

**INFLUENCE OF TEMPERATURE EFFECTS ON THE
EFFECTIVENESS OF SOLAR PANELS**

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Abstract: *The work investigated the influence of temperature effects on the efficiency of solar panels. The processes of heating solar cells at different levels of solar radiation (800-2000 W/m²) were considered, and the change in output power depending on the temperature was analyzed. It has been established that with increasing temperature, the efficiency coefficient decreases and the output power of the solar panel decreases. It has been experimentally confirmed that the use of a thermal radiator allows for a reduction in the panel's heating temperature and an increase in output power to 1.5-3.7% depending on the solar flux density. The obtained results can be used in the design of cooling systems for photovoltaic installations.*

Keywords: *solar panel, temperature exposure, photovoltaic element, output power, efficiency coefficient, solar radiation, heat flow, thermal resistance, cooling, thermal radiator.*

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Today, the issue of introducing green energy, namely obtaining electrical energy, in particular, the use of solar panels that do not cause much harm to the environment, is becoming increasingly important worldwide.

One of the drawbacks in the application of solar panels is the temperature effect during solar radiation, which negatively affects the efficiency of

electricity generation, resulting in a decrease in the output power of solar panels.

Studies have shown that during the operation of these installations, especially in summer conditions, the temperature effect negatively affects the efficiency of electricity generation.

The ambient temperature at which solar panels operate is an important factor affecting the efficiency, i.e., these installations cannot convert all the energy received and a part of this energy is converted into heat.

All this causes a decrease in the semiconductor band and an increase in saturation current, which leads to a decrease in the output power of solar panels.

Power temperature coefficients change from **-0.3 to -0.4%** to 1°C with increasing temperature. The effect of temperature on the output power value is estimated by the following expression:

$$P_{\{c\}} = P_0(1 + \beta \Delta t),$$

$P_{\{c\}}$ $P_0 \beta \Delta t$ where - solar panel power.

- power at temperature 25°C .
- power temperature coefficient.
- temperature change.

$\beta = -0,4\%/^{\circ}\text{C}$ For single-crystal silicon solar panels, and in this case, the output power is reduced by **0.4%**.

Since the current strength increases significantly less than the voltage decreases, a decrease in power occurs at higher temperatures.

Three factors that lead to heat loss: **heat conductivity, convection, and radiation.**

Δt , Thermal conductivity arises due to the temperature difference between the solar cell and other bodies and environments, including the air surrounding the solar panel, and its ability to transfer heat to its surroundings is characterized by thermal resistance. The driving force in heat transfer with

different thermal resistances is the temperature difference °C between two materials, i.e.:

$$\Delta t = k_t \cdot P_{\{H\}},$$

where P_n is the heat flow created by the solar cell. Thermal resistance depends on the material's thickness and its resistivity. In addition, the area of the heat-conducting surface is calculated, as well as the thickness of the material layer through which the heat passes.

With the help of radiation, the solar panel releases heat to the environment. Its operating temperature is the result of the equilibrium between the heat received and the heat given to the environment. It is also necessary to take the radiation capacity of the material surface, which varies from 0.3 to 0.95 depending on the temperature of the solar panel and the surrounding environment.

Reducing solar panel power due to surface heating is a pressing issue. With increasing temperature, a decrease in stress occurs.

Based on the obtained results, it can be said that increasing the temperature of the solar panel under the influence of solar radiation leads to a decrease in energy conversion efficiency. The maximum temperature value was 66°C, while the solar panel temperature increased by 36°C, resulting in a 7.5% (9.2% of the initial value) decrease in power. On average, with an increase in temperature by 1°C, the maximum output power decreases by 0.25% and leads to a decrease in energy conversion efficiency.

The maximum value of the solar cell temperature for the 800 W/m² flow was 53°C. The output power at the stabilization temperature reached 51.8 mW, which is 3.4 mW (6.1%) less than at the initial temperature.

For a flow of 1400 W/m², the maximum temperature value was 66°C. The output power at the stabilization temperature reached 72.6 mW, which is 7.3 mW (9.13%) less than at the initial temperature.

For a 2000 W/m² flow, the maximum temperature value was 78°C. The output power at stabilization reached 99.3 mW, which is 16.8 mW (14.7%) less than at the initial temperature.

As a result of the research, it was obtained that with an increase in the flow from 800 to 2000 W/m², the heating temperature of the solar panel increases and, as a result, the output power decreases from 14.7 to 6%.

In this regard, to increase the output power of the solar panel, it is proposed to reduce the thermal radiator, which allows for the dissipation of accumulated temperature from the back of the solar panel.

This thermal radiator is made in the form of a 10×10 cm plate, 2.5 mm thick, flat on one side, which is attached to the solar panel, and on the other side - it has a riffled surface with notches or wavy lines, coated with black paint with a radiation coefficient equal to 0.95.

At a flow of 800 W/m², the stabilization temperature decreased by 5°C and amounted to 48°C instead of 53°C. The average value of the power decrease by 1°C practically did not change and amounted to 0.12 mW, but due to the lower maximum heating temperature, the output power increased by 1.2 mW, i.e., by 2.3%.

At a flow of 1400 W/m², the stabilization temperature decreased by 8.1°C and amounted to 58°C. The maximum power increased by 2.8 mW (3.7%).

At a flow of 2000 W/m², the stabilization temperature decreased by 7.1°C and amounted to 71°C. The maximum power increased by 4.9 mW (4.7%).

As a result, the maximum heating temperature with the radiator was 63°C, while the solar panel without the radiator was heated to 66°C.

The minimum voltage with the emitter was 10.3 V, which is 0.14 V higher than that of the sample without heat dissipation.

The maximum heating temperature of the sample with a radiator is 63°C, which is 3°C lower than that of a solar panel without a radiator.

The output power at the maximum temperature was 73.6 mW, which is 1 mW more.

On average, with an increase in temperature by 1°C, the output power decreased by 0.15 mW, i.e., by 2.4%, which is 0.4% less than without a radiator.

Thus, by installing the radiator on a solar panel, it is possible to increase the output power at the maximum heating temperature by 1.5% compared to a solar panel without a radiator with a solar radiation flux of 1400 W/m².

LIST OF REFERENCES

1. Afanasyev V. P., Terukov E. I., Shcherchenkov A. A. Thin-film solar cells based on silicon. SPb.: SPbGETU "LETI" Publishing House, 2011. 168 p.
2. Andreev V. M., Griliches V. A., Rumyantsev V. D. Photoelectric Conversion of Concentrated Solar Radiation. - L.: Nauka, 1989. 308 p.
3. Patel M. R. Wind and solar power systems: design, analysis, and operation. New York, USA: Taylor & Francis, 2006. 448 p.
4. The effect of temperature on the efficiency of solar panels // GWS energy. URL: <http://gws-energy.ru/blog/40-vliyanie-temperatury-na-effektivnost-solnechnyh-batarej> (accessed 4.04.18).
5. Jumaev A. Ya. Analysis of the influence of temperature on the operating mode of a photovoltaic solar station // Technical Sciences - From Theory to Practice: Collection of articles on mother. 46th International Scientific-Practical Conf. Novosibirsk: Sibak, 2015. No 5 (42). P. 33-40.
6. Linxiao Z., Aaswath R., Ken X. Radiative cooling of solar cells // Optical. 2014. Vol. 1. P. 32-38.