

Electric Power / Controls
0.2 kW



ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS, SERIES 8010



Shown with optional equipment.

GENERAL DESCRIPTION

The production of energy using renewable natural resources such as wind, sunlight, rain, tides, geothermal heat, etc., has gained much importance in recent years as it is an effective means of reducing greenhouse gas (GHG) emissions. The need for innovative technologies to make the grid smarter has recently emerged as a major trend as the increase in electrical power demand observed worldwide makes it harder for the actual grid in many countries to keep up with demand. Furthermore, electric vehicles, from bicycles to cars, are developed and marketed with more and more success in many countries all over the world.

To answer the increasingly diversified needs for training in the wide field of electrical energy, Lab-Volt developed the Electric Power Technology Training Program, a modular study program for technical institutes, colleges, and universities. The program starts with a variety of courses providing in-depth coverage of

basic topics related to the field of electrical energy such as AC and DC power circuits, power transformers, rotating machines, ac power transmission lines, and power electronics. These basic courses incorporate most of the subject matter covered in other well established Lab-Volt training systems such as the Electromechanical Training System, Model 8006, Power Electronics Training System, Model 8032, and Power Transmission Training System, Model 8055, as well as many new topics related to recent technologies. The program then builds on the knowledge gained by the student through these basic courses to provide training in more advanced subjects such as home energy production from renewable resources (wind and sunlight), large-scale electricity production from hydropower, large-scale electricity production from wind power (doubly-fed induction generator [DFIG], synchronous generator, and asynchronous generator

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technologies), smart-grid technologies (SVC, STATCOM, HVDC transmission, etc.), storage of electrical energy in batteries, and drive systems for small electric vehicles and cars.

The Electric Power Technology Training Systems, Series 8010, are based on the Lab-Volt Electric Power Technology Training Program, each system providing a turn-key solution dealing with some aspects of the wide field of electrical energy. Each system in the 8010 Series is based on Lab-Volt's proven modular design approach. Also, most systems use computer-based data acquisition and control to provide unrivaled training in electrical energy. For this purpose, Lab-Volt developed the Four-Quadrant Dynamometer/Power Supply, Model 8960, and the Data Acquisition and Control Interface, Model 9063, two state-of-the-art USB peripherals which greatly enhance the learning experience of students. Refer to the Electric Power Technology Training Systems section of this data sheet for more information about each training system available in Series 8010.

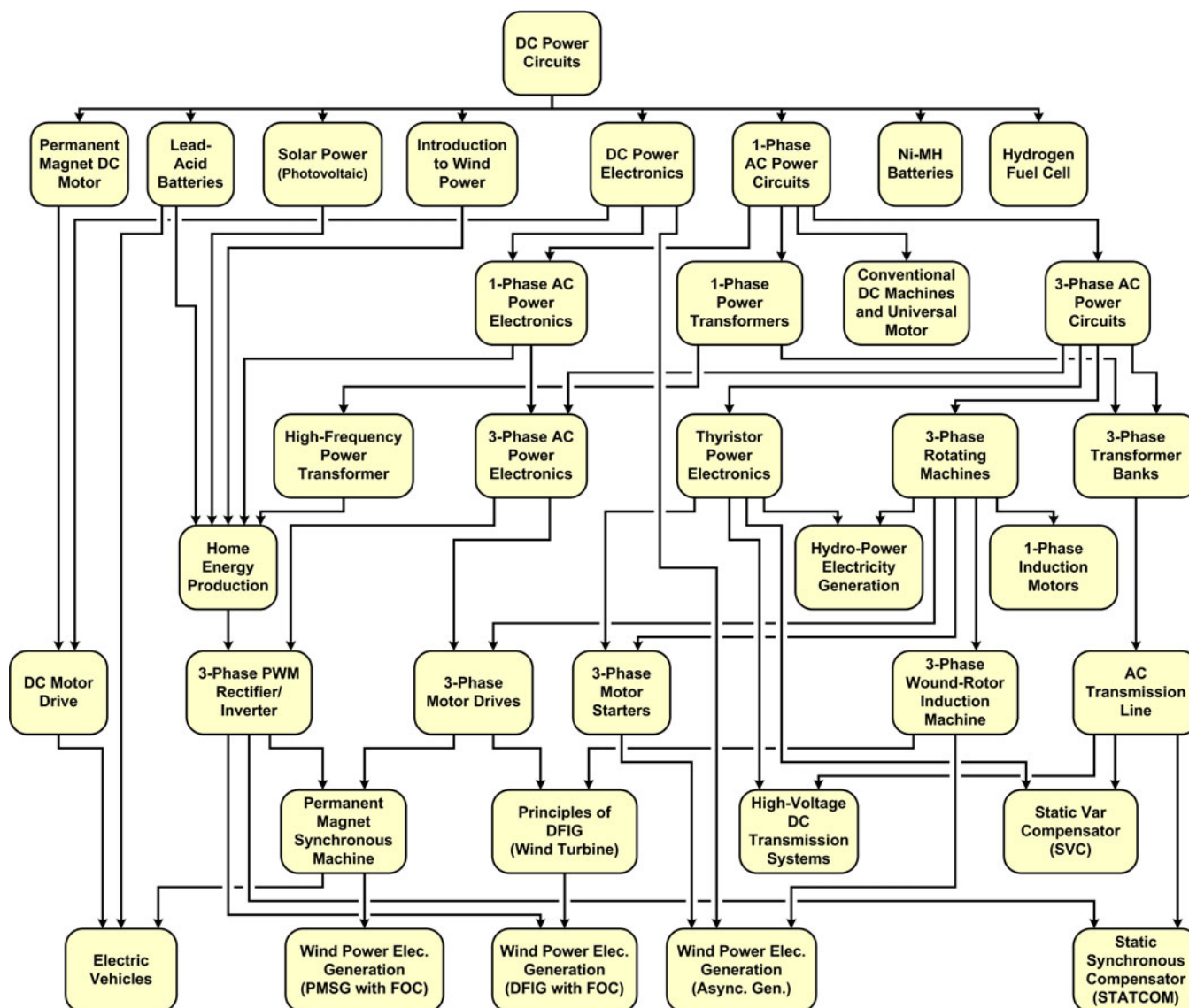
The Lab Volt Electric Power Technology Training Program being highly modular, both hardware and courseware wise, it allows you to select courses (topic coverage) to build a training solution that matches your specific needs. Refer to the Custom Training Solutions section of this data sheet for more information.

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The Lab-Volt Electric Power Technology Training Program is a modular study program divided into courses, each course dealing with a specific aspect of the wide field of electrical energy. The program is shown below as a flow chart, each box in the flow chart representing a course. Each course in the program includes a color student manual providing all the theoretical matter required, guided lab-exercise procedures to be performed with Lab-Volt training equipment, and review questions that

test the knowledge gained by the student. Whenever possible, each course is built to bring the student to actual applications as soon as possible. A color instructor guide providing all lab results and answers to questions is also included with each course. Refer to the Course Description section of this data sheet for additional information about each of the courses in the Lab-Volt Electric Power Technology Training Program.



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ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS

Lab-Volt offers a series of Electric Power Technology Training Systems that are based on the Electric Power Technology Training Program. The following systems are currently available in the 8010 Series:

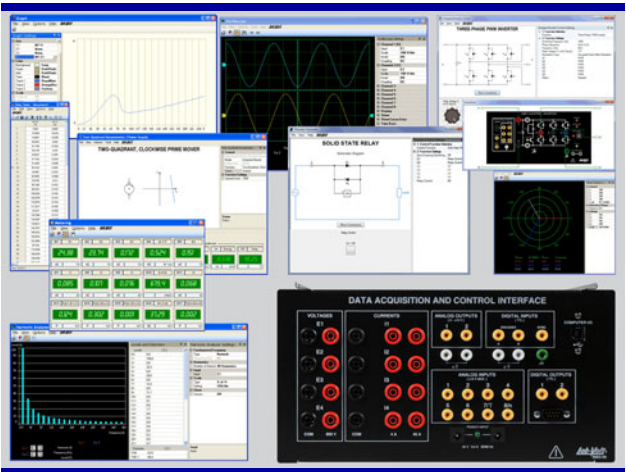
SYSTEM NAME	MODEL NUMBER
DC and AC Power Circuits Training System	8010-1
Solar Power Training System	8010-2
Small-Scale Wind Power Electricity Generation Training System	8010-3
Lead-Acid Batteries Training System	8010-4
Basic Renewable Energy Training System	8010-5
DC Power Electronics Training System	8010-6
Home Energy Production Training System	8010-7
Hydrogen Fuel Cell Training System	8010-8
Electromechanical Training System	8010-9
<i>This system closely matches classic Lab-Volt Electromechanical System, Model 8006.</i>	
Power Electronics Training System	8010-A
<i>This system closely matches classic Lab-Volt Power Electronics Training System, Model 8032.</i>	

Other systems will be added to the 8010 Series as additional courses in the Electric Power Technology Training Program become available. Each system in the 8010 Series is a turn-key solution that includes the equipment and courseware material required to perform a different combination of courses in the Electric Power Technology Training Program (see table on the next two pages) focusing on a specific set of aspects related to the wide field of electrical energy. Each system uses the Four-Quadrant

Dynamometer/Power Supply, Model 8960, and/or the Data Acquisition and Control Interface, Model 9063, two state-of-the-art USB peripherals, newly-developed by Lab-Volt, that greatly enhance hands-on learning. Refer to the Lists of Equipment section of this data sheet for the list of equipment included in each training system.



The Four-Quadrant Dynamometer/Power Supply, Model 8960, is a highly versatile USB peripheral that is used for multiple functions (dc power source, single-phase ac power source, prime mover, brake, wind turbine emulator, etc.) in the lab exercises included with the various courses in the Electric Power Technology Training Program.



The Lab-Volt Data Acquisition and Control Interface, Model 9063, is a highly versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical parameters in electric power systems and power electronics circuits.

The following table indicates the combination of courses which can be performed with each training system in the 8010 Series. Black dots in the table indicate the courses that can be performed with each training system. Red dots indicate popular complementary courses that can optionally be added to a training system.

If none of these Electric Power Technology Training Systems meets your specific training needs, please refer to the Custom Training Solutions section of this data sheet to learn how Lab-Volt can provide a training solution adapted to your needs.

Courseware		Electric Power Technology Training System Model Number									
Title	Part Number	8010-1	8010-2	8010-3	8010-4	8010-5	8010-6	8010-7	8010-8	8010-9	8010-A
DC Power Circuits	86350	•	•	•	•	•	•	•		•	
Lead-Acid Batteries	86351			•	•	•		•			
Ni-MH Batteries	86354										
Solar Power (photovoltaic)	86352		•			•		•			
Introduction to Wind Power	86353			•		•		•			
Permanent Magnet DC Motor	86357									•	
Hydrogen Fuel Cell	86355								•		
DC Power Electronics (diodes, IGBTs, and choppers)	86356						•	•			•
DC Motor Drive*	88553										•
Single-Phase AC Power Circuits	86358	•						•		•	
Single-Phase Power Transformers	86377							•		•	
Conventional DC Machines and Universal Motor*	88943									•	
Single-Phase AC Power Electronics	86359							•			•
High-Frequency Power Transformers	86378							•			
Home Energy Production*	86361							•			
Three-Phase AC Power Circuits	86360									•	
Three-Phase Rotating Machines	86364									•	
Single-Phase Induction Motors*	88944									•	
Three-Phase Wound-Rotor Induction Machine	86367										
Three-Phase Transformer Banks	86379									•	
AC Transmission Line	86365										

* **Note:** Equipment and course may still be under development. Contact your Lab-Volt sales representative for more information.

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Courseware		Electric Power Technology Training System Model Number									
Title	Part Number	8010-1	8010-2	8010-3	8010-4	8010-5	8010-6	8010-7	8010-8	8010-9	8010-A
Three-Phase AC Power Electronics	86362										●
Thyristor Power Electronics	86363										●
Hydropower Electricity Generation*	86369										●
Three-Phase Motor Starters*	88197										●
Three-Phase Motor Drives	86368										●
Principles of DFIG (Wind Turbine)	86376										
Three-Phase PWM Rectifier/Inverter	86366										
Permanent Magnet Synchronous Machine*	86373										
High-Voltage DC Transmission Systems	86380										●
Static Var Compensator (SVC)	86370										
Static Synchronous Compensator (STATCOM)	86371										
Wind Power Electricity Generation (Async. Gen.)*	86374										
Wind Power Electricity Generation (PMSG with FOC)*	86372										
Wind Power Electricity Generation (DFIG with FOC)*	88809										
Electric Vehicles*	86375										

* **Note:** Equipment and course may still be under development. Contact your Lab-Volt sales representative for more information.

CUSTOM TRAINING SOLUTIONS

The modularity of the Lab-Volt Electric Power Technology Training Program allows you to build your own training solution by selecting courses in the program that correspond to your specific needs. To build a custom training solution, refer to the Course Description section of this data sheet to learn about the topic coverage and prerequisites of each course in the Electric Power Technology Training Program, then select the courses that meet your specific training needs. The Lab-Volt sales representative can easily determine the exact list of equipment required to perform the lab exercises associated with your selection of courses using the Custom Training Solutions application (shown on next page). A few examples of custom solutions for specific training needs are shown below.

