

PELTIER MODULE BASED AIR CONDITIONER USING SOLAR ENERGY SYSTEM

R.Subhashini^[1] B.Subhashri^[2] R.Iswariya^[3] Mrs.Deepthi Joseph^[4]

^{1,2,3,4} Department of Electrical and Electronics Engineering

^{1,2,3,4} Vel Tech Multi Tech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, India

^[1]subhashini0396@gmail.com ^[2]subhashri.balan@gmail.com

^[3]iswariya.tmns@gmail.com ^[4]deepthijoseph@veltechmultitech.org

Abstract: Our project mainly deals with a renewable and eco-friendly type air conditioning. This is completely a dc based system. There are two parts namely primary and secondary part. The primary part involves the cooling system and the secondary part involves the reuse of heat dissipation. The most important part of the system is the peltier module which serves as a heart for the complete system. The input is got from a solar panel which is completely a dc source. The peltier module works on the principle of peltier effect. The potential difference given to the module creates a temperature difference which is the reverse of seebeck effect. This temperature is distributed by using a dc fan. So the cold air gives cooling on one side while the hot air from the other side is again used for many domestic applications like water heating or the hot air can be converted into electricity. An efficient cooling can be achieved by this technique. The main advantage of this system is that it is a renewable energy based system, no electric charges in terms of cost, simpler and less costlier.

Keywords: Peltier Module, Heat Sink, DC Fan, Thermoelectric Effects.

I.INTRODUCTION:

Now a day, air conditioners are used in all industries and houses. But it is still a dream for people below poverty line. The global increasing demand for refrigeration air conditioning, food preservation, vaccine storages, medical services and cooling for electronic devices, led to production of more electricity and consequently more release of CO₂ all over the world which leads to the increase in global temperature that is global warming. So the air conditioner based on peltier effect changes this condition as it is less costlier and also there is no electric charges as it uses the renewable energy. This peltier based air conditioning is an

alternative as it converts the waste heat into cooling. Thermoelectric refrigeration is needed for the developing countries which gives long life and low maintenance. Conventional cooling systems uses a compressor and a working fluid to transfer heat. The peltier base air conditioner has many advantages than the conventional system. They are purely solid-state devices with no moving parts which make them more reliable, quiet and rugged. They use no ozone depleting chlorofluorocarbon, so it provides an environment friendly air cooling. This system is extremely compact than the conventional air conditioning system. Peltier module is used in many small application but this paper projects an extensive use of peltier on large applications.

II.PELTIER EFFECT

Thermoelectric effect is a direct conversion of temperature changes into electricity or viceversa. There are three effects based on thermoelectric principle. They are

- Seebeck effect
- Peltier effect
- Thomson effect

Here we use the peltier effect. Peltier effect is creating a temperature difference by passing electricity. Here a peltier module named TEC1-12706 is used.

The figure shown below clearly explains the peltier effect. When the potential difference is given to a semiconductor material namely bismuth or telluride, it creates a temperature difference by absorbing heat from one end and dissipating it on

other side. The semiconductor material is made of two type material namely n-type and p-type where the electron and holes concentration are maximum respectively. The electron in the n-type (majority charge carriers are electrons) moves opposite to the current direction whereas the holes in the p-type (majority charge carriers are holes) moves in the direction of the current. Thus peltier effect is clearly explained

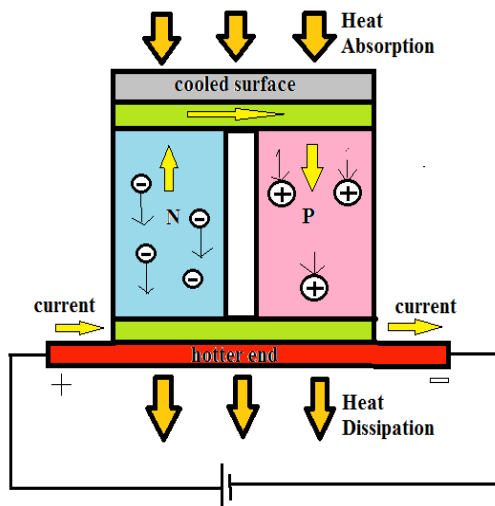


FIGURE 1. – PELTIER EFFECT

III.COMPONENTS REQUIRED

The main components required for making a solar based air conditioner are

- Peltier module
- Heat sink
- DC fan
- Solar panel
- Inverter
- Transformer
- Bridge rectifier
- Igloo box

A.PELTIER MODULE:

The peltier module used here is TEC1-12706 which can give a temperature difference of nearly 40 degree celcius. The peltier module is made of 127 thermocouple. The size of the module is 40*40 mm. This single stage module is made of some selected high performance superi-

or cooling material which can give a temperature difference of maximum 60°C.



