COMPUTER-ASSISTED WIND POWER TECHNOLOGY

Electromechanical Training System 0.2 kW
Models 8052-00 and 8052-10

Description

Lab-Volt Systems, Inc. is proud to lead the way in offering a new hands-on training program in Wind Power Technology. With over 50 years of dedicated Electrical and Mechanical training systems development, Lab-Volt continues to be at the forefront of safe, highly-regarded learning environments and the first choice for teachers and departments who want the best programs for their students.

The Lab-Volt Computer-Assisted 0.2-kW Wind Power Electromechanical Training System, Model 8052-10: Wind Power Technology Asynchronous and Doubly Fed Generators, covers electrical basics, from Ohm’s law and complex impedance through single- and three-phase transformers, typical wind power asynchronous generator principles, and synchronization, as well as doubly-fed induction generators and the associated power electronic converters. Lab-Volt also offers trainers that cover additional wind power topics such as mechanical, hydraulics, programmable logic controllers, power electronics, etc.

The Model 8052-00: Wind Power Technology Power Systems and Transformers training system forms a modern modular program that, with the integration of data acquisition, provides new opportunities for laboratory observations in the study of electric power technology.

Relying on decades of satisfied users, as well as feedback from the power utility industry, wind power companies, and professional educators, Lab-Volt has developed a “hands-on” training system that fits the needs of the emerging wind power energy and turbine

- Developed specifically for low-power (0.2-kW) educational equipment, this system enables students to understand and safely operate industrial-type equipment.
- Careful attention to engineering detail ensures easy-to-understand laboratory results, easily-observed data values, 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.
- Modular-program course materials provide instructors with complete versatility in selecting and adapting lessons and experiments to fit specific student needs and teaching objectives.
- This highly-modular training system is based on time-proven technologies. Multi-use modules are applicable to other electrical topics, such as transmission lines, protective relaying, industrial motors, motor controls, power electronics, etc, offering a great opportunity for lower-cost future expansions.
Features and Benefits

- **Modularity** – System modularity maximizes flexibility and variety for experimentation, and allows multiple possibilities for expansion and customization.

- **Lab-Volt Motors** – Lab-Volt machines are designed and constructed at Lab-Volt and make learning the basic principles of motors and generators realistic and engaging. Lab-Volt’s time proven set of 18 fractional HP motor-generators, identical in size, power, and construction, offer the same characteristics as most large, off-the-shelf machines.

- **Safety** – Lab-Volt Electromechanical System (EMS) equipment is designed for student safety. All moving parts are completely enclosed. Our system utilizes safety leads only; all electrical connections are protected; and our motors are designed to be overloaded. It is nearly impossible to achieve Lab-Volt’s level of safety and visibility with commercially available machines.

- **Expandable** – The Lab-Volt EMS is the nucleus of an entire line of Electric Power and Controls training equipment including control devices, motor drives, and power electronics. All EMS equipment is compatible with the entire line of Lab-Volt training systems.

- **Courseware** – Lab-Volt’s industry-leading courseware is available as traditional lab manuals (with hundreds of time-tested experiments), using a computer-interfaced data acquisition laboratory.

- **Data Acquisition** – Data acquisition saves student time in the lab. Instead of copying instrument readings in tables and hand-drafting graphs, the data acquisition unit allows fast, recallable experiment setup while supplying advanced instruments, such as an Eight-Trace Oscilloscope, Phasor Analyzer, Power Factor Meter, Spectrum Analyzer, Harmonics Analyzer, etc. LabView® drivers are supplied with the data acquisition module, allowing for more advanced research projects. Also available with conventional instruments (optional).

### 8052-00 Topic Coverage

**Generator Fundamentals**

- **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
  - Phase Angle
  - Instantaneous Power

- **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 and Phasors in Series AC Circuits
  - Vectors and Phasors in Parallel AC Circuits
  - Impedance

- **Three-Phase Circuits**
  - Balanced Three-Phase Circuits
  - Three-Phase Power Measurement
  - Phase Sequence

- **Single-Phase Transformers**
  - 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
8052-10 Topic Coverage

Asynchronous and Doubly-Fed Generators

Introduction
• Safety Rules and Measurements in Power Electronics

Fundamentals for Rotating Machines
• Prime Mover Operation

AC Induction Motors
• The Three-Phase Squirrel-Cage Induction Motor
• Eddy-Current Brake and Asynchronous Generator
• Effect of Voltage on the Characteristics of Induction Motors

