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EN 01.4 - STAND ALONE PHOTOVOLTAIC INSTALLATION DEMONSTRATOR

The equipment EN 01.4 has been designed as a stand alone photovoltaic solar power plant, with 2 modules and all the elements necessary to complete the installation.

The equipment consists of: 2 photovoltaic panels of 20Wp, 2 batteries, a voltage regulator, an inverter, a pyranometer, different loads in DC and AC, and modules of control and data acquisition.

This working station is equipped with tension and current meters in the key sections, to make it easy for the student to understand its operation.

The system works in exactly the same way as the photovoltaic stand alone facilities of electrical generation, that are normally used on boats, caravans, pumping groups, or remote locations where access to the public mains does not exist.

In addition, this equipment allows for the connection of the panels and the batteries, in series or in parallel.

EN 01.5 - STAND ALONE AND NETWORK PHOTOVOLTAIC DEMONSTRATOR

The equipment EN 01.5 reproduces a scale, complete photovoltaic solar installation. It has been designed with special emphasis on the didactic aspect. It offers the opportunity to observe all the components of a real photovoltaic solar installation and its layout.

It is supplied with adapted cables to connect and disconnect the components of the installation in different ways, so allowing to observe and analyze the operation of the connected panels in series, parallel, with batteries in series or in parallel, with direct exit in DC or AC, working standalone or connected to the network.

The equipment is supplied with metering devices for the variables necessary to analyze the characteristics of the panels and their behavior. Likewise, it has a pyranometer that indicates the intensity of solar radiation that affects the panels, with tension and current meters to show to the generated voltage and its intensity.

Additionally, it has tension and current meters in each one of the batteries to indicate the state of these and the direction of the current, if they are being loaded or contributing load, and it also has a metering device that shows a complete description of the obtained alternating current after the standalone inverter.

The grid connected inverter is implemented with software where the parameters of generation can be observed. In order to feed the grid-connected inverter, there are 3 panel simulators, with power regulation and tension and current metering devices.

EN 01.6 - COMPUTERIZED PHOTOVOLTAIC INSTALLATION DEMONSTRATOR

The EN 01.6 reproduces a complete photovoltaic solar system. It has been designed with special emphasis on the didactic aspect of it, being able to observe at a glance all the components that a solar photovoltaic installation has and its arrangement. It allows the study of both, isolated photovoltaic solar energy installations and grid connection.

The equipment consists of: 2 photovoltaic panels of 20Wp with forced air cooling system, 2 batteries, regulator, insulated inverter, grid inverter, solar panel emulator, pyranometer, temperature sensors in panels, various DC and AC loads, and module control and data acquisition.

It has cables ready to connect and disconnect the various elements of the installation in different ways, being able to observe and analyze the operation of the panels connected independently, in series, in parallel, with batteries in series or in parallel, with direct output in Direct current or direct current to AC converter, working stand alone or connected to the grid.

It is provided with elements of measurement of the variables necessary to analyze the characteristics of the panels and their behavior. Thus, it has a pyranometer that indicates the intensity of radiation that affects the panels, with voltmeters and ammeters that show us respectively the voltage and the intensity generated.

It also has ammeter and voltmeter in each of the batteries to indicate the state of these and the direction of flow of the current in them, that is to say if they are loading or providing load. It has also a measuring instrument that provides us all the characteristics of the

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

EN 04.1 - WINDMILL TEST-BENCH

The Windmill Test-bench (EN 04.1), is a wind tunnel of 2 meters length designed to work with windmills of less or equal to 630mm diameter. The equipment has a 612 mm windmill included, which has a torque and rotation speed measurement system.

The wind tunnel has a transparent part, so a complete sight of the windmill working is allowed. That part, can also be opened, to facilitate the access and manipulation of the system.

The tunnel has a built-in system for the measurement of the speed of the air by means of electronic pressure transducers, to monitor in real time the speed of the air that the windmill is put under.

