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Network photovoltaic system

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ABSTRACT

The aim of this paper is to present an on-grid photovoltaic system of power of 1 kWp, which is used for training students of specialty "Renewable energy systems" in University of Chemical Technology and Metallurgy - Sofia following the M.Sc. course "Photovoltaic energy systems" and for research related to basic energy performance of the system.

Keywords: *on-grid PV system, network PV system.*

INTRODUCTION

The application of different renewable energy sources (RES) combined with rational energy use is considered the best solution of the problems related to energy supply security, environmental protection and sustainable economic development of the EU. According to the Photovoltaic Geographical Information System (PVGIS) the climatic conditions of Bulgaria favor electricity production from the sun [1].

A photovoltaic system of a peak power 1 kWp is connected to University of Chemical Technology and Metallurgy (UCTM) electricity grid in the middle of September 2015.

The PV installation (Fig. 1) is in built by 4 pieces of polycrystalline solar panels Ecoplus of Innotech Solar (manufactured in Sweden, warranty 12 years [2]) of:

– a peak power of 240 Wp, tolerance of 0 - 10 W;

– a voltage Umpp of 30.2 V, Uoc: 37.1 V;

– a current Impp of 8.11 A, Isc: 8.66 A;

– an efficiency of 14.6 - 15.2 %.

The network connection is performed using the inverter SMA Sunny Boy 1.5 kW of SMA Solar Technology, Germany providing a 5 years warranty [3].

The SMA inverter is especially developed for small photovoltaic systems. It is a transformerless PV inverter which converts the direct current of the PV array to grid alternating current and feeds it into the utility network. It is characterized by a wide range of input voltage (80 V to 600 V). Furthermore it allows, through an intuitive user web-based interface, local monitoring via its own wireless network or online monitoring over the Internet.

ACCOUNTING OF THE SYSTEM ENERGY PERFORMANCE

In practice the inverter user interface of SMA Sunny Boy provides opportunity to monitor the

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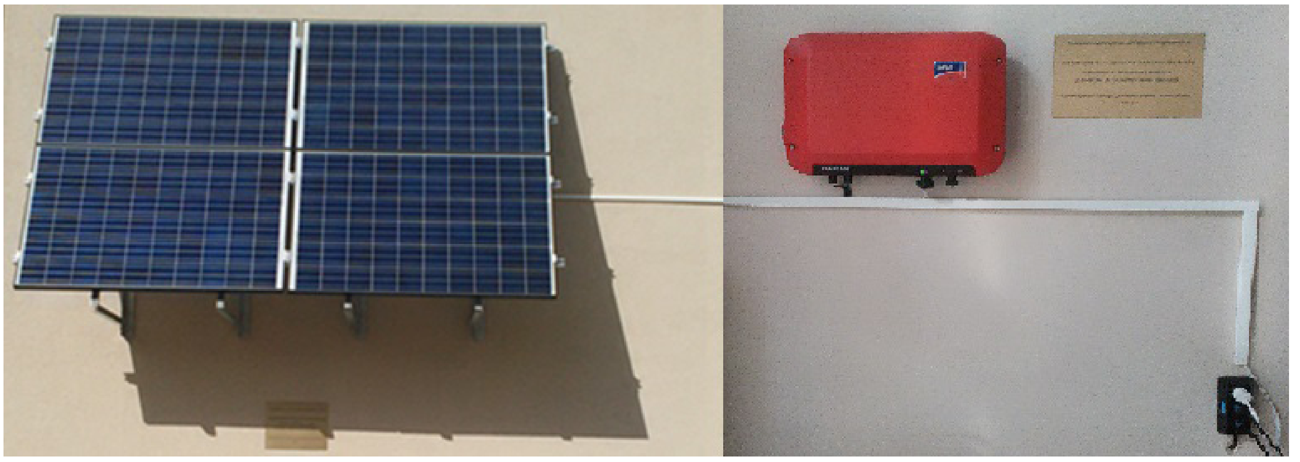

Fig. 1. A view of the network photovoltaic system (1 kWp), panels and an inverter.

system data to any computer, tablet, PC or a smartphone. There are two methods of connection:

– a direct connection via WLAN - wireless communication;

– a direct connection via Ethernet - wired communication.

The easiest way is by connecting to the built-in Wi-Fi network through a password set by the operator (in the initial configuration).

The initial display (Home), which is shown in the status of the inverter (Ok), the instantaneous power (Current power) and the performance of the power system (Yeld), as shown in Fig. 2,

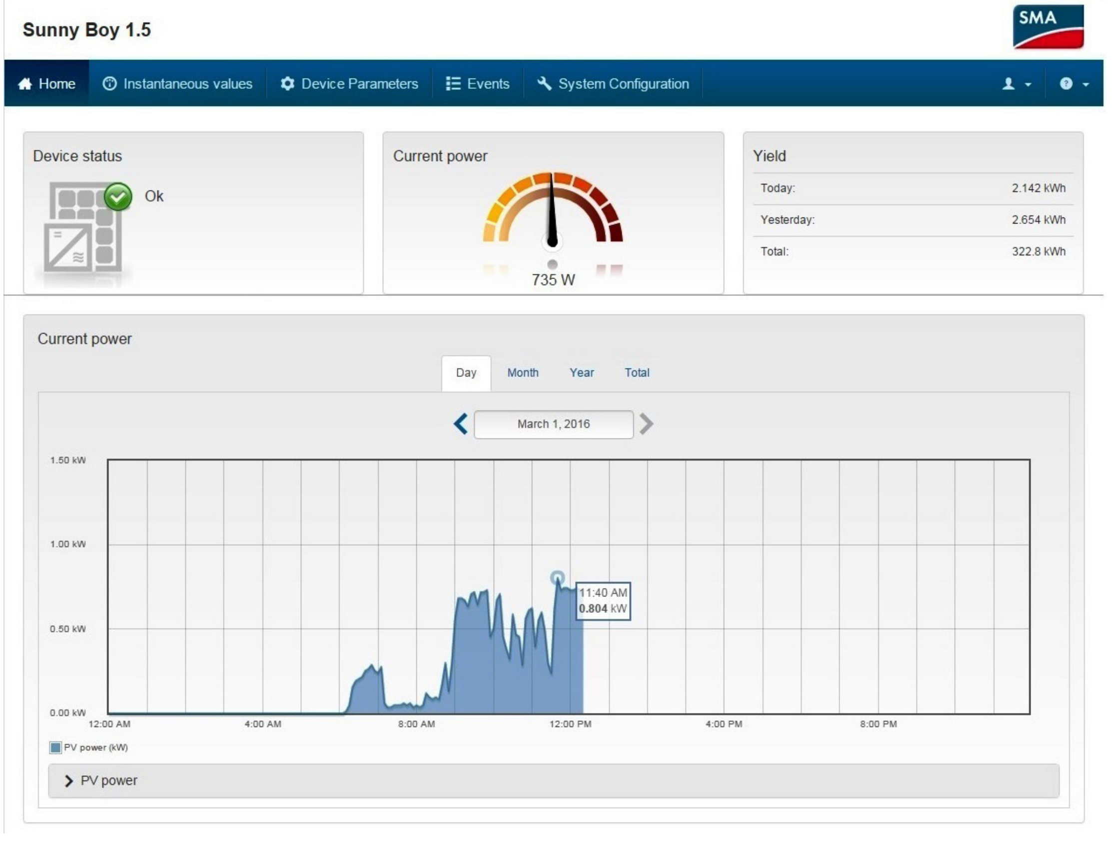

Fig. 2. The inverter start display (Home).

appear on connecting.

The bottom of the same screen shows the system performance (PV power) in hours for the current day (Day). The values of hours and the corresponding current produced are seen when the mouse is positioned at a specific location (for example max or another point). This position can refer to a number of days ago within a month.

The yields of days per a month (Month), of months per a year (Year) as well as the total one per years (Total) can be seen when selected. This is illustrated in Fig. 3 below.

In addition, the value of the yield by a day, a month or a year can be accurately read by positioning the pointer at a given column.

Case of need in statistical processing, this requires repeating the positioning of each moment. Thus makes a report on the PV yield of the system.

An additional menu (Instantaneous values) from the menu bar is selected to account for the values of the current, voltage, power and frequency. The available options for monitoring in this case are shown in Fig. 4.

Fig. 3. Displays of PV yield monitoring by days, months and years.

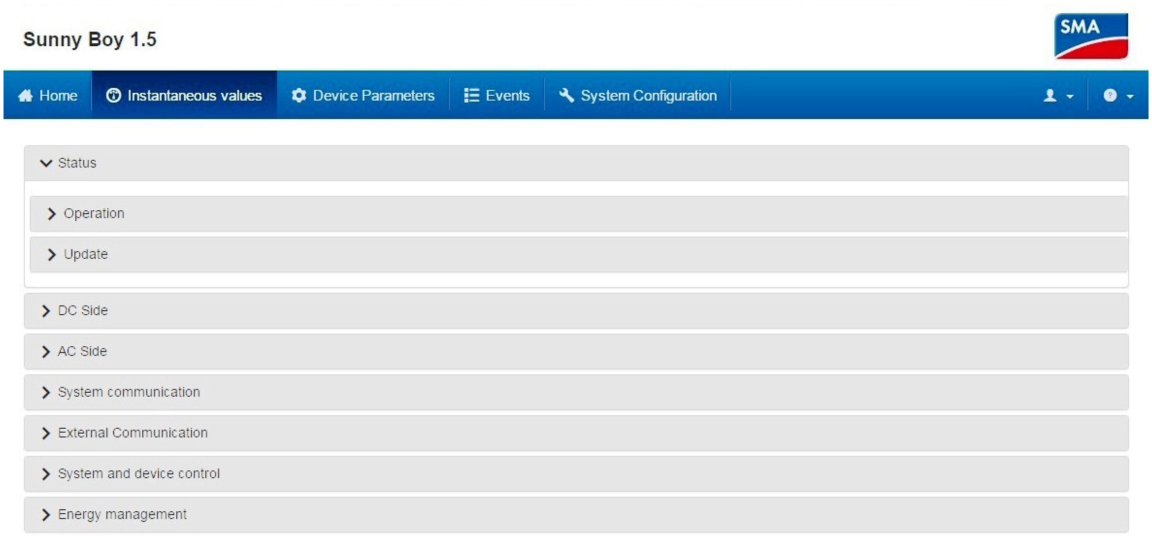

Fig. 4. Display of instantaneous values monitoring.

The main elements here are DC Side and AC Side. The submenus DC-measurement and Grid (Network)-measurements show the value of power, voltage, current on DC side or power and frequency on Grid side (Fig. 5).

Fig. 6 shows a summary display that includes current, voltage and power per phases (three-phase inverter). The data displayed are actually reported.

The 1 kWp PV system described is positioned on the southern wall of UCTM Library building. The expected average month and annual yields refer to 78.9 kWh and 947 kWh, correspondingly.

As the PV system is still in its initial stage of operation, the data obtained is not sufficient to analyze and evaluate its performance and effectiveness. Therefore the statistics information provided by the Photovoltaic Geographical Information System in connection with evaluation of EU solar radiation and efficiency of photovoltaic technology [4] has to be used for a comparison.

CONCLUSIONS

An on-grid photovoltaic system of lower power (1 kWp) connected to the network of

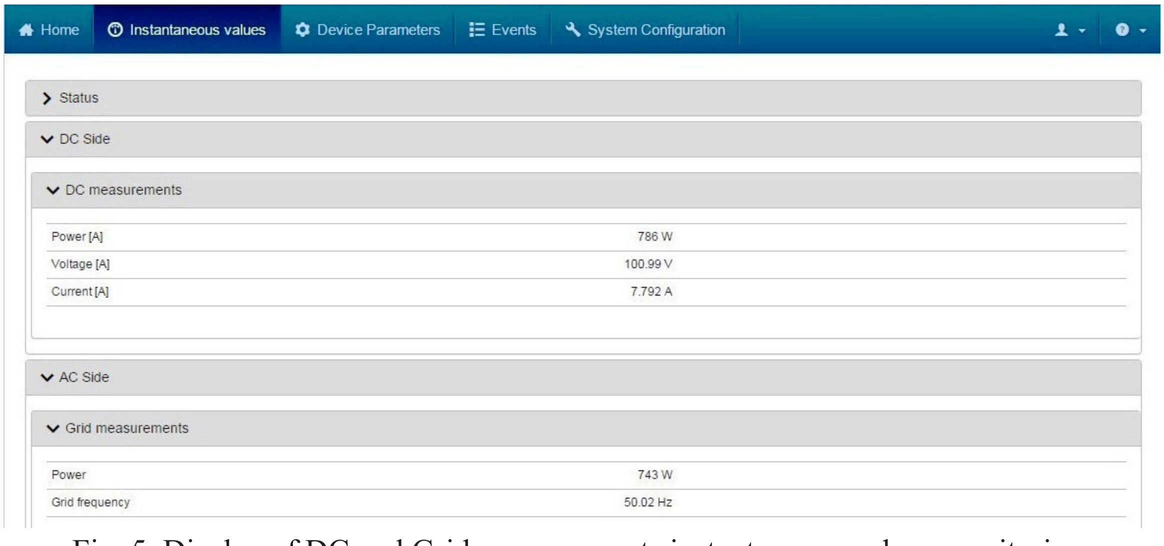

Fig. 5. Display of DC and Grid measurements instantaneous values monitoring.

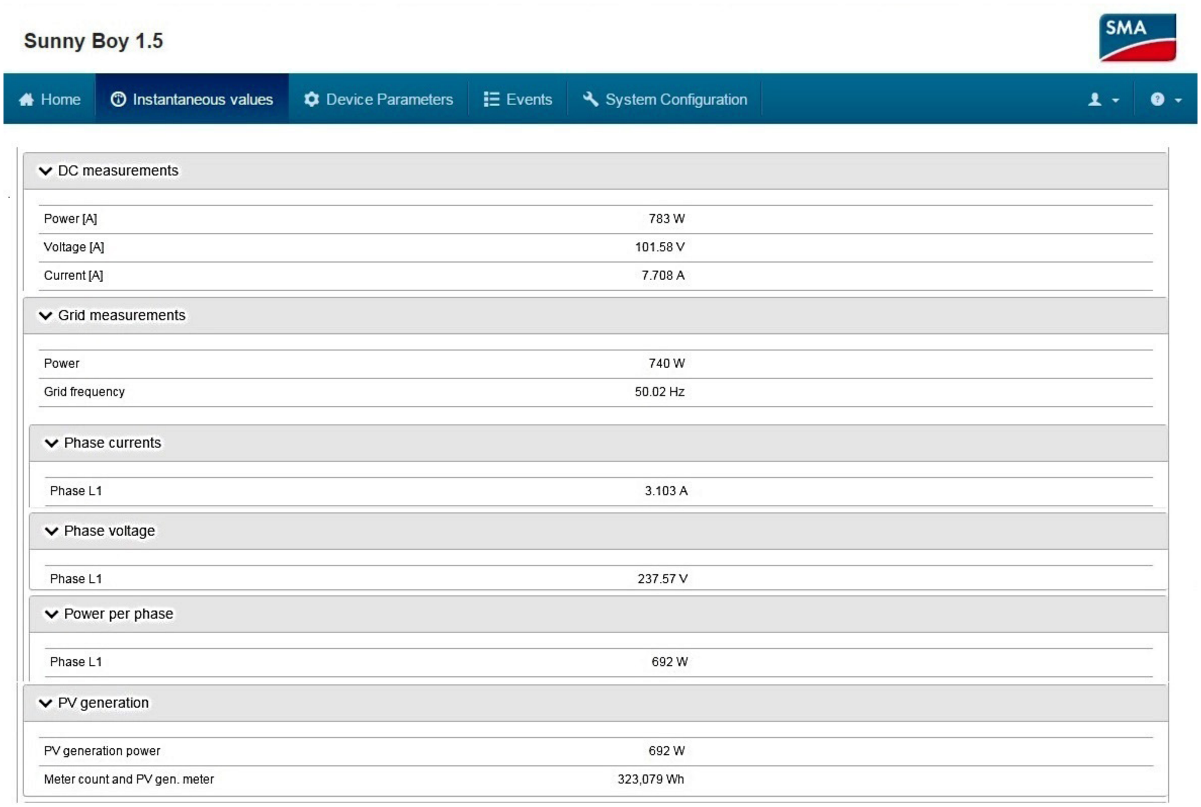

Fig. 6. Summary display of instantaneous values monitoring.

UCTM is presented.

Displays referring to the energy performance of the system - current, voltage, power prior to (DC side) and following the inverter (AC side) are shown in details.

An assessment of the performance and efficiency of the system and an economic analysis of the investments expedience will be carried out later when the data required will be accumulated.

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