



RE540

Hilton Photovoltaic Trainer



- Demonstrates the Practical Application of a Solar Power Generation System***
- Expandable 80W Panels and Deep Cycle Batteries, Allow Substantial Loads to be Applied***
- Optional Solar Simulator Available***
- Optional Computerised Data Acquisition***
- Safe for Student Operation***
- Two Year Warranty***



Introduction

Solar power is one of the few, truly renewable energy sources that is currently commercially available. Ongoing research and the expansion of production facilities for photovoltaic panels means that capital costs for practical installations are reducing. The reality of global warming and carbon taxes related to the burning of fossil fuels means that interest in solar power generation is expanding beyond novel applications to more mainstream situations.

As solar panels are almost never used without a method of power storage, it is important that engineers, architects and designers are aware of the advantages and limitations of the various types of photovoltaic panel, controls and battery systems that are available. In addition an understanding of the method of generating readily useable alternating current from the direct current of the battery is also essential.

The **Hilton Photovoltaic Trainer RE540** will provide interesting and instructive experimental work for all students, and will be of particular interest to those studying:

- **Environmental Engineering**
- **Energy Conservation**
- **Mechanical Engineering**
- **Architecture**
- **Building Services**
- **Electronics**
- **Electrical and Electronic Engineering**
- **Automotive Engineering**
- **Plant & Process Engineering.**

The combination of photovoltaic power generation and hydrogen fuel cells represent a potential solution to the storage of solar energy for use on demand. P.A.Hilton Ltd have a Proton Exchange Membrane (RE510) Fuel Cell available for training purposes. Please refer to our website <http://www.p-a-hilton.co.uk> for details.

Experimental Capabilities

- Investigation of electrical conversion efficiency relative to solar radiation.
- Investigation of the effect of panel inclination and angle of latitude.
- Measurement of solar panel output characteristics under load and the effect of panel temperature.
- Examination of battery charge management system.
- Measurement of overall system performance under load.

Description

A practical sized solar panel with nominal 80W output is connected to a control panel containing relevant instrumentation and a battery charge control system. This in turn connects to a substantial deep cycle sealed lead acid battery. This allows the application of locally sourced loads, or, loads available as optional extras.

The solar panel is supplied with an adjustable stand that allows inclination to be varied together with an accurate panel mounted solarimeter. This allows the radiation incident on the panel (kW / m^2) to be measured and compared with the electrical power generated. This enables system efficiency to be measured.

The instrumentation provided allows the isolated panel characteristics and the overall system performance to be measured under load. A monitoring point is provided to allow detailed investigation of the charge controller operation by advanced students (Oscilloscope required, not provided as standard).

In order to expand the capacity of the unit additional panels and batteries are available as optional extras.

To allow long term monitoring of system performance an optional data acquisition system is available that can be supplied as a factory fitted option or alternatively for addition as a user fitted accessory.

In order to demonstrate the use of solar power for AC power generation an optional inverter is available.

For environments where abundant solar radiation cannot be relied upon an optional solar simulator (See RE540E) is available that requires connection to a local electrical power supply.

The RE540 unit is complimentary to the Hilton RE550 Flat Plate Solar Energy Collector which allows students to examine water heating directly from solar energy.

Safety

The integral charge control system provides overload protection and battery protection.

Excluding the optional inverter and solar simulator options all components are low voltage (10-20v DC).

Where appropriate components are protected by overload circuit breakers or fuses.



Specification

General

A complete 80W solar panel system with instrumentation panel containing a battery charge controller, panel loading system, all relevant instrumentation and an external deep cycle 110Amp hour battery. Instrumentation includes high accuracy solarimeter, panel temperature, electrical charging and load power measurement.

The system may be expanded by the addition of extra optional solar panels and batteries.

Computerised data acquisition, a solar simulator, external loads and an inverter are also available as optional extras.

Detailed

Solar Panel: High quality nominal 80W 12v solar panel (Areal 0.6m²) suitable for continuous external use. Optional expansion up to 4 panels per unit.

Instrumentation and Control: Instrumentation panel containing battery charge controller, panel loading system, power and panel temperature measurement, power outlet and integral safety cut outs.

Battery: Deep cycle, sealed lead acid 110Amp hour. Additional batteries available as optional extra.

Dimensions

(Nominal overall depending upon panel inclination)
Height: 1200mm Depth: 750mm
Width: 527mm Weight: 42 kg

Accessories and Spares

Unit supplied with:

One experimental operating and maintenance manual in English, Spanish, French

Accessories and spares for 2 years normal operation. List available on request.

Services Required

If operated in ambient sunlight the unit is self powered and requires no mains services.

Optional Items:

Solar Simulator RE540E requires a mains power supply. Details available on request.

