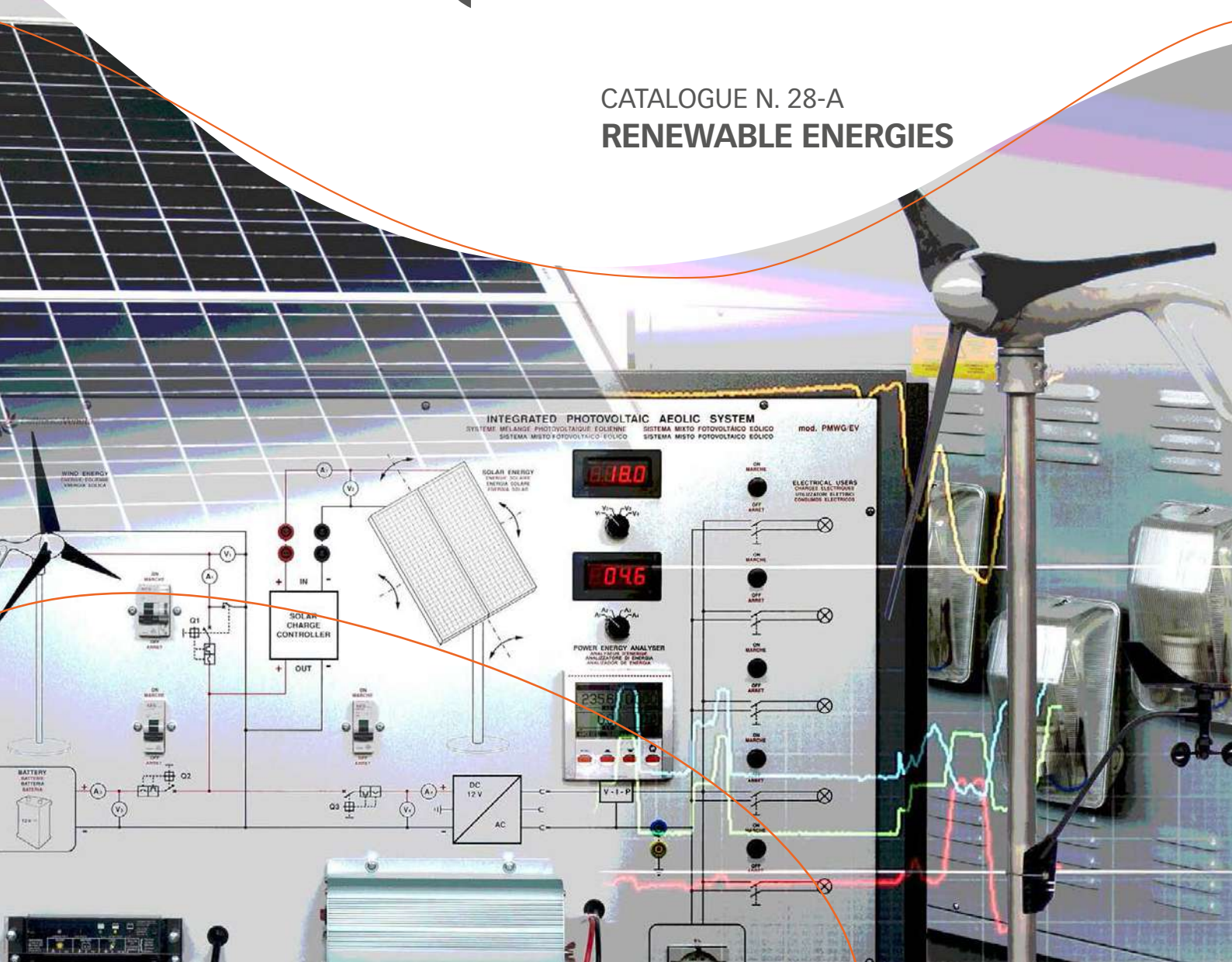
ElettronicaVeneta

CATALOGUE N. 28-A

RENEWABLE ENERGIES



ElettronicaVeneta

CATALOGUE N. 28-A

RENEWABLE ENERGIES

Renewable Energies
export@elettronicaveneta.com
www.elettronicaveneta.com

28A-E
Rel. M22

RENEWABLE ENERGIES
CATALOGUE N. 28-A

INDEX

GENERAL INTRODUCTION	1
PRESENTATION	2

SOLAR THERMAL ENERGY

	Mod.	Page
COMPUTERIZED FLAT PLATE COLLECTOR TRAINER	TBS/EV	**ST** 3
COMPUTERIZED SOLAR CONCENTRATOR TRAINER	SSC/EV	**ST** 6
COMPUTERIZED SOLAR THERMAL ENERGY TRAINER	STETCP/EV	**ST** 9
SOLAR THERMAL KIT WITH FLAT PLATE COLLECTOR	SOL-K/EV SOL-KC/EV	**ST** 12
DHW SOLAR THERMAL SYSTEM SIMULATOR	SIM-BS/EV	**ST** 15
SIMULATOR OF SOLAR THERMAL COMBISYSTEM FOR SPACE HEATING AND DOMESTIC WATER HEATING	SIM-BSC/EV	**ST** 16

PHOTOVOLTAIC ENERGY

	Mod.	Page
PHOTOVOLTAIC PANEL TRAINER	PM-E/EV PM/EV	**PE** 3
COMPUTERIZED OFF-GRID PHOTOVOLTAIC TRAINER	PV-OG/EV	**PE** 6
COMPUTERIZED ON-GRID PHOTOVOLTAIC TRAINER	PV-GR/EV	**PE** 8
PHOTOVOLTAIC ENERGY GENERATION KIT	PM-K/EV PM-K2/EV	**PE** 10
SOLAR ENERGY MINI LABORATORY	SMK/EV	**PE** 11
PHOTOVOLTAIC SYSTEM SIMULATOR	SIM-PM/EV	**PE** 12

WIND ENERGY

	Mod.	Page
WIND POWER GENERATOR TRAINER	WG-C/EV WG/EV	**WI** 3
AEROGENERATOR WITH WIND TUNNEL COMPUTERIZED TRAINER	WIND-TU2/EV	**WI** 6
COMPUTERIZED OFF-GRID WIND POWER PLANT TRAINER	WG-OG/EV	**WI** 9
COMPUTERIZED ON-GRID WIND POWER PLANT TRAINER	WG-GR/EV	**WI** 11
WIND ENERGY GENERATION KIT	WG-K/EV	**WI** 13

HYDROELECTRIC ENERGY

	Mod.	Page
COMPUTERIZED MINI HYDROELECTRIC POWER PLANT TRAINER	WPP/EV	**HE** 3
HYDROELECTRIC ENERGY GENERATION KIT	WPP-K/EV	**HE** 6

FUEL CELL TECHNOLOGY

	Mod.	Page
COMPUTERIZED FUEL CELL TRAINER	FCBA/EV	**FC** 3
COMPUTERIZED FUEL CELL TESTING PANEL	FUEL-C.../EV	**FC** 6

www.elettronicaveneta.com

COMBINED SOLUTIONS

	Mod.	Page
GRID-CONNECTED RENEWABLE ENERGY SYSTEM	REMDI/EV	CS 3
INTEGRATED PHOTOVOLTAIC-WIND POWER SYSTEM	PMWG-E/EV PMWG/EV	CS 6
COMPUTERIZED OFF-GRID PHOTOVOLTAIC - WIND POWER PLANT TRAINER	PVWG-OG/EV	CS 9
COMPUTERIZED ON-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	PVWG-GR/EV	CS 12
COMPUTERIZED ON-GRID / OFF-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	PVWG/EV	CS 14
INTEGRATED PHOTOVOLTAIC-WIND POWER KIT	PMWG-K/EV	CS 17

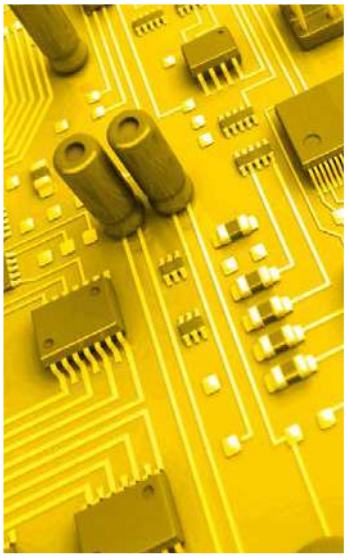
ACCESSORIES AND INSTRUMENTS

		Mod.	Page
ACCESSORIES	SPOTLIGHT	ACL220V	AI 3
	LAMP	DCL12V DCL24V	AI 3
	DIRECT CURRENT MOTOR	DCM/EV	AI 3
	ENERGY DISSIPATION KIT	DW-EP/EV	AI 3
	ELECTRIC BATTERY CHARGER	EBCH	AI 3
	METAL HYDRIDE STORAGE TANK	H2-300	AI 3
	HYDROGEN GENERATOR	HG-1	AI 4
	PEM ELECTROLYZER	HG-600	AI 4
	PORTABLE RHEOSTAT *(1 x 20Ω)*	PRH-1	AI 4
	PORTABLE RHEOSTAT *(2 x 20Ω)*	PRH-2	AI 4
	PORTABLE RHEOSTAT *(3 x 35Ω)*	PRH-3	AI 4
	BATTERY PACK	SOLBA	AI 4
	SOLAR TRACKER	SOLTR/EV	AI 5
	INDOOR LIGHTING DEVICE	SS-1/EV SS-2/EV	AI 5
	WIND POWER GENERATOR INDOOR OPERATION DEVICE	WG-IE	AI 5
	WIND POWER GENERATOR INDOOR OPERATION DEVICE	WG-I/EV WG-IM/EV WG-IIG/EV	AI 6
INSTRUMENTS	SOLAR RADIATION METER	SORM	AI 7
	CUP VANE AIR VELOCITY METER	THAC	AI 7
	PORTABLE ANEMOMETER	THAM	AI 7
	PORTABLE THERMOHYGROMETER	THHY	AI 7
	PORTABLE THERMOMETER	THRN	AI 7

Note: The catalog is constantly updated. Please send any suggestion you have to export@elettronicaveneta.com. We would also like to remind you that, due to the continuous technological upgrades, the described products may be subjected to design and/or technical modifications. Nevertheless, we guarantee that the educational content of our equipment remains unchanged.

www.elettronicaveneta.com

GENERAL INTRODUCTION



ELETTRONICA VENETA S.p.A. has been designing and manufacturing educational equipment since 1963. This equipment, covering the different fields of technology, fulfils two important educational objectives:

- to facilitate the learning process of the student by means of real systems which illustrate practically the important aspects of the theory learned in the classroom.
- to simplify the work of the teacher enabling the demonstration of the real, practical applications of the theory learned.

Increasing the efficiency of the didactic process improves and simplifies the integration of young students into the world of employment and justifies the material and human investments made in schools throughout the world.

ELETTRONICA VENETA S.p.A. operates on an international level and takes into consideration the training programs and cultures of each specific country. In order to meet different requirements, we offer flexible systems which ensure maximum compliance with the latest technologies, technological advances and the professional profile requirements of local industry.

The proposed laboratories and training equipment are suitable for regular school education as well as ongoing post-diploma training courses and professional re-qualification.

Our training equipment covers most of the technological sectors included in the training programs of vocational schools, technical institutes and universities, both national and international.

The integration of these efficient training systems into local school structures ensures high-quality, state-of-the-art training programs which meet the diverse professional expectations of the student and the technological requirements of industry and research within their specific local contexts.

ELETTRONICA VENETA S.p.A. headquarters is located in the green fields of the Veneto region, not far from Venice, and constitute a centre for equipment design and development suited to the training needs of all professional and technical profiles. The modern premises integrates R&D laboratories, a production plant and a fully equipped teacher training centre.

The ISO 9001 (Quality System Certification) obtained in 1998 and updated in application of the latest edition of the International Standard, is further testament to the quality-driven organisation of **ELETTRONICA VENETA S.p.A.** aimed at providing top standard equipment, training and service.

PRESENTATION

The catalogue of renewable energies includes all educational equipment for an easy study of the sources of renewable energies (alternative to fossil fuels) applied to home and industrial installations.

The apparatuses have been designed to train engineers so that they can acquire skills on the most advanced applications besides the basics of renewable energies.
Moreover the development of technology leads to a continuous theoretical, experimental and practical refreshment of the operators in this sector.

All that involves the need of having flexible and modular training systems being able to adapt to diversified and varying requirements.

ELETTRONICA VENETA S.p.A. has developed systems and solutions for training and research answering this purpose perfectly: in fact the apparatuses produced enable to analyze all the topics concerning renewable energies from both the theoretical and experimental points of view, starting from the basic concepts to the most complex issues.

This catalogue is subdivided into six product lines:

- **Solar thermal energy**
- **Photovoltaic energy**
- **Wind energy**
- **Hydroelectric energy**
- **Fuel cell technology**
- **Combined solutions**

Every line covers the topic under examination exhaustively; for instance, as regards Solar Photovoltaic Energy, attention can be focused onto the study of photovoltaic effect for converting solar energy into electric current, or onto the type of connection of the modules for assembling the most suitable photovoltaic field.

This catalogue is completed with an eighth section concerning accessories and instruments that includes the optional equipment for the theoretical-practical activities of laboratory.

The range of equipment produced by ELETTRONICA VENETA S.p.A. for the creation of RENEWABLE ENERGIES laboratories is divided into the following sections:

- **SOLAR THERMAL ENERGY**
- **PHOTOVOLTAIC ENERGY**
- **WIND ENERGY**
- **HYDROELECTRIC ENERGY**
- **FUEL CELL TECHNOLOGY**
- **COMBINED SOLUTIONS**
- **ACCESSORIES AND INSTRUMENTS**

www.elettronicaveneta.com

28-A

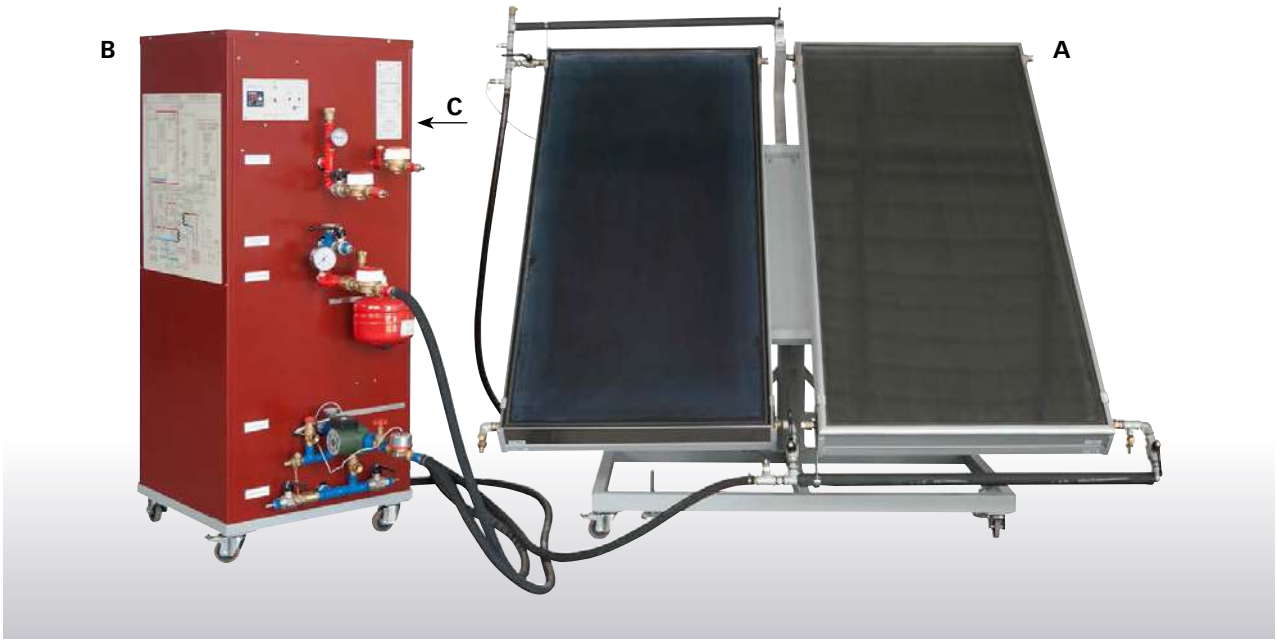
SOLAR THERMAL ENERGY

	Mod.	Page
COMPUTERIZED FLAT PLATE COLLECTOR TRAINER	TBS/EV	**ST** 3
COMPUTERIZED SOLAR CONCENTRATOR TRAINER	SSC/EV	**ST** 6
COMPUTERIZED SOLAR THERMAL ENERGY TRAINER	STETCP/EV	**ST** 9
SOLAR THERMAL KIT WITH FLAT PLATE COLLECTOR	SOL-K/EV SOL-KC/EV	**ST** 12
DHW SOLAR THERMAL SYSTEM SIMULATOR	SIM-BS/EV	**ST** 15
SIMULATOR OF SOLAR THERMAL COMBISYSTEM FOR SPACE HEATING AND DOMESTIC WATER HEATING	SIM-BSC/EV	**ST** 16

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED FLAT PLATE COLLECTOR TRAINER

Mod. TBS/EV



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 sunlight into thermal energy for domestic hot water production by means of two flat plate solar collectors. The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

The system consists of:

A) Flat plate solar collectors array mounted on castors

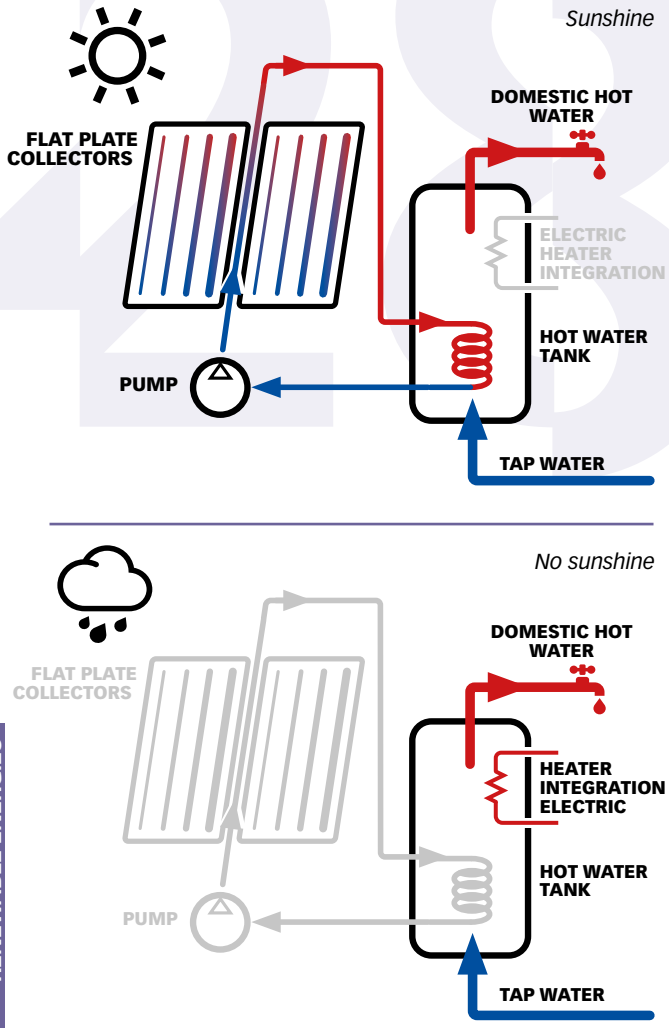
B) Water storage tank with circulation unit and instrumentation

C) PC data acquisition

Relevant features:

- The solar collectors array is equipped with shut-off valves that control the operation of one collector or both
- The collectors array can be used outdoors and indoors. In case of indoor use, the lighting device *SS-1/EV* is required (**optional item** - refer to the end of this data sheet)
- The solar collectors array is mounted on castors; the frame can be tilted to compare system performance under different inclination and orientation
- The hot water stored in the tank is used as domestic hot water
- In case of prolonged absence of sun, the equipment allows to heat the water in the storage tank electrically.

Operating principle:



When sun is shining the solar rays strike the flat plate collector highly absorbent surface heating the water there contained. After reaching a temperature slightly higher than that of the water contained in the storage tank hydraulically connected to the collectors, the circulation pump switches on and transfers heat from the collectors to the tank.
In case of prolonged absence of sunshine, an electric heater can meet the domestic hot water demands.

TRAINING PROGRAM

- Physical principles whereby solar energy heats water exploiting flat plate collectors
- Sizing of collector surface, storage tank, primary circuit
- Flat plate collector energy balance and efficiency
- Efficiency line
- Filling and maintenance operations
- Experimental assessment of flat plate collector instantaneous efficiency and system efficiency
- Plant parameters optimization
- Domestic hot water daily production assessment
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS

Flat plate solar collectors array mounted on castors:

- Steel frame with adjustable inclination
- Flat plate collectors:
  - 1 solar collector, surface area 2 m², copper absorber plate, rockwool insulation
  - 1 high efficiency solar collector with thin specially flattened and shaped copper pipes, surface area 1,8 m², ceramic fiber insulation
- Air venting valve
- Shut-off valves

Water storage tank with circulation unit and instrumentation

- Tank for domestic hot water storage mounted on castors:
  - capacity: 200 liters
  - 2 coil heat exchangers
  - dial thermometer, range: 0 ÷ 120°C
  - wells for temperature measurements
  - 1,5 kW built-in electrical resistance with immersion thermostat for thermal power integration
  - thermal insulation: polyurethane, thickness 6 cm
- Circulation unit including:
  - variable speed pump, maximum head: 50 kPa, maximum flow rate: 3,5 m³/h
  - safety valve
  - check valve
  - gate valve
  - automatic air venting valve
  - fill/drain cock
  - dial pressure gauge, range: 0 ÷ 6 bar
  - dial flow and return thermometers, range: 0 ÷ 120°C
  - mechanical water counter
- Water feeding line including:
  - shut-off ball valve
  - check valve
  - safety valve
- Expansion vessel
- Domestic hot water line including mechanical water counter
- Comprehensive colored diagram of the system
- Thermomagnetic differential switch

Flexible pipes

- 10 + 10 meter length 120°C black pipe for connection of the collector array to the tank
- 6 meter length reinforced pipe for connection of water feeding line and hot water line (if present)

www.elettronicaveneta.com

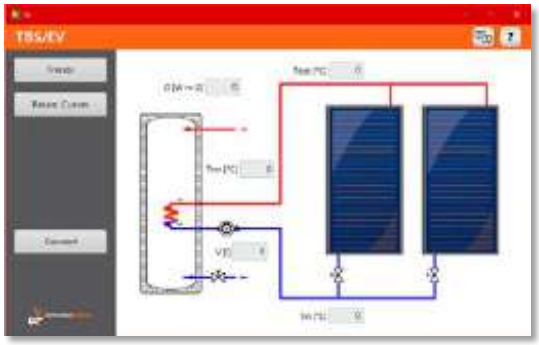
 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

Probes and sensors

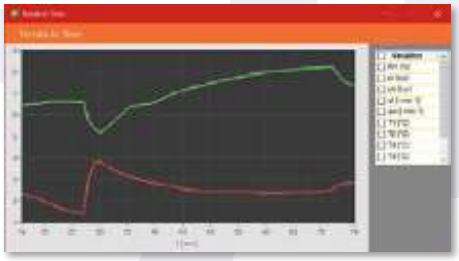
- Freely configurable digital controller for the management, monitoring and control of systems with HVAC applications
- PC communication interface module with USB port
- Collector outlet temperature sensor
  - Range: -30 ÷ +180°C
- Collector inlet temperature sensor
  - Range: -30 ÷ +130°C
- Storage tank temperature sensor
  - Range: -30 ÷ +130°C
- Environment temperature sensor
  - Range: -35 ÷ +90°C
- Universal mechanical meter with pulse output for water count
  - Rated flow rate: 1,5 m^3/h
- Solar radiation sensor
  - Range: 0 ÷ 2000 W/m^2

PC data acquisition

- The trainer is supplied with a specific software for monitoring the system parameters.
- Parameters displayed:
  - solar collectors inlet and outlet temperature
  - environment temperature
  - solar radiation incident on the collectors plane
  - quantity of water drawn by the pump



- The software enables to:
  - Visualize and modify the digital controller configuration parameters
  - Visualize the trend of the solar radiation incident on the collectors, quantity of water drawn by the pump and all process temperatures



  - Save the exercises data for future analysis and for calculating the instantaneous and average collectors efficiency

Power supply: 230 Vac 50 Hz single-phase - 1500 VA
(Other voltage and frequency on request)

Dimensions

Storage tank:	70 x 70 x 150 cm
1 Solar collector:	100 x 200 x 10 cm
Solar collectors array:	230 x 150 x 150 cm
Net weight:	300 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

UTILITIES (PROVIDED BY THE CUSTOMER)

- **Water supply:** min pressure 1 bar - max pressure 2,5 bar

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

INDOOR LIGHTING DEVICE
Mod. SS-1/EV
To operate the solar collectors array indoor

COMPUTERIZED SOLAR CONCENTRATOR TRAINER

Mod. SSC/EV

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 sunlight into thermal energy by means of a parabolic trough solar collector. The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

The system consists of:

A) Wheeled solar concentrator including:
- **A.1)** Parabolic trough collector
- **A.2)** Evacuated solar collector
- **A.3)** Solar tracker
- **A.4)** Photovoltaic panel

B) Water storage tank with circulation unit and instrumentation

C) Table top control panel

D) Portable thermometer

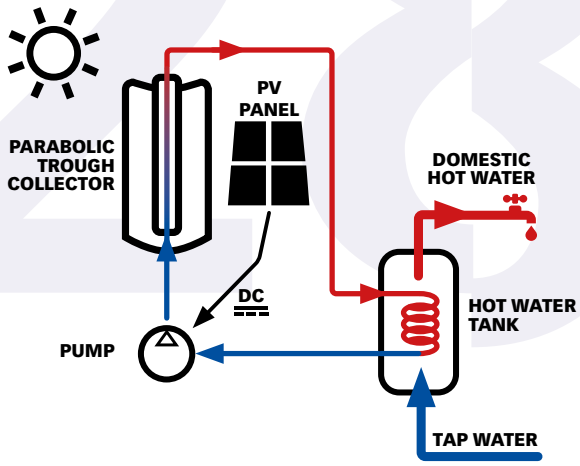
Relevant features:

- The pump transferring heat from the absorber to the tank can be powered by solar energy (photovoltaic panel) or by the grid.
- The solar concentrator can be used outdoors and indoors. In case of indoor use, the lighting device *SS-1/EV* is required (**optional item** - refer to the end of this data sheet)
- The solar concentrator can automatically track the sun along one or two axes, to allow the comparison of the performance between a single-axis tracking installation and a biaxial tracking installation.

