एस.टी.टी.सी./गोरखपुर

प्रयोगात्मक अध्ययन एवं परीक्षण

इन्टीग्रेटेड पावर सप्लाई – एस/पी.एस.–1

प्रशिक्षणार्थी का नाम :..... कोर्स : .....

पद : ..... अनुदेशक : .....

मंडल : ..... . दिनांक : ..... .

इन्टीग्रेटेड पावर सप्लाई सिस्टम एक विश्वसनीय पावर सप्लाई सिस्टम है।जिसके कारण एप्रोचिंग ट्रेन के सम्मुख सिगनल के ब्लैंक होने की संभावना नही होती है। यह ए.सी. और डी. सी.आउटपुट 10% टालरेंस लेबल के साथ प्रदान करता है।इससे सिगनलिंग व्यवस्था के लिए सभी आवश्यक पावर सप्लाई नियंत्रित रूप में अबाधित तरीके से प्राप्त होती है। इसमें निम्नलिखित सब सिस्टम होते है।

1. एस.एम.पी.एस. पैनल (एस.एम.पी.एस. बैट्री चार्जर हाट स्टैन्ड बाई मोड के साथ सुपरवाइजरी कन्ट्रोल यूनिट)
2. ए.सी. डिस्ट्रीब्यूशन पैनल (स्टेप डाउन ट्रांसफार्मर ,इनवर्टर ,सी.वी.टी.)
3. डी.सी. डिस्ट्रीब्यूशन पैनल (डी.सी.– डी.सी. कनवर्टर)
4. स्टेटस मानीटरिंग पैनल (ए.एस.एम. के कमरे हेतु)
5. कम अनुरक्षण बैट्री बैंक

1. सिग. एवं दूर संचार प्रशि. केन्द्र/गोरखपुर में स्थापित इन्टीग्रेटेड पावर सप्लाई सिस्टम से जुड़े लैब/उपकरणों के नाम लिखें।

2. माडल रूम में लगे इन्टीग्रेटेड पावर सप्लाई सिस्टम के ब्लाक डायग्राम का अध्ययन करें और बताए कि इन्टीग्रेटेड पावर सप्लाई सिस्टम में कितने आटो चेन्जओवर लगे है?

3. एस.एम.आर. पैनल पर निम्नलिखित रीडिंग की जांच करें।
   (क) इनपुट A.C. वोल्टेज –

   (ख) इनपुट A.C. करेन्ट –

   (ग) आउटपुट D.C. वोल्टेज –

   (घ) बैटरी करेंट –

   (च) टोटल आउटपुट करेंट –

4. एस.एम.पी.एस. बेस्ड चार्जर पैनल पर लगे इंडीकेशन की जांच करे तथा लिखें।

5. एस.एम.पी.एस. बेस्ड चार्जर पैनल पर लगे '' की बोर्ड '' का कार्य लिखें।

6. ACDP पर निम्न रीडिंग की जांच करें।

   (क) इनवर्टर –1 का ए.सी. आउटपुट वोल्टेज –

   (ख) इनवर्टर –2 का ए.सी. आउटपुट वोल्टेज –

7. इनवर्टर–1 का स्विच आफ करे तथा इनवर्टर–2 पर इंडीकेशन और वोल्टेज की जांच करे।

8. इनवर्टर–1 का स्विच आन करे तथा इनवर्टर–2 का स्विच आफ करे तथा इनवर्टर–1 पर इंडीकेशन और वोल्टेज की जांच करे।

9. इनवर्टर–1 तथा इनवर्टर–2 का स्विच आफ करें तथा CVT वोल्टेज की जांच करें।

10. निम्न पर वोल्टेज की जांच करें।

(1) स्टेप डाउन ट्रांसफार्मर/सिगनल/अप–1 –
(2) स्टेप डाउन ट्रांसफार्मर/सिगनल/अप–2 –
(3) स्टेप डाउन ट्रांसफार्मर/सिगनल/डा0–1 –
(4) स्टेप डाउन ट्रांसफार्मर/सिगनल/डा0–2 –
(5) स्टेप डाउन ट्रांसफार्मर/ट्रैक/अप–1 –
(6) स्टेप डाउन ट्रांसफार्मर/ट्रैक/अप–2 –
(7) स्टेप डाउन ट्रांसफार्मर/ट्रैक/डा0–1 –
(8) स्टेप डाउन ट्रांसफार्मर/ट्रैक/डा0–2 –

