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Technical Teaching Equipment

Photovoltaic Solar Energy Unit

EESFB

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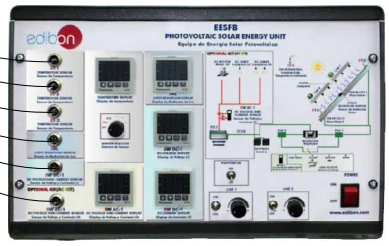
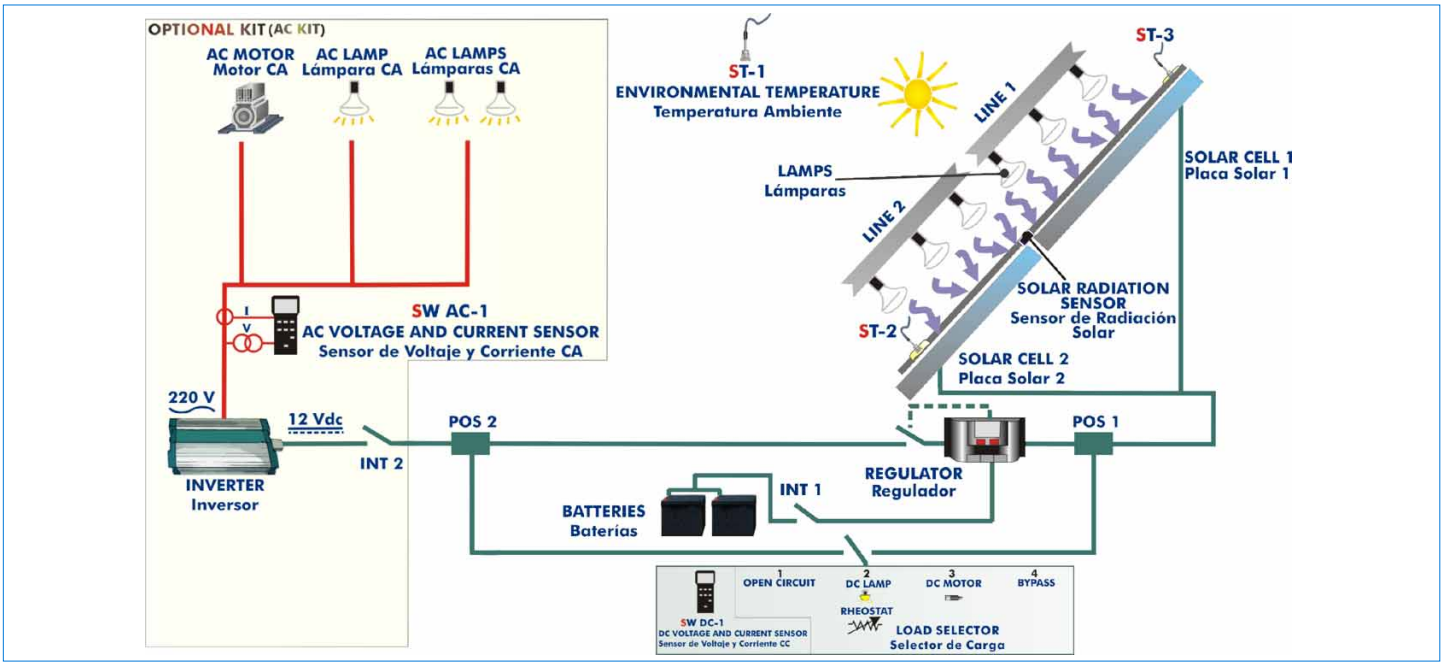
Products
Products range
Units
5.-Energy



Electronic console

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate
(Worlddidac Member)

GENERAL DESCRIPTION

"EESFB" is an unit for the study of the transformation of solar energy into electric energy.
This unit uses the photoconversion solar system for the direct conversion of solar radiation into electricity. The absorbed energy is provided by simulated solar radiation; in our case, this is done by means of a panel with powerful light sources.
Basically it is formed by:

- Photovoltaic Solar Panels.
- Solar Simulator formed by solar lamps.
- DC Load and Battery Charger Regulator.
- Auxiliary battery charger.
- Battery.
- DC Loads Module.
- Sensors (temperature, light radiation, DC voltage and current).
- Electronic console.

Optional (NOT included in the standard supply):

- EE-KIT. Kit of Conversion and Consumption Simulation (AC):
  - Single-phase inverter.
  - AC Loads Module:
    - Lamps of 220V-240V, 50-60Hz, 15W; Fan of 230V; and 4 Positions selector.
  - AC Voltage and current sensors.
- EE-KIT2. Grid Connection Inverter Kit:
  - Grid Connection Inverter.
  - Energy Generation Simulator.

SPECIFICATIONS

Anodized aluminium structure and panels in painted steel.

