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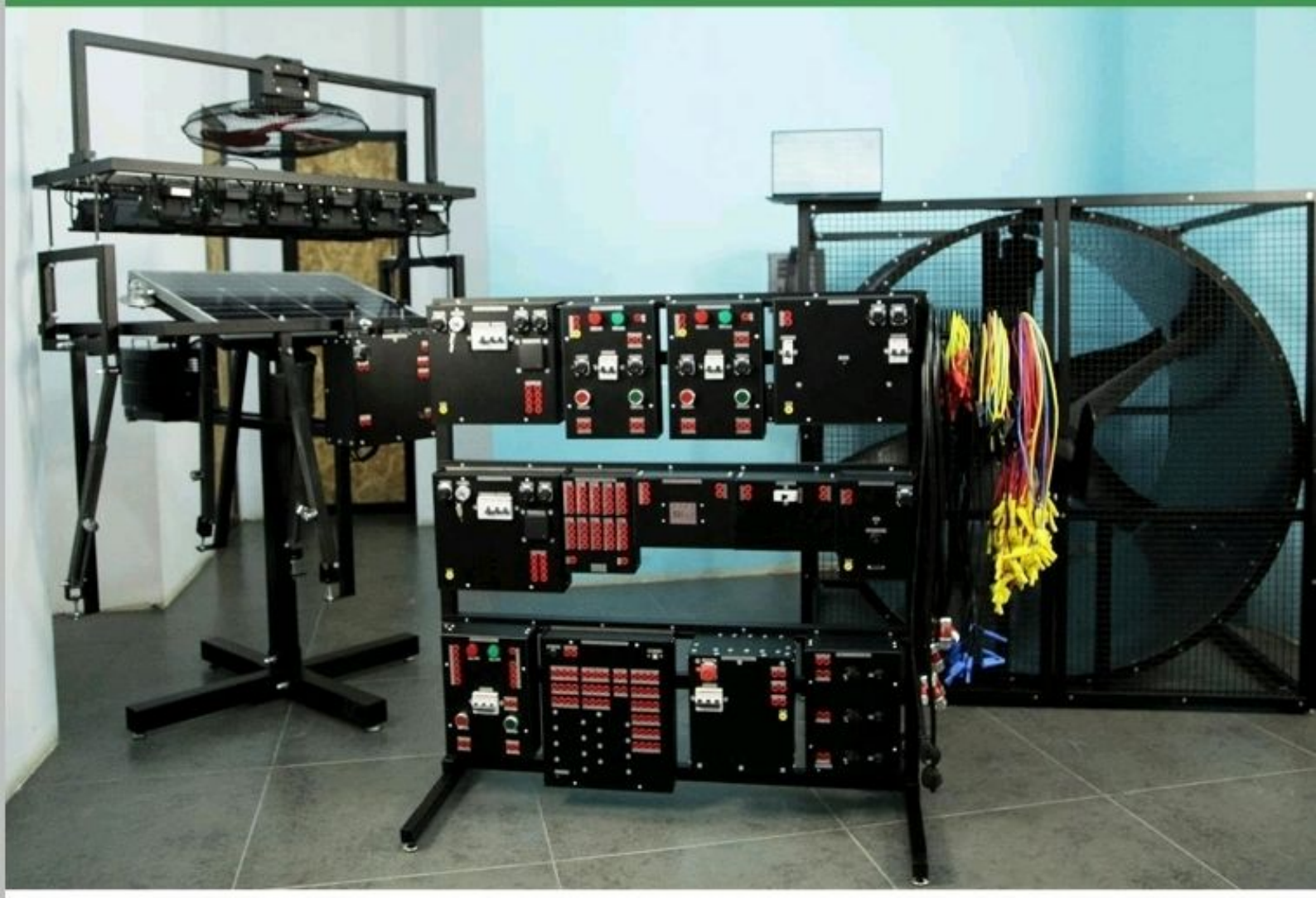
POWER LABS ECOSYSTEM ™



Contents

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No.	DESCRIPTION	Merk			BITLISMEN	
		Model / Type	Qty		Unit Sell (Rp.) Franco Bks.	Sell Price (Rp.) Franco Jkt
1	**SOLAR POWER GENERATION TRAINER**		1	SET	*Asking the price information*	

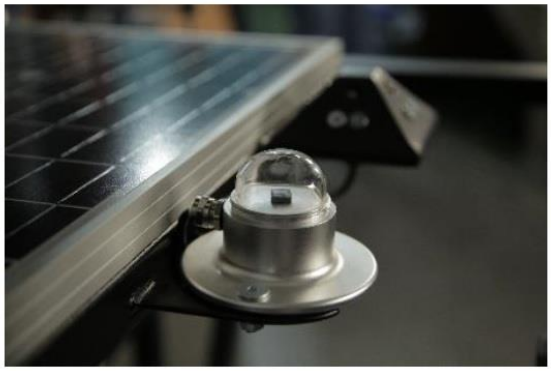
This option of the Solar Power Generation Trainer can work in both off-grid and on-grid modes. It consists of a PV panel and an array of halogen lamps as a sun simulator. The positions of both the PV panel and Sun Simulator can be controlled manually using joysticks and also from the software. The trainer also has a dual-axis solar tracking system. The trainer allows to simulate real light, daytime, yeartime and investigate the PV performance in different irradiation. In off-grid mode it allows to investigate the battery charging process using a DC charge controller and also the discharge using an AC-DC Inverter and loads. In on-grid mode it allows to implement the synchronization with the mains power grid using a Grid-tie inverter.

YouTube Link: https://youtu.be/mZPBO_Bq8qI

Topics covered

- Structure and design of a solar photovoltaic power plant
- Study of photovoltaic solar panels
- Operation of the solar power station in battery charging mode
- Autonomous operation of a solar power plant supplying a load
- Operation of on-grid solar power plant
- Protection in solar power plant in case of emergencies

Solar Power Generation Trainer Hardware Pictures



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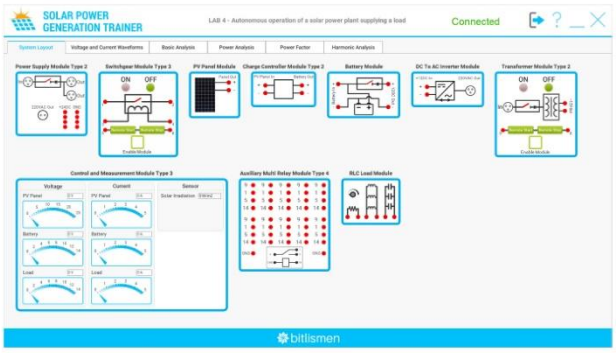
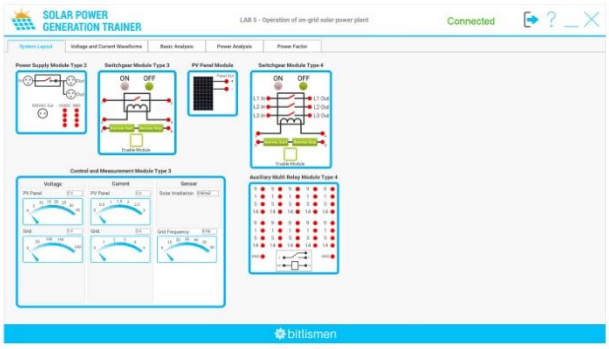
Solar Power Generation Trainer Software Screenshots





2	**WIND POWER GENERATION TRAINER**		1	SET	*Asking the price information*

This option of the Wind Power Generation Trainer can work in both off-grid and on-grid modes. It consists of a wind tunnel and a real wind turbine-generator set. The trainer allows to simulate real wind and investigate the generator performance in different wind speeds. In off-grid mode it allows to investigate the battery charging process using an AC charge controller and also the discharge using an AC-DC Inverter and loads. In on-grid mode it allows to implement the synchronization with the mains power grid.

