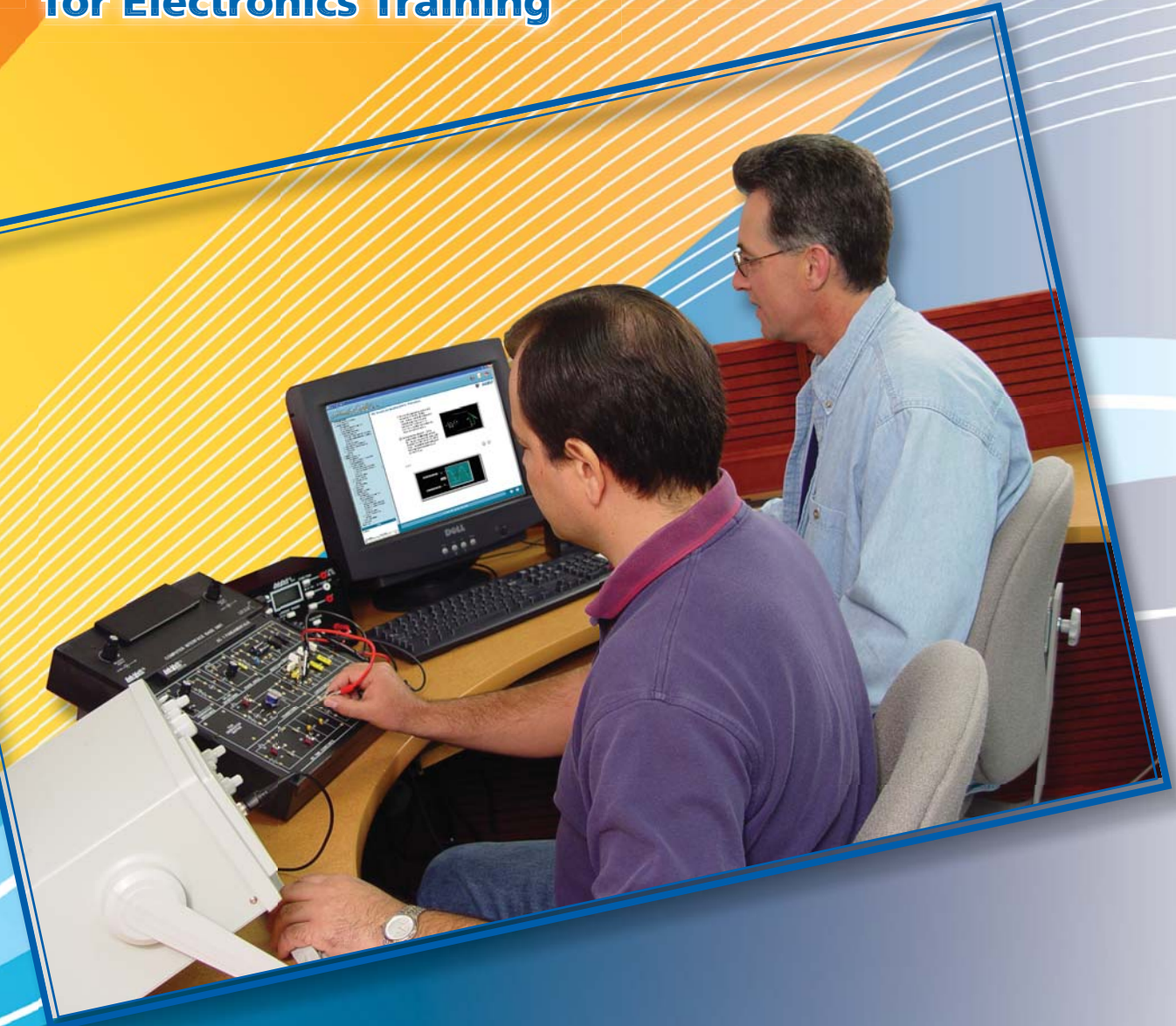


Lab-Volt®

FACET®

**Computer-Based Learning
for Electronics Training**



- Basic Electricity & Electronics
- Digital and Microprocessor Electronics
- Industrial Electronics
- Communications Systems

ELECTRONICS TRAINING SYSTEMS/FACET®

INTERNATIONAL AWARD WINNER FOR EXCELLENCE IN TECHNICAL TRAINING PRODUCTS



Lab-Volt is the proud recipient of more International Worlddidac Awards for product excellence than any other manufacturer of scientific and technological training apparatus for student and classroom use. Lab-Volt serves thousands of trade schools, colleges and universities, educational ministries, military training centers, and industrial plants throughout most countries in Africa, Asia, Europe, the Middle East, Pacific Rim, and the Americas.

To meet the needs of its global customers, Lab-Volt has sales offices and manufacturing plants in the United States, Canada, Malaysia, and Colombia, along with a network of factory-trained staff strategically placed around the world.

Lab-Volt is proud to continue the tradition of excellence that has become its international trademark.

Alternative and Renewable Energy Training Systems

- Core Technical Systems
- Electricity and Electronics
- Electrical Power Transmission, Generation, and Distribution
- Instrumentation Process Control Systems
- Web-Based Training Systems
- Early Technology Science Education

Electric Power and Controls

- Electromechanical
- Power Electronics and Drives
- Power Transmission, Distribution, and Protection
- Industrial Controls

Telecommunications

- Digital and Analog Telecommunications
- Radar Technology
- Microwave Technology
- Antenna
- Telephony
- Fiber Optic Communications

Mechatronics and Industrial Manufacturing Technology

- Automation and Robotics
- Fluid Power Systems
- Instrumentation and Process Control
- Refrigeration, Air Conditioning, and Heating

- Exploratory Technology
- Electrical and Mechanical Systems
- Electricity and Electronics
- Electric Power and Controls
- PLCs and Drives
- Manufacturing Technologies
- Web-Based Industrial Training

Tech-Design®

- Communications
- Transportation
- Construction
- Manufacturing
- Bio-Related
- Family & Consumer Sciences
- Project-Based Curriculum

Tech-World®

- Applications in Pre-Engineering & Manufacturing Technology

Computer-Based Learning for Electronics Training (FACET®)

- Basic Principles of Electricity and Electronics
- Circuit Simulations
- Digital and Microprocessor
- Telecommunications
- Industrial Electronics



Building Training Systems for the Global Workplace

For five decades, Lab-Volt has provided state-of-the-art systems for technician training in the basic and most advanced applications of electricity and electronics, fluid power, industrial controls, process control and instrumentation, mechatronics and telecommunications.

Today, Lab-Volt's highly effective approach to training and education has earned us the distinction as the leading North American producer of hands-on technical training systems. Key to our success has been our ability to anticipate the applications of new technologies and develop modular training systems that allow us to address the basic, as well as specialized, needs of industry and education. In our approach to training and education, we begin by carefully defining each new training need. Next, we methodically design and create the best curriculum, instrumentation, delivery method, management platform, and laboratory furniture to suit real-world training goals and the real needs of students and instructors.

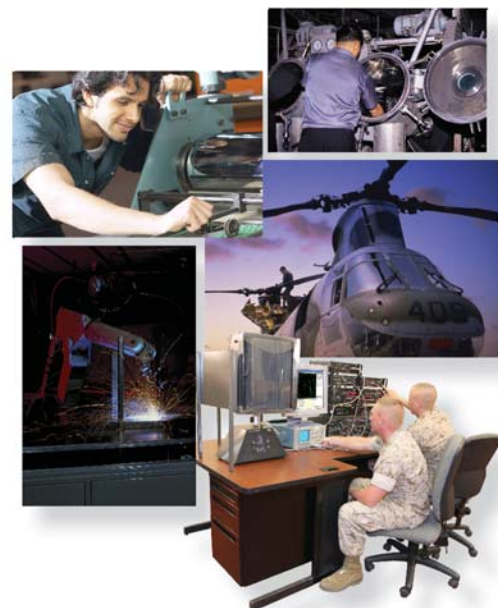
Lab-Volt training systems are carefully balanced to provide a solid theoretical grounding in the subject matter, along with numerous and diverse hands-on applications. By design, our first-quality, industry-standard training systems are modular and open-ended so that students may enter or exit a program at many points. Lab-Volt training systems bring technical theory to life, teaching the latest technologies along with valuable troubleshooting, critical thinking and reasoning skills.

Lab-Volt maintains a staff of educators, instructional system designers, and engineers who are always available to assist teachers, training directors, and administrators in designing program content, selecting or modifying equipment and software, and providing professional teacher training.

In designing our laboratory equipment, we ensure compatibility with international power requirements that prevail throughout North America, Africa, Asia, Europe, the Middle East, South America and Southeastern Asia. Whether at a high school or community college in the United States, an air traffic control center in Saudi Arabia, or a technical institute

in the Philippines, Lab-Volt training systems provide state-of-the-art teaching and classroom-management tools built on computer-mediated platforms that deliver, manage, and control the educational process.

Lab-Volt's systems have been used to train technicians who are successfully employed in leading multinational companies, such as General Telephone & Electronics, Lockheed Aviation, United States Steel, Western Electric and Westinghouse, Intel and Micron Semiconductor, Ford Motor Company, General Motors, IBEW, Bell Telephone of New Jersey and many others. In addition, Lab-Volt-trained technicians hold positions throughout the world at leading colleges, universities, educational ministries, and military installations. FACET, Lab-Volt Simulation Systems® (LV-SIM), Alternative and Renewable Energy Systems, Lab-Volt Automation™, and Tech-World® by Lab-Volt are among the most widely used, integrated technology-education systems today. Trainees in more than 30,000 schools, industrial sites and military installations in more than 50 countries worldwide use Lab-Volt systems to learn skills that are necessary to keep up with the world's rapid technological growth well into the future.



Known for Excellence in Electronics Training

Lab-Volt's FACET®: A Totally Integrated Learning System for Electronics Training

Fusing comprehensive, interactive LAN-based* curriculum delivery, online automated classroom management, and curriculum editing into one seamless platform, FACET is the most advanced, hands-on instructional tool in electrical and electronics technical education today.

The only electronics training program in the world to offer the full range of benefits inherent in an integrated, LAN-based learning system, the award-winning FACET system features:

- Educationally substantive, **competency-based curriculum** providing hands-on activities for learning, testing, troubleshooting, applying and designing basic to advanced electronics circuits.
- An ever-increasing selection of courses, with 30 currently available, covering **four key areas of electronics study**:
 - Basic Electricity and Electronics
 - Digital and Microprocessor Electronics
 - Industrial Electronics
 - Communications Systems
- **Mind-Sight-based delivery** (LCMS platform), with graphics, animation, simulation, multimedia and interactivity to enhance learning speed and retention.
- **Automated Classroom-Management System**: the essential survival tools for every classroom instructor/manager, including easy-to-use features to enhance and augment the curriculum.

* Mind-Sight is mainly offered as a LAN-based solution to deliver curriculum locally. However, developed as SCORM-compliant software, remote delivery using other Learning and Content Management Systems is also possible.

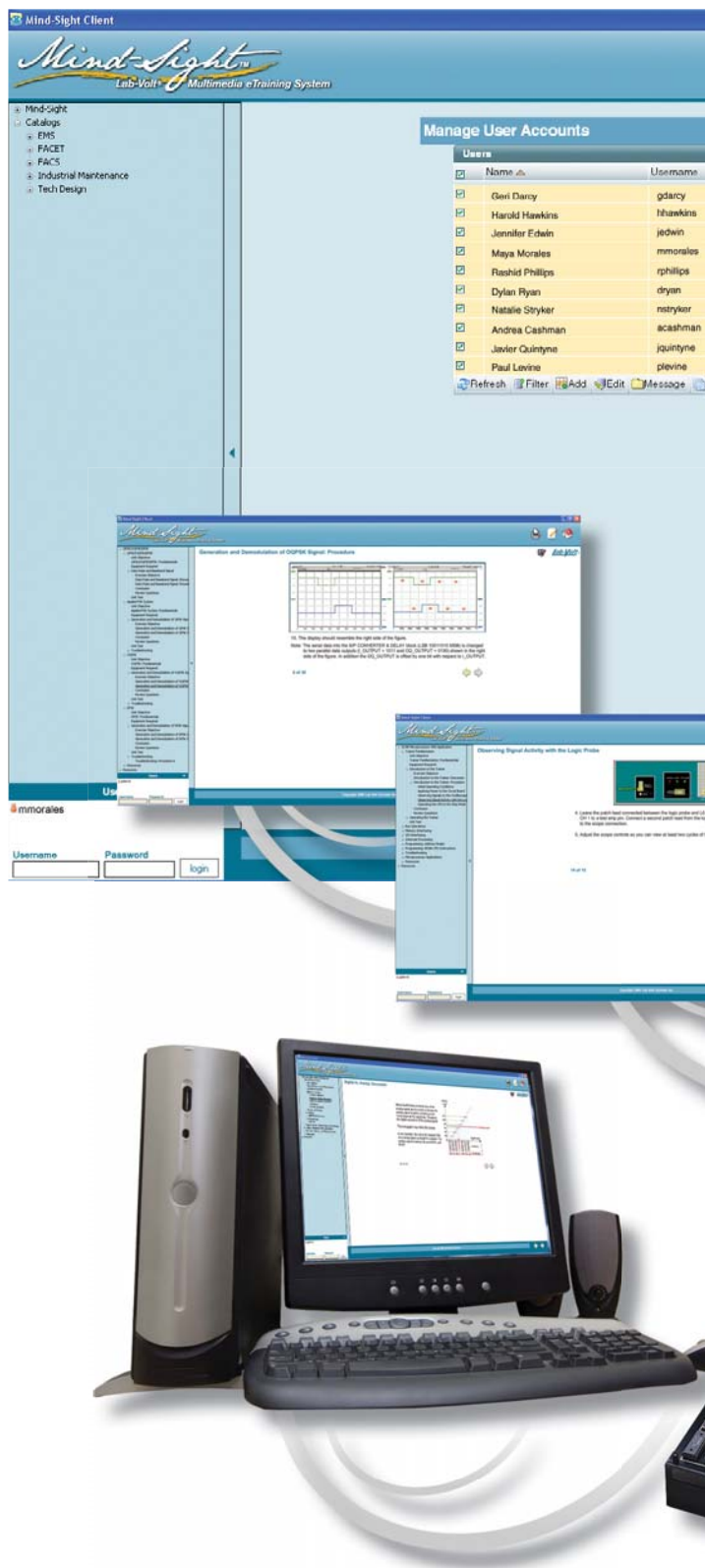


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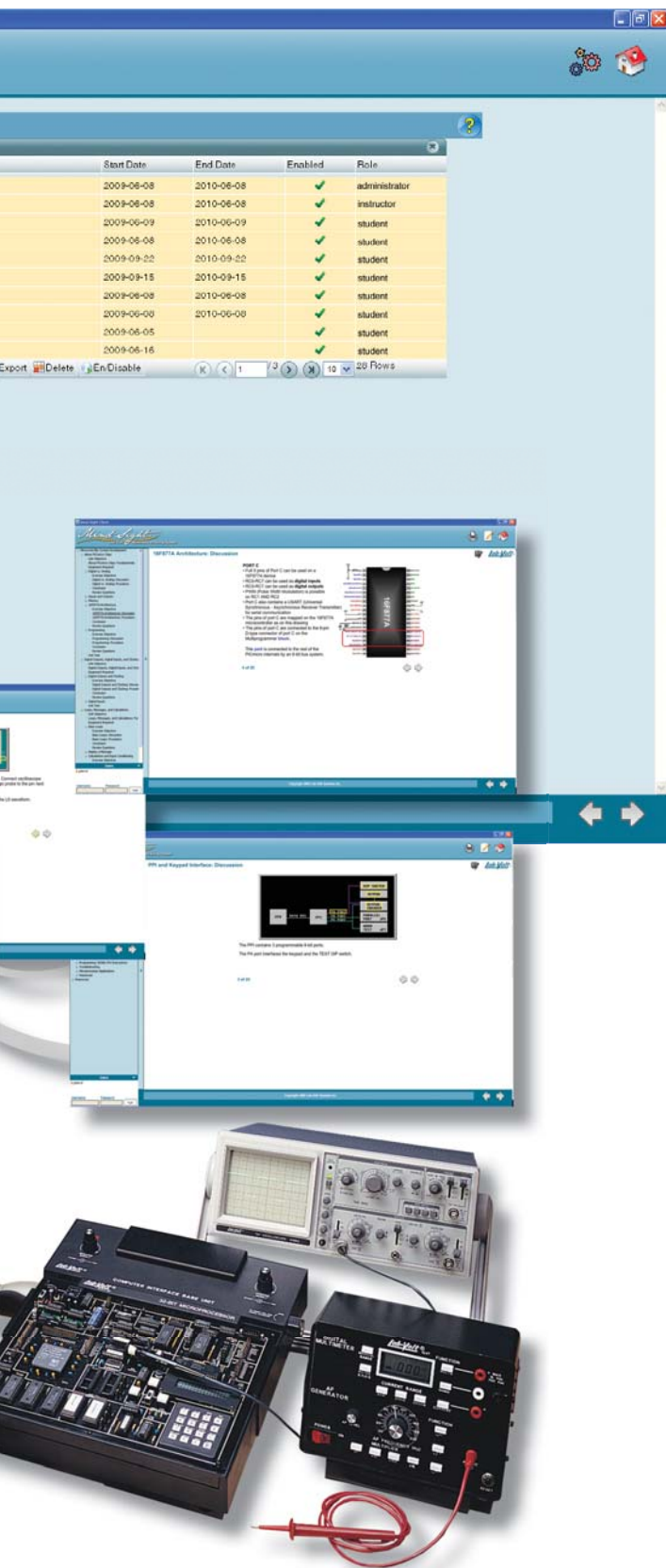
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The FACET® Curriculum

Comprehensive Study in Four Key Areas of Electronics

The entire FACET program currently consists of 30 courses, each carefully designed to foster recognition, understanding, experimentation, troubleshooting, application, design, and evaluation of analog and digital electronics circuitry.

Rich in comprehensive content and competency-based, hands-on learning activities, each course gives students critical skills in one or more of the key areas of electronics study*:

■ Basic Electricity and Electronics

- DC Fundamentals
- DC Network Theorems
- AC 1 Fundamentals
- Magnetism/Electromagnetism
- AC 2 Fundamentals
- Semiconductor Devices
- Transistor Amplifier Circuits
- Transistor Power Amplifiers
- Transistor Feedback Circuits
- Power Supply Regulation Circuits
- FET Fundamentals
- Thyristor and Power Control Circuits
- Operational Amplifier Fundamentals
- Operational Amplifier Applications

■ Digital and Microprocessor Electronics

- Digital Logic Fundamentals
- Digital Circuit Fundamentals 1
- Digital Circuit Fundamentals 2
- 32-Bit Microprocessor
- Digital Signal Processor
- Breadboard
- Microcontrollers

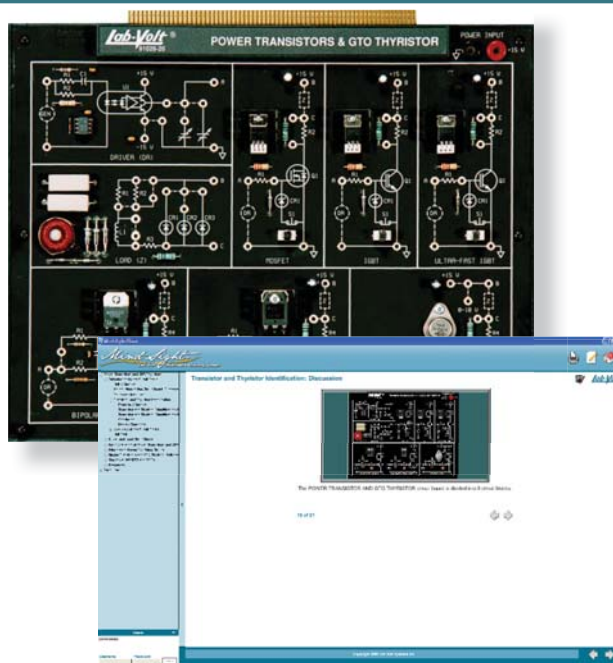
■ Industrial Electronics

- Transducer Fundamentals
- Motors, Generators and Controls
- FET Fundamentals
- Thyristor and Power Control Circuits
- Power Transistors and GTO Thyristors

■ Communications Systems

- Analog Communications
- Digital Communications 1
- Digital Communications 2
- Fiber Optic Communications
- Transmission Lines
- QPSK/OQPSK/DPSK

* Some courses overlap areas of study.



A Program Designed for Student Achievement

Conforming to the highest measure of educational quality, FACET courseware is designed to facilitate and reinforce progressive mastery of the course material. Delivered by means of student manuals or FACET software, the courseware provides an extensive array of instructional benefits, including:

- An outline of the principles and concepts covered in each course helps to clarify course content and focus.
- General and specific objectives stated in each unit help define learning outcomes and expectations for students.
- Topic discussions help to foster thorough comprehension.
- Hands-on activities engender dynamic and retentive learning.
- Emphasis on, and definition of new words and phrases throughout the text, helps students to develop comfort and familiarity with highly technical terms.
- Equipment lists support students' efforts to efficiently organize time and materials.
- Students receive constant feedback with a review test and competency ratings with each exercise, comprehensive unit tests, and additional questions on new material.
- Online data collection of exercise results, quizzes, and unit tests facilitates instant feedback to students.
- Troubleshooting skill development is facilitated through 12 instructor- or computer-activated fault switches and 20 circuit-modification switches.

Introducing Mind-Sight™: Lab-Volt's Multimedia eTraining/Learning Management System

Available as an upgrade from Tech-Lab or as a stand-alone system



eSeries FACET®

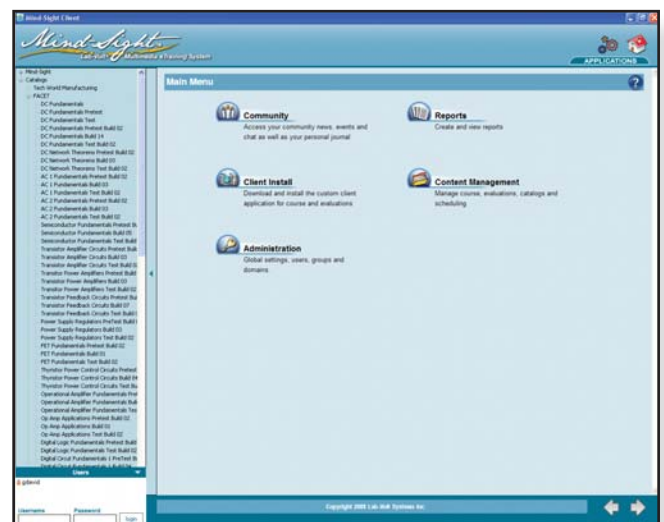
Lab-Volt's new eSeries FACET® enhances learning speed and retention by featuring interactive multimedia courseware for circuit design and analysis within our new Mind-Sight Learning and Content Management (LCMS) system.

What is Mind-Sight?

Lab-Volt's Mind-Sight program is a seamless integration of courseware delivery and classroom management with hands-on learning activities.

Instructors and administrators can use Mind-Sight to manage student enrollment, schedule learning activities, customize courseware curriculum, and track performance objectives and assessments.

Mind-Sight is mainly offered as a LAN-based solution to deliver curriculum locally. However, developed as SCORM-compliant software, remote delivery using other Learning and Content Management Systems is also possible.



Mind-Sight Learning and Content Management System

Introducing Mind-Sight (Cont.)

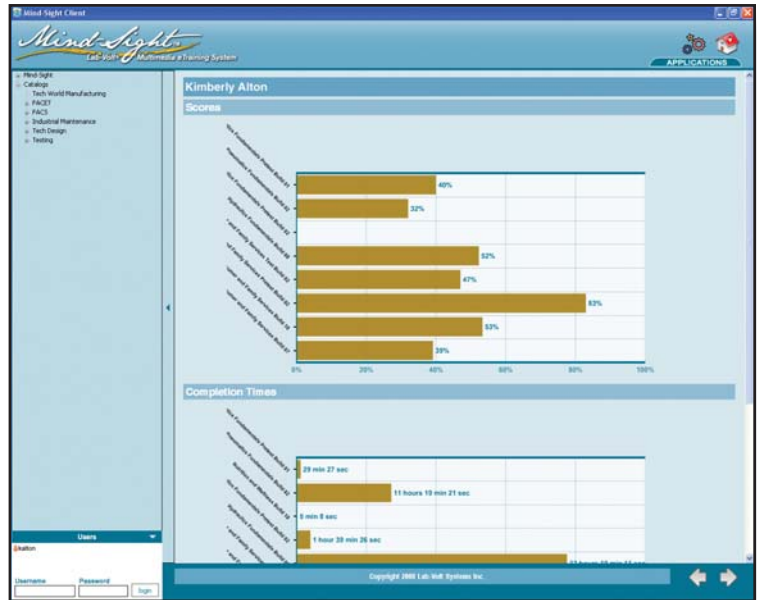
How does Mind-Sight work?

Mind-Sight comes ready to “plug-and-play.” Lab-Volt provides a fully-supported network appliance which has been pre-installed with the management and communication software. Without disturbing an existing school network, Mind-Sight is connected to a spare LAN connection and client software is installed. Course content and class management are administered from the instructor control software.

How are courses accessed and what about updates?

Users purchase perpetual or subscription-based content. Additionally, all Mind-Sight courseware and associated student data is stored locally, on the user’s Mind-Sight network appliance. Each site has

a unique installation code that allows the Mind-Sight network appliance to automatically install and update content from Lab-Volt’s content servers. Content is pulled onto the network appliance via an Internet connection.



Student Management

What are some of the features and benefits of using Mind-Sight?

Mind-Sight offers complete courseware delivery and classroom management. The administrator can:

- add and delete students.
- create and delete passwords.
- run activity and assessment reports.
- customize curriculum content and run other SCORM 1.2 content.
- run external applications.
- annotate curriculum.
- communicate with individual students or the whole classroom.

