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ABSTRACT

PRESENTATION

PAPER

Krzysztof Dziarski is a master of science degree and is an assistant at the Institute of Electrical Power Engineering of the Poznań University of Technology (Politechnika Poznańska) in Poznań, Poland. He is interested in thermography, thermometry in infrared and in image (and thermogram) processing and infrared in electronics and semiconductors.

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THE INDIRECT THERMOGRAPHIC MEASUREMENT OF THE TRANSISTOR DIE TEMPERATURE MADE THROUGH THE VIEWFINDER

The semiconductor devices are used in many fields. They are used to build the electronic systems used, among others, in photovoltaics, the industrial automation and scientific research. They consist of a case and connectors inside it called die. The temperature of the die increases because the movement of the electrons and holes it conducts generates heat. Another cause of the increase in die temperature is the Joule-Lenz effect and quantum effects. Another reason for the increase in die temperature is the imperfect connections between die elements and the defects in the crystal lattice. Additional causes of the increase in die temperature are miniaturization, the increasing power of the density and the reduced efficiency. In the case of the transistors, an increase in die temperature can be recorded when the switching frequency increases. This is caused by the generation of the additional heat due to the movement of the electric charges. As the switching frequency increases, the influence of the inductive and capacitive effects increases. Another phenomenon is the occurrence of the leakage current - an undesirable current flow through the transistor when it should not conduct.

A separate group of methods that enable determining the temperature of a semiconductor element are methods using the detection of infrared radiation. One of them is the thermography. The direct thermographic measurements of the temperature of a semiconductor element have been described in the literature. The indirect thermographic measurement of the temperature of a semiconductor element is also described. It involves performing a thermographic measurement of the temperature of the case and determining the die temperature based on the known difference between the temperature of the case of the semiconductor device and the die temperature. The use of this method makes it possible to determine the temperature of the die transistor during its operation. There is also no risk of electric shock. Performing the indirect thermographic measurement of the temperature of the semiconductor element of a transistor also has disadvantages. Determining the difference in the temperature of the case of the semiconductor element and the die temperature requires knowledge of the structure of the transistor and determining the temperature distribution using simulation work. The conditions prevailing during the thermographic measurement of the temperature of the case of the semiconductor device and the air flow around the case of the semiconductor device should also be taken into account.