YouTube Link: https://youtu.be/AqVeRIMnY9A

Topics covered

- Structure and characteristics of wind turbines and wind power plants working off-grid.
- Structure and characteristics of wind generators used in wind power plants.
- Characteristics of electrical loads of wind power plants.
- Characteristics of on-grid wind power plant depending on airflow.
- Characteristics of wind power plant in battery charging mode.
- Characteristics of off-grid wind power plant supplying the load.
- Protection in wind power plant in case of emergencies

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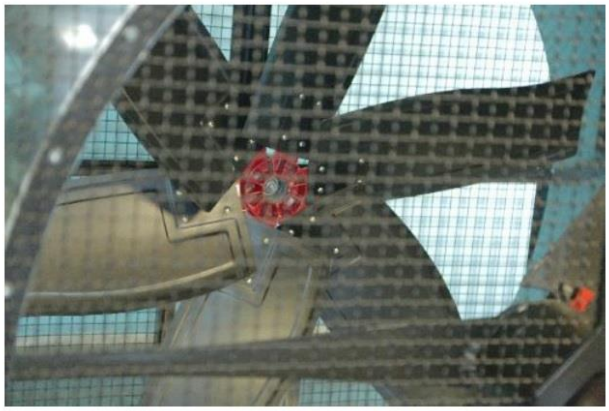
Wind Power Generation Trainer Hardware Pictures



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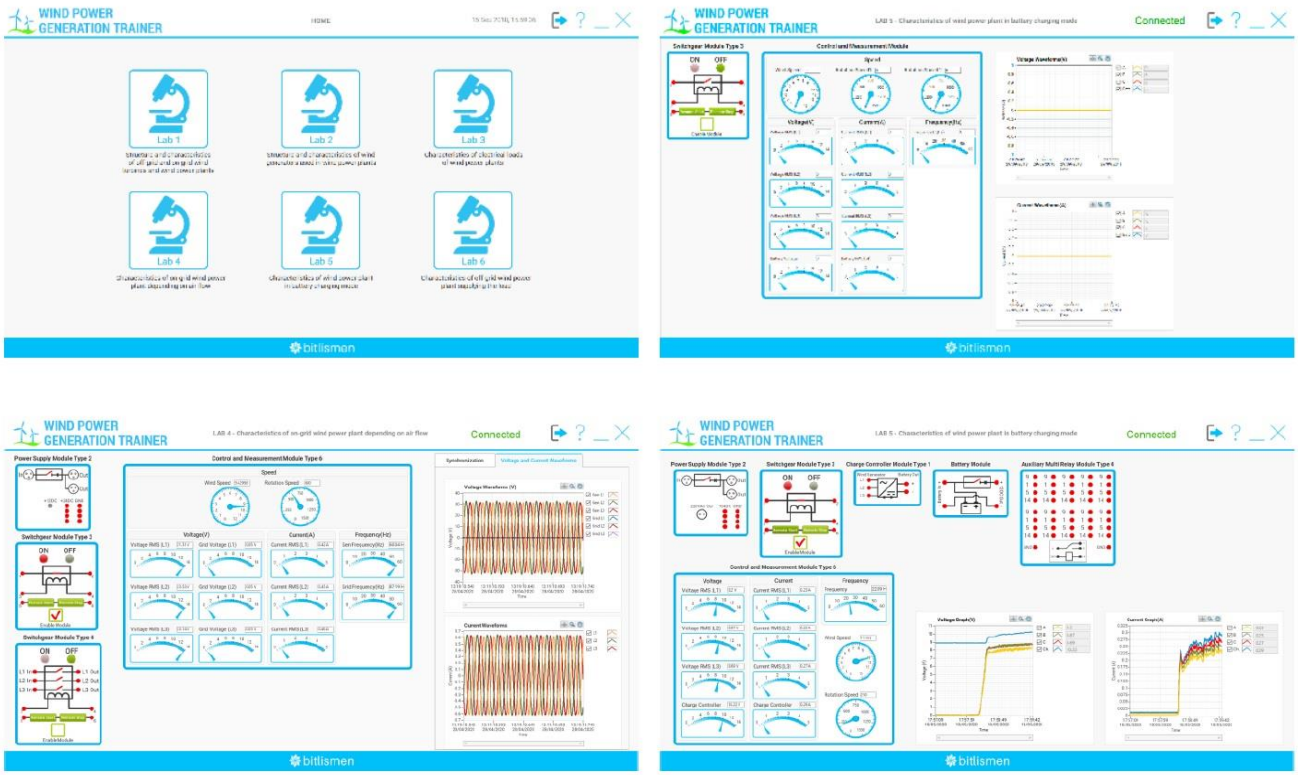
	Wind Power Generation Trainer Software Screenshots 				
3	**SOLAR & WIND POWER GENERATION TRAINER**		1	SET	*Asking the price information*

This trainer allows to investigate the synchronous operation of Solar Power Generation and Wind Power generation as small microgrid. The solar part consists of a PV panel and an array of halogen lamps as a sun simulator. The positions of both the PV panel and Sun Simulator can be controlled manually using joysticks and also from the software. It allows to simulate real light, daytime, yeartime and investigate the PV performance in different irradiation. The wind part consists of a wind tunnel and a real wind turbine-generator set. It allows to simulate real wind and investigate the generator performance in different wind speeds. In off-grid mode it allows to investigate the battery charging process using a DC charge controller and also the discharge using an AC-DC Inverter and loads. In on-grid mode it allows to implement the synchronization with the Wind Power Generation using a Grid-tie inverter.

YouTube Link: https://youtu.be/gwI6dK0r4u0

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Topics covered

- Structure and design of a solar photovoltaic power plants
- Study of photovoltaic solar panels
- Operation of the solar power station in battery charging mode
- Autonomous operation of a solar power plant supplying a load
- Protection in solar power plant in case of emergencies
- Structure and characteristics of wind turbines and wind power plants working off-grid
- Structure and characteristics of wind generators used in wind power plants.
- Characteristics of electrical loads of wind power plants.
- Characteristics of wind power plant in battery charging mode.
- Characteristics of off-grid wind power plant supplying the load.
- Protection in wind power plant in case of emergencies
- Operation of PV and Wind systems in synchronized mode.

Solar & Wind Power Generation Trainer Hardware Pictures

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Solar & Wind Power Generation Trainer Software Screenshots

4	HYDROGEN FUEL CELL TRAINER		1	SET	*Asking the price information*

This option of the Hydrogen Fuel Cell Trainer can work in off-grid mode. It consists of a hydrogen cylinder, PEM fuel cell stack, DC-DC converter, load, pressure meter, flow meter, etc. The trainer allows to investigate the main principles of fuel cell operation and its characteristics. The students will learn how the hydrogen and air reaction can produce electrical energy.
The fuel cell stack uses ambient air. The hydrogen cylinder should be refilled with 99.99% purity hydrogen by the user.

YouTube Link:
https://youtu.be/oNJpB03RUL4

Topics covered

- Structure and design of hydrogen fuel cell
- Structure and design of electrolyser
- Electrochemical processes of electrolysis
- Characteristics of the fuel cell

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No.	D E S C R I P T I O N	Merk		BITLISMEN	
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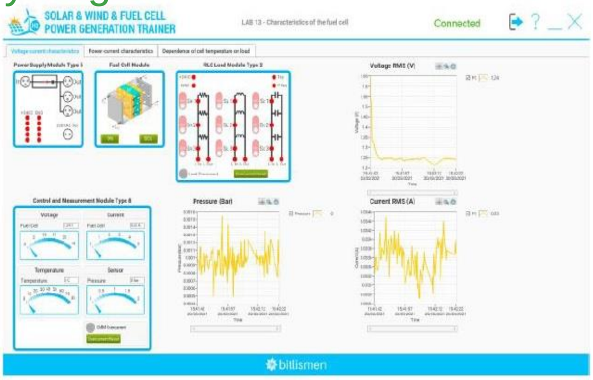
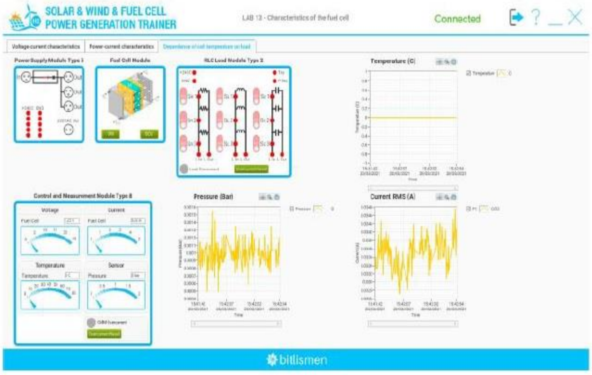
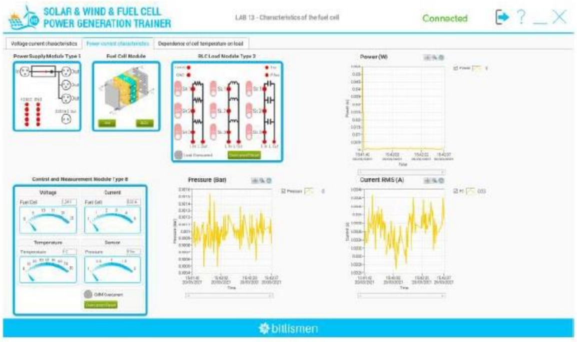
Hydrogen Fuel Cell Trainer Hardware Pictures

