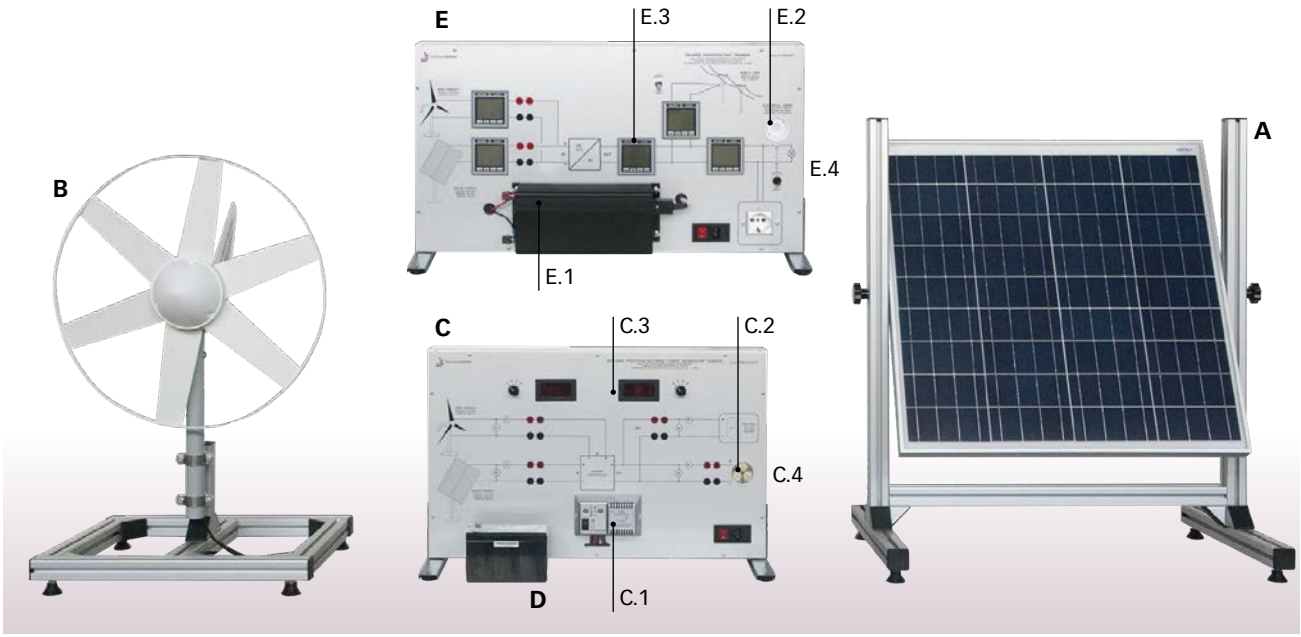
ON-GRID / OFF-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER

Mod. PVWG-E/EV
Mod. PVWG/EV (computerized vers.)



INTRODUCTION

Energy saving and environmental pollution reduction are crucial global issues. Using renewable energies as alternative sources to fossil fuels can address both issues, with great benefits especially in countries where traditional energy sources are scarce.

Considering the above, this system enables experimental investigation on the conversion of solar energy into electricity exploiting the photovoltaic effect and of wind energy into electricity by means of a wind power generator. The equipment is manufactured using real components available on the market.

DESCRIPTION

System configuration:

- Stand-alone (isolated from the grid) or
- Grid-connected

The system consists of:

A) Silicon cell photovoltaic panel
- **A.1)** Solar radiation sensor (*PVWG/EV* only)
- **A.2)** PV panel temperature sensor (*PVWG/EV* only)

B) Horizontal axis wind power generator
- **B.1)** Wind speed sensor (*PVWG/EV* only)

C) Table top control panel for **OFF-GRID operation** including:
- **C.1)** Charge regulator
- **C.2)** DC electric load (lamp)
- **C.3)** Electric instrumentation for detecting the energy flows in the circuit branches
- **C.4)** PC data acquisition system (*PVWG/EV* only)

D) Buffer battery

E) Table top control panel for **ON-GRID operation** including:
- **E.1)** Grid-Tie Inverter
- **E.2)** AC electric load
- **E.3)** Electric instrumentation for detecting the energy flows in the circuit branches
- **E.4)** PC data acquisition system (*PVWG/EV* only)

