AN INNOVATIVE APPROCH TO RENEWABLE ENERGY

SOLAR ASSISTED POWER BANK IN A BAG

Project work Done by

FAREENA FIROS

AB23PHY013

Under the guidance of

DR.FRINCY FRANCIS

Department of PhysicsandCenter forResearch,StTeresa's College (Autonomous), Ernakulam

In partial fulfillment of the requirements for the award of the degree of BACHELOR SCIENCE IN PHYSICS

St. Teresa's College (Autonomous), Ernakulam.

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CERTIFICATE

This is to certify that the project report entitled This is to certify that the project report entitled "AN INNOVATIVE APPROACH TO RENEWABLE ENERGY SOLAR ASSISTED POWER BANK IN A BAG" is the original work carried out by *FAREENA FIROS (AB23PHY013)* in the Department of Physics and Centre for Research at St Teresa's College, Ernakulam. This project was conducted under the supervision and guidance of ***Dr. FRINCY FRANCIS*** Assistant Professor. The completion of this project fulfills a part of the requirements for the degree of Bachelor of Science in Physics, during the academic year 2023-2026.The work presented in the dissertation has not been submitted for any other degree in this or any other University

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Head of the
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BSC. PHYSICS PROJECT REPORT

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Register number : AB23PHY013

Year of work : 2023 - 2026

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Dr. FRINCY FRANCIS
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Supervising guide

DATE : 16/04/26

EXAMINARS : 1 ....

2 ....

DECLARATION

I, **FAREENA FIROS** finalyear B.Sc. Physics students from Department of Physics, St. Teresa's College (Autonomous), Ernakulam, do hereby declare that the project work entitled **“AN INNOVATIVE APPROACH TO RENEWABLE ENERGY SOLAR ASSISTED POWER BANK IN A BAG"**has been originally carried out under the guidance and supervision of Smt. Dr. FRINCY FRANCIS, Assistant Professor, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, in partial fulfilment for the award of the degree of Bachelor of Physics. I further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to the best of my knowledge.

PLACE : ERNAKULAM

DATE :

FAREENA FIROS

ACKNOWLEGEMENT

I would like to offer my heartfelt gratitude to everyone who assisted me in reaching this point of fulfilment. First and foremost, I thank the Lord Almighty for His abundant mercy throughout this project. I am grateful to Dr. Fríncy Francis, St. Teresa's College (Autonomous), for her invaluable direction and regular monitoring, as well as for supplying vital project information and assistance in finishing the project. I want to thank all the teachers and non- teaching staff for their helpful advice and suggestions in completing the project. My gratitude and appreciation also go to everyone who has freely assisted us. Thank you all for your support and contributions.

ABSTRACT

This project aims to design and construct a solar power bank implemented in a bag that charges using solar energy. The technology enables users to charge their mobile devices in places where electricity is unavailable, making it especially useful during travel and during any calamities.One of the primary benefits of this project is reducing reliance on traditional energy sources such as fossil fuels by generating electricity from solar panels to power electronic gadgets, particularly during natural calamities and other situations where grid electricity is inaccessible. The renewable solar bag represents an innovative portable energy solution by integrating solar- assisted technology. It can also help lower energy bills and reduce environmental impact. This abstract explores the design, functionality, and environmental benefits highlighting its ability to harness solar energy for charging mobile devices, especially in emergency situations and challenging environments. Additionally, solar power is a renewable energy source that is continuously replenished, unlike finite fossil fuels.

MOTIVATION

The motivation behind incorporating a solar power bank unit into bag arises from growing concerns about sustain able energy solutions and the increasing reliance on electronic devices in today’s world. Integrating a solar charging unit into bags enables individuals to harness solar energy to charge their devices without depending on traditional electricity sources. Aligned with India’s new education policy that emphasizes equitable and inclusive development, this project represents a strategic and innovative initiative addressing the rising need for sustainable energy. Its primary objective is to provide a reliable and eco-friendly solution for charging mobile devices, especially during emergencies such as power outages, natural disasters like floods and hurricanes, or in areas with limited access to electricity. The solar power bank unit ensures rapid and convenient charging, helping individuals stay connected and access critical information without delay. By applying renewable energy to everyday essentials, the project promotes sustainable living practices and supports a greener future, moving toward a vision where sustainable energy becomes an integral part of daily life.