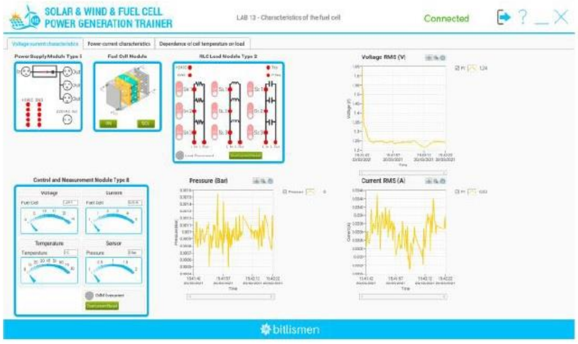



Hydrogen Fuell Cell Trainer Software Screenshots``









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5	**SOLAR & WIND & FUEL CELL POWER GENERATION TRAINER**		1	SET	*Asking the price information*	

`This trainer combines features from Solar Power Generation, Wind Power Generation and Hydrogen Fuel Cell.

The Solar Power Generation Trainer mainly consists of solar panel, solar simulator, a battery, a charge controller, an inverter, different types of loads, a solar irradiation sensor, a power supply module and a control and measurement module programmable through LabVIEW.

The Wind Power Generation Trainer mainly consists of the wind turbine-generator set, wind tunnel with a controllable air fan, wind speed meter, a charge controller, battery, an inverter, and different types of loads.

The Fuel Cell Energy Trainer mainly consists of PEM fuel cell stack with controller, hydrogen cylinder, a hydrogen flowmeter, a pressure meter, resistive load, a power supply module and a control and measurement module programmable through LabVIEW.

YouTube Link: https://youtu.be/3BVgMTcu0i4

Topics covered

- Structure and design of a solar photovoltaic power plant
- Study of photovoltaic solar panels
- Operation of the solar power station in battery charging mode
- Autonomous operation of a solar power plant supplying a load
- Structure and characteristics of wind turbines and wind power plants working off-grid
- Structure and characteristics of wind generators used in wind power plants.
- Characteristics of electrical loads of wind power plants.
- Characteristics of wind power plant in battery charging mode.
- Characteristics of off-grid wind power plant supplying the load.
- Structure and design of hydrogen fuel cell
- Structure and design of electrolyser
- Electrochemical processes of electrolysis
- Characteristics of the fuel cell

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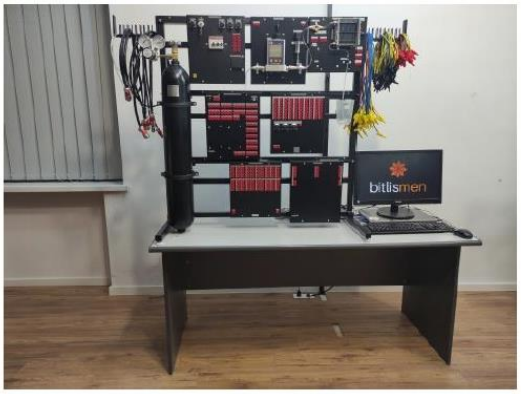
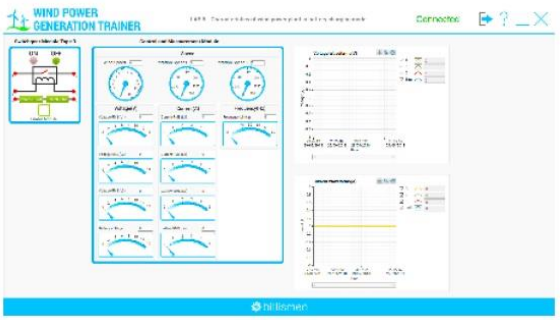
Solar & Wind & Fuel Cell Power Generation Trainer Hardware Pictures



Solar & Wind & Fuel Cell Power Generation Trainer Software Screenshots



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6	HYDRO POWER GENERATION TRAINER		1	SET	*Asking the price information*	

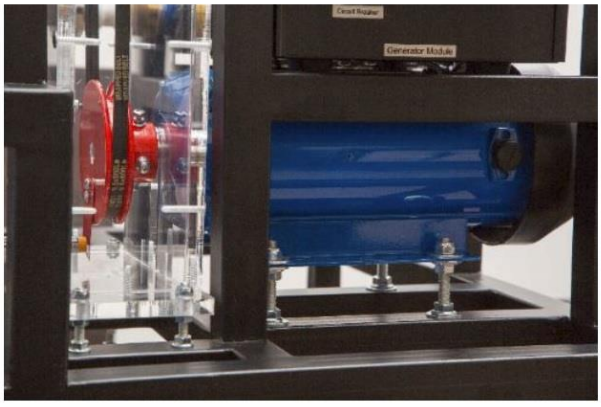
This option of the Hydro Power Generation Trainer can work in both off-grid and on-grid modes. It consists of a 3-phase synchronous generator moved by a real Pelton turbine. The trainer simulates real water flow using a pump. With the manually controlled valves, it allows to simulate different water flow and head pressure and investigate the generator performance in different conditions. In off-grid mode it allows to investigate the supply of local loads, as well as voltage and frequency regulation. In on-grid mode it allows to implement the synchronization with the mains power grid.

YouTube Link: https://youtu.be/SVfrU1zqAuA

Topics covered

- Structure of the Turbine
- Structure of the Generator
- Measurement of the Generated Current, Voltage and Power
- Main Characteristics of the turbine
- Main Characteristics of the generator
- Main characteristics of off-grid hydro power plant
- Main characteristics of on-grid hydro power plant
- Protection in hydro power plant in case of emergencies

Hydro Power Generation Trainer Hardware Pictures



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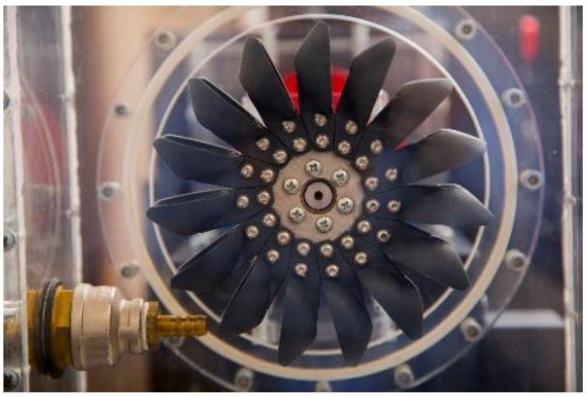
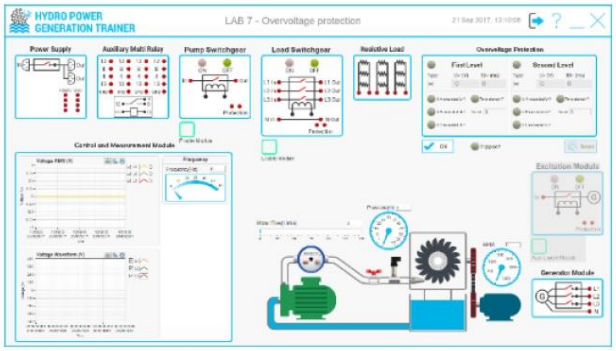
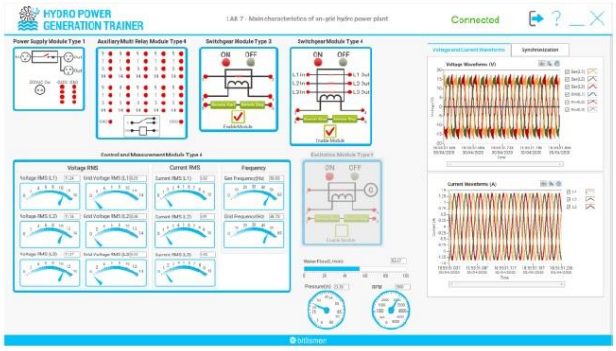