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- The hot water stored in the tank can be used as domestic hot water or for space heating. In this last case the energy dissipation kit *DW-EP/EV* is required (**optional item** - refer to the end of this data sheet)

Operating principle:



The direct sun rays hit the highly reflective surface of the parabolic trough collector and converge along a straight line (formed by all the focuses of all the parables constituting the cylinder orthogonal sections). The vacuum solar collector is positioned in correspondence of this line. Absorbing energy, the water contained in the collector heats. When it reaches a temperature slightly higher than that of the water tank connected to the collector, the circulation pump switches on and transfers heat from the collectors to the tank.

TRAINING PROGRAM

- Physical principles whereby solar energy heats water exploiting a parabolic trough solar collector
- Parabolic trough solar collector energy balance and efficiency
- Efficiency line
- Filling and maintenance operations
- Experimental assessment of collector instantaneous efficiency
- Experimental assessment of system efficiency
- Plant parameters optimization
- Domestic hot water daily production assessment
- Water storage tank stratification measurements and energy losses assessment
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS:

Solar concentrator mounted on castors:

- AISI 304 stainless steel framework
- Parabolic trough collector composed by high reflectance layers deposited on a substrate of mirror finished brightened and anodized high purity aluminium
  - geometrical properties: chord 750 mm, focal distance: 200 mm, depth: 1500 mm
  - optical properties: Total Solar reflectance: 89,9%, Total reflectance "Visible range": >93%
- Evacuated solar collector
  - black painted copper absorber
  - borosilicate glass pipe
- Solar tracker
  - Solar sensors assembly
  - Actuators with DC motors
  - Control panel for automatic/manual two axes tracking: UP/DOWN and EAST-WEST
- Crystalline silicon cells Photovoltaic Panel, 60 W peak power, for hydraulic pump feeding

Water storage tank with circulation unit and instrumentation

- AISI 304 stainless steel storage tank
  - capacity: 50 liters
  - 2 coil heat exchangers
  - 3 wells for temperature measurements
  - thermal insulation
- Circulation unit including:
  - 12 Vdc pump, maximum head: 38 kPa, maximum flow rate: 1,5 m^3/h
  - safety valve
  - 2 fill/drain cocks
  - dial pressure gauge, range: 0 ÷ 10 bar
  - balancing valve with built-in flow meter and indicator with magnetic movement, range: 2 ÷ 7 liters/minute
  - deaerator with air vent
  - dial flow and return thermometers, range: 0 ÷ 160°C
  - 2 shut-off valves with built-in check valve
  - pre-formed shell insulation
- Water feeding line including:
  - shut-off ball valve
  - check valve
  - safety valve
- Expansion vessel
- Domestic hot water line including mechanical water counter
- Fast connection fittings for connection to the external energy dissipation kit *DW-EP/EV* (**optional item** - refer to the end of this data sheet)

Table top control panel

- Steel framework with a comprehensive colored diagram of the system
- Thermomagnetic differential switch
- Freely configurable digital controller for the management, monitoring and control of systems with HVAC applications
- PC communication interface module with USB port

Collector outlet temperature sensor

- Range: -30 ÷ +180°C

Collector inlet temperature sensor
- Range: -30 ÷ +130°C

Storage tank temperature sensor
- Range: -30 ÷ +130°C

Environment temperature sensor
- Range: -35 ÷ +90°C

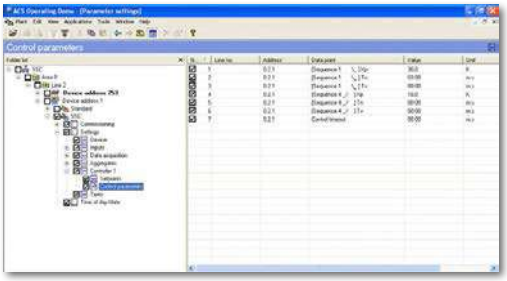
Universal mechanical meter with pulse output for water count
- Rated flow rate: 1,5 m^3/h

Solar radiation sensor
- Range: 0 ÷ 1000 W/m^2

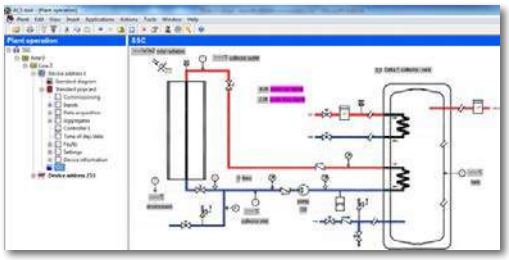
Multi-channel portable thermometer with 2 thermocouple probes, printer and transport case:
- Temperature range: -50 ÷ +350 °C

Flexible pipes
- 6 + 6 meter length 120°C black pipe for connection of the collector to the tank
- 6 meter length reinforced pipe for connection of water feeding line and hot water line (if present)

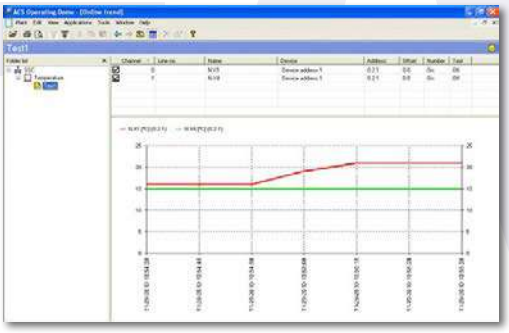
PC data acquisition
- The trainer is supplied with a specific software for monitoring the system parameters.



- Parameters displayed:
  - solar collector inlet and outlet temperature,
  - environment temperature
  - storage tank temperature
  - solar radiation incident on the concentrator plane
  - quantity of water drawn by the pump



- The software enables to:
  - Visualize and modify the digital controller configuration parameters
  - Visualize the trend of the solar radiation incident on the concentrator, quantity of water drawn by the pump and all process temperatures



- Save the exercises data for future analysis and for calculating the instantaneous and average collector efficiency

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

Dimensions
Wheeled solar concentrator: 120 x 120 x 150 cm
Storage tank: 100 x 100 x 100 cm
Total net weight: 170 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

UTILITIES (PROVIDED BY THE CUSTOMER)
- **Water supply:** min pressure 1 bar - max pressure 4 bar

SUPPLIED WITH
THEORETICAL-EXPERIMENTAL HANDBOOK

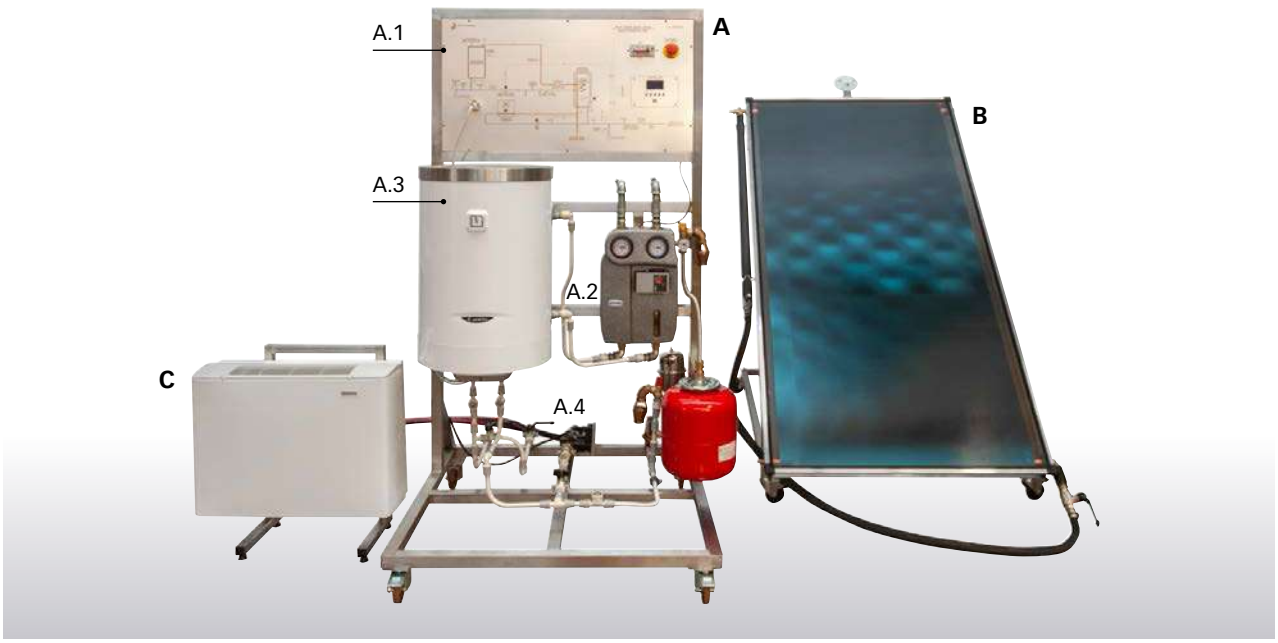
OPTIONAL (REF. ACCESS. AND INSTRUMENTS)
ENERGY DISSIPATION KIT
Mod. DW-EP/EV
To use the hot water for space heating

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED SOLAR THERMAL ENERGY TRAINER

Mod. STETCP/EV



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 radiation into thermal energy by means of a flat plate solar collector. The equipment is manufactured using real components available on the market.

DESCRIPTION

Relevant features:

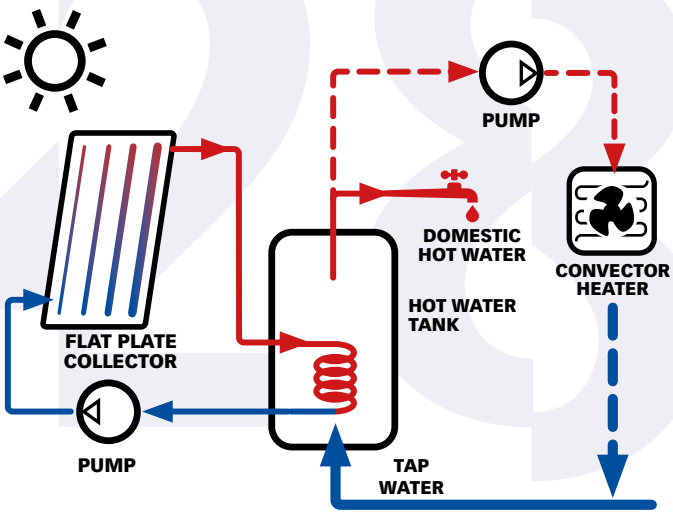
- The collector can be used outdoors and indoors. In case of indoor use, the lighting device *SS-1/EV* is required (**optional item** - refer to the end of this data sheet)
- The solar collector is mounted on castors; the frame can be tilted to compare system performance under different inclination and orientation
- The hot water stored in the tank is used as domestic hot water or to power the convector heater

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

Operating principle:



The solar rays strike the flat plate collector highly absorbent surface heating the water there contained. After reaching a temperature slightly higher than that of the water contained in the storage tank hydraulically connected to the collector, the circulation pump switches on and transfers heat from the collector to the tank. The hot water stored in the tank can be used for space heating using the convector or for sanitary use.

TRAINING PROGRAM

- Physical principles whereby solar energy heats water exploiting flat plate collectors
- Identification of all installed components
- Interpretation of technical parameters of all components
- Local control
- Convector heater, storage tank and pumps operation
- Sizing criteria for DHW facilities, air conditioning, etc.
- Assembly and maintenance criteria for facilities
- PC data acquisition and supervision

TECHNICAL SPECIFICATIONS

Main module (A)

The components are placed vertically on a base, facilitating comfortable access to all components. The trainer design allows the students to see its part from each side. It is mounted on castors and includes:

- Front control panel placed in the top part (A.1)
  - System block diagram
  - Data acquisition card with USB interface for connection to the PC
  - Situation lights
  - Thermomagnetic differential switch
- Electric water heater with solar circuit heat exchanger (A.2):
  - magnesium anode
  - capacity: 80 litres
  - solar circuit heat exchanger surface: 0,15 m^2
  - power: 1,2 kW
  - heating time (ΔT = 45 °C): h, min: 3,16
  - max working temperature: 75 °C
  - thermal dispersion at 65 °C: kWh/24h 1,51
  - max working pressure: bar 8
- Solar circuit including (A.3):
  - loading/unloading valve
  - flow regulator
  - air release valve
  - safety valve
  - manometer
  - thermometer
  - check valve
  - expansion tank
  - solar circuit pump
- DHW circuit including (A.4):
  - water filling unit
  - DHW pump for convector feeding

The hydraulic sockets for cold water inlet, hot sanitary water outlet, connection to the solar panel, etc., are located at the back of this module.

Real flat plate solar collector mounted on castors (B)

- Steel frame with adjustable inclination
- Connected to the main module through flexible pipes
- Flat plate collector:
  - Dimension: 1004 x 2004 x 78 mm
  - Aperture area: 1,83 m^2
  - Absorber area: 1,74 m^2
  - Volume of the fluid: 1 l
- Provided with manual air venting valve and shut-off valves

Convector heater (C)

- 3 speed fan
- Thermal power: max / med / min 1250 / 1100 / 850 W
- Air flow rate: max / med / min 227 / 189 / 136 m^3/h

Sensors

The Trainer includes the following Pt100 range -50 ÷ +150 °C temperature sensors:

- Collector sensor hot side
- Collector sensor cold side
- Tank sensor hot side
- Tank sensor cold side
- DHW return sensor
- Cold water inlet sensor

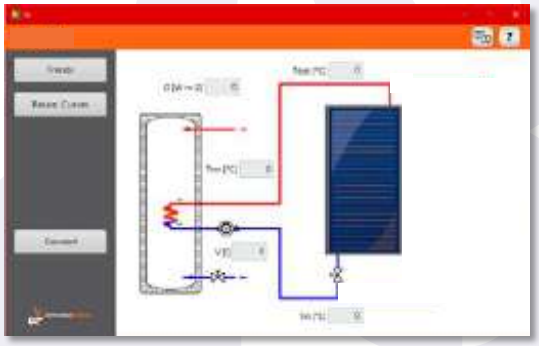
Furthermore, a solar radiation sensor is included, range 0 ÷ 2000 W/m^2.

www.elettronicaveneta.com

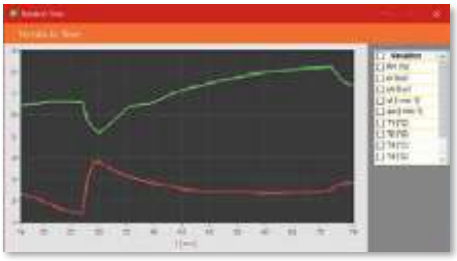
 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

PC data acquisition

The trainer is supplied with a specific software for monitoring the system parameters



- Displayed parameters:
  - Collector inlet/outlet temperature
  - Tank inlet/outlet temperature
  - DHW return temperature
  - Cold water inlet temperature
  - Solar radiation
- The software enables to:
  - Visualize the trend of all the process temperatures and the solar radiation



  - Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase - 1500 VA
(Other voltage and frequency on request)

Dimensions

Main unit: 100 x 100 x 190 cm
Solar collector: 120 x 190 x 180 cm (assembly)
Convector: 70 x 30 x 70 cm
Total net weight: 200 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

UTILITIES (PROVIDED BY THE CUSTOMER)

- **Water supply:** min pressure 1 bar - max pressure 2,5 bar

SUPPLIED WITH

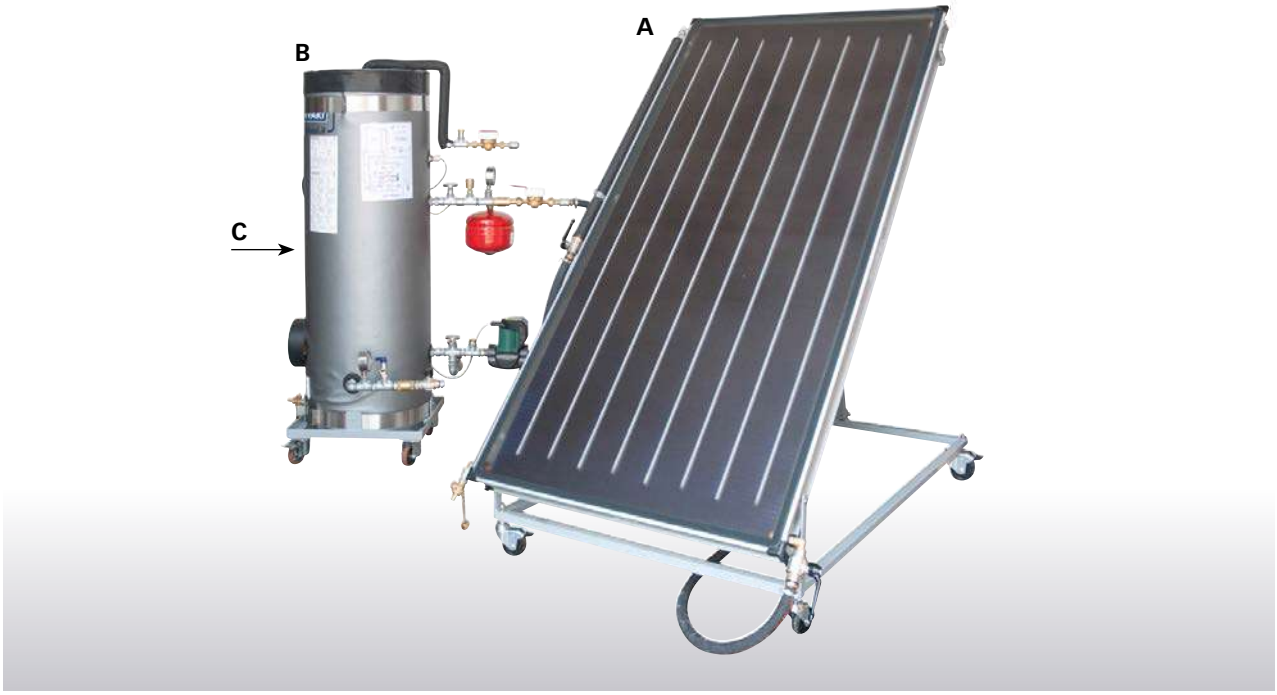
THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

INDOOR LIGHTING DEVICE
Mod. SS-1/EV
To operate the solar collector indoor

SOLAR THERMAL KIT WITH FLAT PLATE COLLECTOR

Mod. SOL-K/EV
Mod. SOL-KC/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 sunlight into thermal energy for domestic hot water production by means of a flat plate solar collector. The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

The system consists of:

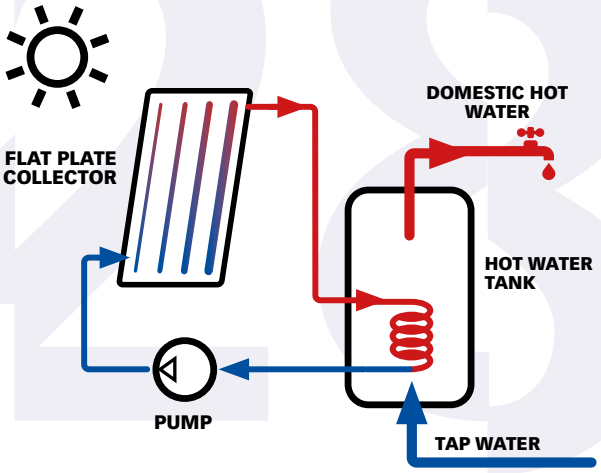
A) Flat plate solar collector mounted on castors
B) Water storage tank with circulation unit and instrumentation
C) PC data acquisition (*SOL-KC/EV* only)

Relevant features:

- The collector can be used outdoors and indoors. In case of indoor use, the lighting device *SS-1/EV* is required (**optional item** - refer to the end of this data sheet)
- The solar collector is mounted on castors and is equipped with variable inclination structure. This allows to compare system performance under different inclination and orientation.
- The hot water stored in the tank is used as domestic hot water.

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

Operating principle:



The solar rays strike the flat plate collector highly absorbent surface heating the water there contained. After reaching a temperature slightly higher than that of the water contained in the storage tank hydraulically connected to the collectors, the circulation pump switches on and transfers heat from the collector to the tank.

TRAINING PROGRAM

- Physical principles whereby solar energy heats water exploiting flat plate collectors
- Sizing of collector surface, storage tank, primary circuit
- Flat plate collectors energy balance and efficiency
- Efficiency line
- Filling and maintenance operations
- Experimental assessment of flat plate collector instantaneous efficiency and system efficiency (for *SOL-K/EV* the solar radiation meter *SORM* is required - **optional item** - refer to the end of this data sheet)
- Plant parameters optimization
- Domestic hot water daily production assessment
- Water storage tank stratification measurements and energy losses assessment (for *SOL-K/EV* the portable thermometer *THRN* is required - **optional item** - refer to the end of this data sheet)
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS

Flat plate solar collector mounted on castors:

- Surface area 2 m^2
- Steel frame with adjustable inclination
- Air venting valve
- Shut-off valves

Water storage tank with circulation unit and instrumentation

- Wheeled tank for domestic hot water storage
  - capacity: 150 liters
  - coil heat exchanger
  - dial thermometer, range: 0 ÷ 120°C
  - wells for temperature measurements
  - thermal insulation: polyurethane, thickness 6 cm
- Circulation unit including:
  - variable speed pump
  - safety valve
  - check valve
  - gate valve
  - automatic air venting valve
  - fill/drain cock
  - dial pressure gauge, range: 0 ÷ 6 bar
  - dial flow and return thermometers, range: 0 ÷ 120°C
  - mechanical water counter
- Water feeding line including:
  - shut-off ball valve
  - check valve
  - safety valve
- Expansion vessel
- Domestic hot water line including mechanical water counter
- Comprehensive colored diagram of the system

Control panel with:

- Thermomagnetic differential switch
- Digital controller (*SOL-K/EV* only)
- Freely configurable digital controller for the management, monitoring and control of systems with HVAC applications (*SOL-KC/EV* only)
- PC communication interface module with USB port (*SOL-KC/EV* only)

Flexible pipes

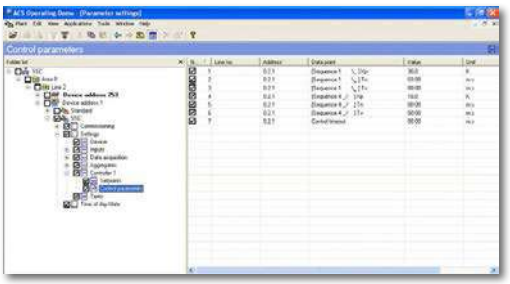
- 10 + 10 meter length 120°C black pipe for connection of the collector array to the tank
- 6 meter length reinforced pipe for connection of water feeding line and hot water line (if present)

Complete sensors set including (*SOL-KC/EV* only):

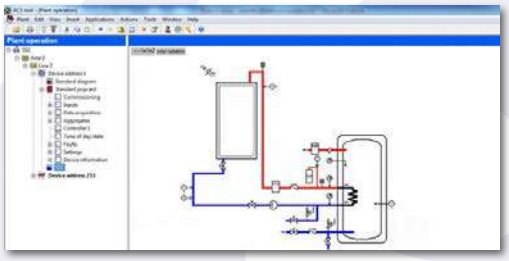
- Collector outlet temperature sensor; range: -30 ÷ +180°C
- Collector inlet temperature sensor; range: -30 ÷ +130°C
- Storage tank temperature sensor; range: -30 ÷ +130°C
- Environment temperature sensor; range: -35 ÷ +90°C
- Universal mechanical meter with pulse output for water count; rated flow rate: 1,5 m^3/h
- Solar radiation sensor; range: 0 ÷ 1000 W/m^2

PC data acquisition (*SOL-KC/EV* only)

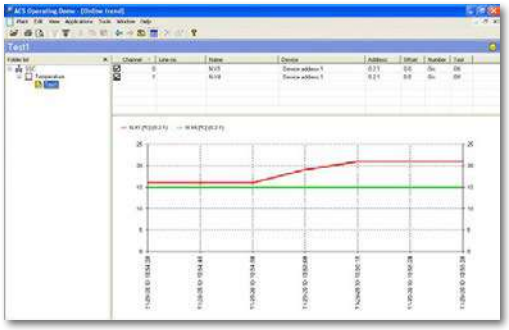
- The trainer is supplied with a specific software for monitoring the system parameters.



- Parameters displayed:
  - solar collectors inlet and outlet temperature,
  - environment temperature
  - storage tank temperature
  - solar radiation incident on the collectors plane
  - quantity of water drawn by the pump



- The software enables to:
  - Visualize and modify the digital controller configuration parameters
  - Visualize the trend of the solar radiation incident on the collector, quantity of water drawn by the pump and all process temperatures



- Save the exercises data for future analysis and for calculating the instantaneous and average collector efficiency

Power supply: 230 Vac 50 Hz single-phase - 150 VA
(Other voltage and frequency on request)

Dimensions:

Storage tank:	70 x 70 x 150 cm
Solar collector:	100 x 200 x 10 cm
Solar collector array:	120 x 120 x 200 cm
Total net weight:	200 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -
(*SOL-KC/EV* only)

UTILITIES (PROVIDED BY THE CUSTOMER)

- **Water supply:** min pressure 1 bar - max pressure 2,5 bar

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

PORTABLE THERMOMETER
Mod. THRN (*SOL-K/EV* only)
For stratification measurements

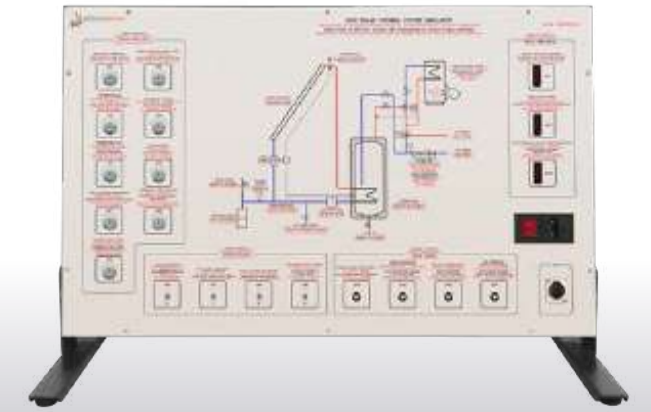
SOLAR RADIATION METER
Mod. SORM (*SOL-K/EV* only)
To calculate the solar energy into electric energy conversion efficiency

INDOOR LIGHTING DEVICE
Mod. SS-1/EV
To operate the solar collector indoor

DHW SOLAR THERMAL SYSTEM SIMULATOR
Mod. SIM-BS/EV

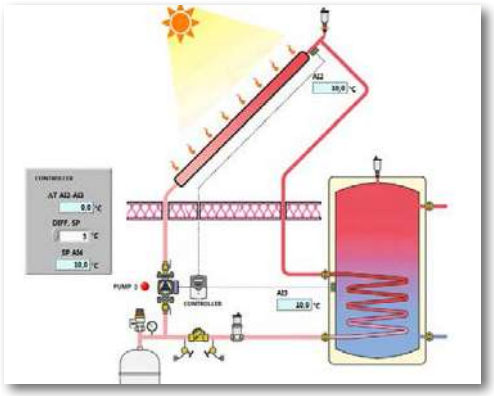
INTRODUCTION

The simulator, properly designed on educational purposes, allows to study the operation of active solar thermal systems for domestic water heating for individual users.
It must necessarily be connected to the PC (not included).