11. आइ.पी.एस. में लो वोल्टेज डिस्कनेक्शन स्विच (LVDS) का कार्य लिखें।

12. स्टेटस मानीटरिंग पैनल–

क्र. सं.	सूचना	स्थिति	LED कंडीशन	रिमार्क
01	स्टार्ट जनरेटर	50%		
02	आपात् स्टार्ट जनरेटर	60%		
03	सिस्टम शट डाउन	70%		
04	एस. एन्ड टी. स्टाफ को बुलाना	उपकरण विफलता		

13. इन्टीग्रेटेड पावर सप्लाई सिस्टम का 4–लाइन गैर विद्युतीय क्षेत्र के लिए ब्लाक डायग्राम बनाएं।

प्रशिक्षणार्थी का हस्ताक्षर

Solar Power Supply System

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
पाठय्क्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुदेशक का gLrk{kj
Instructor Initial :

Overview of Solar Power Supply System

(Specification: IRS: S 84/92 with Amd. 2)

Aim: Study of Solar Power Supply System

Solar energy is an alternative energy source. It is also called as a non-conventional or renewable energy source. Solar energy is abundant in nature and is free of cost. Solar energy is obtained through the use of Solar cells. The Solar cells convert sunlight into electrical energy, based on the principle of photovoltaic effect. The electricity so obtained can directly be used to charge the batteries used for operating various appliances. Solar energy has a wide range of applications in Indian Railways especially at remote or hilly places where grid supply is not available round the clock or not available at all.

Advantages:

- Fuel source for Solar Panel is Sunlight which is free of cost.
- Unlimited life of Solar Modules, fast response and high reliability.
- Can operate under high temperature and in open weather.
- Inherently short circuit protected and safe under any load condition.
- Pollution free and requires Minimum Maintenance
- Can work as an independent unit
- Operation is simple and no electrochemical reactions and no liquid medium.
- Noise-free as there are no moving parts.
- No AC to DC conversion losses as DC is produced directly.
- No transmission losses as installed in the vicinity of the load.
- Suitable for remote, isolated and hilly places.
- Can be used with moving loads also.
- Modular design and scope for future expansion.
- It can generate powers from milli-watts to several mega watts.
- It can be used almost everywhere from small electronic device to large scale MW power generation station.
- It can be installed and mounted easily with minimum cost.