The new system also has an electronic control of the pitch, to be modified from the control panel or from the computer.

All the system, is monitored and controlled through a control module, which also can be connected to a computer with a USB port.

EN 04.2 - WIND POWER PLANT TRAINER

With this equipment, we emulated the behavior of a wind turbine in a practical and didactic way. An electric motor acts as the blades and bush of a wind turbine, dragging a three-phase synchronous generator of permanent magnets, which transforms the mechanical energy transmitted to the shaft into electrical energy at the output.

The current generated is three-phase AC, having to transform into DC to be able to feed the inverter, which in turn, transforms it into single-phase AC current with the appropiate frequency, and other characteristics necessary to be able to pour supply current into network.

The equipment is designed to understood in a very visual and intuitive way quickly the operation of the assembly, not only knowing the elements of which it consists, but having them also to connect by means of the security cables supplied for that purpose. This is achieved by arranging the equipment in schematic and connectable panels.

In addition it counts on a computer from which we control the operation of the equipment and we obtain the reading of all the necessary variables for the analysis of the system.

EN 04.3 - GRID CONNECTED DC WINDMILL GENERATOR TRAINER

With this equipment the behavior of a windmill is emulated in a practical and didactic way. An electrical motor does the times of the turbine of a windmill to move the DC generator, which transforms the transmitted mechanical energy to the axis into electrical energy.

The generated DC feeds the inverter which transforms this in AC with the suitable frequency, in our case 50 Hz, and other characteristics necessary to be able to connect to the public grid.

The equipment is designed to be very visual and work in an intuitive way, the operation of the set is understood quickly, not only knowing the elements of which it consists, but having also to connect the different modules by means of provided wires.

This is obtained by means of the disposition of the equipment in schematic and connectable panels.

From the computer with touch screen (provided) we can control the operation of the equipment and obtain the reading of all the necessary variables for the analysis of the system.

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EN 04.4 - INSULATED WIND POWER PLANT TRAINER

With this equipment, we emulated the behavior of a wind turbine in a practical and didactic way. An electric motor acts as the blades and bush of a wind turbine, dragging a three-phase synchronous generator of permanent magnets, which transforms the mechanical energy transmitted to the shaft into electrical energy at the output.

The current generated is alternating three-phase, having to transform into direct current to be able to feed the regulator of charge of batteries and consumptions, and later to the inverter that in turn turns this into alternating current with the appropriate frequency. So that the generated electric energy can be stored in batteries or consumed directly, or also use the stored charge for consumption when is no wind.

The equipment is designed to understood in a very visual and intuitive way quickly the operation of the assembly, not only knowing the elements of which it consists, but having them also to connect by means of the security cables supplied for that purpose. This is achieved by arranging the equipment in schematic and connectable panels.

In addition it counts on a computer from which we control the operation of the equipment and we obtain the reading of all the necessary variables for the analysis of the system.

EN 05.1 - HYDROELECTRIC PLANT WITH PELTON TURBINE

Trainer EN 05.1 has been designed as a small-scale hydropower plant and it is equipped with a Pelton turbine that provides full operation along with all the other accessories that complete a standard installation.

This training unit is composed of: a Pelton turbine, a water tank with a pump, a battery, a regulator, a current converter, a choice of charges both for DC and AC, a control panel, as well as voltage and current meters in key points in the installation circuit. Therefore, the unit enables students to observe and interpret accurately how a hydropower plant operates.

This trainig unit simulates the operation of a power generator, taking into account the hydraulic head of a reservoir, whereby water potential energy is transformed into electricity thanks to the operation of a turbine.

Additionally, the turbine is equipped with devices for measuring the motor torque and the rotational speed which enables calculations on mechanical energy retrieved and the mechanical and electric power efficiency rate.

Finally, there is a digital pressure transducer at the turbine inlet and a flowmeter which enable the calculation of hydropower energy.

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