Example 1 – Training solution dealing with Single-Phase AC Power Electronics

Course selection:

- DC Power Circuits (86350)
- DC Power Electronics (86356)
- Single-Phase AC Power Circuits (86358)
- Single-Phase AC Power Electronics (86359)

Example 2 – Training solution dealing with Hydropower Electricity Generation

Course selection:

- DC Power Circuits (86350)
- Single-Phase AC Power Circuits (86358)
- Three-Phase AC Power Circuits (86360)
- Three-Phase Rotating Machines (86364)
- Thyristor Power Electronics (86363)
- Hydropower Electricity Generation* (86369)

Example 3 – Training solution dealing with Large-Scale Wind Power Electricity Generation

Course selection:

- DC Power Circuits (86350)
- Lead-Acid Battery (86351)
- Solar Power (86352)
- Introduction to Wind Power (86353)
- DC Power Electronics (86356)
- Single-Phase AC Power Circuits (86358)
- Single-Phase Power Transformers (86377)
- High-Frequency Power Transformers (86378)
- Single-Phase AC Power Electronics (86359)
- Three-Phase AC Power Circuits (86360)
- Home Energy Production (86361)
- Three-Phase Rotating Machines (86364)
- Three-Phase AC Power Electronics (86362)
- Thyristor Power Electronics (86363)
- Three-Phase Motor Drives (86368)
- Three-Phase Motor Starters* (88197)
- Three-Phase PWM Rectifier/Inverter (86366)
- Three-Phase Wound-Rotor Induction Machine (86367)
- Wind Power Electricity Generation using Async. Generators* (86374)
- Permanent Magnet Synchronous Machine* (86373)
- Wind Power Electricity Generation using PMSG with FOC* (86372)
- Principles of Doubly-Fed Induction Generators (DFIG) (86376)
- Wind Power Electricity Generation using DFIG with FOC * (88809)

Example 4 – Training solution dealing with Smart-Grid Technologies

Course selection:

- Home Energy Production (86361)
- Hydropower Electricity Generation* (86369)
- AC Transmission Line (86365)
- Static VAR Compensator (SVC) (86370)
- Three-Phase PWM Rectifier/Inverter (86366)
- Static Synchronous Compensator (STATCOM) (86371)
- High-Voltage Direct-Current (HVDC) Transmission Systems (86380)

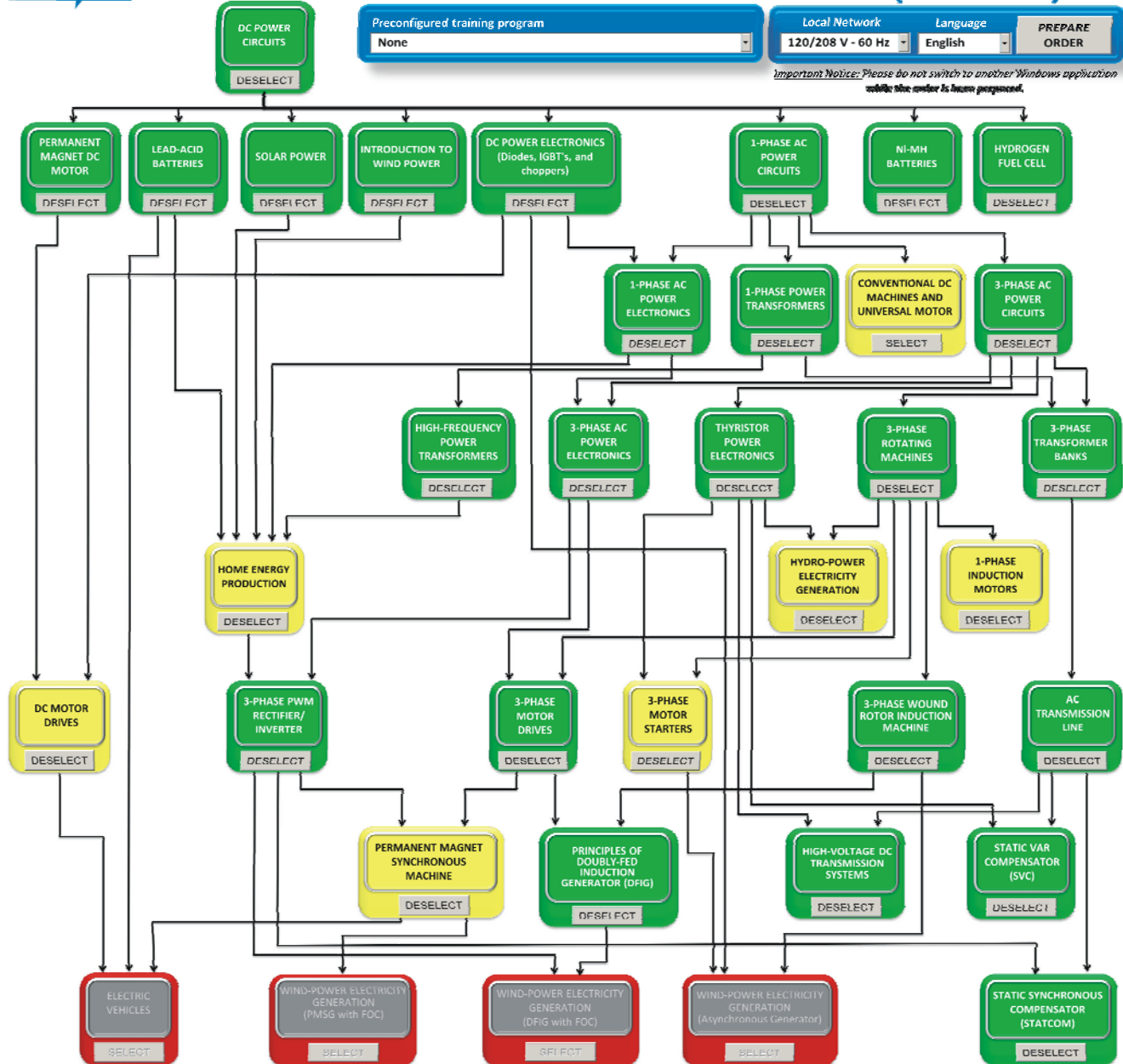
* **Note:** Equipment and course may still be under development. Contact your Lab-Volt sales representative for more information.

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

CUSTOM TRAINING SOLUTIONS APPLICATION



ELECTRIC POWER TECHNOLOGY TRAINING PROGRAM (8010 SERIES)



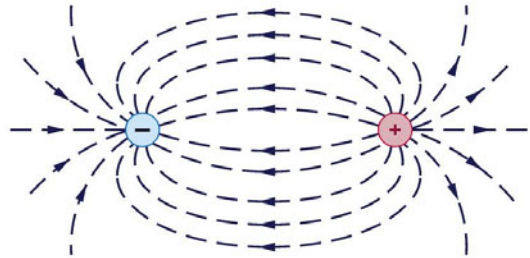
COURSE DESCRIPTION

The Lab-Volt Electric Power Technology Training Program consists of a wide selection of courses which are listed below.

- DC Power Circuits
- Lead-Acid Batteries
- Ni-MH Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- Permanent Magnet DC Motor
- Hydrogen Fuel Cell
- DC Power Electronics
- DC Motor Drives*
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers
- Conventional DC Machines and Universal Motor*
- Single-Phase AC Power Electronics
- High-Frequency Power Transformers
- Home Energy Production*
- Three-Phase AC Power Circuits
- Three-Phase Rotating Machines
- Single-Phase Induction Motors*
- Three-Phase Wound-Rotor Induction Machine
- Three-Phase Transformer Banks
- AC Transmission Line
- Three-Phase AC Power Electronics
- Thyristor Power Electronics
- Hydropower Electricity Generation*
- Three-Phase Motor Starters*
- Three-Phase Motor Drives
- Principles of Doubly-Fed Induction Generators (DFIG)
- Three-Phase PWM Rectifier/Inverter
- Permanent Magnet Synchronous Machine (PMSM)*
- High-Voltage Direct-Current (HVDC) Transmission Systems
- Static VAR Compensator (SVC)
- Static Synchronous Compensator (STATCOM)
- Wind Power Electricity Generation using Asynchronous Generators*
- Wind Power Electricity Generation using PMSG with FOC*
- Wind Power Electricity Generation using DFIG with FOC*
- Electric Vehicles*

The remainder of this section briefly describes each course and provides the topic coverage and prerequisites for each course.

DC Power Circuits (86350)



The DC Power Circuits course introduces the student to the fundamentals of electricity such as the direct current (DC), DC voltage, resistance, Ohm's Law, etc.

Topic Coverage (4 exercises)

- Voltage, Current, and Ohm's Law
- Equivalent Resistance
- Power in DC Circuits
- Series and Parallel Circuits

Prerequisites

- None

Lead-Acid Batteries (86351)



The Lead-Acid Batteries course explains how a lead-acid battery produces electricity from a chemical reaction. The course familiarizes the student with the charge and discharge characteristics of lead-acid batteries. The student also learns the various methods of charging lead-acid batteries.

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

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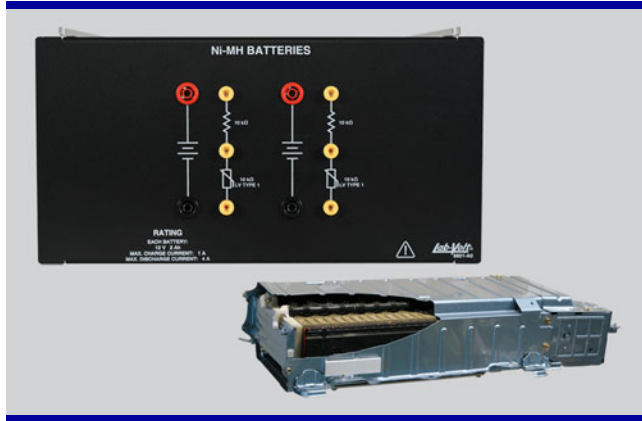
Topic Coverage (4 exercises)

- Battery Fundamentals
- Discharge Characteristics
- Battery Charging Fundamentals
- Battery Charging Methods

Prerequisites

- DC Power Circuits

Ni-MH Batteries (86354)



The Ni-MH Batteries course explains how a nickel-metal hydride (Ni-MH) battery produces electricity from a chemical reaction. The course familiarizes the student with the charge and discharge characteristics of Ni-MH batteries. The student also learns the various methods of charging Ni-MH batteries, with emphasis on the various methods of terminating the charge (temperature cutoff, voltage drop, and rate of temperature increase).

Topic Coverage (4 exercises)

- Battery Fundamentals
- Battery Capacity Versus Discharge Rate
- Battery Charging Fundamentals
- Battery Charging Methods

Prerequisites

- DC Power Circuits

Solar Power (86352)



The Solar Power course familiarizes the student with the production of electricity using photovoltaic (PV) solar panels. The course begins by introducing the diode, the basic semiconductor component in PV solar panels. The student then learns how a solar panel produces electricity from solar power as well as how to store this electric energy in batteries to ensure electric power is available during cloudy periods. The student also learns how to connect PV panels in series and in parallel to increase the voltage and current produced, respectively, as well as how shading affects solar panel operation. Finally, the student learns how to set the orientation of solar panels so the maximum amount of energy is produced.

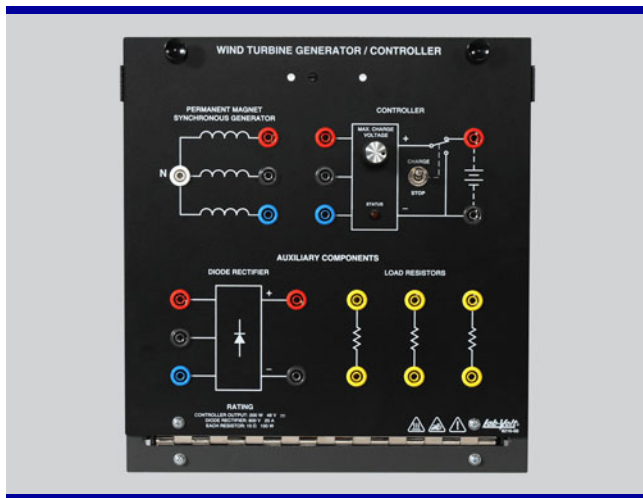
Topic Coverage (7 exercises)

- The Diode
- The Solar Panel (Photovoltaic Panel)
- Effect of Temperature on Solar Panel Performance
- Storing Energy from Solar Panels into Batteries
- Effect of Shading on Solar Panel Operation
- Solar Panel Orientation (optional)
- Solar Panel Performance versus Insolation (optional)

Prerequisites

- DC Power Circuits

Introduction to Wind Power (86353)



The Introduction to Wind Power course familiarizes the student with the small-scale production of electricity using a fixed-pitch, direct-drive wind turbine. The student learns how a wind turbine produces electricity from wind power as well as how to store this electric energy in batteries to ensure electric power is available when there is no wind or during low wind periods. In lab exercises, the Lab-Volt Wind Turbine Emulator is used to realistically emulate wind blowing on the rotor of a small-wind turbine, and make the wind turbine generator operate exactly as if it would be subjected to actual wind.

