Electric Power / Controls

0.2 kW

COMPUTER-ASSISTED 0.2-kW ELECTROMECHANICAL TRAINING SYSTEM, MODEL 8006

GENERAL DESCRIPTION

The Lab-Volt Computer-Assisted 0.2-kW Electromechanical Training System (EMS), Model 8006, is a modern modular program that provides new opportunities for laboratory observations in the study of electric power technology. The program incorporates various techniques used in industry to generate and use electrical energy. The courseware covers power circuits, transformers, and common AC/DC machines. It is presented in two student manuals and in the optional form of a Computer-Based Learning (CBL) program.

Developed by educators to satisfy educational requirements for industrial applications of electric power technology, this program has been designed to meet a variety of training objectives, as follows:

- The system has been designed for low-power (0.2-kW or 1/4-hp) educational equipment that enables students to understand and safely operate industrial-type equipment.
- Careful attention to engineering detail ensures laboratory results that are easy to understand, data values that are easily observed, and data which, when applied to governing formulas, provides results that verify electrical laws rather than deny them on the basis of large operational-tolerance errors.
- As a modular program, course materials provide instructors with complete versatility in selecting and adapting lessons and experiments to fit specific student needs and teaching objectives.

(732) 938-2000 / 800-LAB-VOLT, FAX: (732) 774-8573, E-MAIL: us@labvolt.com
(418) 849-1000 / 800-LAB-VOLT, FAX: (418) 849-1666, E-MAIL: ca@labvolt.com
INTERNET: http: //www.labvolt.com

Measurement Instruments

All measurements are performed using the Lab-Volt Data Acquisition and Management for Electromechanical Systems (LVDAM-EMS). This modern and versatile system is built around an interface module that provides electrical insulation and performs data acquisition. The interface module connects to a Pentium-type host computer (via a USB port connection) that runs the LVDAM-EMS software.

The LVDAM-EMS software consists of a set of conventional and specialized instruments, each instrument appearing as a window on the computer screen. The software uses the acquired data received from the interface module to calculate the values of common parameters such as voltage, current, electrical power (apparent, active, and reactive), power factor, energy, efficiency, complex impedance, frequency, speed, torque, mechanical power, etc.

The values of up to 18 parameters can be displayed simultaneously using a metering window. These values can be recorded to a data table and used to obtain on-screen graphs. Data tables can be exported to any popular spreadsheet programs (e.g. Microsoft® Excel) for further analysis.

The LVDAM-EMS software includes the following three other instruments (windows) which allow observation and analysis of the various parameters: an eight-channel oscilloscope, a phasor analyzer, and a harmonic analyzer.

Courseware

The student manuals guide the students through the experiments and provide the necessary theoretical background to allow successful completion of the educational objectives. Manuals are structured in a Unit-Exercise format. Each Exercise approaches the subject matter from a theoretical point of view and uses a hands-on approach to the study of Electrical Power Technology. Students are guided through step-by-step exercise procedures that confirm concepts and theory presented in the exercise discussion. A conclusion and a set of review questions complete each exercise. A 10-question unit test helps evaluate knowledge gained in the courseware unit. The flexibility of this system allows students to use their own initiative during the laboratory sessions. Under the guidance of an instructor, students gain the required competencies for successful employment.

The optional Electromechanical Systems Computer-Based Learning (EMS-CBL) program, Model 8980, covers the same topics as the student manuals. Color animations and over six hundred highly detailed color figures provide clear illustrations of the theory as well as the hands-on exercise procedures. The EMS-CBL program is designed to run under the Lab-Volt platform Tech-Lab Systems and Utilities. It can be used with the Computer-Assisted 0.2-kW Electromechanical Training System, Model 8006, or the Electromechanical Systems Simulation Software (LVSIM®-EMS), Model 8970.

Modules

The system's modular approach allows instructors to start their EMS laboratory with basic courseware and equipment and to add new modules over time without needless duplication of equipment. All modules can be inserted into standard workstations (table-top or mobile) and are constructed of heavy-gauge steel, finished in baked enamel, with acrylic faceplates permanently mounted on the chassis. Symbols and diagrams specific to each module are clearly silk-screened on the faceplates. Standard, color-coded, 4-mm safety jacks are used to interconnect all system components.

Power Supply

A separate power supply for each workstation provides complete control of the necessary power sources. This allows maximum use of laboratory equipment, and reduces interference with other laboratory experiments being performed at the same time. The power supply module provides all AC and DC power sources, fixed and variable, at each station.

