IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 09, Issue 5 (May. 2019), ||S (IV) || PP 31-33

Implementation of Solar Device Using Thermoelectric Peltier Effect

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Abstract: *Through the combine application of photovoltaic and thermal technologies, the total energy of the overall system can be improved by 25%-40%. The use of thermoelectric cooling system improves the power capacity of photovoltaic by 2%-20% and enhances the power efficiency of the photovoltaic by 2.29%-3.37%..Solar energy is one of the energy which can be used in various forms like solar lamps, solar cookers etc. For that purpose PV panel is required. Each module is related by its dc output power under standard test conditions (STC), photovoltaic panel were used to integrate the extraction of light energy and thermal energy*
Keywords: *Arduino, Microprocessor, PCB Board, Peltier, Solar Panel*

I. Introduction

This is even more important on Concentrating Photo-Voltaic (CPV) Systems when solar radiation could be much higher leading to higher cell temperature. The electrical current crossing the cell structure produces the Peltier effect. This heat captured can be utilized either for domestic purposes or for power generation. The idea of Solar Peltier System consists of: 1) Photovoltaic cell & 2) Thermoelectric Module / Peltier Module. Photovoltaic cells convert some of the absorbed photon energy to electricity. Peltier modules are used to convert heat energy to electricity. This idea is a reasonable approach to provide a quiet and easy way to control the temperature of PV panel. PV cells convert some of the absorbed photon energy to electricity, but most of the energy is converted to heat. To utilize this dissipated heat efficiently Peltier module are used to convert heat energy to electricity. Increase in the temperature of solar panel can cause significant damages to the Solar cells. Due to the varying nature of solar radiation, the allowable temperature range is a vital factor which needs to be considered before designing a PV system for a specific application.

II. Peltier Module

The source of our heater system is renewable energy resource, here PV cells are used. The power from the solar panel is given to two batteries (12V,7.25A). From batteries the power is delivered to peltier modules connected in parallel each attached to their respective heat sinks. Once the module gets the supply, it starts functioning (either heating or cooling according to its respective mode). The battery also supplies DC (Heat sink). Microcontroller receives 5V from the A.C power source i.e. through step down transformer (230V to 12V), which monitiors cooling and heating of the system.

III. Indentations and Equations

Output of a single thermoelectric generator

1. Current through the load $I = (1)\ \frac{S \times dT}{R_C + R_L}$

Where,

R_L -load resistance

R_C -Internal resistance

Efficiency of the thermoelectric generator

$$Eg = \frac{V \times I}{Qh}$$

The total heat input to the couple= Qh

$$\eta_{TEG} = \frac{\Delta T\sqrt{1+ZT} - 1}{\sqrt{1+ZT} + \left[\frac{T_C}{T_H}\right]}$$

T_C= Temperature at cold junction T_H= Temperature at hot junction
There for the total DC power generation of TEG is 2.8W
If waste heat is available in 24 hr then DC output power of 1 day is

$$\mathbf{P} = 2.8 \times 60 \times 24 = 4032W$$

IV. Figures and Tables

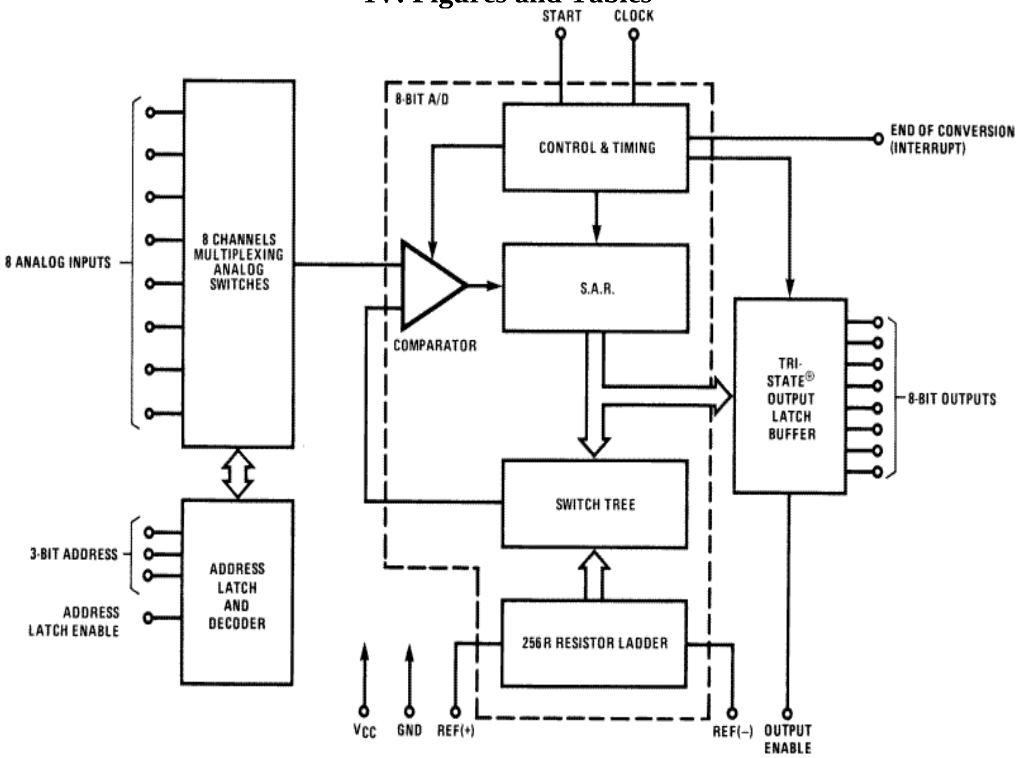

Fig. 1.1: Operational circuit diagram

V. Conclusion

As we know that the energy consumption is going to be increasing day by day, for this power generation has to be increase. Whole world is suffering from global warming, dense fog due to pollution, and acute disease like cancer due to ozone depletion pollution.Since Peltier cooling is not efficient comparatively and due to its small size applications, it is not widely used. It found its application only in electronics cooling etc. But, we have seen that there is a huge scope of research in this field about thermoelectric materials, its fabrication, heat sink design etc. Researcher are working on reducing irreversibility in the systems, because Peltier cooler has more potential which we can see from the vast difference between value of first law efficiency and second law efficiency.

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