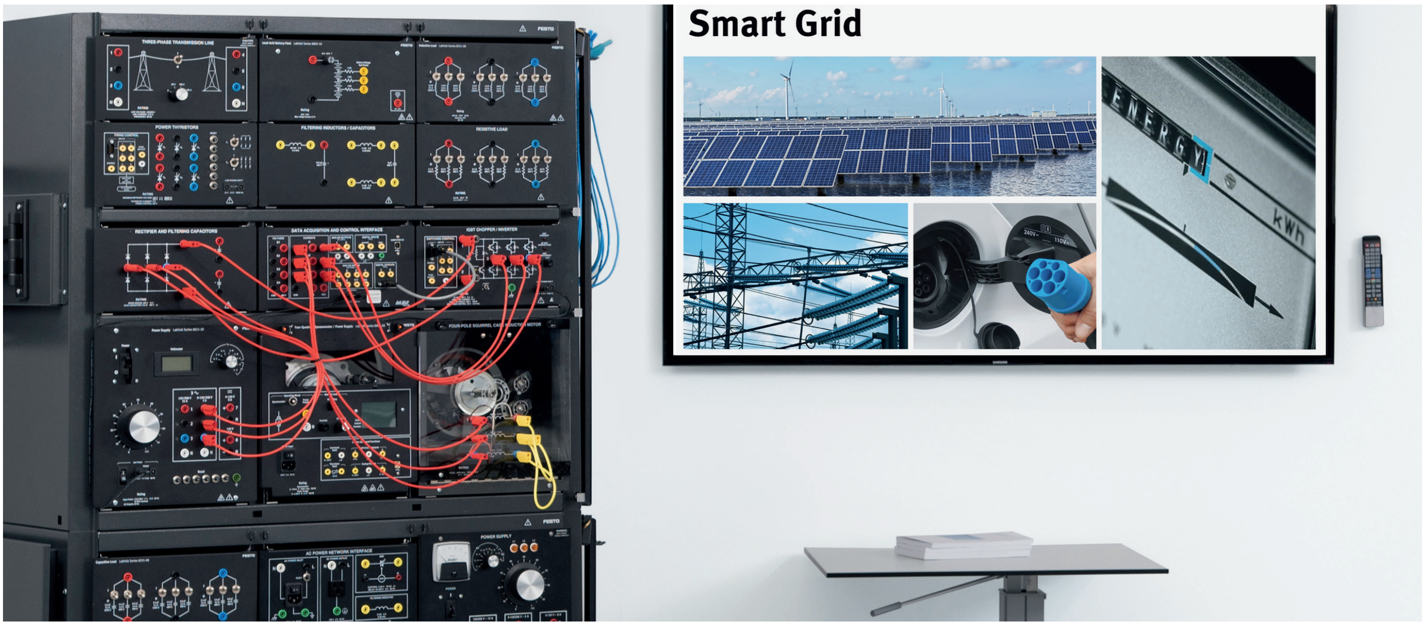
Power grid modernization:
Turn your EMS into a smart grid

FESTO



- Electric power substations
- Numerical protective relays
- Transmission lines
- High-voltage DC transmission
- Static var compensators
- Static synchronous compensators
- Series compensation
- Power factor correction
- Power generation: hydropower, diesel, DFIG, renewable energies
- Home energy production
- Batteries
- Fuel cells
- Power electronics

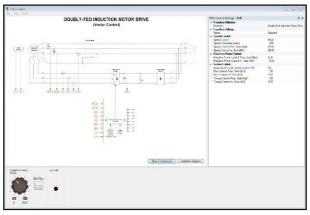
If your lab facilities are currently equipped with electric power technology training systems (EMS from the LabVolt Series), you are only a few modules away from a first-rate, smart grid laboratory!

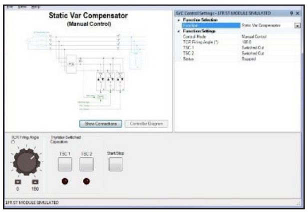
An important field in power engineering
There is a growing need for qualified workers to modernize power grids; making them more reliable, efficient, resilient, secure, and sustainable. This directly impacts training and skills requirements. Are your programs keeping pace?