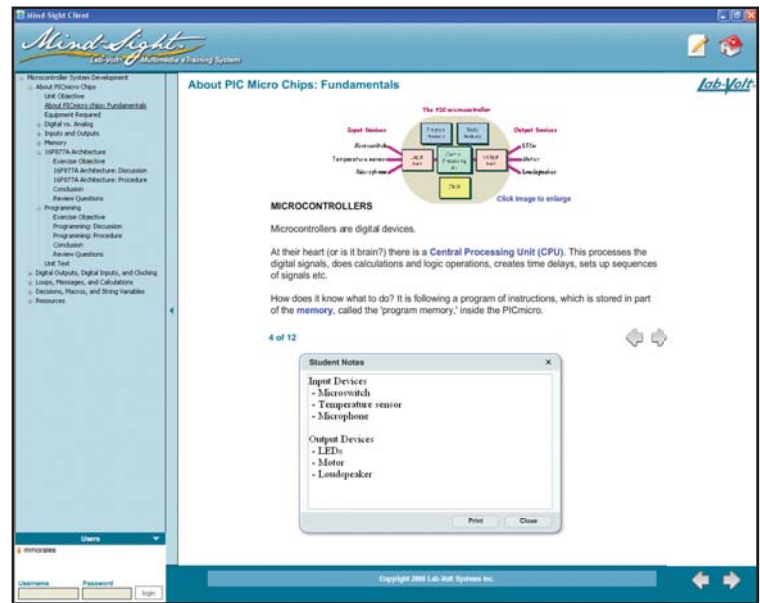


Mind-Sight Features

Mind-Sight LCMS and Utilities

Mind-Sight is a powerful new platform that operates all components of the multimedia curriculum, as well as the classroom-management system. Mind-Sight provides these features:

- **Content Management:** Import additional Mind-Sight content from CD, DVD, or external device. Manage course catalogs. Upload new SCORM courses. Add a new catalog. Manage catalogs. Assign User Groups to catalogs.
- **Teacher Annotations:** Teachers can change words or paragraphs and add additional text, supplementary information, or instructions within the curriculum.
- **Course Content Editing:** Easy-to-use tools enable the addition of information, course building from existing content, and SCORM package uploading.
- **Access to students' electronic journals:** Instructors can communicate with students about notes they save in the journals, projects, progress, etc.



- **Announcement Posting:** Teachers can send messages to the entire class in one easy step.
- **Real-Time Journal/Blog:** Instructors can communicate with selected students in writing. The blog feature enhances communication among teachers and students.
- **Application Tab:** Any application can be linked to the application tab and launched from this tab in the top right corner of the screen.
- **Student Notes:** Each content screen displays a student notes icon that opens a note-taking window in front of the content screen. Students can see the content about which they are taking notes. These notes can then be printed out individually or exported to a single file for printing.
- **Reporting:** Teachers can run reports by Courses or Students. More reports features, including Competencies and Standards, are currently in development.

Durable, Industrial-Grade Hardware Provides Safe, Effective Training

FACET® Base Units

The FACET base units provide necessary protection and voltage conditioning circuitry to run each FACET board. To accommodate a variety of system configurations, Lab-Volt offers four base unit models: two for the computer-based system configuration (one with built-in power supply and one without) and two for the manual system configuration (one with built-in power supply and one without).

Regardless of its configuration, each lightweight, portable FACET base unit features:

- Distributed ± 15 and variable ± 10 Vdc power to the circuit board, with coarse and fine controls to adjust the variable ± 10 Vdc supplies
- Self-protection against short-circuit, reverse-voltage and over-voltage conditions
- Long-life ZIF connector, protected from damage by built-in stops, with a rotary knob that locks the training module into the base unit
- Gold-plated fingers on connectors for added durability.



*Base unit with computer interface and built-in power supply
(Model 91000-50)*

FACET is ideal for a multitude of training configurations in educational, industrial and military laboratories. Adhering to the highest measure of educational integrity, FACET® offers unparalleled safety, quality and curriculum features, as demonstrated in:

- Durable construction of mechanical components capable of withstanding thousands of cycles of operation
- Electrical components capable of withstanding any combination of voltage or connections from the base unit
- Voltage regulation and protection against overvoltage and short-circuit conditions for safety
- Gold-plated zero insertion force (ZIF) connector technology
- Silk-screened circuit and component identification
- Circuit boards mounted in sturdy poly-styrene trays for easy handling and connection to the FACET® base unit
- Minimal wiring required, which saves lab time
- Variety of industrial-grade components providing broad hands-on, real-world training experience
- Active components mounted in sockets on each PCB for easy replacement.



FACET boards slip easily into the base unit by means of zero-insertion force (ZIF) connectors.

The manual system also features:

- Student-controlled circuit-modification capability
- Instructor-controlled fault-insertion capability
- Manual, stand-alone configuration.

The computer-based system also features:

- Computer-activated circuit-modification and fault-insertion capability
- Computer-controlled configuration
- Network configuration.



Computer interface base unit without built-in power supply (Model 91000-20)

Computerized Base Units

(Models 91000-50)

Each computerized base unit communicates with the computer through a serial communication port or a USB port via an optional adapter. The base unit's on-board microcontroller sends system status to the host and receives control commands required to set and reset circuit modification (CM) and fault controls. When a CM or fault is activated on the circuit board, the base unit transmits a message that appears on the computer screen. In some cases, when it is necessary for the student to compare an unmodified circuit with one containing a CM, the software assigns a function key on the computer keyboard to control the appropriate reed relay that toggles the CM on and off.

In the troubleshooting exercises, faults also are inserted automatically by the computer, thereby freeing the instructor to assist students with individual activities.

Manual Base Units

(Model 91000-30)

Each manual system base unit comes with an accessory kit containing terminal posts, connectors, adapters and patchcords required to perform experiments on the FACET® training modules.

CMs and faults are controlled by a bank of 32 toggle switches located on the base unit (12 fault switches are located under a lockable cover).



Manual base unit with built-in power supply (Model 91000-30)

The FACET® System at-a-Glance

A complete FACET laboratory station requires a **FACET Circuit Board** that connects to and receives power from a **FACET Base Unit**.

Also required to run the LAN-based eSeries FACET system are:

- Accessory kit
- The Lab-Volt Laboratory Instrumentation Package Model 1247) or instrumentation that includes:
 - Multimeter
 - Dual-trace oscilloscope
 - Audio function generator
- Courseware: manual (hard copy) or computer-based (Windows)

Minimum Recommended Requirements to run Mind-Sight eSeries FACET

Server requirements

Recommendations are for server connectivity. Network appliance itself is supplied by Lab-Volt and requires a 10Mb Ethernet LAN connection.

- Recommended access to internet via port 80/443 (HTTP/SSL) or via proxy server
- Recommended will allow for quick and easy registration and updating.

Client workstations

Minimum:

- Microsoft Windows XP
- Internet Explorer 6
- .NET 3.0 framework
- Flash 8 (multimedia may require Flash 9)
- Sound card
- 10Mb Ethernet
- 1024 pixel width display resolution

Recommended:

- Internet Explorer 7
- .NET 3.0 framework
- Flash 8 (multimedia may require Flash 9)
- Sound card
- 100Mb Ethernet
- 1280 pixel width display resolution

Options to supplement the FACET Integrated Learning System include:

- Virtual Instrument Package (Model 1250-10)
- GradePoint 2020™ Automated Classroom-Management and Gradebook System
- Instructor Guides
- Pre-tests
- Post-tests
- Answer Keys
- Student workbooks for computer-based courseware

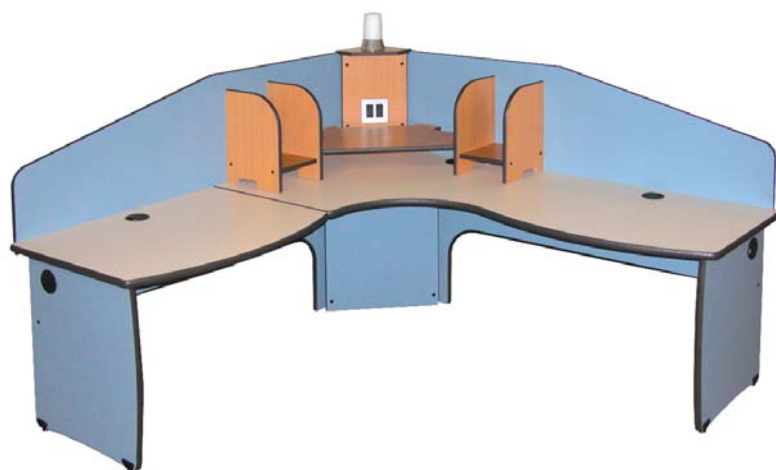
Flexible Modular Workstations

Lab-Volt's 41000 Series

WORKSTATIONS

Lab-Volt's 41000 Series workstations come in various styles that allow units to be positioned along the perimeter of the classroom, in the center of the room as islands, and around inside or outside corners – taking full advantage of limited space. Each workstation is freestanding with a smooth laminated work surface, and provides ample space for two students to perform computer tasks and hands-on activities.

Both the Standard Style Workstation and the Streamline Style Workstation are L-shaped units designed as 1/4-quadrant stations, accommodating two students. They can be integrated with additional units to form 1/2-quadrants (two stations/4 students), 3/4-quadrants (three stations/6 students), or full quadrants (four stations/8 students).



Shown with Optional Call Light, Model 41000-10

STANDARD WORKSTATION

Model 41500-20 (81" x 81")

Model 41500-30 (69" x 69")

The standard style frame, made of heavyweight material suitable for stationary placement in the lab, includes a lower, polygon-shaped pylon mounted to the work surface and modesty panels.

Work Surface Depth:	30"
Upper Divider Panels:	22" H
Lower Modesty Panels:	16.5" from floor
Leg Panel:	23.5" x 28.5"
Center Pedestal:	18" x 18" clipped at 45 degrees

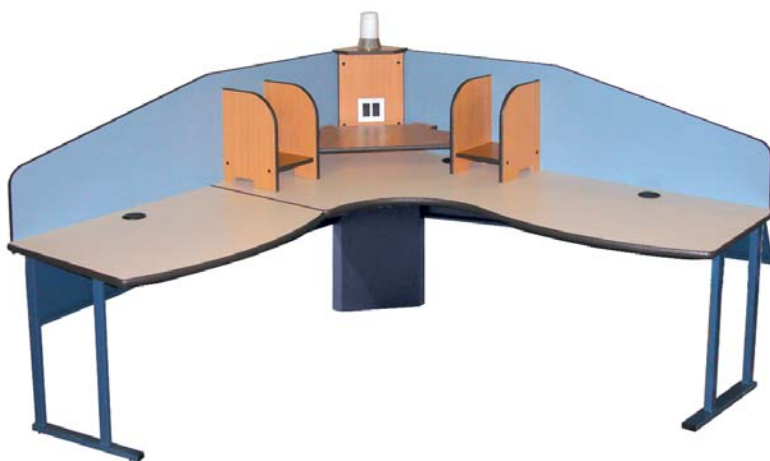
STREAMLINE WORKSTATION

Model 41600-30 (81" x 81")

Model 41600-40 (69" x 69")

The streamline style 1/4-quadrant frame features light-weight steel leg assemblies for mobility, modesty panels, and an open-style oak-grained riser cabinet.

Work Surface Depth:	30"
Upper Divider Panels:	22" H
Lower Modesty Panels:	16.5" from floor
Leg Panel:	23.5" x 28.5"
Center Pedestal:	18" x 18" clipped at 45 degrees



Shown with Optional Call Light, Model 41000-10

INLINE WORKSTATIONS

The Inline Workstation is constructed of the same heavier-weight material as the standard style, but is unique in its rectangular shape. Several units, configured side-by-side, permit workstations to be positioned "in line." The inline workstation features a shelf for books and other supplies, and a center console containing power outlets on either side and an on/off power switch on the front.

Work surfaces are laminated and include holes in the back corners to accommodate cables and wiring.

Modesty panels are mounted to the leg assemblies and/or lower power pylon to provide additional stability to the workstation and privacy for students.



Shown with Optional Call Light, Model 41000-10

STREAMLINE INLINE WORKSTATION

Model 41800-60 (30" x 72")

Model 41800-70 (30" x 84")

Work Surface Depth:	30"
Upper Divider Panels:	22" H
Lower Modesty Panels:	16.5" from floor
Leg Panel:	23.5" W x 28.5" H

STANDARD INLINE WORKSTATION

Model 41800-40 (30" x 72")

Model 41800-50 (30" x 84")

The standard version of the inline workstation has the same dimensions as the streamline version, with sturdy leg panels designed for stationary placement in the lab.

INSTRUCTOR WORKSTATIONS

Remove the riser and privacy panel from the standard or streamline units, and you have the Instructor Workstation, a desktop workplace that provides ample area for a computer, keyboard, bookshelves, and floor cabinets. The Instructor Workstation is available in both standard and streamline versions.

STANDARD INSTRUCTOR WORKSTATION

Model 41500-40 (81" x 81")

Model 41500-50 (69" x 69")

Work Surface Depth:	30"
Lower Modesty Panels:	16.5" from floor
Leg Panel:	23.5" x 28.5"



STREAMLINE INSTRUCTOR WORKSTATION

Model 41600-50 (81" x 81")

Model 41600-60 (69" x 69")

The streamline version of the instructor workstation has the same dimensions as the standard version, with lightweight metal legs for mobility.



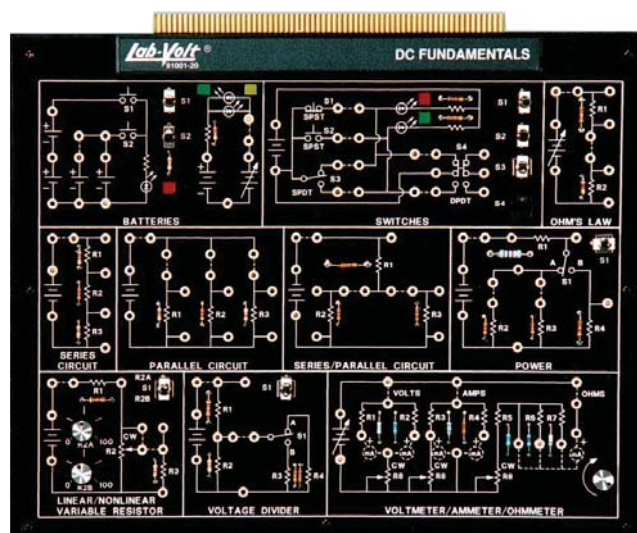
DC FUNDAMENTALS MODEL 91001

The DC Fundamentals course provides comprehensive, hands-on instruction in the terminology, principles and applications of DC circuits. Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

All DC power to the circuit board is supplied by the 15V power supply via the base unit and its protection circuitry. Students troubleshoot DC circuit faults inserted by the computer or manually by the instructor, who alters hidden switches located under a locking cover.

TOPIC COVERAGE

- Instrument Familiarization
- FACET Base Unit Familiarization
- DC Fundamentals Circuit Board Familiarization
- Symbols and Schematics
- Basic Safety Rules
- Electrical Safety Rules
- Circuit Voltage
- Circuit Current
- Circuit Resistance
- DC Power Sources in Series and in Parallel Series
- Opposing DC Sources
- Identify Types of Switches
- Switching Concepts
- Ohm's Law: Circuit Resistance
- Ohm's Law: Circuit Current
- Ohm's Law: Circuit Voltage
- Resistance in a Series Resistive Circuit
- Current in a Series Resistive Circuit
- Voltage in a Series Resistive Circuit
- Resistance in a Parallel Resistive Circuit
- Voltage and Current in a Parallel Resistive Circuit
- Resistance in a Series-Parallel Resistive Circuit
- Voltage in a Series-Parallel Resistive Circuit
- Current in a Series-Parallel Resistive Circuit
- Power in a Series Resistive Circuit
- Power in a Parallel Resistive Circuit
- Power in a Series-Parallel Resistive Circuit
- The Rheostat
- The Potentiometer
- Voltage Dividers
- Current Dividers
- Voltage/Current Dividers
- The DC Ammeter
- The DC Ohmmeter
- The DC Voltmeter
- Troubleshooting DC Circuits 1



CIRCUIT BLOCKS

- Batteries
- Switches
- Ohm's Law
- Series Circuit
- Parallel Circuit
- Series-Parallel Circuit
- Power
- Linear/Non-Linear Variable Resistor
- Voltage Divider
- Voltmeter/Ammeter/Ohmmeter

DC NETWORK THEOREMS MODEL 91002

Comprised of nine training circuit blocks and a constant source generator block, the DC Network Theorems course provides comprehensive, hands-on instruction in the terminology, principles and applications of theoretical DC principles. For example, when a circuit has two voltage sources in different branches, theorems must be used to determine voltage and/or current in these circuits where Ohm's Law cannot be applied.

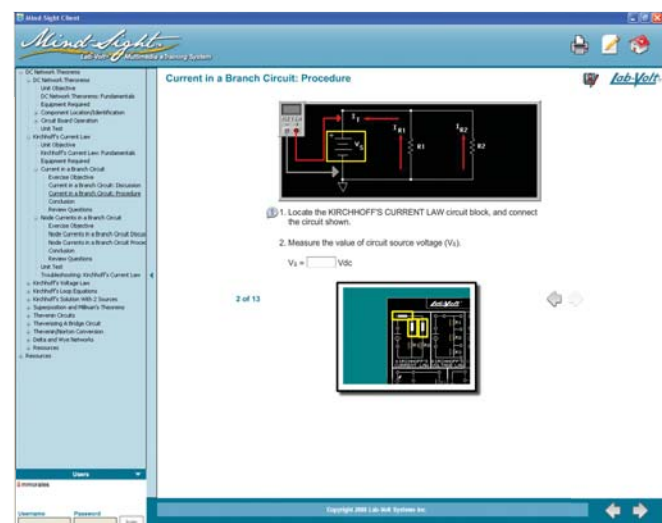
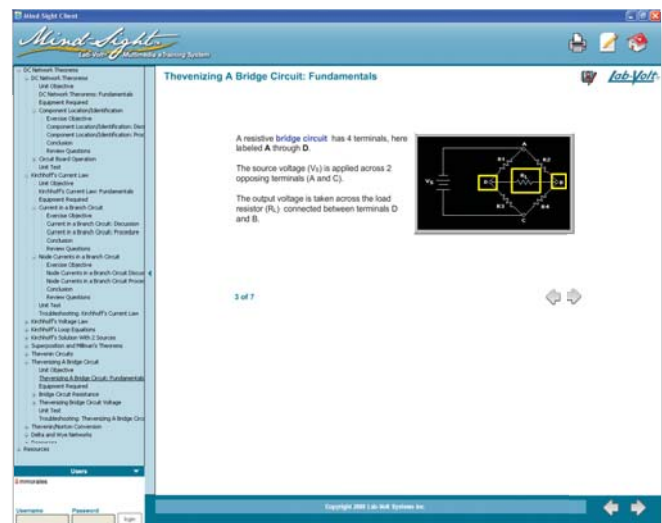
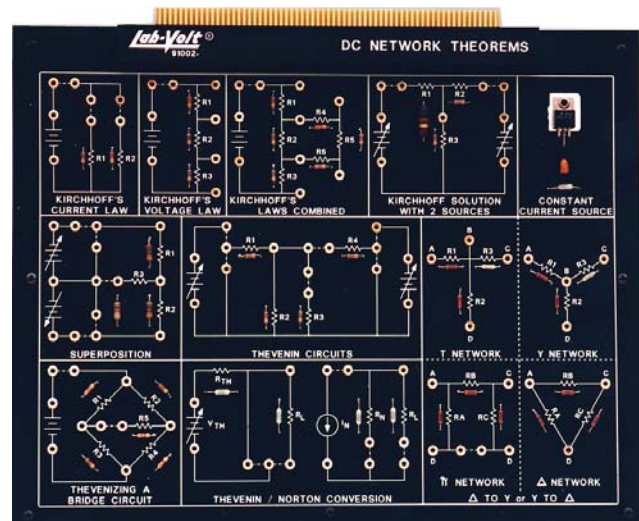
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Component Location and Identification
- Circuit Board Operation
- Currents in a Two-Element Branch Circuit
- Node Currents in a Two-Element Branch Circuit
- Voltages in a Three-Element Series Circuit
- Algebraic Sum of Voltages in a Series Circuit
- Generating Loop Equations
- Generating Node Equations
- Kirchhoff's Voltage Law with a Two-Source Circuit
- Kirchhoff's Current Law with a Two-Source Circuit
- Mesh Solutions of a Two-Source Circuit
- Superposition Solution for a Two-Source Circuit
- Millman's Theorem Solution for a Two-Source Circuit
- Thevenizing a Single-Source Network
- Thevenizing a Dual-Source Network
- Thevenin Resistance (R_{TH}) of a Bridge Circuit
- Thevenin Voltage (V_{TH}) of a Bridge Circuit
- Thevenin-to-Norton Conversion
- Norton-to-Thevenin Conversion
- Tee and Wye or Pi and Delta Networks
- Transformation of Delta and Wye Networks
- Troubleshooting Basics
- Troubleshooting DC Networks

CIRCUIT BLOCKS

- Kirchhoff's Current Law
- Kirchhoff's Voltage Law
- Kirchhoff's Laws Combined
- Kirchhoff's Solution with Two Sources
- Superposition
- Thevenin Circuits
- Thevenizing a Bridge Circuit
- Thevenin/Norton Conversion
- Delta to Wye or Wye to Delta



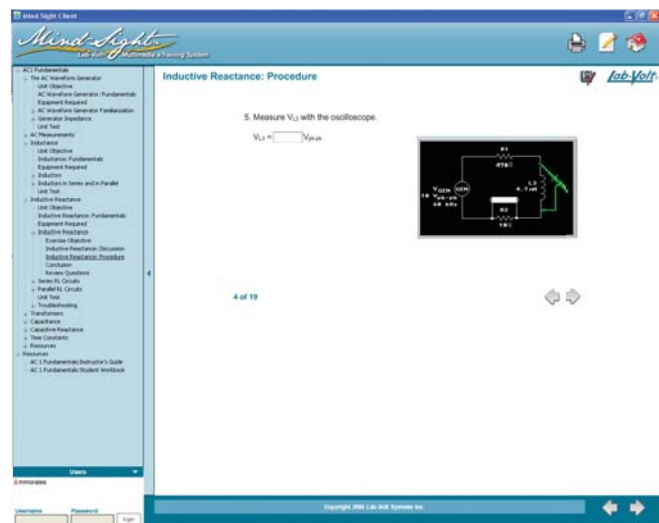
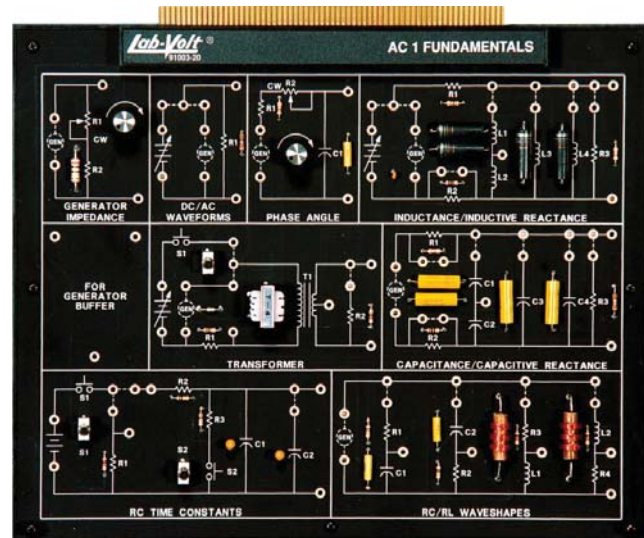
AC 1 FUNDAMENTALS MODEL 91003

The AC 1 Fundamentals* course provides comprehensive, hands-on instruction in the terminology, principles and applications of AC circuits. It is specifically designed to teach AC concepts with minimal wiring required to save lab time. All fault and circuit-alteration components are hidden from the students' view.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- What is Magnetism?
- Magnetic Fields
- Making a Magnet
- The Oscilloscope
- The AC Waveform Generator
- AC Amplitude Measurement
- Measuring AC Voltage, Current and Impedance with an Oscilloscope
- Measuring and Setting Frequency
- Inductors
- Phase Angle
- Inductors in Series and in Parallel
- Fundamentals of Inductive Reactance
- Inductive Reactance and Impedance
- Series RL Circuits
- Parallel RL Circuits
- What is an Electromagnet?
- The Solenoid
- The Relay
- Transformer Windings
- Mutual Inductance
- Transformer Turns and Voltage Ratios
- Transformer Secondary Loading
- Capacitors
- Capacitors in Series and in Parallel
- Fundamentals of Capacitive Reactance
- Series RC Circuits
- Parallel RC Circuits
- RC Time Constants
- RC/RL Waveshapes
- Troubleshooting Basics
- Troubleshooting the AC 1 Fundamentals Circuit Board



CIRCUIT BLOCKS

- Generator Impedance
- AC/DC Waveforms
- Phase Angle
- Inductance/Inductive Reactance
- Transformer
- Capacitance/Capacitive Reactance
- RC Time Constraints
- RC/RL Wave Shapes

*A course in Magnetism/Electromagnetism is available as an extension of the AC 1 Fundamentals course. For a description of the Magnetism/Electromagnetism module, see page 15.

MAGNETISM/ELECTROMAGNETISM MODEL 91020

The Magnetism/Electromagnetism course is an extension of the AC 1 Fundamentals training module that provides comprehensive, hands-on instruction in the terminology, principles and applications of magnetism and electromagnetism.

