# Effect and Analysis of Thermal Cycling on Commercial Thermoelectric Modules

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The large temperature gradients experienced by thermoelectric modules induce significant thermal stresses which eventually lead to device failure. The impact of thermal cycling on a commercial thermoelectric module is investigated through characterization of the electrical properties. In this work, we measure the evolution of the thermoelectric and electrical properties with thermal cycling. One side of the thermoelectric module is cycled between -10°C and 90°C every 20 minutes while the other side is held at ~20°C. The thermoelectric figure of merit, $Z\omega T$, and electrical resistivity are measured after every 1000 cycles by using impedance spectroscopy meter. The measured $Z\omega T$ value is compared using both a modified Harman method and an electrical measurement technique analyzed with an electrical circuit model. In addition, the change in output power and resistivity with cycling are reported. This study provides insight into characterization methods for thermoelectric modules and quantifies reliability characteristics of thermoelectric modules.