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Performance Evaluation of Mobile Charger Using Heating Technology

Mobile Charger using Teg Module

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Abstract

In today's fast growing world, the energy requirements are increasing with a rapid pace. A quick reflection on a typical day revels that majority of our everyday gadgets require energy that is generated either in renewable or non-renewable form. The increased reliance on technology necessitates availability of energy on our planet in a humongous amount; but unfortunately, it is limited, therefore the world is inquisitive about the energy that can last up to decades, such that the resources do not exhaust and are available for our future generations to come. We have made an attempt to unearth the technology of generating the energy from air, water even the sun rays using solar panels, but to a certain extent they are quiet costly and have their respective feasibility limitations. The technology we focus here is using heat as a source to produce electric power sufficient to charge a mobile phone. Since the heat is ubiquitous, it can be collected and converted into the desired form. This technology has vast applications; from charging various gadgets to providing electricity in a distant rural home where the ease of electricity is out of reach. The motive of presenting this paper is to analyze the heating module that can produce the energy when heated and how it can be converted into charge for a mobile phone.

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1 Introduction

In this aeon of burgeoning technology world, the utilization of resource is more and to fulfill it, the demand of resources is copious. Our earth possess limited amount of fossils fuel that can be used for a limited time, therefore to use this fuel wisely is the key term for the good life of our future. Therefore the alternate sources of the energy formation is discovered, the one such technology we are going to analyze is the heat module which is capable of producing voltage at its terminals when the heat is applied. This energy is sufficient to charge any gadget like mobile, radio, mp3, satellite phone and can be used in many geographically far-flung areas, where the resources are limited like in remote villages or camps, to charge electronic device such as mobile or torch. The figure of TEG heating module is:

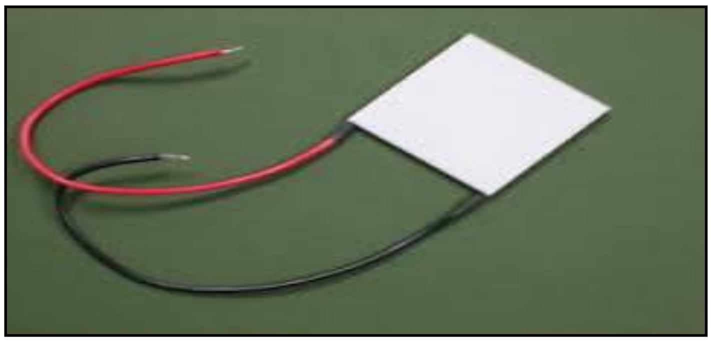

Figure 1: TEG heating module

However, solar panels are a tough contender in substituting it, but this module outnumbers its advantages. This module can be used under all weather conditions, works day and night. Due to absence of any moving parts its maintenance is low. At times solar panels fail to serve the purpose in areas with low solar radiation i.e. areas at higher altitudes with snow or no sunshine, lots of cloud or tree canopy or dusty deserts. Also solar cells use only the high frequency part of radiation, while the low frequency heat gets wasted. Therefore this module is portable, lightweight, more efficient and easy to use.

2 About TEG (Thermo electric Generator)

These devices make use of the See-beck Effect to generate electrical energy power. The crux of this effect is the fact that a temperature gradient in a conducting material results in heat flow that result in the diffusion of charge carriers. The flow of charge carriers between the hot and cold regions in turn creates a voltage difference.

The module contains two dissimilar thermoelectric materials joining in their ends: an n-type (negatively charged) and a p-type (positively charged) semiconductor. The direct current flow in the circuit is proportional to the temperature difference between the two materials. Thus, greater the temperature difference, the more power generated. While all of our thermoelectric devices will generate some power, the following devices are the most efficient and capable of operating at 320°C on the hot side. Power generation efficiency can reach 6% with 300°C on hot side and 25°C on cool cold side.

