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Measurement and Characterization of Solar Cells and Modules

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16.1 INTRODUCTION

Methods of assessing the performance of photovoltaic cells and modules are described in this chapter. The performance of cells and modules can be described by their current versus voltage ($I-V$) and spectral responsivity versus wavelength ($S(\lambda)$) characteristics. Measurement equipment, procedures, and artifacts are discussed for $I-V$ and $S(\lambda)$. The most common performance indicator is the photovoltaic (PV) efficiency under standard reporting conditions (SRC) (temperature, spectral irradiance, total irradiance). The efficiency is the maximum electrical power divided by the total irradiance. Procedures for accurately determining the efficiency or the maximum power with respect to reference conditions are described. Alternatives to the standard peak watt rating and how they compare with actual field performance are discussed. Since photovoltaics must operate for 20 to 30 years, with a degradation of less than 1% per year, procedures for assessing the durability of PV modules are also discussed.

16.2 RATING PV PERFORMANCE

A variety of performance indicators have been employed by the photovoltaic community to rate the performance of PV cells and modules [1–4]. Domestic and international consensus standards have been adopted to rate the performance of PV cells and modules in terms of the output power, or equivalently their efficiency with respect to SRC defined by temperature, spectral irradiance, and total irradiance [5–15]. Modules and systems are rated by their peak power under SRC because manufacturers sell and customers purchase PV modules and systems according to the price per watt of power produced. Other performance indicators may be more appropriate for niche markets, such as aesthetics

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