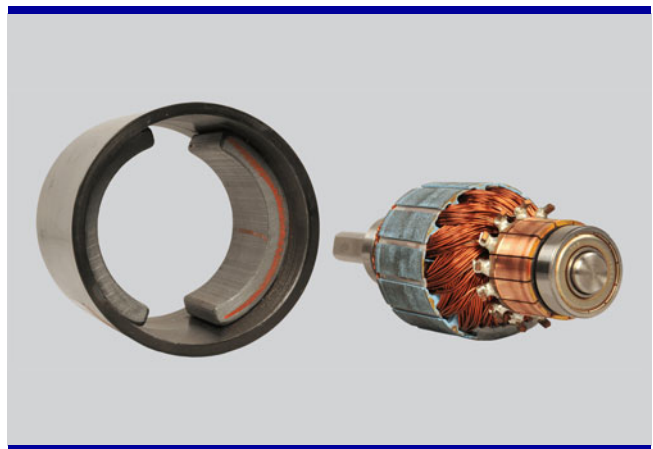
Topic Coverage (4 exercises)

- Voltage-Speed Characteristic of a Wind Turbine Generator
- Torque-Current Characteristic of a Wind Turbine Generator
- Power versus Wind Speed
- Storing the Energy Produced by a Wind Turbine into Batteries

Prerequisites

- DC Power Circuits

Permanent Magnet DC Motor (86357)



The Permanent Magnet DC Motor course covers the operating characteristics of a permanent magnet DC motor. In this course, students will learn the motor characteristics when used as a motor or as a generator.

Topic Coverage (3 exercises)

- Prime Mover and Brake Operation
- Permanent Magnet DC Motor Operating as a Generator
- Permanent Magnet DC Motor Operating as a Motor

Prerequisites

- DC Power Circuits

Hydrogen Fuel Cell (86355)



The Hydrogen Fuel Cell course teaches foundational engineering principles of fuel cell systems. The course covers the structure and functioning principles, the thermodynamics theory, and the different characteristics of a real 50 W fuel cell system. Through numerous

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experiments, the students will also learn about the safety aspects of this type of technology.

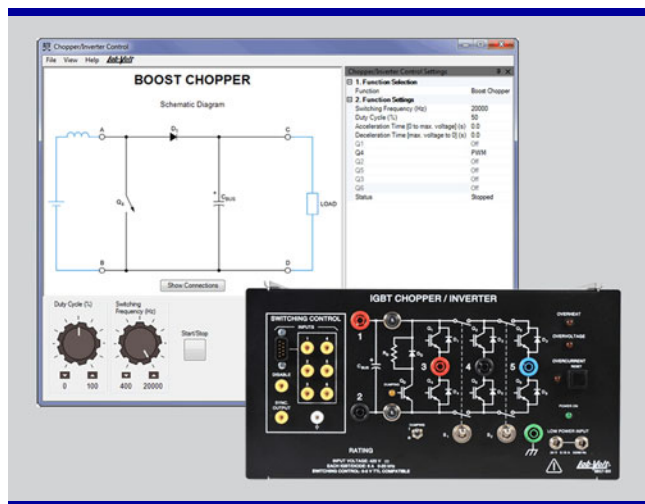
Topic Coverage (9 exercises)

- The Basic Functions of the Fuel Cell System
- The Characteristic Curve of a Fuel Cell
- Parameters Influencing the Characteristic Curve
- Determination of the Hydrogen Current Curve
- Efficiency of the Fuel Cell Stack
- Set-up of a Fuel Cell Power Supply
- Efficiency of a Fuel Cell Power Supply
- Fuel Cell Application I: Remote Traffic Light
- Fuel Cell Application II: Fuel Cell Car

Prerequisites

- DC Power Circuits

DC Power Electronics (86356)



The DC Power Electronics course introduces the student to power electronic components and circuits (choppers) required to manage DC power, such as the DC power stored in batteries or produced from wind power or solar power. The course first presents the diode and the switching transistor, the two main semiconductor components used in power electronics. Through the remainder of the course, the student becomes familiar with the main types of choppers, is introduced to high-speed power switching (voltage-type and current-type circuits, free-wheeling diodes, etc), learns how to control ripple in choppers, and discovers how to build a battery charger using a buck chopper.

Topic Coverage (8 exercises)

- The Diode and Switching Transistor
- The Buck Chopper
- Introduction to High-Speed Power Switching
- Ripple in Choppers
- The Lead-Acid Battery Charger
- The Boost Chopper
- The Buck/Boost Chopper
- The Four-Quadrant Chopper

Prerequisites

- DC Power Circuits

DC Motor Drive* (88553)

The DC Motor Drive courses familiarizes the student with the operation and use of DC variable speed drives. Through the curriculum, students will learn the basic concepts (e.g., torque control, regenerative braking, etc.) used in DC motor drives. They will be able to demonstrate their utilization to control the speed of a DC motor.

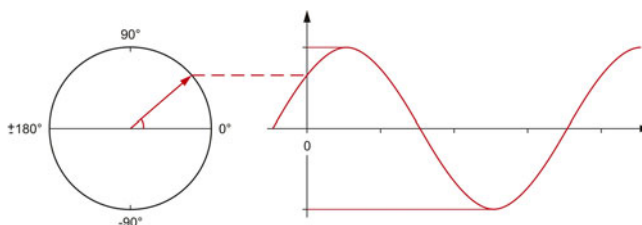
Topic Coverage (4 exercises)

- The Buck Chopper Drive
- The Buck-Boost Chopper Drive
- The Four-Quadrant Chopper Drive
- DC Motor Control using Speed and Current Feedback

Prerequisites

- DC Power Circuits
- Permanent Magnet DC Motor
- DC Power Electronics

Single-Phase AC Power Circuits (86358)



The Single-Phase AC Power Circuits course first introduces the student to the fundamentals of alternating current (AC) such as the sine wave, period and frequency, phase angle and phase shift, instantaneous and average power, etc. The student then becomes familiar with the inductor and capacitor. The course continues with more advanced topics such as the impedance, active power, reactive power, apparent power, and power triangle. The course concludes by teaching the student how to solve AC power circuits using the impedance calculation method or the power triangle method.

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

Topic Coverage (10 exercises)

- The Sine Wave
- Phase Angle and Phase Shift
- Instantaneous Power and Average Power
- Inductive Reactance
- Capacitive Reactance
- Impedance
- Active and Reactive Power
- Apparent Power and the Power Triangle
- Solving Simple AC Circuits using Circuit Impedance Calculation
- Solving AC Circuits Using the Power Triangle Method

Prerequisites

- DC Power Circuits

Single-Phase Power Transformers (86377)



The Single-Phase Power Transformers course covers, through theory and demonstrations, the operating characteristics of single-phase power transformers. Through measurements, students will learn the important characteristics of a power transformer, such as the turns ratio, voltage and current ratios, winding polarity, voltage regulation, power losses, and transformer ratings. The course also covers the effect which frequency has on the transformer rating as well as the operation and special characteristics of the autotransformer.

Topic Coverage (6 exercises)

- Voltage and Current Ratios
- Transformer Winding Polarity and Interconnection
- Transformer Losses, Efficiency, and Regulation
- Transformer Rating
- Effect of Frequency on Transformer Rating
- The Autotransformer

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits

Conventional DC Machines and Universal Motor* (88943)



The Conventional DC Machines and Universal Motor course introduces the student to the operation and characteristics of the following rotating machines: separately-excited, shunt, series, and compound dc motors, separately-excited, shunt, and compound dc generators, and universal motor. These machines, although still in use in numerous applications today, are less common in modern battery-powered applications (e.g., electric bicycles, mobility scooters, etc.) where power efficiency is at a premium. In such applications, the permanent magnet dc motor is often preferred because of its superior power efficiency.

Topic Coverage

- The Separately-Excited DC Motor
- Separately-Excited, Series, Shunt, and Compound DC Motors
- Separately-Excited, Shunt, and Compound DC Generators
- Armature Reaction and Saturation Effect
- The Universal Motor

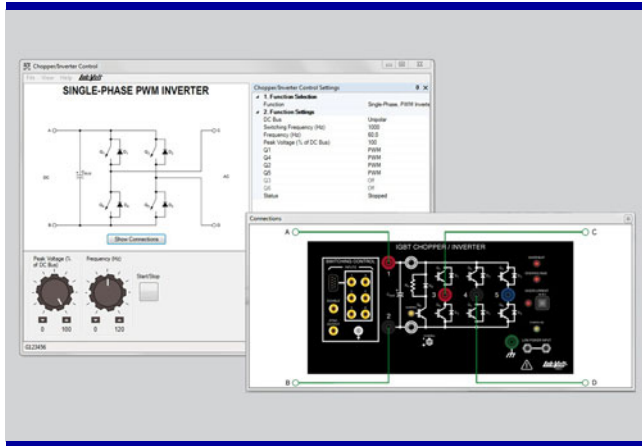
Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

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Single-Phase AC Power Electronics (86359)



The Single-Phase AC Power Electronics course introduces the student to power electronic circuits (rectifiers and inverters) used to perform AC/DC power conversion in single-phase circuits. The course begins with the study of single-phase diode rectifiers. The student then becomes familiar with the operation of the single-phase inverter and the single-phase PWM inverter. The course concludes with the study of power flow in a single-phase PWM inverter.

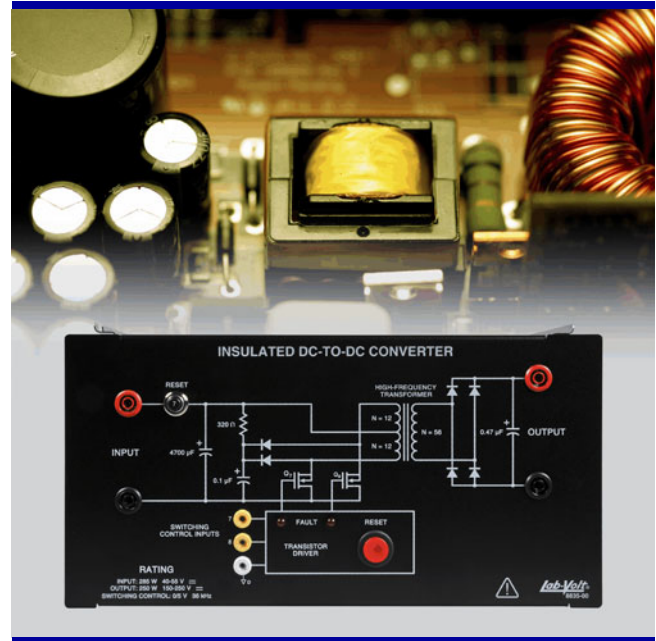
Topic Coverage (2 exercises)

- Power Diode Single-Phase Rectifiers
- The Single-Phase PWM Inverter

Prerequisites

- DC Power Circuits
- DC Power Electronics
- Single-Phase AC Power Circuits

High-Frequency Power Transformers (86378)



The High-Frequency Power Transformers course demonstrates how high-frequency switching can be used to increase the power handling capability of power transformers. This type of power transformer is commonly used to perform DC-to-DC conversion in switched-mode power supplies (SMPS) as well as in grid-tied inverters used for home energy production.

Topic Coverage (1 exercise)

- High-Frequency Power Transformer Operation

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers

Home Energy Production* (86361)



The Home Energy Production course explains how to produce AC power from DC power produced using renewable natural resources (e.g., wind, sunlight, etc) or stored in batteries. The course first shows how to produce AC power for local use (typically at remote sites) from DC power produced from renewable resources and stored in batteries. The course continues by introducing the single-phase grid-tied inverter (i.e., the PWM rectifier/inverter), the essential device required to convert DC power into AC power that can feed the grid. Then the student learns how to feed the grid with AC power obtained from DC power produced from renewable resources. Finally, the student is introduced to large-scale energy storage, an important step in the implementation of the smart grid.

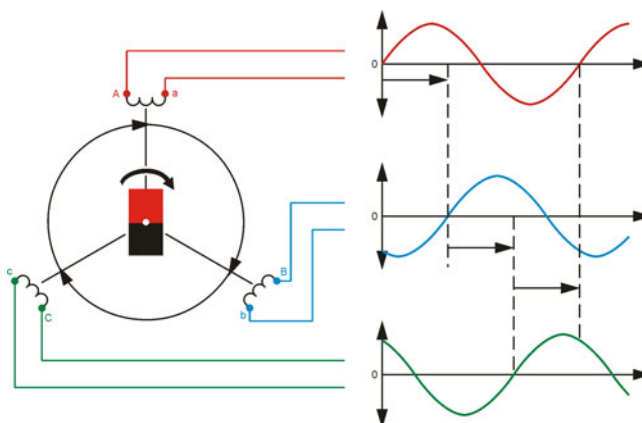
Topic Coverage (5 exercises)

- Stand-Alone Home Energy Production
- The Single-Phase Grid-Tied Inverter (PWM Rectifier/Inverter)
- Grid-Tied Home Energy Production Using a Solar or Wind Power Inverter without DC-to-DC Converter
- Grid-Tied Home Energy Production Using a Solar or Wind Power Inverter with DC-to-DC Converter
- Large-Scale Energy Storage: A Step in the Implementation of the Smart Grid

Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- High-Frequency Power Transformers

Three-Phase AC Power Circuits (86360)



The Three-Phase AC Power Circuit course familiarizes the student with three-phase power systems. The course first introduces the student to the fundamentals of three-phase power systems such as the wye (star) and delta configurations, phase and line voltages, phase and line currents, phase balance, etc. The student then learns how to measure power in three-phase circuits using the two-wattmeter method as well as how to determine the power factor. Finally, the student learns what the phase sequence is and how to determine the phase sequence of a three-phase power system.

