

◆ Hybrid Solar-Wind Turbine Station

ATHJ1-1

Discover the future of practical learning with our hands-on educational equipment for renewable energy. Our Wind/Solar Hybrid System provides a hands-on experience, helping learners grasp electrical concepts, efficiency calculations, and energy integration. This allows learners to acquire crucial skills for green energy and contribute to a sustainable future.



Benefits and Learning Outcomes:

- Implement Hands-On Experiments to Demonstrate Electrical Characteristics of Wind Turbines and Solar Panels
- Conduct Practical Assessments to Gauge the Efficiency of a Wind/Solar Hybrid System
- Engage in Wiring and Configuration Exercises for Direct Application in Energy Grid Integration
- Execute Practical Scenarios for Diagram Creation and Cabling in Remote Energy Utilization
- Explore Real-Life Components and Installation Techniques in Wind/Solar Hybrid Systems
- Utilize Lab Equipment for Precise Electrical Measurements Across Varied Parameters
- Interpret Real-Time Measurement Results Through Practical Examples
- Simulate and Analyse Practical Scenarios Reflecting the Impact of Wind Strength and Sunlight on System Efficiency
- Construct and Examine Practical Models of the Complete Energy Chain, Emphasizing Production, Storage, Utilization, and Behavioural Dynamics.
- Implement Simulated Sunlight Scenarios to Assess and Enhance Wind/Solar Hybrid System Efficiency
- Using smartphone apps, students can observe real time parameters of the system, thus making learning experience more interesting

Key features of our system:

- **Wind simulation for the turbine:** understanding wind dynamics is crucial, and our wind simulation feature facilitates hands-on learning. Simulate varying wind speeds (0-600 rpm) using the included speed controller and SOMOVE software, allowing students to explore wind turbine technology with real-world scenarios.
- **Solar light simulation:** Our solar light simulation device accurately mimics sunlight, offering practical insights into photovoltaic systems. This compact tool, with wind simulation, not only ensures a realistic solar learning experience but also acts as a cooling device for photovoltaic cells, observing efficiency at different temperatures while preventing overheating.
- **Photovoltaic Cells:** empower learners with our Photovoltaic Solar Panel featuring monocrystalline silicon cells. With adjustable tilt angles, robust construction, and sealed IP65 connections, this panel offers hands-on exploration of solar energy principles.
- **Wind Turbine:** explore renewable energy with our Three-Phase 360W Wind Turbine. Producing 360W at 600 rpm, it offers both three-phase AC and 100V DC output. The compact, mobile design, coupled with wind simulation capabilities, provides a comprehensive introduction to wind energy technology.
- **Electrical Cabinet:** embark on a practical learning journey with our Educational Electrical Cabinet. Compact and engineered for vocational training, it includes essential components like circuit breakers, differentials, and surge protection. This mobile unit offers hands-on experience in renewable energy systems.
- **User friendly interface:** since we value practicality our hybrid station has all ports, switches on the front of the machine case. This ensures hassle-free experience.
- **Included addons free of charge:** our sets come with included additional tools and meters to provide practicality experience and better notice practical connection. Tools/Meters that are included: solar radiation meter, digital level and slope meter, all required cables and software.
- **Smartphone integration:** The Victron® connect smartphone app provides real-time insights, allowing students to grasp the intricacies of smart energy management. With features like customizable cut-off voltages, adjustable output parameters, and ECO mode, students gain hands-on experience in observing battery connected systems parameters. If system is connected on the grid, then using Solax® cloud app you can watch in real time as energy is instantly used during high demand and surplus energy is sent to the grid when the demand is low. The app's graphs display the net energy balance, giving you a clear view of energy production and consumption
- **Functionality Coupled to Grid and Disconnected:** Our renewable energy systems are versatile and can be connected to the electrical grid or disconnected from the grid and used in isolation:

If the solar/wind hybrid station is connected to the grid, then a Solax® inverter efficiently converts energy generated by solar panels and wind turbines into electricity for the grid at 230VAC and 50Hz. The inverter is equipped with safeguards against polarity reversal and overloads, ensuring a reliable and secure operation.

Inverter parameters	Specification
<i>Input voltage range</i>	45-430VDC
<i>Input max. current</i>	14A
<i>Output voltage</i>	230VAC 50Hz
<i>Output max. current</i>	3.3A
<i>Output power</i>	700W

If solar/wind hybrid station is disconnected and isolated from the power grid, the generated energy can be used to power electrical devices. First, the energy produced is directed to charge two 12V batteries. These batteries are connected to a Victron® inverter, which steps up the voltage to 230VAC. This converted power can then be employed to power various electrical devices. It's crucial to note that during high-load situations, the batteries may not be actively charged, and the energy may bypass the charging process, ensuring uninterrupted usage for connected devices.