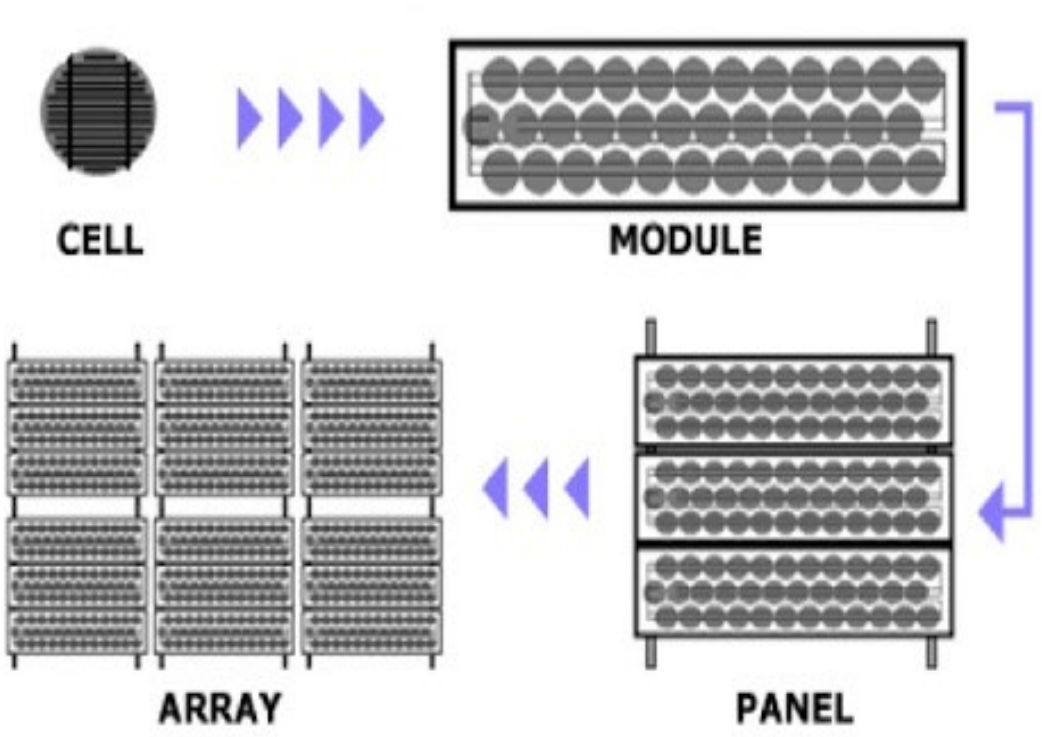
DEFINITIONS

Solar Cell: Solar Cell is the basic photovoltaic device, which generates electricity when exposed to sunlight.

Module: A Module is the smallest complete environmentally protected assembly of interconnected Solar cells

Solar Panel: A group of modules fastened together and interconnected to serve as a field installable unit is called a Panel

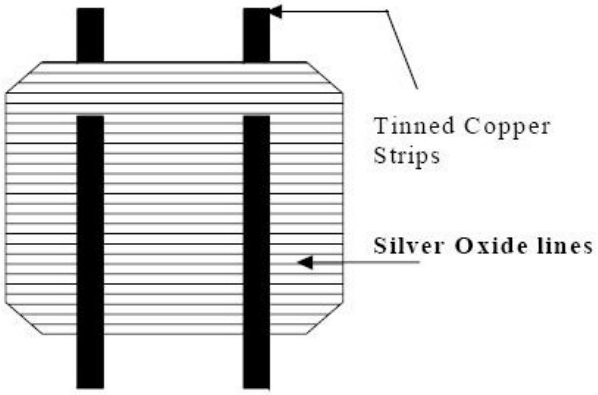
Array: An Array is the complete power-generating unit, consisting of many number of PV modules and panels.



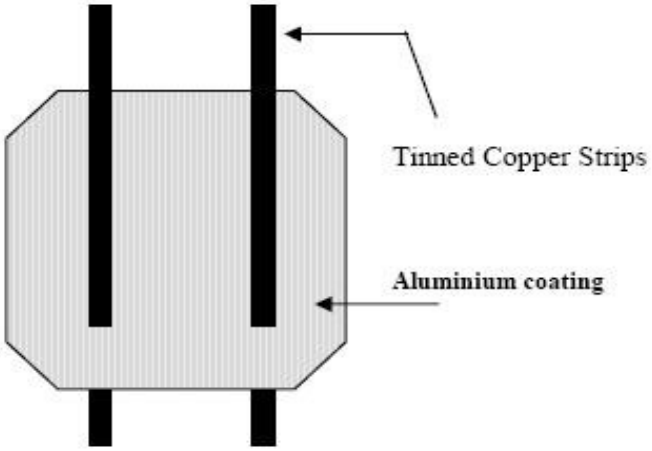
Solar Cell:

The basic building block of a photovoltaic system is the Solar Cell, a semiconductor device having a simple p-n junction and which when exposed to sunlight produces DC electricity. The solar cell is made of Silicon with an area of a few sq. centimeters to 200 sq. centimeters and even more.

A thin p type silicon wafer is taken through phosphorus diffusion process and by screen-printing technology electrodes are made. On the PN junction device of the Solar Cell front and back electrical contacts are screen-printed. The side, which has negative polarity, is taken as front side and that which has positive polarity is taken as backside. The front or Negative side is exposed to sunlight for conduction to take place. Two Tinned copper strips work as terminal leads for interconnection to other cells. For collection of charge from the cell and conduction to terminal leads on negative side, Silver Oxide lines are screen printed horizontally and these are joined to terminal leads at close spacing. These lines cover only 5% of the total area of the cell, so that these do not pose any hindrance to the exposure of Sunrays. The back or Positive side is not exposed to sunlight; hence Aluminium is coated on whole surface for better conductivity.

