SOLAR ASSISTED MOBILE CHARGER

PROJECT REPORT

Submitted by

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Register no: AB21PHY014

Under the guidance of

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Submitted to

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ST. TERESA'S COLLEGE (AUTONOMOUS)

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THE FEAR OF THE LORD IS THE BEGINNING OF WISDOM

ST. TERESA'S COLLEGE (AUTONOMOUS) ESTD 1925

CERTIFICATE

This is to certify that the project report entitled 'SOLAR ASSISTED MOBILE CHARGER' is an authentic work done by ASHA ELDHOSE St. Teresa's College, Ernakulam , under my supervision at the Department of Physics St. Teresa's College for the partial requirement for the award of Degree of Bachelor of Science in Physics during the academic year 2023-2024. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

Ms. Minu Pius
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Place: ERNAKULAM

Date: 29/04/2024

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BSC PHYSICS

PROJECT REPORT

ASHA ELDHOSE

Register no: AB21PHY014

Year of work: 2023-2024

This is to certify that this project work entitled 'SOLAR ASSISTED MOBILE CHARGER' is an authentic work done by ASHA ELDHOSE.

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Date: 29/04/2024

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3

DECLARATION

ASHA ELDHOSE final year B.Sc Physics student, Department of Physics, St Teresa's College, Ernakulam do hereby declare that the project work entitled **'SOLAR ASSISTED MOBILE CHARGER'** has been originally carried out under the guidance and supervision of Ms. MINU PIUS, Assistant Professor, St Teresa's College(Autonomous), Ernakulam in partial fulfillment for the award of the degree of Bachelor of Physics. I further affirm that this project is not being presented in part or entirely for any other purpose and that the data provided in the project is accurate to the best of our knowledge.

Place: ERNAKULAM

ASHA ELDHOSE

Date: 29/04/2024

ACKNOWLEDGEMENT

I would like to extend my sincere gratitude and appreciation to all the individuals involved in this successful implementation of the Solar Assisted Mobile Charger project. I thank the Lord Almighty for his abundant mercy throughout this project. I am grateful for the support received from our project guide Ms. Minu Pius , 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. The encouragement and guidance received from all the teachers and non-teaching staffs did help us in completing the project. My gratitude and appreciation also go to everyone who has freely assisted us.

ABSTRACT

A solar powered smart phone charger was constructed in this project and the experiment was repeated with increasing a number of solar panels and the rate of charging was checked in different inclination. Solar mobile charger use energy from sun to create the power needed to charge the phone's battery, there will always be a plentiful supply of solar energy because it is one of the main renewable energy sources. In this project we studied the V-I characteristics of many solar panels with varying voltages and current under varied lighting circumstances. Comparing the charging time of the panel under direct sunlight and on AC mains at 1% is how the panels performance is assessed. Mobile phone charging is investigated for the range of tilt angles and light levels.

SOLAR ASSISTED MOBILE CHARGER

CONTENTS

INTRODUCTION

As the demand for clean and renewable energy sources continues to rise, the introduction of solar mobile chargers has gained significant traction in both commercial and consumer markets. These innovative devices harness the power of sunlight to efficiently convert solar energy into electricity, providing a convenient and environmentally-friendly solution for charging various electronic devices on the go. With advancements in technology, modern solar mobile chargers are equipped with high-efficiency solar panels, portable batteries, and multiple charging ports to accommodate different devices simultaneously. Additionally, these chargers offer versatility by being lightweight, compact, and easy to carry, making them ideal for outdoor activities or emergencies when traditional charging methods are unavailable. Overall, the introduction of solar mobile chargers showcases a promising shift towards sustainable practices in meeting our daily energy needs.

1.1 RENEWABLE AND NON RENEWABLE ENERGY

Renewable and non-renewable energy sources are two distinct types of energy that serve as the foundation of our modern world. Renewable energy sources, such as wind, solar, and hydro power, are derived from natural resources that can be replenished and are considered sustainable in the long run. On the other hand, non-renewable energy sources, such as fossil fuels and nuclear power, are derived from finite resources that will eventually be depleted.