TRAINING PROGRAM

- Instantaneous solar collector efficiency
- Flat plate collectors and evacuated tube collectors
- Stagnation conditions
- Controllers for solar thermal systems
- Freeze protection methods:
  - Antifreeze based systems
  - Drainback systems
- Coil or plate heat exchangers
- Single-tank and two-tank systems
- Fuel or electric power integration
- Anti-scald mixing valve



TECHNICAL SPECIFICATIONS

- Coloured panel reproducing a typical solar thermal system for domestic water heating
- Data acquisition and actuators control board
- PC connection via USB cable
- 9 potentiometers to simulate the following analog inputs:
  - Inlet fluid parameter
  - Solar collector outlet temperature
  - Temperature at the tank bottom
  - Controller setpoint
  - Temperature at the tank top or at the second tank
  - Tank setpoint
  - User hot water temperature
  - Anti-scald mixing valve setpoint
  - Domestic water needs
- 3 bar-LEDs to simulate the following analog outputs:
  - Solar collector efficiency
  - Mixing valve opening
  - Integration fuel boiler power modulation
- 4 switches to simulate the following digital inputs:
  - System enabling
  - Flat plate / evacuated tubes collector
  - Power integration enabling
  - Hot water faucet opening
- 4 LEDs to simulate the following digital outputs:
  - Primary circuit pump status
  - Power integration fuel boiler status
  - Electric heater status
  - 2nd "drainback" system pump status
- Application software developed in LabVIEW

Power supply: 230 Vac 50 Hz single-phase - 200 VA
(Other voltage and frequency on request)
Dimensions: 65 x 40 x 12 cm
Net weight: 5 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

SIMULATOR OF SOLAR THERMAL COMBISYSTEM FOR SPACE HEATING AND DOMESTIC WATER HEATING

Mod. SIM-BSC/EV

INTRODUCTION

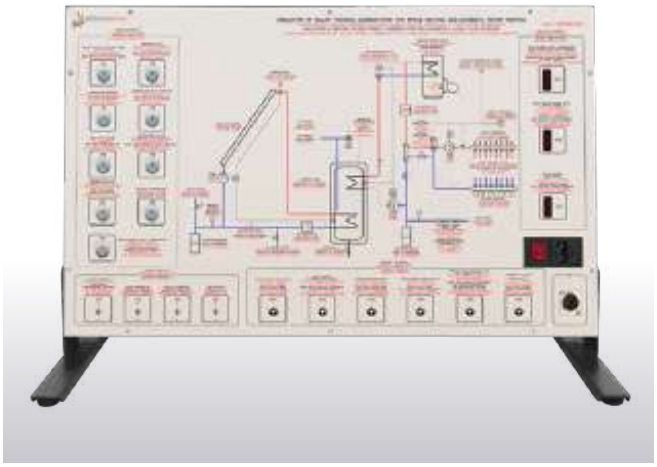
The simulator, properly designed on educational purposes, allows to study the operation of active solar thermal systems for both space heating and domestic water heating for individual users.
It must necessarily be connected to the PC (not included).

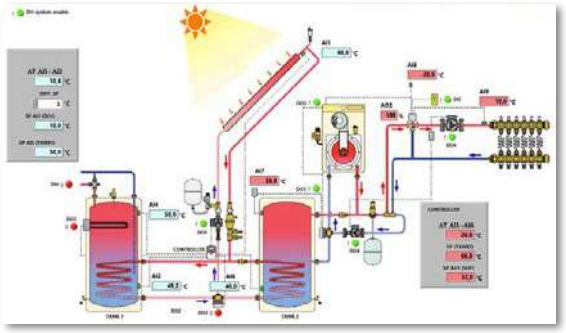
TRAINING PROGRAM

- Instantaneous solar collector efficiency
- Flat plate collectors and evacuated tube collectors
- Controllers for solar thermal systems
- Outdoor reset controller
- Freeze protection methods:
  - Antifreeze based systems
  - Drainback systems
- Coil or plate heat exchangers
- Single-tank and two-tank systems
- Mixing and diverting valves

TECHNICAL SPECIFICATIONS

- Coloured panel reproducing a typical solar thermal combisystem for space heating and domestic water heating
- Data acquisition and actuators control board
- PC connection via USB cable
- 9 potentiometers to simulate the following analog inputs:
  - Solar collector outlet temperature
  - Temperature at the tank bottom
  - Solar controller setpoint
  - Temperature at the tank top
  - Domestic hot water tank setpoint
  - Temperature at the 2nd tank bottom
  - Temperature at the 2nd tank top
  - Outdoor temperature
  - Space heating supply water temperature
- 3 bar-LEDs to simulate the following analog outputs:
  - Space heating water supply temperature based on outdoor reset control
  - Space heating mixing valve control signal
  - Space heating pump speed
- 4 switches to simulate the following digital inputs:
  - System enabling
  - Room thermostat
  - 2nd room thermostat
  - Domestic hot water request
- 6 LEDs to simulate the following digital outputs:
  - Solar circuit pump status





  - Solar circuit diverting valve status
  - DHW integration electric heater status
  - Primary and secondary loop space heating pump state
  - Primary loop diverting valve and burner state
  - "drainback" system DHW primary loop pump status
- Application software developed in LabVIEW

Power supply: 230 Vac 50 Hz single-phase - 200 VA
(Other voltage and frequency on request)
Dimensions: 65 x 40 x 12 cm
Net weight: 5 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

28-A

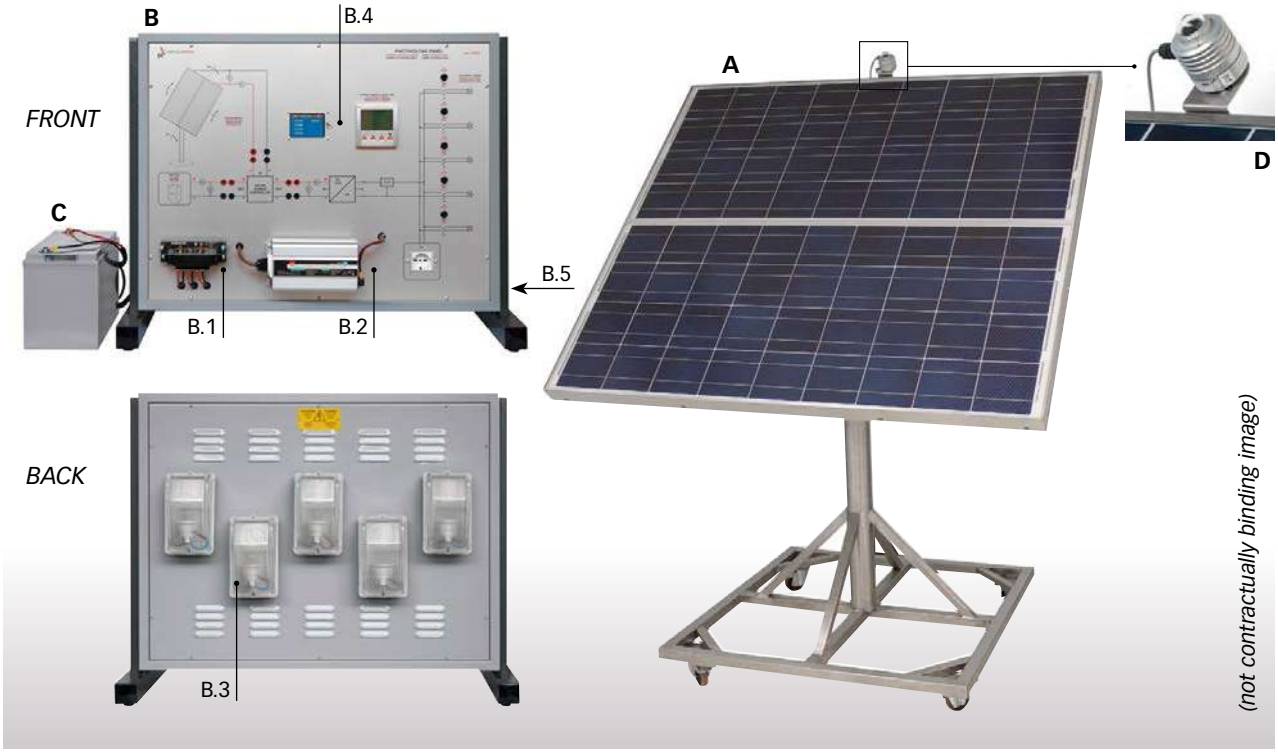
PHOTOVOLTAIC ENERGY

	Mod.	Page
PHOTOVOLTAIC PANEL TRAINER	PM-E/EV PM/EV	**PE** 3
COMPUTERIZED OFF-GRID PHOTOVOLTAIC TRAINER	PV-OG/EV	**PE** 6
COMPUTERIZED ON-GRID PHOTOVOLTAIC TRAINER	PV-GR/EV	**PE** 8
PHOTOVOLTAIC ENERGY GENERATION KIT	PM-K/EV PM-K2/EV	**PE** 10
SOLAR ENERGY MINI LABORATORY	SMK/EV	**PE** 11
PHOTOVOLTAIC SYSTEM SIMULATOR	SIM-PM/EV	**PE** 12

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

PHOTOVOLTAIC PANEL TRAINER

Mod. PM-E/EV
Mod. PM/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. The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

System configuration: stand-alone (isolated from the grid)

The system consists of:

A) Mobile silicon cell photovoltaic (PV) panel

B) Table top control panel including:

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

C) Buffer battery

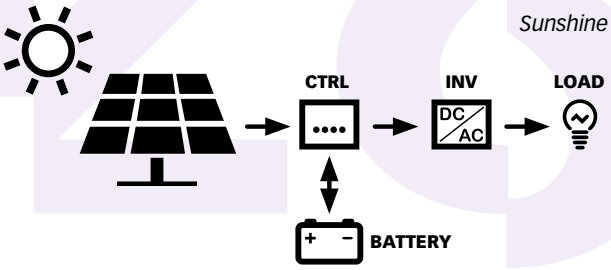
D) Solar radiation sensor (*PM/EV* only)

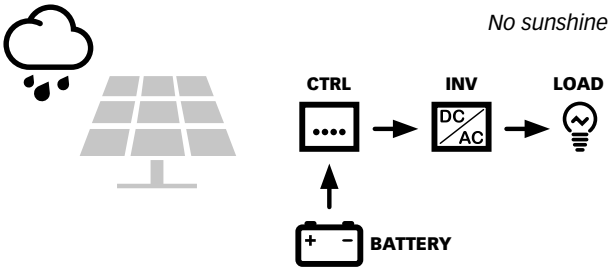
Relevant features:

- The trainer can operate with or without the sun
- The PV panel can be used both outdoors and indoors. In case of indoor use, the lighting device *SS-1/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 (one single module, two modules - parallel connection, two modules - series connection). The portable rheostat *PRH-2* is required (**optional item** - refer to 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 the solar tracker *SOLTR/EV* is required (**optional item** - refer to the end of this data sheet)

Operating principle:





- In case there is no sunshine, all the energy consumed by the user (loads) is taken from the battery.
- In case there is sunshine but no load is connected, all the energy produced by the system charges the battery.
- In case there are both sunshine 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 the sun, the power surplus is given by the battery.

TRAINING PROGRAM

- Components of a stand-alone solar system for electricity production
- Effect of solar radiation on the panel output voltage (*)
- Effect of applied load variation on the electric power produced by the panel
- Effects of shading on a real solar installation (*)
- Photovoltaic panel energy conversion efficiency (*)
- Battery charging system management
- Operation and efficiency of a DC/AC inverter
- Connection to portable rheostat *PRH-2* (**optional item** – refer to the end of this data sheet) for photovoltaic panel characteristic curve construction

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

TECHNICAL SPECIFICATIONS

Mobile photovoltaic solar array:

- Wheeled stainless steel frame
- Photovoltaic panel consisting of two modules, 120 W peak power each

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 (equivalent) 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:
  - multifunction instrument, microprocessor-based, touchscreen display, for DC parameters
  - multifunction instrument, microprocessor-based, for AC parameters
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)
- Ø 4 mm safety holes for connection to the portable rheostat *PRH-2* (**optional item** - refer to the end of this data sheet)
- Ø 4 mm safety holes for connection to the lamp *DCL12V* (**optional item** - refer to the end of this data sheet)

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

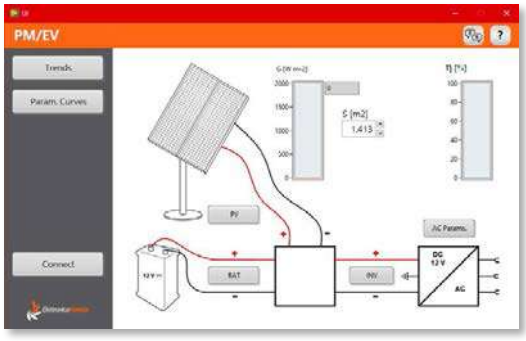
- Transducer type: pyranometer
- Range: 0 ÷ 2000 W/m^2

Buffer battery

- Rated voltage: 12 Vcc
- Capacity: 100 Ah

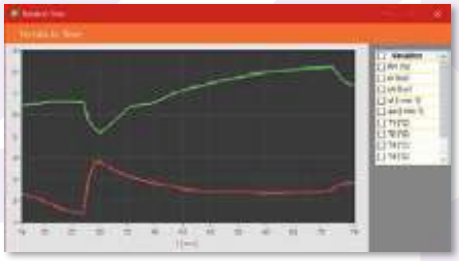
PC data acquisition (*PM/EV* only)

- The trainer 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 system parameters.

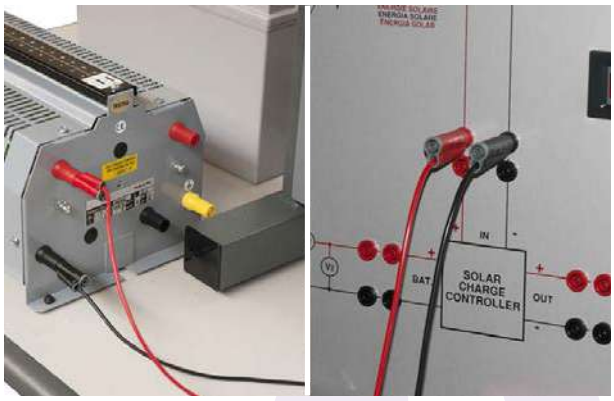


 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- Parameters displayed:
  - All DC and AC parameters
  - Global solar radiation incident on the PV panel
- The software enables to:
  - Calculate solar energy conversion efficiency
  - Visualize the trend of the solar radiation incident on the PV panel and the energy flows to and from buffer battery, inverter and PV panel
  - Draw the PV panel characteristic curves current / voltage and power / voltage to find out the point of panel maximum performance



- Save the exercises data for future analysis or project work



Connection of rheostat PRH-2 (optional item) to the control panel to draw the photovoltaic panel characteristic curve.

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

Dimensions:
Control panel: 92 x 46 x 72 cm
Mobile solar array: 120 x 120 x 200 cm
Tot weight: 180 kg

Detail of the touchscreen multifunction instrument

Detail of the Solar tracker SOLTR/EV (optional item) and its control box.

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -
(*PM/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

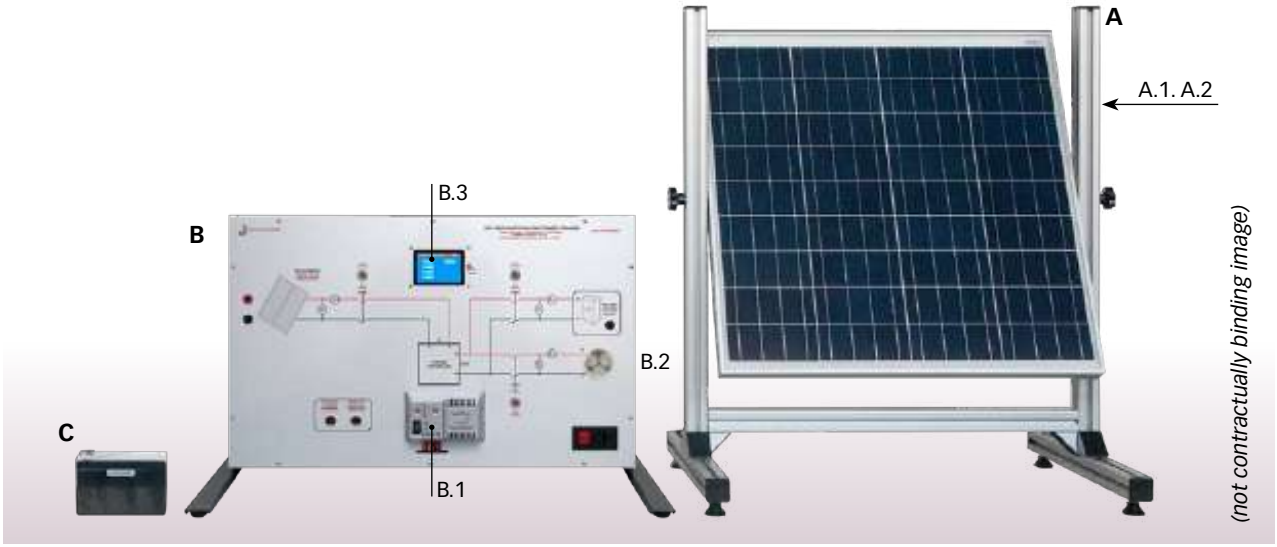
SPOTLIGHT Mod. ACL220V
To be used as 230 Vac electric load

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

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

COMPUTERIZED OFF-GRID PHOTOVOLTAIC TRAINER

Mod. PV-OG/EV



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. The equipment is manufactured using real components available on the market.

DESCRIPTION

System configuration: stand-alone (isolated from the grid)

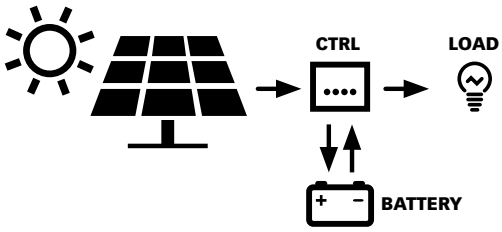
How to operate the photovoltaic solar panel:

- Outdoors
- Indoors; in this case the lighting device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)

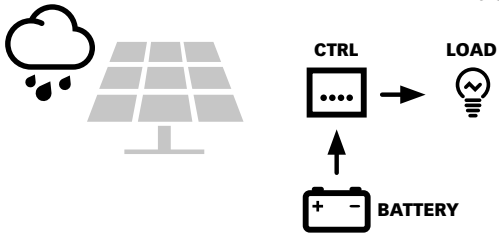
Operating principle:

- WITH load: the energy produced charges the battery and powers the load
- WITH NO load: the energy produced charges the battery
- In case there is no sunshine (or *SS-2/EV* lighting device) the energy consumed by the user (loads) is taken from the battery

Sunshine



No sunshine



www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

TRAINING PROGRAM

- Components of a stand-alone 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
- Battery charging system management
- Connection to portable rheostat *PRH-1* (**optional item** - refer to the end of this data sheet) for photovoltaic panel characteristic curve construction

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel (A)

- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel
- Sensors:
  - Solar radiation sensor for measuring and transmitting the global solar radiation incident on the PV panel to the control panel. Range: 0 ÷ 2000 W/m² **(A.1)**
  - Temperature sensor for measuring and transmitting the PV panel temperature to the control panel. Range: -50 ÷ +70 °C **(A.2)**

Table top control panel (B)

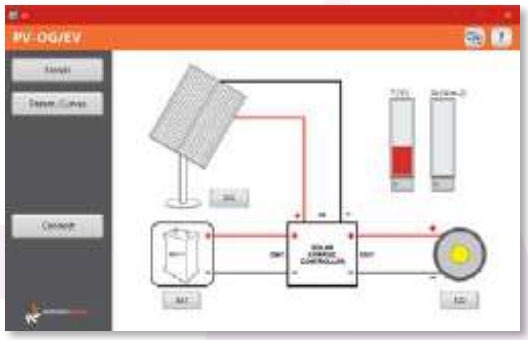
- Metal structure with complete color synoptic diagram
- Charge regulator **(B.1)**:
  - Rated voltage: 12 Vdc
  - Max power input from solar panel: 6,5 A
  - Max switch off current at load output: 6 A
- Electric load: 12 Vdc lamp **(B.2)**
- Multifunction instrument, microprocessor-based, touchscreen display, for DC parameters **(B.3)**

Buffer battery (C)

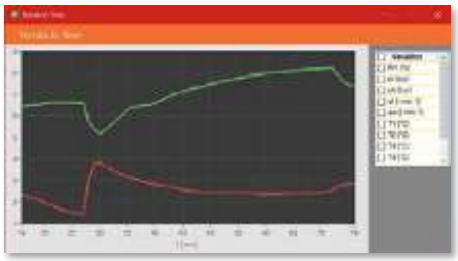
- Rated voltage: 12 Vdc
- Capacity: 12 Ah

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC



- A specific software (developed with LabView) is supplied to monitor the system parameters
- The visualized parameters are:
  - All DC parameters
  - Global solar radiation incident on the PV panel
  - PV panel temperature
- The software enables to:
  - Calculate energy conversion efficiency
  - Visualize the trend of the solar radiation incident on the PV panel and its temperature and the energy flows to and from PV panel, buffer battery 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 panel	65 x 40 x 15 cm
	Solar panel	80 x 50 x 88 cm
Tot weight:	50 kg	

REQUIRED

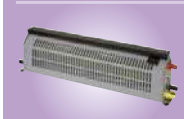
PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

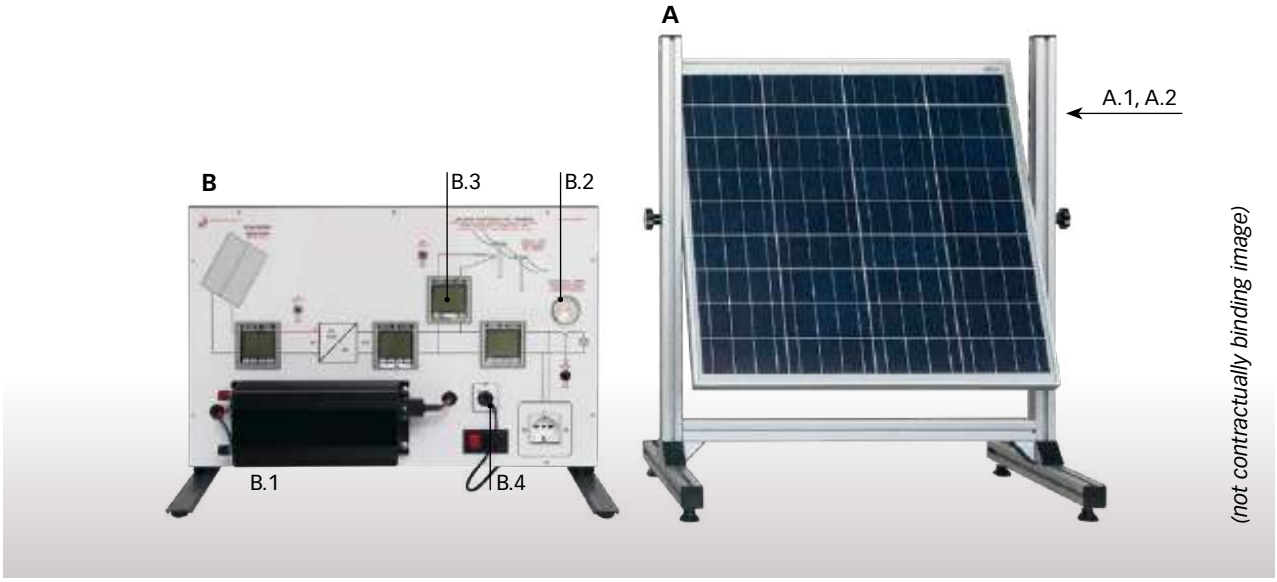
INDOOR LIGHTING DEVICE
Mod. SS-2/EV
To operate the photovoltaic panel indoor



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

COMPUTERIZED ON-GRID PHOTOVOLTAIC TRAINER

Mod. PV-GR/EV



INTRODUCTION

Energy saving and renewable energy exploitation are issues of fundamental importance at global level. The use of a photovoltaic panel allows to face these issues.

The proposed system, which uses real components available on the market, allows the study and experimentation of the operation of a photovoltaic panel.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

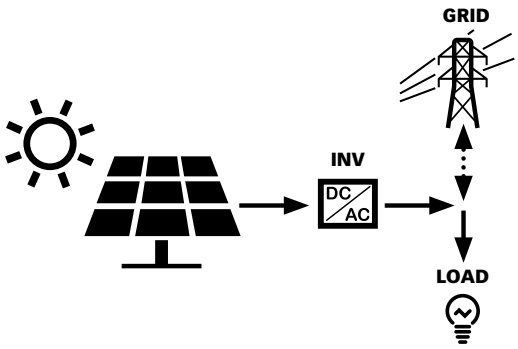
System configuration: grid-connected

How to operate the photovoltaic solar panel:

- Outdoors
- Indoors; in this case the lighting device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)

Operating principle:

- Sufficient solar energy: surplus supplied to the grid
- Insufficient solar energy: surplus provided by the grid



RENEWABLE ENERGIES

www.elettronicaveneta.com

28A-E-PE-PVGR-0

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

TRAINING PROGRAM

- Components of a grid connected 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
- Interconnection of solar 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

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel (A)

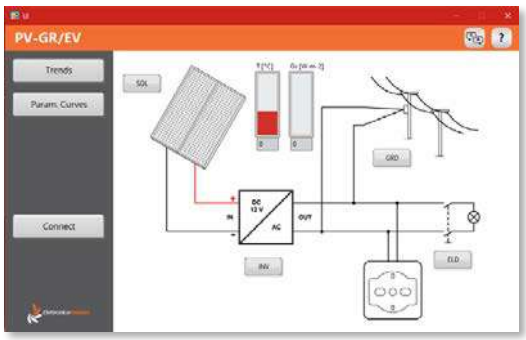
- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel
- Sensors:
  - Solar radiation sensor for measuring and transmitting the global solar radiation incident on the PV panel to the control panel. Range: 0 ÷ 2000 W/m^2 **(A.1)**
  - Temperature sensor for measuring and transmitting the PV panel temperature to the control panel. Range: -50 ÷ +70 °C **(A.2)**

Table top control panel (B)

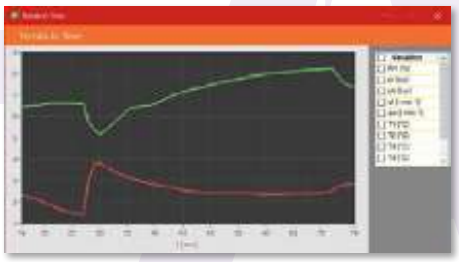
- Metal structure with complete color synoptic diagram
- Grid tie power inverter **(B.1)**:
  - Rated AC Output Power: 450 W
  - AC Output Voltage: 230 V
  - AC Output Frequency: 50 Hz
  - DC Input Voltage Range: 11 ÷ 28 V
  - Output Current Waveform: Pure Sine-wave
  - Protection vs: Over Current, Over Temperature, Reverse Polarity, Anti-Island
- Electric load: 230 V lamp **(B.2)**
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)
- Microprocessor-based instruments for DC/AC parameters **(B.3)**

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC
- A specific software (developed with LabView) is supplied to monitor the system parameters



- Parameters displayed:
  - All DC / AC parameters
  - Photovoltaic panel incident solar radiation
  - Photovoltaic panel temperature
- The software enables to:
  - Calculate solar energy conversion efficiency
  - Visualize the solar radiation incident on the panel surface and its temperature and the energy flows to and from photovoltaic panel, public 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 panel:	65 x 40 x 10 cm
	Solar panel:	80 x 50 x 88 cm
Tot weight:	35 kg	

REQUIRED

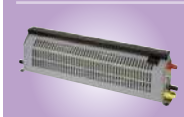
PERSONAL COMPUTER
- NOT INCLUDED -

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

PHOTOVOLTAIC ENERGY GENERATION KIT

Mod. PM-K/EV (1 photovoltaic module)
Mod. PM-K2/EV (2 photovoltaic modules)

INTRODUCTION

This kit is the typical system configuration for exploiting solar energy through silicon photovoltaic cells that allow the direct transformation of solar energy into electrical power.

TRAINING PROGRAM

- Components of a stand-alone solar system for electricity production
- Photovoltaic panel energy conversion efficiency (*)
- Battery charging system management
- Connection to portable rheostat *PRH-1* (**optional item** – refer to the end of this data sheet) for photovoltaic panel characteristic curve construction

(*) Solar radiation meter *SORM* (**optional item** – refer to the end of this data sheet) required

TECHNICAL SPECIFICATIONS

- Photovoltaic panel:
  - 1 module 120 W peak power (*PM-K/EV*)
  - 2 modules 120 W unitary peak power (*PM-K2/EV*)
  - wheeled framework with adjustable inclination
- Charge controller for photovoltaic panels:
  - rated voltage: 12 Vdc
  - maximum current: 20 A
- Buffer battery:
  - rated voltage: 12 Vdc
  - capacity: 100 Ah
- Inverter:
  - continuous output power: 600 W
  - output peak 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
- Clamp meter:
  - voltage range (ac/dc): 0 ÷ 600 V
  - current range (ac/dc): 0 ÷ 200 A

Overall dimensions and weights

mod. PM-K/EV: 67 x 120 x 155 cm, 62 kg
mod. PM-K2/EV: 135 x 120 x 155 cm, 75 kg

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

SOLAR RADIATION METER Mod. SORM
To calculate the solar energy into electric energy conversion efficiency

ELECTRIC BATTERY CHARGER Mod. EBCH
To recharge the buffer battery after a prolonged period of inactivity of the system

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

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

PORTABLE RHEOSTAT
Mod. PRH-1 (to be used with *PM-K/EV*)
Mod. PRH-2 (to be used with *PM-K2/EV*)
To draw the photovoltaic panel characteristic curve

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

SOLAR ENERGY MINI LABORATORY
Mod. SMK/EV

INTRODUCTION

This is a set of electrical and optical instruments and components which enable a group of 4-6 students to carry out a wide range of measurements. The aim is to implement a complete program of experiences which enable students to learn the main characteristics of solar radiation and of photovoltaic conversion process.

The whole set is packed in a suitcase and is supplied with a theoretical-experimental handbook. This system is expressly fitted for a complete and organic study of local insolation characteristics.

TRAINING PROGRAM:

- Study of radiation intensity with different inclinations of the solarimeter
- Calibrating the solarimeter with the solar radiation
- Plotting charts of daily diurnal insolation, for total, diffuse and direct radiation, on horizontal surface and on surface perpendicular to the sun rays
- Graphical and statistical results interpretations
- Assessing the current output of a solar cell by changing its orientation to the light source
- Experimental assessment of voltage-current curves of a silicon cell for different lighting values
- Assessing the maximum electric power output by a silicon cell for different lighting or insolation values
- Calculating the efficiency of a photovoltaic cell
- Parallel and series connection of solar cells
- Calculation of the average power supplied by a silicon cell panel
- Battery recharge

TECHNICAL SPECIFICATIONS:

The system for solar energy study consists of:

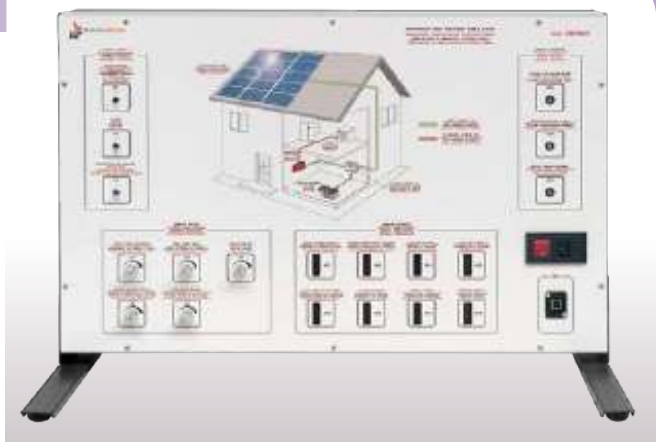
- 1 solarimeter with bar for shadow projection
- 1 milliammeter with 2 ranges: 1 mA f.s. (x1, x2)
- 1 voltammeter with 2 ranges:
  - 1 V f.s. (x1, x4)
  - 0,5 A f.s. (x1, x4)
- 1 load rheostat
- 2 silicon solar cells of standard dimensions
- 2 silicon solar cells of different dimensions
- 1 portable compass
- 1 solar tracking system
- 1 solar panel made of silicon cells
- 1 lead accumulator
- 1 d.c. motor
- 1 solar ruler
- 1 adjustable stand

Power supply: 230 Vac 50 Hz single-phase - 100 VA
(Other voltage and frequency on request)
Box dimension: 60 x 48 x 20 cm
Net weight: 11 kg

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

PHOTOVOLTAIC SYSTEM SIMULATOR
Mod. SIM-PM/EV



INTRODUCTION

Educational simulator mod. SIM-PM/EV is designed to study the operation of a stand-alone photovoltaic system (insulated from the mains). Thanks to a photovoltaic panel, this type of equipment collects and transforms the incident solar radiation, so that it is available as electric energy to all users. The perfect system operation is ensured by a battery charge controller and by an inverter. The simulator enables to analyze the system behavior depending on the battery charge level, the power requested by users and the panel position; it also enables to analyze the consequences of a disturbance on the system, such as clouds or the breaking of a cell.
The simulator should necessarily be connected with a PC (not included).

TRAINING PROGRAM

- Study of solar energy: photovoltaic effect
- Calculation of the average power developed by the sun on a specific place
- Monocrystalline and polycrystalline silicon cells
- Energy balance of the panel, efficiency
- Devices for storing energy
- Batteries charge control

TECHNICAL SPECIFICATIONS

- Colour panel reproducing the photovoltaic system
- Board for data acquisition and control of output signals to the actuators
- PC connection via USB cable
- 5 potentiometers to simulate the following analog inputs:
  - storage battery charge
  - power requested by users
  - panel inclination angle (referred to the horizontal surface)
  - panel azimuth angle (referred to south direction)
  - time of day
- 8 bar LEDs to simulate the following analog outputs:
  - photovoltaic panel voltage
  - panel output current
  - battery voltage
  - current supplied/absorbed by the battery
  - current absorbed by the inverter
  - solar power incident on the photovoltaic panel
  - power absorbed by users
  - system efficiency
- 3 switches to simulate the following digital inputs:
  - enabling system operation
  - clouded sky
  - insertion of simulated faults
- 3 LEDs to simulate the following digital outputs:
  - alarm for low charge level of the storage battery
  - alarm for inverter overload
  - battery in charging or discharging phase
- Photovoltaic system simulation software

Power supply: 230 Vac 50 Hz single-phase - 200 VA
(Other voltage and frequency on request)
Dimensions: 65 x 40 x 12 cm
Weight: 5 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

28-A

WIND ENERGY

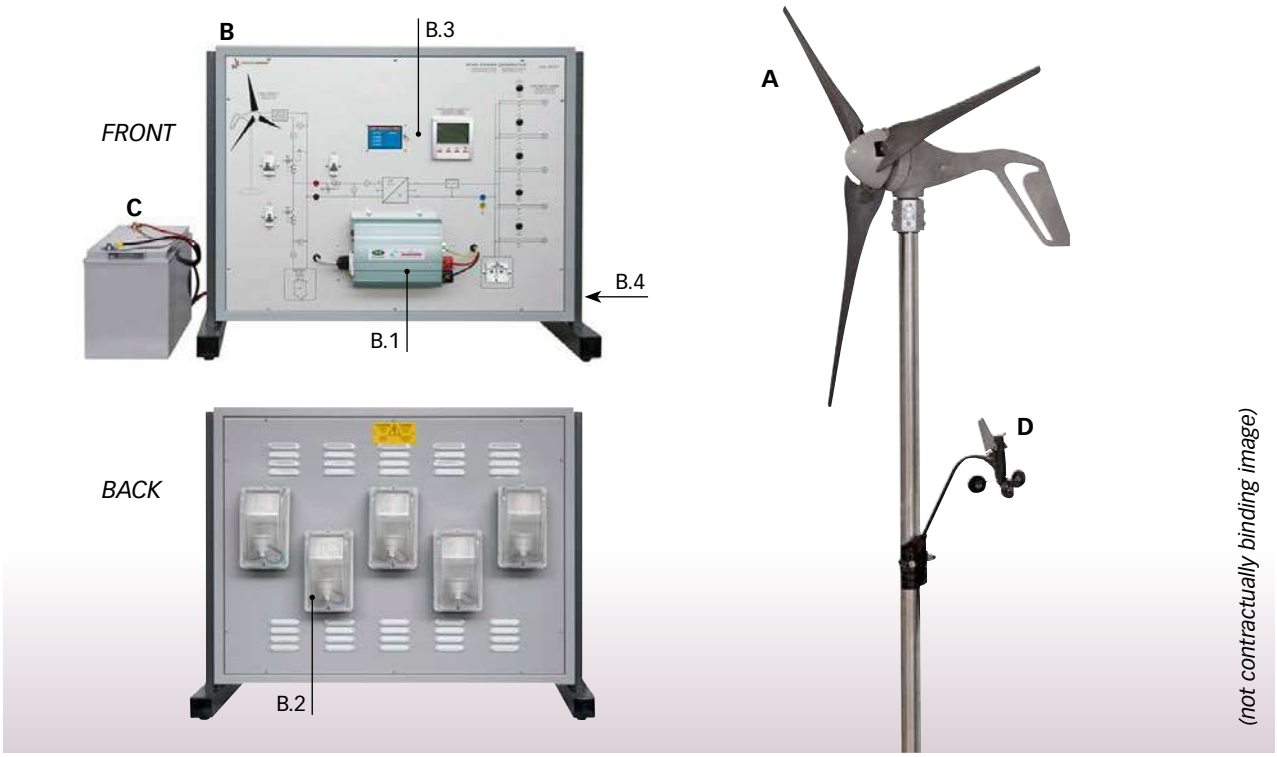
	Mod.	Page
WIND POWER GENERATOR TRAINER	WG-C/EV WG/EV	**WI** 3
AEROGENERATOR WITH WIND TUNNEL COMPUTERIZED TRAINER	WIND-TU2/EV	**WI** 6
COMPUTERIZED OFF-GRID WIND POWER PLANT TRAINER	WG-OG/EV	**WI** 9
COMPUTERIZED ON-GRID WIND POWER PLANT TRAINER	WG-GR/EV	**WI** 11
WIND ENERGY GENERATION KIT	WG-K/EV	**WI** 13

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

WIND POWER GENERATOR TRAINER

Mod. WG-C/EV
Mod. WG/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 wind energy into electricity by means of a wind power generator. The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

System configuration: stand-alone (isolated from the grid)

The system consists of:

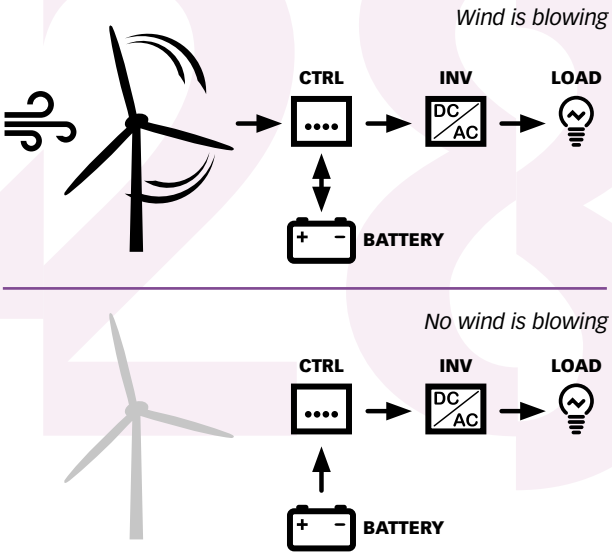
A) Horizontal axis wind power generator including a microprocessor-based controller
B) Table top control panel including:
- **B.1)** Sinewave inverter
- **B.2)** Electric loads
- **B.3)** Electric instrumentation for detecting the energy flows in the different branches of the circuit
- **B.4)** Data acquisition board with USB interface for PC connection (*WG/EV* only)

C) Buffer battery
D) Wind speed and direction sensor (*WG/EV* only)

Relevant features:

- The trainer can operate with or without the wind
- The wind generator can be used both outdoors and indoors. In the latter case, an indoor operation device is required (**optional** - for models and configurations refer to the end of the 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 wind blowing, all the energy consumed by the user (loads) is taken from the battery.
- In case there is wind blowing but no load is connected, all the energy produced by the system charges the battery.
- In case there are both wind blowing 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 the wind, the power surplus is given by the battery.

TRAINING PROGRAM

- Components of a stand-alone wind power system for electricity production
- Effect of the wind speed on the generator output voltage (*)
- Effect of applied load variation on the electric power produced by the wind generator
- Wind generator energy conversion efficiency (*)
- Battery charging system management
- Operation and efficiency of a DC/AC inverter
- Connection of the indoor operation device (**optional** – for models and configurations refer to the end of the data sheet) for the construction of the wind generator characteristic curve

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

TECHNICAL SPECIFICATIONS

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 supplied with a 10 meter indoor / outdoor unit connection cable

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 (equivalent) switchable lamps
- 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:
  - multifunction instrument, microprocessor-based, touchscreen display, for DC parameters
  - multifunction instrument, microprocessor-based, for AC parameters
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)
- Ø 4 mm safety holes for connection to the lamp *DCL12V* (**optional item** - refer to the end of this data sheet)

Buffer battery

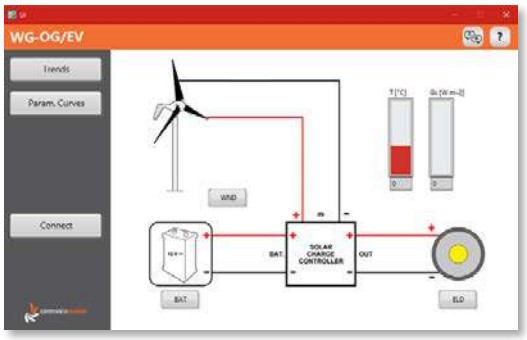
- Rated voltage: 12 Vdc
- Capacity: 100 Ah

Wind speed and direction sensor (*WG/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 ÷ 40 m/s
- Wind direction range: 0 ÷ 360°

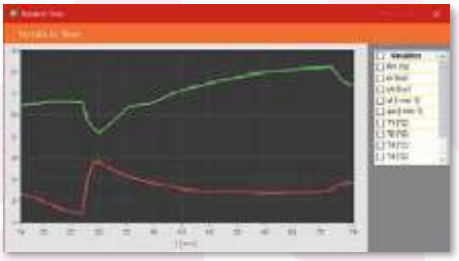
PC data acquisition (*WG/EV* only)

- 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 system parameters.
- Parameters displayed:
  - All DC and AC parameters
  - Wind speed and direction



ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- The software enables to:
  - Calculate wind energy conversion efficiency
  - Visualize the trend of the wind speed and the energy flows to and from buffer battery, inverter and wind power generator



  - 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 - 100 VA
(Other voltage and frequency on request)

Dimensions:

Control panel:	92 x 46 x 72 cm
Wind generator rotor diameter:	117 cm
Net weight:	110 kg

Detail of the touchscreen multifunction instrument

The aerogenerator installed outdoors at a school facility

REQUIRED

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

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

WIND POWER GENERATOR INDOOR OPERATION DEVICE
Mod. WG-I/EV
It works with the aerogenerator supplied with the trainer

WIND POWER GENERATOR INDOOR OPERATION DEVICE
Mod. WG-IIG/EV
It includes an additional aerogenerator

ELECTRIC BATTERY CHARGER
Mod. EBCH
To recharge the buffer battery after a prolonged period of inactivity of the system

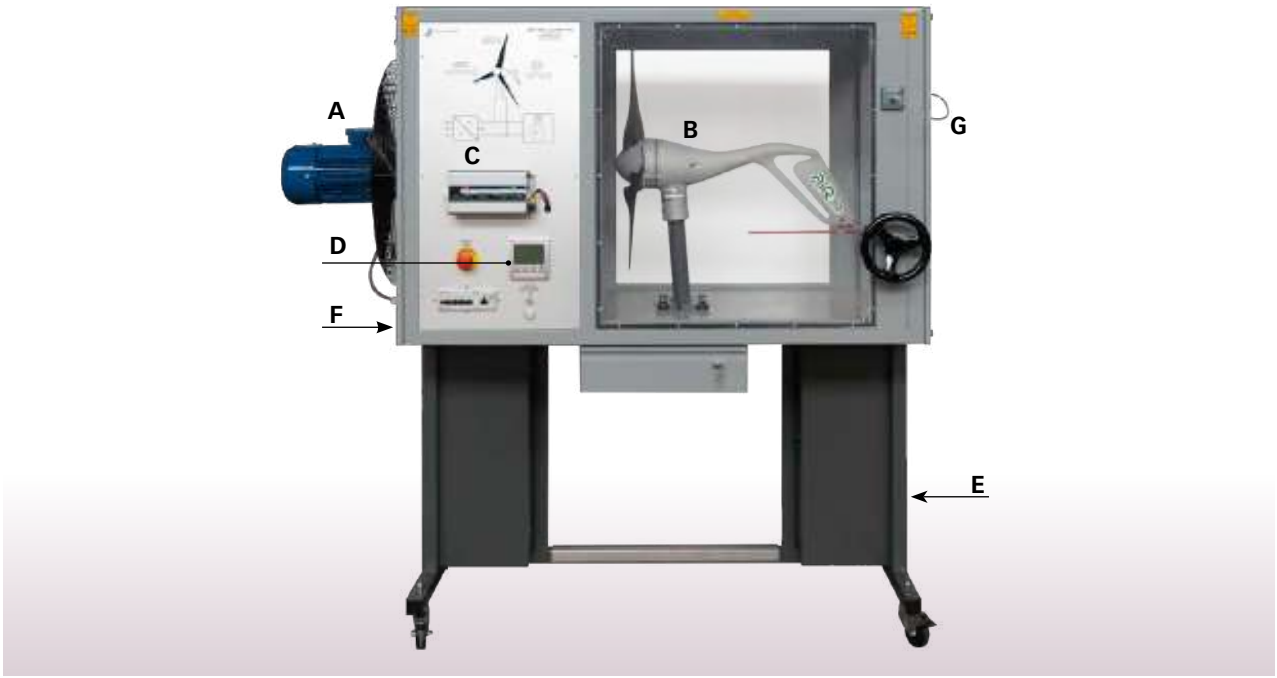
SPOTLIGHT Mod. ACL220V
To be used as 230 Vac electric load

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

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

AEROGENERATOR WITH WIND TUNNEL COMPUTERIZED TRAINER

Mod. WIND-TU2/EV



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 wind energy into electricity by means of a wind power generator. The equipment is manufactured using real components available on the market and includes a wind source (variable speed axial fan).

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

System configuration: stand-alone (isolated from the grid)

The system consists of:

A) Axial fan with frequency converter
B) Horizontal axis wind power generator including a microprocessor-based controller
C) Sinewave inverter
D) Electric instrumentation for detecting the energy flow from the aerogenerator
E) Buffer battery
F) Data acquisition board with USB interface for PC connection
G) Air speed sensor

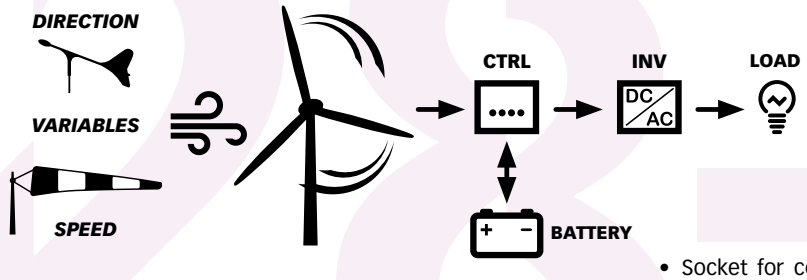
Relevant features:

- The wind speed is adjustable
- The aerogenerator orientation is adjustable depending to the wind direction

www.elettronicaveneta.com

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

Operating principle:



- In case no load is connected to the system, all the produced energy charges the battery.
- In case some electric loads are connected to the system, the produced energy partially charges the battery and partially powers the loads.
- When the consumption is higher than the power available from the wind, the power surplus is given by the battery.

TRAINING PROGRAM

- Physical principles whereby wind power is transformed into electrical power
- Study of brushless generators
- 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
- Battery charge control
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS

Wheeled steel structure with:

- A wind tunnel with two transparent observation windows to prevent contact with the moving parts
- A comprehensive colored diagram of the system

Wind source consisting of:

- Axial fan with three phase electric motor, rated power: 2,2 kW
- Frequency converter, applicable motor: 2,2 kW

Horizontal axis wind power generator:

- Aluminium generator body
- 3 composite material blades (rotor diameter approx. 0,70 m)
  - 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
- Aerogenerator axial orientation manual adjusting device

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
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)

Switch board

- E.L.C.B. and T.M.C.B.
- Emergency pushbutton
- Multifunction instrument, microprocessor-based, for CC parameters

Buffer battery

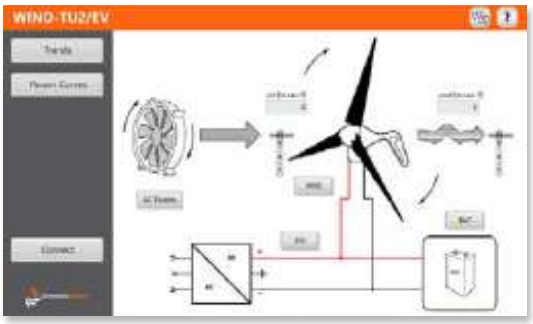
- Rated voltage: 12 Vdc
- Capacity: 80 Ah

Hot wire air speed sensors

- Range: 0 ÷ 15 m/s
- Range: 0 ÷ 40 m/s

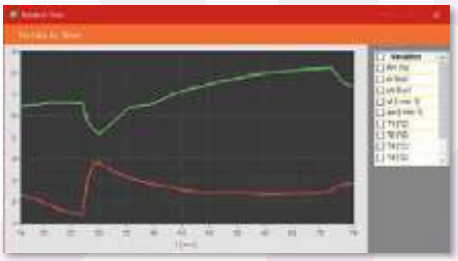
PC data acquisition

- The trainer 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 system parameters.

