

# Thermo-solar Power Production in Satellites

Aman Srivastava

SRM University, Kattankulathur Campus, Chennai-603203  
E-mail: [infinitem@gmail.com](mailto:infinitem@gmail.com)

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**Abstract**—As the power production in satellite limits the functioning of it, a general setup is proposed for increasing the power output onboard. In this model, thermo-solar cell is used in satellite. Thermo-solar cell is a combination of solar panel fixed with thermoelectric modules, giving higher power output than the conventional solar panels.

## 1. INTRODUCTION

Artificial Satellites are the powerful weapons for space exploration as well as military and civilian Earth observation. Currently, About 6,600 satellites have been launched. The latest estimates are that 3,600 remain in orbit. Of those, about 1,000 are operational, placed into orbit around other bodies such as Moon, Mercury, Venus, Mars, Jupiter, Saturn, Vesta, Eros, Ceres and the Sun. The work load of the satellite solely depends on the instrumentation present in the satellite. This instrumentation system functions are limited by the power supply onboard. Hence, to make the satellite more effective and multipurpose, the power system needs to be upgraded and power produced is needed to be amplified. A model has been proposed here to increase power production in the satellite using combination of a thermoelectric module and solar cell called thermo-solar cell. The hotter side of the module will be fixed with the opposite side of solar panels and the colder side will be given some insulation for its protection.

## 2. REQUIREMENTS

### 2.1. Thermo-electric generator module

- Bi<sub>2</sub>Te<sub>3</sub>(Bismuth Telluride) SERIES 1. Up To 320°C or equivalent

### 2.2. Solar cell

- multijunction photovoltaic cells ( gallium-arsenide and silicon)

### 2.3. Rigid capsule

- To encapsulate the whole setup and to increase mechanical strength.

### 2.4. Rechargeable Batteries

- To store the output power by the setup.

### 2.5. Solar Track mount

- To track the sun for maximum power output.

## 3. OPERATION

1. When the setup fit in the satellite faces the sun, with solar panel part facing towards sun, solar radiations fall on the surface of it.
2. This causes photo-electric current production from solar cells.
3. As the satellite is in space, the solar facing side of the setup will goes to approximate temperature up to 120 degree Celsius, while the shadowed part will go down up to minus 100 degree Celsius.
4. Solar panel will reflect some amount of the radiated heat which fell upon it and remaining it will transfer to the upper(hot side) of generator modules raising it to significant temperature.
5. Due to this, a temperature difference is being created across the opposite faces of module which gives rise to thermo electric voltage .
6. Hence the total power production will be the sum of the individual power production by thermoelectric modules and solar cells.
7. A solar track mount is used to keep the solar panel side always facing towards sun.

## 4. RESULTS AND DISCUSSION

The solar cells joined with thermoelectric modules give rise to higher power output than a conventional solar panel. The total power production depends upon the intensity of solar radiation falling on the surface which can be considered to be constant in space. Hence this setup gives a constant stable output power throughout lifetime. The major drawbacks of such setup are the low strength and inability to survive in space environment for a longer time. Such a setup is heavy and manufacturing is very complicated. A further research and use of future technologies will surely minimize these hurdles in future.

## REFERENCES

- [1] [http://en.wikipedia.org/wiki/Solar\\_panels\\_on\\_spacecraft](http://en.wikipedia.org/wiki/Solar_panels_on_spacecraft)
- [2] <http://thermoelectrics.matsci.northwestern.edu/thermoelectrics/engineering.html>

- [3] <http://www.ee.sc.edu/personal/faculty/simin/ELCT566/21%20Solar%20Cells%20II.pdf>
- [4] <http://www.sciencedirect.com/science/article/pii/S2214993714000062>
- [5] [http://inside.mines.edu/~Zhiwu/research/papers/F08\\_mrs.pdf](http://inside.mines.edu/~Zhiwu/research/papers/F08_mrs.pdf)
- [6] <http://www.samlexsolar.com/learning-center/solar-panels-characteristics.asp>