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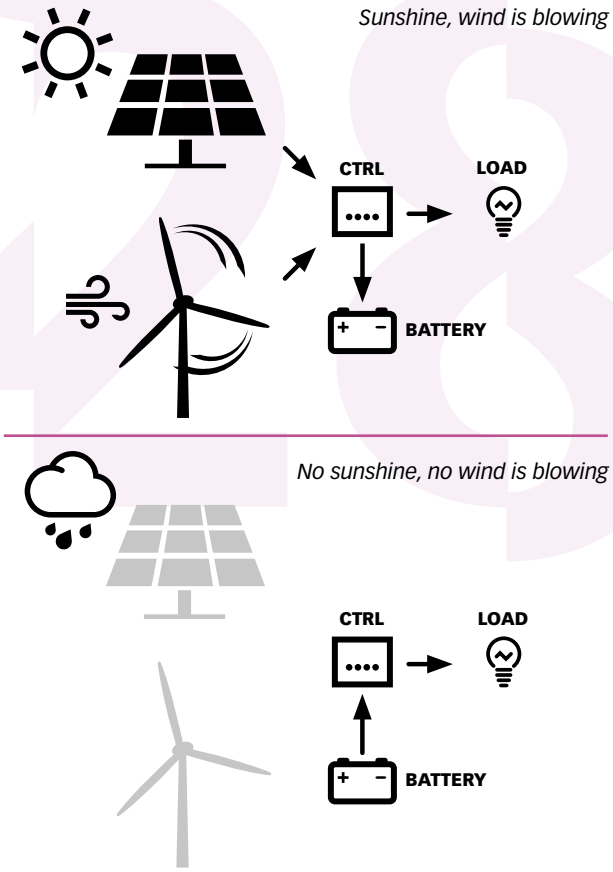
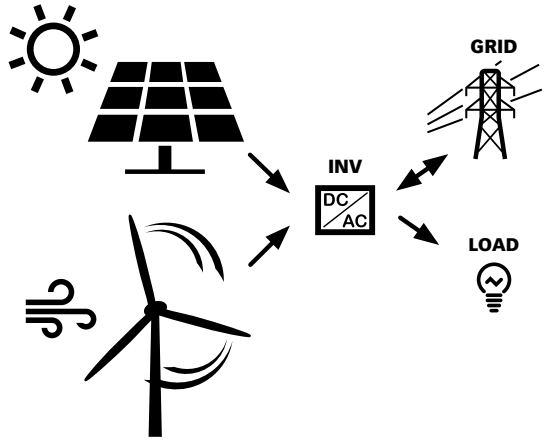
OFF-GRID operation:



- In case there is no sunshine or wind blowing, all the energy consumed by the user (load) is taken from the battery
- In case there is sunshine and/or wind blowing but no load is connected, all the energy produced by the system charges the battery
- In case there are both sunshine and/or wind blowing and load, the energy produced by the system partially charges the battery and partially powers the load
- When the consumption is higher than the power available from the sun and the wind, the power surplus is given by the battery

ON-GRID operation:



- In case the user consumption is lower than the available energy from sun and/or wind, the excess power is fed to the grid
- On the contrary, when consumption is higher than the available energy, the additionally required energy is supplied by the grid

Relevant features:

- The PV panel can be used both outdoors and indoors. In case of indoor use, the indoor operation device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)
- The PV panel can be disconnected from the system to draw the characteristic curve. The portable rheostat *PRH-1* is required (**optional item** - refer to the end of this data sheet)
- To operate the wind generator the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

TRAINING PROGRAM

- Components of a combined no-grid / off-grid wind and solar system for electricity production
- Effect of solar radiation on the panel output voltage (*)
- Effects of shading on a real solar installation (*)
- Photovoltaic panel energy conversion efficiency (*)
- Effect of the wind speed on the generator output voltage (**)
- Wind generator energy conversion efficiency (**)
- Battery charging system management
- Interconnection of solar/wind power energy to the public grid
- Operation and efficiency of a DC/AC inverter
- Connection to portable rheostat *PRH-1* (**optional item** - refer to the end of this data sheet) for photovoltaic panel characteristic curve construction
- Connection to wind power generator indoor operation device *WG-IE* (**required** - refer to the end of this data sheet) for wind generator characteristic curve construction