Cost-effective expansion
Take advantage of the modularity of your electric power technology systems to provide students with new learning opportunities and marketable skills.

Spend wisely, avoid equipment duplication, and maximize your current assets. Smart moves for a smart grid!

Everything you need to create a customized, practical learning environment





Firmware control functions implemented using the DACI, via the free LVDAC-EMS software program, allow the implementation of complex devices, such as an SVC and HVDC, directly in the laboratory. Firmware functions can be purchased individually or in packages.

Digitalize your lab equipment

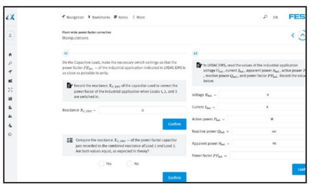
The smart grid model is built upon digital technology and computerized equipment: electric power laboratories should be too. Various technologies expand system monitoring and operation, facilitate data collection and analysis, and make hardware more flexible.

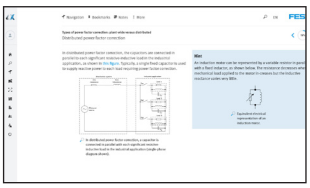
Two computerized modules form the cornerstone of an EMS-based, digitalized electrical engineering lab:

- the Four-Quadrant Dynamometer/Power Supply and
- the Data Acquisition and Control Interface (DACI).

These modules are unparalleled partners for teaching and conducting experiments in power electronics, renewable energies, and power management.

+ Create your own topologies and control strategies for research purposes with software development kits.
+ Replicate a SCADA infrastructure in your lab.
+ Control the hardware remotely.
+ Easily integrate third-party equipment.
+ Explore all possibilities!





Our courses are available as eLab courses on Festo LX, the eLearning portal from Festo, or in PDF for print format. Screen captures above from the Power Factor Correction eLab course.

Courses that support learning, as well as teaching

Our renowned Electrical Power Technology training program offers a range of courses relevant to the smart grid: Home Energy Production, Power Factor Correction, Automatic Power Factor Correction Systems, Numerical Protective Relays, Electric Power Substations, AC Transmission Lines, HDVC, SVC, STATCOM, DFIG, power electronics, and more, as well as courses covering transmission lines, power flow control, and grid efficiency.

Illustrated courseware conveys theory straightforwardly and guides students step-by-step through practical experiments for enhanced student autonomy during lab sessions.

The modularity of the courseware gives teachers full flexibility over its integration in their course plans. Turnkey pedagogical content and lab experiments save teachers precious time, helping them update curricula and keep pace with technological changes.

Download the course flowchart and descriptions:
→ bitly.com/Electric-Power-Technology-Program-Flowchart-EN-A4

Basic through advanced topics in electricity production, transmission, and distribution

Expand your system with relevant modules

Renewable energy production

Electricity production from renewable sources is a smart grid tenet and encompasses topics covered by the training program: solar photovoltaic power, wind power, hydrogen fuel cell, and hydropower. The program also covers energy storage into batteries.

Power electronics

Power electronics devices accommodate fluctuations in frequency or voltage, improve resource optimization, and safely interconnect with power systems. Several power electronics modules can be controlled through the DACI:

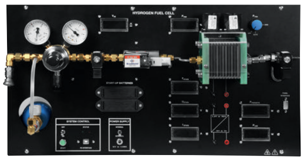
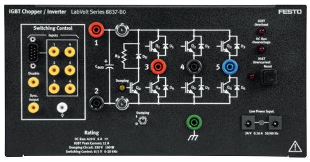
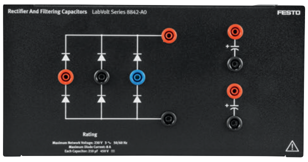
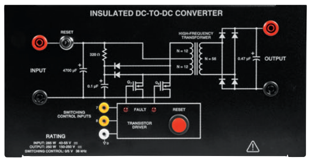
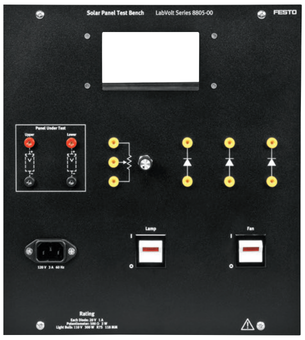
- SVC Reactors/Thyristor Switched Capacitors (8334) implement the TCR and TSCs for SVC operation.
- The Insulated DC-to-DC Converter (8835) implements a solar/wind power inverter with HF transformer topology.
- The IGBT Chopper/Inverter (8837-B) implements the solar/wind power inverter for home energy production and the three-phase PWM rectifier/inverter for STATCOM operation.
- Power Thyristors (8841) implement the TCR and TSCs for SVC operation and the thyristor converters for HVDC operation.
- Rectifier and Filtering Capacitors (8842-A) implement the three-phase rectifier for DFIG operation.
- Power Diodes (8842-1) convert AC to DC.

