

## Determination of Temperature Dependent Characteristic Material Properties of Commercial Thermoelectric Modules

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**Abstract :** Thermoelectric modules are integrated to electronic components to keep their temperature in specific values in electronic cooling applications. They can be used in different ambient temperatures. The cold side temperatures of thermoelectric modules depend on their hot side temperatures, operation currents, and heat loads. Performance curves of thermoelectric modules are given at most two different hot surface temperatures in product catalogs. Characteristic properties are required to select appropriate thermoelectric modules in thermal design phase of projects. Generally, manufacturers do not provide characteristic material property values of thermoelectric modules to customers for confidentiality. Common commercial software applied like ANSYS ICEPAK, FloEFD, etc., include thermoelectric modules in their libraries. Therefore, they can be easily used to predict the effect of thermoelectric usage in thermal design. Some software requires only the performance values in different temperatures. However, others like ICEPAK require three temperature-dependent equations for material properties (Seebeck coefficient ( $\alpha$ ), electrical resistivity ( $\beta$ ), and thermal conductivity ( $\gamma$ )). Since the number and the variety of thermoelectric modules are limited in this software, definitions of characteristic material properties of thermoelectric modules could be required. In this manuscript, the method of derivation of characteristic material properties from the datasheet of thermoelectric modules is presented. Material characteristics were estimated from two different performance curves by experimentally and numerically in this study. Numerical calculations are accomplished in ICEPAK by using a thermoelectric module exists in the ICEPAK library. A new experimental setup was established to perform experimental study. Because of similar results of numerical and experimental studies, it can be said that proposed equations are approved. This approximation can be suggested for the analysis includes different type or brand of TEC modules.

**Keywords :** electrical resistivity, material characteristics, thermal conductivity, thermoelectric coolers, seebeck coefficient

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