Power Electronics Fundamentals
• Familiarization with the Reversible DC Power Supply
• Power Diode Single-Phase and Two-Phase Rectifiers
• Power Diode Three-Phase Rectifiers
• Familiarization with the Chopper/Inverter Control Unit (Chopper Modes)
• Familiarization with the Chopper/Inverter Control Unit (Inverter Modes)
• Familiarization with the pa8837-AIGBT Chopper/Inverter
• Introduction to High-Speed Power Switching
• The Buck Chopper
• The Boost Chopper
• The Buck/Boost Chopper
• The Four-Quadrant Chopper
• The Single-Phase Inverter
• Saturation and Effect of Frequency in Magnetic Circuits

Wound-Rotor Doubly Fed Induction Machines
• Wound-Rotor Induction Motor
• Wound-Rotor Induction Motor with Short-Circuited Rotor
• Wound-Rotor Induction Motor with Variable Rotor Resistors
• Wound Rotor Frequency Conversion Principles
• Variable Speed Doubly-Fed Induction Generator using Rotor Resistors
• Variable Speed Doubly-Fed Induction Generator using Rotor Frequency Injection

Supplemental Projects

8052-20 – Power Utility Networks (To Be Established)
Project: Automatic Generator Synchronization, Protective Relaying, Transmission Lines

8075-50 – PLC and Mechanics of the Wind Turbine (To Be Established)
Project: Clutches, Brakes, Wind Sensors, Yaw and Pitch Control, Gearboxes, Wind Turbine Electronic Supervision, Vibration Analysis
### 8052-00 System Components

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>30328</td>
<td>Manual 8006 Power Cir.</td>
</tr>
<tr>
<td>30328-10</td>
<td>Manual 8006 Instructor</td>
</tr>
<tr>
<td>8134-20</td>
<td>Workstation 7.5 Mod.</td>
</tr>
<tr>
<td>8311</td>
<td>Resistive Load</td>
</tr>
<tr>
<td>8321</td>
<td>Inductive Load</td>
</tr>
<tr>
<td>8331</td>
<td>Capacitive Load</td>
</tr>
<tr>
<td>8341</td>
<td>Transformer</td>
</tr>
<tr>
<td>8348</td>
<td>Transformer 1:1 3PH</td>
</tr>
<tr>
<td>8821-20</td>
<td>Power Supply</td>
</tr>
<tr>
<td>8951</td>
<td>Connection Leads</td>
</tr>
<tr>
<td>9062-10</td>
<td>Data Acquisition Interface</td>
</tr>
</tbody>
</table>

### 8052-10 System Components

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>8211</td>
<td>DC Motor/Generator</td>
</tr>
<tr>
<td>8221</td>
<td>Four-Pole Squirrel-Cage Induction Motor</td>
</tr>
<tr>
<td>8231</td>
<td>Three-Phase Wound-Rotor Induction Motor</td>
</tr>
<tr>
<td>8325</td>
<td>Smoothing Inductors</td>
</tr>
<tr>
<td>8621</td>
<td>Synchronizing Module</td>
</tr>
<tr>
<td>8731</td>
<td>Three-Phase Rheostat</td>
</tr>
<tr>
<td>8737</td>
<td>Tandem Rheostats</td>
</tr>
<tr>
<td>8837-A0</td>
<td>IGBT Chopper/Inverter</td>
</tr>
<tr>
<td>8840</td>
<td>Enclosure/Power Supply</td>
</tr>
<tr>
<td>8842</td>
<td>Power Diodes</td>
</tr>
<tr>
<td>8942</td>
<td>Timing Belt</td>
</tr>
<tr>
<td>8951-99</td>
<td>Connection Leads</td>
</tr>
<tr>
<td>8960-10</td>
<td>Prime Mover/Dynamometer</td>
</tr>
<tr>
<td>9017</td>
<td>Thyristor Speed Controller</td>
</tr>
<tr>
<td>9029</td>
<td>Chopper/Inverter Control Unit</td>
</tr>
<tr>
<td>9033</td>
<td>Function Generator</td>
</tr>
<tr>
<td>9034</td>
<td>PID Controller</td>
</tr>
<tr>
<td>9056</td>
<td>Current/Voltage Isolator</td>
</tr>
<tr>
<td>8311</td>
<td>Resistive Load</td>
</tr>
<tr>
<td>8331</td>
<td>Capacitive Load</td>
</tr>
<tr>
<td>85822</td>
<td>Student Manual</td>
</tr>
<tr>
<td>85822-10</td>
<td>Instructor Guide</td>
</tr>
</tbody>
</table>

*For additional Alternative and Renewable Energy Technology training systems, such as Mechanics, Hydraulics, etc., please request our Alternative and Renewable Energy Technology Product Guide.