PERFORMANCE EVALUATION OF POLYCRYSTALLINE SILICON MODULE UNDER OUTDOOR CONDITIONS IN NORTH CENTRAL, NIGERIA

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Abstract

A performance assessment of a polycrystalline module as a function of global solar radiation was carried out in Minna (9° 37' N, 6° 32' E), North central geopolitical Zone of Nigeria. Outdoor characterisation method was employed to determine the I-V characteristics of the module, and data extracted from the I-V measurements were used to calculate the module performance parameters. The result obtained reveals that the maximum power output and conversion efficiency of the module show only slight variation from the rated values. The average conversion efficiency of the poly-crystalline module during the period of this study is 11.64% which represents 91.7% of the manufacturer's specification.

Keywords: Photovoltaic, Polycrystalline module, Characterisation

Introduction

The production of photovoltaic (PV) modules has been increasing by an average of more than 20% each year since 2002, making it the world's fastest growing energy technology. At the end of 2010, the total nominal 'peak power' of installed PV was about 40 GWp [1]. Photovoltaic modules are rated at Standard Test Conditions (STC) of an irradiance of 1000W/m^2, a spectral distribution conforming to AM 1.5 spectrum and a PV module cell temperature of 25^{0}C. However, these conditions do not represent what is typically experienced under outdoor operation [2].

More than 83% of the PV modules produced for terrestrial applications are made from crystalline silicon solar cells. Hence, a performance assessment of a polycrystalline module as a function of global solar radiation was carried out in Minna (9^0 37' N, 6^0 32' E), North central geopolitical Zone of Nigeria. The experiment was carried out between May and June, 2012.

PV system design and application are location based and the performance of the system depends on the solar radiation characteristics of the site. To determine the performance of PV modules under site specific climatic conditions, the voltage-current characteristics of the modules under varying solar irradiation and ambient temperature in such site needs to be known. Outdoor characterisation of PV modules is essential because it provides relevant data for reliable PV system design. Durish *et al* [3], explained that the use of outdoor data leads to more reliable results and enables selection of the most suited module type for a specified application at a selected site, as well as realistic assessment of the productivity of PV generators.

Experimental Procedures

This study involves careful measurement and analysis of outdoor performance of a poly-crystalline module under varying solar irradiance and temperature conditions.

The equipment and materials used for the I-V measurements are listed below:

- 80 W Polycrystalline Solar module
- Multimeters (two 830D Series Digital Multimeters)
- Variable resistor (three 11.3 ohms and two 41.5 ohms rheostats connected in series)
- Davis Weather Instrument (Vantage PRO 2) with a data logger
- Connecting wires

Experimental Set-up

An outdoor experimental set-up was put in place to carry out a series of I-V measurements under varying solar irradiance and temperature values for a polycrystalline solar module.

A solar rack was constructed and used to hold up the PV module (80 W Poly-crystalline module) used in this experiment. The system was installed at the concrete top of a building beside Physics Laboratory at Bosso Campus of the Federal University of Technology, Minna. It was faced southward at a tilt angle 10° which is approximately equal to Minna latitude. The location of the solar module was chosen such that no shadow would be cast onto the solar module at