

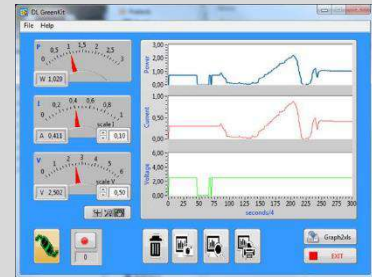


## SOLAR-WIND-FUEL CELLS ENERGY TRAINER



**DL GREENKIT**

This trainer has been designed for the study of renewable energies sources: **solar energy, wind energy and hydrogen fuel cell systems.**



Complete with connecting cables, experiment manual, connection to PC through the RS485 serial port and **software for data acquisition and display.**

### TRAINING OBJECTIVES

#### Study of a solar system

- Voltage and current in a solar panel as a function of light intensity
  - Measuring  $V_{OC}$  and  $I_{SC}$  characteristics of a solar panel
  - Influence of temperature on solar panels
  - Connecting solar panels in parallel
  - Connecting solar panels in series.
  - Influence of tilt angle on solar panels
  - Effect of shade on solar panels
- Current-Voltage characteristic, power curve and efficiency of a solar panel.
  - Study of solar panel under load. (Tracing the VI and power curve to determine MPP).
  - Solar panel efficiency

#### Study of a wind system

- The wind energy experiment-study of influence of wind speed and direction
  - Studying and understanding the power from the wind

### COMPONENTS INCLUDED

- Reversible PEM fuel cells
- PEM Electrolyser
- Reversible hydrogen fuel cell to assemble
- Hydrogen and oxygen tanks
- Syringe
- Motor and fan with propeller blade
- 1 Watt solar panel
- 0.75 Watt solar cell
- Mini wind turbine (wind power generator)
  - Blade pitch, blade profile and number of blades can be evaluated
  - Vane aligns the turbine automatically to the direction of the wind
  - Special 3 phase alternator for higher output power
- Vehicle chassis with LED light & motor
- Battery pack with connecting leads
- Three DC instruments: range 10 V, 2 A.
- Decade Resistor



- Influence of wind speed on generated power.
- Influence of wind direction on generated power.
- The study of influence of the wind turbine characteristics on generated power.
  - Influence of the number of rotor blades.
  - Influence of the pitch.
  - Influence of the blades shape.
- The study of current-voltage characteristic of the wind generator; the influence of the load over rotor movement
  - Trace the current-voltage characteristic curve of a wind generator
  - Finding the MPP for different wind speeds (Tuning for max. power)
  - Study the “stability” of the wind turbine when it is influenced by the load (braking mode)

### Study of a fuel cell system

- Understanding Fuel Cell General Installation
- Understanding Fuel Cell Structure (Assembling a fuel cell)
- Electrolyser: Producing Hydrogen as an electrical energy storage method
  - Determining the Minimum Voltage for Water Decomposition
  - Determining the flow of gas generated by the electrolyser
  - Determining the characteristic V-I curve of PEM electrolyser.
  - Energy efficiency and faraday efficiency of PEM electrolyser.
- Fuel cell: Producing electrical energy from stored Hydrogen.
  - Determining the V-I characteristic and power curve of a PEM fuel cell.
  - Energy efficiency and faraday efficiency of PEM fuel cell.

### Study of a hybrid (Autarkic) system

- Implementing hybrid wind solar power system with hydrogen storage.
- Implementing hybrid fuel cell solar power system: studying the autonomy of a hydrogen powered car.

### GENERAL FEATURES

Average training hours: 8h.

Approx. packing dimensions: 0.81x0.61x0.61 m.

Net weight: 29 kg.

### Note:

DL GREENKIT requires table fan and halogen lamps. They are not included in the kit.