A DETAILED PROCEDURE FOR PARAMETER EXTRACTION OF THE ONE-DIODE SOLAR CELL MODEL

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Many models for solar cells operation were developed on the basis of the Shockley theory of the illuminated p-n junction [1]. As a result, the equivalent circuit of the solar cell can be described at different levels of approximation. The one-diode model defines the most common approximation of the current-voltage (I-V) characteristics of a solar cell operating in standard test conditions (STC) (Fig. 1). STC specifies the global irradiance incident normal on the surface of a PV module at $G_{STC} = 1000\,\mathrm{W/m^2}$ with a spectral distribution *AM1.5G* and cell temperature $T_{STC} = 25°C$. The equivalent circuit captures the physical process that governs the operation of a solar cell. The photocurrent (I_L) is modeled by a current source mainly depending on solar irradiance. The diode models the dark current losses (D). Current loss caused by increased junction conductivity at cell edges is modeled by the shunt resistance (R_P). The series resistance (R_S) captures the resistive loses in the cell such as the contact resistances and neutral regions resistances.

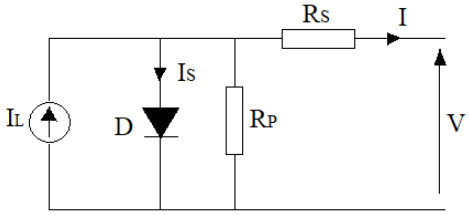

Fig. 1. One-diode model of a solar cell: the electrical circuit.

The most popular equation developed in the frame of one-diode model is the five-parameter equation:

$$I(V) = I_L - I_S\left[\exp\left(\frac{e(V+IR_S)}{mk_BT}\right) - 1\right] - \frac{V+IR_S}{R_P} \tag{1}$$

where e is the elementary charge and k_B is the Boltzmann constant.

The I-V characteristics of a PV module consist of a superposition of the I-V characteristics of its constituent solar cells. A PV module is usually delivered by manufacturer with a datasheet which emphasizes three notable points on the I-V characteristic: the short-circuit current, the open-circuit voltage and the maximum power point (MPP). These points are measured at STC.

In this paper a detailed procedure [2] for parameters extraction is presented and assessed from the perspective of performance in modeling the I-V characteristics. The procedure uses only the information provided in datasheets, i.e the three notable points of the I-V characteristic. For this, the numerical results are compared with measured data. The samples were prepared at ISC Konstanz and characterized at the PV Laboratory of the West University of Timisoara.

[1] S. Lineykin, M. Averbukh, A. Kuperman, An improved approach to extract the single-diode equivalent circuit parameters of a photovoltaic cell/panel, Renew Sustain Energy Rev **30**, 282-289 (2014).

[2] A. Sabadus, V. Mihailetchi, M. Paulescu, Parameter extraction for the one-diode model of a solar cell, American Institute of Physics Proceedings Series, article number: 040005 (2017).