Performance analysis of portable power generator by using TEG module

Siti Halma Johari*, Mohd Faiz Che Pa, Khalil Azha Mohd Annuar, Suziana Ahmad, Madiha Zahari

Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

*Corresponding e-mail: siti.halma@utem.edu.my

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ABSTRACT – This paper presents the development of portable thermoelectric power generator by using heat as a main source. The aimed groups of this project are hikers and campers those need a portable power generator that can charge their small electronic gadgets while doing their activity. The generation of electricity is based on the Seebeck Effect of Thermoelectric Generator (TEG) module. The developed power generator is consisting of TEG module, heatsink and boost converter. The hot side of the TEG module was mounted on an opposite of the heat source. Then, the heatsink is installed on the cold side of the module with a cooling fans to provide a forced air cooling. Boost converters are used to step up and constant the output voltage from TEG module. Result from the experiment shows that the power generator can produce constant output voltage of 5V and the handphone was successfully charged. This portable power generator can be an alternative power supply while the power source cannot be reached.

1. INTRODUCTION

In present times, small electronic gadgets such as smartphone, camera, GPS device and others become a widely deployed and useful tools. The limitations of these gadgets are power reserve where the battery of these gadgets cannot stand for a long time when it was used extensively. This become a major problem for people who always go out for camping trips, hiking or backpacking. The foundation of the thermoelectric generator (TEG) is based on the Seebeck effect which was discovered by Thomas Seebeck in 1821. Thermoelectric energy production which is one of the many processes of changing heat flow directly into electrical energy, promises a long life working without maintenance due to its reliability, silence, simplicity and the non-existence of moving parts [1]. Applying this TE effect enables thermal energy in waste heat to be converted into electrical energy so as to retrieve the energy [2]. For any type of TEG employed, the output increases depending upon the clamping force in addition to maximum permissible temperature gradient Peltier effect is the existence of cooling or heating at a junction of two different conductors [3]. An electric current is generated in the two dissimilar materials by the Peltier effect as long as one of the two temperature reservoirs are hotter than the other [4].

2. METHODOLOGY

Bunsen burner was used to generate heat energy as shown in Figure 1. This heat energy will be converted into an electrical energy by using a peltier or TEG module. Then, thermoelectricity, seebeck effect and peltier effect was applied where the process involved in the operation of device is related to the project development. After that, the input of DC boost converter circuit is connected to the output wire of TEG module to step up and maintain the voltage and current generated by the TEG module. Figure 2 demonstrates the testing setup to charge a handphone using portable power generator.

Figure 1 Heating process.

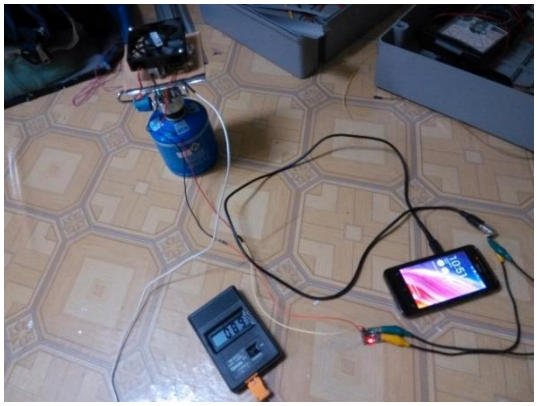

Figure 2 Testing setup to charge a handphone.

3. RESULTS AND DISCUSSION

Figure 3 and 4 show the relationship between current and voltage against the temperature. Both graph

displays that each current and voltage is directly proportional with the temperature. For Figure 3, the current is increasing as the temperature is increased until it reached 90˚C then the current remains constant at 700mA up to 139˚C.

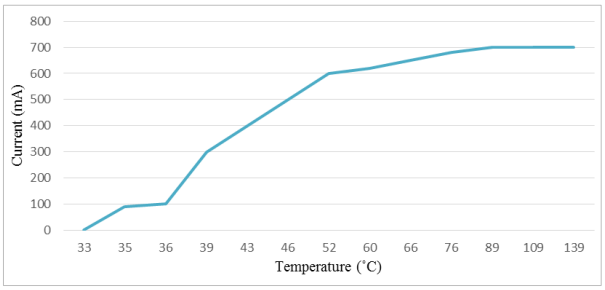

Figure 3 TEG Module Output (Current Vs Temperature).

In Figure 4, the voltage also increases when the temperature is increased. When the temperature reached 139˚C, the voltage measured is 3.31V. The maximum output voltage can reach up to 5.6V based on the explanation in the TEG module datasheet.

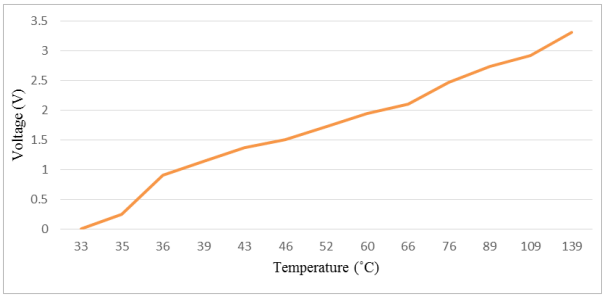

Figure 4 TEG module output (voltage vs. temperature).

The output voltage measured from TEG module will boost up the voltage until 5V. The purpose of getting 5V is used to charge a mobile handphone. Figure 5 and 6 show the current and voltage output of boost converter reacts with the temperature. In Figure 5, the current increases when the temperature is greater than 36˚C and become constant at 400mA after 46˚C. The current remains even the temperature is risen up and reach 139˚C. In Figure 6, shows that the voltage is boosted up to 5V after the TEG module being heated just up to 39˚C. And the voltage remains stable even the temperature is still increasing up to 139˚C.

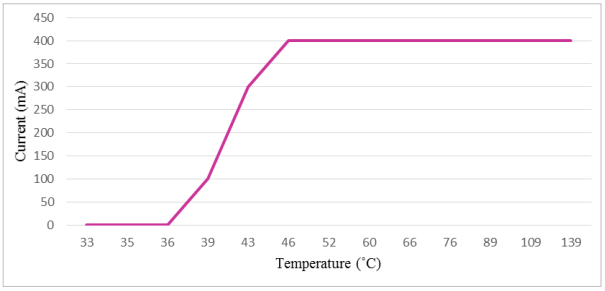

Figure 5 Boost converter output (current vs. temperature).

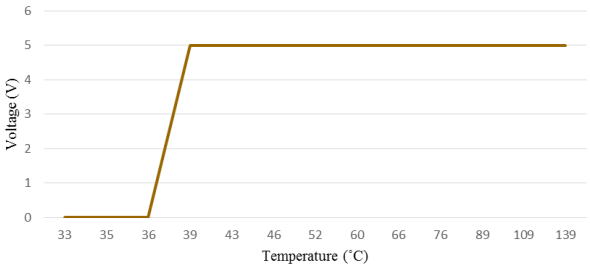

Figure 6 Boost converter output (voltage vs. temperature).

4. CONCLUSIONS

This research is conducted to examine bunsen burner and others thermal source is effective enough to be use to generate an electricity. The voltage produced by the thermal energy reaction is enough to generate a small electricity with value in the range of 1V – 3.75V. From the analysis, the voltage and current is directly proportional with temperature. For the power generated, the TEG module produced more power the longer it being exposed to the heat. Then, the boost converter used to achieve the desired voltage 5V and stabilize the voltage to constant and able to use charge a small gadget.

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