Order as:

RE540 Photovoltaic Trainer

RE540/230/RC Photovoltaic Trainer Computer Linked

RE540/115/RC Photovoltaic Trainer Computer Linked

Optional Items:

RE540A Water Pump

RE540B Single Phase Inverter

RE540C Additional 80W Solar Panel

RE540D Additional Deep Cycle Battery

RE540E Solar Simulator



Optional Extras

RE540A Water Pump

RE540B Single Phase Inverter

RE540D Additional Deep Cycle Battery



Photograph showing typical Optional RE540A, RE540B and RE540D.

It is essential for students to be aware that components of a practical photovoltaic system must be compatible and designed for purpose if the system is to be successful.

The optional water pump and single phase inverter are specifically designed for use with photovoltaic systems.

The single phase inverter allows students to investigate the conversion of battery derived low voltage DC to AC mains power at 230V 50Hz (110v 60Hz available on request).

The use of standard vehicle batteries with photovoltaic systems is impractical as these devices are designed for short duration high current draw (vehicle starting) and then rapid re-charging.

Solar panel batteries must be capable of repeated long duration deep discharge and then slow re-charge, without damage.

The optional RE540D is purpose designed for use with a solar array.

Additional optional batteries, RE540D and optional solar panels RE540C allow a system with greater capacity to be constructed at any time for demonstration and research purposes.

RE540C Additional 80W Solar Panel



A high quality nominal 80W 12v solar panel (Area 0.6m²) suitable for continuous external use. Up to 4 of the optional RE540C panels may be attached to the standard RE540 console together with an unlimited number of the optional RE540D deep cycle batteries.

RE540E Solar Simulator



In countries where solar radiation cannot be relied upon, the Optional Solar Simulator allows The RE540 unit and solar panel to be investigated in detail under controlled conditions. The full equatorial solar heat flux can be simulated with the Optional RE540E.

The solar simulator consists of 2 banks of 6 x 500W floodlights that are arranged in 2 banks of 6 lamps giving 2 x 3kW output. **(1)Top bank of 6 lamps (3kW), (2) Lower bank of 6 lamps (3kW).**

The lamps are supplied by two separate power leads and power circuits. Each circuit has an individual **RCCB(3,4)** and **switch/circuit breaker (5,6)**. This allows the two power leads to be connected to two separate mains outlets. In most countries a single power outlet in a laboratory is capable of supplying up to 3kW, hence the arrangement.



RE541A Data Acquisition Upgrade

Hardware details

The Optional Computerised Data Acquisition Upgrade consists of a 21 channel Hilton Data logger together with pre-configured, ready to use, Windows™ compatible educational software.

Factory fitted coupling points on the base unit allow installation of the upgrade to the unit at any time in the machine's extensive life.

The Hilton Data logger connects, using the cable supplied, to a standard USB port on the user-supplied PC. If more than one logger is required connection is via a second USB port or standard USB hub.

The combined educational software and hardware package allows immediate computer monitoring and display of all relevant parameters on the base unit.

Software Details

The pre-configured menu driven Software supplied with the Computer Upgrade allows all recommended experiments involving the electronic transducers and instruments on the base unit to be carried out with the aid of computerised data acquisition, data storage and on-screen data presentation. This enhances student interest and speeds comprehension of the principles being demonstrated.

Students are presented with either raw data for later hand calculation or alternatively data may be transferred to most spreadsheets for computerised calculation and graphical presentation.

Data may be stored on disc and displayed at any time using the software supplied. Alternatively data may be transferred to any compatible spreadsheet together with individual time and date stamp on each reading for complex analysis.

Additional Data Logging Facility Supplied As Standard

The Data Logger comprises an industrially proven 21 channel interface with 8 thermocouples (type T and K as standard) / differential voltage inputs ($\pm 100\text{mv DC}$), 8 single ended DC voltage inputs ($\pm 8\text{v}$), 4 logic or frequency inputs and one mains voltage input. In addition there are on board 12v DC, $\pm 5\text{V DC}$ and $\pm 15\text{v DC}$ power supplies for most commercially available transducers.

The Hilton Data Logging software supplied as standard with the computer link upgrade, allows the logger to be disconnected from the base unit and used together with most standard transducers as a stand-alone computer data logger for the instrumentation and monitoring of existing laboratory equipment using locally sourced industrial transducers. The software is also backwards compatible with our many second generation D102 data loggers that are already in use worldwide.

Full data logger command protocol and communications details are provided in an extensive user manual that allows other software applications to communicate with the logger via the USB interface. Users can write their own software, typically in LabView, Matlab, C, C++, Visual Basic etc. This further expands the student project capabilities of the data logging package from teaching and demonstration into the field of research and postgraduate study.

Computer Hardware Requirements

The menu driven Software supplied with the Computer Upgrade will operate on a PC which has at least 0.5Gb Mb ram, VGA graphics, 1Gb hard drive, CD drive and an available USB port. The software is Windows 2000, XP and 7 compatible.

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