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EVEN MAGNETIC PHOTOEFFECT AND ITS APPLICATION FOR MEASURING THE ELECTROPHYSICAL PARAMETERS OF SEMICONDUCTORS

The phenomenon of decreasing the photocurrent of different semiconductor structures under the influence of a magnetic field is considered. This effect is called the "Even magnetic photo effect". The wide possibilities of applying this effect in the development of new and nondestructive methods for measuring the electrophysical parameters of semiconductors are shown.

Keywords: semiconductor, photocurrent, magnetic field, measurement, parameters.

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ANALYZING THE PARAMETERS OF SOLAR ENERGY DEVICES FOR AUTOMATED CONTROL

To develop automated control systems, it is necessary to investigate the parameters of solar power equipment. The parameters of energy systems to be used in automated control systems are analyzed.

Keywords: solar energy, monitoring system, solar devices, parameters.

Introduction. Investment in solar energy is rapidly increasing worldwide. Therefore the need arises to have automated control system for solar energy devices. Proposed automated control system will help investors to monitor the system work and do necessary actions (send maintenance team to the solar power plant, etc) in case of some alarms or events. For example based on monitored parameters it can appear that the surface of solar cells are dusty and it is required to clean them, etc.

A solar energy system consists of a solar generator that produces electricity from sunlight, battery and power inverters for energy extraction and grid interface control (Fig. 1).

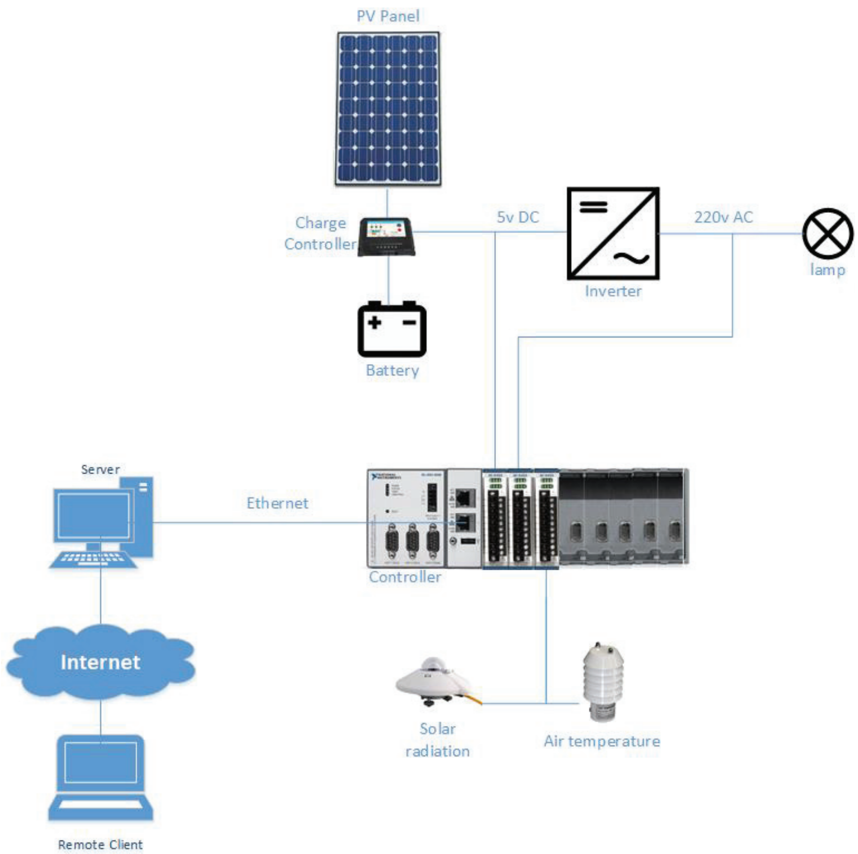

Fig. 1

The smallest unit of a PV generator is a solar cell and a large PV generator built by many solar cells that are connected together through certain series and parallel connections [1].

Experimental setup and discussion. Unlike the traditional power generation, the operation of a solar PV system depends on the geographic coordination of the electrical system and PV cells under certain weather conditions. In order to find an optimal geographic coordination and weather conditions for a given region, it is important to study how the electrical characteristics of the power inverter and solar cells change under various coordination and weather conditions. To do this, it is required to have automated control and monitoring system. In order to build an automated control and monitoring system for solar energy systems, it is important to investigate and analyze the electrical characteristics of the power inverter and solar cells [2].

Traditionally, the solar cell and power inverter parameters are usually inspected in separate environments at the solar generator and grid integration levels, respectively [3].

For automated control and remote monitoring of the solar energy systems we will divide the measured parameters into two groups:

- the electrical parameters of solar cell (Direct Current (DC) part)
- the electrical parameters of power inverters (Alternating Current (AC) part)

To have the mentioned parameters in the remote monitoring system, it is necessary to investigate and understand how to measure or calculate the parameters one by one.