Topic Coverage (3 exercises)

- Three-Phase Circuits
- Three-Phase Power Measurement
- Phase Sequence

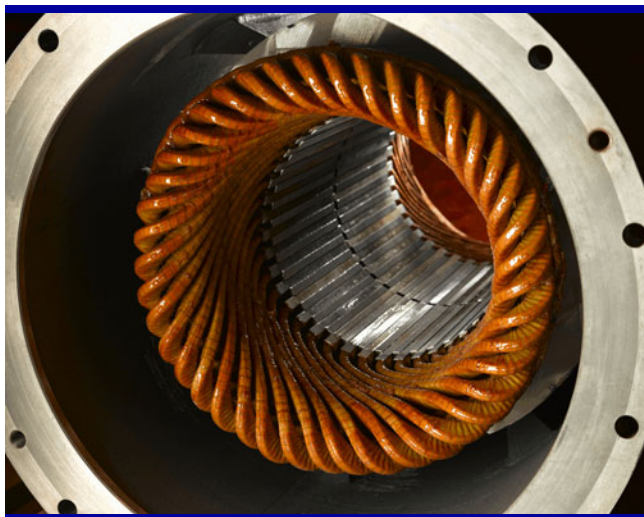
Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

Three-Phase Rotating Machines (86364)



The Three-Phase Rotating Machines course familiarizes the student with the various three-phase machines used for large-scale production of electricity from wind power and hydropower. The course begins with fundamentals of rotating machines such as the torque, rotation speed, direction of rotation, motor power, power losses in motor, motor efficiency, etc. The student then studies the operation (both as a motor and a generator) of the following three-phase machines: squirrel-cage induction machine, and synchronous machine.

Topic Coverage (8 exercises)

- Prime Mover and Brake Operation
- The Three-Phase Squirrel Cage Induction Motor
- Eddy-Current Brake and Asynchronous Generator
- The Three-Phase Synchronous Motor
- Synchronous Motor Pull-Out Torque
- Three-Phase Synchronous Generator No-Load Operation
- Voltage-Regulation Characteristics
- Generator Synchronization

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits

Single-Phase Induction Motors* (88944)



The Single-Phase Induction Motors course introduces the student to the operation and characteristics of the following two types of single-phase induction motor: capacitor-start induction motor and split-phase induction motor. These motors, although still in use in numerous applications today, are less common in modern applications where they are often replaced with three-phase induction motor drives (i.e., a three-phase squirrel-cage induction motor plus a variable-frequency, three-phase inverter) for added flexibility of operation and improved performance.

Topic Coverage

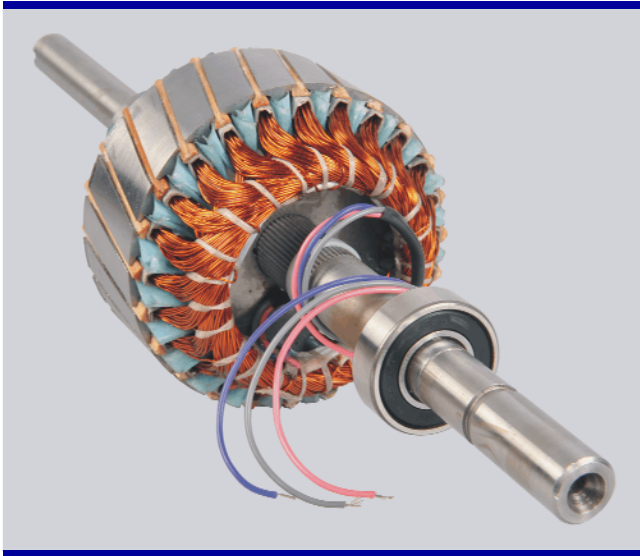
- Operation and Characteristics of Single-Phase Induction Motors

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits
- Three-Phase Rotating Machines

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

Three-Phase Wound-Rotor Induction Machine (86367)



The Three-Phase Wound-Rotor Induction Machine course introduces the student to the operation of three-phase wound-rotor induction machines. The student then learns the effects which varying the rotor resistor has on the starting current and torque of the machine. Through this process, the student also learns how to vary the rotation speed of a wound-rotor induction machine.

Topic Coverage (2 exercises)

- Three-Phase Wound-Rotor Induction Machine with a Short-Circuited Rotor
- Three-Phase Wound-Rotor Induction Machine with Rotor Resistance

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits
- Three-Phase Rotating Machines

Three-Phase Transformer Banks (86379)



The Three-Phase Transformer Banks course covers the operating characteristics of three-phase transformer banks. The course covers the winding connection (wye and delta configurations) and shows how to ensure proper phase relationships between the phase windings.

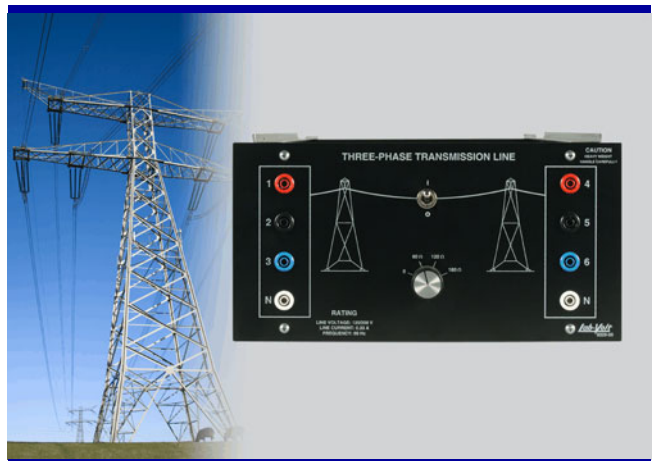
Topic Coverage (1 exercise)

- Three-Phase Transformer Configurations

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits

AC Transmission Line (86365)



The AC Transmission Line course familiarizes students with the fundamental principles of three-phase ac power transmission lines. The student first studies the voltage regulation characteristics of ac power transmission lines, then learn how to achieve voltage

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

compensation using shunt capacitors. The course then discusses the power transmission capacity of ac transmission lines and shows how to apply voltage compensation to long ac transmission lines. The course terminates by demonstrating control of the amount of active and reactive power flowing through ac transmission lines used in an interconnected power network.

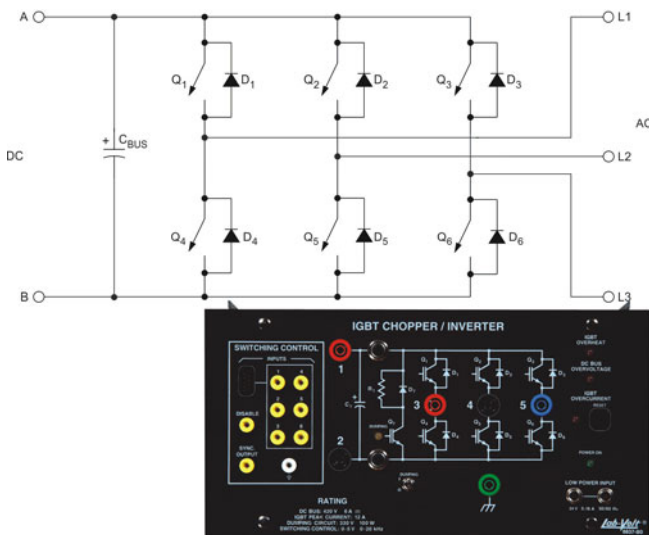
Topic Coverage (5 exercises)

- Voltage Regulation Characteristics
- Voltage Compensation
- Power Transmission Capacity
- Voltage Compensation in Long AC Transmission Lines
- Control of Active and Reactive Power Flow

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits
- Three-Phase Transformer Banks

Three-Phase AC Power Electronics (86362)



The Three-Phase Power Electronics course introduces the student to power electronic circuits (rectifiers and inverters) used to perform AC/DC power conversion in three-phase circuits. The course begins with the study of three-phase diode rectifiers. The student then becomes familiar with the operation of the single-phase PWM inverter built with a dual-polarity DC bus. The course continues with the operation of the three-phase PWM inverter built with a single-polarity or dual-polarity DC bus. The course concludes with the study of the three-phase PWM inverter.

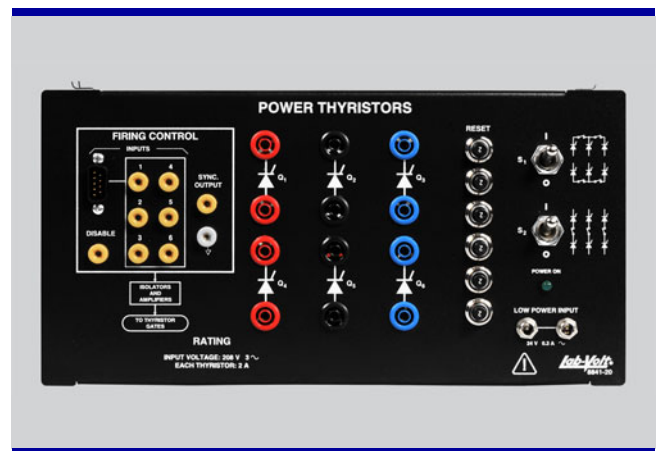
Topic Coverage (3 exercises)

- Power Diode Three-Phase Rectifiers
- The Single-Phase PWM Inverter with Dual-Polarity DC Bus
- The Three-Phase PWM Inverter

Prerequisites

- DC Power Circuits
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Three-Phase AC Power Circuits

Thyristor Power Electronics (86363)



The Thyristor Power Electronics course introduces the student to the power diode and thyristor, two electronic components used to control very large amount of power in ac and dc power systems. The course begins with the study of both the single-phase and three-phase power diode rectifiers. The student is then introduced to the thyristor operation. The remainder of the course deals with the following applications of the power thyristor: solid state relay, single-phase and three-phase ac power control circuits using either phase angle control or burst fire control, and three-phase thyristor bridge. Both the rectifier and inverter modes of operation are discussed when studying the three-phase thyristor bridge.

Topic Coverage (7 exercises)

- Power Diode Single-Phase Rectifiers
- Power Diode Three-Phase Rectifiers
- The Power Thyristor
- The Solid State Relay
- Single-Phase AC Power Control
- Three-Phase AC Power Control
- Thyristor Three-Phase Rectifier/Inverter

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits

Hydropower Electricity Generation* (86369)



The Hydropower Electricity Generation course examines the large-scale production of electricity from hydro power using a synchronous generator, a proven technology long used worldwide by power utilities. The course first introduces the student to the configuration of a typical hydropower plant. The student then learns how to adjust the voltage and frequency of the synchronous generator in a hydropower plant as well as how to synchronize the generator using a synchro-check relay. The course concludes with a study of the automatic speed (frequency) and voltage regulation systems used in a hydropower plant. The course also includes an optional exercise dealing with the operation of hydropower generators connected in parallel as well as with load sharing.

Topic Coverage (4 exercises + 1 optional exercise)

- Generator Frequency and Voltage Control Principles
- Generator Synchronization Using a Synchro-Check Relay
- Generator Operation with Speed and Voltage Regulation
- Generator Speed and Voltage Regulation with Droop
- Generator Parallel Operation and Load Sharing (Optional)

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits
- Thyristor Power Electronics
- Three-Phase Rotating Machines

Three-Phase Motor Starters* (88197)

The Three-Phase Motor Starters course demonstrates how using a three-phase motor starter to help start an induction motor allows the motor to start smoothly by avoiding inrush currents and is a better option than connecting the motor directly to a three-phase power source.

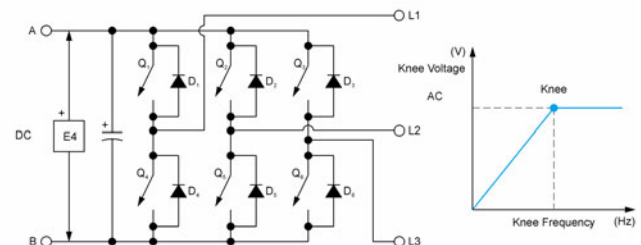
Topic Coverage (2 exercises)

- Direct On-Line Starters
- Soft Starters

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits
- Thyristor Power Electronics
- Three-Phase Rotating Machines

Three-Phase Motor Drives (86368)



The Three-Phase Motor Drives course teaches the fundamentals principles and operating characteristics of three-phase induction motor drives. The three-phase induction motor is rugged, requires few maintenance, and is low cost, making it attractive in numerous commercial and industrial applications. To control the rotational speed of an induction motor, a motor drive using variable frequency and voltage is necessary.