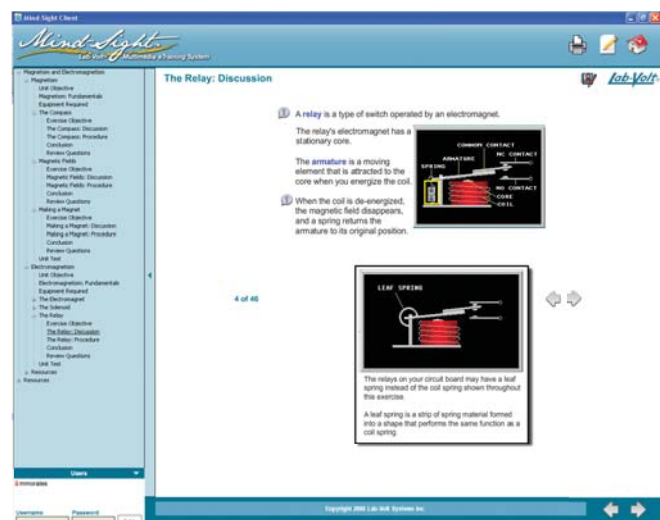
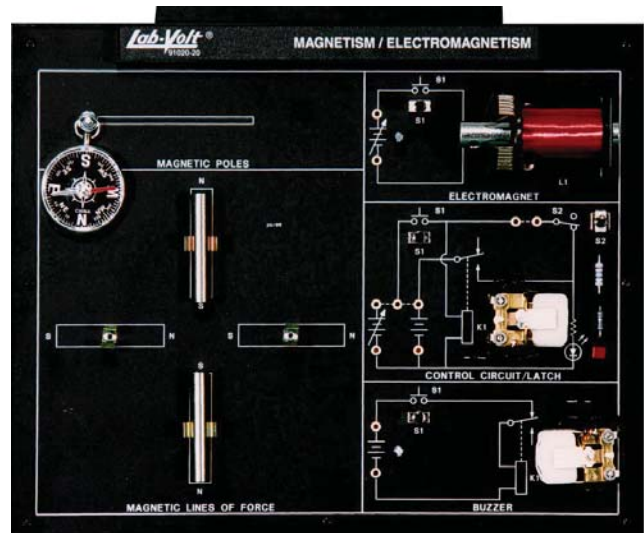
Following a carefully designed instructional program, students will become familiar with all components of the board; and will be able to isolate, identify and test a series of circuits.

TOPIC COVERAGE

- What is Magnetism?
- Magnetic Fields
- Making a Magnet
- What is an Electromagnet?
- The Solenoid
- The Relay

CIRCUIT BLOCKS

- Magnetic Poles
- Magnetic Lines of Force
- Electromagnet/Solenoid
- Control Circuit/Latch
- Buzzer



AC 2 FUNDAMENTALS MODEL 91004

The AC 2 Fundamentals* course provides students with additional, in-depth practice with the terminology and functions of AC circuits.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

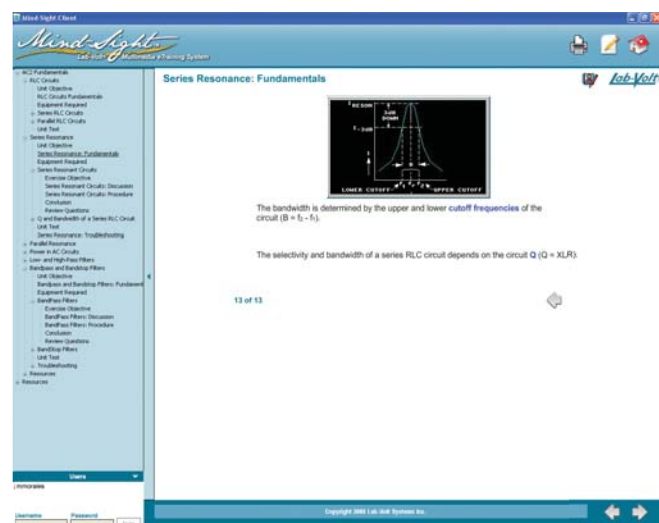
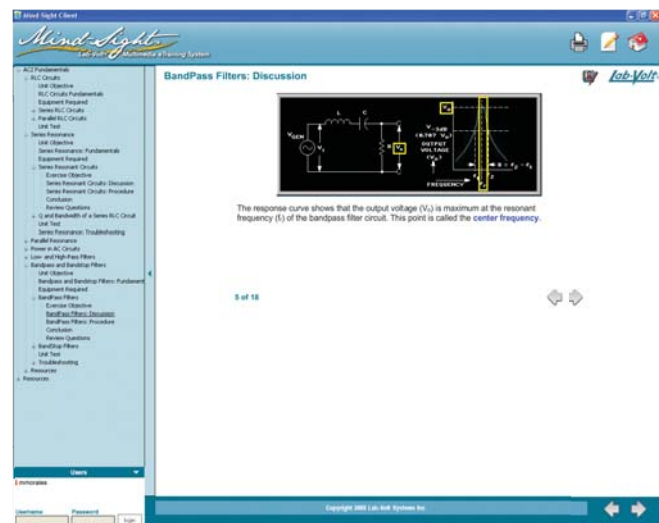
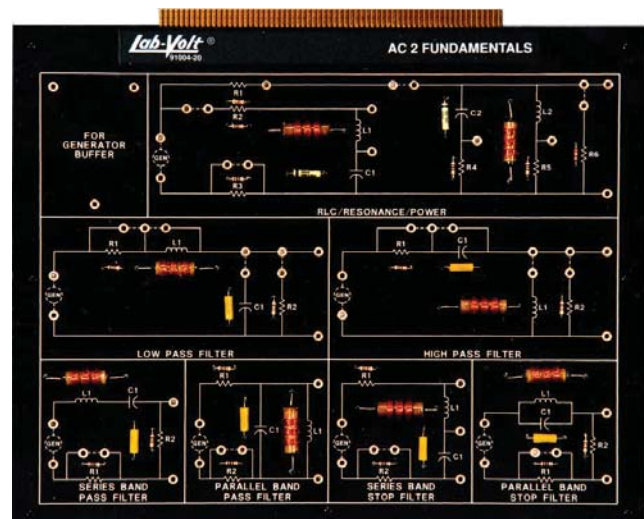
TOPIC COVERAGE

- Series RLC Circuits
- Parallel RLC Circuits
- Series Resonant Circuits
- Q and Bandwidth of a Series RLC Circuit
- Resonant Frequency in a Parallel RLC Circuit
- Q and Bandwidth
- Power Division
- Power Factor
- Low-Pass Filters
- High-Pass Filters
- Band-Pass Filters
- Band-Stop Filters
- Troubleshooting Basics
- Troubleshooting the AC 2 Fundamentals Circuit Board

CIRCUIT BLOCKS

- RLC/Resonance/Power
- Low-Pass Filter
- High-Pass Filter
- Series Band-Pass Filter
- Parallel Band-Pass Filter
- Series Band-Stop Filter
- Parallel Band-Stop Filter

* A course in Magnetism/Electromagnetism also is available. For a description of this module, see page 15.



SEMICONDUCTOR DEVICES MODEL 91005

After completion of the FACET programs in AC and DC fundamentals, and AC and DC circuits and analysis, students are ready to proceed to training in Semiconductor Devices. Components in this course include Resistors, Linear Potentiometers, Power Transformers, LED Indicators, Silicon and Zener Diodes, and Bridge Rectifiers.

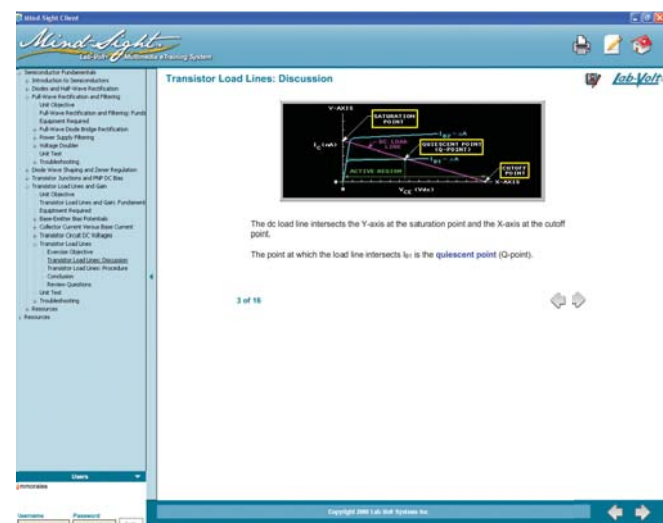
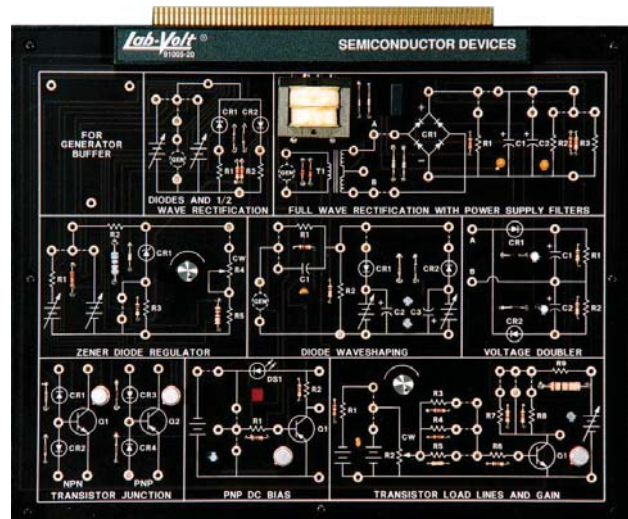
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Semiconductor Component Identification
- Control of a Semiconductor Switch
- Diode and DC Characteristics
- Half-Wave Rectification
- Full-Wave Diode Bridge Rectification
- Power Supply Filtering
- Voltage Doubler
- Diode Waveshaping
- The Zener Diode
- Zener Diode Voltage Regulation
- Testing the Junctions of a Transistor
- PNP Transistor Current Control Circuit
- Emitter-Base Bias Potentials
- Collector Current Versus Base Bias
- Transistor DC Circuit Voltages
- Transistor Load Lines
- Troubleshooting Basics
- Troubleshooting the Semiconductor Devices Circuit Board

CIRCUIT BLOCKS

- Diodes and Half-Wave Rectification
- Full-Wave Rectification with Power Supply Filters
- Zener Diode Regulator
- Diode Waveshaping
- Voltage Doubler
- Transistor Junction
- PNP DC Bias
- Transistor Load Lines and Gain



TRANSISTOR AMPLIFIER CIRCUITS MODEL 91006

The Transistor Amplifier Circuits course provides students with comprehensive, hands-on instruction in the terminology and principles of transistor amplifier circuits.

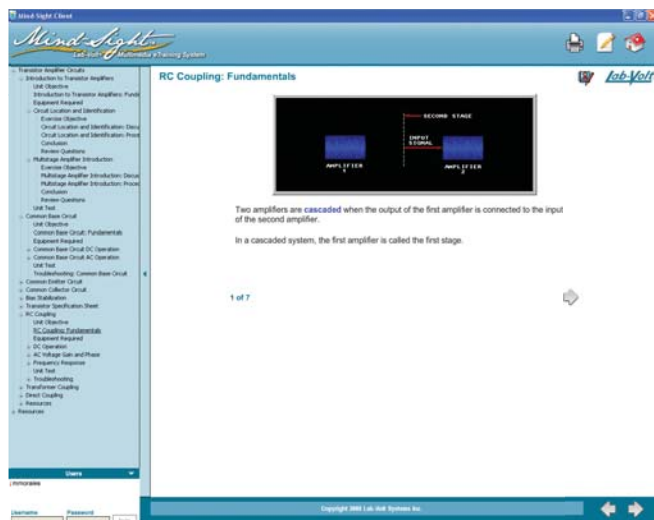
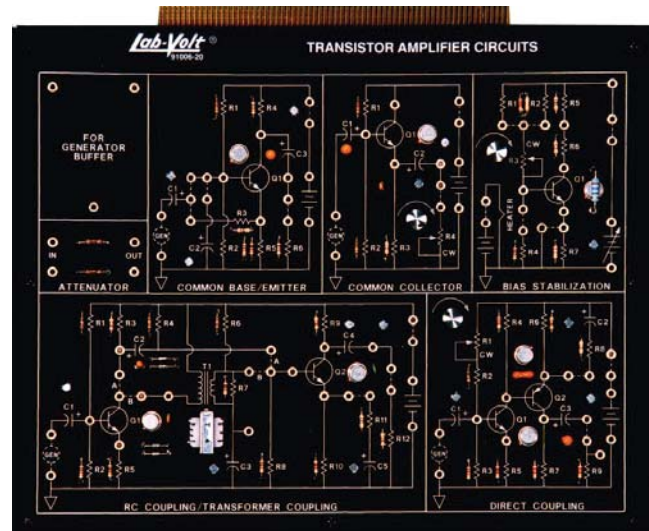
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify, and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Circuit Location and Identification
- Multistage Amplifier Introduction
- Common Base Circuit DC Operation
- Common Base Circuit AC Operation
- Common Emitter Circuit DC Operation
- Common Emitter Circuit AC Operation
- Common Collector Circuit DC Operation
- Common Collector Circuit AC Operation
- Temperature Effect on Fixed Bias Circuit
- Temperature Effect on Voltage Divider Bias Circuit
- Transistor Parameters Familiarization
- Using the Transistor Specification Sheet
- RC Coupled Amplifier DC Operation
- RC Coupled Amplifier AC Voltage Gain and Phase Relationship
- RC Coupled Amplifier Frequency Response
- Transformer Coupled Amplifier DC Operation
- Transformer Coupled Amplifier AC Operation
- Transformer Coupled Amplifier Frequency Response
- Direct Coupled Amplifier DC Operation
- Direct Coupled Amplifier AC Operation
- Direct Coupled Amplifier Frequency Response
- Troubleshooting Basics
- Troubleshooting Transistor Amplifier Circuits

CIRCUIT BLOCKS

- Attenuator
- Common Base/Emitter
- Common Collector
- Bias Stabilization
- RC Coupling/Transformer Coupling
- Direct Coupling



TRANSISTOR POWER AMPLIFIERS MODEL 91007

The Transistor Power Amplifiers course provides comprehensive, hands-on instruction in the terminology, principles and applications of transistor power amplifier circuitry.

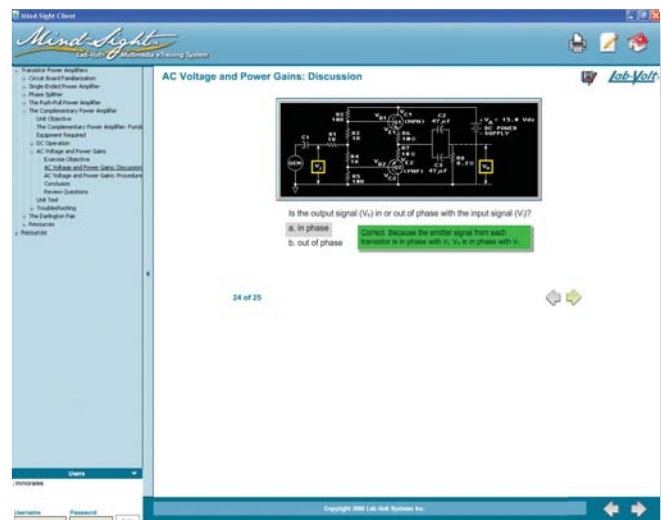
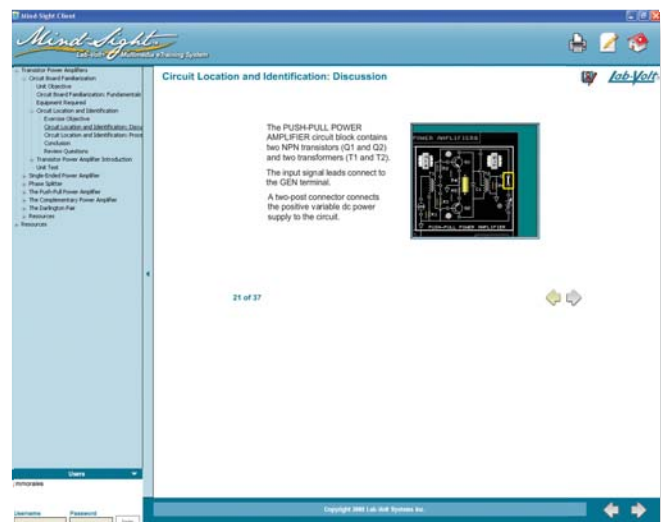
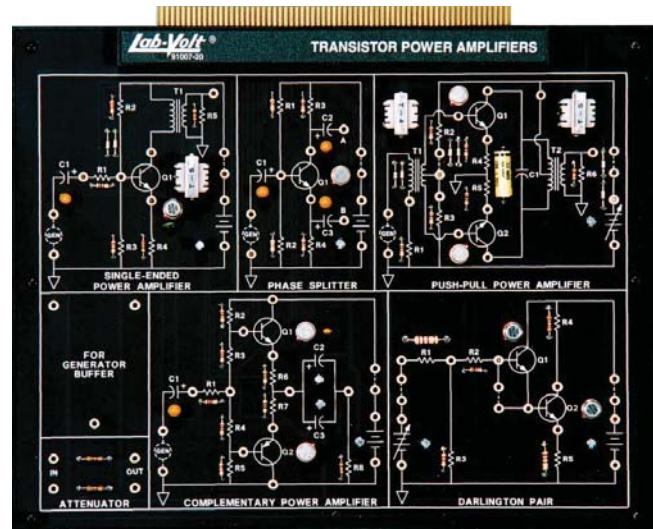
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Circuit Location and Identification
- Transistor Power Amplifier Introduction
- Single-Ended Power Amplifier DC Operation
- Single-Ended Power Amplifier AC Voltage Gain and Power Gain
- Phase Splitter DC Operation
- Voltage Gain and Input/Output Signal Phase Relationship
- Push-Pull Power Amplifier DC Operation
- Push-Pull Power Amplifier AC Voltage Gain and Power Gain
- Complementary Power Amplifier DC Operation
- Complementary Power Amplifier AC Voltage Gain and Power Gain
- Darlington Pair Current Gain Characteristics
- Darlington Pair Input and Output Impedance
- Troubleshooting Basics
- Troubleshooting Transistor Power Amplifiers

CIRCUIT BLOCKS

- Single-Ended Power Amplifier
- Phase Splitter
- Push-Pull Power Amplifier
- Attenuator
- Complementary Power Amplifier
- Darlington Pair



TRANSISTOR FEEDBACK CIRCUITS

MODEL 91008

The Transistor Feedback Circuits course provides comprehensive, hands-on instruction in the terminology, principles and applications of transistor feedback.

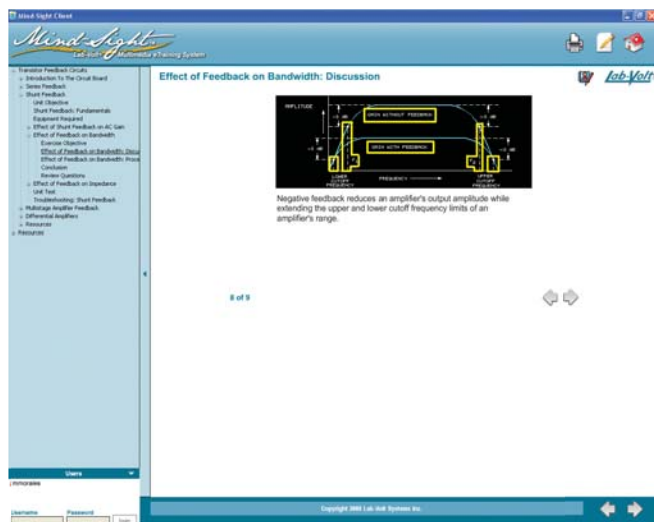
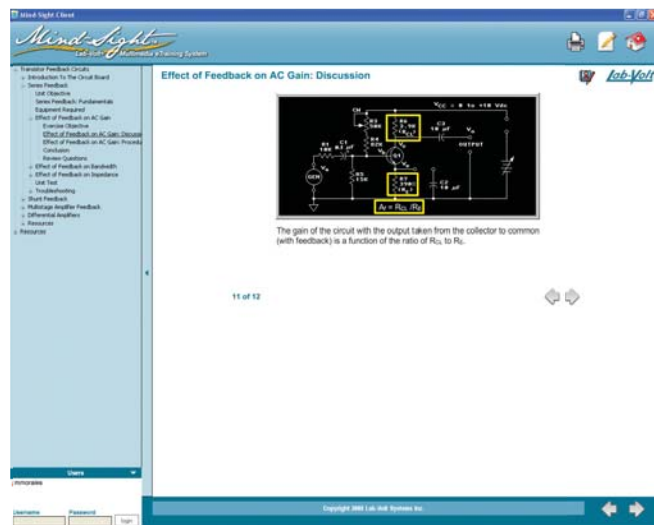
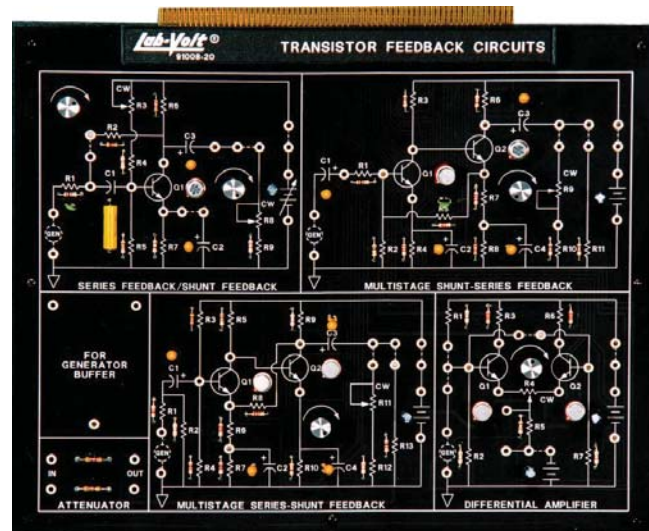
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Component Location and Identification
- Series Feedback Amplifier Operation
- The Effect of Feedback on AC Gain
- The Effect of Negative Series Feedback on Bandwidth
- The Effect of Series Feedback on Input and Output Impedance
- The Effect of Shunt Feedback on AC Gain
- The Effect of Shunt Feedback on Bandwidth
- The Effect of Shunt Feedback on Input and Output Impedance
- Shunt Series Multistage Amplifier Current Gain
- Shunt Series Multistage Amplifier Output Gain
- Shunt Series Multistage Amplifier Voltage Gain
- Shunt Series Multistage Amplifier Output Impedance
- Differential Amplifier Operation
- Single-Ended and Differential Gain Characteristics
- Common Mode Gain and Rejection Ratio
- Troubleshooting Basics
- Troubleshooting Transistor Feedback Circuits

CIRCUIT BLOCKS

- Series Feedback/Shunt Feedback
- Multistage Shunt-Series Feedback
- Attenuator
- Multistage Series-Shunt Feedback
- Differential Amplifier



POWER SUPPLY REGULATION CIRCUITS MODEL 91009

The Power Supply Regulation Circuits course provides comprehensive, hands-on instruction in the terminology, principles and applications of power supply regulation circuits.

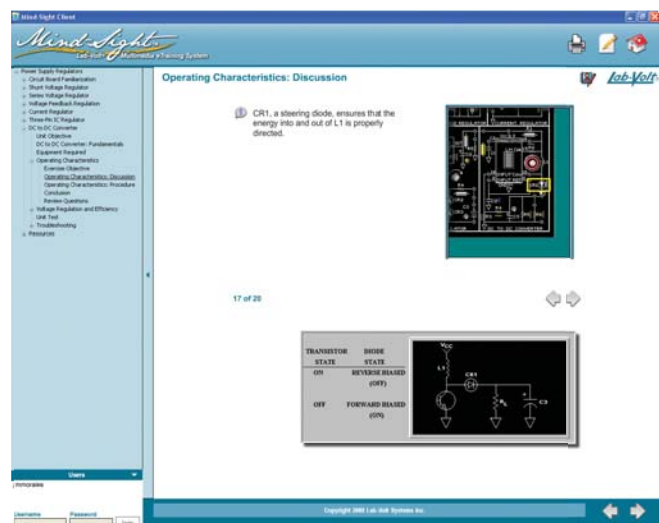
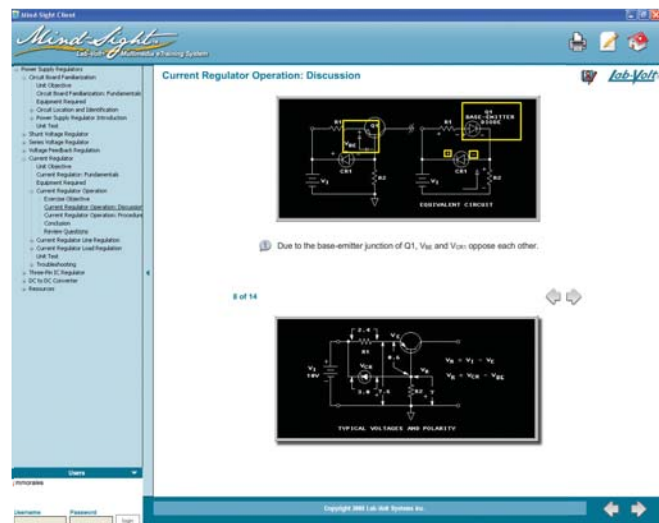
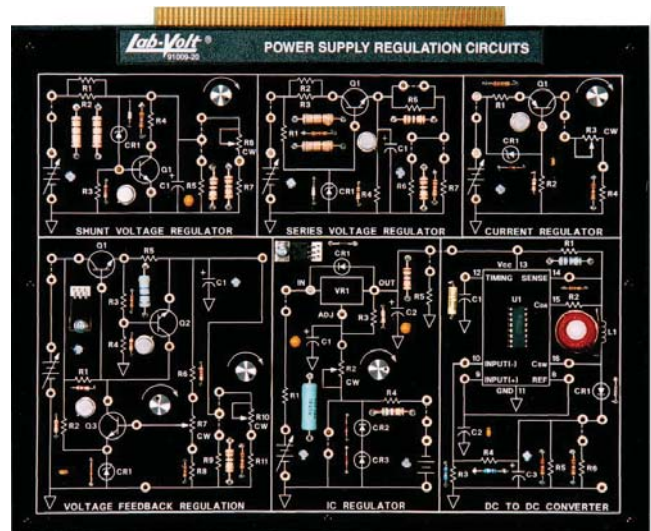
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Circuit Location and Identification
- Power Supply Regulator Introduction
- Shunt Regulator Operation
- Line Regulation
- Load Regulation
- Series Regulator Operation
- Voltage Feedback Regulator Operation
- Voltage Feedback Load Regulation
- Foldback Current Limiting Active Protection Circuit
- Current Regulator Operation
- Current Regulator Line Regulation
- Current Regulator Load Regulation
- Three-Pin IC Regulator Operation and Voltage Regulation
- Three-Pin IC Current Regulation and Power Efficiency
- DC-to-DC Converter Operating Characteristics
- DC-to-DC Converter Voltage Regulation and Efficiency
- Troubleshooting Basics
- Troubleshooting Power Supply Regulation Circuits

CIRCUIT BLOCKS

- Shunt Voltage Regulator
- Series Voltage Regulator
- Current Regulator
- Voltage Feedback Regulation
- IC Regulator
- DC-to-DC Converter



FET FUNDAMENTALS MODEL 91010

The FET Fundamentals course provides comprehensive, hands-on instruction in the terminology, principles and applications of JFET, MOSFET and UJT.

