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MONITORING OF THE SOLAR PHOTOVOLTAIC ENERGY

This paper presents the adopted solutions of registration the basic solar energy parameters for the Resita, 'Eftimie Murgu' University location, respectively around the parallel 45^0 north latitudinal. This information is necessary to realize photovoltaic installation in Romania. The monitoring system ensures a real time (on-line) registration of the incident solar radiation, the module temperature, ambient temperature as well as electrical parameters: voltage, current, obtained power for a longer period (couple of years). This information allows then a correct estimation of the energy that can be obtained with this kind of installation.

1. Introduction

The stand that monitories the solar photovoltaic energy represents an ensemble made from: solar module, sensors, data acquisition equipment as well as the adequate programs to registry those parameters in real time (on-line) for a longer period (at less two years) and to count the energy injected in the public grid.

2. Monitoring stand

Figure 1 presents the principle scheme of the stand that monitories the photovoltaic solar energy. This stand is gone to be installed now on the 'Eftimie Murgu' University from Resita. It can be observed that the installation is such called hybrid solution, because the produced energy will be connected and delivered in the public grid.

The stand includes the solar module (1) – photovoltaic generator, fixed on the roof of the university building, because the module is a 'roof integrated' one. To obtain a maximum of energy through the optimal position of the module against the solar radiation, the module is orientated to the south. To realize a better energy conversion, caused of the solar module position, it will be possible in future, to place the module on an adjustable support, so that the inclination angle should be able to be modified from zero degrees to nineteen degrees. Also it could be created one more sophisticate system that follows the sun on his way on the sky, in this case, a maximum efficiently conversion of the solar generator would be ensured.

This construction would allow establishing an optimum inclination angle as well for the warm period as for could period during on year. That are the principal reasons that would justify the opportunity of an adjustable setting.

Sensor number (2) measures the density of the incident solar radiation (W/m^2) and the sensors (3) measure the solar module temperature and the ambient temperature. Through the points (4) and (4') the electrical current is measured before and after the inverter using current transformers. All this measured values are taken to a measuring PC board (5) – data logging unit, connected to a computer via his serial port. All this registrations are hold up in a data base, created in MySQL, which can be any time called up from a dedicated internet page, with a graphical evolution of the parameters during on day or, a comparison through different days or parameters.

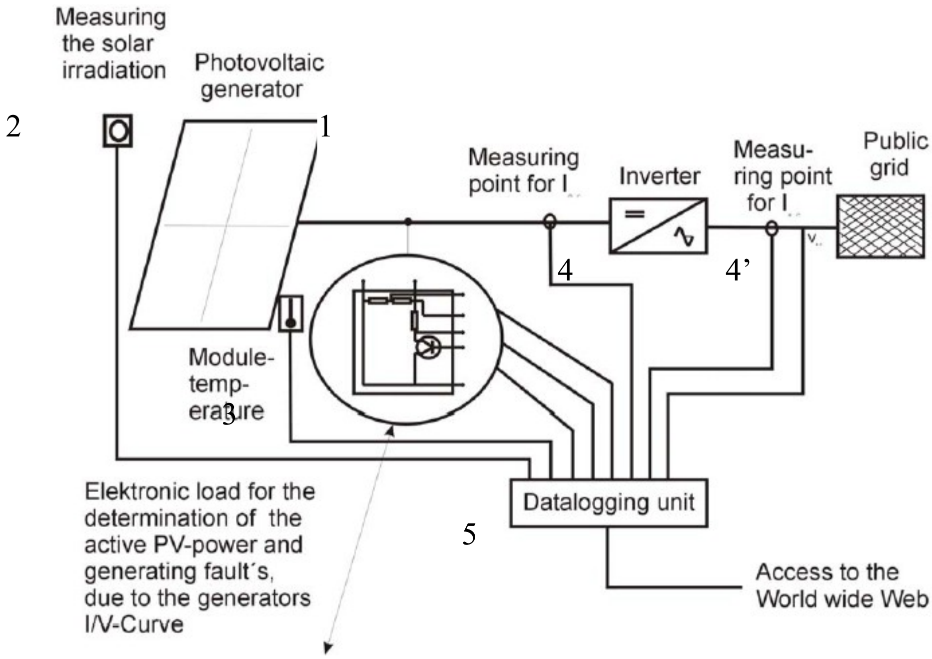

Figure 1. Principle scheme of the stand that monitories the photovoltaic solar energy

A problem that generates interest is given by the determination of the active power generated by the solar module and delivered to the public grid; also, to emphasis some wrong functionalities of the entire system. To determine the active power, the proposed solution is to use an electronically load, figure 1, with which help the voltage current characteristic of the solar module, figure 2, is gone to be graphically build and offer the possibility to analyze different conditions during the functioning period.