FIGURE 2. - PELTIER MODULE

The main features of peltier module are listed below;

- High effective cooling and efficiency.
- No moving parts, no noise, and solid-state.
- Compact structure, small in size, light in weight.
- Environmental friendly, Ro HS compliant.
- Precise temperature control.
- Exceptionally reliable in quality, high performance.

The applications of peltier module are also listed below;

- Food and beverage service refrigerator
- Photonic and medical systems
- Temperature stabilizer
- Liquid cooling
- Portable cooler box for cars

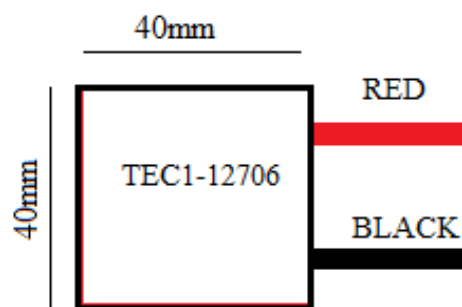


FIGURE 3. - DESCRIPTION OF MODULE

B. HEAT SINK:

Heat sink is a passive heat exchanger that transfers the heat from the electronic devices. In computers, heat sinks are used to cool central processing units or graphics processors. It is also used in many power electronics de-

ances for cooling purpose. The heat sink is normally made of copper or aluminium. Copper has high thermal conductivity. Aluminium is also a good heat sink but it is heavier than copper. The heat sink used here is aluminium.



FIGURE 4. – STRAIGHT TYPE HEAT SINK ATTACHED TO A DC FAN

The heat sink are of two types namely pin type and straight type. Here straight type heat sinks are used. The straight type heat sink can withstand a temperature of 44°C.

C. IGLOO BOX:

The igloo box used here is made of polystyrene. It is a synthetic aromatic polymer made from monomer styrene. Polystyrene can be a solid or foam. The solid polystyrene is in expensive and light in weight.

It is a solid but when heated above 100°C cooling and so used in many cooling applications.



FIGURE 5- IGLOO BOX

D. DC FAN:

A fan is attached to the device used for active cooling and may refers to fan that draws cooler air into the case from the outside and also expel warm air from inside or move air across a heat sink to cool a particular component. Fans used in the peltier module are usually used in combina-

tions with a heat sink to give effective cooling or liberating the heat, thereby improve the efficiency of the system.



FIGURE 6. – BRUSHLESS DC FAN

A brushless dc fan is used in our proposed system. They are the most simple type of fan which has only two terminals for fan control namely positive and negative for only supply. The fans are necessary for peltier to aid in cooling it and without it, the system would overheat and cease functioning. Here the dc fan is used on both side of peltier module for cooling and heating purpose.

E. TRANSFORMER:

The transformer used here is an step down transformer. It is an induction transformer which can give an output of 12V and 40Ah. It is designed by using aluminium winding instead of copper in order to get reduced cost. The transformer used in this module is shown below,



FIGURE 7.- TRANSFORMER

F. SOLAR PANEL:

Solar panel is an electrical device that converts the energy of light directly into the elec-

tricity by the photovoltaic effect. The operation of photovoltaic cell requires three attributes. They are;

- The absorption of light, generating electron hole pair.
- Separation of charge carriers of opposite types
- Separate extraction of those carriers to an external circuit.

IV. PROPOSED SYSTEM:

The proposed system has two parts. They are primary and secondary part. The primary part consists of the cooling unit whereas the secondary unit is used for utilizing the heat dissipated. The important part of the system is the peltier module. TEC1-12706 is the module used here. It can give an efficient cooling of up to 20°C. The peltier module is attached to a heat sink along with a dc fan as shown above. They are attached on both sides that is cooling and heating side. This is completely a DC system. The supply is fed from the solar panel. The sunlight is converted into a DC supply and it is fed to an inverter for converting DC to AC. then the output from the inverter is given to a step down transformer which is specially designed and the

output from the transformer is a 12V AC. This AC current is again converted into DC by using a bridge rectifier. Now the expected supply of 12V and 40 A is got, which is given to the peltier module and dc fan. Thus the peltier module works on the principle of peltier effect. When the supply is given to the two terminals of peltier module, one side becomes hot and the other end becomes cold. This is achieved by absorbing hot air from one end and liberating it on the other side. This forms the primary circuit where cooling is the effective result.