AN INNOVATIVE APPROCH TO RENEWABLE ENERGY

SOLAR ASSISTED POWER BANK IN A BAG

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1.INTRODUCTION

2.PROJECT ANALYSIS

3.DESIGN AND DEVELOPMENT

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CHAPTER 1
INTRODUCTION

1.1 RENEWABLE ENERGY

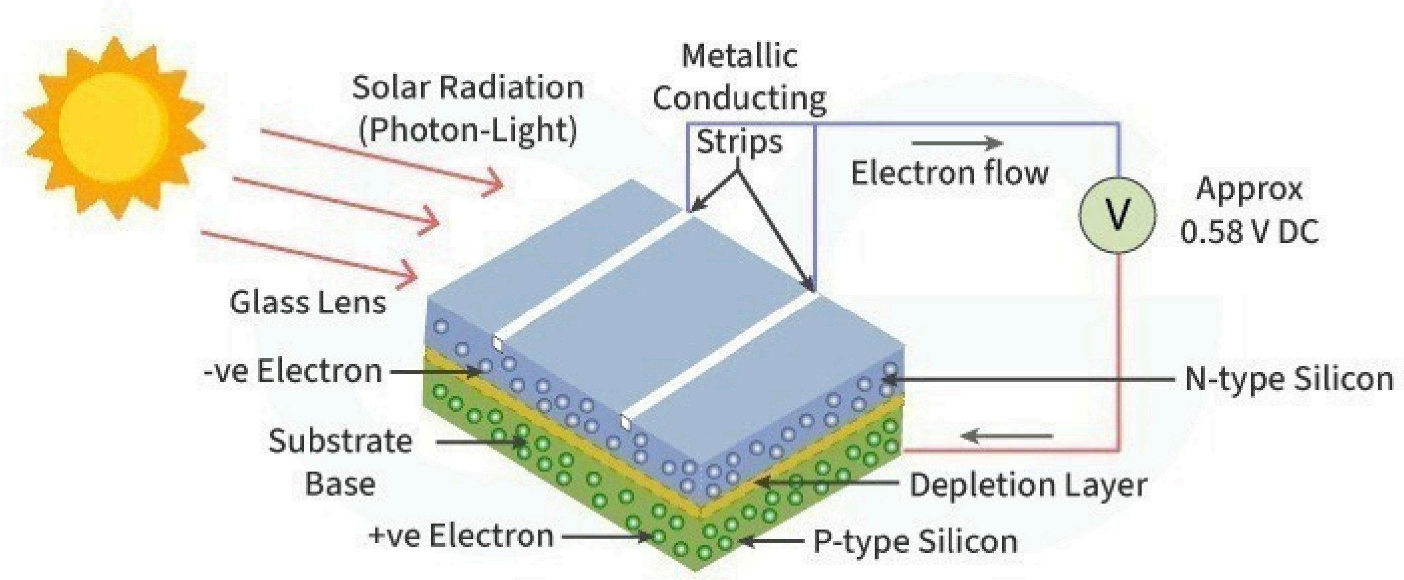
Renewable energyis energy derived from natural sources that are naturally replenished, such as sunlight, wind, water, and biomass. It is considered a sustainable and environmentally friendly alternative to conventional energy sources, as it reduces pollution and conserves non-renewable resources. Renewable energy plays an important role in meeting increasing energy demands while supporting environmental protection and sustainable development.

1.2 IMPORTANCE OF RENEWABLE ENERGY

Renewableenergy plays a vitalrolein meeting the growing global energy demand in a sustainable manner. It helps reduce dependence on fossil fuels, which are limited in supply and harmful to the environment. The use of renewable energy sources such as solar, wind, and hydro power significantly reduces greenhouse gas emissions and environmental pollution. Renewable energy is also economically beneficial in the long terminal, as it lowers energy costs and promotes energy security. Furthermore, it supports sustainable development by providing clean energy solutions and encouraging the efficient use of natural resources.