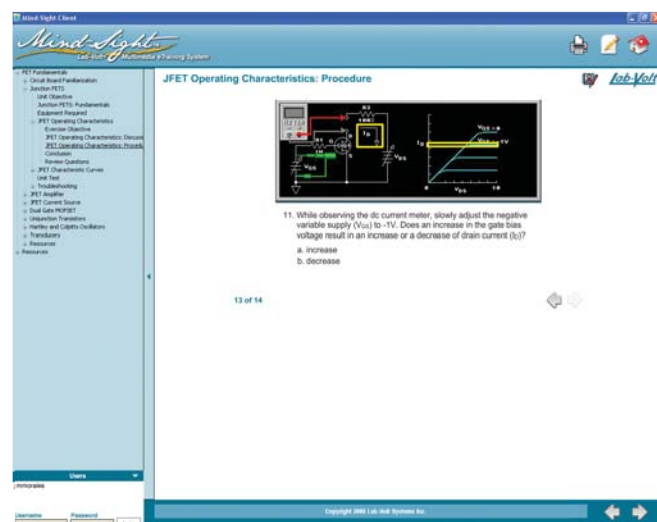
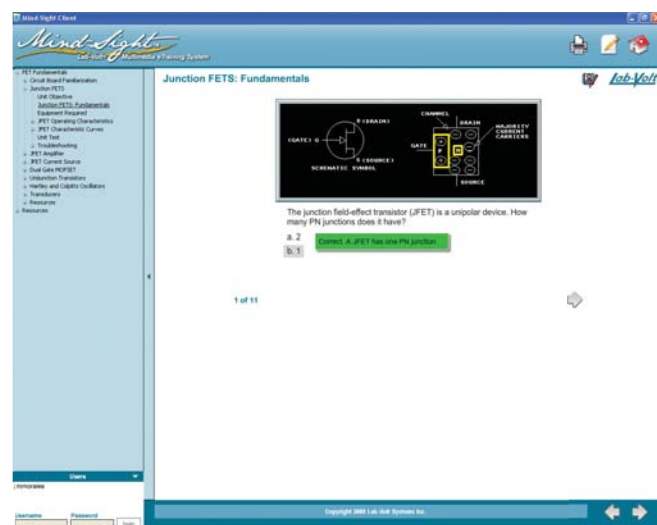
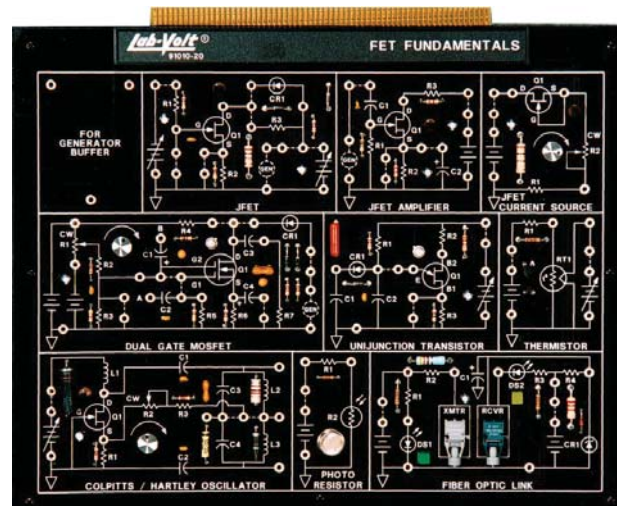
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Component Location and Identification
- Unijunction Oscillator Operation
- JFET Operating Characteristics
- The Effect of Gate Bias on Pinch-off
- JFET Dynamic Characteristic Curves
- JFET Amplifier DC Operation
- JFET Amplifier Voltage Gain
- JFET Current Source DC Operation
- JFET Current Source Power and Load Voltage Variation
- Zero Bias Characteristic of a MOSFET
- MOSFET Modes of Operation
- MOSFET Voltage Amplifier
- Dual Gate MOSFET Mixer
- UJT Operating Characteristics
- UJT Waveform Generation
- Hartley Oscillator Operation
- Colpitts Oscillator Operation
- Thermistor Operation
- Photoresistor Operation
- Fiber Optic Light Transfer
- Troubleshooting Basics
- Troubleshooting FET Circuits
- FET Specification Sheets
- Unijunction Transistor Specification Sheets
- Transducer Specification Sheets

CIRCUIT BLOCKS

- JFET
- JFET Amplifier
- JFET Current Source
- Dual Gate MOSFET
- Unijunction Transistor
- Thermistor
- Colpitts/Hartley Oscillator
- Photoresistor
- Fiber Optic Link



THYRISTOR AND POWER CONTROL CIRCUITS MODEL 91011

The Thyristor and Power Control Circuits course provides comprehensive, hands-on instruction in the fundamental terminology, principles and applications of thyristor and power control circuits.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

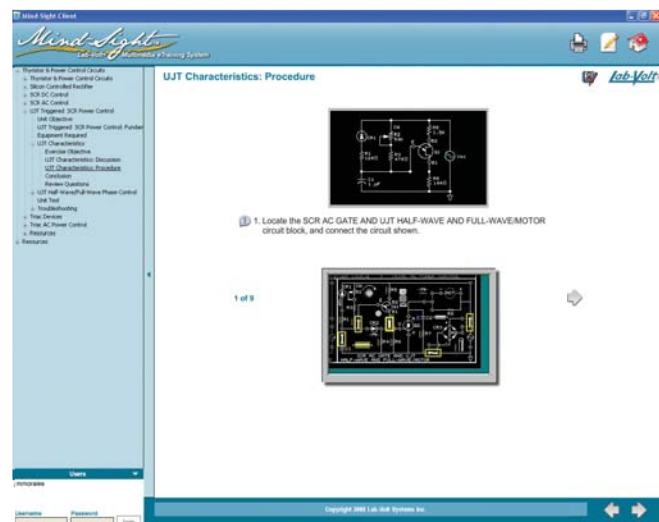
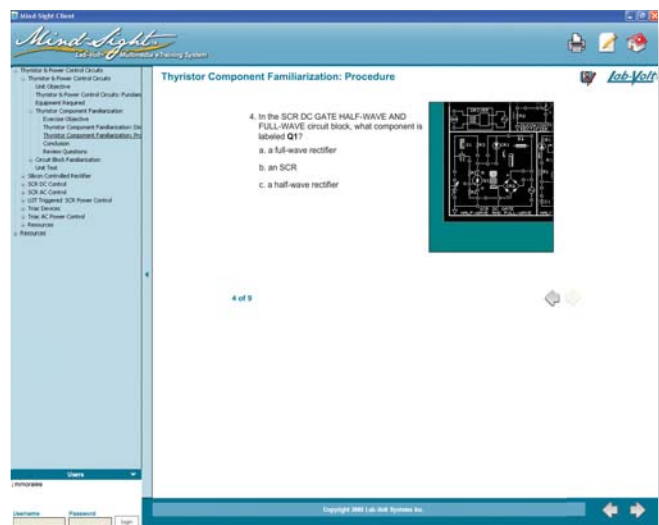
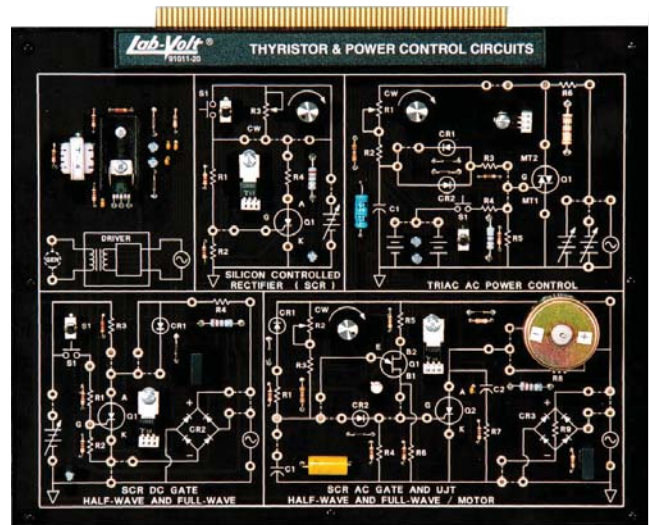
TOPIC COVERAGE*

- Thyristor Component Familiarization
- Thyristor Circuit Fundamentals
- Test a Silicon-Controlled Rectifier (SCR)
- SCR DC Operation
- Gate Trigger Voltage and Holding Current
- SCR Half-Wave Rectifier
- SCR Control of a Half-Wave Rectifier
- SCR Control of a Full-Wave Rectifier
- Half-Wave Phase Control
- Full-Wave Phase Control
- UJT Characteristics
- UJT Half-Wave and Full-Wave Phase Control
- Bidirectional Conduction
- The Four Triggering Modes
- Half-Wave Phase Control
- Full-Wave Phase Control
- Troubleshooting Basics
- Troubleshooting Thyristor and Power Control Circuits

CIRCUIT BLOCKS

- Silicon-Controlled Rectifier (SCR)
- Triac AC Power Control
- SCR DC Gate Half-Wave and Full-Wave
- SCR AC Gate and UJT Half-Wave and Full-Wave/ Motor

* This course also includes a driver circuit for the applied generator signal.



OPERATIONAL AMPLIFIER FUNDAMENTALS MODEL 91012

The Operational Amplifier Fundamentals course provides comprehensive, hands-on instruction in the terminology, principles and applications of the circuitry used in analog applications.

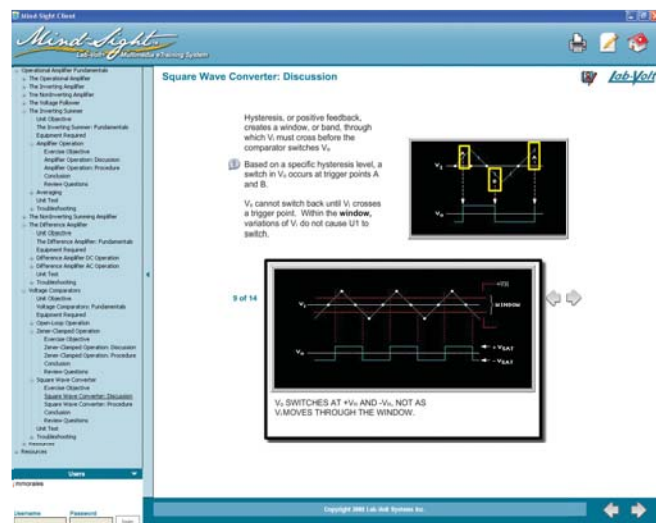
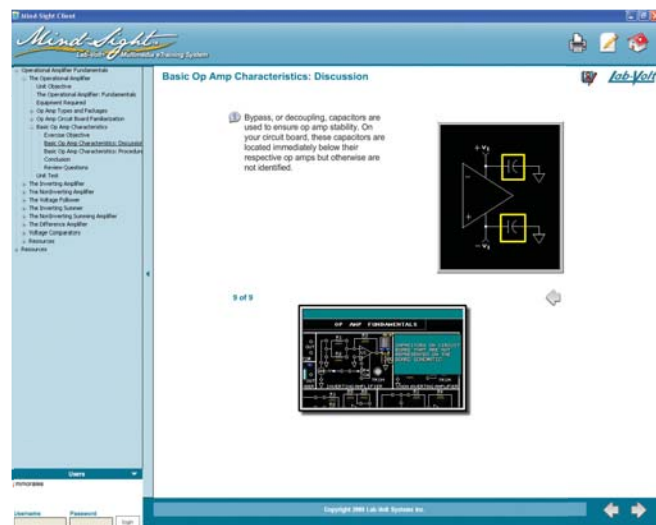
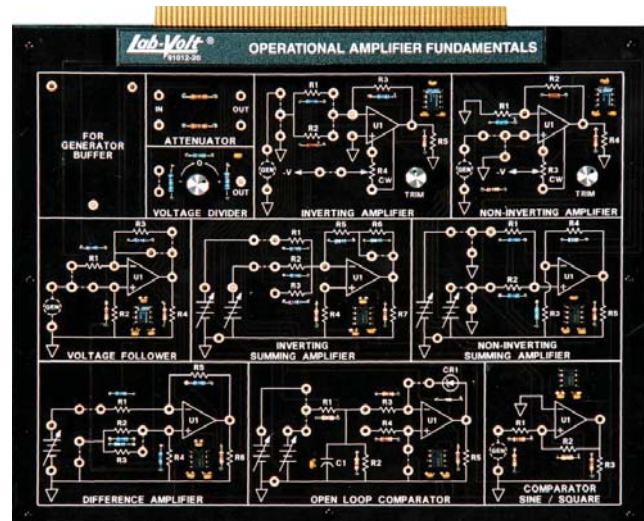
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Operational Amplifier Types and Packages
- Circuit Board Recognition and Description
- Basic Operational Amplifier Characteristics and Parameters
- DC Characteristics of the Inverting Amplifier
- AC Characteristics of the Inverting Amplifier
- Other Characteristics of the Inverting Amplifier
- DC Characteristics of the Non-inverting Amplifier
- AC Characteristics of the Non-inverting Amplifier
- Other Characteristics of the Non-inverting Amplifier
- The Voltage Follower DC Operation
- The Inverting Gain-of-One Amplifier
- The Voltage Follower AC Operation
- Inverting Summing Amplifier Operation
- Summing, Scaling, and Averaging
- Non-Inverting Summing Amplifier Operation
- Summing Amplifier Configurations
- Difference Amplifier DC Operation
- Difference Amplifier AC Operation
- Open-Loop Operation
- Zener-Clamped Operation
- The Sine Wave to Square Wave Converter
- Troubleshooting Basics
- Troubleshooting Operational Amplifier Circuits

CIRCUIT BLOCKS

- Attenuator
- Voltage Divider
- Inverting Amplifier
- Non-inverting Amplifier
- Voltage Follower
- Inverting Summing Amplifier
- Non-inverting Summing Amplifier
- Difference Amplifier
- Open-Loop Comparator
- Sine/Square Comparator



OPERATIONAL AMPLIFIER APPLICATIONS MODEL 91013

The Operational Amplifier Applications course provides comprehensive, hands-on instruction in the terminology, principles and applications of operational amplifiers.

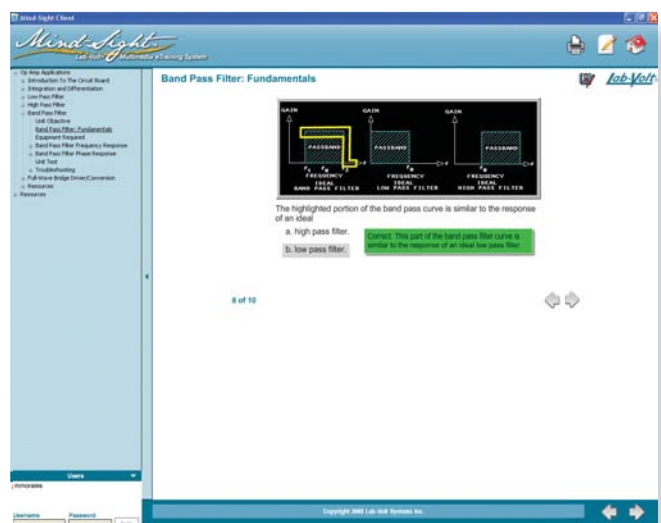
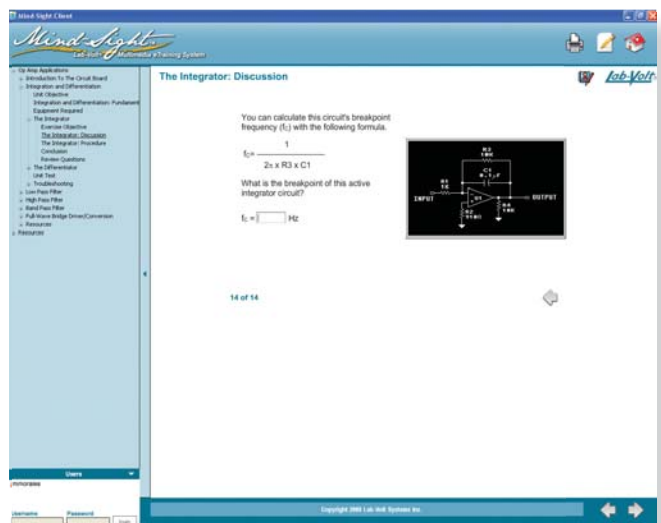
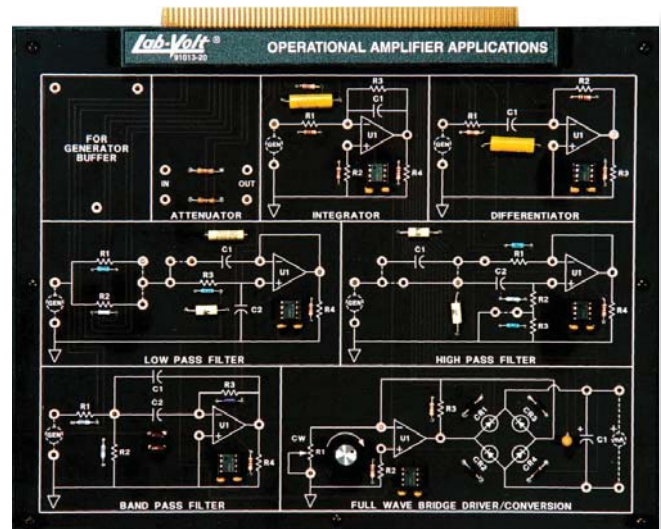
Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Component Location and Identification
- Band-Pass Filter Operation
- The Integrator
- The Differentiator
- Low-Pass Filter Frequency Response
- Low-Pass Filter Phase and Transient Response
- High-Pass Filter Frequency Response
- High-Pass Filter Phase and Transient Response
- Band-Pass Filter Frequency Response
- Band-Pass Filter Phase Response
- DC Characteristics of an Active Voltage-to-Current Converter
- AC Characteristics of an Active RMS or Average Calibrated Voltage-to-Current Converter
- Troubleshooting Basics
- Troubleshooting Operational Amplifier Circuits

CIRCUIT BLOCKS

- Attenuator
- Integrator
- Differentiator
- Low-Pass Filter
- High-Pass Filter
- Band-Pass Filter
- Full-Wave Bridge Driver/Conversion



DIGITAL LOGIC FUNDAMENTALS MODEL 91014

The Digital Logic Fundamentals course provides comprehensive, hands-on instruction in the terminology, principles and applications of digital logic circuits.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

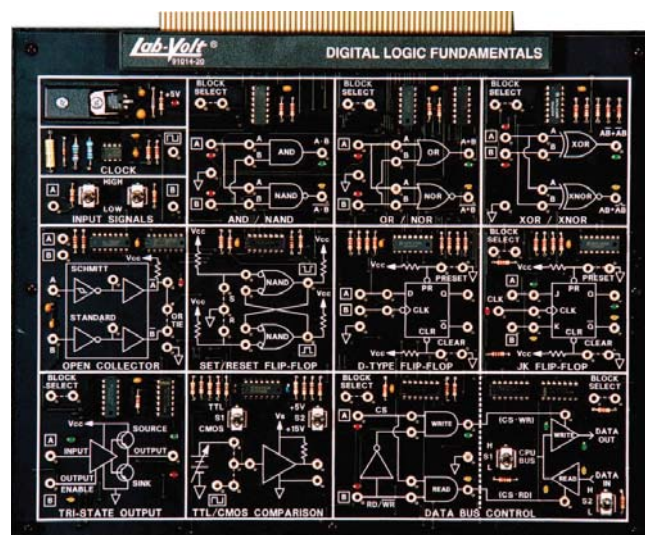
- Component Location and Identification
- Operation of General Circuits
- IC Package Fundamentals
- AND/NAND Logic Functions
- OR/NOR Logic Functions
- Exclusive OR and NOR Gates
- Dynamic Response of XOR/XNOR Logic Gates
- DC Operation of a NOT and an OR-TIE
- Transfer Characteristics of a Schmitt and a Standard LS TTL Gate
- Set/Reset Flip-Flop
- D-Type Flip-Flop
- Static JK Flip-Flop Operation
- Dynamic Operation of a JK Flip-Flop
- Output Enable Control of a Tri-State Gate
- Sink and Source Control of a Tri-State Gate
- Static Trigger Levels of a TTL and CMOS
- Dynamic Transfer Characteristics of TTL and CMOS
- Static Control of a Data Bus
- Dynamic Control of a Data Bus
- Troubleshooting Basics
- Troubleshooting Digital Circuits

ADDITIONAL FEATURES

- +5 V regulated supply
- Built-in clock circuit
- Manual input signal control

CIRCUIT BLOCKS

- AND/NAND
- OR/NOR
- XOR/XNOR
- Open Collector
- SET/RESET Flip-Flop
- D-Type Flip-Flop
- JK Flip-Flop
- Tri-State Output
- TTL/CMOS Comparison
- Data Bus Control



DIGITAL CIRCUIT FUNDAMENTALS 1 MODEL 91015

The Digital Circuit Fundamentals 1 course provides comprehensive, hands-on instruction in the terminology, principles and applications of digital circuits.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

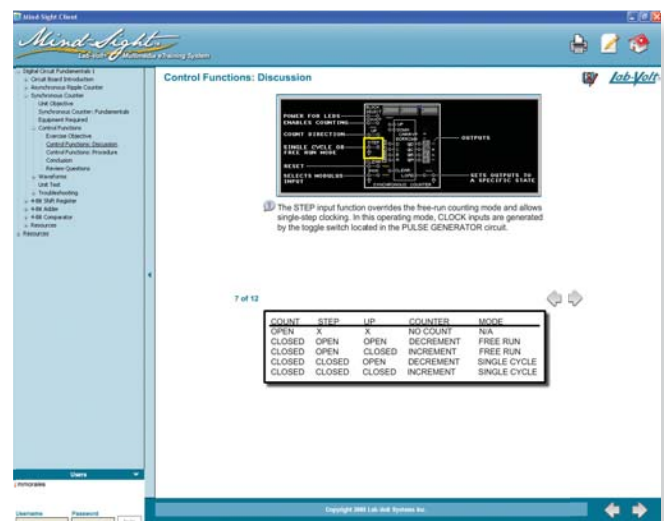
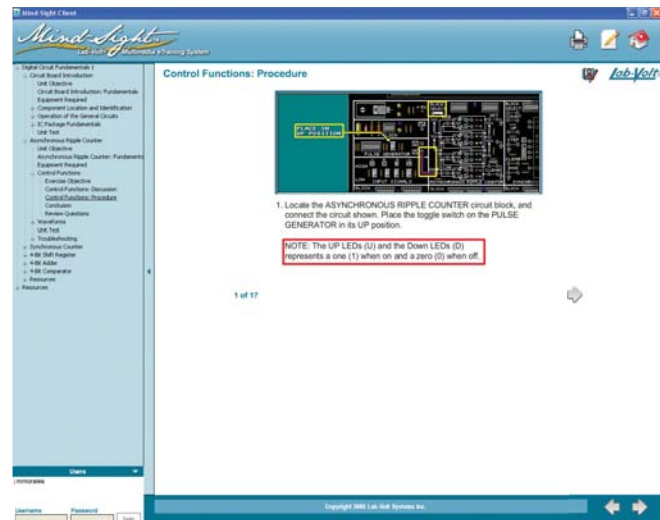
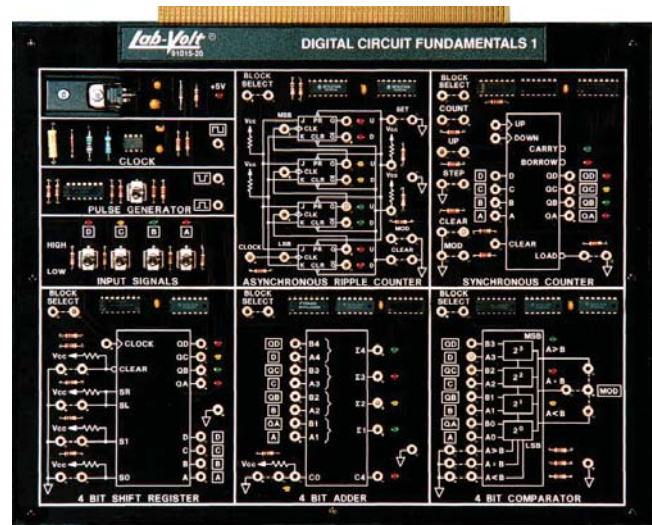
- Component Location and Identification
- Operation of General Circuits
- IC Package Fundamentals
- Basic Counter Control Functions
- Ripple Counter Waveforms
- Synchronous Counter Circuit Waveforms
- Synchronous Counter Circuit Glue Logic
- Basic Operating Modes of the Shift Register
- Shift Register Circuit Waveforms
- Fundamental Binary Addition
- Binary Addition with Input and Output Carry
- Fundamental Binary Comparisons
- Comparators and Counter Modulus Control
- Troubleshooting Basics
- Troubleshooting Digital Circuits
- The 74LS193 Counter
- The 74LS283 4-Bit Adder
- The 74LS194 Shift Register
- The 74LS285 Comparator