The hot air liberated from the other end can be used for various purposes like water heating or mobile charging or it can be converted into electricity by using a thermocouple and storing it in a battery which can be used further for other applications. Water heating is an effective method because it reduces the use of conventional heaters. This forms the secondary circuit. Thus the complete system is a useful one and can be used everywhere. This is the complete proposed system

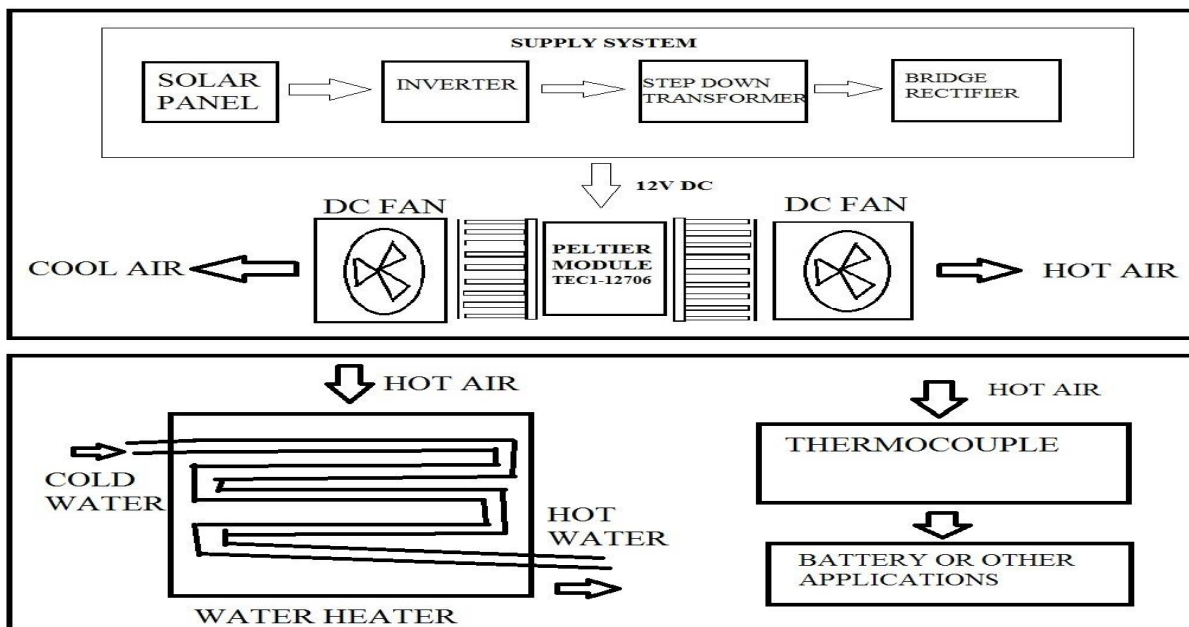


FIGURE 8: PROPOSED SYSTEM-BLOCK DIAGRAM

V. FINAL SYSTEM- HARDWARE ARRANGEMENT



FIGURE VIII: FRONT VIEW OF SYSTEM



FIGURE IX: BACK VIEW OF THE SYSTEM

VI. COMPARISON OF CONVENTIONAL SYSTEM WITH PELTIER SYSTEM:

TABLE I COMPARISON

FEATURES	CONVENTIONAL SYSTEM (1TONNE AC)	PELTIER SYSTEM (4 MODULES)
INITIAL COST	RS. 25,000- RS .31,000	RS.5,000- RS .8,000
SPACE FOR COOLING	20*20 sq ft	10*10 sq ft
WEIGHT OF THE SYSTEM	HEAVIER	LIGHTER
TEMPERATURE	16°C - 30°C	25°C - 30°C

ELECTRICITY BILL	DEPENDS ON USAGE APPOX: Rs 2500/MONTH	NO
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VII.FUTURE SCOPE:

The objective of our project to give effective cooling for long time even in case of power failure because it uses the renewable energy. A TER based cooling gives a better cooling by using a single stage 12V peltier cooler module.

With recent development taking place in the field of thermoelectric cooling, the new proposed model has given a perfect results. The future scope of this project is that it can be built for large industries by using solar as a renewable supply source. So that the electricity bills of industries can be reduced and also the electricity demand will be reduced since it uses a renewable energy.

VIII. CONCLUSION:

This eco-friendly initiative can be used for both cooling and heating applications. The proposed model can be implemented using appropriate hardware.

A reasonable cooling can be achieved using our proposed model. Although the prototype works well in small enclosed space, a more versatile version may be developed for general purpose applications. The major advantages of this system are renewable energy based system, Cheaper than the conventional technique, Simpler module, No elec-

trical charges in terms of cost, Eco-friendly equipment.

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