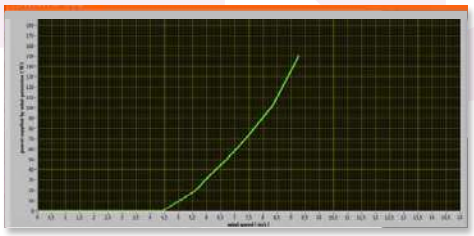


- Parameters displayed:
  - All DC and AC parameters powering the electric motor
  - Wind speed at the nose and tail of the wind power generator

- The software enables to:



- Calculate wind energy conversion efficiency
- Visualize the trend of the energy flows to and from buffer battery, inverter and wind power generator



- Draw the wind power generator characteristic curve output power vs wind speed
- Draw the wind power generator characteristic curve efficiency vs wind speed
- Save the exercises data for future analysis or project work

Power supply: 400 Vac 50 Hz three-phase - 2000 VA
(Other voltage and frequency on request)
Dimensions: 180 x 95 x 170 cm
Weight: 230 kg

Wind tunnel detail

www.elettronicaveneta.com

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

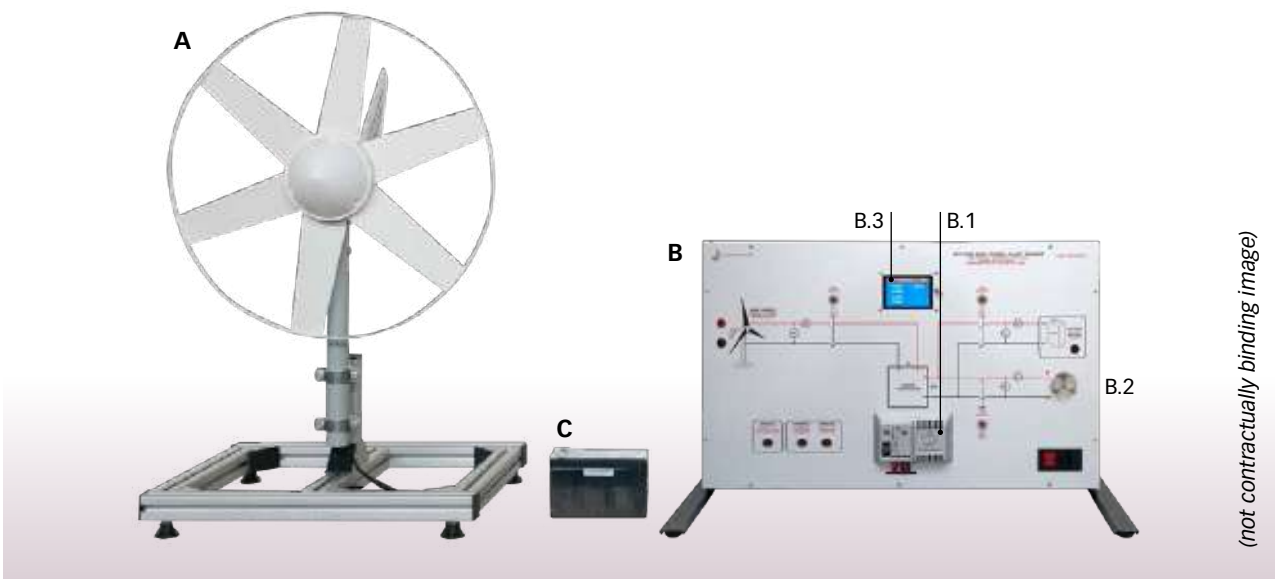
ELECTRIC BATTERY CHARGER Mod. EBCH
To recharge the buffer battery after a prolonged period of inactivity of the system

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

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED OFF-GRID WIND POWER PLANT TRAINER

Mod. WG-OG/EV



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 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)

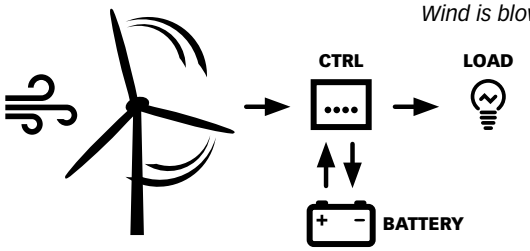
How to operate the wind generator:

- Indoors; the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

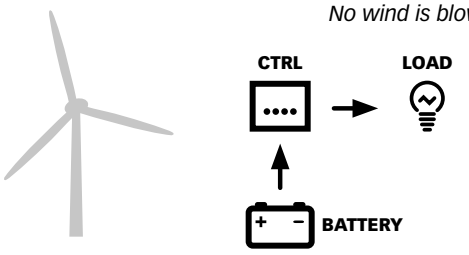
Operating principle:

- WITH load: the energy produced charges the battery and powers the load
- WITH NO load: the energy produced charges the battery
- In case the indoor operation device *WG-IE* is not running (no wind condition) all the energy consumed by the user (loads) is taken from the battery

Wind is blowing



No wind is blowing



TRAINING PROGRAM

- Components of a stand-alone wind power system for electricity production
- Effect of the wind speed on the generator output voltage
- Wind generator energy conversion efficiency
- Battery charging system management
- Use of wind power generator indoor operation device *WG-IE* (**required** - refer to the end of this data sheet) for wind generator characteristic curve construction

TECHNICAL SPECIFICATIONS

Horizontal axis wind power generator (A)

- 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 (B)

- Metal structure with complete color synoptic diagram
- Charge regulator **(B.1)**:
  - Pulse Width Modulation (PWM) regulation
  - LED indicators for battery voltage levels and charging status
- Electric load: 12 Vdc lamp **(B.2)**
- Multifunction instrument, microprocessor-based, touchscreen display, for DC parameters **(B.3)**

Buffer battery (C)

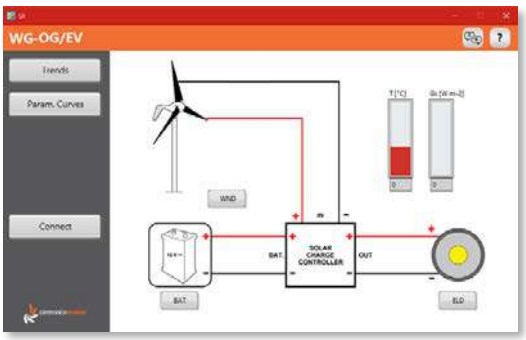
- Rated voltage: 12 Vdc
- Capacity: 12 Ah

Wind speed sensor

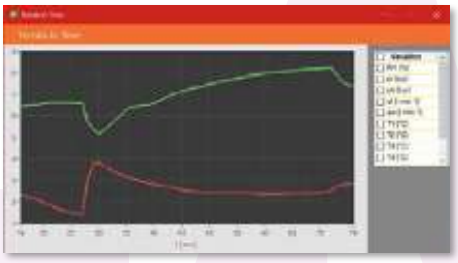
- For measuring and transmitting wind speed to the control panel

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC
- A specific software (developed with LabView) is supplied to monitor the system parameters
- The visualized parameters are:
  - All DC parameters
  - Wind speed



- The software enables to:
  - Calculate energy conversion efficiency
  - Visualize the trend of the wind speed and the energy flows to and from wind generator, buffer battery 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 panel	65 x 40 x 15 cm
	Wind gen. rotor diameter	51 cm
Tot weight:	50 kg	

REQUIRED

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

PERSONAL COMPUTER
- NOT INCLUDED -

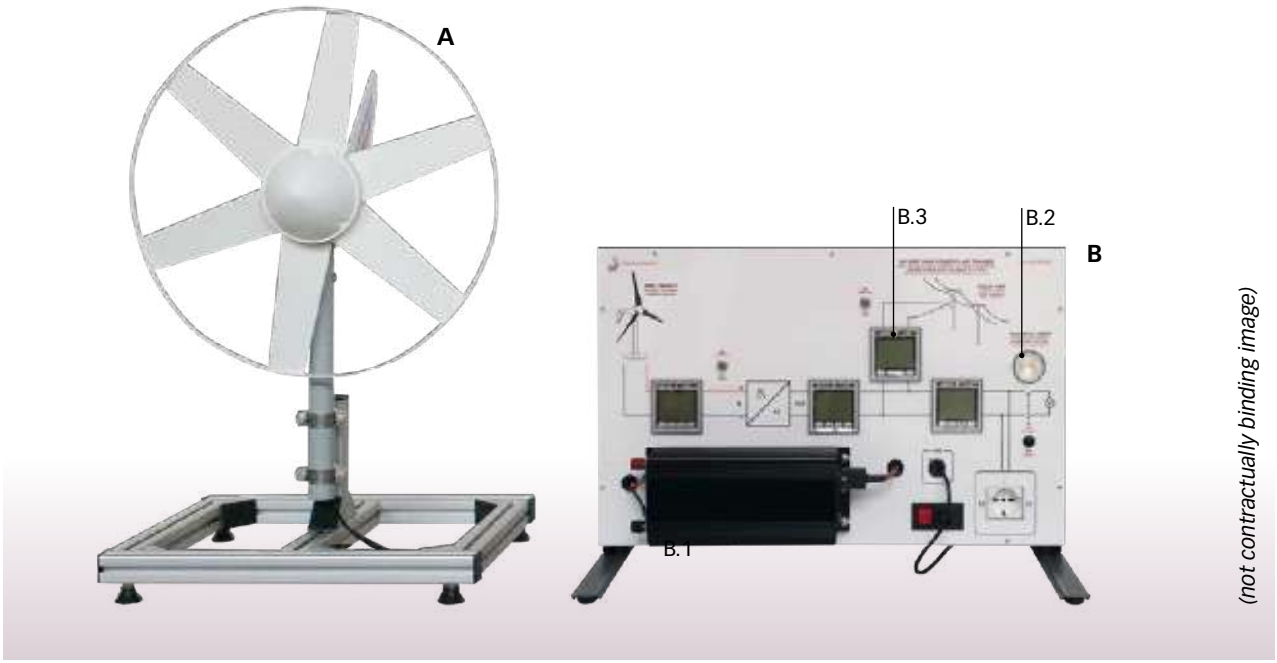
SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

www.elettronicaveneta.com

COMPUTERIZED ON-GRID WIND POWER PLANT TRAINER

Mod. WG-GR/EV



(not contractually binding image)

INTRODUCTION

Energy saving and environmental pollution reduction are crucial global issues. Using wind power generators can address both issues.

This system enables experimental investigation on the operation of a wind power generator. The equipment is manufactured using real components available on the market.

DESCRIPTION

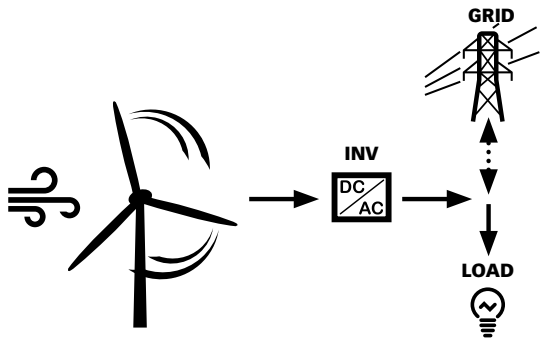
System configuration: grid-connected

How to operate the wind generator:

- Indoors; the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

Operating principle:

- Sufficient wind energy: surplus supplied to the grid
- Insufficient wind energy: surplus provided by the grid



TRAINING PROGRAM

- Components of a grid connected wind power system for electricity production
- Effect of the wind speed on the generator output voltage
- Wind generator energy conversion efficiency
- Interconnection of wind energy to the public grid
- Operation and efficiency of a DC/AC inverter
- Use of wind power generator indoor operation device *WG-IE* (**required** - refer to the end of this data sheet) for wind generator characteristic curve construction

TECHNICAL SPECIFICATIONS

Horizontal axis wind power generator (A)

- 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 (B)

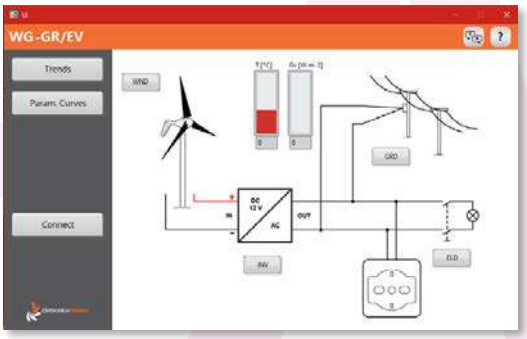
- Metal structure with complete color synoptic diagram
- Grid tie power inverter **(B.1)**:
  - Rated AC Output Power: 450 W
  - AC Output Voltage: 230 V
  - AC Output Frequency: 50 Hz
  - DC Input Voltage Range: 11 ÷ 28 V
  - Output Current Waveform: Pure Sine-wave
  - Protection vs: Over Current, Over Temperature, Reverse Polarity, Anti-Island
- Electric load: 230 V lamp **(B.2)**
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)
- Microprocessor-based instruments for DC/AC parameters **(B.3)**

Wind speed sensor

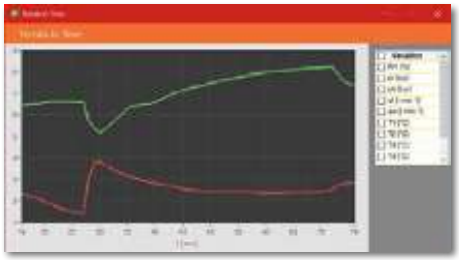
- For measuring and transmitting wind speed to the control panel; range 0 ÷ 15 m/sec

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC
- A specific software (developed with LabView) is supplied to monitor the system parameters



- Parameters displayed:
  - All DC / AC parameters
  - Wind speed
- The software enables to:
  - Calculate energy conversion efficiency
  - Visualize the trend of the wind speed and the energy flows to and from wind power generator, 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 panel: 65 x 40 x 10 cm Wind gen. rotor diameter: 51 cm
Tot weight:	35 kg

REQUIRED

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

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

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

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

WIND ENERGY GENERATION KIT
Mod. WG-K/EV

INTRODUCTION

This equipment features the typical configuration of a horizontal axis wind power generator, used to convert the wind kinetic energy directly into electric energy.

TRAINING PROGRAM

- Components of a stand-alone wind system for electricity production
- Wind generator energy conversion efficiency (*)
- Battery charging system management
- Connection to wind power generator indoor operation device *WG-IM/EV* (**optional item** – refer to the end of this data sheet) for wind generator characteristic curve construction

(*) Cup vane air velocity meter *THAC* (**optional item** – refer to the end of this data sheet) required

TECHNICAL SPECIFICATIONS

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

Buffer battery:

- Rated voltage: 12 Vdc
- Capacity: 100 Ah

Inverter:

- Continuous output power: 600 W
- Output peak 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

Clamp meter:

- Voltage range (ac/dc): 0 to 600 V
- Current range (ac/dc): 0 to 200 A

Dimensions

Rotor diameter: 117 cm

Net weight: 70 kg

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-IM/EV
To operate the aerogenerator indoor

ELECTRIC BATTERY CHARGER Mod. EBCH
To recharge the buffer battery after a prolonged period of inactivity of the system

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

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

CUP VANE AIR VELOCITY METER Mod. THAC
For the calculation of the wind energy into electric energy conversion efficiency

www.elettronicaveneta.com

28-A

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

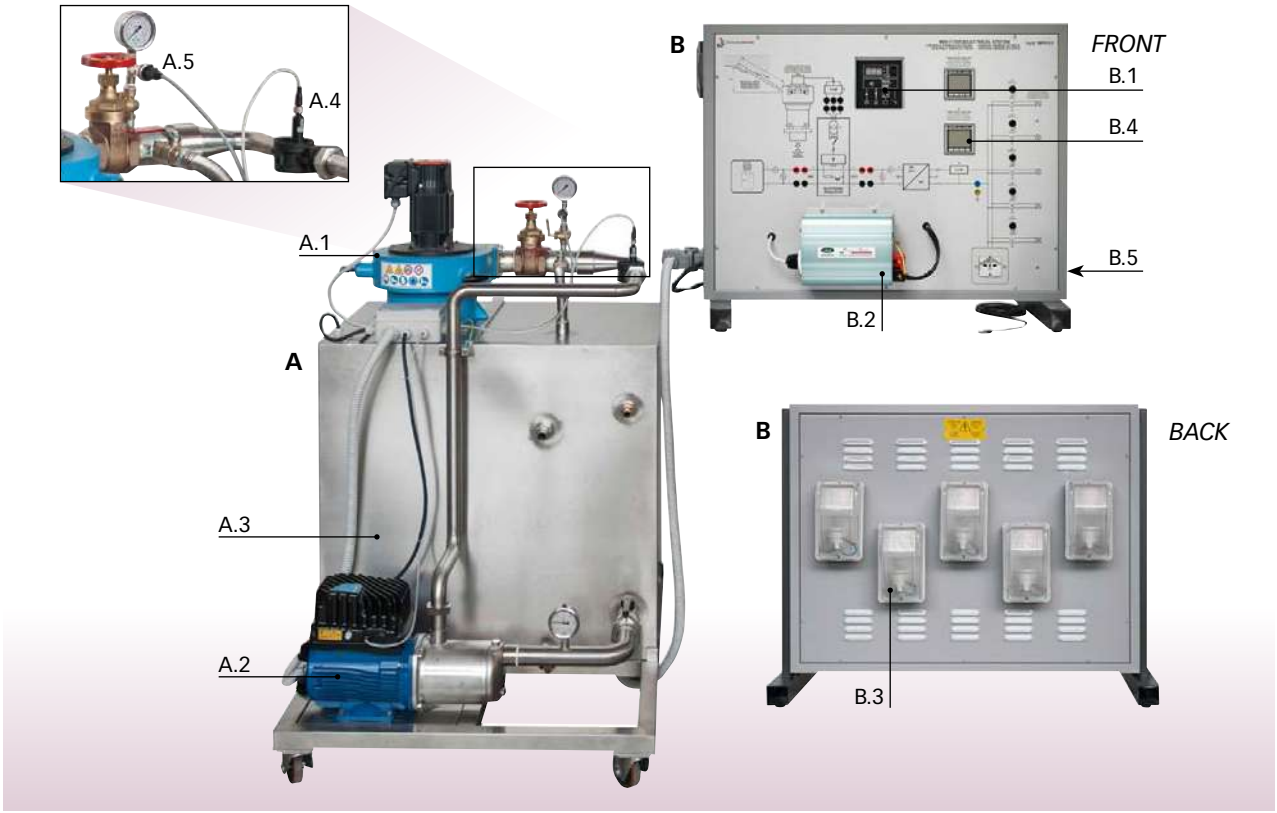
HYDROELECTRIC ENERGY

	Mod.	Page
COMPUTERIZED MINI HYDROELECTRIC POWER PLANT TRAINER	WPP/EV	**HE** 3
HYDROELECTRIC ENERGY GENERATION KIT	WPP-K/EV	**HE** 6

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED MINI HYDROELECTRIC POWER PLANT TRAINER

Mod. WPP/EV



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

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

The system consists of:

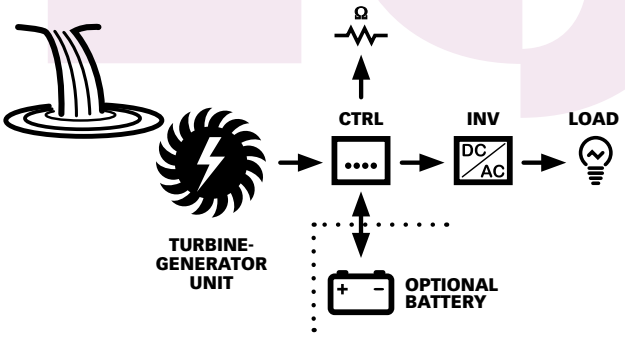
A) Mini hydroelectric power plant mounted on castors including:
- **A.1)** Turbine-generator unit with water distributor
- **A.2)** Variable speed centrifugal pump
- **A.3)** Stainless steel water tank
- **A.4)** Flow rate sensor
- **A.5)** Pressure sensor and pressure gauge

B) Table top control panel including:
- **B.1)** Controller with air dissipation system
- **B.2)** Sinewave inverter
- **B.3)** Electric loads
- **B.4)** Electric instrumentation for detecting the energy flows in different branches of the circuit
- **B.5)** Data acquisition board with USB interface for PC connection

Relevant features:

- The turbine-generator unit is equipped with a 6-jet water distribution system. In correspondence of each jet, a nozzle or a cap can be installed, thus modifying the geometry with which the water hits the turbine. Nozzles of different diameter are available.
- 3 jets can be externally intercepted
- The turbine-generator unit can be disconnected from the system, for drawing the external characteristic curve. In this case the portable rheostat *PRH-3* (**optional item** - refer to the end of this data sheet) is required

Operating principle:



- If no load is connected to the system, all the produced energy is dissipated in air or used to charge the battery pack *SOLBA* (**optional item** - refer to the end of this data sheet)
- In case some loads are connected to the system, the produced energy partially feeds the loads and partially charges the battery pack (optional item) or is dissipated in air.
- When the consumption is higher than the power available from the water, the power surplus is given by the battery pack (optional item).

TRAINING PROGRAM

- Components of a stand-alone hydraulic system for electricity production
- Effect of water pressure variation on the electric power produced by the generator
- Effect of applied load variation on the electric power produced by the generator
- Hydraulic energy conversion efficiency
- Battery charging system management
- Operation and efficiency of a DC/AC inverter
- Connection to portable rheostat *PRH-3* (**optional item** – refer to the end of this data sheet) for generator external characteristic curve construction

TECHNICAL SPECIFICATIONS

Mini hydroelectric power plant mounted on castors:

- Turbine-generator unit:
  - AISI 304 stainless steel Pelton turbine, d = 100 mm, blade no. = 20
  - 6-jet distributor
  - 3 jets can be externally intercepted
  - permanent magnets synchronous generator
  - rated voltage: 25 Vac three phase
  - frequency: 200 Hz
  - nominal electric power output: 0,5 kW (height 30 m, flow rate 3 l/s)
  - generator speed: 3000 rpm
- AISI 304 stainless steel horizontal axis multistage monoblock pump:
  - power: 0,75 kW
  - maximum flow rate: 10 m^3/h
  - maximum head: 43 m
  - frequency converter for rpm adjustment
- AISI 304 stainless steel water tank, capacity: 250 liters
- AISI 304 stainless steel hydraulic circuit feeding the turbine-generator unit with:
  - ball valve and dial vacuum gauge, range: -1 ÷ 5 bar, at pump suction
  - dial pressure gauge, range: 0 ÷ 6 bar, and gate valve at pump discharge
  - ball valve at distributor-tank by-pass

Flow rate sensor for measuring and transmitting the water flow rate to the control panel

- Transducer type: rotating vane
- Range: 25 ÷ 250 liters/minute

Pressure sensor for measuring and transmitting the water pressure to the control panel

- Transducer type: piezoresistive
- Range: 0 ÷ 16 bar

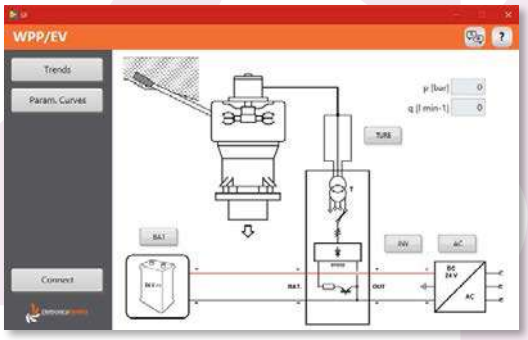
Table top control panel:

- Steel structure with:
  - front side: comprehensive colored diagram of the system
  - back side: AC loading system consisting of 5 30 W (equivalent) switchable lamps
- Controller
  - Rectifier
  - Air dissipation system
  - Digital voltmeter for the DC parameters
  - Digital ammeter for the DC parameters
- Inverter
  - continuous output power: 600 W
  - peak output power: 1200 W
  - input voltage: 24 Vdc
  - output voltage: 230 Vac - 50 Hz
  - output waveform: modified sine wave
  - stop for low battery charge
  - protection against overload, short circuit, overtemperature
- Instrumentation
  - multifunction instruments, microprocessor-based, for AC parameters
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)
- Ø 4 mm safety holes for connection to the portable rheostat *PRH-3* (**optional item** - refer to the end of this data sheet)
- Ø 4 mm safety holes for connection to the lamp *DCL24V* (**optional item** - refer to the end of this data sheet)

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

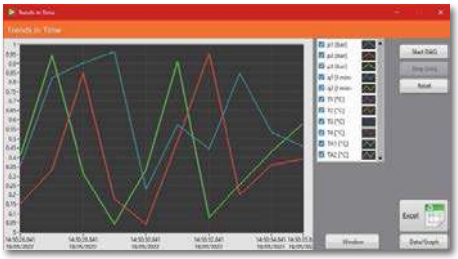
PC data acquisition

- The trainer 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 system parameters.



- Parameters displayed:
  - All DC and AC parameters

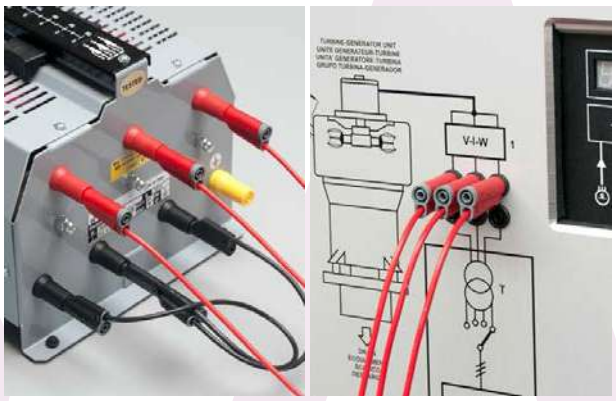
  - Water pressure and flow rate
- The software enables to:
  - Calculate the hydraulic energy conversion efficiency
  - Visualize the energy flows to and from turbine-generator unit, battery pack (if present) and inverter
  - Draw the characteristic curve efficiency / flow rate to find out the point of maximum performance of the turbine-generator unit



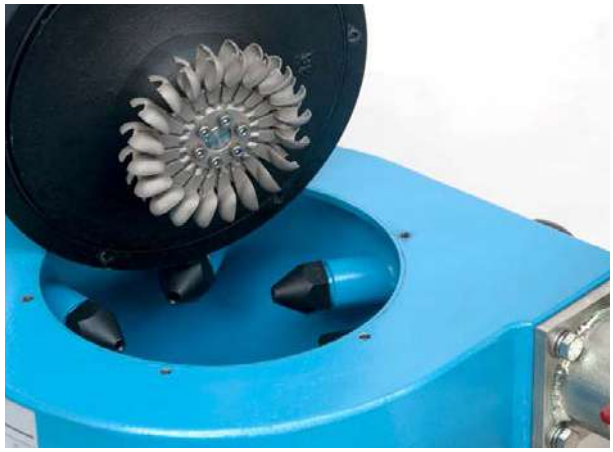
  - Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase - 1000 VA
(Other voltage and frequency on request)

Dimensions:
Control panel: 92 x 46 x 72 cm
Mini hydroelectric station: 100 x 80 x 130 cm
Weight: 170 kg



Connection of rheostat mod. PRH-3 (optional item) to the control panel to draw the generator external characteristic curve.



Detail of Pelton turbine and distributors

REQUIRED

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

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

PORTABLE RHEOSTAT Mod. PRH-3
To draw the external characteristic curve of the generator

BATTERY PACK Mod. SOLBA
To store the generated electricity

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

LAMP Mod. DCL24V
To be used as 24 Vdc electric load

HYDROELECTRIC ENERGY GENERATION KIT

Mod. WPP-K/EV

INTRODUCTION

This equipment, expressly designed for educational purposes, is an example of use of a Pelton hydraulic turbine for the production of electric power in mini plants driven by small streams.

