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Portable solar power supply system

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Abstract:

This paper deals with the fabrication of a portable solar system using photovoltaic cells (electricity generated by sunlight). Solar cells are usually made of semiconductor materials, especially silicon. Two layers of semiconductor materials combine with each other.

These layers are exposed to sunlight,

They absorb photons. By doing so, the electrons are excited and some of them jump from one layer to the next, causing an electric current. This is to protect the environment, prevent the felling of trees and the low cost of this system. The solar energy portal is used in ,space probes,space craft, homes, telecommunications and remote villages that require electricity.

Keywords: Photovoltaic cell, module, layer, crystal, inverter

1. Introduction:

Portable solar power supply system and its operation

Solar cell energy diagram

By connecting a p-type semiconductor to an n-type semiconductor, electrons are transferred from region n to region p and holes are transferred from region p to

region n.With the transfer of each electron to region p, a positive ion remains in region n, and with the transfer of each hole to region n, a negative ion remains in region p.The positive and negative ions generate an internal electric field whose direction is from region n to region p. This field becomes stronger with the transfer of more carriers(electrons and holes) to the point where the net transfer of carriers reaches zero.[1] Under these conditions, the Fermi planes of the two regions are aligned with each other and an internal electric field is formed. Many have to be separated by the internal field of the bond before recombination.

The electric field directs the electrons to region n and the holes to region p.This increases the negative charge density in region n and the positive charge density in region p.

This charge density can be measured in the form of voltage at both ends of the junction. If the two ends of a bond are short-circuited, the extra electrons in region n travel through the wire to region p, forming a short-circuit current. If a consumer is used instead of a wire, the current passing through the consumer gives it energy. In this way, the energy of the photons of sunlight is converted into electrical energy.[2]

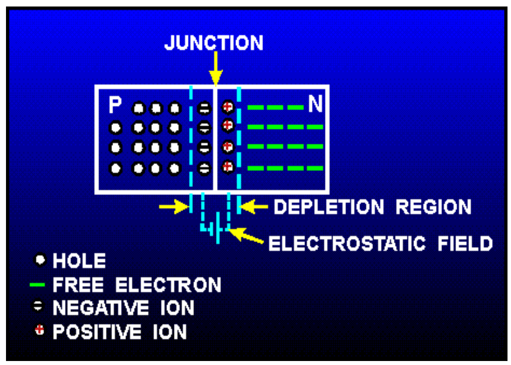

Fig1A solar cell created using a PN-bond

Crystalline silicon-based solar cells The most common bulk material for the cell is crystalline silicon (c-Si). Silicon bulk material is divided into several parts according to the type of crystal and the size of the crystal.

Mono-crystalline silicon (c-Si) Poly-crystalline silicon Solar cell String Ribbon Thin film solar cells Simply put, a thin film is a method of producing a solar cell in which one or more thin layers of photovoltaic material are placed on a substrate. These cells are also known as Thin Film Photo VoltaicCells(TFPV).[3]

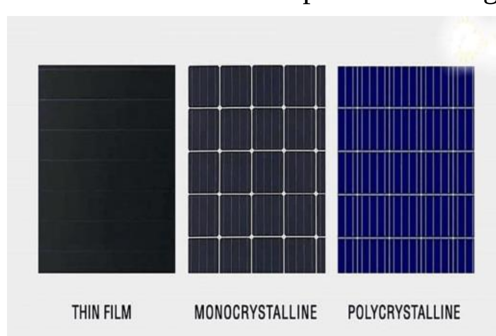

Fig 2 Types of solar cells

Solar systems convert solar energy directly into electricity without the need for intermediate mechanical systems. The light-absorbing plates used in this type of system are called solar panels.[4]

In modification, solar absorber panels are called solar panels or solar cells or photovoltaic panels or photovoltaic cells. Solar photovoltaic modules by heating a prefabricated sandwich panel consisting of sterile cells, glass, material EVA (ethylene vinyl acetate and back sheet) is produced.These cells are thin squares of disks or semiconductor films that produce enough voltage and current when exposed to sunlight. Conventional solar panels are divided into two types, monocrystalline and polycrystalline. Monocrystalline panels are slightly better than polycrystalline panels.[5]

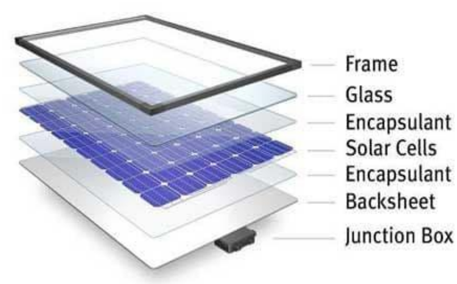

Fig 3 Solar panel components

2.Solar system connections:

The panels are connected to increase the voltage by the mc4 connector. Connecting the panels in series and in parallel to each other increases the voltage and the physical and electrical characteristics of the panels must be the same.