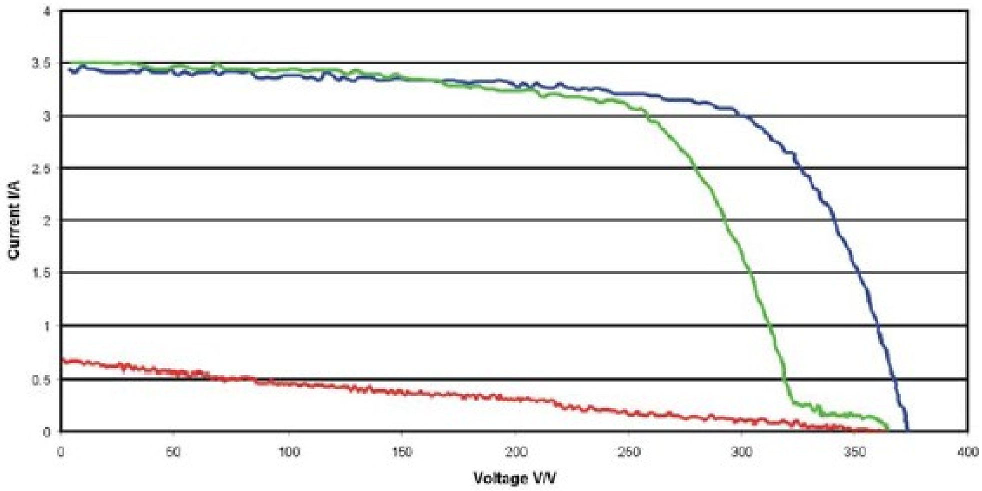

Figure 2. I/V curves for different for different operating conditions

The inverter transforms the DC current supplied by the solar module in AC current that's gone be injected in the public grid. The used inverter is an analog type that functions with very high efficiency, even by low power, so that the year efficiency that has to be determinate based on measuring will reach or even exceed 90%. The inverter has to ensure the quality parameters of the given voltage, correlated with the standardized demands, which make the connection to the public grid possible.

Figure 3 presents a detailed scheme of the monitoring stand where the connection mode can be observed as follow: on the DC side a special, double isolated cable, protected to eventual grounding or short-circuited is used. Then a principal bipolar contactor follows through witch the load can be disconnected from the generator (solar module). The present of the contactor is very important because the contacts, wires and terminals are under voltage as long as the sun shines or light is outside. This principal contactor has to be also far-seed with an integrated protection to high voltage.

Table 1 presents the principal components and their parameters that are used in the experimental installation.

Table 1 the components of the photovoltaic stand

Nb.	Name	Typ	Technical parameter	Company
1.	Solar module	300	P_n=300Wp	Schuco International KG Germany
2.	Inverter with connection cable	DMI 350/50	To P=459Wp	Solar-Wind-Technick
3.	Solar radiation sensor	Si 10-TC	Radiation in [W/m^2]	Menge&Tegmeyer
4.	Current transformer	HX-05-P	10A / 100V	LEM Verkauf At&CEE
5.	Temperature sensor	Termoresistence PT 100	-30^0 / +100^0	Conex
6.	Acquisition Board	Labjack U12	8 inputs/ outputs analogical	Epi Sistem SRL
7.	Energy counter	EM 600 Expert	To 3.6kW	Solar-Wind-Technick
8.	Connection cable	DC H07RN-F, 1m, 2.5mm AC H07RN-F, 1m, 4*1, .5mm	220V / 20A	Solar-Wind-Technick
9.	Measuring laboratory	Multi E/A WR		Solar-Wind-Technick
10.	DC contactor		Protection to high voltage	Electroaparatj
11.	DC voltage Source	Electronic	± 15V	Solar-Wind-Technick

All the signals are brought from the sensors to the acquisition board, namely from the solar module (radiation, temperature), from the electrical load (current, voltage), from the inverter and the energy counter. This signals represent parameters that are gone to be processed with a special adequate program that runs on the PC and that keeps the dates in a data bank (MySQL) with a sample period (time interval) that can be adjust based on the users needs. The soft includes a graphical user interface that can be placed and accessed from the World Wide Web.