Hydro Power Generation Trainer Software Screenshots





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7	TRADITIONAL POWER GENERATION TRAINER		1	SET	*Asking the price information*	

This option of the Traditional Power Generation Trainer can work in both off-grid and on-grid modes. It consists of a 3-phase synchronous generator moved by an asynchronous motor using a VFD. With the manually controlled excitation current and motor, it allows to investigate the generator performance in different mechanical energy. In off-grid mode it allows to investigate the supply of local loads, as well as voltage and frequency regulation. In on-grid mode it allows to implement the synchronization with the mains power grid.

YouTube Link: https://youtu.be/Kev6Ni612kU

Topics covered

- Types of traditional power plants
- Energy sources and drive engines of traditional power plants
- Electric generators of traditional power plants
- Operation of autonomous traditional power plants
- Operation of on-grid traditional power plants
- Protection in traditional power plant in case of emergencies

Traditional Power Generation Trainer Hardware Pictures

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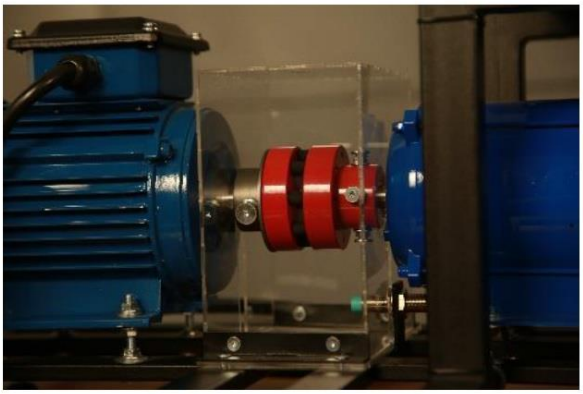
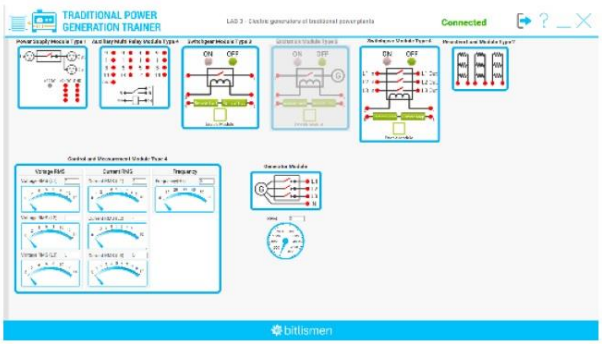
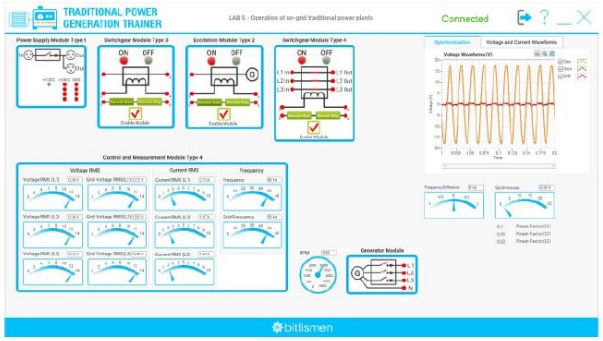


Traditional Power Generation Trainer Software Screenshots





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8	**TRADITIONAL & HYDRO POWER GENERATION TRAINER**		1	SET	*Asking the price information*	

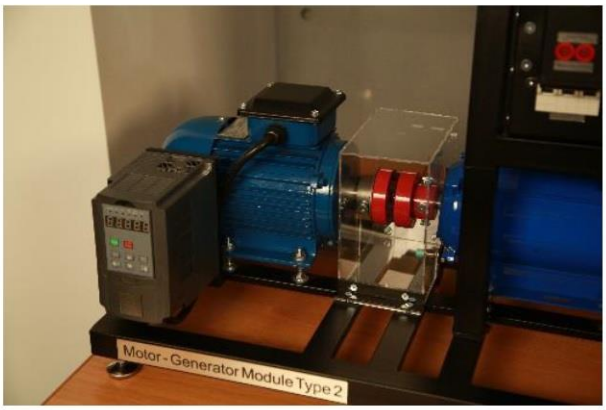
This trainer allows to investigate how the traditional and renewable generations sources work in parallel (synchronously) within a microgrid. Firstly, the Hydro Generation Trainer is synchronized to the traditional one, and vice versa. In both cases the voltage and frequency regulation is implemented. During the parallel operation of two generation sources, the users are able to adjust the power factor to have minimum reactive power generation.

YouTube Link: https://youtu.be/0npSBW-9Y6A

Topics covered:

- Types of traditional power plants
- Types of traditional power plants
- Energy sources and drive engines of traditional power plants
- Electric generators of traditional power plants
- Operation of autonomous traditional power plants
- Operation of on-grid traditional power plants
- Protection in traditional power plant in case of emergencies
- Structure of the Turbine
- Structure of the Generator
- Measurement of the Generated Current, Voltage and Power
- Main Characteristics of the turbine
- Main Characteristics of the generator
- Main characteristics of off-grid hydro power plant
- Main characteristics of on-grid hydro power plant
- Protection in hydro power plant in case of emergencies

Traditional Power Generation Trainer Hardware Pictures



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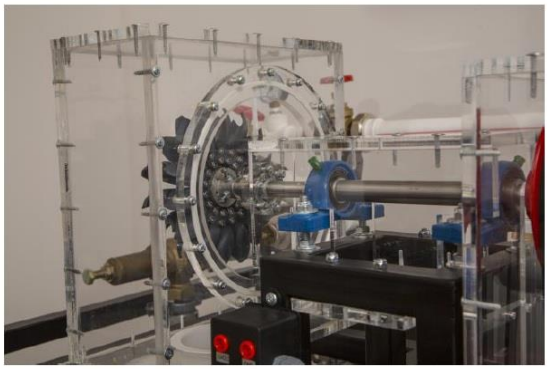

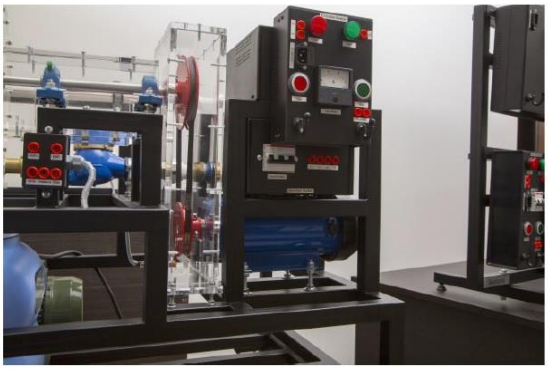

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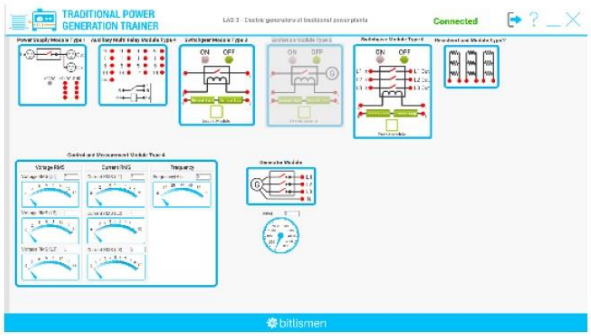

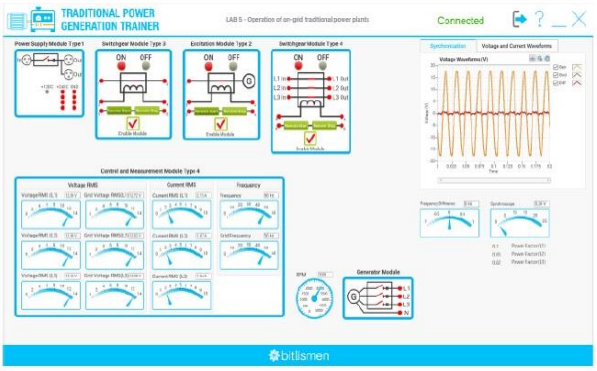

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9	**POWER TRANSMISSION TRAINER**		1 SET	*Asking the price information*	

The Power Transmission Trainer consists of step-up and step-down transformers, overhead line models and loads. It allows to simulate real AC transmission lines and investigate mechanisms of decreasing the loses on the lines, protection from real-simulated earth-short circuits and line-to-line short circuits, and reactive power compensation. It allows also to investigate the power transformer characteristics.