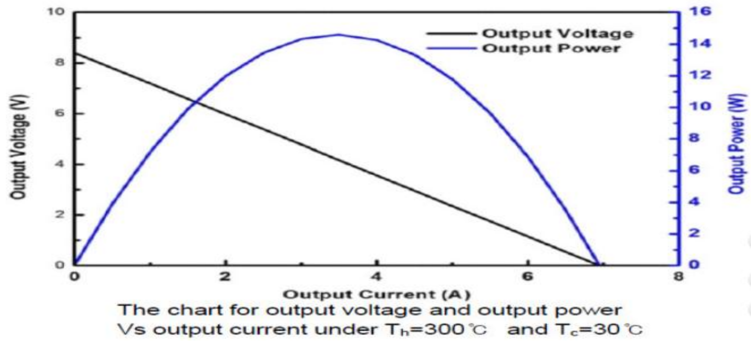

Figure 2: Sensing Chart

TEG module comes with coated graphite foil Thermal Interface Material (TIM) pre-applied to both sides. TIM is a material that is placed in between two components (usually heat source and heat sink) to enhance its thermal coupling. Here it is used to radiate the heat energy for the module's proper functioning. Thus there is no need to apply any TIM externally.

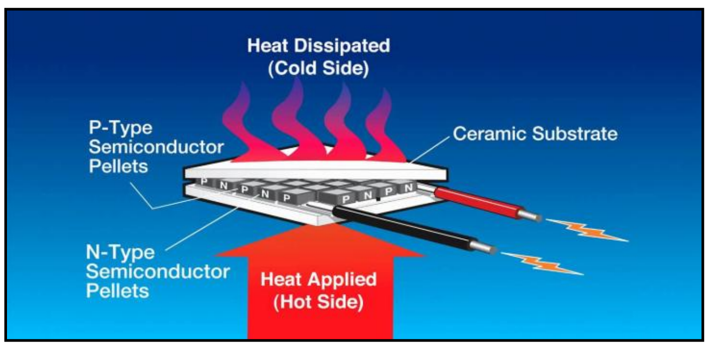

Figure 3: TEG Generator

TEG Module TEG1-12611-6.0 is a thermos electric power generator whose one side gets extreme hot and other side cold when put under external bias the module when putted under phenomenal heat or high temperature the reverse effect shows the potential difference between its two terminals.

3 Circuit of the Charger

To design the circuit the very firstly the TEG Module takes the energy and convert it to the respective voltage, the power generated from the module is not stable and also not convenient to charge a mobile phone therefore a DC-DC Power module is to used to get a stable power to charge the mobile, therefore to design the circuit we need minimum 5v and 500-600 mA power to charge a mobile effectively.

The circuit is built at 5v thermoelectric module, dc-to-dc boost converter and Schottky diode (1N5817).The thermoelectric module is connected to connector j1 and dc to dc boost converter module to connector j2.

The connection of the module is given in the picture below:

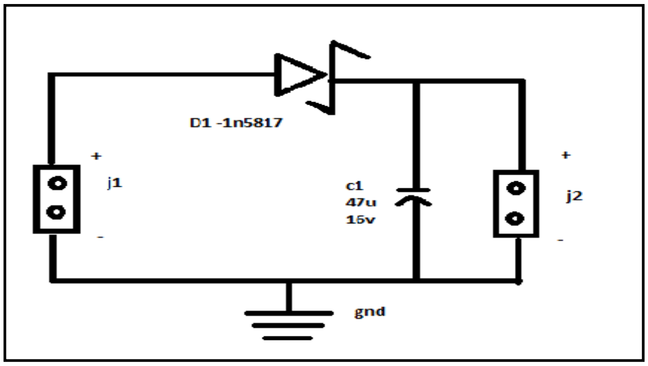

Figure 4: Charger Circuit

In the above figure the j1 pin is connected to the TEG module whereas the j2 pin is connected to the DC-DC power booster which is necessary to provide the supply to the module and gives a stable output.

3.1 DC to DC Booster

With an input voltage of 0.9V to 5V DC, the module gives a stable 5V DC output through its USB socket. Using two AA batteries, we can expect an output current of 500 to 600mA, and a single AA battery gives output current about 200mA. The conversion efficiency is up to 96%.