Inverter parameters	Specification
<i>Input voltage range</i>	18.4-34VDC
<i>Input max. current</i>	15A
<i>Output voltage range</i>	230VAC 50Hz
<i>Output current</i>	2A
<i>Output power</i>	500W

Technical characteristics of individual components:

❖ ELECTRICAL CABINET

Embark on a transformative learning experience with our Educational Electrical Cabinet – a compact yet powerful hub tailored for vocational training in renewable energy. With dimensions of 800 x 600 x 1850mm, this mobile unit is engineered for practical education.

- 2 circuit breakers
- 1 300mA-16A differential
- 1 30mA-16A differential for added protection
- 1 lightning surge protection + fuses
- 3 100 Wh resolution meters
- 1 Mushroom head emergency stop
- 1 source inverter
- 1 charging controller 12/24/48VDC-20A
- 1 set of solar connectors
- 1 700W rated inverter output
- 1 Voltage converter 24VDC/230VAC-400W
- Dimensions: 800 x 600 x 1850mm



❖ PHOTOVOLTAIC SOLAR PANEL 115WC ON TILTING FRAME

Empower the next generation of green innovators with our Photovoltaic Solar Panel designed for vocational schools. With its adjustable tilt angle, sturdy aluminium frame, and efficient monocrystalline silicon cells, students can explore the principles of solar energy in a practical and engaging way.

- Voltage in open circuit: 23.32 Voc
- Current in short circuit: 6.61 A
- Operational voltage: 19V DC
- Optimal operational current: 6.04A
- Peak power: 115Wc (variation of $\pm 10\%$ depending on the series)
- Sealed connections rated IP65 – 1000V at the rear of the panel.
- Cell type: Monocrystalline silicon
- Sturdy aluminium frame.
- Output: 19 VDC – 6.04 A – 115Wc per panel on 2 photovoltaic terminals.
- Tilt angle measuring device included (Insize 2170-1)
- Adjustable tilt angle ranging from 5° to 90°
- Two ball joints with clamping levers for orienting the panel to the desired tilt angle.
- Lightweight and easily manoeuvrable.
- Folded dimensions: 1030 x 668 x 100mm (with $\pm 10\%$ variation depending on the series)
- Addons: pyranometer, angle measuring device, cables.



❖ ARTIFICIAL SOLAR SOURCE

This innovative solution addresses sunlight loss by implementing artificial illumination with a spectral composition closely resembling natural sunlight. The artificial light achieves sufficient intensity, enabling the solar panel to effectively harness solar energy. The device is designed to accommodate three solar panels on its sides, incorporating several technical features.

- Achieves 40% of solar energy generation capacity or 3.6 kW
- Generated artificial light frequency spectra resembles that of a natural sunlight
- Works with 3 solar panels attached to sides
- The wind simulation feature not only creates wind conditions but also serves as a cooling mechanism for solar cells.
- 2 Temperature sensors that protects device and solar panels from overheating
- Frame is built from durable material
- Dimensions: 700x750x1520mm



❖ THREE PHASE 360W WIND TURBINE

Explore renewable energy with our Wind Turbine Learning Kit, producing 360W at 600rpm through three-phase AC and 100V DC outputs. Simulate wind conditions hands-on using the included speed controller, offering dynamic learning experiences. Compact, mobile, and equipped with practical assignments, this kit provides a comprehensive introduction to wind energy technology.

Wind turbine specifications:

- Three-phase output: 3 x 70V AC, generating 360W at 600rpm on safety terminals.
- Current output 100V DC, producing 360W at 600 rpm on safety terminals.
- Option to choose between these outputs using an installed rectifier or direct connection.

Wind simulation features:

- Squirrel-cage three-phase asynchronous motor.
- Speed controller that simulates wind turbine speed within the range of 0-600 rpm.
- Maximum speeds of the turbine can be achieved without any safety problems ether on the grid or on the isolated site mode.
- Using the supplied SOMOVE software, the PC can change:
 - Acceleration of the wind speed.
 - Deceleration of the wind speed.



General features:

- Equipped with a wheeled frame with brakes.
- Overall dimensions: 845x720x1500 mm
- Top cover constructed with an Aluminum frame and Plexiglass sides
- Power supply: 1P+N+E 230V AC - 50/60Hz (10m lead with mains plug)
- Non-contact tachometer (Insize 9223-120)
- Supplied with: Practical assignments presented in the form of measurements/tests; RJ45-USB cable for linking between the speed controller and the PC; Schneider® SoMove software.

❖ SMART FEATURES

When operating off the power grid, charged batteries and a specialized inverter can supply power to your home appliances, with the Victron® Connect app allowing easy monitoring and control of battery levels, cutoff voltages, power output, and ECO mode via your smartphone. In isolated system setting, the Solax® cloud app enables observation of the net energy produced and consumed.

- Sense battery temperature and voltage
- Receive alerts when the battery voltage reaches a critical low.
- Safeguard your battery by setting cut-off and restart voltages.
- Change output voltage and frequency of the battery.
- Turn on/off ECO mode for enchanted power efficiency. In ECO mode inverter shuts down, thus saving battery power.
- Observe power balance when system is connected to the grid.