TRAINING PROGRAM

- Study of hydroelectric power
- Power as function of water flow rate and difference in height of the hydraulic pipe
- Head losses
- Electric power output
- Plant efficiency

TECHNICAL SPECIFICATIONS

Mini hydroelectric plant mounted on castors

- Turbine-generator set:
  - stainless steel Pelton turbine
  - 6-jet distributor, 3 of which can be externally intercepted
  - permanent magnets synchronous generator
  - rated voltage: 25 Vac three phase
  - frequency: 200 Hz
  - nominal electric power output: 0,5 kW (height 30 m, flow rate 3 l/s)
  - generator speed: 3000 rpm
  - Ø 4 mm safety holes for connection to portable rheostat *PRH-3* (**optional item** – refer to the end of this data sheet)
- AISI 304 stainless steel horizontal axis multistage monoblock pump:
  - power: 0,75 kW
  - maximum flow rate: 10 m^3/h
  - maximum head: 43 m
  - frequency converter for rpm adjustment
- Water tank
- Flow meter, pressure gauge and gate valve on the pump discharge line

Controller

- Rectifier
- Air dissipation system
- Digital voltmeter for the DC parameters
- Digital ammeter for the DC parameters
- Ø 4 mm safety holes for connection to the generator, to the lamp *DCL24V* (**optional item** - refer to the end of this data sheet) and to the battery pack *SOLBA* (**optional item** - refer to the end of this data sheet)

Clamp meter

- Voltage range (ac/dc): 0 to 600 V
- Current range (ac/dc): 0 to 200 A

Power supply: 230 Vac 50 Hz single-phase - 1000 VA
(Other voltage and frequency on request)

Dimensions: 80 x 100 x 128 cm

Control panel dimensions: 80 x 40 x 60 cm

Net weight: 100 kg

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

PORTABLE RHEOSTAT Mod. PRH-3
To draw the external characteristic curve of the generator

BATTERY PACK Mod. SOLBA
To store the generated electricity

LAMP Mod. DCL24V
To be used as 24 Vdc electric load

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

LUFTDRUCK PRESSURE PRESSION PRESIÓN
H2
Hydrogen
zero e

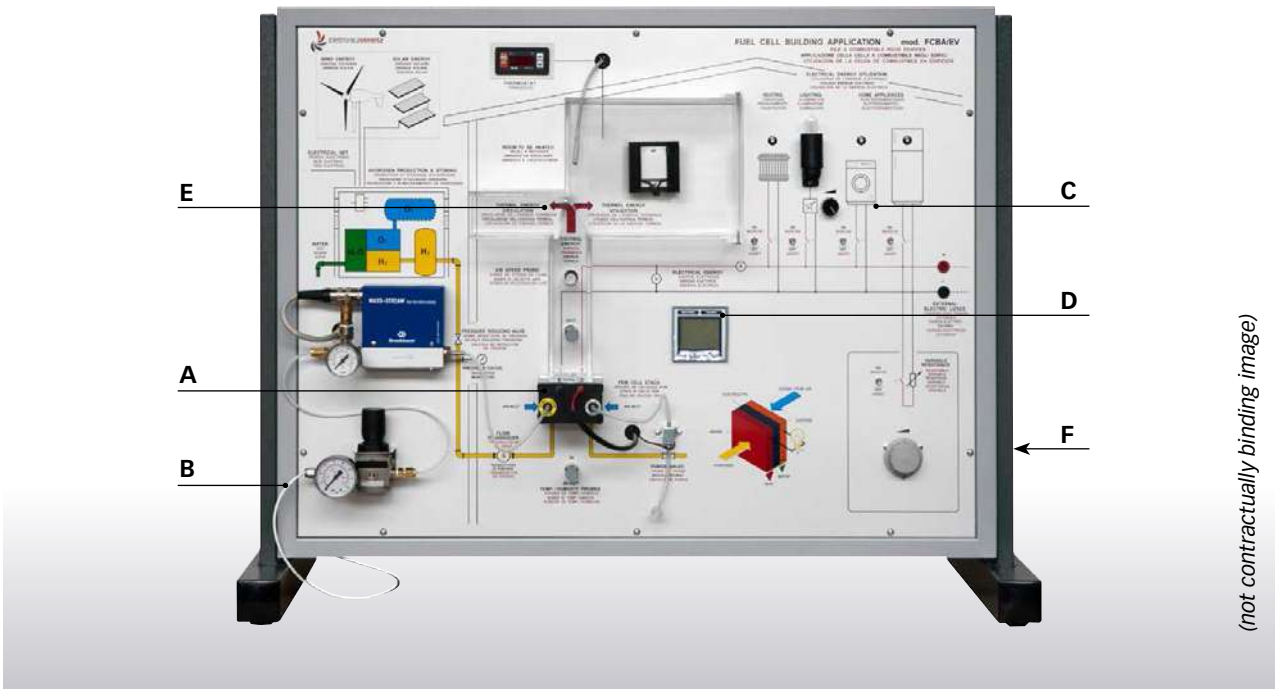
28-A

FUEL CELL TECHNOLOGY

	Mod.	Page
COMPUTERIZED FUEL CELL TRAINER	FCBA/EV	**FC** 3
COMPUTERIZED FUEL CELL TESTING PANEL	FUEL-C.../EV	**FC** 6

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED FUEL CELL TRAINER
Mod. FCBA/EV



INTRODUCTION

Energy saving and environmental pollution reduction are crucial global issues. Using Hydrogen as alternative source to fossil fuels can address both issues, especially if it is produced with the help of renewable energies.
Considering the above, this system enables experimental investigation of the electrochemical energy conversion taking place in a fuel cell stack fed by hydrogen and oxygen (present in atmospheric air). The equipment is manufactured using real components available on the market.

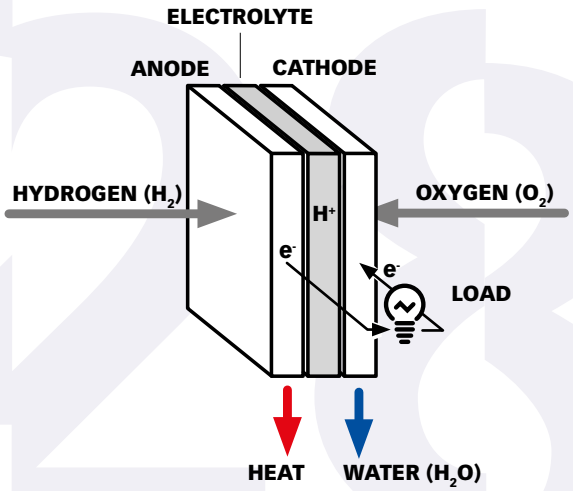
DESCRIPTION

The system consists of:
A) Fuel cell stack
B) Hydrogen feeding line
C) Switchable electric loads
D) Instrumentation
E) Transparent room for simulation of domestic heating
F) Data acquisition system with USB interface for PC connection

Relevant features:

- The fuel cell stack is PEM type and consists of 13 cells connected in series.
- The room air feeding the stack carries the oxygen and cools the stack at the same time.
- To operate, the fuel cell stack must be fed with hydrogen supplied by the generator *HG-1* (or the electrolyzer *HG-600*) and the storage tank *H2-300* (**required** - refer to the end of this data sheet)
- The fuel cell stack can be connected to constant or variable electric loads supplied with the equipment. It can also be connected to the DC motor *DCM/EV* (**optional item** - refer to the end of this data sheet)
- The stack cooling air can be conveyed to a reduced-size transparent room to increase the temperature of the room itself.

Operating principle:



The hydrogen coming from the hydrogen generator or the cylinder crosses the membranes of the fuel cell stack and combines with the oxygen of the air forming water. This process produces, on the one hand, electricity and, on the other hand, heat. The electricity is used to power an electric load while the heat is properly conveyed to heat a reduced-size room; as soon as the room setpoint is reached, the room thermostat switches the position of a damper which allows to release this heat (no longer needed) into the atmosphere.

TRAINING PROGRAM

- Electrochemical power conversion in a fuel cell
- Characteristics and application of fuel cells
- Measurement of the fuel cell stack output parameters in different conditions of load
- Drawing the characteristic curves
- Fuel cell stack efficiency calculation
- Calculation of the heating power produces by the fuel cell stack
- Study of energy flows and related measurement devices

TECHNICAL SPECIFICATIONS

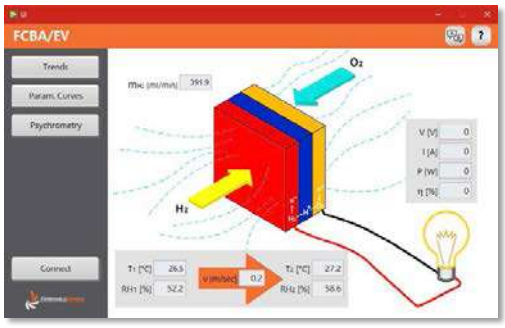
- Table top steel structure with a comprehensive colored diagram of the system
- Fuel cell stack including controller:
  - fuel cell type: PEM
  - cells number: 13
  - rated power: 20 W
  - performance: 7,8 V @ 2,6 A
  - humidification: self-humidified
  - cooling: air (plug-in fan)
  - hydrogen flow rate at maximum power: 0,28 l/min
  - stack efficiency at rated power: 40%
- Hydrogen feeding and discharge to the atmosphere lines with:
  - pressure regulator
  - dial pressure gauge, range: 0 ÷ 1 bar
  - safety valve
  - thermal mass flow meter, range: 20 ÷ 1000 ml/min for measuring and transmitting to the data acquisition board the flow rate of hydrogen feeding the fuel cell stack
  - purge solenoid valve
- Air stream plexiglass conveyor at the stack outlet
- Plexiglass reduced-size room with door with motorized damper and air dissipator
- Electric instrumentation
  - multifunction instruments, microprocessor-based, for CC parameters
  - digital thermometer with Pt100 probe for measuring the temperature inside the reduced-size room
- Switchable DC loads:
  - toroidal rheostat with adjustment knob for drawing the stack characteristic curves
  - variable intensity lamp
  - 3 fixed resistors with indicator LEDs for simulating loads appliances
- Ø 4 mm safety holes for connection to the DC motor *DCM/EV* (**optional item** - refer to the end of this data sheet)

Thermo-hygrometric sensors for measuring and transmitting to the data acquisition board air temperature and relative humidity at stack inlet and outlet, range: 0 ÷ 50°C (temperature) and 0 ÷ 100% (relative humidity)

Air speed sensor for measuring and transmitting to the data acquisition board the air speed at the stack outlet, range: 0 ÷ 5 m/s

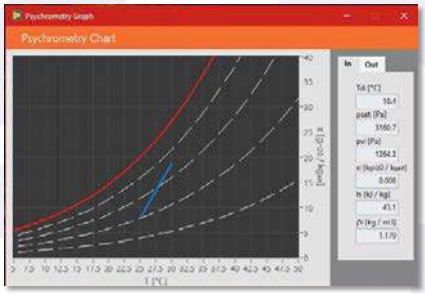
PC data acquisition

- The trainer includes a data acquisition board with USB interface for connection to PC.
- The trainer is supplied with a specific software for monitoring the system parameters.
- Parameters displayed:
  - Voltage and current generated by the stack and powering the loads
  - Average flow rate of hydrogen feeding the stack
  - Temperature and relative humidity of air at stack inlet and outlet
  - Air speed at stack outlet

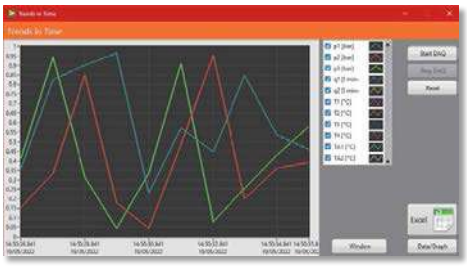


 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- The software enables to:
  - Calculate the energy conversion efficiency
  - Visualize the trend of power entering the stack (related to the hydrogen flow rate), stack electric power output, thermal power released by the stack
  - Visualize the air and hygrometric rate at stack inlet and outlet



  - Visualize the trend of air temperature and relative humidity at stack inlet and outlet
  - Draw the fuel cell stack characteristic curves output voltage vs output current and efficiency vs output current to find out the point of stack maximum performance



  - Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase - 60 VA
(Other voltage and frequency on request)
Dimensions: 92 x 46 x 72 cm
Weight: 37 kg

INDISPENSABLE

PERSONAL COMPUTER
- NOT INCLUDED -

HYDROGEN GENERATOR
Mod. HG-1 (NOT INCLUDED)
To feed the storage tank;
capacity: 200 ml/min, **or alternatively:**

PEM ELECTROLYZER
Mod. HG-600 (NOT INCLUDED)
To feed the storage tank;
capacity: 600 ml/min

METAL HYDRIDE STORAGE TANK
Mod. H2-300 (NOT INCLUDED)
To feed the fuel cell; capacity: 300 l

SUPPLIED WITH

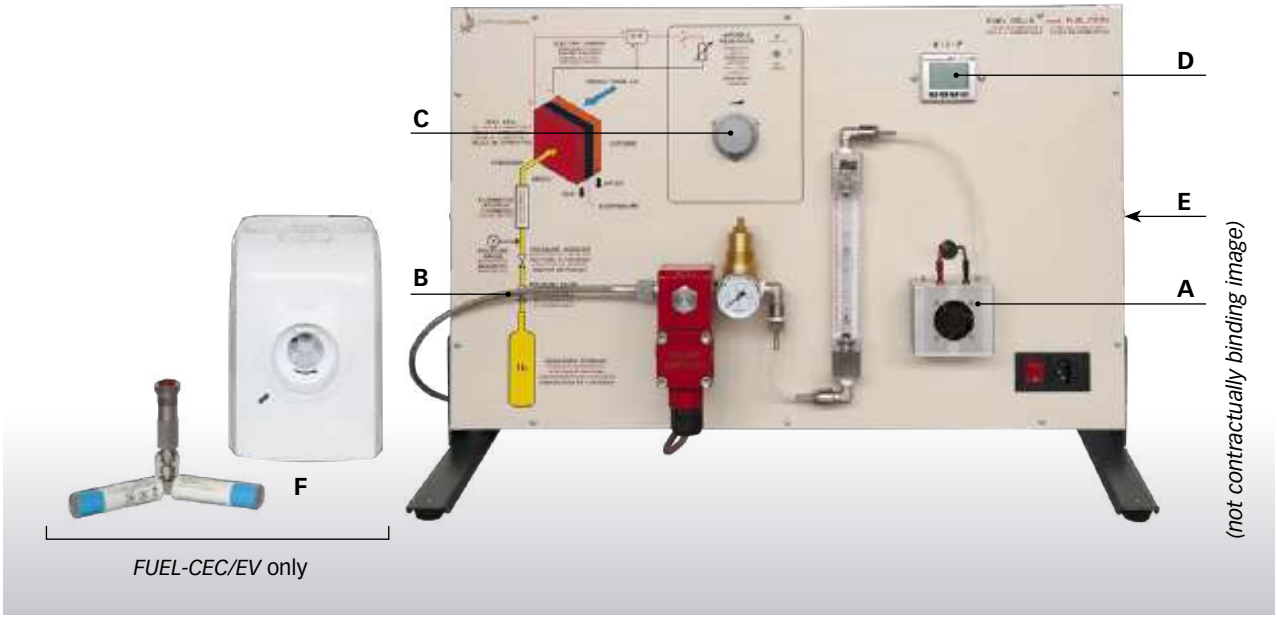
THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

DIRECT CURRENT MOTOR Mod. DCM/EV
Direct current variable-speed motor,
for studying the application of fuel cells
in the field of road transport

COMPUTERIZED FUEL CELL TESTING PANEL

Mod. FUEL-C.../EV



INTRODUCTION

Energy saving and environmental pollution reduction are crucial global issues. Using Hydrogen as alternative source to fossil fuels can address both issues, especially if it is produced with the help of renewable energies.
Considering the above, this system enables experimental investigation of the electrochemical energy conversion taking place in a fuel cell stack fed by hydrogen and oxygen (present in atmospheric air). The equipment is manufactured using real components available on the market.

A video demonstration is available on Elettronica Veneta YouTube channel

Scan code to watch

DESCRIPTION

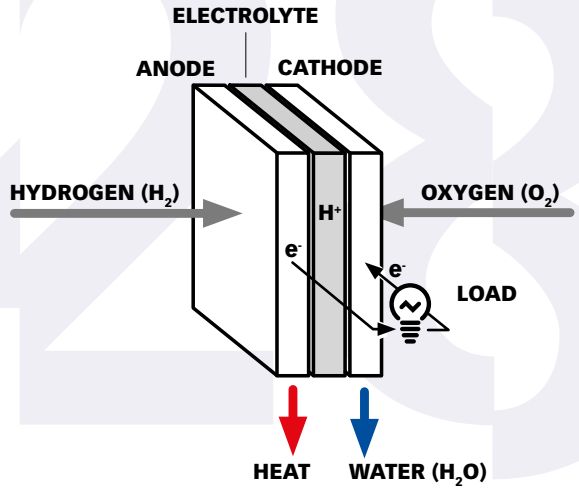
The system consists of:
A) Fuel cell stack
B) Hydrogen feeding line
C) Variable electric load
D) Instrumentation
E) Data acquisition system with USB interface for PC connection
F) Mini Electrolyzer with a set of metal hydride cartridges (*FUEL-CEC/EV* only)

Relevant features:

- The fuel cell stack is PEM type and consists of cells connected in series.
- The room air feeding the stack carries the oxygen and cools the stack at the same time.
- To operate, the fuel cell stack must be fed with hydrogen supplied by the generator *HG-1* (or the electrolyzer *HG-600*) and the storage tank *H2-300* (**required** - refer to the end of this data sheet). For model *FUEL-CEC/EV* only, a mini electrolyzer with its set of metal hydride cartridges is already included.

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

Operating principle:



The hydrogen coming from the metal hydride cylinder crosses the membranes of the fuel cell stack and combines with the oxygen of the air forming water. This process produces, on the one hand, electricity and, on the other hand, heat. The electricity is used to power an electric load while the heat is released to the environment.

TRAINING PROGRAM

- Hydrogen storage in metal hydrides
- PEM fuel cells
- System startup
- Evaluation of the system operating parameters
- Calculation of the produced and consumed power
- Calculation of the efficiency of energy conversion
- Drawing the fuel cell stack characteristic curves
- Data acquisition and system supervision via PC

TECHNICAL SPECIFICATIONS

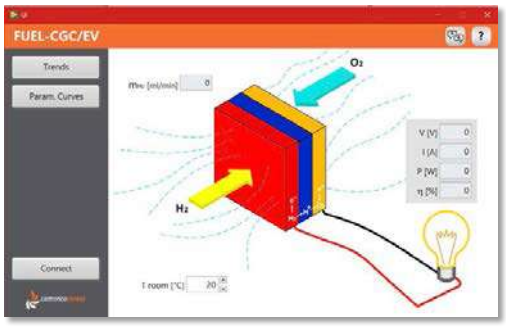
- Painted metallic framework with fore panel of insulating material
- Comprehensive colored diagram of the system
- Stack of PEM fuel cells including air supplying and cooling fan/s and purge solenoid valve:

Model	Nominal power (W)	Regulator
FUEL-CEC/EV	12	NO
FUEL-CBC/EV	20	YES
FUEL-CDC/EV	30	YES
FUEL-CFC/EV	100	YES

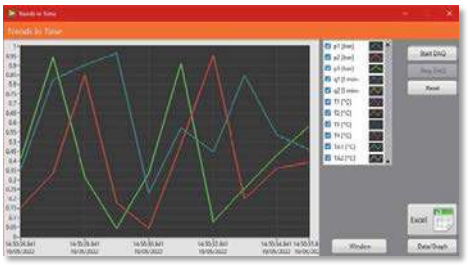
- Hydrogen feeding line with:
  - solenoid valve
  - pressure regulator
  - pressure gauge
  - thermal mass flow meter for measuring and transmitting to the data acquisition system the flow rate of hydrogen feeding the fuel cell stack
- DC multifunction analyzer for the fuel cell stack output electric parameters
- DC electric load: toroidal rheostat with adjustable knob
- Set of three metal hydride cartridge for hydrogen storage (*FUEL-CEC/EV* only)
- Electrolyzer for cartridges refill (*FUEL-CEC/EV* only)

PC data acquisition

- The panel includes a data acquisition system with USB interface for connection to PC
- A specific software (developed with LabView) is supplied to monitor the system parameters



- Parameters displayed:
  - Voltage, current and power generated by the stack and powering the load
  - Average flow rate of hydrogen feeding the stack



- The software enables to:
  - Calculate the energy conversion efficiency
  - Draw the fuel cell stack characteristic curves
  - Save the exercises data for future analysis or project work

Power supply: 230 Vac 50 Hz single-phase
(Other voltage and frequency on request)
Dimensions: 65 x 40 x 10 cm
Net weight: 10 kg

FUEL CELL FEEDING

To operate, the fuel cell stack must be fed with hydrogen supplied by the generator *HG-1* (or the electrolyzer *HG-600*) and the storage tank *H2-300.*

A mini electrolyzer with its set of metal hydride cartridges is included only with *FUEL-CEC/EV*. In this specific case *HG-1* (or *HG-600*) and *H2-300* are optional items and can be used to increase the operating time of the system compared to the supplied accessories.

Example of feeding the fuel cell with hydrogen from the storage tank, previously fed by a PEM Electrolyzer

INDISPENSABLE

PERSONAL COMPUTER
- NOT INCLUDED -

(optional items for FUEL-CEC/EV)

HYDROGEN GENERATOR
Mod. HG-1 (NOT INCLUDED)
To feed the storage tank;
capacity: 200 ml/min, **or alternatively:**

PEM ELECTROLYZER
Mod. HG-600 (NOT INCLUDED)
To feed the storage tank;
capacity: 600 ml/min

METAL HYDRIDE STORAGE TANK
Mod. H2-300 (NOT INCLUDED)
To feed the fuel cell; capacity: 300 l
(optional item for FUEL-CEC/EV)

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

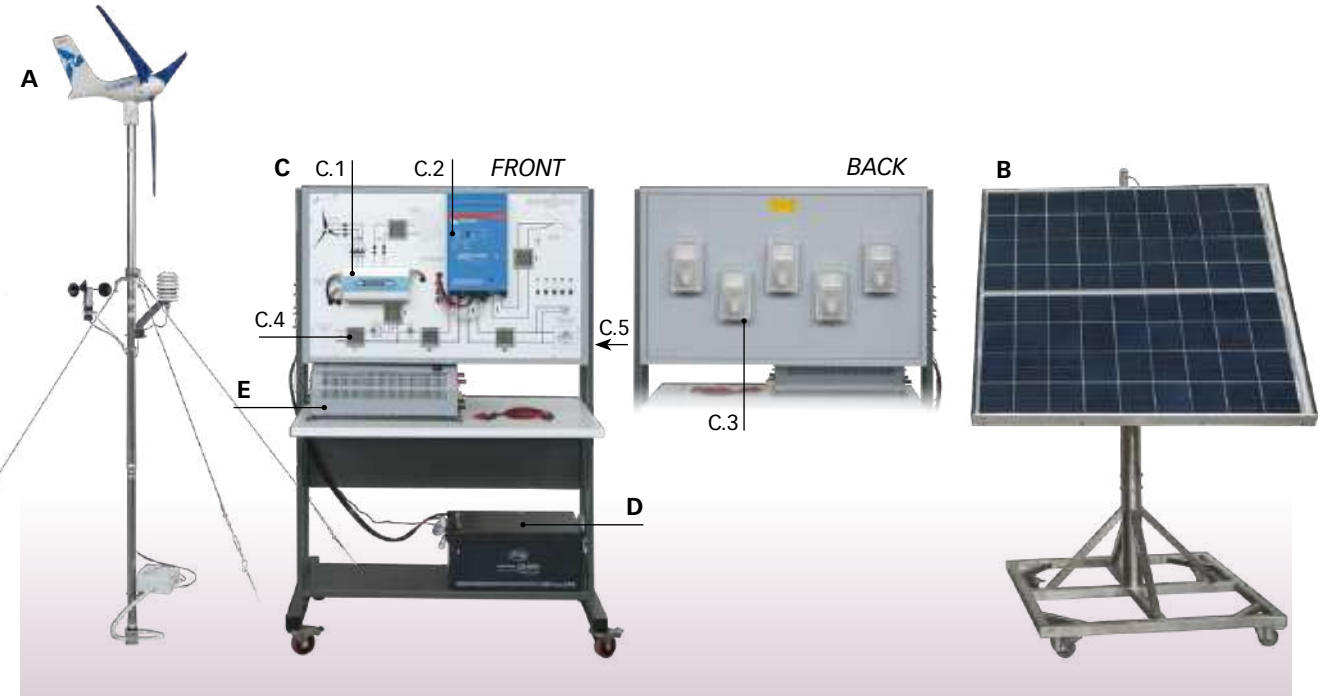
COMBINED SOLUTIONS

	Mod.	Page
GRID-CONNECTED RENEWABLE ENERGY SYSTEM	REMDI/EV	**CS** 3
INTEGRATED PHOTOVOLTAIC-WIND POWER SYSTEM	PMWG-E/EV PMWG/EV	**CS** 6
COMPUTERIZED OFF-GRID PHOTOVOLTAIC - WIND POWER PLANT TRAINER	PVWG-OG/EV	**CS** 9
COMPUTERIZED ON-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	PVWG-GR/EV	**CS** 12
COMPUTERIZED ON-GRID / OFF-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	PVWG/EV	**CS** 14
INTEGRATED PHOTOVOLTAIC-WIND POWER KIT	PMWG-K/EV	**CS** 17

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

GRID-CONNECTED RENEWABLE ENERGY SYSTEM

Mod. REMDI/EV



INTRODUCTION

Nowadays the use of domestic electrical energy is changing and this trend is evolving with time.
This change is related to the interconnection of renewable energies (photovoltaic and wind energy, the most common in domestic use) with the public grid, in a totally transparent way for the end user.

This change carries the following consequences:

- Reduction of fossil fuels consumption at the electrical power houses and the related pollution
- For countries with no fossil fuel resources, a reduction in the national energy bill and the subsequent increased independence from oil and gas producers
- For remote areas, increased energy independence and selfsufficiency
- Reduction of Joule losses in electrical power transmission lines
- And finally a consistent saving in the electrical costs for the end user

Elettronica Veneta Spa, always in line with technical advancements and trends, has designed this system for the future generations of engineers that will face this change.

DESCRIPTION

This advanced system combines the study of the most common domestic renewable energies with their interconnection devices and circuits to the public grid.

