

## Analysis of Thermoelectric Coolers as Energy Harvesters for Low Power Embedded Applications

**Authors :** Yannick Verbelen, Sam De Winne, Niek Blondeel, Ann Peeters, An Braeken, Abdellah Touhafi

**Abstract :** The growing popularity of solid state thermoelectric devices in cooling applications has sparked an increasing diversity of thermoelectric coolers (TECs) on the market, commonly known as “Peltier modules”. They can also be used as generators, converting a temperature difference into electric power, and opportunities are plentiful to make use of these devices as thermoelectric generators (TEGs) to supply energy to low power, autonomous embedded electronic applications. Their adoption as energy harvesters in this new domain of usage is obstructed by the complex thermoelectric models commonly associated with TEGs. Low cost TECs for the consumer market lack the required parameters to use the models because they are not intended for this mode of operation, thereby urging an alternative method to obtain electric power estimations in specific operating conditions. The design of the test setup implemented in this paper is specifically targeted at benchmarking commercial, off-the-shelf TECs for use as energy harvesters in domestic environments: applications with limited temperature differences and space available. The usefulness is demonstrated by testing and comparing single and multi stage TECs with different sizes. The effect of a boost converter stage on the thermoelectric end-to-end efficiency is also discussed.

**Keywords :** thermoelectric cooler, TEC, complementary balanced energy harvesting, step-up converter, DC/DC converter, energy harvesting, thermal harvesting

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