Solar cells produce DC electricity, so the power output of each cell will be equal to: $P=V\times I$ [6]

Photovoltaic cells are like light emitting diodes and will produce different amounts of radiation. The output voltage in them will decrease with the resistance of the series of raw materials as well as metal connections and the output current will also change with the parallel resistance (shunt).[7]

Obviously, when the current is zero, ie we have the open circuit mode, our voltage

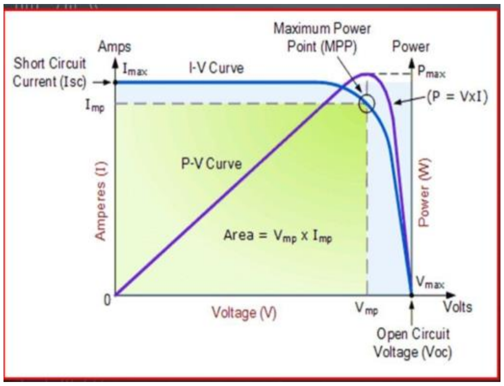

Fig 4 Voltage-current -voltage-Power curve of a solar module.

(Voc) will be at the maximum possible value, and when the voltage is zero, ie the short circuit mode has occurred, we will have the maximum current (Isc). In operational mode, that is, when the sun shines on the cell and is connected to circuits and charges, what will be the voltage and current and how will they behave?

Notice the curve shown above, approximately close to the open circuit voltage there is an elbow in the curve, which is called the maximum cell power point (MPP). The current and voltage at that point are called Imp and Vmp and the product of the two together is called the nominal power Pmax of the cell.[8]

3.Standard Test Conditions (STC)

In order to be able to compare different solar cells and finally different solar modules, we have to measure them under the same conditions, which are called standard test conditions.

Test conditions should include the following three:

1. The intensity of radiation E should be 1000 w / m2.
2. 2. The cell temperature should be 25 degrees Celsius, which can be 2 2 degrees difference.

Electrical Properties (STC[2])

Module Type	280 W	285 W
MPP Voltage Vmpp (V)	31.5	31.7
MPP Current Impp (A)	8.90	9.00
Open Circuit Voltage Voc (V)	38.6	38.8
Short Circuit Current Isc (A)	9.39	9.50
Module Efficiency (%)	17.1	17.4
Operating Temperature (°C)	-40 ~ +90	
Maximum System Voltage (V)	1000	
Maximum Series Fuse Rating (A)	20	
Power Tolerance (%)	0 ~ +3	

[2] STC (Standard Test Condition): Irradiance 1000 W/m², module temperature 25 °C, AM 1.5.
The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.

3. The spectrum of light with air mass AM = 1.5.

Catalog

The rated power or maximum power is 280 watts, the short circuit current is 9.39 amps and the open circuit voltage is 38.6 volts, and the maximum current and voltage are 8.9 amps and 31.5 volts, respectively.

Fig 5 Check the parameters of current, voltage, power

Two points are very important here, first, that the maximum power is obtained by multiplying the voltage and maximum current by each other, and second, that these values of power, voltages and currents will occur in the standard test conditions.[9]

Maximum power point tracking is a method to maximize the output power of wind turbines and photovoltaic (PVV) systems.

Photovoltaic systems are used in a variety of ways. Power generated by solar panels:

1. It is converted to alternating current by an inverter and is connected directly to the national power grid

2. Part of the output power of the inverter is transferred to the power grid and part of it is transferred to the battery bank

3. No power is transferred to the power grid and the output power of the panels is transferred to the battery bank by an inverter with mppt capability.

η=FF.Voc.Isc/F.A [10]

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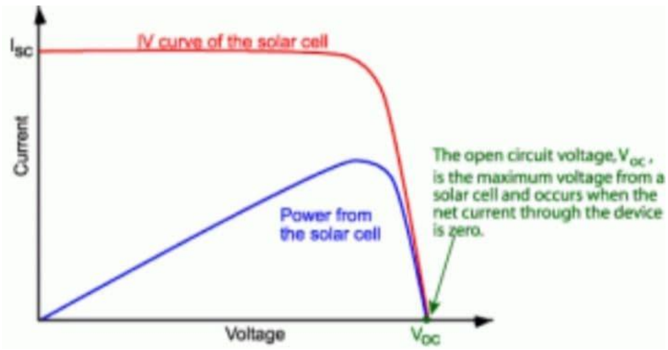

Fig 6 Output voltage diagram of the solar panel.

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In this article, for the convenience of consumers, the versatility of this system has been used, which can be converted to cd by the city inverter in case of need for more electricity and voltage.

Solar power package consists of the following four main components:

• Solar panel (solar energy absorbing panels)

• Solar charge controller (device that is placed between the solar panel and batteries)

• Batteries (responsible for storing the electrical energy generated by the solar panel)

• Inverters (responsible for converting battery power to city electricity)

4.Solar detectors:

In the case of solar arrays installed on the ground or designs placed on a pole, one can also use systems called revolving panels or solar trackers, which follow the passage and direction of the sun's rays, and according to each situation, the array in Use all hours, in the best possible condition, in direct sunlight.[11]

To calculate the electrical energy consumed, it is sufficient to multiply the power of the electrical device by the number of hours it is lit per day, and finally, to calculate the electrical energy consumed by a residential or industrial unit, add the energy consumption of all appliances per day.