YouTube Link: https://youtu.be/5rCyL1Pvywo

Topics covered

- Power transmission channel structure
- Voltage transformation in power transmission
- Loses and power quality distortions during power transmission
- Reactive power compensation in power transmission
- Protection during emergencies in power transmission channels

Power Transmission Trainer Hardware Pictures

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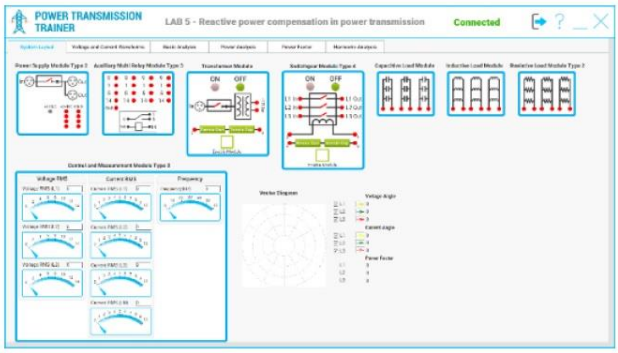
	Power Transmission Trainer Software Screenshots    					
10	**POWER DISTRIBUTION TRAINER**		1	SET	*Asking the price information*
	The Power Distribution Trainer is a combination of physical models of power busbars and switchgears. It allows investigate the control mechanisms of different buses and investigate the system behavior in case of different emergency situations. **YouTube Link: https://youtu.be/6c_LpRPpido** Topics covered • Substation structure and layout for power distribution • Electrical loads of consumers • Switching operations in substation when changing the scheme of power distribution • Protection of the distribution substation in case of emergencies Power Distribution Trainer Hardware Pictures    					

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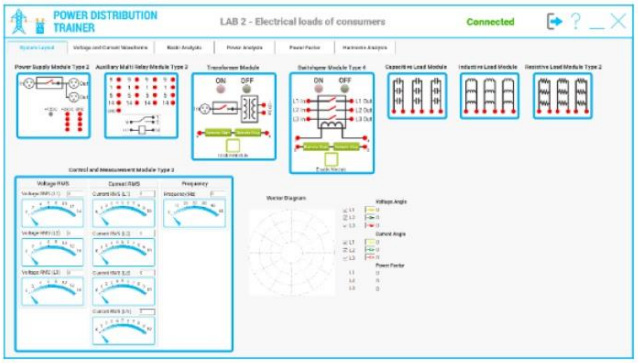
Power Distribution Trainer Software Screenshots



11	SUBSTATION AUTOMATION TRAINER		1	SET	*Asking the price information*

The Substation Automation Trainer is a small model of a distribution substation. It includes small scale modules for switchgears, busbars, circuit breakers, transformers and loads.

It allows to study basics of substation automation system. It allows to investigate how the monitoring and control (RTU) system is implemented in hardware using NI myRIO platform.

The educational trainer is a part of a real SCADA system.

Features

- Remote monitoring and control of switchgears
- Remote monitoring and power quality analyses
- Remote monitoring of protection
- Alarms & Events handling
- Real-time data monitoring
- Communication through DNP3.0 protocol

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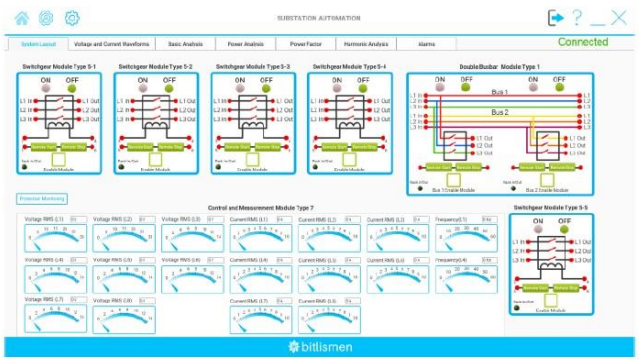
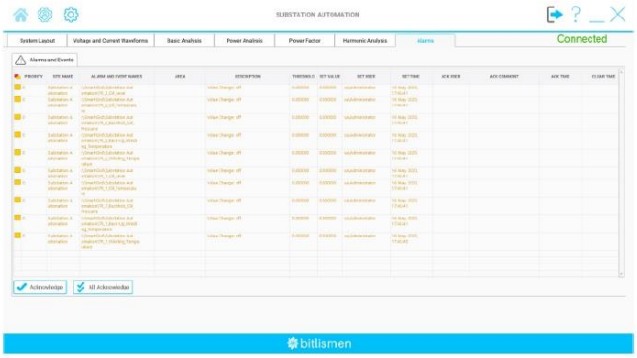
		Model / Type	Qty	Unit Sell (Rp.) Franco Bks.	Sell Price (Rp.) Franco Jkt

Substation Automation Trainer Hardware Pictures




Substation Automation Software Screenshots





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12	**RELAY PROTECTION TRAINER**		1 SET	*Asking the price information*	

This trainer includes electromechanical relay protections and microprocessor-based relay protection. The Electromechanical Relay Protection is a combination of different types of electromechanical relays and a DC generator. This trainer allows to concentrate on different protection circuits that are used in different points of real power network. It allows to investigate the relays as separate equipment, as well as their use in advanced protection circuits with and without the generator.
The microprocessor-based relay is implemented on myRIO. It allows to investigate the logic behind every protection as well as adding new types of custom algorithms using graphical programming language LabVIEW.

YouTube Link: https://youtu.be/vz88ImCyl6s

Topics covered

- Indicating Relay
- Auxiliary Relay
- Time Relay
- Undervoltage Relay
- Overvoltage Relay
- Overcurrent Relay
- Reverse Power Protection (simulated)
- Undervoltage Protection
- Undervoltage Protection (with Generator)
- Overvoltage Protection
- Overvoltage Protection (with Generator)
- Under and Overvoltage Protection
- Under and Overvoltage Protection (with Generator)
- Overcurrent Protection
- Overcurrent Protection (with Generator)
- Current Cutoff Protection
- Current Cutoff Protection (with Generator)
- Overcurrent and Current Cutoff Protection
- Overcurrent and Current Cutoff Protection (with Generator)
- Thermal Relay Protection

- Three Phase Undercurrent Protection
- Three Phase Overcurrent Protection
- Earth-Fault Overcurrent Protection
- Voltage Controlled Overcurrent Protection