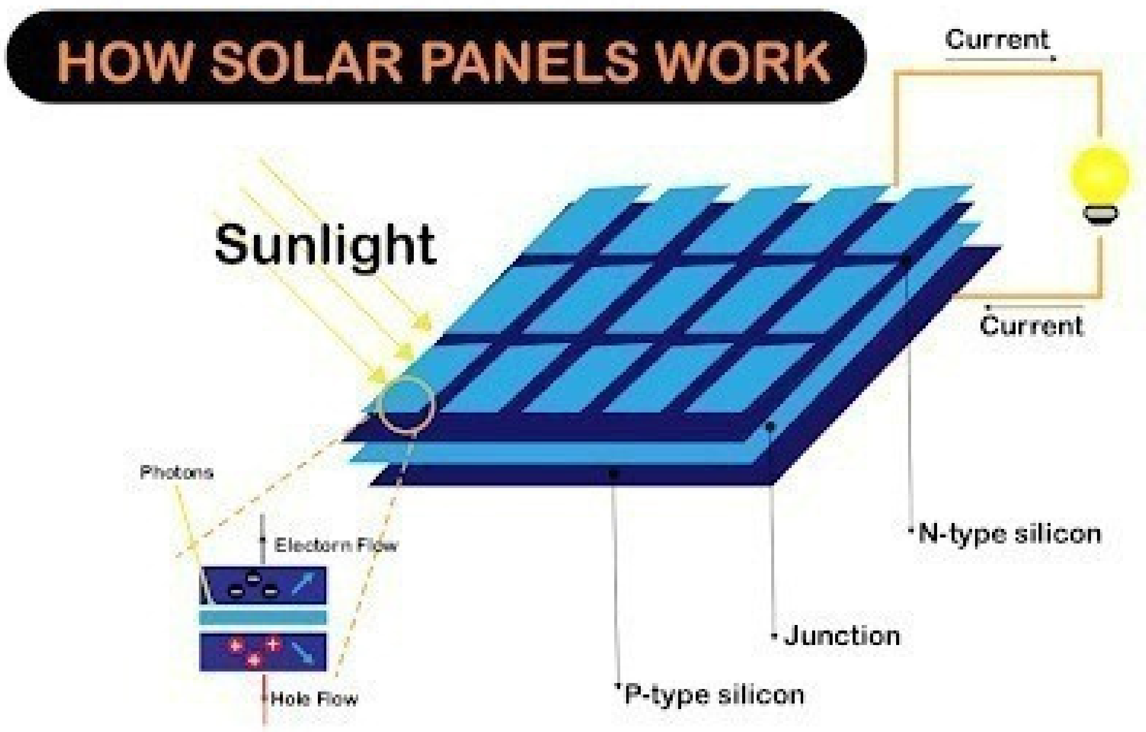
1.3 WORKING OF SOLAR CELL

A solar cell is a semiconductor device that converts solar energy directly into electrical energy by the photovoltail effect. It is made using a p–n junction, generally from silicon. When sunlight falls on the solar cell, photons with sufficient energy strike the semiconductor material an excite electrons from the valence band to the conduction band, creating electron–hole pairs. Due to the internal electric field present at the p–n junction, electrons move toward the n-type region while holes move toward the p type region. This separation of charges creates a potential difference across the terminals of the solar cell. When a external load is connected, electrons flow through the circuit, producing direct current (DC) electricity. Thus solar energy is converted into usable electrical energy without any moving parts or pollution.



1.4 SOLAR PANEL

A solar panel is a device made up of many interconnected solar cells arranged in series and parallel combinations to produce a usable amount of electrical power. Each sola cell works on the photovoltaic effect, converting sunligh directly into electricity. When sunlight falls on the plane photons energize electrons in the semiconductor matter (usually silicon), causing them to move and generat electric current. The electrical energy produced by a solar panel is in the form of direct current (DC). This DC power can be used directly, stored in batteries, or converted int alternating current (AC) using an inverter for household and industrial applications. Solar panels are clean renewable, and require very little maintenance, making them an important source of sustainable energy.



1.5 IMPORTANCE OF SOLAR CHARGING UNIT

A solar charging unit is an eco-friendly system that converts solar energy into electrical energy and stores it in batteries for later use. Its importance lies in the effective utilization of renewable energy, reducing dependence on fossil fuels and conventional electricity sources. Solar charging units provide a clean and sustainable method of charging electronic devices without causing environmental pollution. They are especially important in remote and rural areas where the power grid is unavailable or unreliable, ensuring an uninterrupted power supply for essential devices such as mobile phones, lamps, and medical equipment. These units help reduce electricity costs, promote energy independence, and support sustainable development. Due to their portability and low maintenance, solar charging units are widely used in emergency situations, outdoor activities, and as backup power systems.

1.6 SIGNIFICANCE OF SOLAR POWER BANK

A solar power bank is an innovative portable charging device that uses solar energy to store electrical power for later use. The significance of a solar power bank lies in its ability to utilize renewable energy efficiently while providing a reliable source of portable power. It reduces dependence on conventional electricity generated from non-renewable resources and helps in conserving energy.

Solar power banks are eco friendly as they produce no pollution and reduce carbon emissions. They are especially useful in remote and rural areas where access to grid electricity is limited. During power failures and emergency situations, a solar power bank serves as an effective backup power source for charging mobile phones and other small electronic devices. Moreover, solar power banks are cost-effective in the long run since they use free and abundantly available solar energy

Their use promotes sustainable development and creates awareness about the importance of renewable energy sources. Hence, solar power banks play a significant role in meeting portable energy needs while supporting environmen protection

1.7 COMPARISON BETWEEN NORMAL AND SOLAR POWER BANK

Normal charger	Solar power bank
▪ Works using electricity from the power grid ▪ Requires continuous AC power supply	▪ Works using energy from sunlight ▪ Does not require grid electricity

▪ Cannot be used during power cuts	▪ Can be used during power failure
▪ Consumes non-renewable energy indirectly	▪ Uses renewable solar energy
▪ Causes indirect environmental pollution	▪ Eco-friendly and pollution-free
▪ Not useful in remote areas without electricity	▪ Highly useful in remote and rural areas
▪ higher electricity cost over long use	▪ No electricity cost

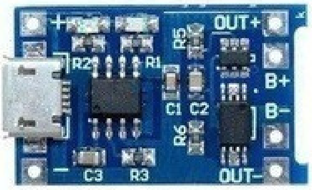
CHAPTER - 2

PROJECT ANALYSIS

2.1 AIM

Ourproject aimstodesign and develop asustainable solar power bank using renewable energy. In earlier designs, the use of multiple components and a buck–boost setup without a Battery Management System (BMS) and efficient modules led to several issues such as increased complexity, higher costs, errors, and performance problems like overheating , electrical noise and slow charging.The battery is vulnerable to overcharging or over-discharging, which can reduce its lifespan or cause damage. The absence of proper protection against overcurrent and short circuits also makes the system less reliable and unsafe. To overcome these challenges, we simplified the setup by reducing unnecessary components and incorporating a Battery Management System for safe and efficient operation. The system includes a solar panel for energy generation and a lithum ion battery for effective energy storage and supply .Two modules for converting sufficient energy form solar to battery and to boost the charge stored in the battery enabling reliable mobile device charging. A diode is used to overcome the discharging of the battery in the absence of sunlight.By harnessing clean solar energy and storing excess power for later use, the project provides a sustainable and eco- friendly charging solution. It demonstrates the feasibility of using solar energy in everyday applications, reduces dependence on conventional energy sources, and promotes a cleaner and more environmentally friendly future. a little bit of body text

2.2 MODULE ANALYSIS

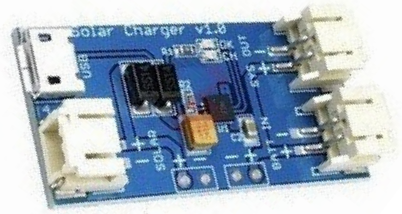


TP4056 Module

Module Type: Linear Lithium-ionbattery charging module (for single 3.7V Li-ion cell) **Input Voltage:** 4V – 8V (typically 5V from USB) **Charge Current**: Up to 1A (adjustable by resistor on board, usually set to 1A) **Features:** The TP4056 module is used to charge a single 3.7V lithium-ion battery safely. It follows the constant current–constant voltage (CC-CV) charging method. The final charging voltage is 4.2V. It has over-charge protection and charging status indicators (LEDs for charging and full charge). It is commonly used in power bank and portable electronics projects.

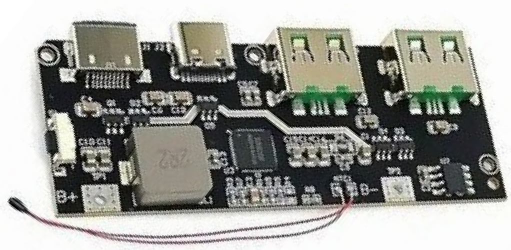
HT4928S Module

Module Type: DC-DC Boost Converter Module **Input Voltage**: 2V – 5V (commonly 3.7V from Li-ion battery) **Output Voltage**: 5V fixed output Output Current: Up to 1A (depends on battery condition) **Features**: The HT4928S module increases low battery voltage (3.7V) to 5V required for mobile charging. It is highly efficient and suitable for power bank applications. It provides stable 5V output and may include USB output ports.



CN3065 Solar Li-ion Charger Module

Module Type: Solar Lithium-ion Battery Charging Module **Input Voltage**: 4.4V – 6V (from solar panel) **Charge Current**: Up to 1A (adjustable) **Features**: The CN3065 module is specially designed for charging 3.7V lithium-ion batteries using solar panels. It supports constant current and constant voltage charging. It has automatic recharge and charging status indication. It is suitable for solar power bank and solar lighting systems.



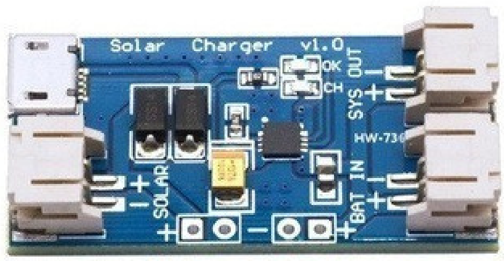
IP5328P module

The fast charging module is an electronic circuit board designed to charge lithium-ion batteries and supply fast charging output through USB ports. It has a micro-USB input port for charging the battery and one or more USB output ports to charge mobile devices. The module includes a boost converter circuit that increases the battery voltage (3.7 V) to a stable 5 V output require for mobile charging. It also supports higher current output such as A or 3 A for fast charging. The module contains LED indicators t show the battery charging level and charging status. It also provide protection features such as over-charge protection, over- discharg protection, and short-circuit protection. This module is commonl used in power banks, solar power banks, and portable charging systems.

CN3791 MPPT Solar Module

Module Type: MPPT Solar Lithium-ion Charger Controller **Input Voltage**: 4.5V – 28V (supports higher solar panel voltage) **Charge Current**: Up to 2A (adjustable) **Features**: The CN3791 module includes MPPT (Maximum Power Point Tracking) technology, which increases solar charging efficiency. It automatically adjusts to extract maximum power from the solar panel. It provides efficient and safe charging for lithium batteries. It is ideal for advanced solar power bank systems.

HW-736 Module



Module Type: DC-DC Boost Converter (Adjustable) **Input Voltage**: 2V – 24V (varies by model) **Output Voltage**: Adjustable (commonly up to 28V) Output Current: Up to 2A (depends on input voltage) **Features**: The HW-736 module is a voltage booster used to increase low DC voltage to a higher level. The output voltage can be adjusted using a potentiometer. It is widely used in power supply circuits, battery-powered systems etc

2.3 DIODE ANALYSIS

<u>IN5819 SCHOTKY DIODE</u>

The IN5819 is a Schottky barrier rectifier diode

commonly used in low-voltage and high-efficiency power circuits. It has a maximum reverse voltage rating of 40 V and a forward current rating of 1 A. One of its main advantages is its very low forward voltage drop, typically between 0.2 V and 0.45 V, which is much lower than that of ordinary silicon diodes. Because of this low voltage drop, it produces less heat and improves overall circuit efficiency. The 1N5819 also has a very fast switching speed and almost zero reverse recovery time, making it suitable for high-frequency applications such as boost converters, SMPS circuits, and solar power banks. In solar charging systems, it is mainly used to prevent reverse current flow from the battery back to the solar panel, thereby protecting the circuit and improving performance.

2.4 PANEL ANALYSIS

Round Panel: 6V 80mAh Polycrystalline, Peak power: 0.48 Watt. Working current: 0–330mA (2W), 0–56mA (0.28W). Working voltage: 6V (2W), 5V (0.28W).

Square Panel:
6V 100mAh Polycrystalline, Max output power: 0.72W. Max working voltage: 6.6V. Max charging current: 110mA. Min output power: 0.6W. Min working voltage: 6V. Min charging current: 100mA. Weights 33g.

Rectangular Panel: The rectangular panel is a 6V, 600mAh polycrystalline solar panel with a maximum power output (Pmax) of 3.6 watts under standard test conditions (STC). It has an open circuit voltage (Voc) of 7.20V DC and a short circuit current (Isc) of 0.60A. The maximum voltage at peak power (Vmpp) is 6.00V DC, while the maximum current at peak power (Impp) is 0.58A.

2 .5 BATTERY ANALYSIS

A Lithium-ion battery is are chargeable battery widely used in electronic devices suchas mobile phones, laptops, and power banks. It works on the principle of movement of lithium ions between the anode and cathode. During charging, lithium ions move from the cathode to the anode, and during discharging, they move back to the cathode, producing electric current. A single Lithium-ion cell provides a nominal voltage of about 3.7V and can be charged up to 4.2V. It has high energy density, lightweight construction, low self-discharge rate, and no memory effect. The battery shows stable voltage output during discharge and has high efficiency. It can be recharged for

2.6 COMPONENTS SELECTION

Afterconducting a thorough comparisonof various

modules, we have finalized our selection for the solar-powered project. Our chosen components include:

Solar Panel: A 3.7V solar panel with a capacity of 600mA, which will efficiently harness solar energy to power our project.

lithium-ionbattery : Ithasanominalvoltageof3.7V.For example, a 3.7V, 1000mAh lithium-ion batterycan supply 1000mA for 1 hour or 500mA for 2 hours.

Modules used :
TheHW-736isasmall DC-DC step- up (boost) converter module commonly used in power bank projects. It converts a 3.7V lithium battery voltage to a stable 5V output, which is required to charge a mobile phone.

fast charging power bank module : used to charge mobile phones quickly. It is designedtoworkwith a 3.7V lithium-ion battery such as an 18650 cell. The module boosts the battery voltage from 3.7V to a stable 5V output, which is required for USB charging. Since it supports up to 3A current, it can charge compatible devices faster than normal 1A charging modules. It usually includes battery level indicator LEDs, a USB output port, and charging input terminals.
This type of module is commonly used in DIY power banks and solar power bank projects to provide efficient and faster mobile charging.

CHAPTER - 3 DESIGN AND DEVELOPMENT

The solar power bank in a bag is an innovative product that integrate a solar panel, modules, lithium ion battery and usb connectivity to charge mobile on- the go

3.1 OBJECTIVES

• To design and develop a solar assisted mobile charging system using photovoltaic technology.
• To convert solar energy into electrical energy efficiently using a solar panel.
• To store the converted energy in a rechargeable lithium-ion battery for later use.
• To implement a HW-736 charging module to ensure safe and controlled battery charging.
• To use a fast charging module to provide a stable 5V USB output.
• To provide a user-friendly USB interface for charging mobile phones and other electronic devices.
• To develop an eco-friendly, portable, and reliable power solution for everyday and emergency use.

3.2 MATERIALS AND COMPONENTS

- Solar panel with output voltage 6v output current is 0.58A
- Lithium ion battery with capacity of 6600 mah

- HW-736 Module: used to convert solar energy to battery and into the IP5328P module IP5328P Module : the fast charging module ensures that the stored energy from the
- lithium-ion battery is delivered efficiently and safely to the mobile phone. Usb type c an output port for device charging a little bit of body text

3.3 PROTOTYPE DEVELOPED

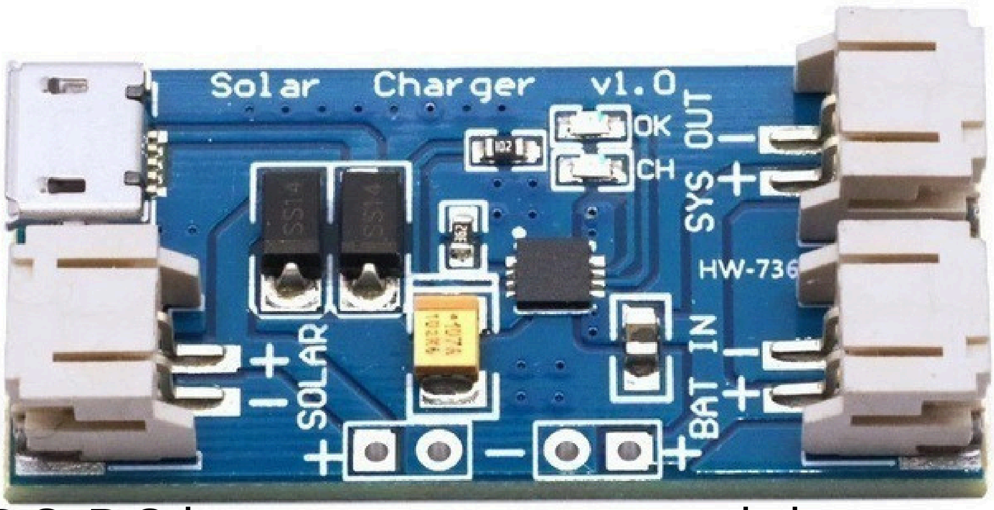
A solar power bank that uses a solar panel, CN3065, 1N5819, IP5328P, and a lithium-ion battery works in a systematic way to convert, store, and supply energy. When sunlight falls on the solar panel, it converts solar energy into DC electrical energy. This generated voltage first passes through the 1N5819 Schottky diode, which prevents reverse current flow from the battery back to the solar panel, especially at night. The power then goes to the CN3065 solar Li-ion charger module. The CN3065 regulates the voltage and current using the constant current–constant voltage (CC-CV) charging method to safely charge the 3.7 V lithium-ion battery. It ensures that the battery is not overcharged and automatically stops charging when the battery reaches about 4.2 V. The lithium-ion battery stores the electrical energy in chemical form. When a mobile phone or other device is connected to the USB output, the IP5328P m lower than the required USB voltage (5 V), the IP5328P connected to the USB output, the IP5328P module comes into action. Since the battery voltage (3.7 V) is lower than the required USB voltage (5 V), the IP5328P boosts the voltage to a stable 5 V output. It also provides fast charging support and multiple protection features such as overcharge, over-discharge, overcurrent, and short circuit protection. Thus, the solar panel generates power, the diode protects the circuit, the CN3065 charges the battery safely, the lithium-ion battery stores energy, and the IP5328P converts and delivers stable output power to charge electronic devices.

3.4 WORKING PRINCIPLE

When sunlight falls on the solar panel, it converts solar energy into DC electricity. This power passes through the 1N5819, which prevents reverse current flow. The electricity then goes to the CN3065, which safely charges the 3.7 V lithium-ion battery using proper voltage and current control. The battery stores the energy. When a mobile phone is connected, the IP5328P boosts the battery voltage from 3.7 V to a stable 5 V USB output and provides protection features. Thus, the system generates, stores, and supplies power efficiently.