ADDITIONAL FEATURES

- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit
- Manual input signal control

CIRCUIT BLOCKS

- Asynchronous Ripple Counter
- Synchronous Counter
- 4-Bit Shift Register
- 4-Bit Adder
- 4-Bit Comparator



DIGITAL CIRCUIT FUNDAMENTALS 2 MODEL 91016

The Digital Circuit Fundamentals 2 course provides further comprehensive, hands-on instruction in the terminology, principles and applications of digital circuits.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

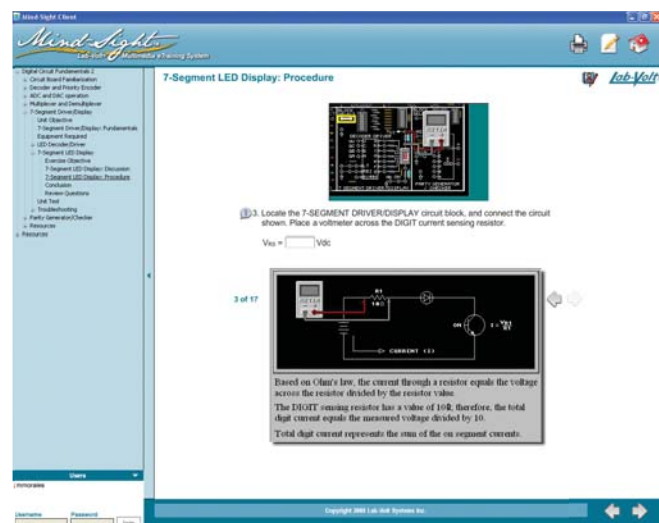
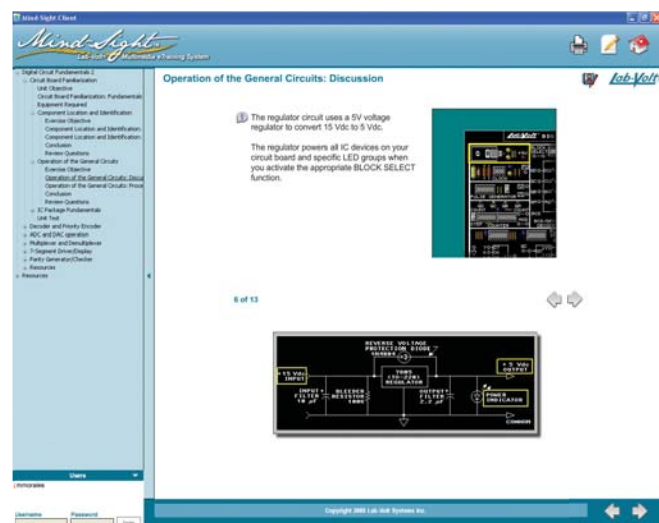
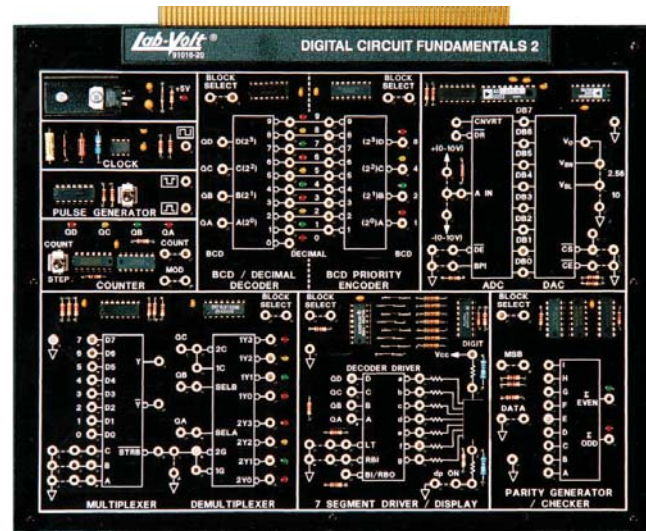
- Component Location and Identification
- Operation of General Circuits
- IC Package Fundamentals
- Fundamental BCD Decoder Operation
- Fundamental Priority Encoder Operation
- Fundamental ADC Operation
- Fundamental DAC Operation
- Data Selector and Multiplexer
- The LS151 Multiplexer and LS155 Demultiplexer
- 1-Line-to-8-Line Demultiplexer
- LED Decoder/Driver
- 7-Segment LED Display
- ODD and EVEN Parity
- Parity Generator/Checker Glue Logic
- Troubleshooting MSI IC Circuits
- Troubleshooting Basics
- Troubleshooting Digital Circuits

ADDITIONAL FEATURES

- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit
- Built-in counter circuitry
- 74LS42 Decoder and LS147 Encoder
- AD673 ADC and AD558 DAC
- LS151 Multiplexer and LS155 Demultiplexer
- LS280 7-Segment Decoder/Driver

CIRCUIT BLOCKS

- BCD Decimal Decoder/BCD Priority Encoder
- ADC/DAC
- Multiplexer/Demultiplexer
- 7-Segment Driver/Display
- Parity Generator/Checker



32-BIT MICROPROCESSOR MODEL 91017

The 32-Bit Microprocessor course* builds on students' knowledge of digital circuitry gained in Digital Logic Fundamentals to provide comprehensive, hands-on instruction in the terminology, principles and applications of 32-bit microprocessor systems.

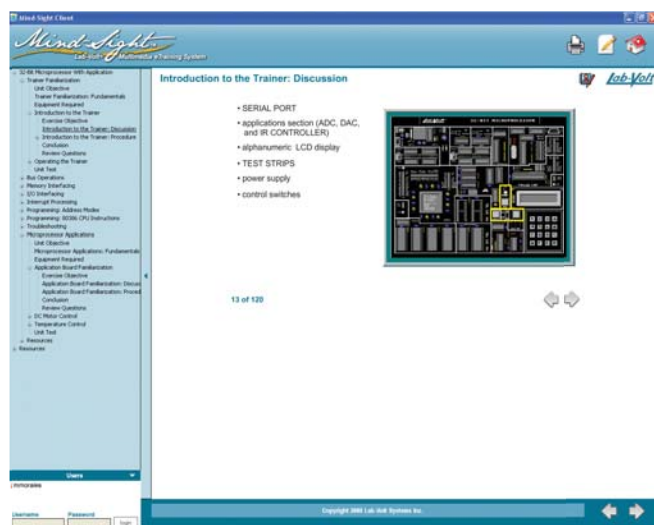
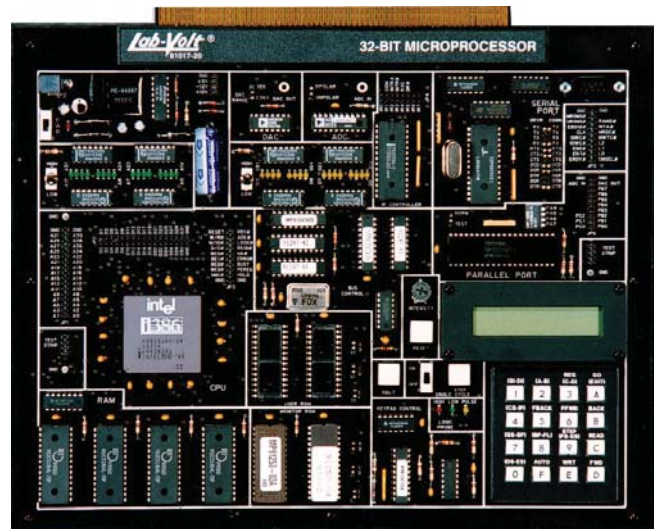
The 80386DX CPU is used to demonstrate microprocessor, memory and I/O concepts, as well as communication with analog systems via A-to-D and D-to-A converters or serial and parallel protocols. A keypad and an alphanumeric LCD display allow direct user interaction with the CPU. An on-board logic probe, single bus cycle execution mode, and the practical, hands-on approach of the courseware guide students in the analysis and troubleshooting of 32-bit microprocessor systems.

* This board can be used as a stand-alone unit and can also be interfaced with higher-level FACET boards, such as Transducer Fundamentals; Motors, Generators and Controls; and Fiber Optic Communications (see pages 33, 34 and 39, respectively).

TOPIC COVERAGE

- Introduction to the Circuit Board
- Operating the Circuit Board
- Bus States
- 32-Bit Bus Transfers
- Read and Write Cycles
- CPU Initialization
- Memory Control Signals
- Memory Address Decoding
- Memory Data Transfers
- DAC and ADC Ports
- PPI and Keypad Interface
- Display and Serial Ports
- Non-maskable Interrupts
- Maskable Interrupts
- Exceptions
- Immediate and Register Addressing Modes
- Memory Addressing Modes – I
- Memory Addressing Modes – II
- Instruction Formats – I
- Instruction Formats – II
- Using the 80386 CPU Instructions – I
- Using the 80386 CPU Instructions – II
- Troubleshooting Basics
- 32-Bit Microprocessor Troubleshooting
- Application Board Familiarization**
- DC Motor Control**
- Temperature Control**

** These exercises require the optional Microprocessor Application Board, Model 91602. Optional accessories include Interface, FACET® 32-Bit Download Micro to PC (91778), Cable (91779), and Adapter 9M/25F (31216).



FEATURES

- 16 KB monitor ROM/User ROM
- Serial Data Port (RS-232)
- Parallel Data Port (8-bit)
- Single Bus Cycle Control
- Single Instruction Cycle Control
- On-Board Applications Interface
- On-Board Logic Probe for signal tracing
- Optional Microprocessor Application Board to demonstrate practical microprocessor-based temperature/ motor control
- Interrupt Controller
- ADC/DAC

DIGITAL SIGNAL PROCESSOR MODEL 91027

The Lab-Volt Digital Signal Processor (DSP) is specifically designed to teach students the control devices and data-processing capabilities of a DSP. Through the operation of the DSP circuit board and accompanying courseware, students gain insight into the internal architecture of a DSP. The unit can be used either with the FACET base unit or as a stand-alone trainer.

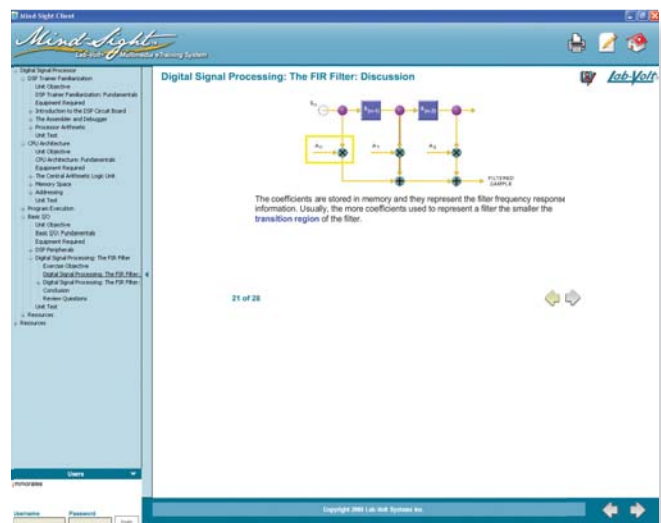
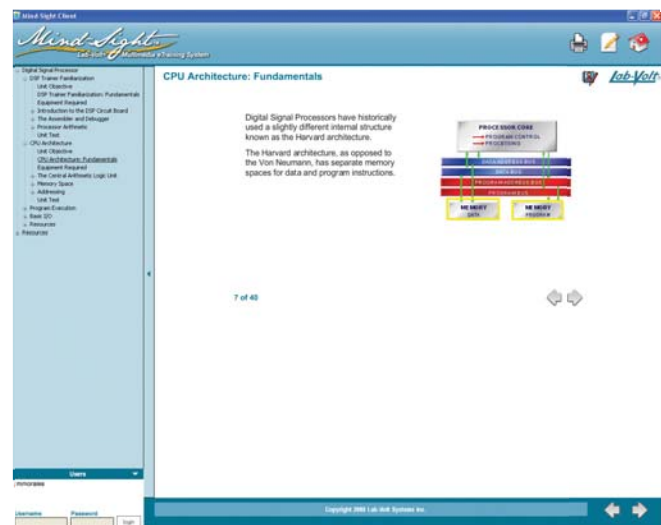
The module consists of a DC source, a microphone pre-amplifier and an audio amplifier. An eight-position DIP switch, four displays, push-button interrupts, and analog input and output connections to the DSP enable students to probe the structure of the TMS320C50 DSP. The auxiliary I/O circuit block has headers that enable students to design additional experiments or prototypes of DSP-controlled circuit boards.

Through a serial link to a computer, Windows-based debugger software enables direct interaction with the DSP registers, memory and peripherals.

Lab-Volt recommends the Digital Logic Fundamentals (91014), Digital Circuit Fundamentals 1 (91015) and Digital Circuit Fundamentals 2 (91016) modules as pre-requisites to the DSP training module. (See pages 26, 27 and 28, respectively.)

TOPIC COVERAGE

- Introduction to the DSP Circuit Board
- The Assembler and the Debugger
- Processor Arithmetic
- The Central Arithmetic Logic Unit
- Memory Space
- Addressing
- Program Control
- Pipelining
- DSP Peripherals
- Digital Signal Processing: The FIR Filter



MICROCONTROLLER SYSTEM DEVELOPMENT MODEL 91030

The Microcontroller System Development course provides comprehensive, hands-on instruction in the terminology, principles, and applications of microcontroller programming.

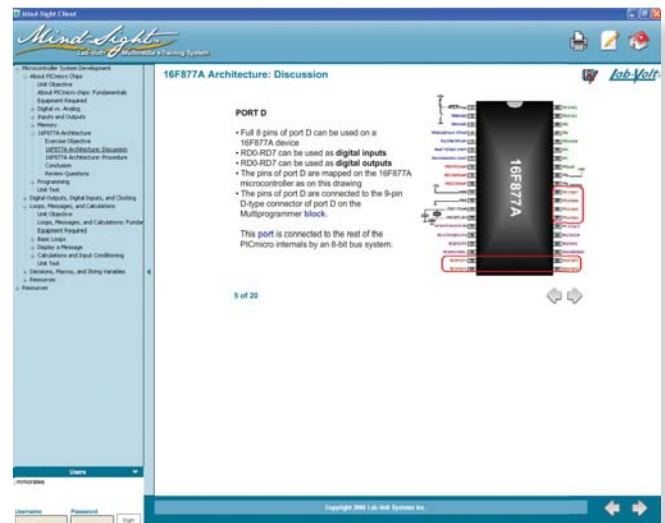
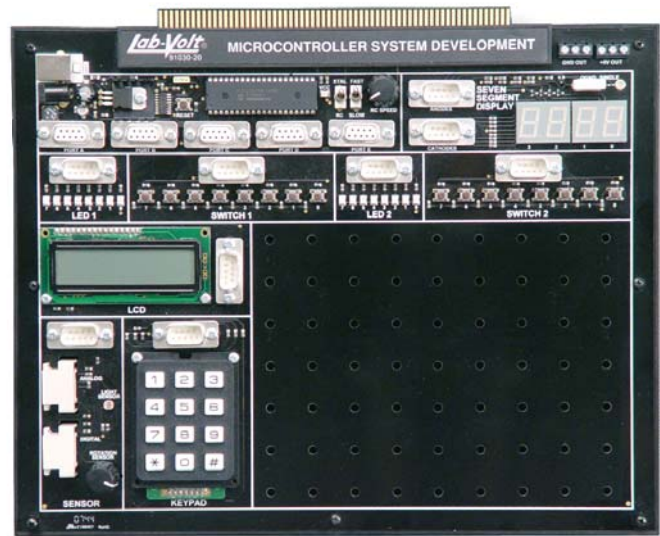
Students learn basic programming using FlowCode™ and microcontroller hardware. This module features a USB programmable PIC microcontroller; on-board peripherals include LEDs, switches, 7-segment single or QUAD display, LCD display, keypad, light sensor, variable voltage source for A/D acquisition, and Vernier™ sensors inputs. An extension surface expands the capabilities of this module for bread-boarding or for a wide range of projects using optional E-Blocks™. The module can either be used with the FACET base unit or as a stand-alone trainer.

TOPIC COVERAGE

- Digital vs. Analog
- Inputs and Outputs
- Memory
- 16F877A Architecture
- Programming
- Digital Outputs and Clocking
- Digital Inputs
- Basic Loops
- Display a Message
- Calculations and Input Conditioning
- Decisions and Macros
- The 7-Segment Display
- String Variables and ASCII Code
- A Simple Hi-Fi

Options include:

- 48070 EBK FACET add-on: C for 16 Series PICmicros
- 48071 EBK FACET add-on: Bluetooth Communications (requires two FACET Microcontroller System Development boards, Model 91030)
- 48072 EBK FACET add-on: Digital Communications
- 48073 EBK FACET add-on: Mobile Telephony
- 48074 EBK FACET add-on: RFID



BREADBOARD MODULE MODEL 91091

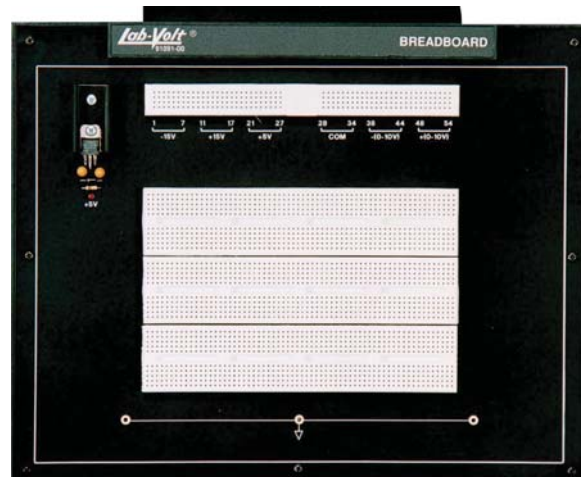
The Breadboard module is a complement to Digital Logic Fundamentals (Model 91014). The Breadboard module consists of three printed circuit boards designed so that students can easily connect and change circuits without the need to solder components.

Students gain the understanding of the physical characteristics of components like pinouts, size, power, and impedance voltage limits.

The breadboard comes with all the leads and components required to connect the studied circuits. These circuits include astable, bistable, and monostable multivibrators, as well as Schmitt trigger (wave-squaring) circuits.

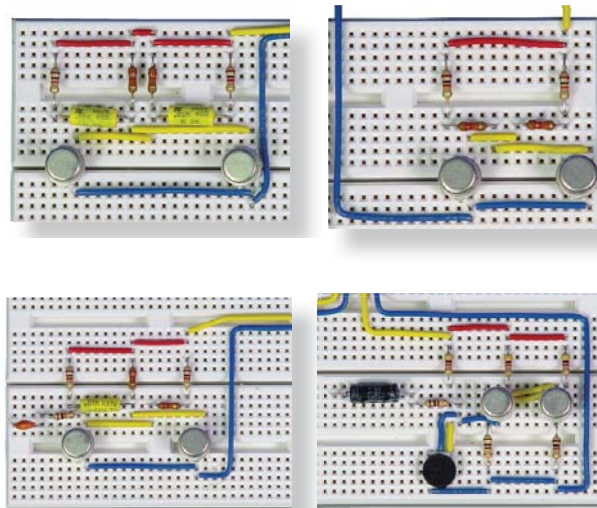
A voltage source powered from the base unit provides the voltages required to power the circuits. These voltages are accessible from an additional solderless breadboard.

The practical, hands-on approach of the courseware guides students in the observation and measurement of signals with an oscilloscope. As a prerequisite, students should be familiar with the operation of bipolar transistor circuits.



TOPIC COVERAGE

- Astable Multivibrator
- Bistable Multivibrator
- Monostable Multivibrator
- Schmitt Trigger



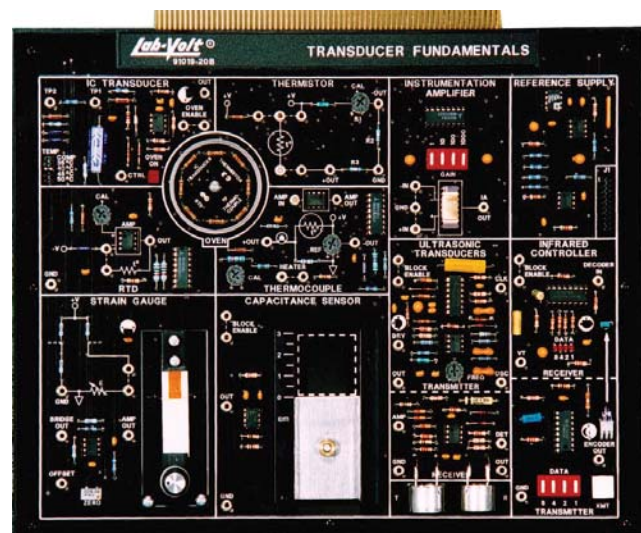
TRANSDUCER FUNDAMENTALS MODEL 91019

The Transducer Fundamentals course guides students through the circuits and devices used to interface computer and control circuits.

Students learn the principles of input and output transducers and how physical quantities, such as heat, position, proximity and force, are converted to electrical signals for detection and processing by computer and control systems.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

This circuit board can be interfaced with the 32-Bit Microprocessor board to demonstrate the principles of data acquisition and microprocessor control of external devices in process control and automation applications.



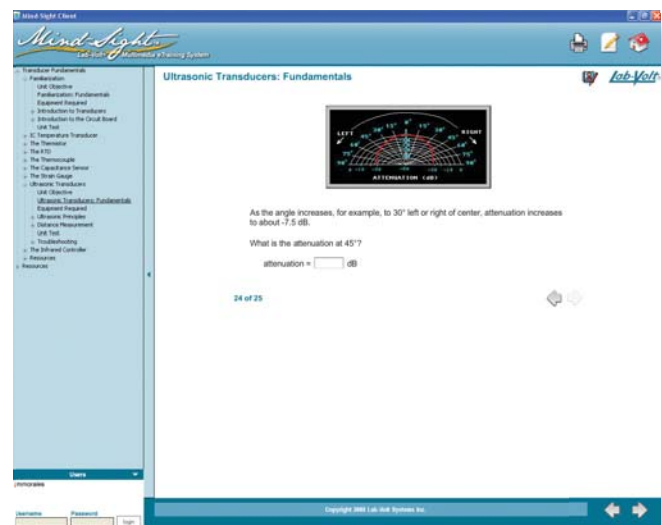
TOPIC COVERAGE

- Introduction to Transducers
- Introduction to the Circuit Board
- Temperature Measurement
- Temperature Control
- Thermistor Characteristics
- Resistance Temperature Detector (RTD) Characteristics
- Thermocouple Characteristics
- Capacitance Sensor
- Touch and Position Sensing
- Strain Gauge Characteristics
- Bending Beam Load Cell (Strain Gauge)
- Ultrasonic Principles
- Distance Measurement
- Infrared Transmission/Reception
- IR Remote Control
- Force Measurement
- Computerized Temperature Control and Measurement*
- Computerized Force Measurement*
- Troubleshooting Transducer Circuits

* These exercises and computer interface require the optional 32-Bit Microprocessor module (91017) plus accessories: 9V Power Supply (91730) and Flat Ribbon Cable (91627).

ADDITIONAL FEATURES

- Reference supply
- Temperature-controlled oven
- Instrumentation amplifier with selectable gain
- Mechanical fixture to demonstrate compressive and tensile strain measurement with a strain gauge
- Separate ultrasonic transmitter and receiver
- Infrared transmission/reception and data link



CIRCUIT BLOCKS

- IC Transducer
- Thermistor
- RTD
- Thermocouple
- Strain Gauge
- Capacitance Sensor
- Ultrasonic Transducers (Transmission/Reception)
- Infrared Controller (Transmission/Reception)

MOTORS, GENERATORS, AND CONTROLS

MODEL 91024

The Motors, Generators and Controls course provides comprehensive, hands-on instruction in the terminology, principles and applications of the DC motor, AC synchronous motor, phase shifter and stepper motor.

Following a carefully designed instructional program, students are able to perform troubleshooting exercises on analog and pulse-width modulated (PWM) DC motor positioning, analog and PWM DC motor speed control, variable frequency speed control of an AC synchronous motor, operation of a tachogenerator circuit, and speed and position control of a stepper motor with optional computer interface.

TOPIC COVERAGE

- DC Motor Circuits Familiarization
- Stepper Motor and AC Motor Circuits
- Analog DC Motor Positioning
- PWM DC Motor Positioning
- Analog Speed Control of a DC Motor
- Pulsed Speed Control of a DC Motor
- Variable Frequency Control
- The Tachometer Generator
- The Stepper Motor
- The Stepper Motor Controller
- Troubleshooting
- Microprocessor Interface*

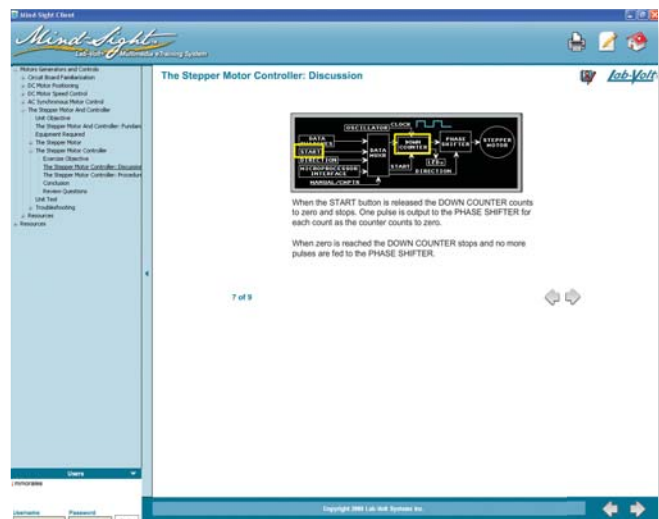
* This exercise and computer interface require the optional 32-Bit Microprocessor module (91017) plus accessories: 9V Power Supply (91730) and Flat Ribbon Cable (91627).