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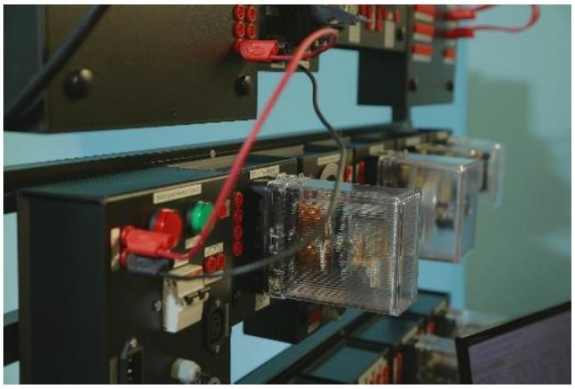
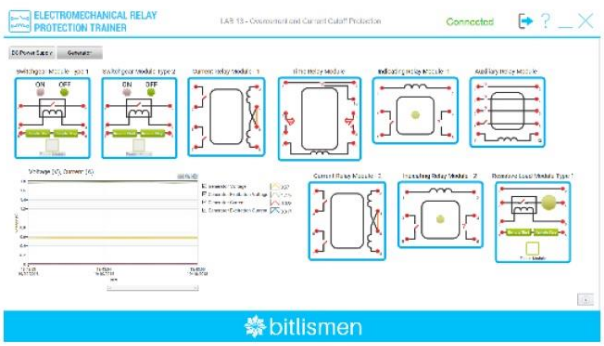
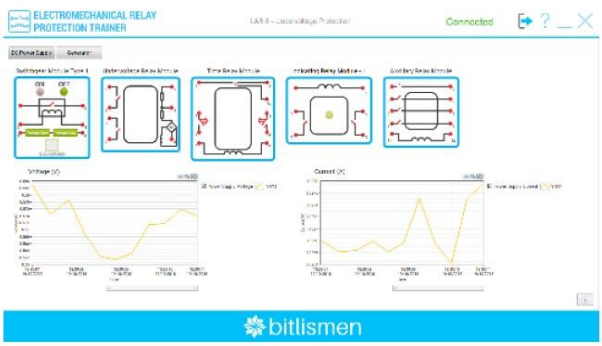
- Phase Overvoltage Protection
- Phase Undervoltage Protection
- Residual Overvoltage Protection
- Over/Under Frequency Protection
- Directional Power Protection

Electromechanical and Microprocessor Relay Protection Hardware Pictures



Electromechanical and Microprocessor Relay Protection Software Screenshots





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13	**SMART GRID TRAINER**		1	SET	*Asking the price information*	

When having Power Labs Ecosystem Trainers, with a use of the Smart Grid Software it is possible to have a Smart Grid system.
The system allows to study the main concepts of smart grid, to explore its benefits and advantages in power network. The system includes a chain of power network (traditional, hydro, wind and solar power generations, power transmission and power distribution, etc.). The system is being monitored and controlled form the SCADA software.

YouTube Link:
https://youtu.be/vJ53DrCUg1g

Features

- Fault protection on generation plants
- Synchronization between generating plants
- Switching of generation sources in case of consumption increase (energy management)
- Power transmission monitoring and fault protection
- Power distribution monitoring, control and fault protection
- Remote control and monitoring of switchgears
- Automatic emergency control of switchgears
- Power consumption measurement and power quality analyses
- Power consumption tariffs
- Alarms&Event and Historical data Handling

Required Trainers

- Solar Power Generation
- Wind Power Generation
- Hydro Power Generation
- Traditional Power Generation
- Power Transmission
- Power Distribution
- Relay Protection
- Substation Automation

Key Benefits

- Wind tunnel for real wind simulation
- Real solar panel with sun simulator
- Real hydro turbine with a pump for flow simulation
- Real 3-phase synchronous generator
- Transparent electromechanical relays
- Open-source software platform for future modifications
- Low voltage usage to avoid shock to the users
- Advanced safety measures in the whole trainer to avoid damages due to incorrect terminations.

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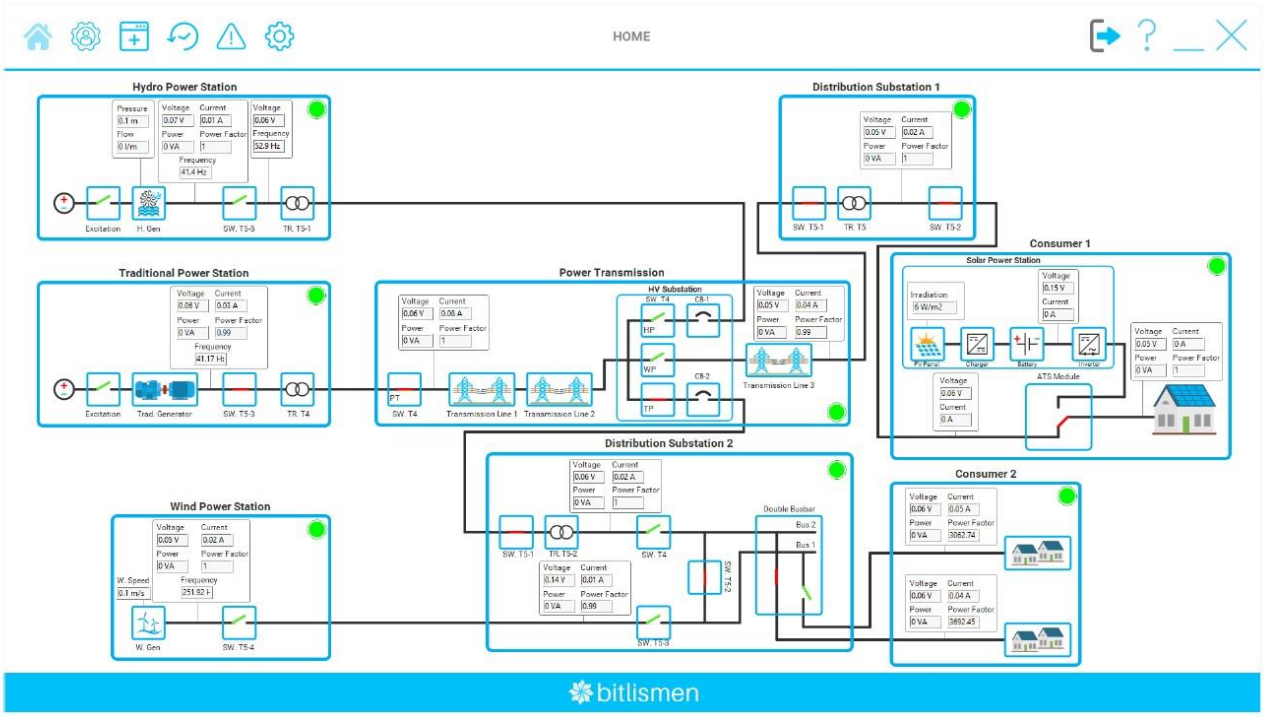
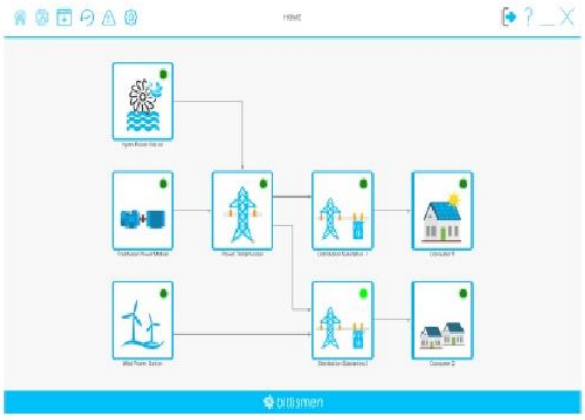
Sample Single Line Diagram

The PLE trainers can be combined to compose microgrid like in the below single line diagram. Although the modularity of the platform allows to make more complex microgrids by adding additional generation stations, power transmission lines and distribution substations.