3.5 TECHNICAL SPECIFICATIONS

<u>HW-736m odule</u>



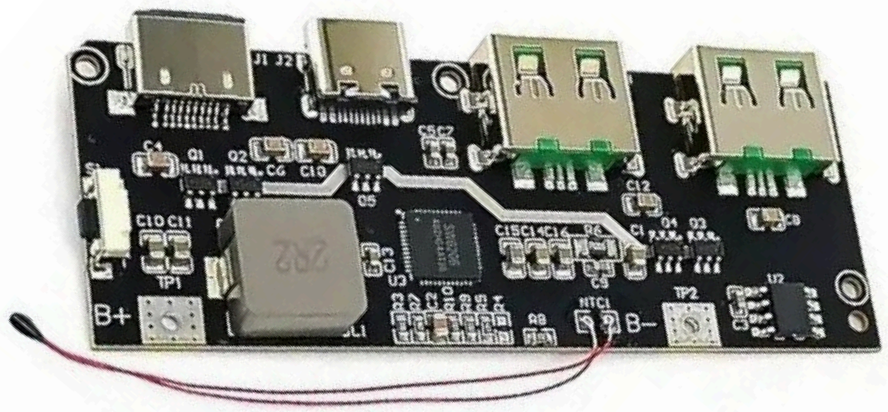
- It is a DC-DC boost converter module.
- It increases low DC voltage to a higher voltage.
- Converts 3.7 V battery voltage to 5 V output.
- Provides stable and regulated output.
- Suitable for USB charging applications.
- Compact and easy to use in small projects

- Used in power banks and portable devices.
- Offers good efficiency with low power loss

Features of HW-736

- Step-up (boost) voltage conversion
- Converts 3V–4.2V to stable 5V output
- Regulated and constant output voltage
- High efficiency operation
- Compact and lightweight design
- Suitable for USB charging
- Low heat generation
- Easy to connect with lithium-ion battery
- Protection features (short circuit / overcurrent in some versions) a little bit of body text

IP5328P MODULE



The IP5328P module is a highly integrated power bank management module used for lithium-ion battery charging and output boosting. It is mainly designed for portable power banks and supports both battery charging and mobile phone charging

functions in a single chip.

Features

- Supports 3.7 V lithium-ion g.
- Provides 5 V USB output for mobile charging.
- Built-in boost converter (3.7 V to 5 V).
- Supports fast charging in some versions.
- Automatic battery level detection.
- Built-in overcharge protection.
- Built-in over-discharge protection.
- Short circuit and overcurrent protection.
- High efficiency and low power loss.
- Compact and suitable for power bank projects
-

IN5819 SCHOTTKY DIODE

What is a Schottky diode? A Schottky diode is a special type of diode that uses a metal– semiconductor junction instead of a normal PN junction. Because of this:

- It switches very fast
- It has low voltage drop
- It produces less heat

SOLAR PANEL

Type: Polycrystalline solar panel Maximum Power (Pmax): 3.6 Watt Open Circuit Voltage (Voc): 7.2 V DC Short Circuit Current (Isc): 0.60 A Maximum Power Voltage (Vmpp): 6.0 V DC Maximum Power Current (Impp): 0.58 A Output Port: Type-A Female USB Standard Test Condition (STC): 1000 W/m² irradiance