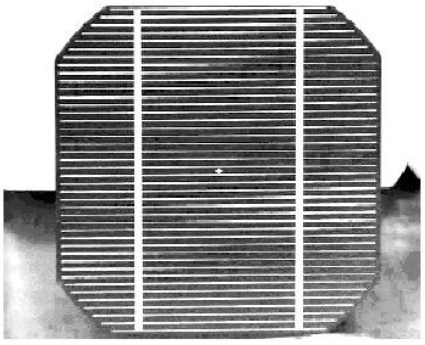


Front side of Solar cell



Rear side of Solar cell

Actual view of Solar Cell



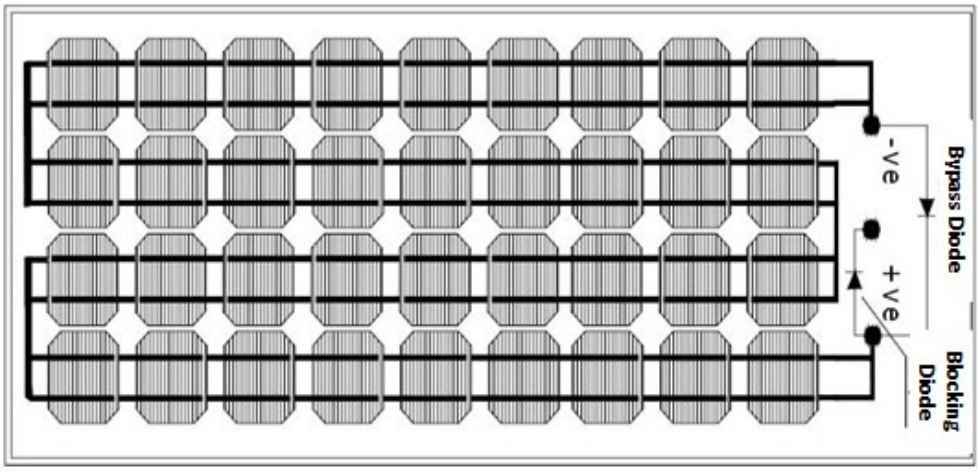
Solar Photo Voltaic (SPV) Module:

For Indian Railways Solar Photovoltaic Module is manufactured as per RDSO Specification No. IRS: S 84/92 with latest amendment.

A Solar module is basically an assembly of suitably interconnected, silicon solar cells working on the principle of photovoltaic conversion of sunlight into electricity.
The Solar module consists of three main components
1. A toughened front glass.
2. A suitable mounting frame.
3. An assembly of interconnected solar cells

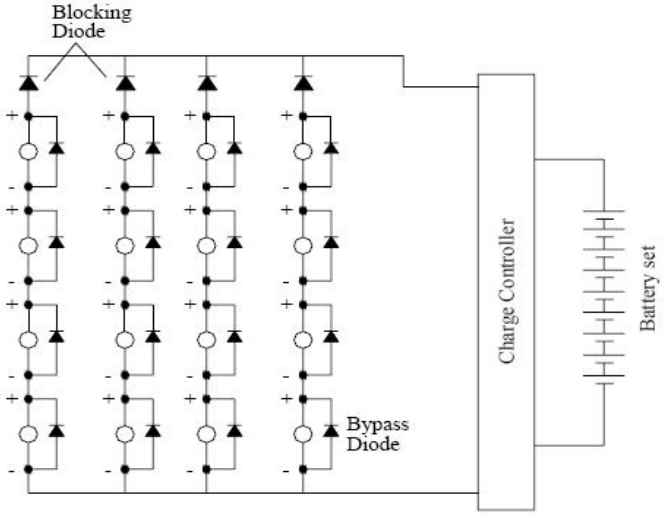
The Solar Cells are made of silicon wafers cut from a large crystal .The silicon wafers are polished and necessary chemical treatment is given to achieve requisite surface characteristics for optimum efficiency of individual solar cells. The P-N junction on individual cell is made by injecting impurity like phosphorous by diffusion process. The power generated by a single cell is very less and therefore several cells are interconnected in series/parallel combination to get the required voltage and current. The interconnection between solar cells in a Module is made through tinned copper foils. The Module shall be mounted behind a high transparency, toughened glass front surface. Two thin transparent films of suitable plastic material, preferably (Ethylene Vinyl Acetate) shall be interposed between the solar cell layer and the front glass and the solar cell layer and the back plastic laminate. This assembly shall then be kept in a temperature controlled oven at a suitable temperature, so that the above assembly becomes a solid mass with the cells protected against corrosion, moisture, pollution and weathering.