Smart Grid Software Screenshots and Hardware Pictures



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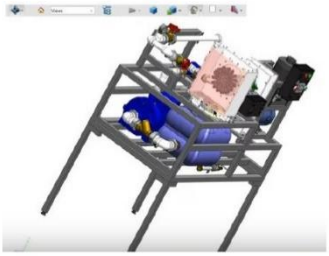
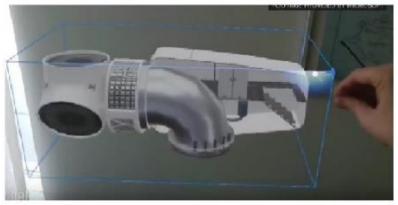
14	**ENERGY OF THE FUTURE | ENERGY 4.0**		1	SET	*Asking the price information*
	• 3D Models of the trainer's modules • Digital Twin of the trainers • AR for IIoT features • AR User Manual • Monitoring and Control from AR models	  			

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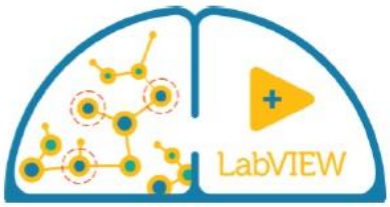
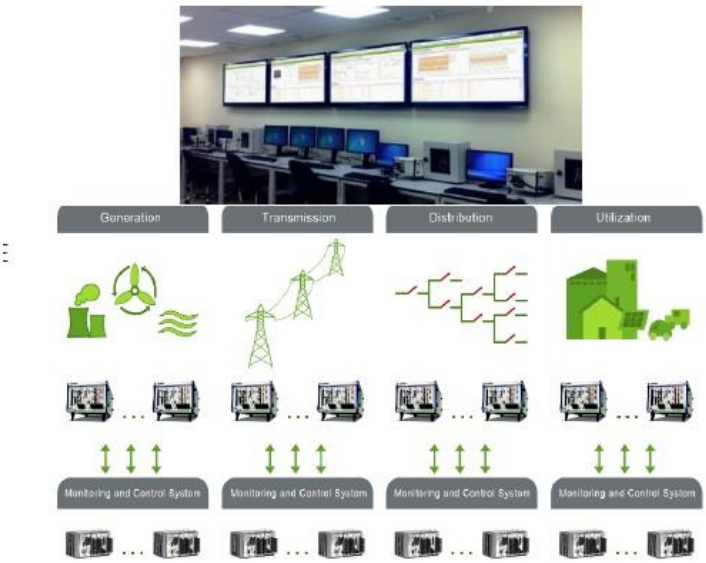
Artificial Intelligence (Machine Learning, Deep Learning, Neural Networks)
o Simple Regression
o Simple Classification
o 1D signal classification
o 1D Signal Regression
o Image Recognition
o AI based power quality analyses ▪ Voltage, current – RMS, Frequency
▪ Harmonics (up to 64th order)
▪ Active, reactive and apparent power
▪ Power factor
▪ Vector diagram





Industrial IoT
✓ Introduction to Sensors and Actuators
✓ Introduction to Data Acquisition and Control
✓ Conversion of Sensor's Data to Physical Quantities
✓ Statistical Analysis
✓ Transmission and Reception of Data
✓ PLE Trainers bidirectional data communications with IIoT gateways

Mixed Power Microgrids
o FPGA based Real Time HIL
o Simulation of various generation plants
o Simulation of power transmission and distribution
o Simulation of complex loads
o Simulation of a network grid
o Real Power In the Loop
o Mixed-grid trainer by mixed combination of PLE hardware trainers with HIL systems

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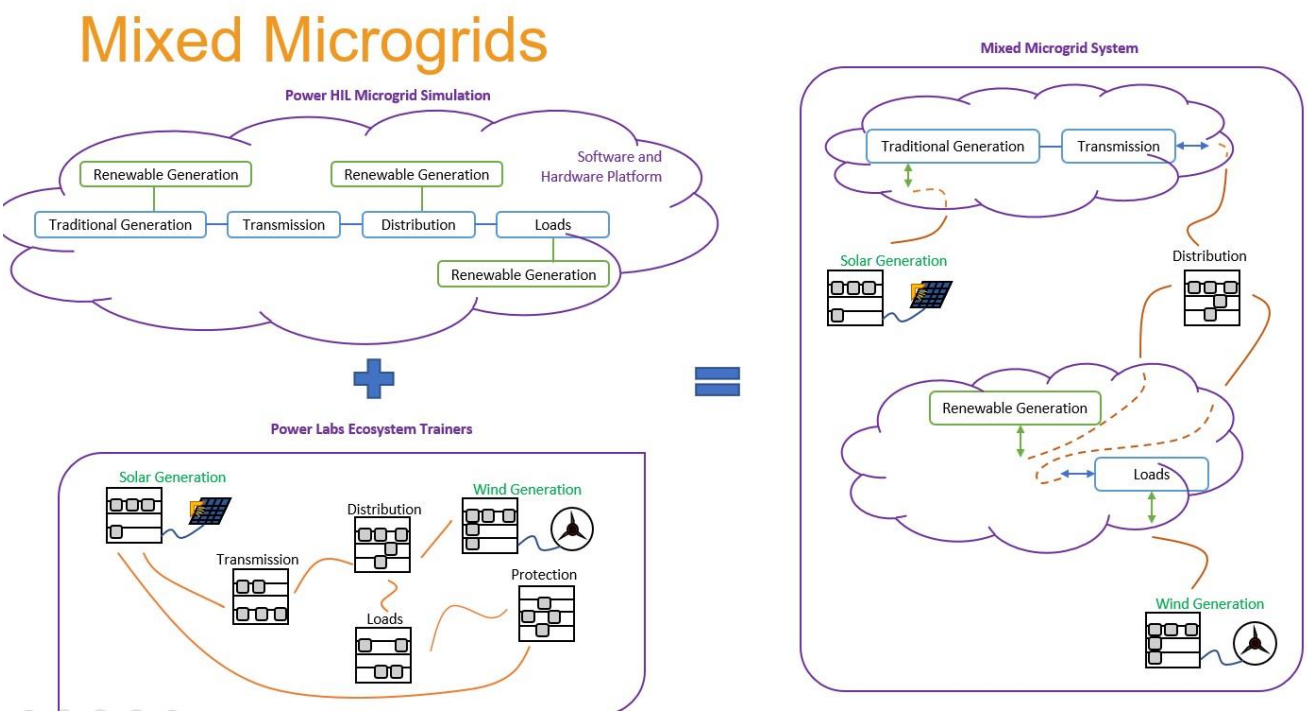

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15	**DISTANCE LEARNING**		1	SET	*Asking the price information*	

The Industry 4.0 and the technological development brought new tools and enablers for Distance Learning as well.
World is changing dramatically and bringing new challenges. The COVID19 is one of them which might reform the Educational system from its roots.
Having Distance Learning feature for the Academic Trainers is already a must. So, the educational trainers should be transformed from a physical once to the distance once.
Biltlismen's Per Students approach and iLab platform comes to fulfill this need. It's an ecosystem of hardware and software solutions which together transforms Power Labs Ecosystem product family trainers to the distance once. The Per Student approach brings hardware to the Student's hands to implement hands on activities and iLab brings student's virtually near to the big scale trainers to implement the experiments in real big scale hardware

Per Student | POWER QUALITY ANALYZER
The trainer is based on NI myRIO platform and is aimed for hands-on studies. It allows to implement IEC based power measurement and quality analyses.
The analyzer is open source, which allow to modify the algorithms inside or to add new analyses. Benefiting from the built-in FPGA and real-time controller, the system allows to make the analyses precisely and have real-time monitoring on the software including the voltage and current oscillograms, which allows to investigate transient effects in the power network. Each student will have his hands-on trainer for an individual work.
Features

- Voltage and current waveforms/oscillograms
- Voltage and current RMS
- Frequency
- THD%
- Harmonics and Interharmonics (up to 64th order)
- Active, Reactive and Apparent Power
- Power factor
- Vector diagram
- Short time flicker
- Unbalances
- Load impedance
- Voltage sags, swells and interrupti

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Software Screenshots

Per Student | MICROPROCESSOR RELAY PROTECTION TRAINER

The trainer is based on NI myRIO platform and is aimed for hands-on studies. It includes combination of different types of protection algorithms. This trainer allows to concentrate on different protection circuits and algorithms that are used in different points of real power network. It allows to investigate the logic behind every protection as well as adding new types of custom algorithms using graphical programming language LabVIEW. Each student will have his hands-on trainer for an individual work

Topics covered

- Three Phase Undercurrent Protection
- Three Phase Overcurrent Protection
- Earth-Fault Overcurrent Protection
- Voltage Controlled Overcurrent Protection
- Phase Overvoltage Protection
- Phase Undervoltage Protection
- Residual Overvoltage Protection
- Over/Under Frequency Protection