Topic Coverage (2 exercises)

- Three-Phase, Variable-Frequency Induction-Motor Drive
- Three-Phase, Variable-Frequency Induction-Motor Drive with Constant V/f ratio

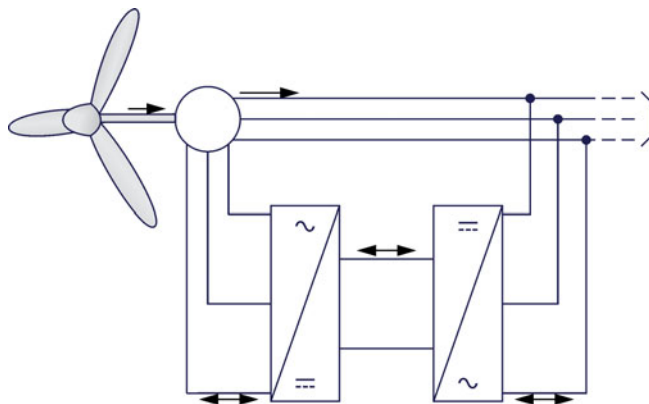
* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

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Prerequisites

- DC Power Circuits
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Three-Phase AC Power Circuits
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines

Principles of DFIG (86376)



The Principles of DFIG course deals with the large-scale production of electricity from wind power using a doubly-fed induction generator (DFIG). This technology allows the generator to operate at different rotation speeds while keeping the frequency of the generated voltage and current fixed; a very useful feature when the generator is used in a wind turbine.

Topic Coverage (3 exercises)

- Three-Phase Wound-Rotor Induction Machine Used as a Synchronous Machine
- Doubly-Fed Induction Motors
- Doubly-Fed Induction Generators

Prerequisites

- DC Power Circuits
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Three-Phase AC Power Circuits
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines
- Three-Phase Motor Drives
- Three-Phase Wound-Rotor Induction Machine

Three-Phase PWM Rectifier/Inverter (86366)

The Three-Phase PWM Rectifier/Inverter course builds on the knowledge the student gained in previous power electronics courses and in the Home Energy Production course to deal with the operation and characteristics of the three-phase PWM rectifier/inverter (grid-tied inverter). The three-phase PWM rectifier/inverter is a key device in several applications such as the static synchronous compensator (STATCOM), large-scale production of electricity from solar power, permanent-magnet synchronous machine (PMSG) control, etc.

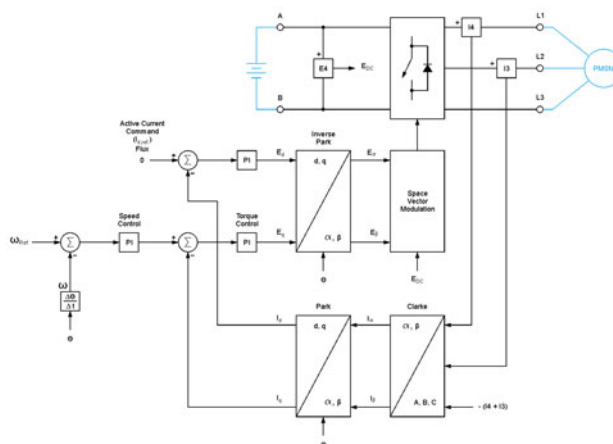
Topic Coverage (1 exercise)

- Operation of a Three-Phase PWM Rectifier/Inverter

Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits
- High-Frequency Power Transformer
- Three-Phase AC Power Electronics
- Home Energy Production*

Permanent Magnet Synchronous Machine* (86373)



The Permanent Magnet Synchronous Machine course covers the construction and operation of that type of machine. The characteristics of the permanent magnet

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

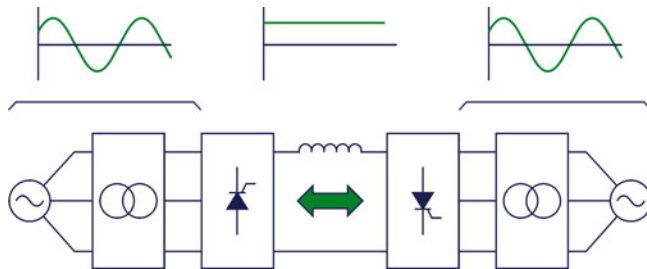
synchronous machine makes it a favorite in applications such as large wind turbines and electric vehicles. Through lab exercises, students experiment the three most used type of permanent-magnet synchronous machine controller : 120° modulation six steps, PWM six steps, and field-oriented control (FOC).

Topic Coverage (to be determined)

Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits
- High-Frequency Power Transformers
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines
- Home Energy Production*
- Three-Phase PWM Rectifier/Inverter
- Three-Phase Motor Drives

High-Voltage DC Transmission Systems (86380)



The High-Voltage Direct-Current (HVDC) Transmission Systems course deals with the operating characteristics of this type of power transmission systems and the technology involved. HVDC transmission systems are used at several nodes of the grid to improve the flexibility and efficiency of electric power transmission, and thus, are an important tool in building a smart grid. Typical applications of HVDC transmission systems are long-distance power transmission, underwater power transmission (submarine link), back-to-back link for easy interconnection of two independent ac power networks, etc.

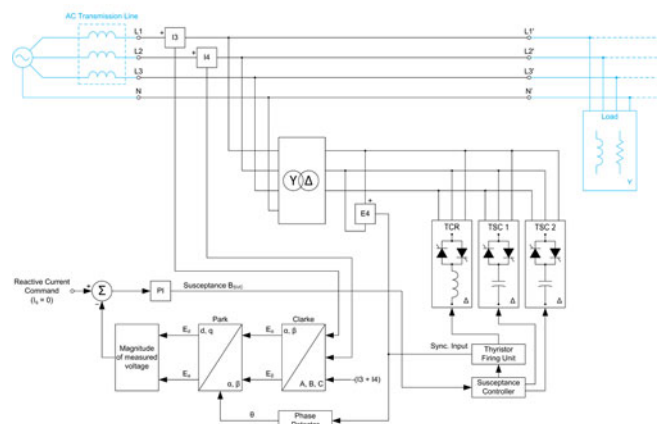
Topic Coverage (5 exercises)

- Voltage Regulation and Displacement Power Factor (DPF) in Thyristor Three-Phase Bridges
- Basic Operation of HVDC Transmission Systems
- DC Current Regulation and Power Flow Control in HVDC Transmission Systems
- Commutation Failure at the Inverter Bridge
- Harmonic Reduction using Thyristor 12-Pulse Converters

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits
- Thyristor Power Electronics
- Three-Phase Transformer Banks
- AC Transmission Line

Static VAR Compensator (86370)



The Static Var Compensator (SVC) course deals with the operation of the SVC (i.e., thyristor-controlled reactor, thyristor-switched capacitors, and SVC controller) as well as with the automatic control of the voltage or the power factor in three-phase ac power systems. As part of the FACTS (Flexible AC Transmission Systems), the SVC technology is used by power utilities to maintain voltage quality for the distribution system as well as by industrial plants for dynamic power factor correction at their electric power entrance.

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

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Topic Coverage (3 exercises)

- Main Components of a Static VAR Compensator (SVC)
- Voltage Compensation of AC Transmission Lines using an SVC
- Dynamic Power Factor Correction Using an SVC

Prerequisites

- DC Power Circuits
- Single-Phase AC Power Circuits
- Single-Phase Power Transformers
- Three-Phase AC Power Circuits
- Thyristor Power Electronics
- Three-Phase Transformer Banks
- AC Transmission Line

Static Synchronous Compensator (STATCOM) (86371)

This course deals with the static synchronous compensator (STATCOM), which mainly consists of a three-phase PWM rectifier/inverter that is used to exchange reactive power, and even active power, with the ac power network. This type of compensator, which is part of the FACTS (Flexible AC Transmission Systems), provides fast and accurate reactive power compensation in three-phase ac power systems. The STATCOM technology is used by power utilities to maintain voltage quality for the distribution system as well as by industrial plants for dynamic power factor correction at their electric power entrance.

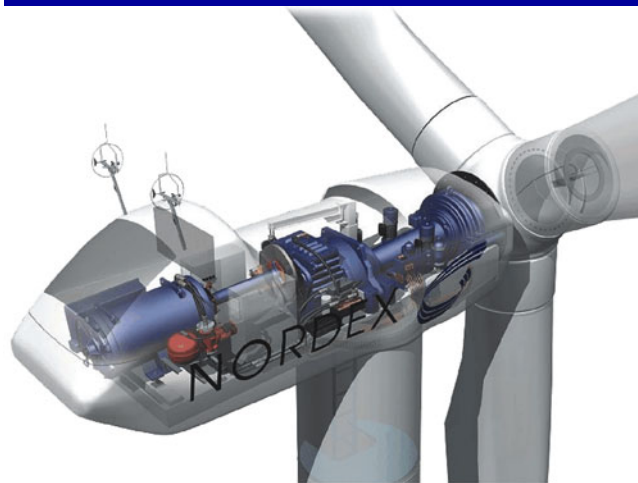
Topic Coverage (2 exercises)

- Voltage compensation of AC transmission lines using a STATCOM
- Dynamic Power Factor Correction Using a STATCOM

Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- High-Frequency Power Transformers
- Three-Phase AC Power Circuits
- Three-Phase Transformer Banks
- Home Energy Production*
- Three-Phase PWM Rectifier/Inverter
- AC Transmission Line

Wind Power Electricity Generation (Async. Gen.)* (86374)



The Wind Power Electricity Generation (Async. Gen.) course deals with the large-scale production of electricity from wind power using asynchronous generators. This technology is used widely as it is relatively easy to implement. The course begins with the study of the asynchronous generator operation, then focuses on the control of an asynchronous generator used in a wind turbine.

Topic Coverage (to be determined)

Prerequisites

- DC Power Circuits
- DC Power Electronics
- Single-Phase AC Power Circuits
- Three-Phase AC Power Circuits
- Three-Phase Rotating Machines
- Three-Phase Wound-Rotor Induction Machine
- Thyristor Power Electronics
- Three-Phase Motor Starters*

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

Wind Power Electricity Generation (PMSG with FOC)* (86372)

The Wind Power Electricity Generation (PMSG with FOC) course deals with the large-scale production of electricity from wind power using permanent magnet synchronous generators (PMSG) using field-oriented control (FOC). This technology simplifies the mechanical design of a wind turbine, thereby reducing mechanical maintenance, but requires additional power electronics.

Topic Coverage (to be determined)

Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- High-Frequency Power Transformers
- Three-Phase AC Power Circuits
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines
- Home Energy Production*
- Three-Phase PWM Rectifier/Inverter
- Three-Phase Motor Drives
- Permanent Magnet Synchronous Machine*

Wind Power Electricity Generation (DFIG with FOC)* (88809)



The Wind Power Electricity Generation (DFIG with FOC) course builds on the knowledge of doubly-fed induction generators (DFIG) the student gained through course Principles of Doubly-Fed Induction Generators to introduce him or her to field-oriented control (FOC) of these generators. FOC is a sophisticated control technique used in DFIG wind turbines to maximize performance.

Topic Coverage (to be determined)

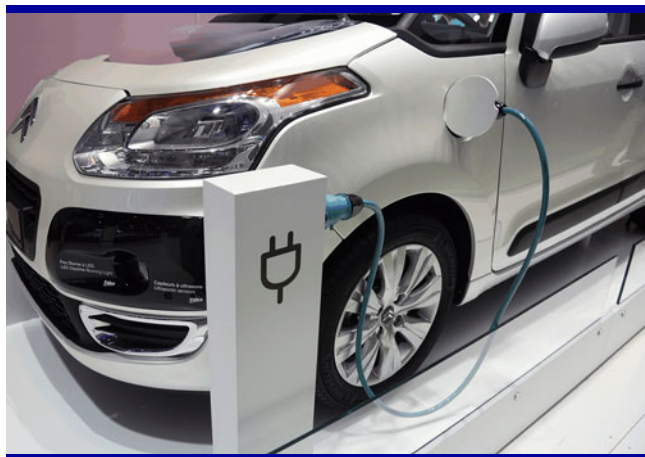
* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

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Prerequisites

- DC Power Circuits
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- High-Frequency Power Transformers
- Three-Phase AC Power Circuits
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines
- Home Energy Production*
- Three-Phase PWM Rectifier/Inverter
- Three-Phase Motor Drives
- Three-Phase Wound-Rotor Induction Machine
- Principles of DFIG

Electric Vehicles* (86375)



The Electric Vehicles course introduces the student to the operation of the drive system in modern electric vehicles (bicycles, scooters, cars, light truck, etc.), which are considered an essential step toward a larger use of renewable energy. The course focuses on the control of the permanent magnet DC motor and permanent magnet synchronous motor when used in an electric vehicle application.

Topic Coverage (to be determined)

Prerequisites

- DC Power Circuits
- Permanent Magnet DC Motor
- Lead-Acid Batteries
- Solar Power (photovoltaic)
- Introduction to Wind Power
- DC Power Electronics
- Single-Phase AC Power Circuits
- Single-Phase AC Power Electronics
- Single-Phase Power Transformers
- High-Frequency Power Transformers
- Three-Phase AC Power Circuits
- Three-Phase AC Power Electronics
- Three-Phase Rotating Machines
- Home Energy Production*
- Three-Phase PWM Rectifier/Inverter
- Three-Phase Motor Drives
- DC Motor Drive*
- Permanent Magnet Synchronous Machine*

* **Note:** Course may still be under development (topic coverage subject to change). Contact your Lab-Volt sales representative for more information.

POWER REQUIREMENT

For training systems 8010-1 to 8010-A (inclusively), a standard single phase AC outlet is required.

For training systems 8010-9 and 8010-A, a three-phase installation that meets the requirements below is also necessary.

Service Installation: 20 A, 3 phases, 5 wires, star (wye) configuration, including neutral and ground wires

Nominal Power: 500 VA (each system)

PERSONAL COMPUTER REQUIREMENTS

A currently available personal computer with USB 2.0 ports, running under one of the following operating systems: Windows® XP, Windows® Vista (32-bit version only), or Windows® 7.