For the DC part:

1. Output DC voltage

This is the output voltage of the solar panel. For measuring, it is required to have an analog-to-digital converter (meter) for the DC voltage;

2. Output DC current

This is the output current of the solar panel. For measuring, it is necessary to have an analog-to-digital converter (meter) for the DC current;

3. Power

This is the output power of the solar panel. The power can be calculated according to this equation:

$$P = V \, x \, I$$

where P is the output power, V – the output voltage (V), I – the output current (A)

4. Efficiency

The solar panel efficiency is the ratio of the electrical output of a solar cell to the incident energy in the form of sunlight. The energy conversion efficiency (η) of a solar panel is the percentage of the solar energy to which the cell is exposed that is converted into electrical energy. This is calculated by dividing a cell's power output (in watts) at its power (P) by the input light (E, in W/m^2) and the surface area of the solar panel (A in m^2):

$$\eta = \frac{P}{E \times A}$$

For the AC part:

1. Output signal waveform

This is the output voltage and current signal waveforms for a DC to AC inverter. To measure this, it is necessary to have high speed (for example up to 10,000 Samples per second) voltage and current devices.

2. Output AC voltage

This is the output voltage of an inverter. For measuring it, we need to have an analog to digital converter for the AC voltage.

3. Output AC current

This is the output voltage of an inverter. For measuring it, we need to have an analog to digital converter for the DC current.

4. Frequency

This is the frequency of the output voltage of the inverter. This parameter can be calculated looking at all zero crossings in the visible region of the waveform signal. It is necessary to calculate the average distance between the zero crossings (rising and falling) to obtain the average semi-period of the signal. Then, to multiply this number by two (average period) and invert to obtain the frequency of the signal.

5. Power (Active, Reactive, Apparent and Power factor)

This is the output power of the inverter. The power of AC circuits can be active and reactive depending on the load resistance. So it is necessary to calculate the active and reactive power separately and the apparent power as well. The active, reactive and apparent powers can be calculated according to this equation:

$$P = V_{rms} I_{rms} \cos\varphi, Q = V_{rms} I_{rms} \sin\varphi, S = \sqrt{P^2 + Q^2}$$

where P is the active power (W), V_{rms} – the Root mean square (RMS) value of voltage (V), I_{rms} – the Root mean square (RMS) value of current (A), φ - the phase angle between the current and the voltage, Q – the reactive power (var), S – the apparent power (VA).

The ratio between the active power (P) and apparent power (S) in a circuit is called the power factor.

$$PF = \frac{P}{S} = \cos\varphi$$

6. Output Energy

This is the output energy of the inverter. For calculating the energy it is required to use the following equation:

$$E = P \times t$$

where E is the energy, P – the generated power per unit time, t - the time.

7. Voltage harmonics

Harmonic voltages in an electric power system are a result of non-linear electric loads. Harmonic frequencies in the power grid are a frequent cause of power quality problems. Harmonics in power systems result in increased heating in the equipment and conductors, misfiring in variable speed drives, and torque pulsations in motors. Reduction of harmonics is considered desirable [4].

8. Total Harmonic Distortion (THD)

The THD is an important indicator used to express the total amount of harmonic components. It is defined as:

$$THD = \frac{\sqrt{\sum_{h=2}^{H} u_h^2}}{u_1} \times 100\%$$

where u_i is the voltage amplitude of i-th harmonic, H – the number of calculated harmonics [4].

9. Voltage Events (Dips/Swells/Interruptions)

A voltage dip is a decrease in the RMS voltage below the nominal voltage or a sliding reference voltage. The decrease lasts from half a cycle to several seconds. A voltage swell is an increase in the RMS voltage above the nominal voltage or a sliding reference voltage. The increase lasts from half a cycle to several seconds. A voltage interruption is a large decrease in the RMS voltage to less than a small percentile of the nominal voltage, or a complete loss of voltage [5].

10. Load impedance

Impedance is represented as a complex quantity Z. The polar form conveniently captures both magnitude and phase parameters.

$$Z = R + iX$$

where the real part of impedance is the resistance R and the imaginary part is the reactance X [6].

11. Inverter efficiency

The efficiency shows what percentage of the power that goes into the inverter comes out as usable AC current. For calculating, it is necessary to use the following equation:

$$\eta_{inv} = \frac{S_{out}}{S_{in}} \times 100\%$$

where S_{out} is the output power of the inverter, S_{in} – the input power of the inverter.