ADDITIONAL FEATURES

- Built-in tachgenerator circuit
- Procedures subdivided into short sections for more hands-on training
- Interface with the 32-Bit Microprocessor module
- Students learn the operation and function of:
 - DC motors in analog and pulse servo systems
 - Linear and pulsed signal speed control of DC motors
 - Variable frequency control and speed monitoring of synchronous motors
 - Speed and position control of stepper motors

CIRCUIT BLOCKS

- DC Motor
- AC Synchronous Motor
- Phase Shifter Motor
- Stepper Motor



POWER TRANSISTORS AND GTO THYRISTORS MODEL 91026

In the Power Transistors and GTO Thyristors course, students perform practical exercises that demonstrate the use of several power electronic self-commutated switches. The course contains six types of switches that are implemented with a MOSFET, an isolated-gate bipolar transistor (IGBT), a fast IGBT, a bipolar resistor, a Darlington resistor and a GTO thyristor. Students' learning of switches is expanded with a Driver section, consisting of an opto-isolator and driver for power thyristors; a Load section, consisting of resistive and inductive components; and general-purpose, fast and ultra-fast free-wheeling diodes.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

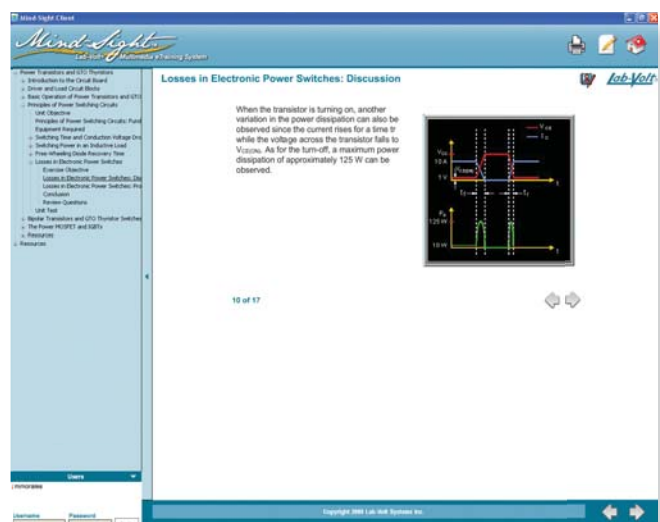
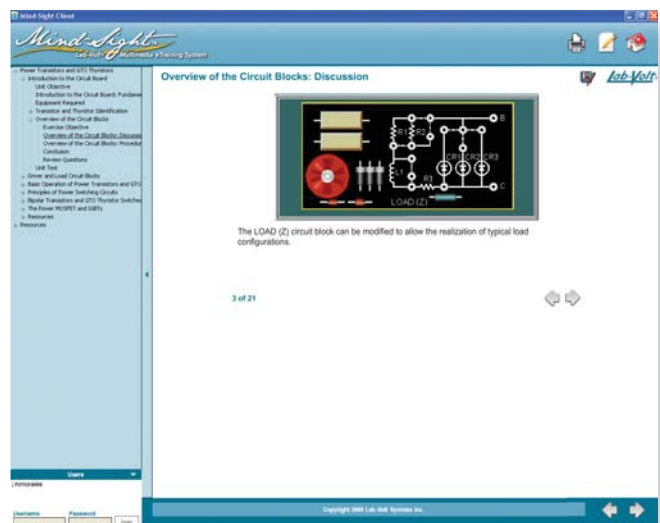
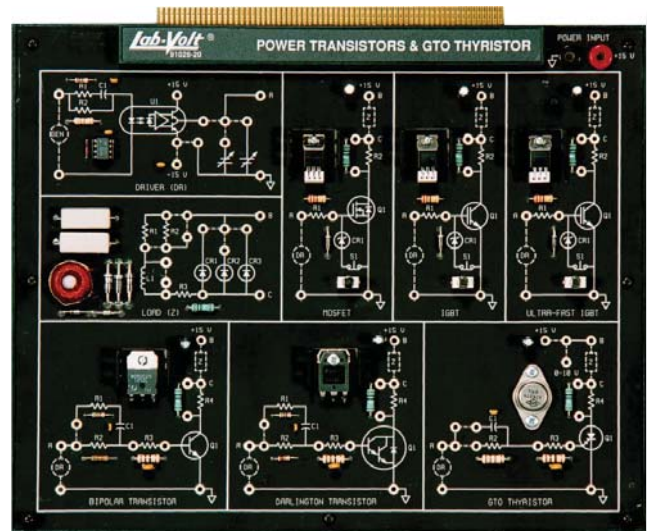
TOPIC COVERAGE

- Power Transistors and GTO Thyristor Identification
- Overview of the Circuit Blocks
- Familiarization with the Driver Circuit Block
- Familiarization with the Load Circuit Block
- Basic Operations of Power Bipolar Transistors
- Basic Operation of Power MOSFETs and IGBTs
- Basic Operation of GTO Thyristors
- Switching Time and Conduction Voltage Drop
- Switching Power in an Inductive Load
- Free-Wheeling Diode Recovery Time
- Losses in Electronic Power Switches
- The Bipolar Power Transistor
- The Darlington Power Transistor
- The GTO Thyristor
- The Power MOSFET
- The IGBT
- The Ultra-Fast IGBT

CIRCUIT BLOCKS

- Driver
- Load
- MOSFET
- IGBT
- Ultra-Fast IGBT
- Bipolar Transistor
- Darlington Transistor
- GTO Thyristor

FET Fundamentals, and Thyristor and Power Control Circuits also are part of Industrial Electronics. See pages 22 and 23, respectively, for details on these modules.



ANALOG COMMUNICATIONS MODEL 91018

The Analog Communications course provides comprehensive, hands-on instruction in the terminology, principles and applications of analog communications.

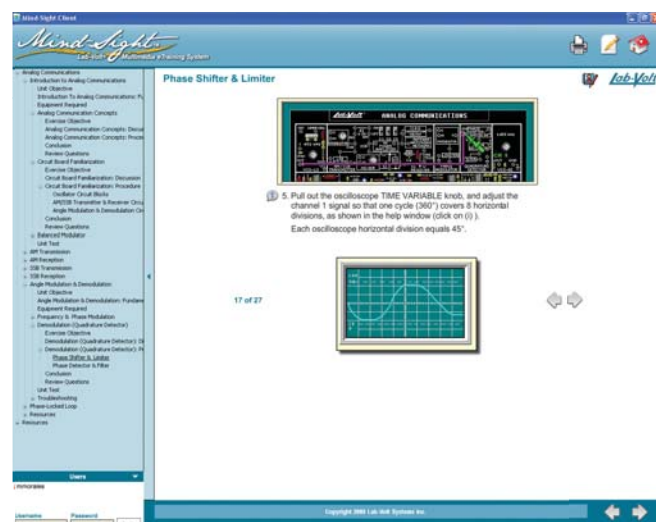
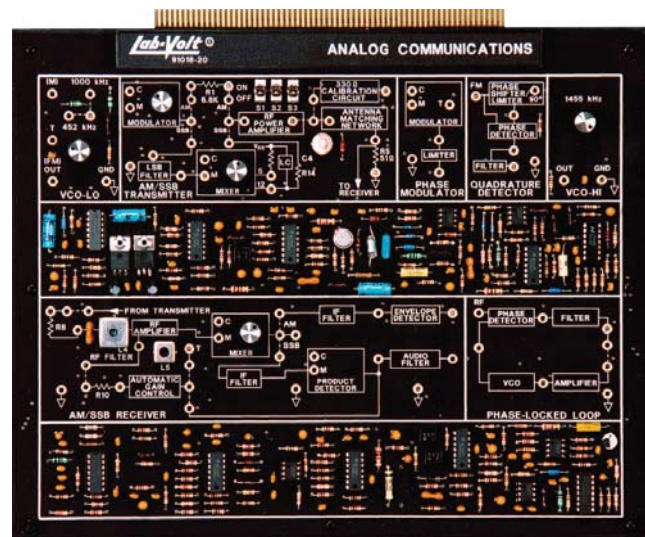
In this course, students receive hands-on circuit training and acquire skills to measure radio signals with an oscilloscope. Students also learn the functions of oscillators, filters, amplifiers, LC networks, modulators, limiters, mixers and detectors in communication circuits.

TOPIC COVERAGE

- Analog Communications Concepts
- Circuit Board Familiarization
- Amplitude Modulation (AM)
- RF Power Amplifier
- Balanced Modulator
- RF Stage
- Mixer, IF Filter and Envelope Detector
- Balanced Modulator and LSB Filter
- Mixer and RF Power Amplifier
- RF Stage, Mixer and IF Filter
- Product Detector and Automatic Gain Control
- Frequency Modulation (FM) and Phase Modulation (PM)
- Demodulation (Quadrature Detector)
- PLL (Phase-Locked Loop) Circuit and Operation
- FM Detection with a PLL
- Troubleshooting Basics
- Troubleshooting Analog Communications Circuits

CIRCUIT BLOCKS

- AM Transmitter and Receiver
- Single-Sideband (SSB) Transmitter and Receiver
- AM Receiver and SSB Receiver with Automatic Gain Control
- Frequency Modulator (FM)
- Phase Modulator (PM)
- Quadrature Detector (FM Demodulation)
- Phase-Locked Loop (PLL) Circuit
- PLL FM Detector



DIGITAL COMMUNICATIONS 1 MODEL 91022

The Digital Communications 1 course provides comprehensive, hands-on instruction in the terminology, principles and applications of digital circuits, including: Sampler, Sample/ Hold, Adder, Ramp Generator, Comparator, Limiter, Filter, CODEC, PLL, Compressor, Expander, Integrator, Differentiator, Latched Comparator, Speaker Amplifier and Channel Simulator.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

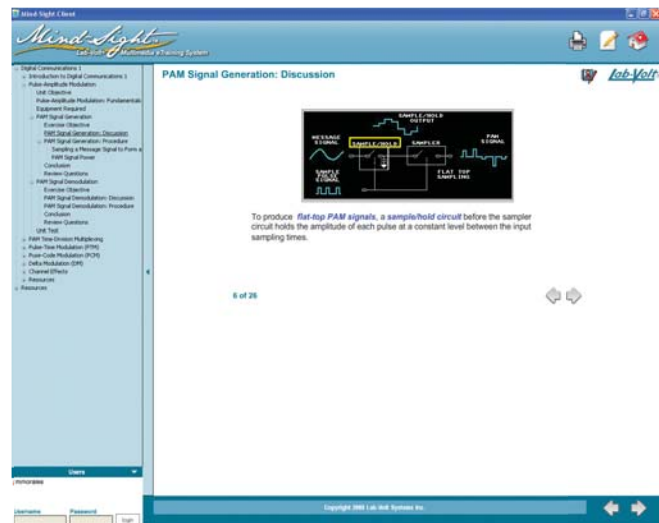
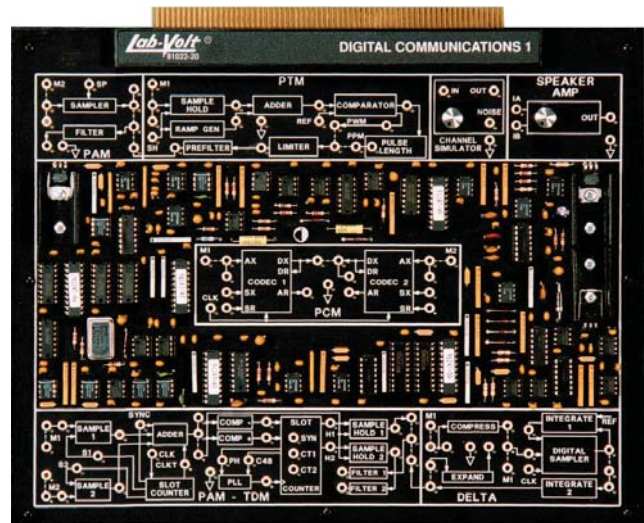
- Concepts of Digital Communications
- Circuit Board Familiarization
- Pulse Amplitude Modulation (PAM) Signal Generation
- PAM Signal Demodulation
- PAM Time-Division Multiplexing (TDM) Transmission
- PAM TDM Reception
- Pulse-Time Modulation (PTM) Signal Demodulation
- PTM Signal Generation
- Pulse-Code Modulation (PCM) Signal Generation and Demodulation
- PCM Signal TDM
- Delta Modulation (DM) Transmitter
- DM Receiver and Noise
- Channel Bandwidth
- Channel Noise
- Troubleshooting Basics
- Troubleshooting Digital Communications 1 Circuits

ADDITIONAL FEATURES

- Each circuit block contains a modulator for transmission and a demodulator for reception.
- Built-in Channel Simulator and Speaker Amp Circuitry.
- The Channel Simulator circuit block enables students to investigate the effects of noise and channel bandwidth on pulse and digital modulation signals.
- The Speaker Amp circuit block permits students to connect a speaker and listen to the signals.
- Communication signals are synchronized for easy display.

CIRCUIT BLOCKS

- PAM
- PTM
- PCM
- PAM-TDM
- DM



DIGITAL COMMUNICATIONS 2 MODEL 91023

The Digital Communications 2 course provides further comprehensive, hands-on instruction in the terminology, principles and applications of digital circuits, including: NRZ, RZ, Manchester Encoding and Decoding, Clock Synchronizer, Frequency-Shift Keying (FSK) Generation, FSK Asynchronous and Synchronous Detection, Phase-Shift Keying (PSK) Generation, PSK Synchronous Detection, Amplitude-Shift Keying (ASK) Generation, ASK Asynchronous and Synchronous Detection, Channel Effects and FSK/DPSK (Differential Phase-Shift Keying) Modem.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

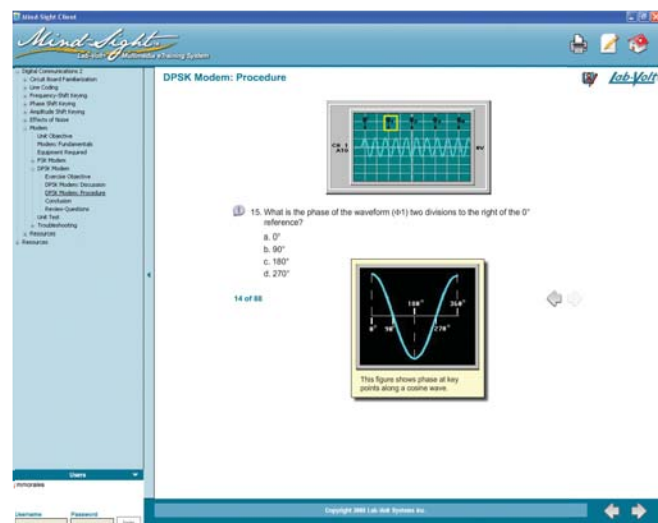
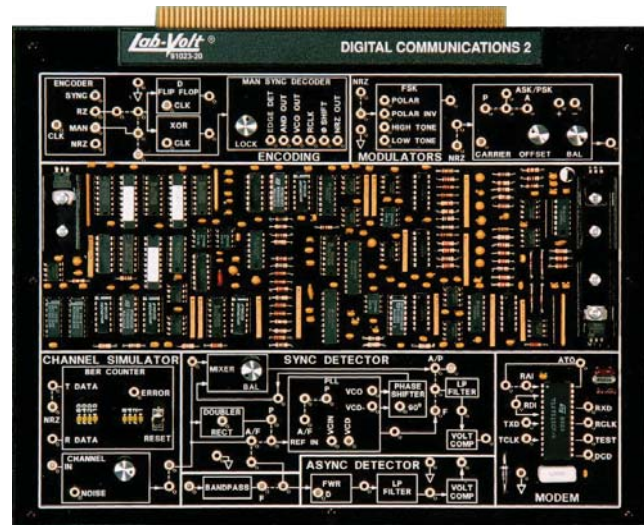
- Circuit Board Familiarization
- Introduction to Digital Transmission
- Encoding
- Decoding
- FSK Signal Generation
- FSK Asynchronous Detection
- FSK Synchronous Detection
- PSK Signal Generation
- PSK Synchronous Detection
- ASK Signal Generation
- ASK Asynchronous Detection
- The Channel Simulator
- Effects of Noise on ASK and PSK Signals
- Effects of Noise on Asynchronously and Synchronously Detected FSK Signals
- Operation of an FSK Modem
- Operation of a DPSK Modem
- Troubleshooting Basics
- Troubleshooting Digital Communications 2 Circuits

ADDITIONAL FEATURES

- The Channel Simulator circuit block and a bit error rate (BER) counter enable students to evaluate the effects of noise on ASK and PSK modulated carrier signals.
- The Modem circuit block contains an FSK/DPSK modem IC, which students use in a loop-back mode to observe the entire signal path.
- Communication signals are synchronized for easy display.

CIRCUIT BLOCKS

- Line Encoding
- Modulators
- Channel Simulator
- Sync Detector
- Modem



FIBER OPTIC COMMUNICATIONS MODEL 91025

The Fiber Optic Communications course provides comprehensive, hands-on instruction in the theory and practice of fiber optic communications technology.

Following a carefully designed instructional program, students will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

- Circuit Board Familiarization
- Introduction to Fiber Optic Communications
- Scattering and Absorption Losses
- Connectors and Polishing
- Numerical Aperture and Core Area
- Bending Loss and Modal Dispersion
- Light Source
- Driver Circuit
- Source-to-Fiber Connection
- Light Detector
- Output Circuit
- Fiber Optic Test Equipment
- Optical Power Budgets
- Analog Communications
- Digital Communications*
- Troubleshooting

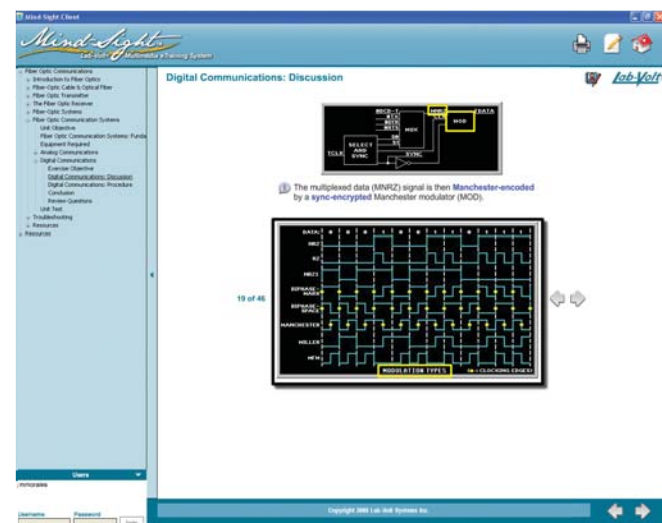
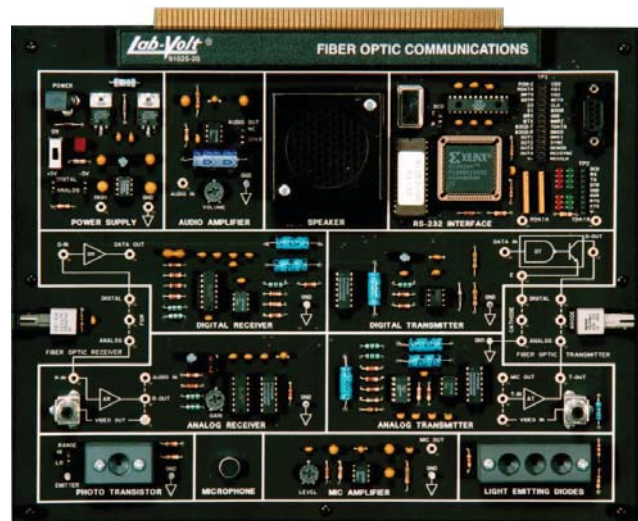
* This exercise and computer interface require the optional 32-Bit Microprocessor (91017) plus accessories: 9V power supply (91730), and Adapter (31216-00). Additional option includes Polishing Kit (92026).

ADDITIONAL FEATURES

- FACET base unit or stand-alone operation
- Interface with the 32-Bit Microprocessor module
- ST connections
- Multimode 62.5/125 cm cable
- High-speed 820 nm transmitter
- Integrated PIN photodiode and trans-impedance receiver
- Digital and analog communications channels
- Full handshake RS232 interface using time-division multiplexing (TDM) and Manchester coding
- On-board microphone and speaker
- Built-in microphone amplifier, power supply, audio-amplifier and photo transmitter
- LED block

CIRCUIT BLOCKS

- Digital Transmitter
- Digital Receiver
- Analog Transmitter
- Analog Receiver
- RS-232 Interface



Digital Signal Processor also is part of Communications Systems. See page 30 for details on this module.

COMMUNICATIONS TRANSMISSION LINES

MODEL 91028

The Transmission Lines circuit board provides students with the theory and measurement skills required to implement and test communications transmission lines. Students first learn the principles and operational characteristics of transmission lines. They then learn how to conduct transmission line measurements under transient (step testing), and sinusoidal steady-state conditions. Finally, students acquire a valuable foundation in the theory and practice of time-domain reflectometry (TDR), as well as impedance matching and transformation.

The circuit board uses two RG-174 coaxial cables, each a length of 24 meters (78.7 feet). They can be used separately or connected end-to-end. Each line has five probing points that permit observation and measurements of signals along the line, using an oscilloscope.

Two generators are provided to study the transmission line behavior: a step generator that produces a 50-kHz square-wave voltage for transient behavior testing, and a signal generator that produces a sinusoidal voltage of variable frequency (5 kHz - 5 MHz) for steady-state behavior testing. Each generator has several BNC outputs providing different output impedances.

A load section, consisting of a configurable network of resistors, inductors, and capacitors, permits connection of different load impedances to the receiving end of each line.

TOPIC COVERAGE

- Characteristics of Transmission Lines
- Transmission Line Measurements Under Transient (Step Testing) Conditions
- Transmission Line Measurements Under Sinusoidal Steady-State Conditions

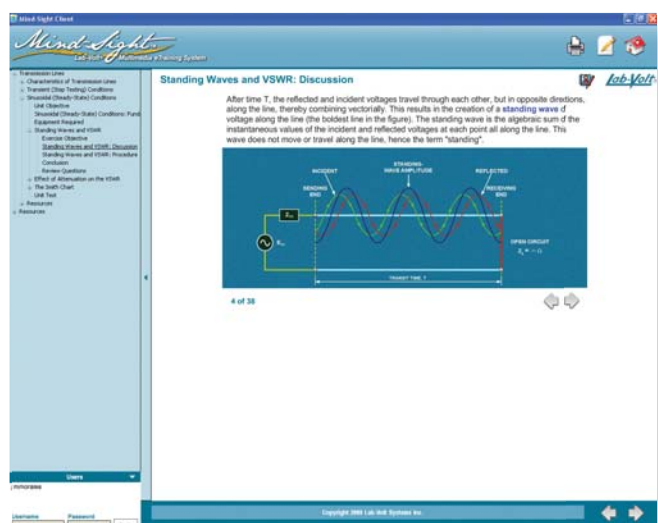
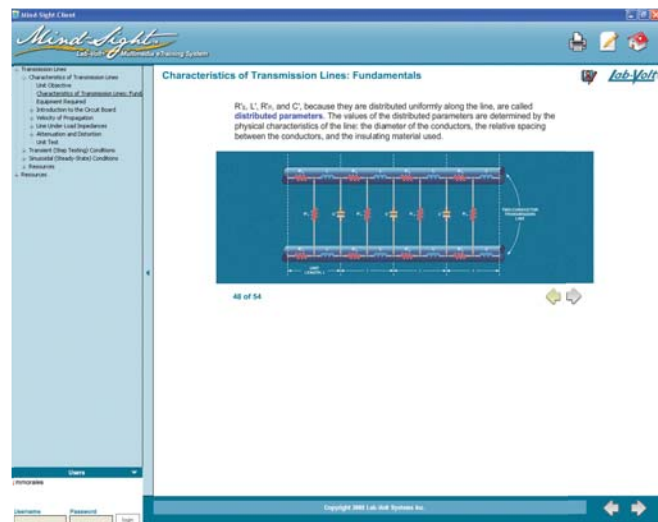
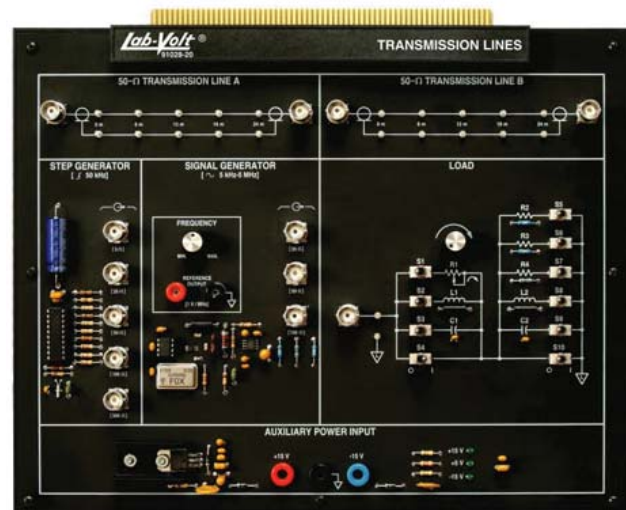
ADDITIONAL FEATURES

The circuit board may be used in the FACET base unit, or as a stand-alone trainer.

- When used in the FACET base unit, the course can be performed through the interactive computer-based learning (CBL) format. Moreover, faults can be inserted into the circuits to allow students to develop troubleshooting capabilities.
- When used as a stand-alone trainer, the course is performed in a conventional way by using the provided Student and Instructor Guides. An external power source is required if the circuit board is used without a base unit.

CIRCUIT BLOCKS

- Transmission Line A
- Transmission Line B
- Step Generator
- Signal Generator
- Load
- Auxiliary Power Input



QPSK/OQPSK/DPSK MODEL 91029

Phase-shift keying (PSK) is a method of digital communication in which the phase of a transmitted signal is varied to convey information.

The QPSK/OQPSK/DPSK board provides students with the theory and measurement skills required to implement and test different types of PSK modulation and demodulation techniques used in pulse-coded modulation (PCM) schemes.

The student first learns the principles and operational characteristics of unipolar and bipolar signals in a baseband transmission. Next, the student measures and compares BPSK, QPSK, OQPSK, and DPSK signals in the time and frequency domains using an oscilloscope and spectrum analyzer, respectively. Lastly, the student will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

TOPIC COVERAGE

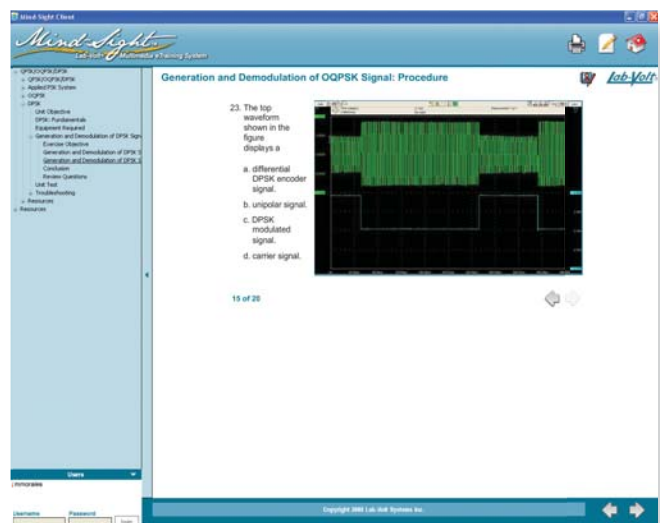
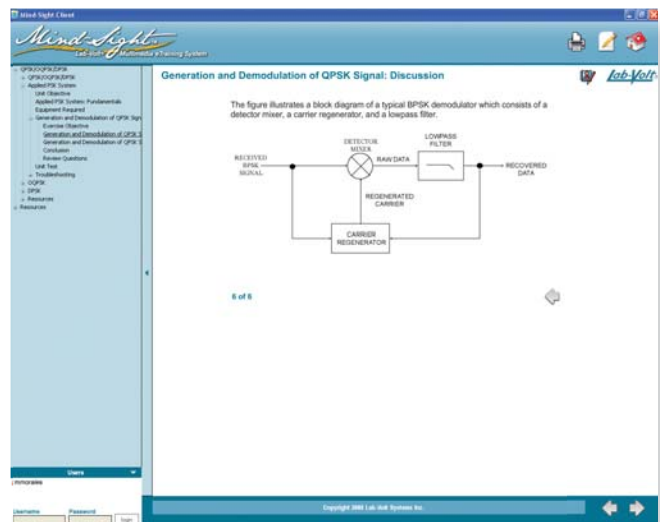
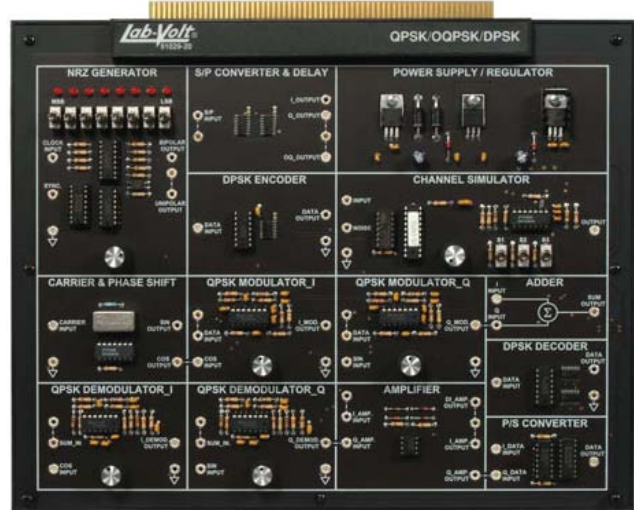
- Digital modulation
- Baseband signals
- Passband signals
- Partitioning of pulse streams
- Signal constellations for MPSK
- General MPSK equations
- Heterodyning baseband signals with a carrier
- Unipolar and bipolar signals in time domain
- Unipolar and bipolar signals in the frequency domain
- Binary PSK (BPSK) modulation and demodulation
- Quadratic PSK (QPSK) modulation and demodulation
- Offset QPSK (OQPSK) modulation and demodulation
- Differential PSK (DPSK) encoding and decoding

ADDITIONAL FEATURES

- Communication signals are synchronized for easy display
- Digital signals observed in both time and frequency domains
- Courseware interfaces with the Lab-Volt Virtual Instrument, Model 1250
- Built-in adjustable NRZ GENERATOR provides various bit pattern streams
- Adjustable bandwidth channel simulator

CIRCUIT BLOCKS

- | | |
|--------------------------|----------------------|
| ■ NRZ Generator | ■ QPSK Modulator_Q |
| ■ S/P Converter & Delay | ■ Adder |
| ■ DPSK Encoder | ■ DPSK Decoder |
| ■ Power Supply/Regulator | ■ QPSK Demodulator_I |
| ■ Channel Simulator | ■ QPSK Demodulator_Q |
| ■ Carrier & Phase Shift | ■ Amplifier |
| ■ QPSK Modulator_I | ■ P/S Converter |



VIRTUAL INSTRUMENT PACKAGE MODEL 1250-10

The Lab-Volt Virtual Instrument Package, Model 1250-10, replaces standard desktop test equipment (FACET Model 1247 and oscilloscope) with a powerful, space-saving, virtual instrumentation package that gives students state-of-the-art tools to measure, analyze, observe, and report the results of electronic circuit tests.

It operates under any of the following Microsoft[®] Windows[®] operating systems: 98, 2000, Me, XP, and Vista.

Fully integrated with the FACET Electronics Training program, the Lab-Volt Virtual Instrument Package enables students to conduct all experiments that would otherwise be performed using separate instruments.

The complete Virtual Instrument Package consists of a Virtual Instrument unit (data acquisition and digital output module) and Windows-based software including the following virtual instruments and signal source:

- Dual-Channel Oscilloscope
- Multimeter
- Arbitrary Waveform Generator (AWG)
- Spectrum Analyzer
- Transient Recorder

The package also includes all necessary software, cables, a user manual, two oscilloscope probes (switchable 1:1 - 1:10), test leads, and a data acquisition instrument that can be connected to the parallel printer port of a personal computer.

Each of the 30 units within the FACET curriculum provides hands-on activities requiring students to measure, test, analyze and troubleshoot electronic circuits. The Virtual Instrument software interfaces with FACET courseware to support experiments in each topic area. In addition, Help screens are included throughout the FACET program to instruct students in the use of each virtual instrument.

Students use the keyboard, mouse and computer screens to control and display the five measuring instruments. The Windows software menu and tool task bars allow inexperienced students to carry out measurements easily. Measured data can be printed out or stored on a floppy disk or network.

With the Lab-Volt Virtual Instrument Package, students gain experience using modern measurement techniques that prepare them for real jobs in today's electronics industries.

The Lab-Volt Virtual Instrument Package is a lightweight, compact and portable desktop unit. It can be powered from 110 to 240 Vac (50/60 Hz) or 12 to 24 Vdc for portability.

Virtual Instrument

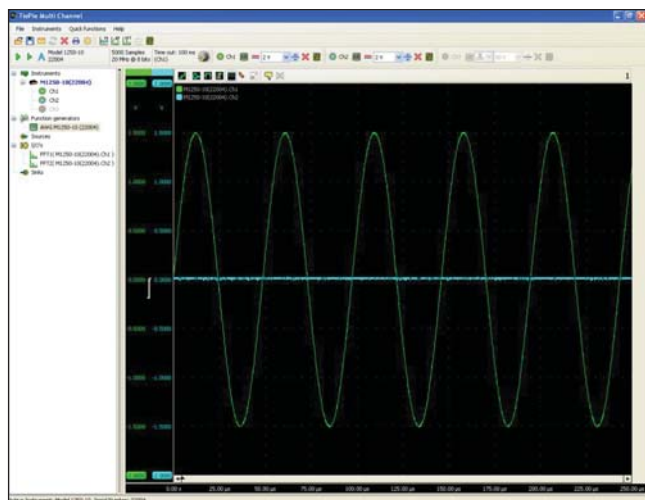


The Lab-Volt Virtual Instrument unit is a lightweight, compact interface module that can be powered from any standard AC power wall outlet (100 to 240 V, 50/60 Hz).

The Virtual Instrument unit samples the signals applied to its various inputs to provide raw signal data that is used by the virtual instrument software to measure and display the input signals. The high sampling rate used (up to 1 GS/s) provides the Virtual Instrument unit with a 250-MHz bandwidth that is amply sufficient for the observation and analysis of the various signals in the FACET Electronics Training program.

The Virtual Instrument unit also generates signal samples (data) that are converted to analog format to produce the AWG output signal. Data exchange between the Virtual Instrument unit and the host computer that runs the virtual instrument software is through a USB link (USB 1.1 and 2.0 compatible). Matlab and LabVIEW interfacing is also possible.

Dual-Channel Oscilloscope



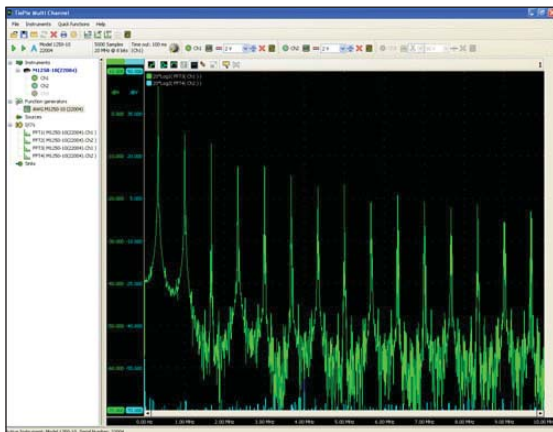
See datasheet for product specifications .

Multimeter



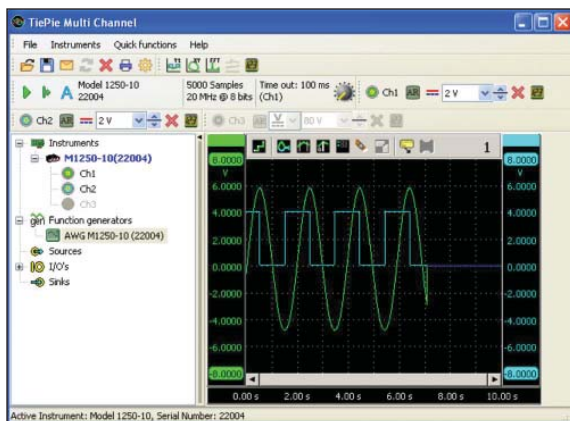
The Multimeter has two independent input channels, each channel being sampled at a rate of up to 500 MS/s (up to 1 GS/s when only one channel is used). The Multimeter can measure the AC and DC values of voltage and current as well as resistance, like any conventional multimeter. The Multimeter can also perform several other types of measurements such as the true-RMS and peak-to-peak values of voltage and current, power, frequency, crest factor, etc.

Spectrum Analyzer



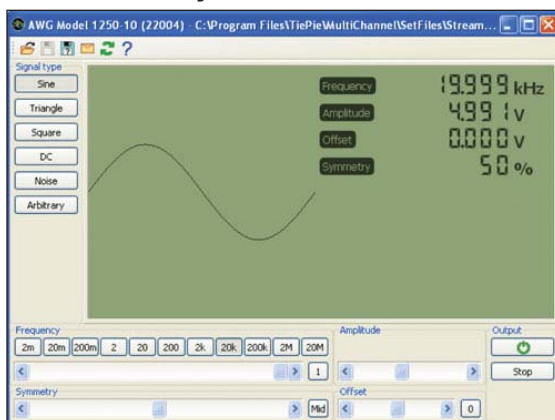
The Spectrum Analyzer has two independent input channels, the signal on each channel being sampled at a rate of up to 500 MS/s (up to 1 GS/s when only one channel is used). The Spectrum Analyzer converts the signal samples into frequency-domain information that is displayed as a graph of signal level as a function of frequency. The Spectrum Analyzer can perform continuous sampling or single-shot sampling of the input signals.

Transient Recorder



The Transient Recorder is designed to record slowly varying parameters such as temperature or pressure. It has two independent input channels allowing two parameters to be recorded at the same time. The time interval between consecutive measurements of the input parameters can be adjusted over a wide range that allows the Transient Recorder to be used in a large variety of applications. Cursors are available to analyze the evolution of the recorded parameters.

Arbitrary Waveform Generator



The Arbitrary Waveform Generator (AWG) can produce sine-wave, triangle-wave, and square-wave signals like any conventional function generator. The AWG can also produce any arbitrary waveform as well as noise. The AWG bandwidth is 20 MHz. The AWG output has a maximum voltage range of -10 to +10 V with 14-bit resolution and adjustable DC offset. The AWG output impedance is 50 Ω .

ELECTRONIC DEVICES AND OPTIONAL EQUIPMENT

MODEL 793 – DUAL-TRACE OSCILLOSCOPE

The Lab-Volt Dual-Trace Oscilloscope is an economical and highly reliable solid-state instrument, ideal for general-purpose use in laboratory and training applications.

Using the Model 793 oscilloscope, students can measure phase difference between waveforms using the X-Y operation mode, and video signals can be measured quickly with the special TV sync separation circuit. The oscilloscope includes CH1, CH2, CHOP and ALT display modes.

MODEL 1247 – DIGITAL MULTIMETER/AF GENERATOR

The Model 1247 Digital Multimeter/AF Generator is a compact, general-purpose instrumentation module that provides the necessary test equipment (except oscilloscope) to perform the lessons in the FACET program. The instrument consists of a sine/square/triangle waveshape AF generator and an auto-ranging digital multimeter. The instrumentation shares a common power input and is housed in a portable enclosure. All components, switches, and terminals are mounted in a tamper-resistant manner. The system's design protects the instruments from inadvertent short circuits and overloads within the FACET system.

MODEL 1401 – FACET STORAGE ENCLOSURE

The Model 1401 FACET Storage Enclosure is a portable wooden enclosure that can house up to ten modules (boards) of the FACET program. The enclosure is finished in laminate and includes a locking cover and a carrying handle. The FACET Storage Enclosure is available in many colors as indicated in Table 2 of the Ordering Number section of this datasheet.

MODEL 39360 – BASE UNIT UPGRADE KIT

For those who are still using the FACET Base Unit Model 91000-4, the Upgrade Kit permits the use of this unit with a USB interface instead of a serial link. The Upgrade Kit consists of a cable with a USB connector at one end and a DB9M connector at the other end. The kit also comes with a DB9F-to-DB25M adapter, as well as a CD-ROM (part number 39167) providing the required drivers for communication with the Base Unit and a readme file explaining how to install the drivers.

MODEL 91021 – GENERATOR BUFFER

The Lab-Volt Generator Buffer module is required for generators used in lab experiments not having an output impedance of 50 Ω .

MODEL 91052 – ACCESSORY KIT

The Model 91052 is a replacement kit that contains the same accessories as those provided with any of the FACET base units, Model 91000. The kit consists of miniature banana-jack jumpers and leads, alligator clips, test point pins, and a DC milliammeter.

Microprocessor Application Board



MODEL 91602 – MICROPROCESSOR APPLICATION BOARD

This board is an add-on to the 32-Bit Microprocessor (Model 91017). It allows students to study how microprocessors can control and communicate with external devices. The Application Board has two application circuits: a DC MOTOR CONTROLLER, and a TEMPERATURE CONTROLLER.

The course can be performed through the interactive computer-based learning (CBL) provided with Model 91017, or in a conventional way by using the manuals provided with Model 91017.

EXPLORATORY ELECTRONICS TRAINING SYSTEM MODEL 555



The Lab-Volt Exploratory Electronics Training System is a self-contained, table-top trainer that provides 25 units of instruction in the fundamental concepts and terminology of electronics. The complete system is easily integrated into an industrial arts program or can serve as the electronics segment of a general science or physics program.

The system comes with three trays of mounted components, including semiconductors, resistors, capacitors, lamps, switches, magnets, relay coil, solar cell and speaker. A voltmeter, milliammeter and AC/DC power supply are housed in an attractive cabinet that also provides storage for the tray-mounted components, leads and loose hardware.

TOPIC COVERAGE

- The Electrical Circuit
- Producing Electricity through Chemistry
- Producing Electricity through Magnetism
- Producing Electricity through Heat
- Conductors and Insulators
- Series Circuits, Using Lamps
- Parallel Circuits, Using Lamps
- Series and Parallel Switching Circuits
- Three-Way Switching
- Voltage and Current
- Lamp Resistance
- Resistance
- Ohm's Law
- The Series Circuit
- The Parallel Circuit

- Magnetism
- Magnetic Force
- The Electromagnet
- The Relay
- The Transistor
- Capacitance
- An Electromechanical Oscillator
- An Electronic Oscillator
- An Electronic Amplifier
- The Photoconductive Cell

VOLTAGE

110/120 Vac, 50/60 Hz

220/240 Vac, 50/60 Hz

LANGUAGE VARIATIONS

English, French, Spanish

PREPARATORY ELECTRICITY AND ELECTRONICS TRAINER (PEET) MODEL 556



The modular Preparatory Electricity and Electronics Trainer (PEET) is ideally suited for skill development in the Fundamentals of AC/DC, Basic Electronics, and Motors and Generators.

These three modules comprise the PEET system and can be purchased as stand-alone units or as a system. The PEET system includes all components along with a storage enclosure.

Three manual skills packages that provide practical experience in building and testing printed circuit boards (PCB) also may be ordered as stand-alone or system units. Each skills package contains components for assembling a PCB, along with a student manual and all the hardware required to assemble the projects.

PEET hardware includes LabVolt's unique Konnect-All breadboard that allows students to build circuits easily. Required equipment includes an AC/DC power supply, electronic VOM, sine/square-wave generator and DC meter. This equipment is available in the LabVolt Laboratory Instrument System, Model 438.

TOPIC COVERAGE

Fundamentals of AC/DC

- Trainer Familiarization
- Symbols and Schematics
- Safety
- An Introduction to Electricity
- Voltage, Current and Resistance
- Sources of Electricity
- Conductors and Insulators
- Basic Electrical Circuits
- Voltage in Electrical Circuits
- Current in Electrical Circuits
- Ohm's Law
- Resistors
- Series Resistor Circuits

- Parallel Resistor Circuits
- Series-Parallel Resistor Circuits
- Magnetism
- Electromagnetism
- Alternating Current
- Capacitors
- Inductors
- Transformers

Basic Electronics

- Diode Basics
- Rectifier
- The Power Supply Filter
- Voltage Dividing
- Voltage Regulation
- Power Supply Circuits
- Transistor Basics
- The Common-Base Circuit
- The Common-Emitter Circuit
- The Common-Collector Circuit
- Amplifiers
- Oscillators
- The MOS and Junction Transistor
- The Silicon-Controlled Rectifier
- The Operational Amplifier
- Binary Numbers
- The Digital Inverter
- The OR Gate
- The AND Gate
- The Flip-Flop
- The Encoder-Decoder

Motors and Generators

- Magnetism
- DC Motors and Generators
- AC Motors
- Motor Control

Courseware Ordering Information

CBL = Computer-Based Learning

N/A = Not Available at time of printing

MODEL DESCRIPTION	120 V - 60 HZ			220 V - 50 HZ			240 V - 50 HZ
	ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
BASIC ELECTRICITY & ELECTRONICS							
91001 FACET® DC FUNDAMENTALS							
Student Manual	90860-00	90860-01	90860-02	90860-00	90860-01	90860-02	90860-00
CBL Student Workbook	91560-00	N/A	N/A	91560-00	N/A	N/A	91560-00
Instructor Guide	90860-10	N/A	90860-12	90860-10	N/A	90860-12	90860-10
CBL Instructor Guide	91560-10	N/A	N/A	91560-10	N/A	N/A	91560-10
Pre-test	90860-40	N/A	N/A	90860-40	N/A	N/A	90860-40
Pre-test Answer Key	90860-50	N/A	N/A	90860-50	N/A	N/A	90860-50
Post-test	90860-60	N/A	N/A	90860-60	N/A	N/A	90860-60
Post-test Answer Key	90860-70	N/A	N/A	90860-70	N/A	N/A	90860-70
Software	91001-W0	N/A	N/A	91001-W0	N/A	N/A	91001-W0
91002 FACET® DC NETWORK THEOREMS							
Student Manual	90861-00	90861-01	90861-02	90861-00	90861-01	90861-02	90861-00
CBL Student Workbook	91561-00	N/A	N/A	91561-00	N/A	N/A	91561-00
Instructor Guide	90861-10	N/A	90861-12	90861-10	N/A	90861-12	90861-10
CBL Instructor Guide	91561-10	N/A	N/A	91561-10	N/A	N/A	91561-10
Pre-test	90861-40	N/A	N/A	90861-40	N/A	N/A	90861-40
Pre-test Answer Key	90861-50	N/A	N/A	90861-50	N/A	N/A	90861-50
Post-test	90861-60	N/A	N/A	90861-60	N/A	N/A	90861-60
Post-test Answer Key	90861-70	N/A	N/A	90861-70	N/A	N/A	90861-70
Software	91002-W0	N/A	N/A	91002-W0	N/A	N/A	91002-W0
91003 FACET® AC 1 FUNDAMENTALS							
Student Manual	90862-00	90862-01	90862-02	90862-00	90862-01	90862-02	90862-00
CBL Student Workbook	91562-00	N/A	N/A	91562-00	N/A	N/A	91562-00
Instructor Guide	90862-10	N/A	90862-12	90862-10	N/A	90862-12	90862-10
CBL Instructor Guide	91562-10	N/A	N/A	91562-10	N/A	N/A	91562-10
Pre-test	90862-40	N/A	N/A	90862-40	N/A	N/A	90862-40
Pre-test Answer Key	90862-50	N/A	N/A	90862-50	N/A	N/A	90862-50
Post-test	90862-60	N/A	N/A	90862-60	N/A	N/A	90862-60
Post-test Answer Key	90862-70	N/A	N/A	90862-70	N/A	N/A	90862-70
Software	91003-W0	N/A	N/A	91003-W0	N/A	N/A	91003-W0
91020 FACET® MAGNETISM/ELECTROMAGNETISM							
Student Manual	90879-00	N/A	N/A	90879-00	N/A	N/A	90879-00
CBL Student Workbook	91580-00	N/A	N/A	91580-00	N/A	N/A	91580-00
Instructor Guide	90879-10	N/A	N/A	90879-10	N/A	N/A	90879-10
CBL Instructor Guide	91580-10	N/A	N/A	91580-10	N/A	N/A	91580-10
Pre-test	90879-40	N/A	N/A	90879-40	N/A	N/A	90879-40
Pre-test Answer Key	90879-50	N/A	N/A	90879-50	N/A	N/A	90879-50
Post-test	90879-60	N/A	N/A	90879-60	N/A	N/A	90879-60
Post-test Answer Key	90879-70	N/A	N/A	90879-70	N/A	N/A	90879-70
Software	91020-W0	N/A	N/A	91020-W0	N/A	N/A	91020-W0
91004 FACET® AC 2 FUNDAMENTALS							
Student Manual	90863-00	90863-01	90863-02	90863-00	90863-01	90863-02	90863-00
CBL Student Workbook	91563-00	N/A	N/A	91563-00	N/A	N/A	91563-00
Instructor Guide	90863-10	N/A	90863-12	90863-10	N/A	90863-12	90863-10
CBL Instructor Guide	91563-10	N/A	N/A	91563-10	N/A	N/A	91563-10
Pre-test	90863-40	N/A	N/A	90863-40	N/A	N/A	90863-40
Pre-test Answer Key	90863-50	N/A	N/A	90863-50	N/A	N/A	90863-50
Post-test	90863-60	N/A	N/A	90863-60	N/A	N/A	90863-60
Post-test Answer Key	90863-70	N/A	N/A	90863-70	N/A	N/A	90863-70
Software	91004-W0	N/A	N/A	91004-W0	N/A	N/A	91004-W0
91005 FACET® SEMICONDUCTOR DEVICES							
Student Manual	90864-00	90864-01	90864-02	90864-00	90864-01	90864-02	90864-00
CBL Student Workbook	91564-00	N/A	N/A	91564-00	N/A	N/A	91564-00
Instructor Guide	90864-10	N/A	90864-12	90864-10	N/A	90864-12	90864-10
CBL Instructor Guide	91564-10	N/A	N/A	91564-10	N/A	N/A	91564-10
Pre-test	90864-40	N/A	N/A	90864-40	N/A	N/A	90864-40
Pre-test Answer Key	90864-50	N/A	N/A	90864-50	N/A	N/A	90864-50
Post-test	90864-60	N/A	N/A	90864-60	N/A	N/A	90864-60
Post-test Answer Key	90864-70	N/A	N/A	90864-70	N/A	N/A	90864-70
Software	91005-W0	N/A	N/A	91005-W0	N/A	N/A	91005-W0