LISTS OF EQUIPMENT

This section lists the equipment for each training system in the 8010 series. Some additional equipment, such as a digital multimeter or a host computer, is required to perform the exercises but is not included in the 8010 series training systems, as most school labs are already equipped with such equipment. Optional equipment can be added to certain training systems to enhance the lab exercises.

The ordering numbers in the following lists of equipment are for English variants of equipment operating at common voltage-frequency combinations.

To order any of the training systems in the 8010 series, use the system ordering number (indicated in blue in the lists below) that corresponds to the variant required (e.g., 8010-70). To order additional or optional equipment, use the model numbers that correspond to the variant required (e.g., 8990-05, 86630-00, etc). For equipment variants in Spanish or French language and/or using a voltage-frequency combination other than those listed below, please contact Lab-Volt Services for availability and ordering numbers.

DC AND AC POWER CIRCUITS TRAINING SYSTEM, MODEL 8010-1

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
DC and AC Power Circuits Training System	1	8010-10	1	8010-15	1	8010-1A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Inductive Load	1	8321-00	-	-	-	-
Capacitive Load	1	8331-00	-	-	-	-
Inductive and Capacitive Loads	-	-	1	8333-05	1	8333-0A
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (Model 8968-2) Standard functions]	1	8960-C0	1	8960-C5	1	8960-CA
Data Acquisition and Control Interface [with Computer-Based Instrumentation (9069-1) function]	1	9063-B0	1	9063-B0	1	9063-B0
24-Vac Power Supply	1	30004-20	1	30004-25	1	30004-2A
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Single-Phase AC Power Circuits (Student Manual)	1	86358-00	1	86358-00	1	86358-00
Single-Phase AC Power Circuits (Instructor Guide)	1	86358-10	1	86358-10	1	86358-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-1

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

¹ The Three-Module Workstation, Model 8131, can be replaced with the Mobile Workstation, Model 8110, or the Workstation, Model 8134.

² Refer to the Computer Requirements section of this data sheet if the computer is to be provided by the end-user.

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SOLAR POWER TRAINING SYSTEM, MODEL 8010-2

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Solar Power Training System	1	8010-20	1	8010-25	1	8010-2A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Lead-Acid Batteries	1	8801-00	1	8801-00	1	8801-00
Solar Panel Test Bench	1	8805-00	1	8805-05	1	8805-0A
Monocrystalline Silicon Solar Panel	1	8806-00	1	8806-00	1	8806-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) Standard functions]	1	8960-B0	1	8960-B5	1	8960-BA
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10		86350-10		86350-10
Solar Power (Student Manual)	1	86352-00	1	86352-00	1	86352-00
Solar Power (Instructor Guide)	1	86352-10	1	86352-10	1	86352-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-2

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Heavy-Duty Tripod	1	40208-10	1	40208-10	1	40208-10

OPTIONAL EQUIPMENT FOR MODEL 8010-2

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Pyranometer	1	8989-00	1	8989-00	1	8989-00

SMALL-SCALE WIND POWER ELECTRICITY GENERATION TRAINING SYSTEM, MODEL 8010-3

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Small-Scale Wind Power El. Gen. Training System	1	8010-30	1	8010-35	1	8010-3A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Wind Turbine Generator/Controller	1	8216-00	1	8216-00	1	8216-0A
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Lead-Acid Batteries	1	8801-00	1	8801-00	1	8801-00
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
Timing Belt	1	8942-00	1	8942-00	1	8942-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Wind Turbine Emulator (8968-3) and Pb-Acid Battery Charger (8968-4) functions]	1	8960-D0	1	8960-D5	1	8960-DA
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Lead-Acid Batteries (Student Manual)	1	86351-00	1	86351-00	1	86351-00
Lead-Acid Batteries (Instructor Guide)	1	86351-10	1	86351-10	1	86351-10
Introduction to Wind Power (Student Manual)	1	86353-00	1	86353-00	1	86353-00
Introduction to Wind Power (Instructor Guide)	1	86353-10	1	86353-10	1	86353-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-3

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

OPTIONAL EQUIPMENT FOR MODEL 8010-3

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Wind Turbine Demonstrator	1	8216-D0	1	8216-D0	1	8216-D0
Magnetic Field Strength Indicator	1	86618-00	1	86618-00	1	86618-00
Wind Turbine Rotor	1	86630-00	1	86630-00	1	86630-00

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

LEAD-ACID BATTERIES TRAINING SYSTEM, MODEL 8010-4

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Lead-Acid Batteries Training System	1	8010-40	1	8010-45	1	8010-4A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Lead-Acid Batteries	1	8801-00	1	8801-00	1	8801-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Pb-Acid Battery Charger (8968-4) function]	1	8960-E0	1	8960-E5	1	8960-E5
DC Power Circuits (Student Manual)		86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Lead-Acid Batteries (Student Manual)	1	86351-00	1	86351-00	1	86351-00
Lead-Acid Batteries (Instructor Guide)	1	86351-10	1	86351-10	1	86351-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-4

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

OPTIONAL EQUIPMENT FOR MODEL 8010-4

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Full-Size Blank Module	-	8160-00	-	8160-00	-	8160-00
Half-Size Blank Module	-	8161-00	-	8161-00	-	8161-00

BASIC RENEWABLE ENERGY TRAINING SYSTEM, MODEL 8010-5

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Basic Renewable Energy Training System	1	8010-50	1	8010-55	1	8010-5A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Wind Turbine Generator/Controller	1	8216-00	1	8216-00	1	8216-0A
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Lead-Acid Batteries	1	8801-00	1	8801-00	1	8801-00
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
Solar Panel Test Bench	1	8805-00	1	8805-05	1	8805-0A
Monocrystalline Silicon Solar Panel	1	8806-00	1	8806-00	1	8806-00
Timing Belt	1	8942-00	1	8942-00	1	8942-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Wind Turbine Emulator (8968-3) and Pb-Acid Battery Charger (8968-4) functions]	1	8960-D0	1	8960-D5	1	8960-DA
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Lead-Acid Batteries (Student Manual)	1	86351-00	1	86351-00	1	86351-00
Lead-Acid Batteries (Instructor Guide)	1	86351-10	1	86351-10	1	86351-10
Solar Power (Student Manual)	1	86352-00	1	86352-00	1	86352-00
Solar Power (Instructor Guide)	1	86352-10	1	86352-10	1	86352-10
Introduction to Wind Power (Student Manual)	1	86353-00	1	86353-00	1	86353-00
Introduction to Wind Power (Instructor Guide)	1	86353-10	1	86353-10	1	86353-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-5

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A
Heavy-Duty Tripod	1	40208-10	1	40208-10	1	40208-10

OPTIONAL EQUIPMENT FOR MODEL 8010-5

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Wind Turbine Demonstrator	1	8216-D0	1	8216-D0	1	8216-D0
Pyranometer	1	8989-00	1	8989-00	1	8989-00
Magnetic Field Strength Indicator	1	86618-00	1	86618-00	1	86618-00
Wind Turbine Rotor	1	86630-00	1	86630-00	1	86630-00

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

DC POWER ELECTRONICS TRAINING SYSTEM, MODEL 8010-6

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
DC Power Electronics Training System	1	8010-60	1	8010-65	1	8010-6A
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Filtering Inductors/Capacitors	1	8325-A0	1	8325-A5	1	8325-A5
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
IGBT Chopper/Inverter	1	8837-B0	1	8837-B5	1	8837-BA
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Pb-Acid Battery Charger (8968-4) function]	1	8960-E0	1	8960-E5	1	8960-EA
Data Acquisition and Control Interface [with Computer-Based Instrumentation (9069-1) and Chopper/Inverter Control (9069-2) functions]	1	9063-C0	1	9063-C0	1	9063-C0
24-Vac Power Supply	1	30004-20	1	30004-25	1	30004-2A
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
DC Power Electronics (Student Manual)	1	86356-00	1	86356-00	1	86356-00
DC Power Electronics (Instructor Guide)	1	86356-10	1	86356-10	1	86356-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-6

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

HOME ENERGY PRODUCTION TRAINING SYSTEM, MODEL 8010-7

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Home Energy Production Training System	1	8010-70	1	TBE ³	1	TBE
Workstation ⁴	1	8134-20	1	8134-20	1	8134-20
Wind Turbine Generator/Controller	1	8216-00	1	8216-00	1	8216-0A
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Resistive Load [network-voltage dependent unit]	-	-	1	8311-05	1	8311-0A
Inductive Load	1	8321-00	-	-	1	-
Filtering Inductors/Capacitors	1	8325-A0	1	8325-A5	1	8325-A5
Capacitive Load	1	8331-00	-	-	1	-
Inductive and Capacitive Loads	-	-	1	8333-05		8333-0A
Transformer	1	8353-00	1	8353-00	1	8353-00
AC Power Network Interface	1	8622-00	1	8622-05	1	8622-0A
Lead-Acid Batteries	1	8801-00	1	8801-00	1	8801-00

³ TBE = To be established (Contact Lab-Volt Services for availability).

⁴ The Workstation, Model 8134, can be replaced with the Mobile Workstation, Model 8110.

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
Solar Panel Test Bench	1	8805-00	1	8805-05	1	8805-0A
Monocrystalline Silicon Solar Panel	1	8806-00	1	8806-00	1	8806-00
Insulated DC-to-DC Converter	1	8835-00	1	8835-05	1	8835-05
IGBT Chopper/Inverter	1	8837-B0	1	8837-B5	1	8837-BA
Rectifier and Filtering Capacitors	1	8842-A0	1	8842-A5	1	8842-AA
Timing Belt	1	8942-00	1	8942-00	1	8942-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer/Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Wind Turbine Emulator (8968-3), Pb-Acid Battery Charger (8968-4), and Solar Panel Emulator (8968-6) functions]	1	8960-F0	1	8960-F5	1	8960-FA
Data Acquisition and Control Interface [with Computer-Based Instrumentation (9069-1), Chopper/Inverter Control (9069-2), and Home Energy Production Control (9069-4) functions]	1	9063-E0	1	9063-E0	1	9063-E0
24-Vac Power Supply	1	30004-20	1	30004-25	1	30004-2A
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Lead-Acid Batteries (Student Manual)	1	86351-00	1	86351-00	1	86351-00
Lead-Acid Batteries (Instructor Guide)	1	86351-10	1	86351-10	1	86351-10
Solar Power (Student Manual)	1	86352-00	1	86352-00	1	86352-00
Solar Power (Instructor Guide)	1	86352-10	1	86352-10	1	86352-10
Introduction to Wind Power (Student Manual)	1	86353-00	1	86353-00	1	86353-00
Introduction to Wind Power (Instructor Guide)	1	86353-10	1	86353-10	1	86353-10
DC Power Electronics (Student Manual)	1	86356-00	1	86356-00	1	86356-00
DC Power Electronics (Instructor Guide)	1	86356-10	1	86356-10	1	86356-10
Single-Phase AC Power Circuits (Student Manual)	1	86358-00	1	86358-00	1	86358-00
Single-Phase AC Power Circuits (Instructor Guide)	1	86358-10	1	86358-10	1	86358-10
Single-Phase AC Power Electronics (Student Manual)	1	86359-00	1	86359-00	1	86359-00
Single-Phase AC Power Electronics (Instructor Guide)	1	86359-10	1	86359-10	1	86359-10
Home Energy Production (Student Manual)	1	86361-00	1	86361-00	1	86361-00
Home Energy Production (Instructor Guide)	1	86361-10	1	TBE	1	TBE
Single-Phase Power Transformer (Student Manual)	1	86377-00	1	86377-00	1	86377-00
Single-Phase Power Transformer (Instructor Guide)	1	86377-10	1	86377-10	1	86377-10
High-Frequency Power Transformer (Student Manual)	1	86378-00	1	86378-00	1	86378-00
High-Frequency Power Transformer (Instructor Guide)	1	86378-10	1	TBE	1	TBE

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-7

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A
Heavy-Duty Tripod	1	40208-10	1	40208-10	1	40208-10

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OPTIONAL EQUIPMENT FOR MODEL 8010-7

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Storage Cabinet [To store modules not installed in the Workstation]	1	8150-10	1	8150-10	1	8150-10
Full-Size Blank Module	-	8160-00	-	8160-00	-	8160-00
Half-Size Blank Module	-	8161-00	-	8161-00	-	8161-00
Wind Turbine Demonstrator	1	8216-D0	1	8216-D0	1	8216-D0
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Pyranometer	1	8989-00	1	8989-00	1	8989-00
Magnetic Field Strength Indicator	1	86618-00	1	86618-00	1	86618-00
Wind Turbine Rotor	1	86630-00	1	86630-00	1	86630-00

HYDROGEN FUEL CELL TRAINING SYSTEM, MODEL 8010-8

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Hydrogen Fuel Cell Training System	1	8010-80	1	8010-80	1	8010-80
Three-Module Workstation ¹	1	8131-00	1	8131-00	1	8131-00
Traffic Lights	1	8380-00	1	8380-00	1	8380-00
Electronic Load	1	8381-00	1	8381-00	1	8381-00
Hydrogen Fuel Cell	1	8803-00	1	8803-00	1	8803-00
Hydrogen Fuel Cell (Student Manual)	1	86355-00	1	86355-00	1	86355-00
Hydrogen Fuel Cell (Instructor Guide)	1	86355-10	1	86355-10	1	86355-10
Hydrogen Fuel Cell (User Guide)	1	86355-E0	1	86355-E0	1	86355-E0
Hydrogen Storage Canister	1	87948-00	1	87948-00	1	87948-00

OPTIONAL EQUIPMENT FOR MODEL 8010-8

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Hydrogen Generator	1	8894-00	1	8894-00	1	8894-00

ELECTROMECHANICAL TRAINING SYSTEM, MODEL 8010-9

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
DESCRIPTION	QTY	MODEL	QTY	MODEL	QTY	MODEL
Electromechanical Training System	1	8010-90	1	TBE	1	TBE
Workstation ⁴	1	8134-20	1	8134-20	1	8134-20
Permanent Magnet DC Motor	1	8213-00	1	8213-00	1	8213-00
Three-Phase Induction Machine	1	8221-B0	1	8221-B5	1	8221-BA
Three-Phase Synchronous Motor/Generator	1	8241-20	1	8241-25	1	8241-2A
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Resistive Load [network-voltage dependent unit]	-	-	1	8311-05	1	8311-0A
Inductive Load	1	8321-00	1	8321-05	1	8321-0A
Capacitive Load	1	8331-00	1	8331-05	1	8331-0A
Inductive and Capacitive Loads	-	-	1	8333-05	1	8333-0A
Three-Phase Transformer Bank	1	8348-40	1	8348-45	1	8348-4A
Transformer	1	8353-00	1	8353-00	1	8353-00
Synchronizing Module / Three-Phase Contactor	1	8621-A0	1	8621-A5	1	8621-AA
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
Power Supply	1	8823-00	1	8823-05	1	8823-0A
Timing Belt	1	8942-00	1	8942-00	1	8942-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer / Power Supply [with Manual-Control (8968-1) and Computer-Based Control (Model 8968-2) Standard functions]	1	8960-C0	1	8960-C5	1	8960-CA
Data Acquisition and Control Interface [with Computer-Based Instrumentation (9069-1) and Synchroscope (9069-C) functions]	1	9063-G0	1	9063-G0	1	9063-G0
24 V AC Power Supply	1	30004-20	1	30004-25	1	30004-2A
DC Power Circuits (Student Manual)	1	86350-00	1	86350-00	1	86350-00
DC Power Circuits (Instructor Guide)	1	86350-10	1	86350-10	1	86350-10
Permanent Magnet DC Motor (Student Manual)	1	86357-00	1	86357-00	1	86357-00
Permanent Magnet DC Motor (Instructor Guide)	1	86357-10	1	86357-10	1	86357-10
Single-Phase AC Power Circuits (Student Manual)	1	86358-00	1	86358-00	1	86358-00
Single-Phase AC Power Circuits (Instructor Guide)	1	86358-10	1	86358-10	1	86358-10
Three-Phase AC Power Circuits (Student Manual)	1	86360-00	1	86360-00	1	86360-00
Three-Phase AC Power Circuits (Instructor Guide)	1	86360-10	1	TBE	1	TBE
Three-Phase Rotating Machines (Student Manual)	1	86364-00	1	86364-00	1	86364-00
Three-Phase Rotating Machines (Instructor Guide)	1	86364-10	1	TBE	1	TBE
Single-Phase Power Transformers (Student Manual)	1	86377-00	1	86377-00	1	86377-00
Single-Phase Power Transformers (Instructor Guide)	1	86377-10	1	86377-10	1	86377-10
Three-Phase Transformer Banks (Student Manual)	1	86379-00	1	86379-00	1	86379-00
Three-Phase Transformer Banks (Instructor Guide)	1	86379-10	1	TBE	1	TBE

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-9

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
DESCRIPTION	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	2	8946-20	2	8946-20	2	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

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OPTIONAL EQUIPMENT FOR MODEL 8010-9

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Storage Cabinet [To store modules not installed in the Workstation]	1	8150-10	1	8150-10	1	8150-10
Full-Size Blank Module	-	8160-00	-	8160-00	-	8160-00
Half-Size Blank Module	-	8161-00	-	8161-00	-	8161-00
Wind Turbine Generator / Controller ⁵	1	8216-00	1	8216-00	1	8216-0A
Resistive Load ⁵ [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Electrical Machines, Drives, and Power Systems, T. Wildi (textbook)	1	17708-00	1	17708-00	1	17708-00

ADDITIONAL EQUIPMENT REQUIRED TO PERFORM THE LAB EXERCISES IN OPTIONAL COURSE CONVENTIONAL DC MACHINES AND UNIVERSAL MOTOR (88943) WITH MODEL 8010-9

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
DC Motor/Generator	1	8211-00	1	8211-05	1	8211-0A
Universal Motor	1	8254-00	1	8254-05	1	8254-0A
Power Supply ⁶	1	8821-20	1	8821-25	1	8821-2A
Conventional DC Machines and Universal Motor (Student Manual)	1	88943-00	1	88943-00		88943-00
Conventional DC Machines and Universal Motor (Instructor Guide)	1	88943-10	1	TBE	1	TBE

ADDITIONAL EQUIPMENT REQUIRED TO PERFORM THE LAB EXERCISES IN OPTIONAL COURSE SINGLE-PHASE INDUCTION MOTORS (88944) WITH MODEL 8010-9

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Capacitor-Start Motor	1	8251-00	1	8251-05	1	8251-0A
Power Supply ⁶	1	8821-20	1	8821-25	1	8821-2A
Single-Phase Induction Motors (Student Manual)	1	88944-00	1	88944-00	1	88944-00
Single-Phase Induction Motors (Instructor Guide)	1	88944-10	1	TBE	1	TBE

⁵ Note: Used solely to perform a single optional section in one lab exercise of course Single-Phase Power Transformers.

⁶ Note: Remove Model 8823 Power Supply and Model 30004-2 24 V AC Power Supply included with Model 8010-9 when ordering Model 8821-2 Power Supply.

POWER ELECTRONICS TRAINING SYSTEM, MODEL 8010-A

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Power Electronics Training System	1	8010-A0	1	TBE	1	TBE
Workstation	1	8134-20	1	8134-20	1	8134-20
Permanent Magnet DC Motor	1	8213-00	1	8213-00	1	8213-00
Three-Phase Induction Machine	1	8221-B0	1	8221-B5	1	8221-BA
Resistive Load [low-voltage unit]	1	8311-00	1	8311-00	1	8311-A0
Resistive Load [network-voltage dependent unit]	-	-	1	8311-05	1	8311-0A
Filtering Inductors/Capacitors	1	8325-A0	1	8325-A5	1	8325-A5
Three-Phase Filter	1	8326-00	1	8326-05	1	8326-0A
Capacitive Load	1	8331-00	1	8331-05	1	8331-0A
Three-Phase Transformer Bank	1	8348-40	1	8348-45	1	8348-4A
Lead-Acid Battery Pack	1	8802-10	1	8802-10	1	8802-10
Power Supply	1	8823-00	1	8823-05	1	8823-0A
IGBT Chopper/Inverter	1	8837-B0	1	8837-B5	1	8837-BA
Power Thyristors	1	8841-20	1	8841-25	1	8841-2A
Rectifier and Filtering Capacitors	1	8842-A0	1	8842-A5	1	8842-AA
Timing Belt	1	8942-00	1	8942-00	1	8942-00
Connection Leads	1	8951-L0	1	8951-L0	1	8951-L0
Four-Quadrant Dynamometer / Power Supply [with Manual-Control (8968-1) and Computer-Based Control (8968-2) Standard functions, and Pb-Acid Battery Charger (8968-4) function]	1	8960-E0	1	8960-E5	1	8960-EA
Data Acquisition and Control Interface [with Computer-Based Instrumentation (9069-1), Chopper/Inverter Control (9069-2), and Thyristor Control (9069-3) functions]	1	9063-D0	1	9063-D0	1	9063-D0
24 V AC Power Supply	1	30004-20	1	30004-25	1	30004-2A
DC Power Electronics (Student Manual)	1	86356-00	1	86356-00	1	86356-00
DC Power Electronics (Instructor Guide)	1	86356-10	1	86356-10	1	86356-10
Single-Phase AC Power Electronics (Student Manual)	1	86359-00	1	86359-00	1	86359-00
Single-Phase AC Power Electronics (Instructor Guide)	1	86359-10	1	86359-10	1	86359-10
Three-Phase AC Power Electronics (Student Manual)	1	86362-00	1	86362-00	1	86362-00
Three-Phase AC Power Electronics (Instructor Guide)	1	86362-10	1	TBE	1	TBE
Thyristor Power Electronics (Student Manual)	1	86363-00	1	86363-00	1	86363-00
Thyristor Power Electronics (Instructor Guide)	1	86363-10	1	TBE	1	TBE
Three-Phase Motor Drives (Student Manual)	1	86368-00	1	86368-00	1	86368-00
Three-Phase Motor Drives (Instructor Guide)	1	86368-10	1	TBE	1	TBE
Three-Phase Motor Starters (Student Manual)	1	88197-00	1	88197-00	1	88197-00
Three-Phase Motor Starters (Instructor Guide)	1	88197-10	1	TBE	1	TBE
DC Motor Drives (Student Manual)	1	88553-00	1	88553-00	1	88553-00
DC Motor Drives (Student Manual)	1	88553-10	1	88553-10	1	88553-10

ADDITIONAL EQUIPMENT REQUIRED FOR MODEL 8010-A

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Digital Multimeter	1	8946-20	1	8946-20	1	8946-20
Personal Computer ²	1	8990-00	1	8990-05	1	8990-0A

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS SERIES 8010

OPTIONAL EQUIPMENT FOR MODEL 8010-A

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Storage Cabinet [To store modules not installed in the Workstation]	1	8150-10	1	8150-10	1	8150-10
Full-Size Blank Module	-	8160-00	-	8160-00	-	8160-00
Half-Size Blank Module	-	8161-00	-	8161-00	-	8161-00
AC Power Network Interface ⁷	1	8622-00	1	8622-05	1	8622-0A
Solar Panel Test Bench ⁷	1	8805-00	1	8805-05	1	8805-0A

ADDITIONAL EQUIPMENT REQUIRED TO PERFORM THE LAB EXERCISES IN OPTIONAL COURSE HYDROPOWER ELECTRICITY GENERATION (86369) WITH MODEL 8010-A

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Synchronous Motor/Generator	1	8241-20	1	8241-25	1	8241-2A
Inductive Load	1	8321-00	1	8321-05	1	8321-0A
Synchronizing Module / Three-Phase Contactor	1	8621-A0	1	8621-A5	1	8621-AA
Turbine Emulator	1	8968-30	1	8968-30	1	8968-30
Generator Control	1	9069-A0	1	9069-A0	1	9069-A0
Hydropower Electricity Generation (Student Manual)	1	86369-00	1	86369-00		86369-00
Hydropower Electricity Generation (Instructor Guide)	1	86369-10	1	TBE	1	TBE

ADDITIONAL EQUIPMENT REQUIRED TO PERFORM THE LAB EXERCISES IN OPTIONAL COURSE HIGH-VOLTAGE DC TRANSMISSION SYSTEMS (86380) WITH MODEL 8010-A

DESCRIPTION	ORDERING NUMBERS					
	120/208 V - 60 Hz		220/380 V - 50 Hz		240/415 V - 50 Hz	
	QTY	MODEL	QTY	MODEL	QTY	MODEL
Three-Phase Transmission Line	1	8329-00	1	8329-05	1	8329-0A
Three-Phase Transformer Bank	1	8348-40	1	8348-45	1	8348-4A
Three-Phase Regulating Autotransformer	2	8349-00	2	8349-05	2	8349-0A
Power Supply ⁸	1	8821-20	1	8821-25	1	8821-2A
Power Thyristors	1	8841-20	1	8841-25	1	8841-2A
Connection Leads	1	8951-N0	1	8951-N0	1	8951-N0
Data Acquisition and Control Interface (Extension Module)	1	9063-00	1	9063-00	1	9063-00
HVDC Transmission System Control	1	9069-70	1	9069-70	1	9069-70
High-Voltage DC Transmission Systems (Student Manual)	1	86380-00	1	86380-00		86380-00
High-Voltage DC Transmission Systems (Instructor Guide)	1	86380-10	1	TBE	1	TBE

⁷ Note: Used solely to perform a single optional section in one lab exercise of course Thyristor Power Electronics.

⁸ Note: Remove Model 8823 Power Supply and Model 30004-2 24 V AC Power Supply included with Model 8010-A when ordering Model 8821-2 Power Supply.

ORDERING NUMBERS

120 V – 60 Hz			220 V – 50 Hz			240 V – 50 Hz
ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
8010-10	TBE	8010-12	8010-15	TBE	8010-17	8010-1A
8010-20	TBE	8010-22	8010-25	TBE	8010-27	8010-2A
8010-30	TBE	8010-32	8010-35	TBE	8010-37	8010-3A
8010-40	TBE	8010-42	8010-45	TBE	8010-47	8010-4A
8010-50	TBE	8010-52	8010-55	TBE	8010-57	8010-5A
8010-60	TBE	TBE	8010-65	TBE	TBE	8010-6A
8010-70	TBE	TBE	TBE	TBE	TBE	TBE
8010-80	TBE	TBE	8010-80	TBE	TBE	8010-80
8010-90	TBE	TBE	TBE	TBE	TBE	TBE
8010-A0	TBE	TBE	TBE	TBE	TBE	TBE
8110-20	8110-20	8110-20	8110-20	8110-20	8110-20	8110-20
8131-00	8131-00	8131-00	8131-00	8131-00	8131-00	8131-00
8134-20	8134-20	8134-20	8134-20	8134-20	8134-20	8134-20
8150-00	8150-00	8150-00	8150-00	8150-00	8150-00	8150-00
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
8213-00	8213-01	8213-02	8213-00	8213-01	8213-02	8213-00
8216-00	8216-01	8216-02	8216-00	8216-01	8216-02	8216-0A
8216-D0	8216-D0	8216-D0	8216-D0	8216-D0	8216-D0	8216-D0
8221-B0	8221-B1	8221-B2	8221-B5	8221-B6	8221-B7	8221-BA
8231-B0	8231-B1	8231-B2	8231-B5	8231-B6	8231-B7	8231-BA
8241-20	8241-21	8241-22	8241-25	8241-26	8241-27	8241-2A
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
8261-A0	8261-A1	8261-A2	8261-A5	8261-A6	8261-A7	8261-AA
8311-00 ⁹	8311-01 ⁹	8311-02 ⁹	8311-00 ⁹	8311-01 ⁹	8311-02 ⁹	8311-A0 ⁹
8311-00 ¹⁰	8311-01 ¹⁰	8311-02 ¹⁰	8311-05 ¹⁰	8311-06 ¹⁰	8311-07 ¹⁰	8311-0A ¹⁰
8321-00	8321-01	8321-02	8321-05	8321-06	8321-07	8321-0A
8325-A0	8325-A1	8325-A2	8325-A5	8325-A6	8325-A7	8325-A5
8326-00	8326-01	8326-02	8326-05	8326-06	8326-07	8326-0A
8326-A0	8326-A1	8326-A2	8326-A0	8326-A1	8326-A2	8326-AA
8329-00	8329-01	8329-02	8329-05	8329-06	8329-07	8329-0A
8331-00	8331-01	8331-02	8331-05	8331-06	8331-07	8331-0A
N/A ¹¹	N/A	N/A	8333-05	8333-06	8333-07	8333-0A
8334-00	8334-01	8334-02	8334-05	8334-06	8334-07	8334-0A
8348-40	8348-41	8348-42	8348-45	8348-46	8348-47	8348-4A
8349-00	8349-01	8349-02	8349-05	8349-06	8349-07	8349-0A
8353-00	8353-01	8353-02	8353-00	8353-01	8353-02	8353-00
8354-00	8354-01	8354-02	8354-05	8354-06	8354-07	8354-0A
8380-00	8380-00	8380-00	8380-00	8380-00	8380-00	8380-00
8381-00	8381-00	8381-00	8381-00	8381-00	8381-00	8381-00
8622-00	8622-01	8622-02	8622-05	8622-06	8622-07	8622-0A
8801-00	8801-01	8801-02	8801-00	8801-01	8801-02	8801-00
8801-A0	8801-A1	8801-A2	8801-A0	8801-A1	8801-A2	8801-A0
8802-10	8802-11	8802-12	8802-10	8802-11	8802-12	8802-10
8803-00	8803-00	8803-00	8803-00	8803-00	8803-00	8803-00
8805-00	8805-01	8805-02	8805-05	8805-06	8805-07	8805-0A
8806-00	8806-01	8806-02	8806-00	8806-01	8806-02	8806-00
8821-20	8821-21	8821-22	8821-25	8821-26	8821-27	8821-2A

Table 1. Equipment Ordering Numbers

⁹ Low-voltage unit

¹⁰ Network-voltage dependent unit

¹¹ N/A = Not available

ELECTRIC POWER TECHNOLOGY TRAINING SYSTEMS

SERIES 8010

120 V – 60 Hz			220 V – 50 Hz			240 V – 50 Hz
ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
8823-00	8823-01	8823-02	8823-05	8823-06	8823-07	8823-0A
8835-00	8835-01	8835-02	8835-05	8835-06	8835-07	8835-05
8837-B0	8837-B1	8837-B2	8837-B5	8837-B6	8837-B7	8837-BA
8841-20	8841-21	8841-22	8841-25	8841-26	8841-27	8841-2A
8842-A0	8842-A1	8842-A2	8842-A5	8842-A6	8842-A7	8842-AA
8894-00	8894-00	8894-00	8894-00	8894-00	8894-00	8894-00
8942-00	8942-00	8942-00	8942-00	8942-00	8942-00	8942-00
8946-20	8946-20	8946-20	8946-20	8946-20	8946-20	8946-20
8951-L0	8951-L0	8951-L0	8951-L0	8951-L0	8951-L0	8951-L0
8951-N0	8951-N0	8951-N0	8951-N0	8951-N0	8951-N0	8951-N0
8951-P0	8951-P0	8951-P0	8951-P0	8951-P0	8951-P0	8951-P0
8960-C0	8960-C1	8960-C2	8960-C5	8960-C6	8960-C7	8960-CA
8960-D0	8960-D1	8960-D2	8960-D5	8960-D6	8960-D7	8960-DA
8960-E0	8960-E1	8960-E2	8960-E5	8960-E6	8960-E7	8960-EA
8960-F0	8960-F1	8960-F2	8960-F5	8960-F6	8960-F7	8960-FA
8968-10	8968-10	8968-10	8968-10	8968-10	8968-10	8968-10
8968-20	8968-20	8968-20	8968-20	8968-20	8968-20	8968-20
8968-30	8968-30	8968-30	8968-30	8968-30	8968-30	8968-30
8968-40	8968-40	8968-40	8968-40	8968-40	8968-40	8968-40
8968-50	8968-50	8968-50	8968-50	8968-50	8968-50	8968-50
8968-60	8968-60	8968-60	8968-60	8968-60	8968-60	8968-60
8989-00	8989-01	8989-02	8989-00	8989-01	8989-02	8989-00
8990-00	8990-01	8990-02	8990-05	8990-06	8990-07	8990-0A
9063-00	9063-01	9063-02	9063-00	9063-01	9063-02	9063-00
9063-B0	9063-B1	9063-B2	9063-B0	9063-B1	9063-B2	9063-B0
9063-C0	9063-C1	9063-C2	9063-C0	9063-C1	9063-C2	9063-C0
9063-D0	9063-D1	9063-D2	9063-D0	9063-D1	9063-D2	9063-D0
9063-E0	9063-E1	9063-E2	9063-E0	9063-E1	9063-E2	9063-E0
9063-F0	9063-F1	9063-F2	9063-F0	9063-F1	9063-F2	9063-F0
9063-G0	9063-G1	9063-G2	9063-G0	9063-G1	9063-G2	9063-G0
9069-10	9069-10	9069-10	9069-10	9069-10	9069-10	9069-10
9069-20	9069-20	9069-20	9069-20	9069-20	9069-20	9069-20
9069-30	9069-30	9069-30	9069-30	9069-30	9069-30	9069-30
9069-40	9069-40	9069-40	9069-40	9069-40	9069-40	9069-40
9069-50	9069-50	9069-50	9069-50	9069-50	9069-50	9069-50
9069-60	9069-60	9069-60	9069-60	9069-60	9069-60	9069-60
9069-70	9069-70	9069-70	9069-70	9069-70	9069-70	9069-70
9069-80	9069-80	9069-80	9069-80	9069-80	9069-80	9069-80
9069-A0	9069-A0	9069-A0	9069-A0	9069-A0	9069-A	9069-A0
17708-00	N/A	N/A	17708-00	N/A	N/A	17708-00
30004-20	30004-20	30004-20	30004-25	30004-25	30004-25	30004-2A
30011-04	30011-04	30011-04	30011-04	30011-04	30011-04	30011-04
40208-10	40208-10	40208-10	40208-10	40208-10	40208-10	40208-10
86350-00	TBE ¹²	86350-02	86350-00	TBE	86350-02	86350-00
86350-10	TBE	86350-12	86350-10	TBE	86350-12	86350-10
86351-00	TBE	86351-02	86351-00	TBE	86351-02	86351-00
86351-10	TBE	86351-12	86351-10	TBE	86351-12	86351-10
86352-00	TBE	86352-02	86352-00	TBE	86352-02	86352-00
86352-10	TBE	86352-12	86352-10	TBE	86352-12	86352-10
86353-00	TBE	86353-02	86353-00	TBE	86353-02	86353-00
86353-10	TBE	86353-12	86353-10	TBE	86353-12	86353-10
86354-00	TBE	TBE	86354-00	TBE	TBE	86354-00
86354-10	TBE	TBE	86354-10	TBE	TBE	86354-10
86355-00	TBE	TBE	86355-00	TBE	TBE	86355-00
86355-10	TBE	TBE	86355-10	TBE	TBE	86355-10

Table 1. Equipment Ordering Numbers (cont'd)

¹² TBE = To be established (Contact your Lab-Volt representative for additional information).

120 V – 60 Hz			220 V – 50 Hz			240 V – 50 Hz
ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
86355-E0	TBE	TBE	86355-E0	TBE	TBE	86355-E0
86356-00	TBE	TBE	86356-00	TBE	TBE	86356-00
86356-10	TBE	TBE	86356-10	TBE	TBE	86356-10
86357-00	TBE	TBE	86357-00	TBE	TBE	86357-00
86357-10	TBE	TBE	86357-10	TBE	TBE	86357-10
86358-00	TBE	86358-02	86358-00	TBE	86358-02	86358-00
86358-10	TBE	86358-12	86358-10	TBE	86358-12	86358-10
86359-00	TBE	86359-02	86359-00	TBE	86359-02	86359-00
86359-10	TBE	86359-12	86359-10	TBE	86359-12	86359-10
86360-00	TBE	TBE	86360-00	TBE	TBE	86360-00
86360-10	TBE	TBE	TBE	TBE	TBE	TBE
86361-00	TBE	TBE	86361-00	TBE	TBE	86361-00
86361-10	TBE	TBE	TBE	TBE	TBE	TBE
86362-00	TBE	TBE	86362-00	TBE	TBE	86362-00
86362-10	TBE	TBE	TBE	TBE	TBE	TBE
86363-00	TBE	TBE	86363-00	TBE	TBE	86363-00
86363-10	TBE	TBE	TBE	TBE	TBE	TBE
86364-00	TBE	TBE	86364-00	TBE	TBE	86364-00
86364-10	TBE	TBE	TBE	TBE	TBE	TBE
86365-00	TBE	TBE	86365-00	TBE	TBE	86365-00
86365-10	TBE	TBE	TBE	TBE	TBE	TBE
86366-00	TBE	TBE	86366-00	TBE	TBE	86366-00
86366-10	TBE	TBE	TBE	TBE	TBE	TBE
86367-00	TBE	TBE	86367-00	TBE	TBE	86367-00
86367-10	TBE	TBE	TBE	TBE	TBE	TBE
86368-00	TBE	TBE	86368-00	TBE	TBE	86368-00
86368-10	TBE	TBE	TBE	TBE	TBE	TBE
86369-00	TBE	TBE	86369-00	TBE	TBE	86369-00
86369-10	TBE	TBE	TBE	TBE	TBE	TBE
86370-00	TBE	TBE	86370-00	TBE	TBE	86370-00
86370-10	TBE	TBE	TBE	TBE	TBE	TBE
86371-00	TBE	TBE	86371-00	TBE	TBE	86371-00
86371-10	TBE	TBE	TBE	TBE	TBE	TBE
86373-00	TBE	TBE	86373-00	TBE	TBE	86373-00
86373-10	TBE	TBE	TBE	TBE	TBE	TBE
86376-00	TBE	TBE	86376-00	TBE	TBE	86376-00
86376-10	TBE	TBE	TBE	TBE	TBE	TBE
86377-00	TBE	TBE	86377-00	TBE	TBE	86377-00
86377-10	TBE	TBE	86377-10	TBE	TBE	86377-10
86378-00	TBE	TBE	86378-00	TBE	TBE	86378-00
86378-10	TBE	TBE	TBE	TBE	TBE	TBE
86379-00	TBE	TBE	86379-00	TBE	TBE	86379-00
86379-10	TBE	TBE	TBE	TBE	TBE	TBE
86380-00	TBE	TBE	86380-00	TBE	TBE	86380-00
86380-10	TBE	TBE	TBE	TBE	TBE	TBE
86618-00	86618-00	86618-00	86618-00	86618-00	86618-00	86618-00
86630-00	86630-00	86630-00	86630-00	86630-00	86630-00	86630-00
87948-00	87948-00	87948-00	87948-00	87948-00	87948-00	87948-00
88197-00	TBE	TBE	88197-00	TBE	TBE	88197-00
88197-10	TBE	TBE	TBE	TBE	TBE	TBE
88553-00	TBE	TBE	88553-00	TBE	TBE	88553-00
88553-10	TBE	TBE	88553-10	TBE	TBE	88553-10
88943-00	TBE	TBE	88943-00	TBE	TBE	88943-00
88943-10	TBE	TBE	TBE	TBE	TBE	TBE
88944-00	TBE	TBE	88944-00	TBE	TBE	88944-00
88944-10	TBE	TBE	TBE	TBE	TBE	TBE

Table 1. Equipment Ordering Numbers (cont'd)

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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