Results. According to the analysis and discussion above, the important parameters for monitoring and controling the solar energy systems are:

For the DC part, we will investigate and measure the following parameters:

1. Output DC voltage
2. Output DC current

3. Power
4. Efficiency

According to the analysis of the [4,5,6,7,8] references for the AC part we will investigate and measure the following parameters:

1. Output signal waveform
2. Output AC voltage
3. Output AC current
4. Frequency
5. Power (Active, Reactive, Apparent and Power factor)
6. Output Energy
7. Voltage harmonics
8. Total Harmonic Distortion (THD)
9. Voltage Events (Dips/Swells/Interruptions)
10. Load impedance
11. Inverter Efficiency

In addition to this it is important to measure the weather condition parameters:

1. solar radiation,
2. temperature.

During research, it has been found that for developing an automated control and remote monitoring system it is preferable to use hardware and software provided by National Instruments (NI) because of the following advantages:

1. Hardware advantages

a. Easy to use
b. Can be used in worst conditions (industrial area)
c. Measuring signals based on international standards
d. The ability to measure up to 50,000 Samples per second

2. Software advantages

a. Designed especially for energy systems
b. Ability to add additional toolkits and packages which are designed especially for energy measurements and calculation based on international standards
c. Can be used to develop large systems in short time

Conclusion. Thus, to realize the automated control and remote monitoring it's important to measure the following parameters:

1. Output DC voltage
2. Output DC current
3. Power
4. Efficiency
5. Output signal waveform

6. Output AC voltage
7. Output AC current
8. Frequency
9. Power (Active, Reactive, Apparent and Power factor)
10. Output Energy
11. Voltage harmonics
12. Total Harmonic Distortion (THD)
13. Voltage Events (Dips/Swells/Interruptions)
14. Load impedance
15. Inverter Efficiency
16. Solar radiation
17. Temperature

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Տ.Ա. ՀԱՄԲԱՐՁՈՒՄՅԱՆ

ԱՐԵՎԱՅԻՆ ԷՆԵՐԳԵՏԻԿ ՍԱՐՔԱՎՈՐՈՒՄՆԵՐԻ ՊԱՐԱՄԵՏՐԵՐԻ ԱՎՏՈՄԱՏԱՑՎԱԾ ՂԵԿԱՎԱՐՄԱՆ ՎԵՐԼՈՒԾՈՒԹՅՈՒՆ

Արևային էներգետիկ սարքավորումների ավտոմատացված ղեկավարման համար անհրաժեշտ է ուսումնասիրել արևային էներգետիկ սարքավորումների պարամետրերը: Վերլուծվել են արևային էներգետիկ սարքավորումների պարամետրերը, որոնք կօգտագործվեն ավտոմատացված ղեկավարման համակարգում:

Առանցքային բառեր. արևային էներգիա, մոնիթորինգային համակարգ, արևային սարքավորումներ, բնութագրիչ պարամետրեր:

Т.А. АМБАРЦУМЯН

АНАЛИЗ ПАРАМЕТРОВ СОЛНЕЧНЫХ ЭНЕРГЕТИЧЕСКИХ УСТРОЙСТВ ДЛЯ АВТОМАТИЗИРОВАННОГО КОНТРОЛЯ

Для разработки автоматизированных систем управления необходимо исследовать параметры солнечного энергетического оборудования. Анализируются параметры энергетических систем, которые будут использоваться в автоматизированной системе управления.

Ключевые слова: солнечная энергия, система мониторинга, солнечные устройства, характеристические параметры.

ՀՏԴ 621.382, 621.383

Ա.Լ. ՀՈՎՀԱՆՆԻՍՅԱՆ

ԷԼԵԿՏՐԱԼՅՈՒՄԻՆԵՍՑԵՆՑԻԱՅԻ ՄԵԹՈԴՈՎ ԱՐԵՎԱՅԻՆ ՄԱՐՏԿՈՑՆԵՐԻ ԱՐԱՏՆԵՐԻ ՈՐՈՇՄԱՆ ՉԱՓԻՉ ՀԱՄԱԿԱՐԳԻ ՄՇԱԿՈՒՄԸ

Մշակվել է էլեկտրալյումինեսցենցիայի մեթոդով արևային մարտկոցների արատների որոշման համակարգ, և կատարվել են համապատասխան փորձարկումներ:

Առանցքային բառեր. էլեկտրալյումինեսցենցիա, արևային մարտկոցներ, չափումներ, չափիչ համակարգ, ինֆրակարմիր տեսախցիկ:

Ներածություն: Ֆոտոէլեկտրական կերպափոխիչները փոխակերպում են տեսանելի ճառագայթային էներգիան էլեկտրական էներգիայի: Այսինքն, ֆոտոէլեկտրական կերպափոխիչները, այդ թվում՝ արևային մարտկոցները, օգտագործվում են որպես այլընտրանքային էներգիայի աղբյուր, ինչը շատ կարևոր է ներկայիս պայմաններում, երբ մարդկությունը կանգնել է էներգետիկ ճգնաժամի առաջ: