International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

Design of USB Charging System using Thermal Byproduct from Two Wheelers

Akash Sagari[1], Hrushikesh Gholap[2]

[1]Professor, Dept. of Automobile Engineering, MMP's Polytechnic, Thergaon, Pune-30, Maharashtra, India
[2]Design and Development engineer, M/S. Fluorotech Polymers Pvt. Ltd., Pune-28, Maharashtra, India

---

Abstract - *We have always been focused on eco-friendly energy production through various design modifications in existing systems. We are focusing on the availability of existing heat energy and converting it in useful electrical form. A thermoelectric generator (TEG) works on the principle of Seebeck effect in which temperature difference generates movement between electrons and holes thereby creating an output voltage. TEG works on the principle of Seebeck effect. We know that, while running a two wheeler engine it loses its some amount of energy in the form of heat generated by fuel. In this research paper, we will discuss how we can convert this dissipated heat in the DC voltage for performing an application. The main purpose of this is to generate safe, clean and user friendly energy that can be utilized to power small LED bulbs (used for indicators or requisite headlamps demanded by the BSIV norms) or also to charge a DC battery of a power bank used for cell phone charging.*

Key Words: **TEG, dissipated heat, Seebeck effect**

1. INTRODUCTION

This project mainly focuses on the application of thermal energy from the engine in creating electrical output. At first, we will extract the heat from the engine or silencer and that heat output will be used as an input to the hot side of the TEG. [1] On the other side, atmospheric air will maintain the lower temperature requirement of the cold side. That is how the temperature difference will be generated in the TEG module (Th - Tc).

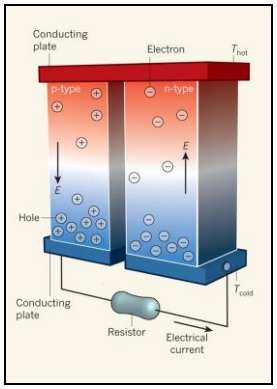

Fig -1: Seebeck effect in TEG

A thermoelectric generator consists of two thermoelectric semiconductors (n-type and p-type) subjected to a temperature difference, (Th – Tc), and electrically connected in series through conducting plates on the top and bottom. In the n-type semiconductor, most charge carriers are negatively charged electrons, whereas in the other one most of the carriers are positively charged holes. In a temperature gradient, electrons and holes tend to accumulate on the cold side. An electric field E develops between the cold side and the hot side of each material, which gives a voltage when integrated over the length of each. The voltages of the n- and p-type semiconductors add up and drive an electrical current through an electrical load, here an electrical resistor. The product of the voltage and the current is the electrical power output of the generator.

1.1 System components

1.1.1 Thermoelectric generator (TEG):

- Working temperatures: We have selected the TEG1-12611-8.0 model considering the available heat output from engine exhaust. The temperature of exhaust (Th) varies between 200±50°C. The ambient temperature is treated as cold side temperature (Tc). [2]
- Application voltage requirement: 5 volt, 1Amp.
- The input and output of TEG is connected with Teflon coated wires with specific colour coding as shown in below figure.

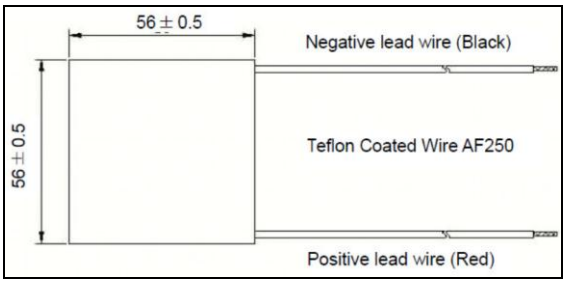

Fig -2: Geometric characteristics

Technical specifications (TEG1-12611-8.0)	
Hot side temperature	300°C
Cold side temperature	30°C
Matched load resistance	1.8 Ohms

Matched load output voltage	4.8 Volts
Matched load output current	2.7 Amp
Matched load output power	13.0 Watts
Heat flow across the module	325 Watts
Heat flow density	10.4 W/cm^2

Table -1: Technical specifications (TEG)

1.1.2 DC Voltage Booster:

We use this booster to match the voltage requirement of a rechargeable battery (power bank).