Workstation

The Workstation (Model 8134) includes spaces to insert six full-size and three half-size modules, or fifteen half-size modules. The Mobile Workstation (Model 8110) has an equivalent area for inserting modules, contains a general storage cabinet and a pull-out work surface at desk height, and is equipped with four swivel casters. The modules are guided into position along stainless-steel guide rails and are held securely in place by a holding mechanism. Front-mounted release levers allow easy removal of modules from the workstation. Safety locking devices prevent students from removing modules from the workstation during lab exercises.

Storage

When modules are not in use, they can be placed in an optional Storage Cabinet (Model 8150). Only the necessary modules for a given exercise are placed in the workstation so that students are not distracted by additional instruments that have no bearing on the experiment at hand.

Machines

All machines are mounted in full-size modules equipped with a clear acrylic faceplate fitted with a chrome-plated piano hinge. The faceplate can be lowered for access to the machine, and when closed, it is secured by two quick-lock fasteners. Each machine module is provided with a safety locking device that prevents students from lowering the faceplate during lab exercises.

All machines have open bell housings (front and rear) to permit visual inspection of the internal construction and observation of the machine during operation. Externally mounted components (such as centrifugal switches, capacitors, brushes, slip-rings, and commutators), in addition to the exposed stator windings, squirrel cage and wound rotors, permit students to clearly determine component function and to understand relative position, number of turns, and wire sizes of the machinery.

The shaft of each machine has a concave-slotted end to facilitate the use of tachometers, holding brakes or plugging switches. A geared pulley is fitted on each machine shaft to mechanically couple machines together using a non-slip timing belt. Tension for the timing belt is provided by the idler tensioning ball-bearings mounted on each machine module.

Electrical Loads

Resistive, inductive, and capacitive load components are housed in separate half-size modules. They are designed to provide equal load magnitudes for all three types of loads. The load impedance can be varied in steps of equal-unit value by switches provided in all load modules. These characteristics simplify calculations required in the learning process.

Mechanical Load

The Prime Mover / Dynamometer (Model 8960) is a permanent-magnet DC motor that can operate as a continuous-duty prime mover or as a dynamometer. A built-in control circuit allows mechanical loading of all Lab-Volt 0.2-kW machines up to breakdown and stalled conditions. A digital display indicates speed or torque. Two low-voltage analog output signals proportional to speed and torque, and a shaft encoder digital output signal are also provided.

Connection Leads

Various components of the system are connected with flexible PVC-insulated connecting leads terminated with 4-mm safety plugs. These leads allow safe connection of components without danger of electrical shock, with live parts of the plugs concealed and insulated in such a way that they cannot be contacted accidentally. They come in three different lengths, each identified by a distinctive color. A handy storage rack can be attached to the side of the workstation.

COMPUTER-ASSISTED 0.2-kW ELECTROMECHANICAL TRAINING SYSTEM
MODEL 8006

LIST OF EQUIPMENT FOR 8006-00

QTY	DESCRIPTION	ORDERING NUMBER[1]
1	Workstation	8134-20
1	DC Motor/Generator	8211-00
1	Four-Pole Squirrel-Cage Induction Motor	8221-00
1	Three-Phase Synchronous Motor/Generator	8241-00
1	Capacitor-Start Motor	8251-00
1	Universal Motor	8254-00
1	Resistive Load	8311-00
1	Inductive Load	8321-00
1	Capacitive Load	8331-00
1	Single-Phase Transformer	8341-00
1	Three-Phase Transformer	8348-00
1	Synchronizing Module	8621-00
1	Power Supply	8821-20
1	Timing Belt	8942-00
1	Connection Leads	8951-00
1	Prime Mover / Dynamometer	8960-10
1	Data Acquisition Interface	9062-10
1	Power Circuits and Transformers (student manual)	30328-00
1	ElectroMechanical System (EMS) 0.2 kW (instructor guide)	30328-10
1	AC/DC Motors and Generators (student manual)	30329-00

OPTIONAL EQUIPMENT

DESCRIPTION	ORDERING NUMBER
Mobile Workstation (can replace Model 8134)	8110-20
Storage Cabinet	8150-10
Full-Size Blank Module	8160-00
Half-Size Blank Module	8161-00
Digital Tachometer	8920-40
Speed Sensor / Tachometer	8931-00
Analog Multimeter	8946-00
Digital Multimeter	8946-10
Electromechanical Systems Computer-Based Learning (EMS-CBL)[2]	8980-S0
Electrical Machines, Drives, and Power Systems, T. Wildi (textbook)	17708-00

ADDITIONAL EQUIPMENT REQUIRED TO PERFORM THE EXERCISES IN THE MANUALS

QTY	DESCRIPTION	ORDERING NUMBER
1	Prime Mover / Dynamometer[3]	8960-10
1	Personal Computer[4]	8990-00

[1] The model numbers shown apply to the English 120-V version. Other versions are available. Refer to the Ordering Numbers section.