Diagram on the front panel with similar distribution to the elements in the real unit.

2 Photovoltaic solar panels (polycrystallines):

- Crystal modules with high level of transmissivity.
- Encapsulater etil-viniloacetatum modified.
- Frame made of aluminium.

Solar simulator:

- Aluminium structure adjustable in horizontal position.
- 11 Solar spectrum lamps of 300W each one, distributed in two independent voltage regulated circuits.
- Electrical safety, constituted by three-phase magneto thermal protection.
- Supply cables.

Ventilation system that allows us to analyze the temperature influence on the system performance operation.

DC Load and Battery Charger Regulator:

- DC Load regulation. PWM regulation. Staggered charge. Quick charge. Floating charge. Under-voltage disconnection and warning messages. Reconnection. Over-voltage disconnection. High temperature protection. Batteries high voltage protection. Load and module over-current protection. Solar panels, batteries and load inverse polarity protection. Inverse current flow protection. Solar panels open-circuit over-voltage protection.

Auxiliary battery charger.

Battery:

- Deep cycle charge battery. Plates with active materials of high density. 24 Amp/hour.

DC Loads Module:

- Metallic box.
- Diagram in the front panel.
- DC lamps of 12Vdc.
- DC motor of 24-36Vdc.
- Rheostat of 300W.
- Independent connection for every load with the help of the 4 Positions selector:
  - With the load selector in position 1, solar panels operate at open-circuit voltage.
  - With the load selector in position 2, the rheostat and the lamps are directly connected to the solar panels. These loads can connect independently or in parallel with the help of manual switches.
  - With the load selector in position 3, the DC motor is directly connected to the solar panels.
  - With the load selector in position 4, no DC load is connected and the solar panels connect directly to the batteries charge regulator.

Sensors:

- 3 Temperature sensors (one in the solar panel 1, other in the solar panel 2 and another of room temperature).
- Light radiation sensor.
- DC voltage and current sensors.

This unit incorporates wheels for its mobility.

Electronic console:

- Metallic box.
- Connectors for the temperature sensors. Digital display for temperature sensors.
- Selector for temperature sensors.
- Connector for the light radiation sensor. Digital display for light radiation.
- Connector for the DC voltage and current sensor.
- Digital display for voltage (DC).
- Digital display for current (DC).
- 2 Switches for the lamps of the two independent circuits.
- 2 Regulators for the light intensity of lamps of the two independent circuits.
- Ventilation system switch.

Cables and Accessories, for normal operation.

Manuals:

- This unit is supplied with the following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, & Practices Manuals.

Optional (NOT included in the standard supply) :

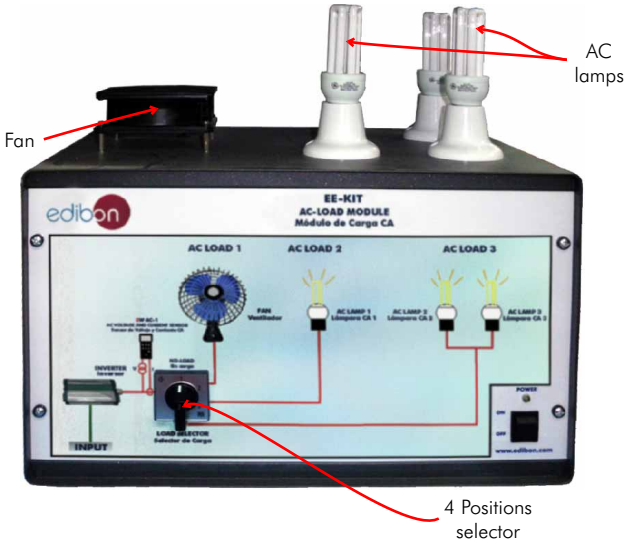
- -EE-KIT. Kit of Conversion and Consumption Simulation (AC).
- -EE-KIT2. Grid Connection Inverter Kit.

EE-KIT. Kit of Conversion and Consumption Simulation (AC):

Inverter

- Single-phase inverter:
  - Single-phase.
  - 25 kHz switch mode technology.
  - Start-up power of 200%.
  - Short-circuits protection.
  - High temperature protection.
  - Overcharge protection.
  - Operation state LED indicator.
  - Rear connection/disconnection switch.

AC Loads Module



- AC Loads Module:
  - Metallic box.
  - Diagram in the front panel.
  - Fan of 230V.
  - Lamps of 220V - 240V., 50-60 Hz., 15W.
  - Independent connection for every load with the help of the 4 Positions selector:
    - With the load selector in position 1, the inverter operates without load.
    - With the load selector in position 2, the fan motor is connected.
    - With the load selector in position 3, one AC lamp is connected.
    - With the load selector in position 4, two AC lamps are connected in parallel.

- AC voltage and current sensors.