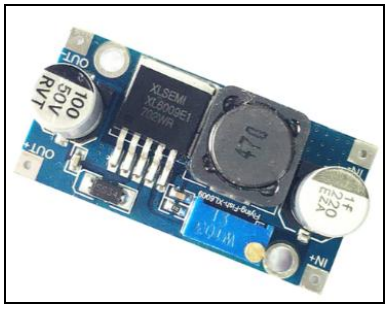

Fig -3: DC Voltage Booster

Technical specifications(XL6009)	
Input voltage	3-32 V
Output voltage	5-35 V
Maximum input current	4.0 Amps
Operating temperature	-40 to +85°C
Dimensions(LxWxH)	43x21x14 mm
Matched load output power	13.0 Watts

Table -2: Technical specifications (XL6009)

1.1.3 USB charging unit:

We are using USB charging unit from car charger to provide electrical output so as to charge the power bank or cell-phone battery. Also the input of this unit is connected with DC voltage booster.

1.1.4 Thermal bonding adhesive:

To make the bond between TEG surface plates and the application surfaces thermal bonding adhesive is used. It also eliminates the minute gap between two surfaces while bonding and promotes maximum heat transfer. [4]

Fig -4: High temperature bonding adhesive

1.2 System block diagram and working

The overall arrangement of the system is shown in the block diagram below:

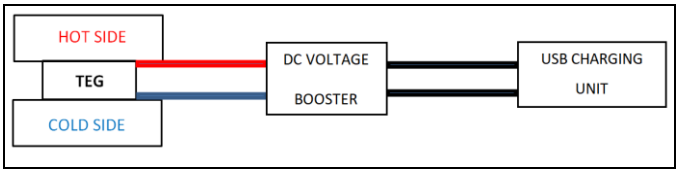

Fig -5: System block diagram

Working: The TEG is mounted near the exhaust of a two wheeler. The hot side temperature (Th) is 200±50°C and that of the cold side (Tc) is 50°C (considered at higher side as it is closer to the high temperature region of silencer).

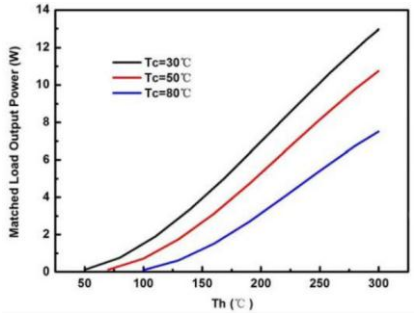

Fig -6: Performance curves for temperature vs. power

This temperature difference creates electrical power at around 5 watts (refer graph). As temperature at hot side (Th) increases, the overall temperature difference (Th - Tc) gets surged. This will ultimately raise the output power. [3] This power output from TEG will be treated as an input for the voltage booster.

The voltage booster is used to step-up the input voltage to required output voltage. This voltage from voltage booster is further supplied to the USB charging unit and used for the charging purpose at the end.

2. CONCLUSION

This complete assembly will add an excellent eco-friendly feature to the existing two wheelers. This charging unit will be more effective in case of long distance travelling by providing an additional source of power to user's devices.

REFERENCES

[1] Ankit Kumar Mishra, Ankit Kumar Singh, Ankur Prakash, Prof. R.S Ambekar, "THERMOELECTRIC GENERATOR," IRJET, Volume: 04 Issue: 06 June -2017, p-ISSN: 2395-0072.

[2] https://tecteg.com/store-thermoelectric-power-module-selection-purchase/56x56/

[3] G Rohit, D Manaswini, Vinod Kotebavi, Nagaraja S R, "Performance Study of Thermo-Electric Generator," AIP Conference Proceedings 1859(1):020094 · July 2017

[4] Sri Sabarinathan R, Ramesh Raj. S, Ramesh. S , Sakthivel. M, Ranjith Kumar. K, "Generation of Power using Heat from Exhaust Gas by Heat Generator," IJERT, Volume 6, Issue 04, Special issue 2018, ISSN: 2278-0181.