[2] Requires the WinFACET System/Utilities, Model 94528-00, when operated under Windows® 98 or previous versions of Windows®. Requires the Tech-Lab System and Utilities, Model 94531, when operated under Windows® 2000 or later versions of Windows®.

[3] An additional unit is required in two experiments. See the Table of Contents of the Student Manuals section.

[4] Refer to the Personal Computer Requirements section if you expect to use your own computer.

SPECIFICATIONS

Model 8006 – Computer-Assisted 0.2-kW Electromechanical Training System		**120/208 V – 60 Hz**	**220/380 V – 50 Hz**	**240/415 V – 50 Hz**
Power Requirement	Input Line Current	15 A	10 A	
	Electrical Distribution	3-phase, 5 wires, star (wye) connected, including neutral and ground		
	Wall Outlet (Lab-Volt P/N)	24852-00	24183-00	
Physical Characteristics	Space Required	5 m^2 (54 ft^2)		
	Full-Size Module Dimensions (H x W x D)	308 x 286 x 419 mm (12.1 x 11.3 x 16.5 in)		
	Half-Size Module Dimensions (H x W x D)	154 x 286 x 419 mm (6.1 x 11.3 x 16.5 in)		
	Net Weight	214 kg (471 lb)		

PERSONAL COMPUTER REQUIREMENTS

A currently available personal computer Pentium type with USB port, running under one of the Microsoft® operating systems, Windows® 98, Windows® 2000, Windows® Me, or Windows® XP is required.

COURSEWARE

ORDERING NUMBER

Student Manuals

Power Circuits and Transformers 30328-00

AC/DC Motors and Generators 30329-00

Instructor Guide

Electromechanical System (EMS) 0.2-kW 30328-10

TABLE OF CONTENTS OF THE STUDENT MANUALS

Power Circuits and Transformers (30328-00)

- **Fundamentals for Electrical Power Technology**
  - Voltage, Current, Ohm's Law
  - Equivalent Resistance
  - Power in DC Circuits
  - Series and Parallel Circuits
- **Alternating Current**
  - The Sine Wave
  - Instantaneous Power
  - Phase Angle
- **Capacitors in AC Circuits**
  - Capacitive Reactance
  - Equivalent Capacitance
  - Capacitive Phase Shift and Reactive Power
- **Inductors in AC Circuits**
  - Inductive Reactance
  - Equivalent Inductance
  - Inductive Phase Shift and Reactive Power
- **Power, Phasors and Impedance in AC Circuits**
  - Power in AC Circuits
  - Vectors & Phasors in Series AC Circuits
  - Vectors & Phasors in Parallel AC Circuits
  - Impedance
- **Three-Phase Circuits**
  - Balanced Three-Phase Circuits
  - Three-Phase Power Measurement
  - Phase Sequence
- **Single-Phase Transformer**
  - Voltage and Current Ratios
  - Transformer Polarity
  - Transformer Regulation
- **Special Transformer Connections**
  - The Autotransformer
  - Transformers in Parallel
  - Distribution Transformers
- **Three-Phase Transformers**
  - Three-Phase Transformer Connections
  - Voltage and Current Relationships
  - The Open-Delta Connection

AC/DC Motors and Generators (30329-00)

- **Fundamentals for Rotating Machines**
  - Prime Mover Operation
  - Dynamometer Operation*
  - Motor Power, Losses, and Efficiency*
- **DC Motors and Generators**
  - The Separately-Excited DC Motor
  - Separately Excited, Series, Shunt, and Compound DC Motors
  - Separately Excited, Shunt, and Compound DC Generator
- **Special Characteristics of DC Motors**
  - Armature Reaction and Saturation Effect
  - The Universal Motor
- **AC Induction Motors**
  - The Three-Phase Squirrel-Cage Induction Motor
  - Eddy-Current Brakes and Asynchronous Generators
  - Effect of Voltage on the Characteristics of Induction Motors
  - Single-Phase Induction Motors
- **Synchronous Motors**
  - The Three-Phase Synchronous Motor
  - Synchronous Motor Pull-Out Torques
- **Three-Phase Synchronous Generators (Alternators)**
  - Synchronous Generator No-Load Operation
  - Voltage Regulation Characteristics
  - Frequency and Voltage Regulation
  - Generator Synchronization

* Two Prime Mover Dynamometer modules are required to perform this experiment. It is suggested that the students from two workstations work together at a single workstation to complete the setup.

