not provide electrical isolation between their windings.

copper losses The copper losses in a power transformer are the power losses occurring in the transformer wires (typically made of copper). Copper losses are dissipated as heat.

current ratio The current ratio of a power transformer represents the proportion between the current flowing in the transformer primary winding ($I_{Pri.}$) and the current flowing in the transformer secondary winding ($I_{Sec.}$). The current ratio of a power transformer is inversely proportional to its turns ratio.

efficiency The efficiency η of a power transformer is a measure of the ability of the transformer to transfer power from the ac power source to the load with minimum power losses. The efficiency of a transformer thus expresses the percentage of power supplied by the ac power source to the transformer that is actually delivered to the load connected to the transformer.

exciting current See magnetizing current.

harmonics The Harmonics of a waveform are the frequency components of the signal. The frequency of each harmonic is a multiple of the fundamental frequency. Harmonics are highly undesirable in any ac power network because they can affect the operation of other equipment connected to the network. Also, harmonics decrease the power factor of the network, and thus, its efficiency.

iron losses The iron losses in a power transformer are the power losses occurring in the transformer iron core. Iron losses primarily consist of hysteresis and eddy-current losses. They are mostly dissipated as heat.

magnetizing current The magnetizing current (or exciting current) of a power transformer corresponds to the current that produces the magnetic field required for the operation of the transformer. Magnetizing current flows in the primary winding of a power transformer as soon as a voltage is applied to the primary winding, no matter whether the transformer is connected to a load or not. Magnetizing current is generally represented by the symbol I_O.

polarity The polarity of a power transformer winding refers to the polarity of the voltage at one end of the winding relative to the voltage at the opposite end of the winding, at any given instant. It has no meaning in itself and is only meaningful in relation to the polarity of the other windings. When one end of two windings of a transformer are of the same polarity, the polarity of the voltage at this end, with respect to the voltage at the other end of the winding, is the same for both windings, and thus, the ac voltages across these windings are in phase. Conversely, when one end of two windings of a transformer are of opposite polarity, the polarity of the voltage at this end for one winding is opposite that of the voltage at the end of the other winding, and thus, the ac voltages across these windings are 180° out of phase.Transformer winding polarity is especially important when connecting transformer windings in series or in parallel.

primary winding The primary winding of a power transformer is the winding to which the ac power source supplying power to the transformer is connected.

secondary winding The secondary winding of a power transformer is the winding that is connected to a load and that supplies power to it.

step-down transformer A step-down power transformer is a transformer whose voltage across the secondary winding is lower than the voltage across the primary winding. Conversely, the current flowing in the secondary winding of a step-down transformer is higher than the current flowing in the transformer primary winding.

step-up transformer A step-up power transformer is a transformer whose voltage across the secondary winding is higher than the voltage across the primary winding. Conversely, the current flowing in the secondary winding of a step-up transformer is lower than the current flowing in the transformer primary winding.

turns ratio The turns ratio of a power transformer is the ratio between the number of turns of wire in the primary winding of the transformer ($N_{Pri.}$) and the number of turns of wire in the secondary winding of the transformer ($N_{Sec.}$). The turns ratio of a power transformer determines the transformer voltage and current ratios.

voltage ratio The voltage ratio of a power transformer represents the proportion between the voltage across the transformer primary winding ($E_{Pri.}$) and the voltage across the transformer secondary winding ($E_{Sec.}$). The voltage ratio of a power transformer is directly proportional to its turns ratio.

voltage regulation The voltage regulation of a power transformer expresses its ability to maintain the load voltage ($E_{Sec.}$) constant as the load current ($I_{Sec.}$) varies. There are two ways to define the voltage regulation of a power transformer: regulation down and regulation up. Regulation down is more commonly used for power transformers and indicates the extent of the variation in the load voltage of the power transformer as the load current increases.

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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 45 shows the load elements and connections. Other parallel combinations can be used to obtain the same impedance values listed.

Table 1. 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

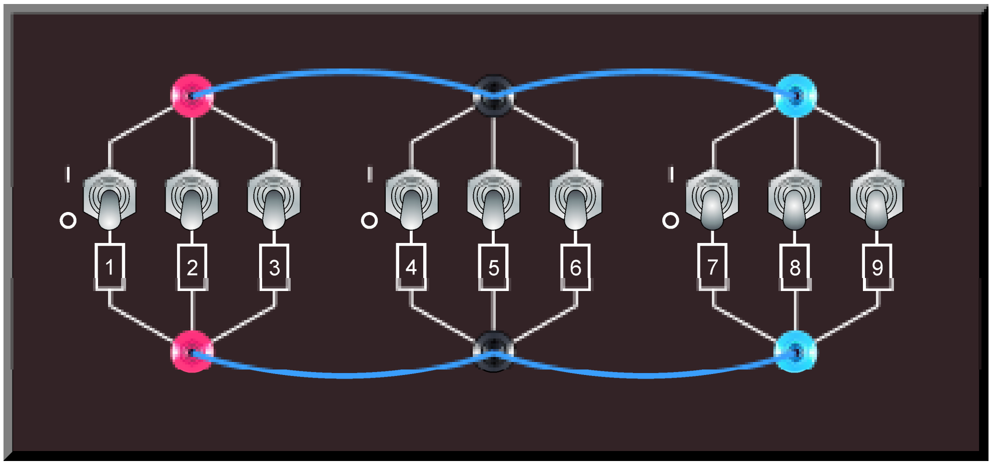

Figure 45. Location of the load elements on the Resistive Load, Inductive Load, and Capacitive Load, Models 8311, 8321, and 8331, respectively.

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