The module consist of two capacitors (C1-C2),one resistor (R1), one inductor (L1), one rectifier diode (D2), one LED (D1), and an IC (U1). All of these components are in SMD form, except the USB 'A' female socket. Observed values of the components are:

C1: 100nF (Input Filter)
C2: 100uF/16V (Output Filter)
L1: 470 (47uH Inductor)
D2: SS14 (Schottky Diode)
D1: Red LED (Input Power Indicator)
R1: 102 (1K Resistor- LED Current Limitor)
IC (U1): A7530 (A7530K3R-XXY series) from AiT Semiconductor Inc.

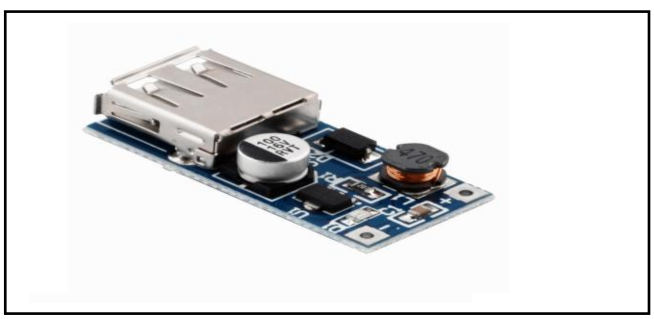

Figure 5: DC-to-DC Booster

4 Hardware Model

Working of the dc-to-dc boost converter module is based on pulse frequency modulation (PFM) technique.

A PFM converter has an alternative DC-to-DC power converter architecture that uses a variable-frequency clock to drive power switches and transfer energy from input to output. Because the drive signals frequency is directly controlled to regulate the output voltage, this architecture is referred to as PFM .DC to DC converter with constant on time or constant of time control is a typical example of this architecture.

In the circuit diagram , the positive terminal(red) of TEG module is connected to the PFM module through Polarity –Guard Schottky diode D1.Buffer capacitor C1 is connected across the converter module to get USB-standard 5V DC output through its USB(A-type) connector. We can use a standard mobile data cable to charge our phone from the output of this convertor module.

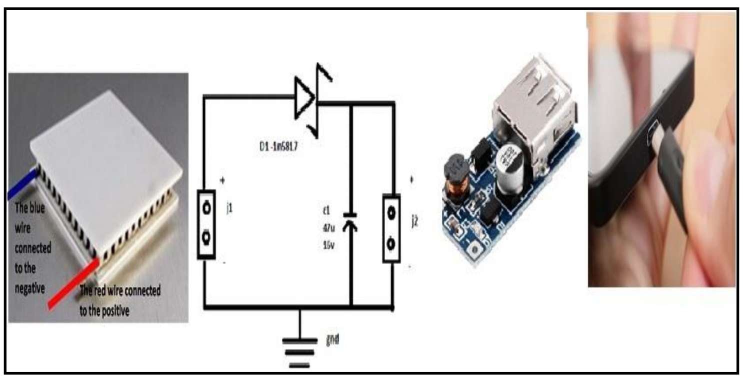

Figure 6: Assembling Charger Unit

As the circuit is complete, the module can be exposed to the heating temperature ranging from 100°C-230°C on the hot surface, which will convert the heat energy into the corresponding electric energy, sufficient to charge a mobile phone. This hot range of temperature can be found near the working machines in industries, fire place, surface of wood stove, log fire, compressors, heat generated in cars, oil and gas fields, pipelines, microprocessors etc. from where the heat energy can be tapped as heat source.

Figure 7: Final Working Charger Unit

5 Future Scope

As the project is concerned with the work on the basis of energy resource, it has a very vast field of application in the area of energy production using heat. It is well suited for equipment with low power needs in remote inhibited locations. It can also be used in the deep ocean offshore seabed using the temperature difference between low temperature seawater and hot fluids released by thermal outlets, from drilled geothermal wells for seafloor electric power needed for sensors in submarines, seafloor research developers and military purposes. The device is also used for the cooling purpose too as the other side of the device is cold so as an heat sink it can be used.

6 Conclusion

The overall effort is made to design a device which can able to produce a sufficient power to charge a cell phone by using the heat as a primary resource and develop a mobile charge which is most useful where the charging source is not available but having a heat source. The charger works very effective above 100 degree Celsius but the optimum temperature to use the device is 80-230 degree Celsius.

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