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Mutual Influence of Printed Conductive Paths of Circuit Boards Installed on a Metal Base and Operating in the Conditions of Space Vacuum

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Abstract. The purpose of the work described in this article was to analyze the mutual thermal effect of conductive paths (CP) of a printed circuit board mounted on a metal base in a vacuum environment, depending on the distance between the conductors when they are located in different layers of the printed circuit board, as well as to determine the distance at which the mutual effect is negligible. The results of the tasks that were solved to achieve the goal are presented: the calculation of the temperature difference between CP and a metal substrate is performed at a different set distance between the two CP when they are located on different layers; approximation of the calculation results is performed; the distance at which the mutual thermal effect of CP becomes negligible is found. For calculation the numerical method implemented in the CAE system was used. The example of the finite element mesh and the temperature field of the printed circuit board is given. Results of calculation in the form of value of the overheat of conductors are given. The technique used for processing of results of calculations in CAE, considering the temperature coefficient of resistance of material of printing conductors is described. Functions, with numerical values of all coefficients which carried out approximation are given. Examples of the diagrams constructed by results of approximation and the values received in CAE in one coordinate system are given. Comparison of both results is made and the approximation error is given. The error lies within $\pm 3^0$ C that is acceptable for technical calculations. On the functions received at approximation diagrams of dependences of distance between printing conductors at which mutual influence practically disappears, from the equivalent thickness of layers of insulating materials between the printing conductor and the basis are found and constructed. Set of these materials is named the package. Equivalent thickness of the package – the size specified to the uniform heat transfer coefficient. In real payments different materials with different thermal conductivities can be used. The explanation of these dependences is given. The question of application of the received results at design of printed circuit boards is discussed. The example of specific application of the received results in practice is given.

Keywords: conductive path, printed circuit board, metal base, space vacuum, overheat, current intensity
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