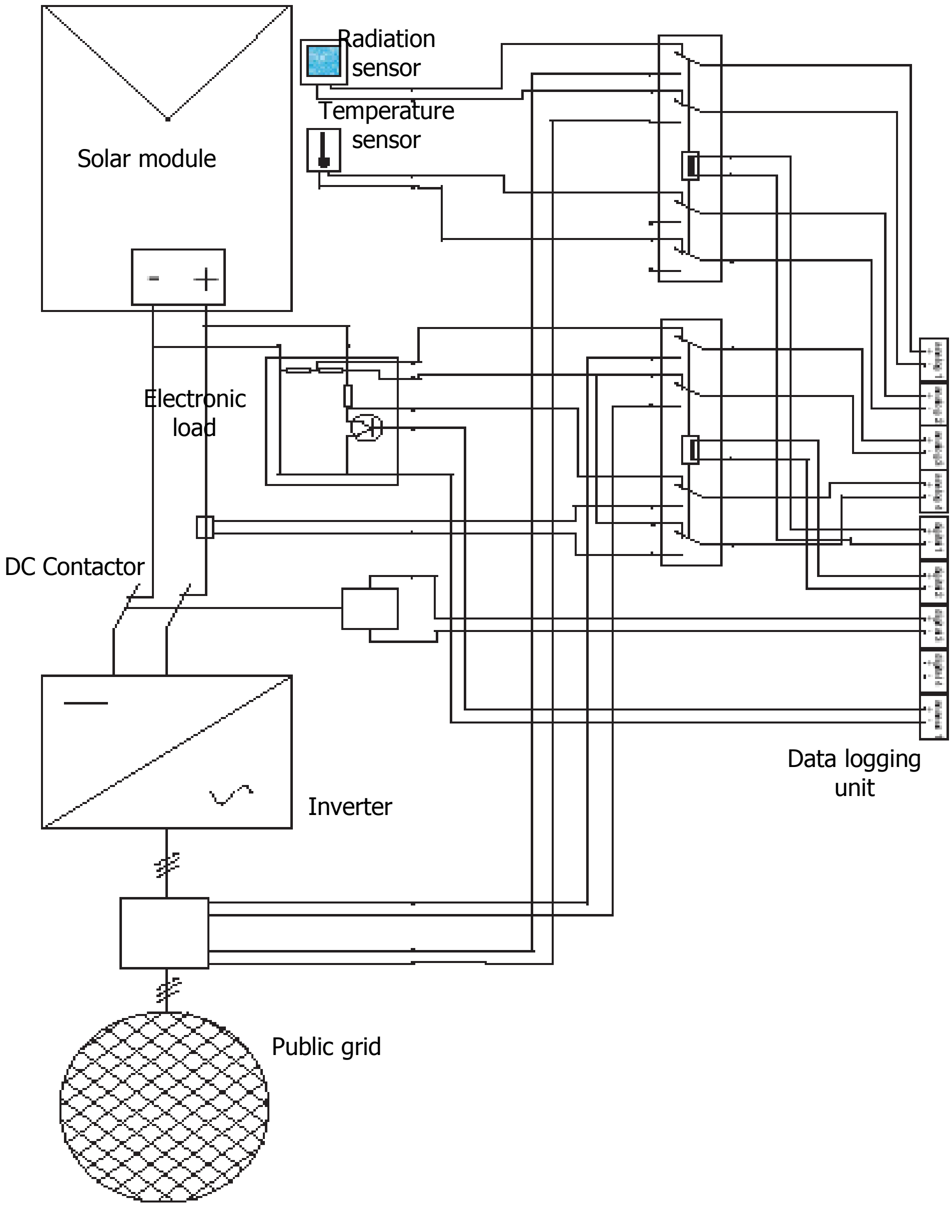

Figure 3. Detailed scheme of the monitoring stand with the connection mode

3. Conclusions

The solar photovoltaic monitoring system represents a first necessary step in knowing the energetically solar potential that can be used through the photovoltaic proceed, around the parallel 45^0 north latitude, namely for the Banat zone, respectively for south Romania and, with an appreciatively extension, for the entire country. The experimental obtained parameter form a scientifically base that can be used in fundamental projecting and creation of solar photovoltaic installations at one hand and otherwise it generates a great impact trough the public in promoting this kind of regenerable energy with a forecast of highest increasing. The study can get thoroughly using other types of solar module, with different performances namely different conversion efficiency. These studies can show the way to the first electrical power plants of this type, because our country benefits of optimal conditions.

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