Power output of solar panels

by Richard N. Tarrant

Experiment Overview

This experiment investigates the characteristics of solar panels as a non-linear source of electrical energy. The experiment also investigates the conditions under which solar panels give maximum power for a given amount of light shining on it.

The aims of the experiment are to expose students to non-linear circuits and develop their familiarity and skills in circuits, data collection, representation and analysis. This experiment is an effective learning tool because it is relevant to contemporary energy source concerns.

Learning Experience

In the School of Physics at he the University of Sydney, we are starting a review of our entire undergraduate electrical circuits / electronics teaching program, following concerns raised that many of our 3rd year physics students had little understanding of the most basic electrical circuits (for example, inability to recognise a diode symbol in an electrical circuit). Part of this review is to re-examine our 1st year laboratory experiments.

The experiment is presented on an no prior experience basis. This experiment has been used in our labs for many years. In previous years, the experiment occupied the second 2 hours of a 3 hour lab, the first hour given over to a 40 minute written physics test. We are considering the removal of the test and extending the experiment to occupy the full three hours of laboratory time.

What parts of the experiment work?

What parts don't work?

How could the experiment be improved?

How could the experiment be expanded?

Aims and Objectives

The aim of the experiment is to

- understand the concept of a characteristic curve and how to measure it,
- have some familiarity with the idea of a non-linear device – for which the characteristic curve is not a straight line,
- use combinations of resistors to obtain a wide range of total resistances,
- calculate current in a circuit rather than measuring it directly.

Level of Experiment

This experiment is used in our first year, second semester Environmental Physics course. This course is designed for students doing medical science and other biology related degrees. Most (but not all) of the students have come through our first semester Physics Fundamentals course, which has been developed for students who have not studied Physics in year 12, or those who obtained poor results (<65). Again, most of these students are studying physics only because their course of study requires it (often to their surprise and consternation!).

Keyword Descriptions of the Experiment

Domain
Circuits, solid state physics

Specific Descriptors
Complex electrical circuits, energy conversion, non-linear devices, combined resistances, solar panels, circuit load

Course Context

PHYS 1004 Physics 1 (Environmental & Life Sciences) – Semester 2, 2009

Module 2 – Electricity and Magnetism

This module is one of 3 comprising PHYS 1004 Physics 1 (Environmental & Life Sciences). This document describes

details of this module and should be read in conjunction with the more general unit of study outline for PHYS 1004 Physics 1 (Environmental & Life Sciences).

GENERAL GOALS OF THIS MODULE

- To investigate the concept of charge, the conservation of charge and the forces between charges.
- To investigate the nature of electric and magnetic fields, how they can be produced and the interactions between
- them.
- To examine simple electrical circuits and concepts of voltage, current and resistance.
- To discuss applications of these concepts to the environmental and life sciences. Such applications include
- capacitance of cell membranes, nerve conduction, the earth's magnetic field, and the principles of operation of
- MRI.

Prerequisite Knowledge and Skills

This is a second semester unit, all students will have undertaken Physics Fundamentals in first semester as a minimum requirement. A few may have done more advanced first semester physics courses.

Time Required to Complete

Prior to Lab: 0.5 hrs of pre-experiment exercises
In Laboratory: 2 hours
After Laboratory: None

Experiment History

This experiment has been used within the School of Physics with little change for many years previous to my involvement.

As noted earlier, we are reviewing all electrical circuits experiments at all undergraduate levels

Comments

The students carry out the preparatory work in their laboratory manuals prior to beginning the experiment, and preferably prior to beginning the laboratory session. Students may not commence the experiment until their preparatory work has been checked off.

The students perform the experiment in teams of three using a single team logbook. The laboratory notes are in the bound laboratory manual, containing all of the semester's experiments, as well as general introductory material including OH&S requirements, laboratory rules, notes on experimental methods, and some sample logbook entries. At back of the manual (which each student is required to purchase) are extensive pages of relevant formulae, methods of data analysis including calculation and propagation of errors, drawing of graphs, and a brief primer on using Microsoft EXCEL for analysing and plotting data.

The experiment notes in the laboratory manual are written as a series of logbook points, designed to encourage the students to think, discuss and work as a team. At each of the several checkpoints, a tutor discusses the logbook entries with the group and provides feedback. If the work is satisfactory the checkpoint is awarded and the group may then proceed. If not, the work is revised until a checkpoint is awarded.

References

R.D. Knight, B. Jones & S. Field, *College Physics: A Strategic*

Approach, Pearson, 2nd ed. 2010.