# PHOTOVOLTAIC SOLAR ENERGY ADVANCED TRAINER

**DL SOLAR-AT**

Modular trainer for the theoretical and practical study of the electric energy generation from photovoltaic panels. With the Photovoltaic Solar Energy Advanced Trainer it is possible to perform experiments to determine the characteristics of a photovoltaic panel, study its off-grid operation with a battery charge regulator and its on-grid operation with the connection to the mains network.

The complete system is supplied with a sun simulation module for indoor use.

## TRAINING OBJECTIVES

- o Measuring solar radiation: Changing the inclination and azimuth of the solar panel
- o Investigating the PV module response to shadow formation
- o 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

- o Off grid system: Measuring the generated power of a PV system and battery charging
- o Off grid system: Using Solar Panel and Battery to supply a DC Load
- o Off grid system: Design and testing of a standalone PV system in direct storage operation and 230V AC

## TECHNICAL SPECIFICATIONS

- – Electronic charge regulation module, with LCD display, MPPT tracking and energy monitor.
- – Load management module with three independent single-phase outputs for the dynamic study of different load types.
- – Active DC load used in the renewable energies laboratories configurable as constant resistance or constant current.
- – 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
- – DC load module. It includes a 20W dichroic lamp and a 3W LED lamp, with independent switches.
- – Inclinable photovoltaic panel, approx. 90W, 12V, complete with a cell for measuring the solar irradiation and a temperature sensor.
- – Battery and battery protection module.
- – A Grid-tie inverter output at mains voltage, 12V, 300W.

- o On grid system: Measuring the electricity delivered to the mains grid
- o On grid system: Measuring the electricity produced by the solar panel, delivered/taken from the mains grid, and the loading of AC lamps
- o On grid system: Determining the efficiency of the grid connected inverter
- o On grid system: Investigating the response of a PV system to a mains failure

- − Multifunction measurement module: solar irradiation (up to 1000 W/m2), 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.
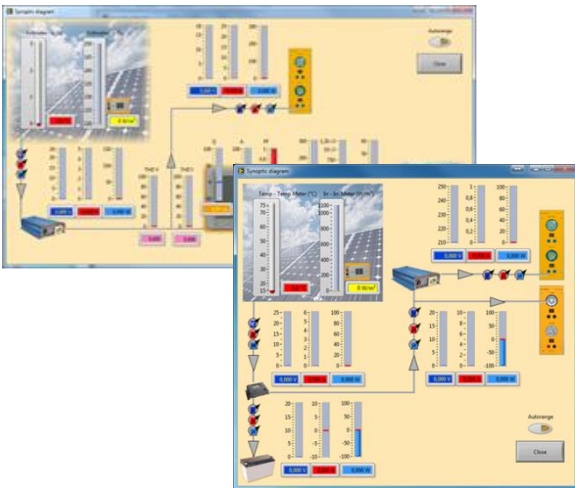


The Photovoltaic Solar Energy Advanced Trainer is supplied with a software developed in LabVIEW that communicates with the main components of the modular system via RS485 serial communication using Modbus RTU protocol to perform data acquisition and processing.