



## SOLAR/WIND ENERGY ADVANCED TRAINER



### DL SUNWIND-AT

Modular trainer for the theoretical and practical study of the electrical installations with photovoltaic solar energy and wind energy.

With the solar/wind advanced trainer it is possible to perform experiments to determine the characteristics of a wind generator and a photovoltaic panel, study their off-grid operation with a battery charge regulator and their on-grid operation with the connection to the mains network. The complete system is supplied with a sunlight simulation module for indoor use.

#### TRAINING OBJECTIVES

##### Study of wind turbine:

- Identification of wind turbine components
- Operating the Wind Turbine Breaker
- Calculating wind power
- Measuring Wind turbine electrical power
- Study of wind turbine with load.

##### Study of off-grid wind system:

- Dimensioning of an off-grid wind system.
- Battery regulating and charging
- Supplying DC load with wind power stored in a battery
- Supplying AC load with wind power and a battery.
- Calculating the system autonomy with different loads

##### Study of on-grid wind system:

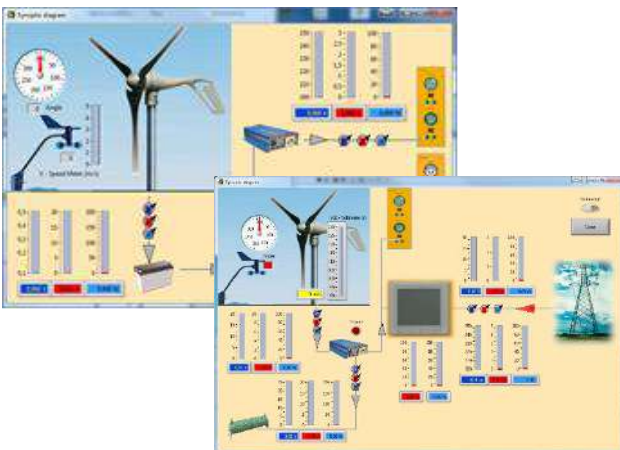
- Measuring the electricity produced by the wind generator, delivered/taken from the mains grid, and the loading of AC lamps.
- Calculating the efficiency of the complete on-grid wind energy system.
- Investigating the response of a wind system to a mains failure
- Energy balance.
- Measuring solar radiation: Changing the inclination and azimuth of the solar panel

#### TECHNICAL SPECIFICATIONS

- Three phase rectifier bridge module
- DC load module. It includes a 20W dichroic lamp and 3W LED lamps, with independent switches.
- Load management modules with three independent single-phase outputs for the dynamic study of different load types
- Network monitor module used to measure electrical parameters in a single phase circuit
- Circuit breaker module
- Fixed single phase power source rated at mains voltage with auxiliary 12 Vdc fixed regulated voltage output to power measurement modules
- 100Ah battery with battery protection module
- Motor/generator group for the simulation of a wind turbine. Includes a three-phase permanent magnet generator of aprox. 400w.
- Three-phase inverter for asynchronous induction motor drive and speed control. Rated power: 1.5 kW
- Off-grid inverter module, with pure sine wave output at mains voltage.
- Wind turbine charge controller with brake system.



- Investigating the PV module response to shadow formation
  - Recording the characteristics of the solar modules: Solar Panel Voltage-Irradiation Curve, Solar Panel Current-Irradiation Curve (calculating the inner resistance of the solar panel), Obtaining the solar panel current-voltage curve, Obtaining the solar panel current-power curve, Measurement of the voltage and current of the photovoltaic module with overload
  - Off grid system: Measuring the generated power of a PV system and battery charging
  - Off grid system: Using Solar Panel and Battery to supply a DC Load
  - Off grid system: Design and testing of a standalone PV system in direct storage operation and 230V AC
  - On grid system: Measuring the electricity delivered to the mains grid
  - On grid system: Measuring the electricity produced by the solar panel, delivered/taken from the mains grid, and the loading of AC lamps
  - On grid system: Determining the efficiency of the grid connected inverter
  - On grid system: Investigating the response of a PV system to a mains failure
- Multifunction measurement module for wind applications: It includes four separate instruments to measure all fundamental parameters for the study of a wind-system.
  - Electronic charge regulation module, with LCD display, MPPT tracking and energy monitor.
  - Active DC load used in the renewable energies laboratories configurable as constant resistance or constant current.
  - Inclined photovoltaic panel, 90W, 12V, complete with a cell for measuring the solar irradiation and a temperature sensor.
  - A Grid-tie inverter with output at mains voltage, 12V, 300W.
  - Multifunction measurement module: solar irradiation (up to 1000 W/m<sup>2</sup>), solar panel temperature (up to 400°C), 2 DC power meters (65Vdc, 20Adc, 1000W) and 1 AC power meter (512Vac, 20Aac, 1000W).
  - Off-grid inverter module, with sinusoidal output at mains voltage. Average power: 300 W.
  - Sun simulator consisting of halogen lamps to provide energy to the photovoltaic module for indoor use
  - Three level frame



The Solar/Wind Energy Advanced Trainer is supplied with a software developed in LabVIEW that is able to communicate with the main components of the modular system via RS485 serial communication using Modbus RTU protocol, in order to perform a data acquisition and processing.