Numerical protective relays

Protective relaying provides detection of abnormal operating conditions in electrical systems and protects circuits, equipment, and people. Our new system (8010-L) offers training in numerical protective relaying based on Siemens technology. Turnkey courses facilitate the study of this complex topic.

Electrical substations

Electric power substations are critical infrastructures that are increasingly automated to ensure reliable and safe electricity distribution. Their operation requires equipment like buses, circuit breakers, disconnecting switches, capacitor banks, protective relays, and more, that are covered by the EMS hardware and courseware.

01 Hydrogen Fuel Cell module
02 IGBT/Chopper Inverter module
03 Rectifier and Filtering Capacitors module
04 Insulated DC-to-DC module
05 Solar Test Bench module
06 Numerical Distance Relay module
07 Electric Power Substations Training System (8010-K) **NEW** with optional modules

Microgrids: Stay tuned for upcoming developments of the EMS concept for this smart-grid-related topic.

Are you ready to grow your teaching to include smart grid?

Example 1: Teach energy production scenarios
For several years, an electrical engineering university teacher has been using the EMS to teach numerous courses on electrical machines and power electronics. She now wants to integrate the topic of stand-alone and grid-tied inverters, coupled with batteries and renewable energy sources, such as solar power.

After discussing this with a Festo representative, she realizes that the only extra modules required are a solar panel emulator and a battery module, along with the solar power and photovoltaic systems courses to update her curriculum. The power electronics modules in her laboratory are compatible with the new courses and equipment. A small investment for integrating new topics!

Example 2: Upskill power utility workers
A technical education college teacher was recently approached by the local power utility company to find out how they could collaborate in upskilling current workers in the field of protective relaying and power transmission. The teacher's EMS laboratory is already well-equipped to conduct classes on power transmission and electric power fundamentals but lacks modern numerical protective relays. His course plan does not currently cover the topic either.

By opting for the new numerical protective relaying training system from Festo Didactic, he receives a turnkey package that combines complete courseware with power-utility-grade hardware. He is ready to establish a partnership to train the local workforce.

Step 1
Gather the project specifications.
Which topics do you want to teach? What competencies do you want to foster? Who are your students? Write up all your requirements (space constraints, time frame, budget, remote/virtual options, etc.). List existing lab equipment. Include your current needs, as well as those needs you can reasonably foresee.

Step 2
Consult our website.
Look at the course flowchart and identify your relevant topics. Then dive into some reading samples for detailed topic coverage. Explore popular system configurations to see how well they fit your needs – this is a good starting point for customization.

Step 3
Seek inspiration and guidance.
Over the years, we have been involved in thousands of educational endeavors of all scopes around the world. Our experience can fuel the success of your projects. We will guide you through the selection of hardware, software, and courseware to create a personalized offering.

Ready?
Start here: → labvolt.festo.com

Festo Didactic Inc.

607 Industrial Way West
Eatontown, NJ 07724y
USA
Phone +1 732 938-2000
services.didactic@festo.com

Festo Didactic Ltd.

675, rue du Carbone
Quebec City (QC) G1K 8W1
Canada
Phone +1 418 849-1000
services.didactic@festo.com

Festo Didactic SE

Rechbergstrasse 3
73770 Denkendorf
Germany
Phone: +49 711 3467-0
did@festo.com

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