The complete solar module shall be sealed in an Anodized Aluminium Frame with RTV silicon rubber compound filling around the edges to give further moisture barrier and shock resistance. The output terminals of the module shall be provided on the back of the Solar Module in a terminal box. Cable outlets from solar module terminal shall be through cable glands to be provided in the terminal box to help in series /parallel connection of solar modules. Hot spots are areas of high temperature that affect only one zone of the solar panel and result in a localized decrease in efficiency, and therefore, lower output power and accelerated material degradation in the area affected by the high temperature. A Bypass diode is connected across +ve and –ve terminals in the terminal box for prevention of hot spot problem. Cathode of the diode will be at +ve terminal and Anode will be at –ve terminal of the module. This diode protects the module cells from overheating due to shadowing of the module or any cell breakage. Generally the rating of bypass diode is 1.52 times of the maximum current of module.



Solar Panel:

A Solar panel consists of a number of solar modules, which are connected in series and parallel configuration to provide specific voltage and current to charge a battery. A diode is connected on the +ve terminal of such string in forward bias. This is called Blocking diode. This diode is provided so that in daytime current can flow from module to battery, but at night or in cloudy day current should not flow back from battery to module or from one string to another string



Main Components of Solar Photo Voltaic System :

The solar power system consists of the following components:

a. Solar array.
b. Battery Bank
c. Solar Charge Controller
d. Field Junction Box
e. Solar Module Mounting Structure
f. Earthing kit
g. Cables.

Solar Array

Solar array consists of series/parallel combination of modules, which are mounted on the metallic structure in sunny and shadow free area at a fixed angle as recommended by designer. The mounting arrangement shall be suitable for pole mounting, column mounting or flat surface, as desired by the purchaser. Provision for directional and angular adjustment shall be provided to get maximum utilization of incident sunlight. All the modules will face the South in Northern hemisphere. Cables from the array area will come to the control and battery room through junction boxes from panels of modules.

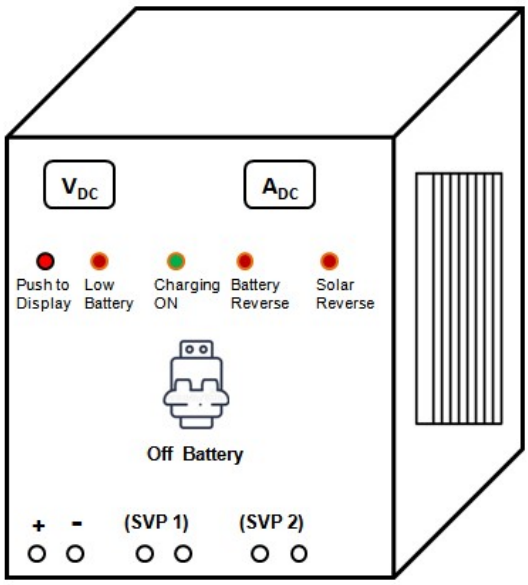
Battery Bank

The Sun is not always available and it is not regular. However, loads are to be fed any time of the day. Therefore power should be stored in a battery bank. Low maintenance Lead acid battery as per IRS: S 88/2004 or latest of specified capacity will be provided.