(*) For *PVWG-E/EV* Solar radiation meter *SORM* (**optional item** - refer to the end of this data sheet) required

(**) For *PVWG-E/EV* Cup vane air velocity meter *THAC* (**optional item** - refer to the end of this data sheet) required

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel

- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel

Horizontal axis wind power generator

- 6 blades with outer ring (turbine diameter 510 mm):
  - Cut in Wind Speed: 3 m/s
  - Nominal power output: 49 W at 15 m/s
- Low friction 3 phase, brushless alternator
  - Output nominal voltage: 12 Vdc
- Metal supporting frame with protecting grid

Table top control panel - OFF-GRID operation

- Metal structure with complete color synoptic diagram
- Charge regulator:
  - Pulse Width Modulation (PWM) regulation
  - LED indicators for battery voltage levels and charging status
- Electric load: 12 Vdc lamp
- Instrumentation:
  - DC digital voltmeter
  - DC digital ammeter

Buffer battery

- Rated voltage: 12 VDC
- Capacity: 12 Ah

Table top control panel - ON-GRID operation

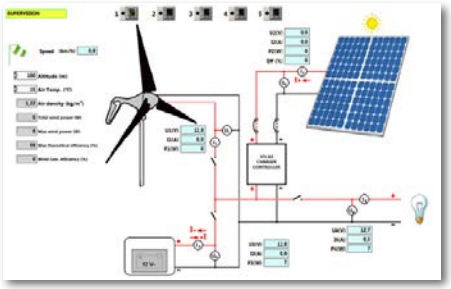
- Metal structure with complete colour synoptic diagram
- Grid tie power inverter:
  - Rated AC Output Power: 450 W
  - AC Output Voltage: 230 V
  - AC Output Frequency: 50 Hz
  - DC Input Voltage Range: 11 ÷ 28 V
  - Output Current Waveform: Pure Sine-wave
  - MPPT Function
  - Protection vs: Over Current, Over Temperature, Reverse Polarity, Anti-Island
- Electric load: 230 V lamp
- Socket for connection to the external AC load *ACL220V* (**optional item** - refer to the end of this data sheet)
- Microprocessor-based instruments for DC/AC parameters

Sensors (*PVWG/EV* only)

- Solar radiation sensor for measuring and transmitting the global solar radiation incident on the PV panel to the control panel. Range: 0 ÷ 2000 W/m^2
- Temperature sensor for measuring and transmitting the PV panel temperature to the control panel
- Wind speed sensor for measuring and transmitting wind speed to the control panel

PC data acquisition (*PVWG/EV* only)

- All instruments and sensors, as described above, are connected in Modbus network. This network is connected to a PC via an adapter RS485/USB
- A specific software (developed with LabView) is supplied to monitor the system parameters
- Displayed parameters:
  - All DC / AC parameters
  - Solar radiation incident on the photovoltaic panel
  - Photovoltaic panel temperature
  - Wind speed
- The software enables to:
  - Calculate energy conversion efficiency
  - Visualize the energy flows to and from the photovoltaic generator, wind turbine, buffer battery or grid and load



- Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase - 50 VA
(Other voltage and frequency on request)

Dimensions

Control panels: 80 x 40 x 15 cm
Solar panel: 70 x 70 x 5 cm
Wind generator rotor diameter: 51 cm
Net weight: 60 kg

REQUIRED

WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-IE
To operate the aerogenerator

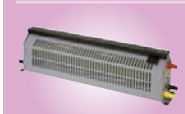
PERSONAL COMPUTER
- NOT INCLUDED -
(*PVWG/EV* only)

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

INDOOR LIGHTING DEVICE Mod. SS-2/EV
To operate the photovoltaic panel indoor



PORTABLE RHEOSTAT Mod. PRH-1
To draw the PV panel characteristic curve

SPOTLIGHT Mod. ACL220V
To be used as 230 Vac electric load

SOLAR RADIATION METER Mod. SORM (*PVWG-E/EV* only)
To calculate the solar energy into electric energy conversion efficiency

CUP VANE AIR VELOCITY METER Mod. THAC (*PVWG-E/EV* only)
For the calculation of the wind energy into electric energy conversion efficiency