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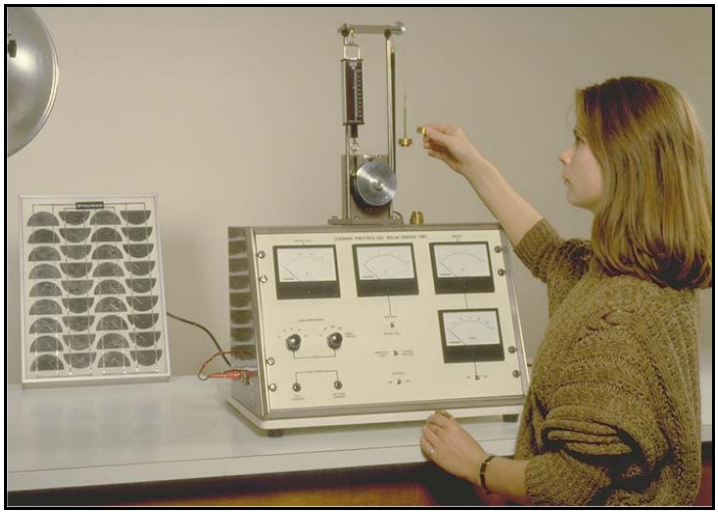
TECHNOLOGY



P9060

PHOTOVOLTAIC SOLAR POWER UNIT

FEATURES

- Collects and stores solar power
- Highly efficient energy conversion - 100 watts/ metre^2
- Does not require complicated reflecting systems
- Stored energy can be converted for use by electric motor

INTRODUCTION

This unit provides students with the means of collecting and storing solar power, measuring the energy thereby made available and investigating the performance of the Photovoltaic unit. Unlike the simple absorbent panels currently widely used in order to supply low grade thermal energy, this unit enables both electrical and mechanical power to be obtained yet it does not require the use of complicated reflecting systems in order to concentrate the solar energy.

It represents a system of solar power utilisation that is coming into increasing use. As solar energy is intermittent almost all applications require some form of storage to permit continuous operation. In other cases the demand for energy may be much higher than the output of the cell but only for a small percentage of total time. Here again the storage system makes this possible.

DESCRIPTION

As shown in the illustration, the power element in the unit is a photovoltaic cell array comprising thirty-six silicon cells connected to a control unit incorporating a storage battery, and a switched loading system consisting of an electric motor and dynamometer and a bank of resistors.

Energy of solar origin stored in the battery can be converted into kinetic energy by the use of the electric motor and measured by the dynamometer and tachometer system. The characteristics of the photovoltaic cell array can be determined by the instrumentation provided. Provision is made for the use of recorders to indicate both the output of the solar cell array and the output of the storage battery. The photovoltaic cell material employed is highly efficient giving an energy conversion of around 10%, i.e. an output of the order of 100 watts per square metre in full sunshine. It is normally mounted out of doors at an angle to the horizontal, the angle being determined by the latitude of the location, alternatively a suitable lamp can be used.

The cells are sandwiched between two panels of glass to protect them from mechanical and atmospheric damage. The glass panels may readily be cleaned so that the radiation absorption rate is not impaired by a coating of dirt. The battery used has a low self-discharge rate; it may be left charged for several months without harm but like all batteries of its type it should not be left discharged. The tachometer provided for use with the dynamometer system is battery powered and the whole unit is independent of mains electricity supply.

BACKGROUND INFORMATION

The modern photovoltaic cell stems from a discovery in the Bell Telephone Laboratories about 1955 that thin films of doped silicon provided a photovoltaic cell of about twenty times the efficiency of previously known materials which had an energy conversion efficiency of only 0.5%. The mode of action is as follows:-

Figure 1 shows diagrammatically a section through the cell which consists of a thin slice cut from a single crystal of purified silicon. The P and N layers are produced by doping with minute quantities of boron and phosphorous. When the upper surface is subjected to a stream of photons from sunlight, some of these have enough energy to detach orbital electrons from their parent atoms. This makes not only free electrons but also positive holes. The sudden creation of extra electrons and holes upsets the balance of positive and negative charge carriers in the P and N type silicon respectively so that there is a migration of charge carriers causing a current to flow in the external circuit. The energy conversion efficiency of 10% is about half that of the theoretical maximum value.

Figure 2 shows the output of a module plotted on a base of solar intensity.

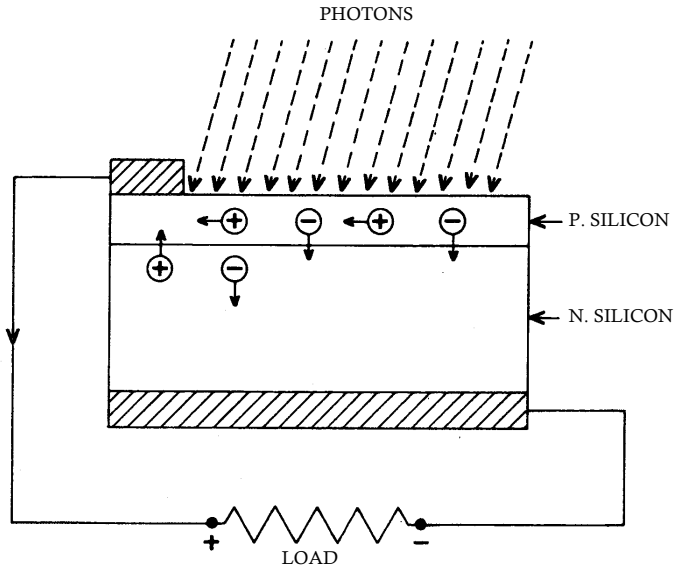


FIG. 1 Sectional Diagram of Silicon Photovoltaic Cell

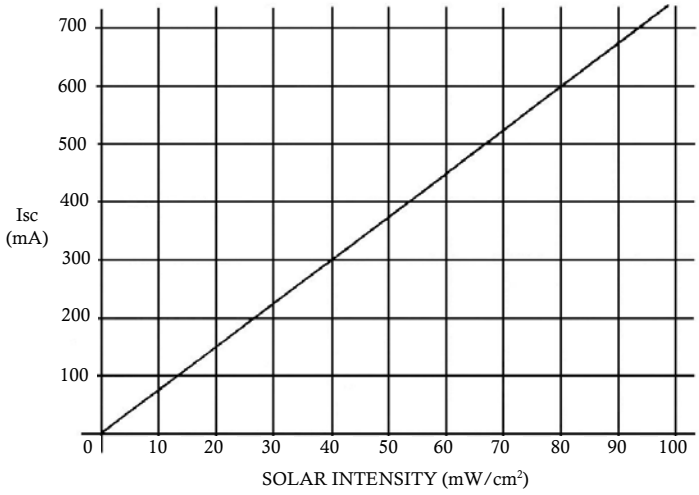


FIG. 2 Performance Curve

TENDER SPECIFICATION

Solar Power Unit comprising six module photovoltaic cell array for mounting externally with maximum output about 9W and control unit for laboratory use comprising switching circuit, load resistors (2 banks), ammeter (2), voltmeter, dynamometer system and tachometer all carried in a high quality instrument case and large capacity lead acid battery supplied in dry charge condition. Supplied complete with 30m of external quality cable.

PHYSICAL DETAILS

	Nett Weight		Length		Width		Height	
	lb	kg	mm	in	mm	in	mm	in
Control Unit	40	18	560	22	630	25	700	28
Array	5.2	2.4	337	12	40	1.5	460	18

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