Solar Charge Controller

Charge controller is the interface between Array and battery bank. It protects the battery from overcharging and regulates the battery charging current. Therefore it enhances the life of the battery bank. It also indicates the charging status of batteries like battery undercharged, overcharged or deep discharged through LEDs indications. Some switches and MCBs are also provided for manual or accidental cut-off of charging. In some charge controllers load terminals are also provided through a low battery charge cut-off device so that it can protect the battery bank from deep discharge. Solar Charge Controller units for Indian Railways are manufactured as per RDSO Specification No.RDSO/SPN/187/2004

The technology adopted nowadays for manufacturing solar charge controller is MOSFET/IGBT technology. With this technology the idle current of the controller is less than 50 mA depending upon the rating of the charge controller and it's current. First the controller is connected to battery bank and then it is connected to Solar panel for sensing the voltage from the module. When the system is put into operation, the Solar panel starts charging the battery bank. Care should be taken that in no case the battery connections are removed from the controller terminals when the system is in operation, otherwise Solar panel voltage may damage the Charge controller, since the Solar voltage is always higher than the battery voltage.



SOLAR CHARGE CONTROLLER

LED indications of Charge Controller		
Sr. No.	**LED Color**	**Indication**
1.	RED	Battery LOW
2.	GREEN	Charging ON (SPV1 & SPV2)
3.	RED	Battery REVERSE
4.	RED	PV REVERSE

Field Junction Box (FJB):

FJB is the interface between Solar panels and the Charge Controller. All the incoming/outgoing cables/wires from Solar panel to Charge Controller are terminated at FJB.

Solar Module Mounting Structure:

This is made up of galvanized iron frames and angles. In this structure flexibility is provided to change the module-mounting angle seasonally. This structure is grouted by small civil work and modules are mounted subsequently. Also, this mounting structure should be earthed suitably at several places if voltage of the array is more than 50 Volts.

Earthing kit:

Earthing kit is provided to earth the mounting structure. Provision of earthing shall be done as follows:

- The installation shall have proper earth terminals and shall be properly earthed.
- Zonal Railways shall provide earthing arrangement as per IS: 3043 and directions issued by RDSO for Lighting and Surge protection for signaling equipment vide letter No. STS/E/SPD dated 22.06.2004.
- The earth resistance shall not be more than 2 ohm. Earth provided shall preferably be maintenance free using earth resistance improvement material.

Cables:

We require different types of cables to connect module to module, modules to charge controller, charge controller to battery, or connect battery to load as required. The cable size used for interconnection of SPV module, Charge Controller and battery shall be minimum 2 X 2.5 sq. mm Cu. Cable. As far as some hardware is concerned the screws and bolts/nuts are of Chrome plated, stainless steel and brass so that rusting shall not be take place.

Operation:

Operation of the solar power source is very simple. Once the system is installed, CHG. ON (Green) LED will glow during daytime and will indicate that the power is available for charging Battery Bank from SPV panel. Connect the equipment to be operated on solar power to the SPV Charge Control Unit at terminals marked 'LOAD' position.

Types of Solar Panels:

Solar panels are classified on the basis of the following points:

1) Crystalline Silicon (Mono/Poly/Amorphous)
2) Different Size or Area of cells
3) Type of cells & nos. (Rectangular/Circular/Square/ Pseudo-square/Semi-circular etc.)
4) Power (High/Mid/Low range)

The recommended values of output power from each module are 4, 6, 9, 12, 30, 32, 35, 40, 50, 70, 80 & 100 watts. The purchaser shall, however, specify the Output wattage of the module required by him.
The recommended nominal voltages of each module are 4, 6, 9, 12 & 24Volts.The purchaser shall, however, specify the voltage of the module required by him.

Demerits:

Initial cost is high. dependent on sunlight. Additional cost for storage battery.
Climatic condition, location, latitude, longitude, altitude, tilt angle, ageing, dent, bird dropping, etc. affect the output.It has no self-storage capacity. Manufacturing is very complicated process.To install solar panel large area is required.

Application of Solar Powered System for Signalling & Telecommunications
Almost all signalling and Telecommunication gears can be run by solar power. In Indian Railway, Signalling system is Solar powered in phased manner. Priorities are given to those locations where there is no conventional power or power transmission through cables is cost effective.

Questions:

1) Explain what is Photovoltaic effect

2) What is the difference between a solar module and a solar panel?

3) What is the purpose of Bypass Diode?

4) What is the purpose of a Blocking Diode?

5) What precaution is to be taken while connecting and disconnecting battery and load to Charge controller?

6) What are the current and wattage of Solar panel being used for Signalling applications?