Calculating the efficiency of a solar panel is the ratio of the energy produced by a solar cell to the energy radiated to the cell surface. The formula for calculating the

efficiency of a solar cell is as follows.

In relation to the calculation of the efficiency of the solar cell E of the radiated energy, VOC is the open circuit voltage of the panel and ISC is the short circuit current of a solar cell.[12]

The numerical quality factor is between zero and one, and the closer this number is to one, the higher the efficiency of the solar cell.

The calculation of the Filling Factor (FF) is as follows.

FF=LMP.VMP/Voc.Isc

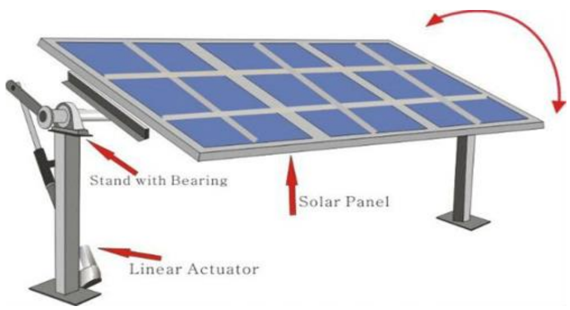

Fig 7 Solar Tracker

Technical specifications of solar panel 300-270 watts

Technical characteristic of Electrical Data stands for unit amount

Nominal power Pm 270 watts

Maximum open circuit voltage and no-load voltage Open circuit voltage VOC 45.23 volts Short-circuit current and maximum current without loading achieve the best performance.[13]

5. Calculate the diameter of the cable used in this solar panel:

We want the diameter of the cable

Specify the requirements for our system.

Solar power is transmitted from the controller output of the building to 12 meters of cable. After the generated electricity enters the building, the required electricity for lighting, sockets and various consumers is supplied by another 10 meters of cable. And we need a total of 22 meters of cable. Use the following equation to calculate the cross section of the cable:

v/20/

$CT= 0.04\ LI$

In this regard:

: L Cable length in meters

I current in Kabul in amperes

: V Selected system voltage (92 or 29 volts)

: CT of cable cross section in square millimeters

If the system voltage is considered to be 12 volts, the cross section of the cable is equal to:

$CT = 0.04 * 22 * \ 14.08 / 12/20 = 20.65mm2$

The calculation method is similar to a 24 volt system as follows

$CT = 0.04 * 22 * \ 7.08 / 24/20 = 5.15mm2$

If it is possible to create a situation where the system voltage is considered 48 volts, the required cross section will be calculated as follows:

$CT = 0.04 * 22 * \ 3.52 / 48/20 = 1.16mm2$ [14].

6.Conclusion :

This portable solar power supply system is used for precise mathematical and energy calculations for places that do not have power transmission lines and the use of this solar energy portal in space probes, spaceships and houses, camps, telecommunications and remote villages that require electricity.

Using the location of the solar system, the amount of electricity consumed by different devices, the amount of time they use day and night and the number of panels and the size of its pv module and daily, weekly or monthly consumption using solar panel equipment, charge controller, deep cycle solar battery Many bicycles), inverters, protection devices and cables were made and produced by our group.

Number of panels required=413.9/110=3.76

For grid-connected systems, the inverter input must be equal to the PV array for the system to operate safely and efficiently.

Total power of all devices=18+60+75=153W

Inverter suitable=153×1.3=198.9

A 200 watt inverter is considered

Battery capacity=(18 w×4 hours)+(60w×2 hours)+(75w×12 hours)×3/(0.85×0.6×12)=35.29

Charger capacity of the controller=4×7.5×1.3=39A

So we choose a 40 or 45 amp 12 volt controller charge.

Intended panel specifications:

Pm = 110 wp

Vm = 16.7 Vdc

Im = 6.6 a

Voc = 20.7 v

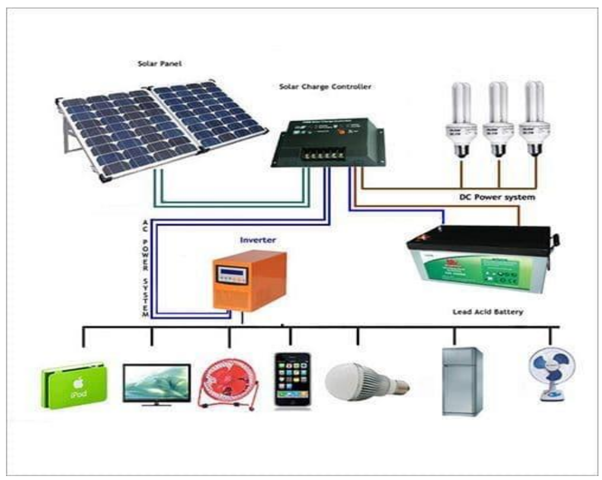

Fig 8 solar panel components

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