EE-KIT2. Grid Connection Inverter Kit:

Inverter used for the conversion and injection to the grid of the power generated by a simulated source of renewable energy. The simulated source is a simulator used to obtain a variable power to be injected to the grid.

The operation mode is displayed by means of a LED indicator at the front side of the housing.

It is equipped with extensive safety measures to ensure that it switches off immediately as soon as the AC plug is removed from the wall socket or the public grid fails in operation.

The inverter can be connected to a PC through RS232 communication to display some parameters such as voltage and current inputs, mains voltage and frequency, maximum AC power, Kwh, etc.

- Grid Connection Inverter:
  - Input (DC):
    - Nominal power @ 25°C: 200 W.
    - Maximum power @ 25°C: 250 W.
    - PV power: 160-300 Wp.
    - MPP voltage: 40-75V DC.
    - Maximum voltage: 155V DC.
    - Nom. rated current: 4A.
  - Output (AC):
    - Voltage: 85% ~ 110% Un (195-253 V).
    - Nominal power: 140 W.
    - Maximum power/fuse: 2.25 A / 3.15 A.
    - Frequency: 49.5 ~ 50.5 Hz.

- Energy Generation Simulator.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Determination of the typical parameters of the solar panels.
2.- Study of the existing relation between generated power and power of solar radiation.
3.- Study of the solar panels maximum performance.
4.- Study of the influence of the temperature on the tension of circuit opened of the solar panels.
5.- Study of the behaviour of the solar panels connected in parallel.
6.- Study of the behaviour of the solar panels connected in series.
7.- Study of the behaviour of the system connected in parallel depending on temperature.
8.- Lamps illumination profile study.
9.- Efficiency experimental determination.
10.- Influence of the angle of incidence on the temperature.
11.- Determination of the material that makes up the solar cell.
12.- Determination of the p and n side of a solar cell.
13.- Determination of the first quadrant of the I-V curve, without illumination of the solar cell.
14.- Determination of the inverse current or the saturation current with regard to a solar cell without illumination.
15.- Determination of the resistance in series and in parallel of a solar cell without illumination.
16.- Dependence of the voltage of open circuit (V_{oc}) with the lumens.
17.- Determination of the characteristic parameters of a solar cell with illumination.
18.- Relation of the maximum power with the power input.
19.- Determination of the parameters that define the quality of a solar cell.
20.- Solar energy measurement.
21.- Measurement of the solar panel voltage in vacuum.
22.- Determination of the cells disposition in a solar panel.
23.- Measurement of the maximum power for a solar panel with load.
24.- Measurement of the solar panel voltage in vacuum with constant illumination and different temperature.
25.- Study of V, I, W according to different loads.
26.- Familiarization with the regulator parameters.
27.- Study of functionality of the photovoltaic system series/parallel with connection of different loads and without the support of the storage battery.
28.- Study of functionality of the photovoltaic system series/paralell with connection of different loads DC and with the support of the storage battery.
29.- Connection of loads to direct voltage.

Practices to be done with the OPTIONAL KIT "EE-KIT":

30.- Study of functionality of the photovoltaic system series/parallel with connection of different loads and without the support of the storage battery.
31.- Study of functionality of the photovoltaic system series/paralell with connection of different loads AC and with the support of the storage battery.
32.- Connection of loads to alternating voltage of 220 V.

Practices to be done with the OPTIONAL KIT "EE-KIT2":

33.- Study of the grid utility inverter.

REQUIRED SERVICES

- Electrical supply: three-phase, 400V, 50-60 Hz, and minimum power 5000VA.

DIMENSIONS & WEIGHTS

EESFB:

Unit:	-Dimensions: 2200 x 1200 x 2005 mm. approx.
	-Weight: 300 Kg. approx.
Electronic console:	-Dimensions: 490 x 330 x 310mm. approx.
	-Weight: 15 Kg. approx.

OPTIONAL

- EE-KIT. Kit of Conversion and Consumption Simulation (AC):
  - Single-phase inverter.
  - AC Loads Module:
    - Lamps of 220V-240V, 50-60Hz, 15W; Fan of 230V, and 4 Positions selector.
  - AC voltage and current sensors.

- EE-KIT2. Grid Connection Inverter Kit:
  - Grid Connection Inverter.
  - Energy Generation Simulator.

- PSA/PC. Polycrystalline photovoltaic solar panel. (2 units)
- PSA/MC. Monocrystalline photovoltaic solar panel. (2 units)
- PSA/AM. Amorphous photovoltaic solar panel. (2 units)

AVAILABLE VERSIONS

Offered in this catalogue:

-EESFB. Photovoltaic Solar Energy Unit.

Offered in other catalogues:

-EESFC. Computer Controlled Photovoltaic Solar Energy Unit.

-MINI-EESF. Photovoltaic Solar Energy Modular Trainer.

✱Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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Issue: ED01/12
Date: January/2012