

INTEGRATED PHOTOVOLTAIC-WIND POWER SYSTEM

Mod. PMWG-E/EV

Mod. PMWG/EV (computerized version)



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 the conversion of wind energy into electricity by means of a wind power generator. The system configuration is stand-alone (isolated from the grid). The equipment is manufactured using real components available on the market.

DESCRIPTION

The system consists of:

- A) A mobile silicon cell photovoltaic panel
- B) Horizontal axis wind power generator including a microprocessor-based controller

C) Table top control panel including:

- C.1) Charge controller
- C.2) Sinewave inverter
- C.3) Electric loads
- C.4) Electric instrumentation for detecting the energy flows in the different branches of the circuit
- C.5) Data acquisition board with USB interface for PC connection (mod. PMWG/EV only)

D) Buffer battery

E) Solar radiation sensor (mod. PMWG/EV only)

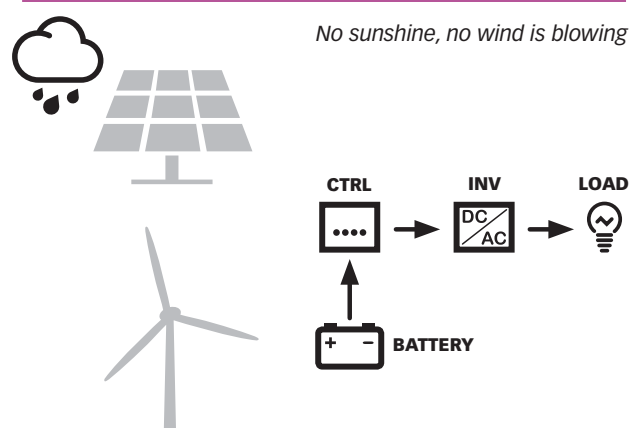
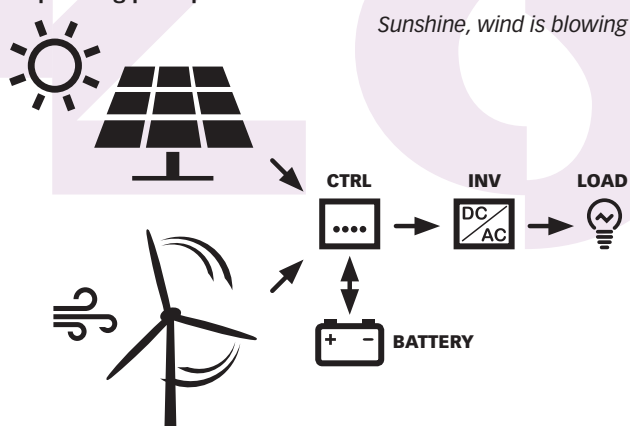
F) Wind speed and direction sensor (mod. PMWG/EV only)

Relevant features:

- The unit can operate with or without sun and wind.
- The PV panel can be used outdoors and indoors. In case of indoor use, an optional indoor operation device is required (refer to mod. SS-1/EV at the end of this data sheet).
- The PV panel can be disconnected from the system to draw the characteristic curve (one single module, two modules - parallel connection, two modules - series connection). An optional device is required (refer to mod. PRH-2 at the end of this data sheet).

- The PV panel can track the sun along two axes, to allow the comparison of the performance between a fixed installation (such as the one on the roof of a house) and an installation with tracking device. In this case, an optional device is required (refer to mod. SOLTR/EV at the end of this data sheet).
- The wind generator can be used both outdoors and indoors. In case of indoor use, an optional indoor operation device is required (refer to mod. WG-I/EV at the end of this data sheet).
- In case of outdoors operation, the wind generator follows the wind direction being able to rotate around its vertical axis.

Operating principle:



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

TRAINING PROGRAM:

- Physical principles whereby solar power is transformed into electrical power
- Characteristics and application of silicon cells
- Physical principles whereby wind power is transformed into electrical power
- Study of brushless generators

- Photovoltaic Generation:
 - Understanding and use of the Country Statistics related to the specific place where the photovoltaic panels are installed
 - Calculation of the average solar power a given site
 - Distinctive features
 - Optimizing installation and positioning
 - Energy balance and efficiency (for mod. PMWG-E/EV an optional instrument is required, refer to mod. SORM at the end of this data sheet)
- Wind Turbine Generator:
 - Understanding and use of the Country Statistics related to the specific place where the wind generator is installed
 - Calculation of average generated power
 - Distinctive features
 - Installation
 - Energy balance and efficiency (for mod. PMWG-E/EV an optional instrument is required, refer to mod. THAC at the end of this data sheet)
- Battery charge control
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS

Photovoltaic solar array mounted on castors:

- Stainless steel frame
- Photovoltaic panel including two modules, 120 W peak power each

Horizontal axis wind power generator:

- Aluminium generator body
- 3 composite material blades (rotor diameter 1.17 m):
 - Energy output: approx. 30 kWh/month at 5.8 m/s (13 mph) average wind speed
 - Startup Wind Speed: 3.6 m/s (8 mph)
 - Survival wind speed: 49.2 m/s (110 mph)
- Permanent magnet brushless alternator
- Microprocessor-based controller
 - Output voltage: 12 Vdc
 - Overspeed protection: electronic torque control
- Stainless steel supporting pole
 - Length 1.5 m
 - Outer diameter: 48,1 mm
 - Mounting kit

Table top control panel

- Steel structure with:
 - Front side: comprehensive colored diagram of the system
 - back side: AC loading system consisting of 5 30 W switchable lamps
- Charge controller:
 - rated voltage: 12 Vdc
 - max. power input from solar panel: 20 A
 - max. switch off current at LOAD-output: 20 A
- Inverter
 - continuous output power: 600 W
 - peak output power: 1200 W
 - input voltage: 12 Vdc
 - output voltage: 230 Vac - 50 Hz
 - output waveform: modified sine wave
 - stop for low battery charge
 - protection against overload, short circuit, overtemperature

- Instrumentation
 - digital voltmeter for DC parameters
 - digital ammeter for DC parameters
 - multifunction instrument, microprocessor-based, for AC parameters
- Ø 4 mm safety holes for connection to the optional portable rheostat (refer to mod. PRH-2 at the end of this data sheet)
- Socket for connection to an external optional AC load (refer to mod. ACL220V at the end of this data sheet)

Buffer battery

- rated voltage: 12 Vdc
- Capacity: 100 Ah

Solar radiation sensor (mod. PMWG/EV only) for measuring and transmitting the global solar radiation incident on the PV panel to the control panel.

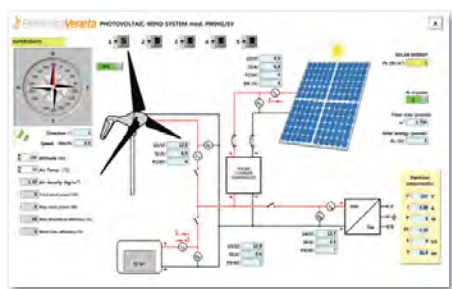
- Transducer type: pyranometer
- Range: 0÷2000 W/m²

Wind speed and direction sensor (mod. PMWG/EV only) for measuring and transmitting wind speed and direction to the control panel.

- Wind speed transducer type: Hall effect sensor
- Wind direction transducer type: 20 Kohm potentiometer
- Wind speed range: 0.5÷40 m/s
- Wind direction range: 0÷360°

PC data acquisition (mod. PMWG/EV only)

- The unit includes a data acquisition board with USB interface for connection to PC and voltage and current converters.
- A specific software (developed with LabView) is supplied to monitor the different parameters of the system.
- Parameters displayed:
 - All DC (V-I-P) and AC (V-I-P-S-Freq-Power Factor) parameters
 - Global solar radiation incident on the PV panel
 - Wind speed and direction
- The software enables to:
 - Calculate solar and wind energy conversion efficiency
 - Visualize the trend of the solar radiation incident on the PV panel, the wind speed and the energy flows to and from buffer battery, inverter, PV panel and wind power generator



- Draw the PV panel characteristic curves output current vs output voltage and output power vs output voltage to find out the point of panel maximum performance
- Draw the wind power generator characteristic curve output power vs wind speed to find out the point of wind power generator maximum performance
- Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase - 1 kVA
(Other voltage and frequency on request)

Dimensions

Control panel: 92 x 46 x 72 cm
Solar array mobile: 120 x 120 x 200 cm
Wind turbine rotor diameter: 117 cm
Net weight: 240 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -
(mod. PMWG/EV only)



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK



OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

SOLAR TRACKER Mod. SOLTR/EV

Steel framework and gearing system for orienting the panel on two degrees of freedom in space (up-down, east-west)

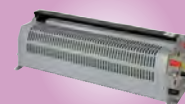


ELECTRIC BATTERY CHARGER Mod. EBCH

To recharge the buffer battery after a prolonged period of inactivity of the system

PORTABLE RHEOSTAT Mod. PRH-2

To draw the PV panel characteristic curve



INDOOR LIGHTING DEVICE Mod. SS-1/EV

To operate the photovoltaic panel indoor

SPOTLIGHT Mod. ACL220V

To be used as 220 Vac electric load



LAMP Mod. DCL12V

To be used as 12 Vdc electric load

SOLAR RADIATION METER Mod. SORM (mod. PMWG-E/EV only)

To calculate the solar energy into electric energy conversion efficiency



WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-I/EV

To operate the aerogenerator indoor

CUP VANE AIR VELOCITY METER Mod. THAC (mod. PMWG-E/EV only)

For the calculation of the wind energy into electric energy conversion efficiency