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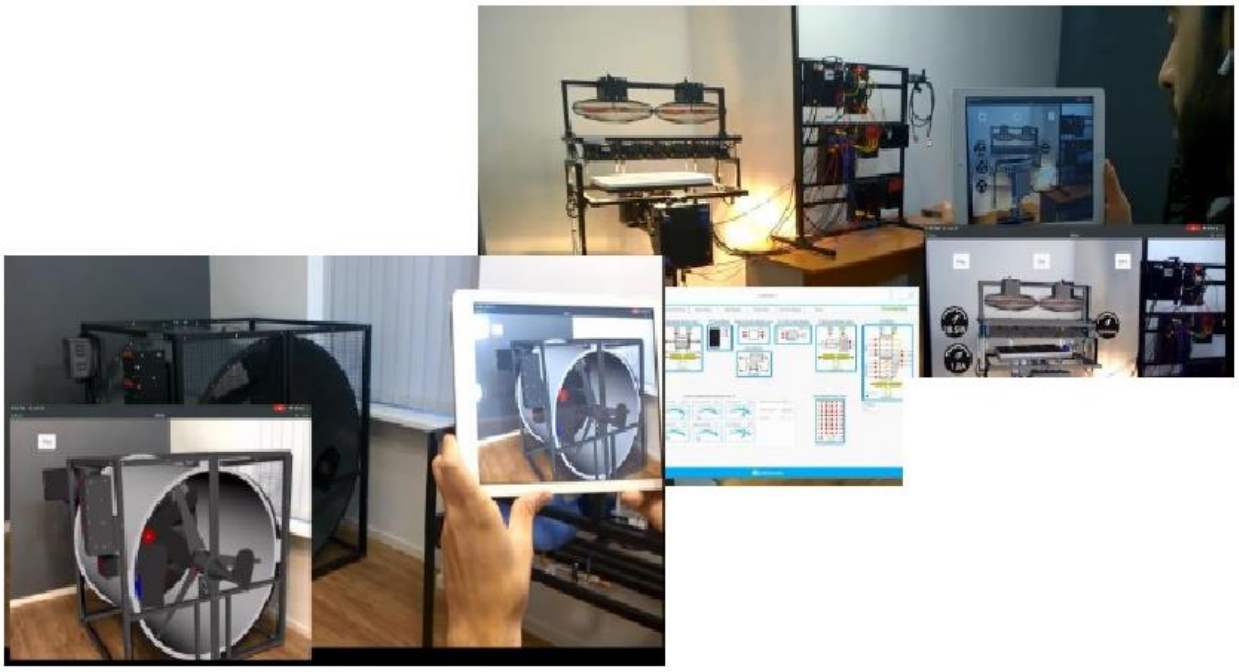
		Model / Type	Qty	Unit Sell (Rp.) Franco Bks.	Sell Price (Rp.) Franco Jkt
	• Directional Power Protection Microprocessor Relay Protection Trainer Software Screenshots  				
16	**iLab Platform**		**1**	**SET**	*Asking the price information*
	 iLab (the Internet of Laboratory Trainers) is a revolutionary concept of bringing the digital transformation into education. We designed this platform to lift the education to the new level and tackle the new challenges of distance learning. The iLab makes it possible to do engineering through internet, and in order to make this process even more deductive it incorporates other higher technologies like ThingWorx for IIoT and Vuforia Studio for Augmented Reality from PTC. With AR features it allows you to virtually bring your educational trainers from classroom to your home or wherever you are. ThingWorx Platform The ThingWorx platform is a complete, end-to-end technology platform designed for the industrial Internet of Things (IIoT). It delivers tools and technologies that empower businesses to rapidly develop and deploy powerful applications and augmented reality (AR) experiences. Thingworx platform provides a complete set of tools and functionality to: • Connect disparate devices and applications to enable access to multiple data sources • Build complete IIoT solutions and augmented reality (AR) experiences quickly and easily • Analyze complex industrial IoT data for real-time insights, predictions and recommendations • Manage the performance of connected devices, processes, and systems • Experience and engage with physical objects in a more contextualized, actionable way Vuforia Studio				

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Vuforia Studio can transform existing CAD and IoT data into detailed AR experiences that provide critical information to front-line workers when and where they need it most. Vuforia Studio is a web-native, easy-to-use tool for authoring domain and task-specific experiences. These experiences provide an integrated view of digital and physical product data, dashboards, and alerts with 2D, 3D, and augmented reality.
The iLab platform is a web service infrastructure that provides manageable access to the online students and professors. Users of the distance trainers can be globally distributed across an arbitrary number of locations linked only by the Internet. The iLab not only helps to neglect the lockdown effect on engineering education by making the distance learning effective more than ever, but also makes it possible to virtually share the technical laboratories with other universities, implement joint experiments, implement live demonstrations for big amount of users and benefiting the unlimited capabilities of the Internet.
The Power Labs Ecosystem Trainers mentioned below can be integrated with the iLab platform:

- ✓ Solar Power Generation Trainer
- ✓ Wind Power Generation Trainer
- ✓ Hydrogen Fuel Cell Trainer
- ✓ Hydro Power Generation Trainer
- ✓ Traditional Power Generation Trainer
- ✓ Power Transmission Trainer
- ✓ Power Distribution Trainer
- ✓ Substation Automation Trainer
- ✓ Relay Protection Trainer
- ✓ Smart Grid

YouTube Playlist Link: https://youtu.be/QOMU5s7H2XI

There are different options of iLab configurations from Basic to Advanced with Distance Learning Assistant and iLab AR integration.

Basic	The trainers are able to be fully controlled and monitored from the software. The trainers automatically re-wire their components for each practical experiment without a need of local human interaction. The trainers' UI is accessible from the browser over the internet. The real-time bidirectional data communication with the trainer is provided.
Advanced	The trainers are able to be fully controlled and monitored from the software. The trainers automatically re-wire their components for each practical experiment without a need of local human interaction. The trainers' UI is accessible from the browser over the internet using the specially designed web platform. The web platform has the following features: -Advanced user management(add/remove/edit) with different access privileges -Creation of schedules for accessing the trainers with specified start and end time and invitation of users -Live video steaming of the lab room (to see how the trainer hardware is operating) -Real-time bidirectional data communication with the trainer is provided
Distance Learning Assistant	The trainers have a web-based software assistant, that allows the users to remotely implement the re-wiring of the trainer components for each practical lab. The wrong wiring done by the users are physically implemented by the assistant but it does not damage the trainer and does not cause any emergencies.
iLab AR	With the AR feature option, each trainer has its digital twin which the students can connect to using the AR glasses or tablets. With this option the iLab will create two-way real-time communication for monitoring and control between the real trainer and its digital twin. The

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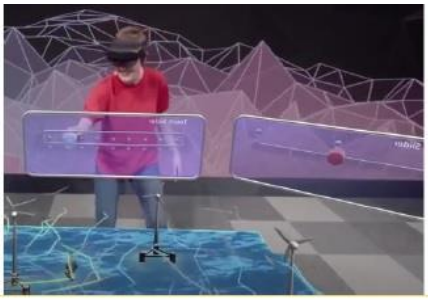
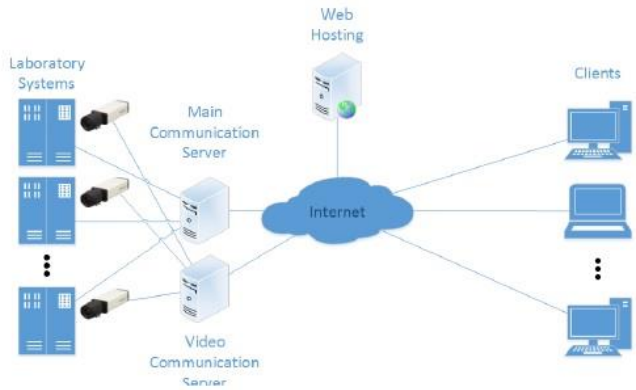
digital twin can bee zoomed in and out, rotated, and fully controllable by the user.



ɔmmunication Architecture:



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