ORDERING NUMBERS

120/208 V – 60 Hz			220/380 V – 50 Hz			240/415 V – 50 Hz
ENGLISH	**FRENCH**	**SPANISH**	**ENGLISH**	**FRENCH**	**SPANISH**	**ENGLISH**
8006-00	8006-01	8006-02	8006-05	8006-06	8006-07	8006-0A
8110-20	8110-20	8110-20	8110-20	8110-20	8110-20	8110-20
8134-20	8134-20	8134-20	8134-20	8134-20	8134-20	8134-20
8150-10	8150-10	8150-10	8150-10	8150-10	8150-10	8150-10
8160-00	8160-00	8160-00	8160-00	8160-00	8160-00	8160-00
8161-00	8161-00	8161-00	8161-00	8161-00	8161-00	8161-00
8211-00	8211-01	8211-02	8211-05	8211-06	8211-07	8211-0A
8221-00	8221-01	8221-02	8221-05	8221-06	8221-07	8221-0A
8241-00	8241-01	8241-02	8241-05	8241-06	8241-07	8241-0A
8251-00	8251-01	8251-02	8251-05	8251-06	8251-07	8251-0A
8254-00	8254-01	8254-02	8254-05	8254-06	8254-07	8254-0A
8311-00	8311-01	8311-02	8311-05	8311-06	8311-07	8311-0A
8321-00	8321-01	8321-02	8321-05	8321-06	8321-07	8321-0A
8331-00	8331-01	8331-02	8331-05	8331-06	8331-07	8331-0A
8341-00	8341-01	8341-02	8341-05	8341-06	8341-07	8341-0A
8348-00	8348-01	8348-02	8348-05	8348-06	8348-07	8348-0A
8621-00	8621-01	8621-02	8621-05	8621-06	8621-07	8621-0A
8631-00	8631-01	8631-02	8631-05	8631-06	8631-07	8631-05
8821-20	8821-21	8821-22	8821-25	8821-26	8821-27	8821-2A
8920-40	8920-40	8920-40	8920-40	8920-40	8920-40	8920-40
8931-00	8931-01	8931-02	8931-00	8931-01	8931-02	8931-00
8942-00	8942-00	8942-00	8942-00	8942-00	8942-00	8942-00
8946-00	8946-00	8946-00	8946-00	8946-00	8946-00	8946-00
8946-10	8946-10	8946-10	8946-10	8946-10	8946-10	8946-10
8951-00	8951-00	8951-00	8951-00	8951-00	8951-00	8951-00
8960-10	8960-11	8960-12	8960-15	8960-16	8960-17	8960-15
8980-S0	8980-S1	8980-S2	8980-S5	8980-S6	8980-S7	8980-SA
8990-00	8990-00	8990-00	8990-05	8990-05	8990-05	8990-0A
9062-10	9062-11	9062-12	9062-15	9062-16	9062-17	9062-15
94531-00	TBE[5]	94531-02	94531-00	TBE	94531-02	94531-00

Table 1. Equipment Ordering Numbers

120/208 V – 60 Hz			220/380 V – 50 Hz			240/415 V – 50 Hz
ENGLISH	**FRENCH**	**SPANISH**	**ENGLISH**	**FRENCH**	**SPANISH**	**ENGLISH**
17708-00	25267-01	N/A[6]	17708-00	25267-01	N/A	17708-00
30328-00	30328-01	30328-02	30328-00	30328-01	30328-02	30328-00
30328-10	TBE	30328-12	30328-15	TBE	TBE	30328-1A
30329-00	30329-01	30329-02	30329-00	30329-01	30329-02	30329-00

Table 2. Courseware Ordering Numbers (hard-copy version)

[5] TBE= To be established

[6] N/A= Not available

COMPUTER-ASSISTED 0.2-kW ELECTROMECHANICAL TRAINING SYSTEM
MODEL 8006

Reflecting Lab-Volt's commitment to high quality standards in product, design, development, production, installation, and service, our manufacturing and distribution facility has received the ISO 9001 certification.

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