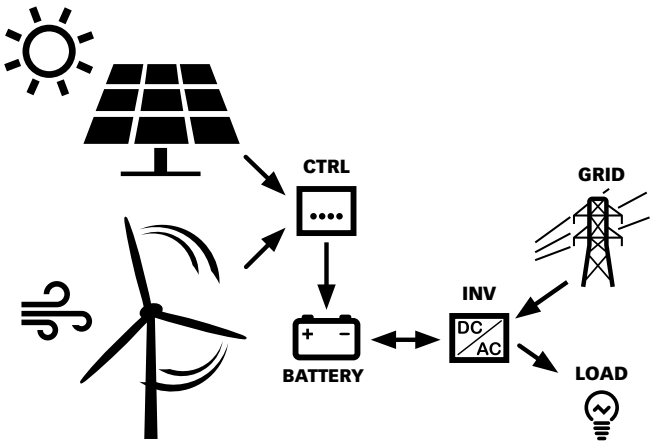
The system consists of:

A) A wind turbine generator
B) A silicon cell photovoltaic panel
C) A wheeled panel including:
  C.1) A hybrid charge controller
  C.2) A sinewave inverter / battery charger
  C.3) Electrical loads
  C.4) Electric instrumentation for detecting the energy flows in the different branches of the circuit
  C.5) USB interface for PC connection
D) Buffer battery
E) Portable rheostat

Relevant features:

- The system can work connected (on-grid) or isolated from the grid (stand-alone)
- The photovoltaic panel and the wind generator can be used both outdoors and indoors. In case of indoor use, the wind power generator indoor operation device *WG-I/EV* and the lighting device *SS-1/EV* (**optional items** - refer to the end of this data sheet) are required
- The photovoltaic panel can be disconnected from the system, for constructing the characteristic curve (one single module, two modules connected in parallel, two modules connected in series)
- The photovoltaic 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
- Experimental data can be saved for future analysis and project work

Operating principle:



All the energy consumed by the user (loads) is taken from the battery. Therefore all the system is intended to charge the battery.
When consumption is higher than the available energy (from the battery and the renewable energy sources), the additionally required energy is supplied by the grid.
The system includes the measuring devices for detecting the energy flows to and from the grid.

TRAINING PROGRAM

- Components of a combined wind and solar system with buffer battery and connected to the grid for electricity production
- Effect of solar radiation on the panel output voltage
- Effect of applied load variation on the electric power produced by the panel
- Effects of shading on a real solar installation
- Photovoltaic panel energy conversion efficiency
- Effect of the wind speed on the generator output voltage
- Effect of applied load variation on the electric power produced by the wind generator
- Wind generator energy conversion efficiency
- Battery charging system management
- Interconnection of solar energy to the public grid
- Operation and efficiency of a DC/AC inverter
- Connection to portable rheostat for photovoltaic panel characteristic curve construction
- Connection to wind power generator indoor operation device *WG-I/EV* (**optional item** - refer to the end of this data sheet) for wind generator characteristic curve construction

TECHNICAL SPECIFICATIONS

Wind power generator:

- Three carbon fibre blades, rotor diameter: 1,15 m
  - Rated wind speed: 14,5 m/s (52 km/h)
  - Start-up wind speed: 2,2 m/s (8 km/h)
  - Start-up charging: 2,5 m/s (9 km/h)
- Three phase permanent magnet generator:
  - Rated voltage: 12 VDC
  - Rated power output: 420 W
  - Charging indicator: LED-blue
- Stackable mast:
  - Material: polished stainless steel
  - Length of the tubes: 3 x 1 m
  - Total height: 2,8 m
  - External diameter: 48,1 mm
  - Mounting Kit

Mobile photovoltaic solar array:

- Wheeled stainless steel frame
- Photovoltaic panel including two modules, 120 W peak power each
- Solar tracker:
  - automatic/manual two axes tracking: RIGHT/LEFT and UP/DOWN for maximum insolation
  - solar sensors assembly
  - actuators with DC motors

Mobile control panel:

- Wheeled steel structure with:
  - front side: comprehensive colored diagram of the system
  - back side: AC loading system consisting of 5 30 W (equivalent) switchable lamps
  - shelf for the buffer battery (12 VDC, 260 Ah)
- Hybrid charge controller:
  - Max. power input from wind generator: 600 W
  - Max. current input from wind generator: 40 A
  - Max. power input from solar panel: 550 Wp
  - Max. current input of the solar panel: 40 A
  - Max. total charge current: 80 A
  - Max. switch off current at LOAD-output: 15 A
  - LCD-display for visualizing all operating parameters
  - 5 touch keys
  - 2 signaling LEDs
  - Thermally switched vent for the correct operating temperature
  - All types of lead batteries (Gel, AGM and acid) can be charged

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

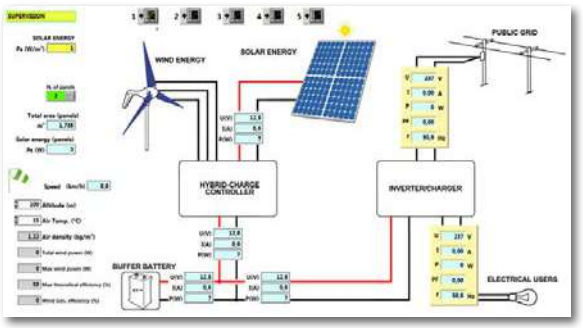
- Sinewave inverter / battery charger featuring adaptive charge technology and high speed power transfer switch:
  - Inverter:
    - Input voltage range: 9,5-17 Vdc
    - Output: voltage 230 Vac ±2%, frequency 50 Hz ±0,1%
    - Continuous output power at 25°C: 800 VA
    - Continuous output power at 25°C: 700 W
    - Peak power: 1600 W
  - Charger:
    - Input 187 ÷ 265 Vac, 45 ÷ 55Hz, Power Factor: 1
    - Charge current battery: 35 A

Instrumentation, including:
- 4 instruments, microprocessor-based, for DC parameters
- 2 instruments, microprocessor-based, for AC parameters

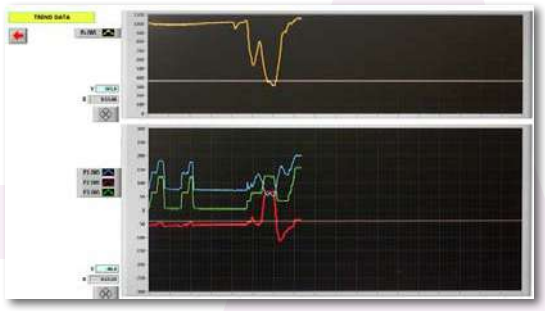
Sensors
- 1 anemometer probe for measuring and transmitting wind speed to control panel
- 1 temperature sensor for measuring and transmitting the environment air temperature to control panel
- 1 pyranometer probe for measuring and transmitting photovoltaic panel incident solar radiation to control panel
- 1 temperature sensor for measuring and transmitting photovoltaic panel temperature to control panel

Portable Rheostat useful for tracing the photovoltaic panel characteristic curve:
- Control slider
- Double winding each with 4 sections
- Ohmic value: 2 x 20 ohm
- Power: 1200 W

PC data acquisition
- 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.
- Parameters displayed:
  - All DC and AC parameters
  - wind speed
  - environment air temperature
  - photovoltaic panel incident solar radiation
  - photovoltaic panel temperature



- The software enables to:
  - Calculate wind and solar energy conversion efficiency
  - Visualize the energy flows to and from the public grid
  - Save the exercises data for future analysis or project work



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

Dimensions

Control panel:	112 x 60 x 160 cm
Wind turbine rotor diameter:	115 cm
Solar array:	120 x 120 x 200 cm
Total net weight:	330 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-I/EV
To operate the aerogenerator indoor

INDOOR LIGHTING DEVICE Mod. SS-1/EV
To operate the photovoltaic panel indoor

INTEGRATED PHOTOVOLTAIC-WIND POWER SYSTEM

Mod. PMWG-E/EV
Mod. PMWG/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 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

System configuration: stand-alone (isolated from the grid)

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 (*PMWG/EV* only)

D) Buffer battery

E) Solar radiation sensor (*PMWG/EV* only)

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

Relevant features:

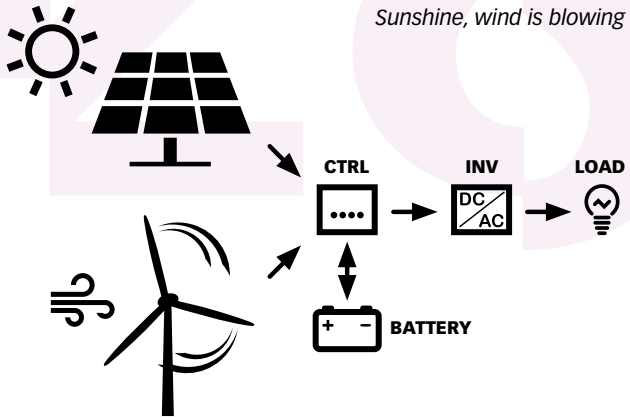
- The trainer can operate with or without sun and wind.
- The PV panel can be used both outdoors and indoors. In case of indoor use, the lighting device *SS-1/EV* is required (**optional item** - refer to the end of this data sheet)
- The PV panel can be disconnected from the system to draw the characteristic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

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

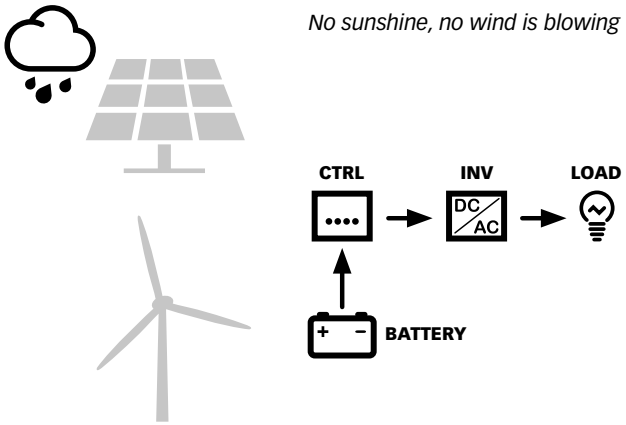
- The PV panel can track the sun along two axes, to allow the comparison of the performance between a fixed installation (such as the one on the roof of a house) and an installation with tracking device. In this case the solar tracker *SOLTR/EV* is required (**optional item** - refer to the end of this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

Operating principle:

Sunshine, wind is blowing



No sunshine, no wind is blowing



- 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

- Components of a combined stand-alone wind and solar system for electricity production
- Effect of solar radiation on the panel output voltage (*)
- Effect of applied load variation on the electric power produced by the panel
- Effects of shading on a real solar installation (*)
- Photovoltaic panel energy conversion efficiency (*)
- Effect of the wind speed on the generator output voltage (**)
- Effect of applied load variation on the electric power produced by the wind generator
- Wind generator energy conversion efficiency (**)
- Battery charging system management
- Operation and efficiency of a DC/AC inverter
- Connection to portable rheostat *PRH-2* (**optional item** - refer to the end of this data sheet) for photovoltaic panel characteristic curve construction
- Connection of the indoor operation device (**optional** – for models and configurations refer to the end of the data sheet) for the construction of the wind generator characteristic curve

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

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 supplied with a 10 meter indoor / outdoor unit connection cable

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 (equivalent) 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
  - multifunction instrument, microprocessor-based, touchscreen display, for DC parameters
  - multifunction instrument, microprocessor-based, for AC parameters
- Ø 4 mm safety holes for connection to the portable rheostat *PRH-2* (**optional item** - refer to the end of this data sheet)

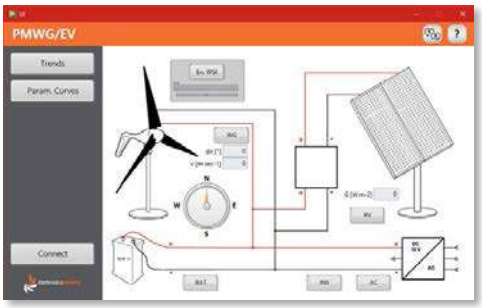
- Socket for connection to the spotlight *ACL220V* (**optional item** - refer to the end of this data sheet)

Buffer battery
- Rated voltage: 12 Vdc
- Capacity: 100 Ah

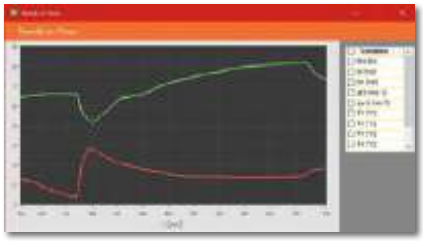
Solar radiation sensor (*PMWG/EV* only) for measuring and transmitting the global solar radiation incident on the PV panel to the control panel.
- Transducer type: pyranometer
- Range: 0 ÷ 2000 W/m²

Wind speed and direction sensor (*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 ÷ 40 m/s
- Wind direction range: 0 ÷ 360°

PC data acquisition (*PMWG/EV* only)
- The trainer 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 system parameters



- Parameters displayed:
  - All DC and AC 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
Mobile solar array: 120 x 120 x 200 cm
Wind turbine rotor diameter: 117 cm

Net weight: 240 kg

REQUIRED

PERSONAL COMPUTER
- NOT INCLUDED -
(*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 230 Vac electric load

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

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

WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-I/EV
It works with the aerogenerator supplied with the trainer

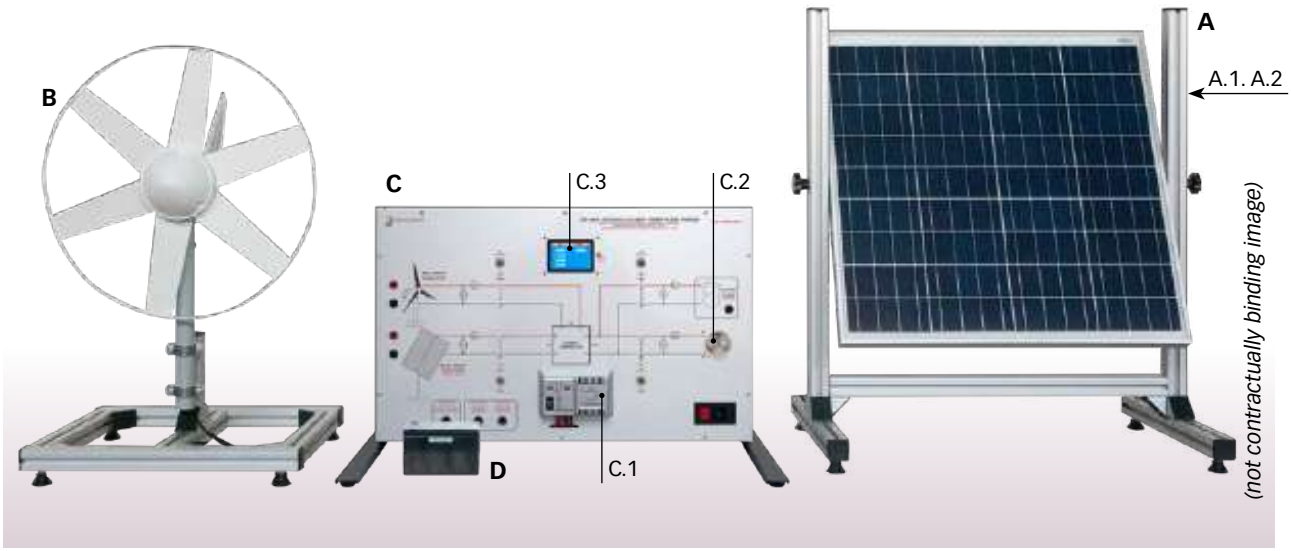
WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-IIG/EV
It includes an additional aerogenerator

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

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

COMPUTERIZED OFF-GRID PHOTOVOLTAIC - WIND POWER PLANT TRAINER

Mod. PVWG-OG/EV



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)

How to operate the photovoltaic solar panel:

- Outdoors
- Indoors; in this case the lighting device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)

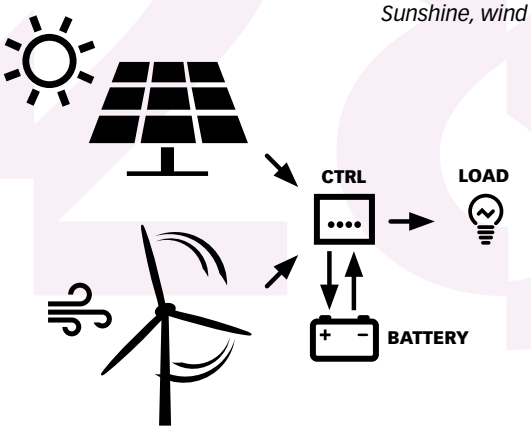
How to operate the wind generator:

- Indoors; the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

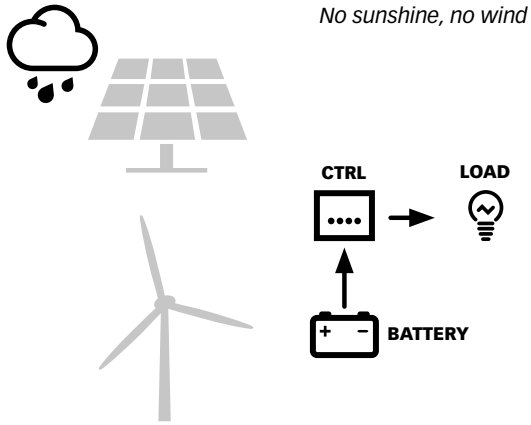
Operating principle:

- WITH load: the energy produced charges the battery and powers the load
- WITH NO load: the energy produced charges the battery
- In case there is no sunshine (or *SS-2/EV* lighting device) or in case the indoor operation device *WG-IE* is not running (no wind condition) the energy consumed by the user (loads) is taken from the battery

Sunshine, wind is blowing



No sunshine, no wind is blowing



TRAINING PROGRAM

- Physical principles whereby solar power is transformed into electrical power
- Physical principles whereby wind power is transformed into electrical power
- Energy balance and efficiency
- Study of the Energy Flows and the related measurement devices
- Connection to portable rheostat *PRH-1* (**optional item** - refer to the end of this data sheet) for photovoltaic panel characteristic curve construction

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel (A)

- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel
- Sensors:
  - 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 **(A.1)**
  - Temperature sensor for measuring and transmitting the PV panel temperature to the control panel. Range: -50 ÷ +70 °C **(A.2)**

Horizontal axis wind power generator (B)

- 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 (C)

- Metal structure with complete color synoptic diagram
- Charge regulator **(C.1)**:
  - Pulse Width Modulation (PWM) regulation
  - LED indicators for battery voltage levels and charging status
- Electric load: 12 Vdc lamp **(C.2)**
- Multifunction instrument, microprocessor-based, touchscreen display, for DC parameters **(C.3)**

Buffer battery (D)

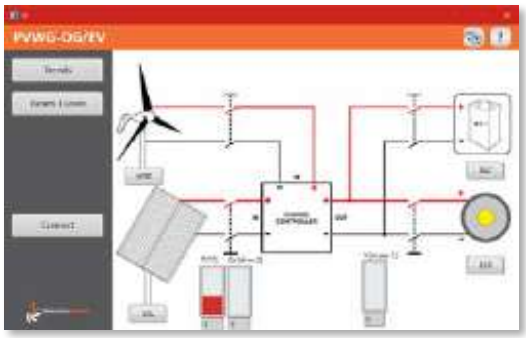
- Rated voltage: 12 Vdc
- Capacity: 12 Ah

Wind speed sensor

- For measuring and transmitting wind speed to the control panel

PC data acquisition

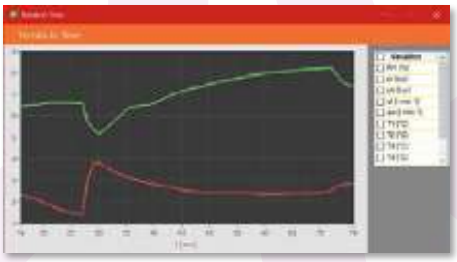
- The trainer is supplied with data acquisition board with USB interface for connection to PC.
- The trainer is supplied with a dedicated software package (LabView environment) for monitoring the different parameters of the system.
- The visualized parameters are:
  - All DC parameters
  - Global solar radiation incident on the PV panel
  - PV panel temperature
  - Wind speed



www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- The software enables to:
  - Calculate energy conversion efficiency
  - Visualize the trend of the solar radiation incident on the PV panel and its temperature, wind speed and the energy flows to and from PV panel, wind generator, buffer battery 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 panel: 65 x 40 x 15 cm
Solar panel: 80 x 50 x 88 cm
Wind generator rotor diameter: 51 cm

Net weight: 50 kg

REQUIRED

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

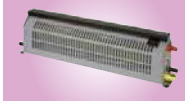
PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

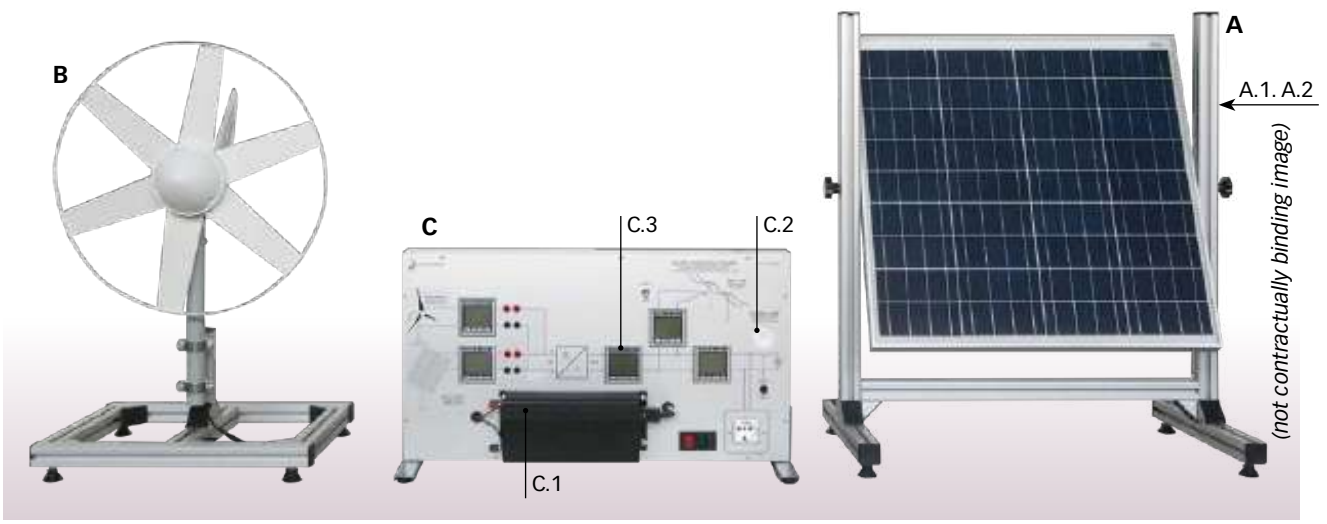
INDOOR LIGHTING DEVICE Mod. SS-2/EV
To operate the photovoltaic panel indoor



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

COMPUTERIZED ON-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER

Mod. PVWG-GR/EV



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: grid-connected

How to operate the photovoltaic solar panel:

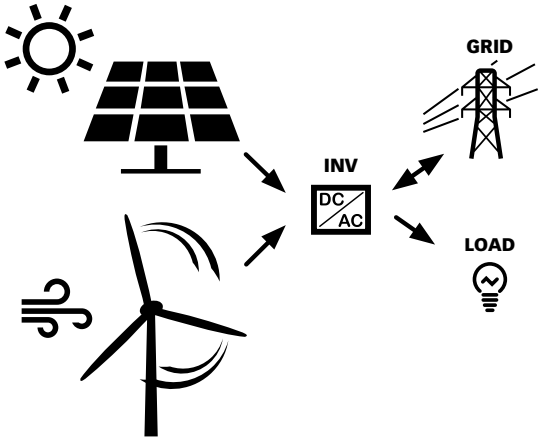
- Outdoors
- Indoors; in this case the lighting device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)

How to operate the wind generator:

- Indoors; the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

Operating principle:

- Sufficient solar and/or wind energy: surplus supplied to the grid
- Insufficient solar and/or wind energy: surplus provided by the grid



TRAINING PROGRAM

- Components of a combined on-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

www.elettronicaveneta.com

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

- Effect of the wind speed on the generator output voltage
- Wind generator energy conversion efficiency
- Interconnection of solar/wind 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

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel (A)

- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel
- Sensors:
  - Solar radiation sensor for measuring and transmitting the global solar radiation incident on the PV panel to the control panel. Range: 0 ÷ 2000 W/m² **(A.1)**
  - Temperature sensor for measuring and transmitting the PV panel temperature to the control panel. Range: -50 ÷ +70 °C **(A.2)**

Horizontal axis wind power generator (B)

- 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 (C)

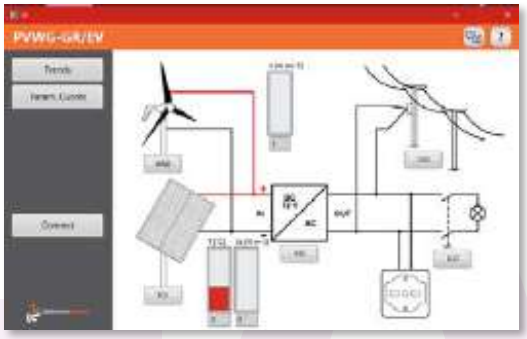
- Metal structure with complete colour synoptic diagram
- Grid tie power inverter **(C.1)**:
  - Rated AC Output Power: 450 W
  - AC Output Voltage: 230 V
  - AC Output Frequency: 50 Hz
  - DC Input Voltage Range: 11 ÷ 28 V
  - Output Current Waveform: Pure Sine-wave
  - Protection vs: Over Current, Over Temperature, Reverse Polarity, Anti-Island
- Electric load: 230 V lamp **(C.2)**
- 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 **(C.3)**

Wind speed sensor

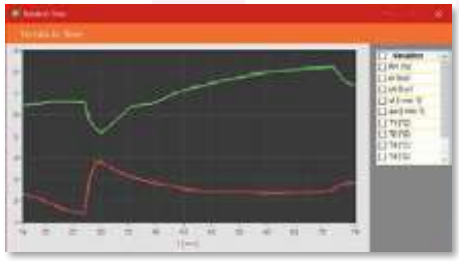
- For measuring and transmitting wind speed to the control panel

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC
- A specific software (developed with LabView) is supplied to monitor the system parameters
- Parameters displayed:
  - All DC / AC parameters
  - Photovoltaic panel incident solar radiation
  - Photovoltaic panel temperature
  - Wind speed