Function in Project

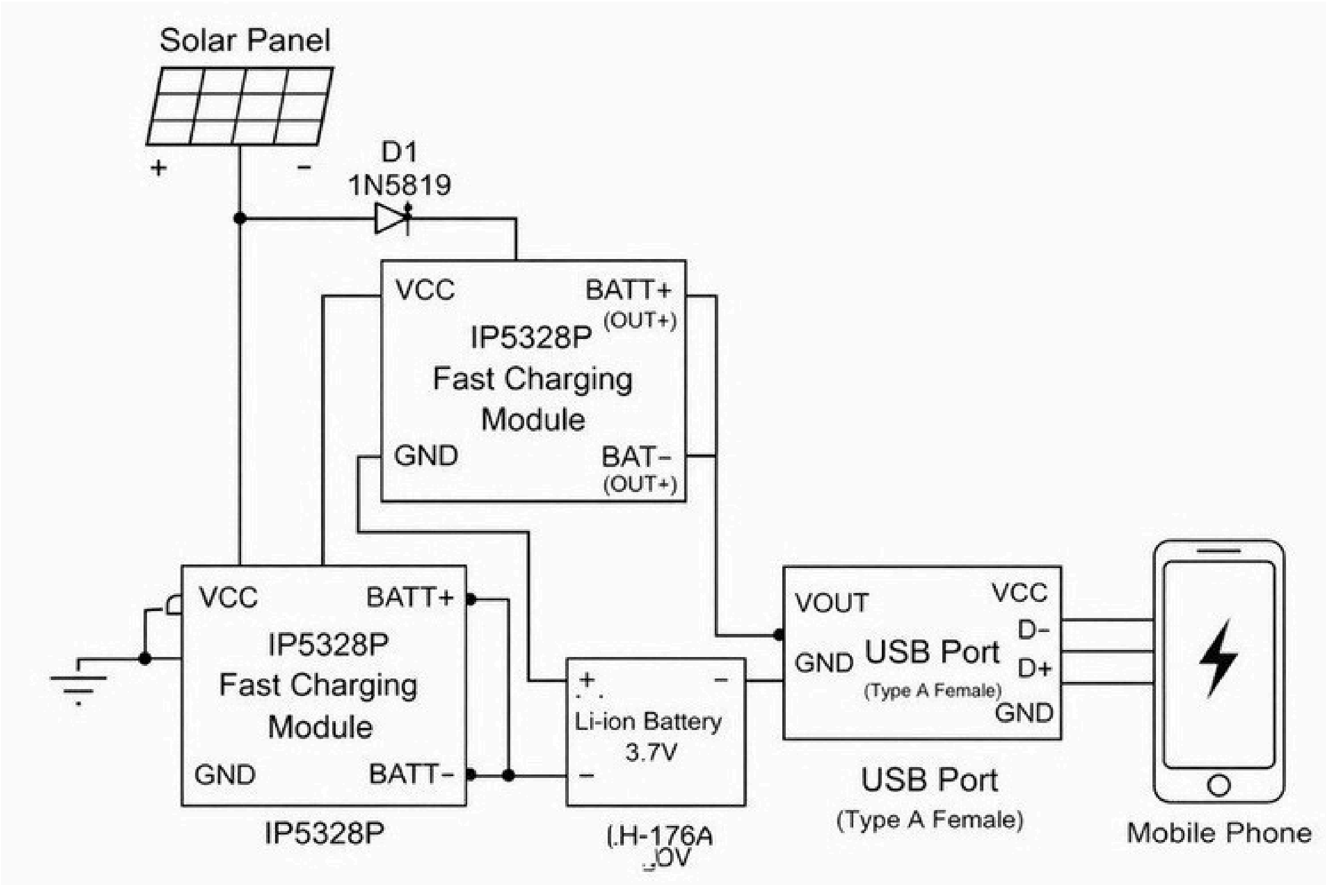
Converts sunlight into electrical energy

Supplies power to the charging module

Charges the 3.7V lithium-ion battery.

Stores energy in the battery for later mobile charging.

3.6 CIRCUIT DIAGRAM



3.7 RESULT AND OBSERVATIONS

The experiment wasconductedto measure the charging time of a mobile phone using a solar panel. The time taken to reach specific percentages of charge was recorded and plotted graph. Initially, it was observed that approximately 1.5 minutes were required to charge the battery by 1%. As the experiment progressed, slight variations in charging time were noticed when the battery level approached higher percentages. The graph illustrates the relationship between charging percentage and time, showing a gradual increase until the battery reached full charge. The total time taken for the battery to reach 100% charge was 1 hour and 45 minutes.

CHAPTER 4
CONCLUSION

4.1 FINDING AND INSIGHTS

solarpower bank ofeffectivelydemonstratetheintegration renewable energy technology into daily usable and portable products. It showcases a practical solution to one of the common modern- day challenges—keeping mobile devices charged while on the move. The inclusion of HW-736 and fast charging modules enhanced the system's performance, stability, and safety. This project not only contributes to the development of sustainable technology but also serves as a stepping stone for future innovations to provide a charging system to use anywhere and green energy applications.

4.2 INTEFERNCE The Time taken for 100% charging was 1 hour

30 minutes
From the overall testing and analysis of the solar power bank, it is clearly understood that the solar panel and battery perform two different but connected functions. The solar panel converts solar energy (sunlight) into electrical energy through the photovoltaic effect. However, it does not store this energy. The electrical energy generated is directed to a rechargeable battery, which stores the charge chemically for later use.

4.3 DISCUSSION

The solar p ower bank project demonstrates the practical application of renewable energyinportable electronic devices. It successfully integrates a solar panel, rechargeable battery, charging module, and voltage regulation system into a compact and user-friendly design. The system shows that solar energy can be effectively converted, stored, and reused for charging mobile phones and other small electronic devices.

Overall,t he projectprovesthatsolar-poweredcharging systemsa re feasible fordailyuse and canbe further improved with higher efficiency solar panels, better battery technology, and advanced power management systems.

4.4 FUTURE SCOPE

The futurescope of a solarpower bank made using a lithium-ion battery and fastcharging sourcesisvery promising. As the use of sma rtphones and electronic gadgets continues to increase, the demand for portable and eco-friendly charging solutions will also grow. Solar power banks provide clean energy by using sunlight and reduce dependence onconventional electricity.

solar power banks can be widely used in rural and remote areas where electricity supply is limited. They will also be useful during travel, camping, and emergency situations such as power cuts and natural disasters. As renewable energy usage increases in countries like India, solar power banks will become an important, affordable, and sustainable power solution for daily life.

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