MODEL DESCRIPTION	120 V - 60 HZ			220 V - 50 HZ			240 V - 50 HZ
	ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
91006 FACET® TRANSISTOR AMPLIFIER CIRCUITS							
Student Manual	90865-00	90865-01	90865-02	90865-00	90865-01	90865-02	90865-00
CBL Student Workbook	91565-00	N/A	N/A	91565-00	N/A	N/A	91565-00
Instructor Guide	90865-10	N/A	90865-12	90865-10	N/A	90865-12	90865-10
CBL Instructor Guide	91565-10	N/A	N/A	91565-10	N/A	N/A	91565-10
Pre-test	90865-40	N/A	N/A	90865-40	N/A	N/A	90865-40
Pre-test Answer Key	90865-50	N/A	N/A	90865-50	N/A	N/A	90865-50
Post-test	90865-60	N/A	N/A	90865-60	N/A	N/A	90865-60
Post-test Answer Key	90865-70	N/A	N/A	90865-70	N/A	N/A	90865-70
Software	91006-W0	N/A	N/A	91006-W0	N/A	N/A	91006-W0
91007 FACET® TRANSISTOR POWER AMPLIFIERS							
Student Manual	90866-00	90866-01	90866-02	90866-00	90866-01	90866-02	90866-00
CBL Student Workbook	91566-00	N/A	N/A	91566-00	N/A	N/A	91566-00
Instructor Guide	90866-10	N/A	90866-12	90866-10	N/A	90866-12	90866-10
CBL Instructor Guide	91566-10	N/A	N/A	91566-10	N/A	N/A	91566-10
Pre-test	90866-40	N/A	N/A	90866-40	N/A	N/A	90866-40
Pre-test Answer Key	90866-50	N/A	N/A	90866-50	N/A	N/A	90866-50
Post-test	90866-60	N/A	N/A	90866-60	N/A	N/A	90866-60
Post-test Answer Key	90866-70	N/A	N/A	90866-70	N/A	N/A	90866-70
Software	91007-W0	N/A	N/A	91007-W0	N/A	N/A	91007-W0
91008 FACET® TRANSISTOR FEEDBACK CIRCUITS							
Student Manual	90867-00	90867-01	90867-02	90867-00	90876-01	90867-02	90867-00
CBL Student Workbook	91567-00	N/A	N/A	91567-00	N/A	N/A	91567-00
Instructor Guide	90867-10	N/A	90867-12	90867-10	N/A	90867-12	90867-10
CBL Instructor Guide	91567-10	N/A	N/A	91567-10	N/A	N/A	91567-10
Pre-test	90867-40	N/A	N/A	90867-40	N/A	N/A	90867-40
Pre-test Answer Key	90867-50	N/A	N/A	90867-50	N/A	N/A	90867-50
Post-test	90867-60	N/A	N/A	90867-60	N/A	N/A	90867-60
Post-test Answer Key	90867-70	N/A	N/A	90867-70	N/A	N/A	90867-70
Software	91008-W0	N/A	N/A	91008-W0	N/A	N/A	91008-W0
91009 FACET® POWER SUPPLY REGULATION CIRCUITS							
Student Manual	90868-00	90868-01	90868-02	90868-00	90868-01	90868-02	90868-00
CBL Student Workbook	91568-00	N/A	N/A	91568-00	N/A	N/A	91568-00
Instructor Guide	90868-10	N/A	90868-12	90868-10	N/A	90868-12	90868-10
CBL Instructor Guide	91568-10	N/A	N/A	91568-10	N/A	N/A	91568-10
Pre-test	90868-40	N/A	N/A	90868-40	N/A	N/A	90868-40
Pre-test Answer Key	90868-50	N/A	N/A	90868-50	N/A	N/A	90868-50
Post-test	90868-60	N/A	N/A	90868-60	N/A	N/A	90868-60
Post-test Answer Key	90868-70	N/A	N/A	90868-70	N/A	N/A	90868-70
Software	91009-W0	N/A	N/A	91009-W0	N/A	N/A	91009-W0
91010 FACET® FET FUNDAMENTALS							
Student Manual	90869-00	90869-01	90869-02	90869-00	90869-01	90869-02	90869-00
CBL Student Workbook	91569-00	N/A	N/A	91569-00	N/A	N/A	91569-00
Instructor Guide	90869-10	N/A	90869-12	90869-10	N/A	90869-12	90869-10
CBL Instructor Guide	91569-10	N/A	N/A	91569-10	N/A	N/A	91569-10
Pre-test	90869-40	N/A	N/A	90869-40	N/A	N/A	90869-40
Pre-test Answer Key	90869-50	N/A	N/A	90869-50	N/A	N/A	90869-50
Post-test	90869-60	N/A	N/A	90869-60	N/A	N/A	90869-60
Post-test Answer Key	90869-70	N/A	N/A	90869-70	N/A	N/A	90869-70
Software	91010-W0	N/A	N/A	91010-W0	N/A	N/A	91010-W0
91011 FACET® THYRISTOR AND POWER CONTROL CIRCUITS							
Student Manual	90870-00	90870-01	90870-02	90870-00	90870-01	90870-02	90870-00
CBL Student Workbook	91570-00	N/A	N/A	91570-00	N/A	N/A	91570-00
Instructor Guide	90870-10	N/A	90870-12	90870-10	N/A	90870-12	90870-10
CBL Instructor Guide	91570-10	N/A	N/A	91570-10	N/A	N/A	91570-10
Pre-test	90870-40	N/A	N/A	90870-40	N/A	N/A	90870-40
Pre-test Answer Key	90870-50	N/A	N/A	90870-50	N/A	N/A	90870-50
Post-test	90870-60	N/A	N/A	90870-60	N/A	N/A	90870-60
Post-test Answer Key	90870-70	N/A	N/A	90870-70	N/A	N/A	90870-70
Software	91011-W0	N/A	N/A	91011-W0	N/A	N/A	91011-W0
91012 FACET® OPERATIONAL AMPLIFIER FUNDAMENTALS							
Student Manual	90871-00	90871-01	90871-02	90871-00	90871-01	90871-02	90871-00
CBL Student Workbook	91571-00	N/A	N/A	91571-00	N/A	N/A	91571-00
Instructor Guide	90871-10	N/A	90871-12	90871-10	N/A	90871-12	90871-10
CBL Instructor Guide	91571-10	N/A	N/A	91571-10	N/A	N/A	91571-10
Pre-test	90871-40	N/A	N/A	90871-40	N/A	N/A	90871-40
Pre-test Answer Key	90871-50	N/A	N/A	90871-50	N/A	N/A	90871-50
Post-test	90871-60	N/A	N/A	90871-60	N/A	N/A	90871-60
Post-test Answer Key	90871-70	N/A	N/A	90871-70	N/A	N/A	90871-70
Software	91012-W0	N/A	N/A	91012-W0	N/A	N/A	91012-W0

MODEL DESCRIPTION	120 V - 60 HZ			220 V - 50 HZ			240 V - 50 HZ
	ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
91013 FACET® OPERATIONAL AMPLIFIER APPLICATIONS							
Student Manual	90872-00	90872-01	90872-02	90872-00	90872-01	90872-02	90872-00
CBL Student Workbook	91572-00	N/A	N/A	91572-00	N/A	N/A	91572-00
Instructor Guide	90872-10	N/A	90872-12	90872-10	N/A	90872-12	90872-10
CBL Instructor Guide	91572-10	N/A	N/A	91572-10	N/A	N/A	91572-10
Pre-test	90872-40	N/A	N/A	90872-40	N/A	N/A	90872-40
Pre-test Answer Key	90872-50	N/A	N/A	90872-50	N/A	N/A	90872-50
Post-test	90872-60	N/A	N/A	90872-60	N/A	N/A	90872-60
Post-test Answer Key	90872-70	N/A	N/A	90872-70	N/A	N/A	90872-70
Software	91013-W0	N/A	N/A	91013-W0	N/A	N/A	91013-W0
DIGITAL & MICROPROCESSOR ELECTRONICS							
91014 FACET® DIGITAL LOGIC FUNDAMENTALS							
Student Manual	90873-00	90873-01	90873-02	90873-00	90873-01	90873-02	90873-00
CBL Student Workbook	91573-00	N/A	N/A	91573-00	N/A	N/A	91573-00
Instructor Guide	90873-10	N/A	90873-12	90873-10	N/A	90873-12	90873-10
CBL Instructor Guide	91573-10	N/A	N/A	91573-10	N/A	N/A	91573-10
Pre-test	90873-40	N/A	N/A	90873-40	N/A	N/A	90873-40
Pre-test Answer Key	90873-50	N/A	N/A	90873-50	N/A	N/A	90873-50
Post-test	90873-60	N/A	N/A	90873-60	N/A	N/A	90873-60
Post-test Answer Key	90873-70	N/A	N/A	90873-70	N/A	N/A	90873-70
Software	91014-W0	N/A	N/A	91014-W0	N/A	N/A	91014-W0
91015 FACET® DIGITAL CIRCUIT FUNDAMENTALS 1							
Student Manual	90874-00	90874-01	90874-02	90874-00	90874-01	90874-02	90874-00
CBL Student Workbook	91574-00	N/A	N/A	91574-00	N/A	N/A	91574-00
Instructor Guide	90874-10	N/A	90874-12	90874-10	N/A	90874-12	90874-10
CBL Instructor Guide	91574-10	N/A	N/A	91574-10	N/A	N/A	91574-10
Pre-test	90874-40	N/A	N/A	90874-40	N/A	N/A	90874-40
Pre-test Answer Key	90874-50	N/A	N/A	90874-50	N/A	N/A	90874-50
Post-test	90874-60	N/A	N/A	90874-60	N/A	N/A	90874-60
Post-test Answer Key	90874-70	N/A	N/A	90874-70	N/A	N/A	90874-70
Software	91015-W0	N/A	N/A	91015-W0	N/A	N/A	91015-W0
91016 FACET® DIGITAL CIRCUIT FUNDAMENTALS 2							
Student Manual	90875-00	90875-01	90875-02	90875-00	90875-01	90875-02	90875-00
CBL Student Workbook	91576-00	N/A	N/A	91576-00	N/A	N/A	91576-00
Instructor Guide	90875-10	N/A	90875-12	90875-10	N/A	90875-12	90875-10
CBL Instructor Guide	91576-10	N/A	N/A	91576-10	N/A	N/A	91576-10
Pre-test	90875-40	N/A	N/A	90875-40	N/A	N/A	90875-40
Pre-test Answer Key	90875-50	N/A	N/A	90875-50	N/A	N/A	90875-50
Post-test	90875-60	N/A	N/A	90875-60	N/A	N/A	90875-60
Post-test Answer Key	90875-70	N/A	N/A	90875-70	N/A	N/A	90875-70
Software	91016-W0	N/A	N/A	91016-W0	N/A	N/A	91016-W0
91017 FACET® 32-BIT MICROPROCESSOR							
Student Manual	90876-00	90876-01	90876-02	90876-00	90876-01	90876-02	90876-00
CBL Student Workbook	91577-00	N/A	N/A	91577-00	N/A	N/A	91577-00
Instructor Guide	90876-10	N/A	90876-12	90876-10	N/A	90876-12	90876-10
CBL Instructor Guide	91577-10	N/A	N/A	91577-10	N/A	N/A	91577-10
Pre-test	90876-40	N/A	N/A	90876-40	N/A	N/A	90876-40
Pre-test Answer Key	90876-50	N/A	N/A	90876-50	N/A	N/A	90876-50
Post-test	90876-60	N/A	N/A	90876-60	N/A	N/A	90876-60
Post-test Answer Key	90876-70	N/A	N/A	90876-70	N/A	N/A	90876-70
Software	91017-W0	N/A	N/A	91017-W0	N/A	N/A	91017-W0
91027 FACET® DIGITAL SIGNAL PROCESSOR							
Student Manual	31946-00	31946-01	31946-02	31946-00	31946-01	31946-02	31946-00
CBL Student Workbook	31946-J0	N/A	N/A	31946-J0	N/A	N/A	31946-J0
Instructor Guide	31946-10	N/A	31946-12	31946-10	N/A	31946-12	31946-10
CBL Instructor Guide	31946-L0	N/A	N/A	31946-L0	N/A	N/A	31946-L0
Software	91027-W0	N/A	N/A	91027-W0	N/A	N/A	91027-W0
91030 FACET® MICROCONTROLLERS							
Student Manual	85161-00	N/A	N/A	85161-00	N/A	N/A	85161-00
CBL Student Workbook	85161-J0	N/A	N/A	85161-J0	N/A	N/A	85161-J0
Instructor Guide	85161-10	N/A	N/A	85161-10	N/A	N/A	85161-10
CBL Instructor Guide	85161-L0	N/A	N/A	85161-L0	N/A	N/A	85161-L0
Pre-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Software	91030-W0	N/A	N/A	91030-W0	N/A	N/A	91030-W0

MODEL DESCRIPTION	120 V - 60 HZ			220 V - 50 HZ			240 V - 50 HZ
	ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH
91091 FACET® BREADBOARD							
Student Manual	37967-00	N/A	N/A	37967-00	N/A	N/A	37967-00
CBL Student Workbook	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Instructor Guide	91733-10	N/A	N/A	91733-10	N/A	N/A	91733-10
CBL Instructor Guide	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Software	N/A	N/A	N/A	N/A	N/A	N/A	N/A

INDUSTRIAL ELECTRONICS

91019 FACET® TRANSDUCER FUNDAMENTALS							
Student Manual	90878-00	N/A	N/A	90878-00	N/A	N/A	90878-00
CBL Student Workbook	91579-00	N/A	N/A	91579-00	N/A	N/A	91579-00
Instructor Guide	90878-10	N/A	N/A	90878-10	N/A	N/A	90878-10
CBL Instructor Guide	91579-10	N/A	N/A	91579-10	N/A	N/A	91579-10
Pre-test	90878-40	N/A	N/A	90878-40	N/A	N/A	90878-40
Pre-test Answer Key	90878-50	N/A	N/A	90878-50	N/A	N/A	90878-50
Post-test	90878-60	N/A	N/A	90878-60	N/A	N/A	90878-60
Post-test Answer Key	90878-70	N/A	N/A	90878-70	N/A	N/A	90878-70
Software	91019-W0	N/A	N/A	91019-W0	N/A	N/A	91019-W0

91024 FACET® MOTORS, GENERATORS AND CONTROLS							
Student Manual	91798-00	N/A	N/A	91798-00	N/A	N/A	91798-00
CBL Student Workbook	91583-00	N/A	N/A	91583-00	N/A	N/A	91583-00
Instructor Guide	91798-10	N/A	N/A	91798-10	N/A	N/A	91798-10
CBL Instructor Guide	91583-10	N/A	N/A	91583-10	N/A	N/A	91583-10
Pre-test	91798-40	N/A	N/A	91798-40	N/A	N/A	91798-40
Pre-test Answer Key	91798-50	N/A	N/A	91798-50	N/A	N/A	91798-50
Post-test	91798-60	N/A	N/A	91798-60	N/A	N/A	91798-60
Post-test Answer Key	91798-70	N/A	N/A	91798-70	N/A	N/A	91798-70
Software	91024-W0	N/A	N/A	91024-W0	N/A	N/A	91024-W0

91026 FACET® POWER TRANSISTORS AND GTO THYRISTORS							
Student Manual	92920-00	N/A	N/A	92920-00	N/A	N/A	92920-00
CBL Student Workbook	92920-J0	N/A	N/A	92920-J0	N/A	N/A	92920-J0
Instructor Guide	92920-10	N/A	N/A	92920-10	N/A	N/A	92920-10
CBL Instructor Guide	92920-L0	N/A	N/A	92920-L0	N/A	N/A	92920-L0
Pre-test	92920-40	N/A	N/A	92920-40	N/A	N/A	92920-40
Pre-test Answer Key	92920-50	N/A	N/A	92920-50	N/A	N/A	92920-50
Post-test	92920-60	N/A	N/A	92920-60	N/A	N/A	92920-60
Post-test Answer Key	92920-70	N/A	N/A	92920-70	N/A	N/A	92920-70
Software	91026-W0	N/A	N/A	91026-W0	N/A	N/A	91026-W0

COMMUNICATIONS SYSTEMS

91018 FACET® ANALOG COMMUNICATIONS							
Student Manual	90877-00	90877-01	N/A	90877-00	90877-01	N/A	90877-00
CBL Student Workbook	91578-00	N/A	N/A	91578-00	N/A	N/A	91578-00
Instructor Guide	90877-10	N/A	N/A	90877-10	N/A	N/A	90877-10
CBL Instructor Guide	91578-10	N/A	N/A	91578-10	N/A	N/A	91578-10
Pre-test	90877-40	N/A	N/A	90877-40	N/A	N/A	90877-40
Pre-test Answer Key	90877-50	N/A	N/A	90877-50	N/A	N/A	90877-50
Post-test	90877-60	N/A	N/A	90877-60	N/A	N/A	90877-60
Post-test Answer Key	90877-70	N/A	N/A	90877-70	N/A	N/A	90877-70
Software	91018-W0	N/A	N/A	91018-W0	N/A	N/A	91018-W0

91022 FACET® DIGITAL COMMUNICATIONS 1							
Student Manual	91733-00	N/A	91733-02	91733-00	N/A	91733-02	91733-00
CBL Student Workbook	91581-00	N/A	N/A	91581-00	N/A	N/A	91581-00
Instructor Guide	91733-10	N/A	91733-12	91733-10	N/A	91733-12	91733-10
CBL Instructor Guide	91581-10	N/A	N/A	91581-10	N/A	N/A	91581-10
Pre-test	91733-40	N/A	N/A	91733-40	N/A	N/A	91733-40
Pre-test Answer Key	91733-50	N/A	N/A	91733-50	N/A	N/A	91733-50
Post-test	91733-60	N/A	N/A	91733-60	N/A	N/A	91733-60
Post-test Answer Key	91733-70	N/A	N/A	91733-70	N/A	N/A	91733-70
Software	91022-W0	N/A	N/A	91022-W0	N/A	N/A	91022-W0

MODEL DESCRIPTION	120 V - 60 HZ			220 V - 50 HZ			240 V - 50 HZ
	ENGLISH	FRENCH	SPANISH	ENGLISH	FRENCH	SPANISH	ENGLISH

91023 FACET® DIGITAL COMMUNICATIONS 2

Student Manual	91739-00	N/A	91739-02	91739-00	N/A	91739-02	91739-00
CBL Student Workbook	91582-00	N/A	N/A	91582-00	N/A	N/A	91582-00
Instructor Guide	91739-10	N/A	91739-12	91739-10	N/A	91739-12	91739-10
CBL Instructor Guide	91582-10	N/A	N/A	91582-10	N/A	N/A	91582-10
Pre-test	91739-40	N/A	N/A	91739-40	N/A	N/A	91739-40
Pre-test Answer Key	91739-50	N/A	N/A	91739-50	N/A	N/A	91739-50
Post-test	91739-60	N/A	N/A	91739-60	N/A	N/A	91739-60
Post-test Answer Key	91739-70	N/A	N/A	91739-70	N/A	N/A	91739-70
Software	91023-W0	N/A	N/A	91023-W0	N/A	N/A	91023-W0

91028 FACET® COMMUNICATIONS TRANSMISSION LINES

Student Manual	36970-00	N/A	N/A	36970-00	N/A	N/A	36970-00
CBL Student Workbook	36970-J0	N/A	N/A	36970-J0	N/A	N/A	36970-J0
Instructor Guide	36970-10	N/A	N/A	36970-10	N/A	N/A	36970-10
CBL Instructor Guide	36970-L0	N/A	N/A	36970-L0	N/A	N/A	36970-L0
Pre-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Software	91028-W0	N/A	N/A	91028-W0	N/A	N/A	91028-W0

91029 FACET® QPSK/OQPSK/DPSK

Student Manual	39158-00	N/A	N/A	39158-00	N/A	N/A	39158-00
CBL Student Workbook	39158-J0	N/A	N/A	39158-J0	N/A	N/A	39158-J0
Instructor Guide	39158-10	N/A	N/A	39158-10	N/A	N/A	39158-10
CBL Instructor Guide	39158-L0	N/A	N/A	39158-L0	N/A	N/A	39158-L0
Pre-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-test Answer Key	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Software	39158-W0	N/A	N/A	39158-W0	N/A	N/A	39158-W0

91025 FACET® FIBER OPTIC COMMUNICATIONS

Student Manual	91967-00	91967-01	N/A	91967-00	91967-01	N/A	91967-00
CBL Student Workbook	91584-00	N/A	N/A	91584-00	N/A	N/A	91584-00
Instructor Guide	91967-10	N/A	N/A	91967-10	N/A	N/A	91967-10
CBL Instructor Guide	91584-10	N/A	N/A	91584-10	N/A	N/A	91584-10
Pre-test	91967-40	N/A	N/A	91967-40	N/A	N/A	91967-40
Pre-test Answer Key	91967-50	N/A	N/A	91967-50	N/A	N/A	91967-50
Post-test	91967-60	N/A	N/A	91967-60	N/A	N/A	91967-60
Post-test Answer Key	91967-70	N/A	N/A	91967-70	N/A	N/A	91967-70
Software	91025-W0	N/A	N/A	91025-W0	N/A	N/A	91025-W0

ADDITIONAL FACET MODULES**555 EXPLORATORY ELECTRONICS TRAINING SYSTEM**

Student Manual	17699-00	N/A	N/A	17699-00	N/A	N/A	17699-00
Teacher Guide	17699-01	N/A	N/A	17699-01	N/A	N/A	17699-01

556 PREPARATORY ELECTRICITY AND ELECTRONICS TRAINING SYSTEM (PEET)

Student Manual: Module 1 AC/DC	16604-00	16604-06	16604-04	16604-00	16604-06	16604-04	16604-00
Teacher Guide: Module 1 AC/DC	16604-01	16604-11	16604-05	16604-01	16604-11	16604-05	16604-01
Students Skills Pkg. Module 1 AC/DC	16821-00	16821-21	16821-04	16821-00	16821-21	16821-04	16821-00
Teacher Skills Pkg. Module 1 AC/DC	16821-01	16821-31	16821-05	16821-01	16821-31	16821-05	16821-01
Student Manual: Module 2 Basic Elec.	16605-00	16605-06	16605-04	16605-00	16605-06	16605-04	16605-00
Teacher Guide: Module 2 Basic Elec.	16605-01	16605-11	16605-05	16605-01	16605-11	16605-05	16605-01
Student Skills Pkg.: Mod. 2 Basic Elec.	16822-00	16822-21	16822-04	16822-00	16822-21	16822-04	16822-00
Teacher Skills Pkg.: Mod. 2 Basic Elec.	16822-01	16822-31	16822-05	16822-01	16822-31	16822-05	16822-01
Student Manual: Mod. 3 Motor/Gen.	16606-00	16606-06	16606-04	16606-00	16606-06	16606-04	16606-00
Teacher Guide: Mod. 3 Motor/Gen.	16606-01	16606-11	16606-05	16606-01	16606-11	16606-05	16606-01
Student Skills Pkg.: Mod. 3 Motor/Gen.	16823-00	16823-21	16823-04	16823-00	16823-21	16823-04	16823-00
Teacher Skills Pkg.: Mod. 3 Motor/Gen.	16823-01	16823-31	16823-05	16823-01	16823-31	16823-05	16823-01
Teacher Manual PES 1-5	17833-00	17833-11	17833-05	17833-00	17833-11	17833-05	17833-00

Other Product Literature Available from Lab-Volt:

Alternative and Renewable Energy Training Systems Product Guide

64-page, four-color catalog describes the courses and equipment that make up alternative and renewable energy training programs, including early education and online programs.



Mechatronics and Industrial Manufacturing Technology Product Guide

72-page, four-color catalog describes Lab-Volt training programs in Electricity and Electronics, Electrical and Mechanical Systems, Fluid Power, Automation and Robotics, HVAC, and Instrumentation and Process Control.



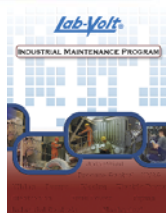
Military Training Systems Brochure

State-of-the-art training systems for military applications in telecommunications, radar, electronic warfare, electronics, fluid power, and electric power technologies. 12-page, four-color brochure.



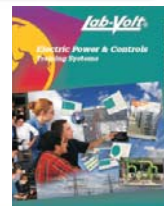
Industrial Maintenance Brochure

12-page, four-color brochure showcasing Lab-Volt's comprehensive industrial training systems, including industrial pumps, mechanical systems, industrial wiring, rigging, and more.



Electric Power/Controls Product Guide

56-page, four-color catalog of Lab-Volt's vast offering of training modules in Electromechanical systems, PLCs, Power Electronics, and corresponding CBT and simulation software programs.



E-Blocks™: Modern Electronics Teaching Resources

32-page, four-color catalog detailing E-Blocks™ small circuit boards, each of which contains a block of electronics typically found in an electronic system. E-blocks provide a very flexible set of parts for learning a range of technical disciplines.



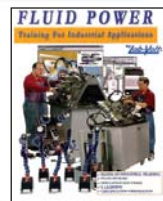
Graymark Information Technology Brochure

12-page, four-color brochure of Graymark's quality IT training products, including PC familiarization, troubleshooting and repair; cable installation; monitor and printer repair; GPS technology; and network technology programs.



Fluid Power Brochure

12 page four-color brochure featuring Lab-Volt's premier line of Fluid Power training systems, including the Hydraulics and Pneumatics Modular Training System.



Lab-Volt Pre-Engineering Programs Brochure

28-page, four-color brochure features Lab-Volt's wide range of pre-engineering programs, which include Microcontroller Programming and System Design, Electricity and Electronics, Mechanical Systems, PLCs, and Automation and Robotics.



Engineering Education & Research for the 21st Century Brochure

This 15-page, four-color brochure details Lab-Volt's engineering programs, which are designed specifically for instructional purposes and comprise integrated learning systems that are fully compatible electrically, mechanically, and educationally.



Tech-Design® Technology Education Catalog

74 page, four-color catalog with detailed descriptions of 43 Tech-Design modules and course objectives, including skills-at-a-glance charts showing competencies associated with each module.



Industrial Training Zone by Lab-Volt

16-page, four-color Industrial Training Zone by Lab-Volt brochure details the broad range of online industrial training courses designed to help you build a more competent, qualified, and efficient workforce.



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