- The software enables to:
  - Calculate solar energy conversion efficiency
  - Visualize the energy flows to and from photovoltaic generator, wind turbine, 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 panel:	80 x 40 x 10 cm
	Solar panel:	80 x 50 x 88 cm
	Wind gen. rotor diameter:	51 cm
Net weight:	50 kg	

REQUIRED

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

PERSONAL COMPUTER
- NOT INCLUDED -

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

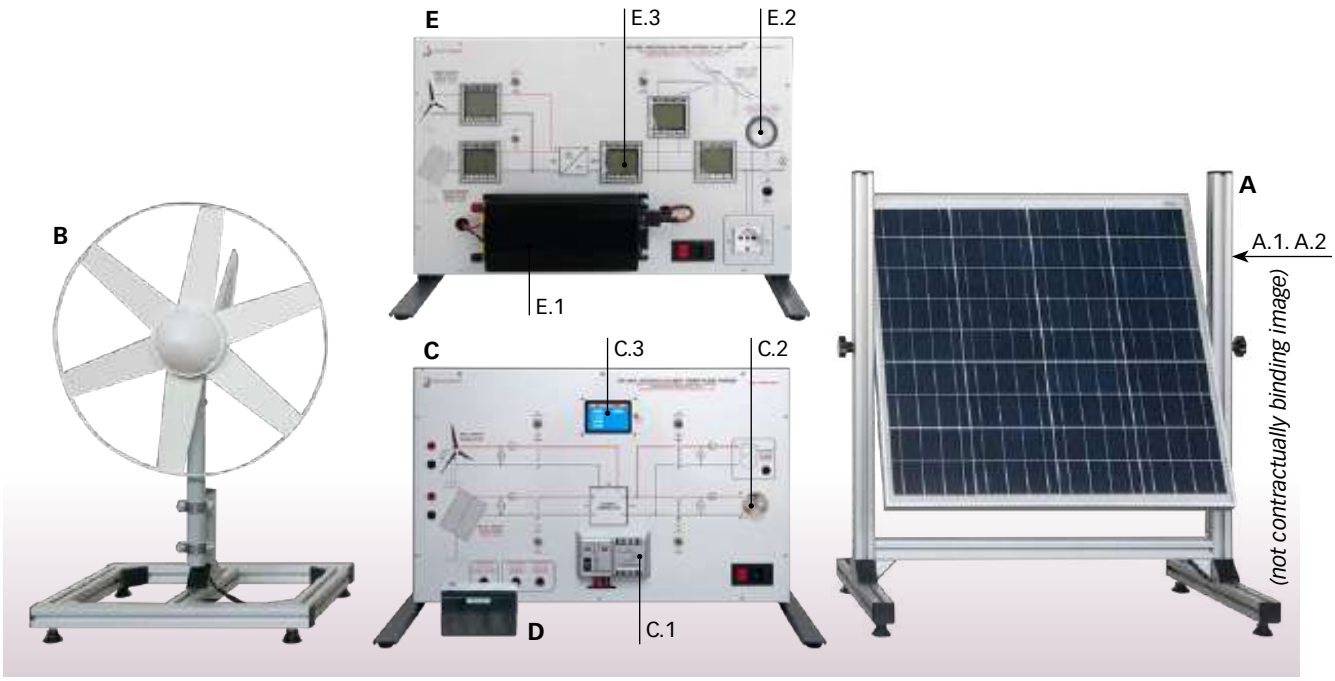
INDOOR LIGHTING DEVICE Mod. SS-2/EV
To operate the photovoltaic panel indoor

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

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

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

Mod. PVWG/EV



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

How to operate the photovoltaic solar panel:

- Outdoors
- Indoors; in this case the lighting device *SS-2/EV* is required (**optional item** - refer to the end of this data sheet)

How to operate the wind generator:

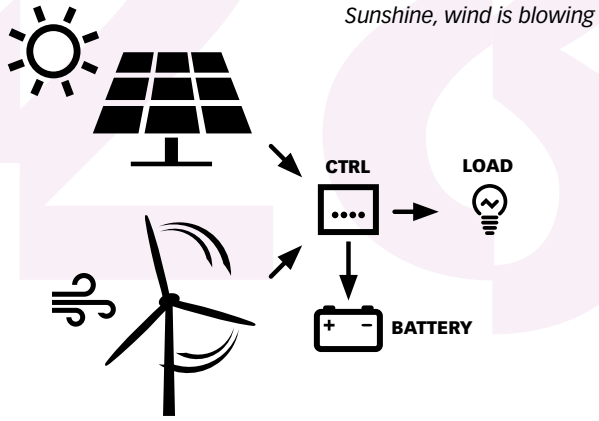
- Indoors; the indoor operation device *WG-IE* is **required** (refer to the end of this data sheet)

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

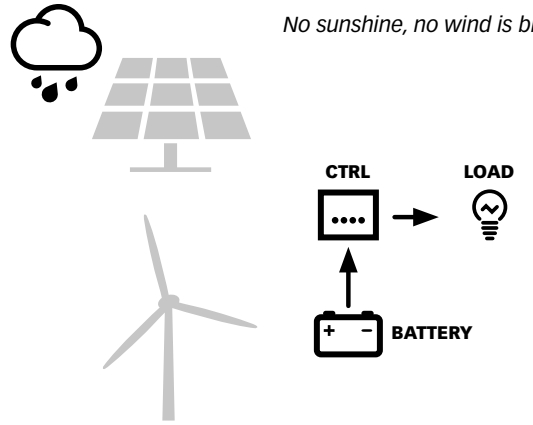
OFF-GRID operation:

- WITH load: the energy produced charges the battery and powers the load
- WITH NO load: the energy produced charges the battery
- In case there is no sunshine (or *SS-2/EV* lighting device) or in case the indoor operation device *WG-IE* is not running (no wind condition) the energy consumed by the user (loads) is taken from the battery

Sunshine, wind is blowing

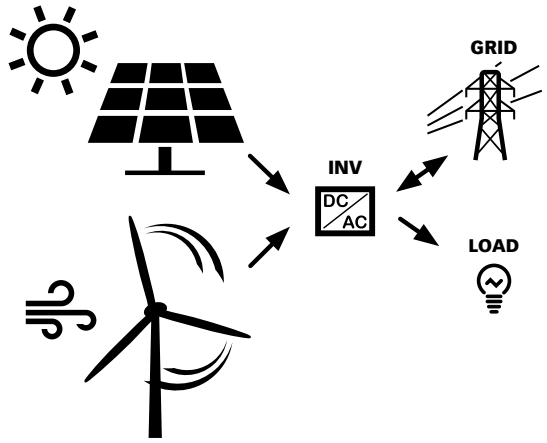


No sunshine, no wind is blowing



ON-GRID operation:

- Sufficient solar and/or wind energy: surplus supplied to the grid
- Insufficient solar and/or wind energy: surplus provided by the grid



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

TECHNICAL SPECIFICATIONS

Silicon cell photovoltaic panel (A)

- Adjustable tilt table top aluminum frame
- 60 W photovoltaic panel
- Sensors:
  - 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 **(A.1)**
  - Temperature sensor for measuring and transmitting the PV panel temperature to the control panel. Range: -50 ÷ +70 °C **(A.2)**

Horizontal axis wind power generator (B)

- 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 (C)

- Metal structure with complete color synoptic diagram
- Charge regulator **(C.1)**:
  - Pulse Width Modulation (PWM) regulation
  - LED indicators for battery voltage levels and charging status
- Electric load: 12 Vdc lamp **(C.2)**
- Multifunction instrument, microprocessor-based, touchscreen display, for DC parameters **(C.3)**

Buffer battery (D)

- Rated voltage: 12 VDC
- Capacity: 12 Ah

Table top control panel - ON-GRID operation (E)

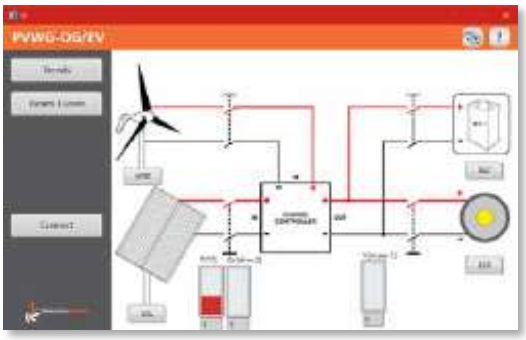
- Metal structure with complete colour synoptic diagram
- Grid tie power inverter **(E.1)**:
  - Rated AC Output Power: 450 W
  - AC Output Voltage: 230 V
  - AC Output Frequency: 50 Hz
  - DC Input Voltage Range: 11 ÷ 28 V
  - Output Current Waveform: Pure Sine-wave
  - Protection vs: Over Current, Over Temperature, Reverse Polarity, Anti-Island
- Electric load: 230 V lamp **(E.2)**
- 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 **(E.3)**

Wind speed sensor

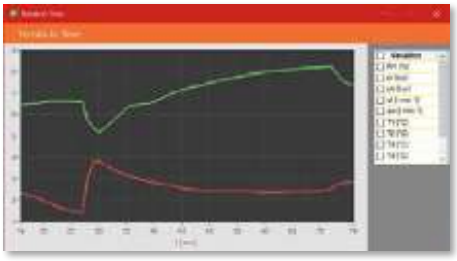
- For measuring and transmitting wind speed to the control panel

PC data acquisition

- The trainer is supplied with data acquisition board with USB interface for connection to PC
- 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

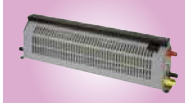
PERSONAL COMPUTER
- NOT INCLUDED -

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

INTEGRATED PHOTOVOLTAIC-WIND POWER KIT

Mod. PMWG-K/EV

INTRODUCTION

This kit represents the typical configuration of an integrated system for the exploitation of renewable energies, with energy production via horizontal axis wind power generator, used to convert the wind kinetic energy directly into mechanical energy, and via silicon photovoltaic cells enabling to transform solar energy into electricity.

TRAINING PROGRAM

- Components of a combined 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
- 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-IM/EV* (**optional item** - refer to the end of this data sheet) for wind generator characteristic curve construction

(*) Solar radiation meter *SORM* (**optional item** - refer to the end of this data sheet) required
(**) Cup vane air velocity meter *THAC* (**optional item** - refer to the end of this data sheet) required

TECHNICAL SPECIFICATIONS

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

Photovoltaic module:
- 120 W Peak power with maximum radiation
- Adjustable inclination framework mounted on castors

Charge controller for photovoltaic panels:
- Rated voltage: 12 Vdc
- Maximum current: 20 A

Buffer battery:
- Rated voltage: 12 Vdc
- Capacity: 100 Ah

Clamp meter:
- Voltage range (ac/dc): 0 to 600 V
- Current range (ac/dc): 0 to 200 A

Inverter:
- Continuous output power: 600 W
- Output peak 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

Dimensions

Rotor diameter:	1,15 m
Photovoltaic module:	67 x 120 x 155 cm
Overall weight:	140 kg

SUPPLIED WITH

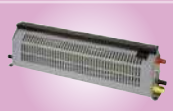
THEORETICAL-EXPERIMENTAL HANDBOOK

OPTIONAL (REF. ACCESS. AND INSTRUMENTS)

WIND POWER GENERATOR INDOOR OPERATION DEVICE Mod. WG-IM/EV
To operate the aerogenerator indoor

ELECTRIC BATTERY CHARGER Mod. EBCH
To recharge the buffer battery after a prolonged period of inactivity of the system

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



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

LAMP Mod. DCL12V
To be used as 12 Vdc electric load

SOLAR RADIATION METER Mod. SORM
To calculate the solar energy into electric energy conversion efficiency

CUP VANE AIR VELOCITY METER Mod. THAC
For the calculation of the wind energy into electric energy conversion efficiency

 ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

m/s
250
300

ACCESSORIES AND INSTRUMENTS

ACCESSORIES	Mod.	Page
SPOTLIGHT	ACL220V	AI 3
LAMP	DCL12V DCL24V	AI 3
DIRECT CURRENT MOTOR	DCM/EV	AI 3
ENERGY DISSIPATION KIT	DW-EP/EV	AI 3
ELECTRIC BATTERY CHARGER	EBCH	AI 3
METAL HYDRIDE STORAGE TANK	H2-300	AI 3
PEM ELECTROLYZER	HG-600	AI 4
HYDROGEN GENERATOR	HG-1	AI 4
PORTABLE RHEOSTAT (1 x 20Ω)	PRH-1	AI 4
PORTABLE RHEOSTAT (2 x 20Ω)	PRH-2	AI 4
PORTABLE RHEOSTAT (3 x 35Ω)	PRH-3	AI 4
BATTERY PACK	SOLBA	AI 4
SOLAR TRACKER	SOLTR/EV	AI 5
INDOOR LIGHTING DEVICE	SS-1/EV	AI 5
INDOOR LIGHTING DEVICE	SS-2/EV	AI 5
WIND POWER GENERATOR INDOOR OPERATION DEVICE	WG-IE	AI 5
WIND POWER GENERATOR INDOOR OPERATION DEVICE	WG-I/EV WG-IM/EV WG-IIG/EV	AI 6

INSTRUMENTS	Mod.	Page
SOLAR RADIATION METER	SORM	AI 7
CUP VANE AIR VELOCITY METER	THAC	AI 7
PORTABLE ANEMOMETER	THAM	AI 7
PORTABLE THERMOHYGROMETER	THHY	AI 7
PORTABLE THERMOMETER	THRN	AI 7

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

ACCESSORIES

SPOTLIGHT
Mod. ACL220V

To be used as electric load, 150W - 230 Vac halogen projector.

LAMP
Mod. DCL12V (12 Vdc vers.)
Mod. DCL24V (24 Vdc vers.)

To be used as 12 or 24 Vdc electric load. 5W Lamp, 4 mm safety holes.

DIRECT CURRENT MOTOR
Mod. DCM/EV

Direct current variable-speed motor, for studying the application of fuel cells in the field of road transport.

ENERGY DISSIPATION KIT
Mod. DW-EP/EV

Kit mounted on castors for dissipation in air of part of the thermal power produced by renewable energy source, including:

- Fan coil unit
- Pump

ELECTRIC BATTERY CHARGER
Mod. EBCH

Device for battery charging 12V – 15A. Protection against:

- Overload
- Overtemperature
- Short circuit

METAL HYDRIDE STORAGE TANK
Mod. H2-300

Hydrogen storage tank useful for fuel cells feeding.

- Capacity: 300 liters
- Maximum recharge pressure: 30 bar

PEM ELECTROLYZER
Mod. HG-600

PEM Electrolyzer ideal for charging metal hydrides hydrogen storage tanks.

Technical specifications:
- Capacity: 600 ml/min
- Colour touch screen display, 3,5"
- Output pressure: 0,1-10 bar
- Gas purity: 99,9999%
- Communication: RS 485, USB, LAN ethernet
- Power supply: 110-120V 60Hz / 220-240V 50Hz
- Dimensions: 460 x 428 x 266 mm (rack 19" 5U)
- Weight: 24 kg

HYDROGEN GENERATOR
Mod. HG-1

Generator for producing pure hydrogen by water electrolysis for feeding a PEM fuel cell.

Technical specifications:
- Capacity: 200 Nml/min
- Purity: 99.9999%
- Max output pressure: 8 bar
- Touchscreen display
- Drying filter
- Solenoid valves for process control and safety
- Water feeding through loading tank
- Safety system against overpressure
- Power supply: 230V / 50 Hz
- Dimensions: 38 x 53 x 47 cm; weight: 30 kg

PORTABLE RHEOSTAT
Mod. PRH-1

Linear slider rheostat needed to draw the photovoltaic panel characteristic curve.
- Single winding
- 4 sections per winding
- Ohm value: 1 x 20 Ω
- Power: 600 W

PORTABLE RHEOSTAT
Mod. PRH-2

Linear slider rheostat needed to draw the photovoltaic panel characteristic curve.
- Double winding
- 4 sections per winding
- Ohm value: 2 x 20 Ω
- Power: 1200 W

PORTABLE RHEOSTAT
Mod. PRH-3

Three-phase linear slider rheostat needed to draw the generator external characteristic curve.
- Absorption: 6,5 A
- Ohm value: 3 x 35 Ω
- Power: 1500 W

BATTERY PACK
Mod. SOLBA

The pack includes two batteries, each having the following characteristics:
- Nominal voltage: 12 Vdc
- Capacity: 100 Ah

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

SOLAR TRACKER
Mod. SOLTR/EV

Sun tracking device, provided with steel framework and gearing system for orienting the panel on two degrees of freedom in space: up-down, east-west.

INDOOR LIGHTING DEVICE
Mod. SS-1/EV

Device for the indoor operation of solar thermal and/or photovoltaic equipment.

- Light source: six 1000 W spotlights.
- Stainless steel wheeled structure with telescopic fixing to ensure the maximum stability of the system.
- Straight and inclined support rods, adjustable in height.

INDOOR LIGHTING DEVICE
Mod. SS-2/EV

Device for the indoor operation of photovoltaic equipment.

- Light source: two 1000 W spotlights
- Aluminium tilting support structure

WIND POWER GENERATOR INDOOR OPERATION DEVICE
Mod. WG-IE

For indoor use of a horizontal axis wind turbine.

- Paddle wheel dimensions 300 mm
- Mains voltage 230V / 50 Hz
- Revolutions per minute 2800 rpm
- Power 500 W
- Air flow 65 m^3/min
- Degree of protection IP 54
- Weight 20 kg
- Noise 69 dB(A)

WIND POWER GENERATOR INDOOR OPERATION DEVICE

Mod. WG-I/EV (trainer powered version)

This device enables to operate indoors the wind power generator **supplied with the trainer** (after removing its blades).
The variable speed asynchronous motor directly coupled to the wind generator permits to simulate the wind action.
The rpm variation is controlled by a potentiometer or by a PC (when used with a computerized version).
The device is powered by the trainer.

WIND POWER GENERATOR INDOOR OPERATION DEVICE

Mod. WG-IM/EV (mains powered version)

This device enables to operate indoors the wind power generator **supplied with the kit** (after removing its blades).
The variable speed asynchronous motor directly coupled to the wind generator permits to simulate the wind action.
The rpm variation is controlled by a potentiometer. The device is powered by the mains.

WIND POWER GENERATOR INDOOR OPERATION DEVICE

Mod. WG-IIG/EV (trainer powered version)

This device enables to operate an **additional** wind power generator (after removing its blades) besides the one supplied with the trainer.
The variable speed asynchronous motor directly coupled to the wind generator permits to simulate the wind action.
The rpm variation is controlled by a potentiometer or by a PC (when used with a computerized version).
The device is powered by the trainer.

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

INSTRUMENTS

SOLAR RADIATION METER
Mod. SORM

The solar radiation meter is an ideal instrument to be used for professional purposes in the field of installation of photovoltaic and thermal solar systems. The measure read on the instrument is expressed in W/m² or in Btu/(ft²·h).
Typical applications:

- Detecting the best incidence angle in the installation of solar panels
- Measurement of the filtering power of glasses or solar screens
- Measurement of solar radiation
- Measurement of solar transmission through transparent films and glasses

CUP VANE AIR VELOCITY METER
Mod. THAC

Cup vane air velocity meter for measuring the wind speed. The wind direction does not affect the measure.

- Possibility to choose the measuring unit: m/s, km/h, ft/min, knots, miles/h
- Min/max values
- Hold button to freeze readings
- LCD Display
- Automatic switching off

PORTABLE ANEMOMETER
Mod. THAM

Compact anemometer for measuring air speed, flow rate and temperature, provided with telescopic handgrip.

- Flow rate can directly be read on the display
- Accurate calculation of flow rate by a simple insertion of duct area
- Calculating the average in time and by points will supply information on the average value of air flow rate, speed and temperature
- Min./max. values can be read on the display
- Hold function will freeze the measure under examination on the display

PORTABLE THERMOHYGROMETER
Mod. THHY

Air humidity / temperature compact measuring instrument, with plug-in humidity probe head. When measuring at hard-to-access points, the humidity probe can be easily removed and attached to the handle via the probe cable.

- Displaying temperature and relative humidity / wet-bulb temperature / dew point
- Min./max. values
- Hold button to freeze readings
- Backlit display
- Automatic switching off

PORTABLE THERMOMETER
Mod. THRN

Instrument for measuring temperature that can be connected with thermocouple probes.

- Continuous display of max/ min values
- HOLD button for freezing the instantaneous measure on the display
- Backlit display

28-A

AI

RENEWABLE ENERGIES

www.elettronicaveneta.com

28A-E-AI

ELETTRONICA VENETA S.P.A. - 31045 Motta di Livenza (TV) Italy - Via Postumia 16 - Tel. +39 0422 765 802 - Fax +39 0422 861 901 - E-mail: export@elettronicaveneta.com

PRODUCTS INDEX
SORTED ALPHABETICALLY BY MODEL

RENEWABLE ENERGIES
CATALOGUE N. 28-A

ST	SOLAR THERMAL ENERGY	FC	FUEL CELL TECHNOLOGY
PE	PHOTOVOLTAIC ENERGY	CS	COMBINED SOLUTIONS
WI	WIND ENERGY	AI	ACCESSORIES AND INSTRUMENTS
HE	HYDROELECTRIC ENERGY		

MODEL	PRODUCT DESCRIPTION	PAGE
ACL220V	SPOTLIGHT	AI 3
DCL12V DCL24V	LAMP	AI 3
DCM/EV	DIRECT CURRENT MOTOR	AI 3
DW-EP/EV	ENERGY DISSIPATION KIT	AI 3
EBCH	ELECTRIC BATTERY CHARGER	AI 3
FCBA/EV	COMPUTERIZED FUEL CELL TRAINER	FC 3
FUEL-C.../EV	COMPUTERIZED FUEL CELL TESTING PANEL	FC 6
H2-300	METAL HYDRIDE STORAGE TANK	AI 3
HG-1	HYDROGEN GENERATOR	AI 4
HG-600	PEM ELECTROLYZER	AI 4
PM-E/EV PM/EV	PHOTOVOLTAIC PANEL TRAINER	PE 3
PM-K/EV PM-K2/EV	PHOTOVOLTAIC ENERGY GENERATION KIT	PE 10
PMWG-E/EV PMWG/EV	INTEGRATED PHOTOVOLTAIC-WIND POWER SYSTEM	CS 6
PMWG-K/EV	INTEGRATED PHOTOVOLTAIC-WIND POWER KIT	CS 17
PRH-1	PORTABLE RHEOSTAT *(1 X 20Ω)*	AI 4
PRH-2	PORTABLE RHEOSTAT *(2 X 20Ω)*	AI 4
PRH-3	PORTABLE RHEOSTAT *(3 X 35Ω)*	AI 4
PV-GR/EV	COMPUTERIZED ON-GRID PHOTOVOLTAIC TRAINER	PE 8
PV-OG/EV	COMPUTERIZED OFF-GRID PHOTOVOLTAIC TRAINER	PE 6
PVWG/EV	COMPUTERIZED ON-GRID / OFF-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	CS 14
PVWG-GR/EV	COMPUTERIZED ON-GRID PHOTOVOLTAIC-WIND POWER PLANT TRAINER	CS 12
PVWG-OG/EV	COMPUTERIZED OFF-GRID PHOTOVOLTAIC - WIND POWER PLANT TRAINER	CS 9
REMDI/EV	GRID-CONNECTED RENEWABLE ENERGY SYSTEM	CS 3
SIM-BS/EV	DHW SOLAR THERMAL SYSTEM SIMULATOR	ST 15
SIM-BSC/EV	SIMULATOR OF SOLAR THERMAL COMBISYSTEM FOR SPACE HEATING AND DOMESTIC WATER HEATING	ST 16
SIM-PM/EV	PHOTOVOLTAIC SYSTEM SIMULATOR	PE 12
SMK/EV	SOLAR ENERGY MINI LABORATORY	PE 11
SOL-K/EV SOL-KC/EV	SOLAR THERMAL KIT WITH FLAT PLATE COLLECTOR	ST 12
SOLBA	BATTERY PACK	AI 4
SOLTR/EV	SOLAR TRACKER	AI 5
SORM	SOLAR RADIATION METER	AI 7
SS-1/EV	INDOOR LIGHTING DEVICE *(6 SPOTLIGHTS, 1000 W EACH)*	AI 5
SS-2/EV	INDOOR LIGHTING DEVICE *(2 SPOTLIGHTS, 1000 W EACH)*	AI 5
SSC/EV	COMPUTERIZED SOLAR CONCENTRATOR TRAINER	ST 6

www.elettronicaveneta.com

STETCP/EV	SOLAR THERMAL ENERGY TRAINER	**ST** 9
TBS/EV	FLAT PLATE COLLECTOR TRAINER	**ST** 3
THAC	CUP VANE AIR VELOCITY METER	**AI** 7
THAM	PORTABLE ANEMOMETER	**AI** 7
THHY	PORTABLE THERMOHYGROMETER	**AI** 7
THRN	PORTABLE THERMOMETER	**AI** 7
WG-C/EV WG/EV	WIND POWER GENERATOR TRAINER	**WI** 3
WG-GR/EV	COMPUTERIZED ON-GRID WIND POWER PLANT TRAINER	**WI** 11
WG-OG/EV	COMPUTERIZED OFF-GRID WIND POWER PLANT TRAINER	**WI** 9
WG-I/EV WG-IM/EV WG-IIG/EV	WIND POWER GENERATOR INDOOR OPERATION DEVICE *(SUITABLE FOR AEROGENERATORS FOR TRAINERS AND KITS)*	**AI** 6
WG-IE/EV	WIND POWER GENERATOR INDOOR OPERATION DEVICE *(SUITABLE FOR TABLE-TOP AEROGENERATORS)*	**AI** 5
WG-K/EV	WIND ENERGY GENERATION KIT	**WI** 13
WIND-TU2/EV	COMPUTERIZED AEROGENERATOR WITH WIND TUNNEL TRAINER	**WI** 6
WPP/EV	COMPUTERIZED MINI HYDROELECTRIC POWER PLANT TRAINER	**HE** 3
WPP-K/EV	HYDROELECTRIC ENERGY GENERATION KIT	**HE** 6

Elettronica Veneta S.p.A. forbids the duplication or the disclosure of the information contained in this catalogue without written authorization.

ElettronicaVeneta

Elettronica Veneta S.p.A.
Via Postumia, 16
31045 Motta di Livenza (Treviso) Italy
Tel. +39 0422 765 802 r.a. - Fax +39 0422 861 901
E-mail: export@elettronicaveneta.com
www.elettronicaveneta.com