1.1.1 ADVANTAGES OF RENEWABLE ENERGY OVERNON-RENEWABLE ENERGY

Renewable energy sources have increasingly gained attention as a sustainable and environmentally friendly alternative to non-renewable energy sources. The advantages of renewable energy over non-renewable energy are numerous, with perhaps the most significant benefit being its infinite supply. Unlike fossil fuels, which are finite and non-renewable, renewable energy sources such as solar, wind, and hydroelectric power are abundant and inexhaustible. This ensures a continuous and reliable energy supply for future generations without depleting valuable resources.

Another notable advantage of renewable energy over non-renewable energy is its reduced environmental impact. Fossil fuels release harmful pollutants and greenhouse gases into the atmosphere when burned for energy, contributing to global warming and air pollution. In contrast, renewable energy sources produce little to no emissions, making them a cleaner and more sustainable option for meeting energy demands. By transitioning to renewable energy, we can significantly decrease our carbon footprint and mitigate the negative effects of climate change.

Additionally, renewable energy sources offer economic benefits by creating new job opportunities and stimulating growth in the green energy sector. Investing in renewable energy technologies and infrastructure not only reduces our dependency on imported fossil fuels but also drives innovation and competitiveness in the market. As the demand for renewable energy continues to grow, there are increasing opportunities for research and development, manufacturing, and installation of renewable energy systems, all of which contribute to economic growth and job creation. Overall, the advantages of renewable energy over non-renewable energy are clear, with a shift towards sustainable energy sources essential for a cleaner, healthier, and more prosperous future.

1.2 IMPORTANCE OF SOLAR ENERGY

Solar energy is becoming increasingly important as the world shifts towards more sustainable and renewable sources of energy. One of the key advantages of solar energy is its environmental benefits. Solar power produces significantly lower greenhouse gas emissions compared to traditional fossil fuels, making it a cleaner and greener energy option. By harnessing the power of the sun, we can reduce our reliance on nonrenewable resources and help combat climate change.

In addition to its environmental advantages, solar energy also offers economic benefits. As the technology continues to improve and costs decrease, solar power has become more affordable and accessible to a wider range of consumers. This means that individuals, businesses, and governments can save money on their electricity bills while also supporting the growth of a sustainable energy industry. Furthermore, solar power can provide energy independence and security, as it is not subject to fluctuations in fuel prices or supply chain disruptions. Overall, solar energy is a crucial component of the transition to a more sustainable and resilient energy system.

1.3 SOLAR PHOTOVOLATIC (PV) TECHNOLOGY

Solar photovoltaic technology, also known as solar PV, is a rapidly growing renewable energy source that harnesses the power of sunlight to generate electricity. This technology utilizes solar panels, typically made of silicon cells, to convert sunlight into direct current (DC) electricity. The electricity produced by solar PV systems can be used to power homes, businesses, and even entire communities, providing a clean and sustainable energy alternative to traditional fossil fuels.

One of the key advantages of solar photovoltaic technology is its ability to reduce dependence on non-renewable energy sources, such as coal and natural gas, which contribute to air pollution and climate change. By harnessing the power of the sun, solar PV systems can help to decrease greenhouse gas emissions and combat global warming. Additionally, solar PV technology can also provide economic benefits, as it creates jobs in the renewable energy sector and can help to lower electricity bills for consumers. Overall, solar photovoltaic technology represents a promising solution to the challenges of climate change and energy security, and its continued growth and development will play a crucial role in transitioning towards a more sustainable energy future.

1.4 SOLAR PANEL DESIGN AND COMPONENTS

The most common design for solar panels consists of multiple solar cells connected in series and parallel circuits to generate the desired amount of electricity. The design also includes a protective covering made of tempered glass to shield the delicate solar cells from environmental factors such as rain, snow, and UV radiation. Furthermore, the design of the solar panel includes a junction box where the electrical components are housed, such as diodes and wiring, to ensure the smooth flow of electricity.

1.4.1 SOLAR CELL

Solar cells, also known as photovoltaic cells, are devices that convert sunlight into electricity using the photovoltaic effect. This renewable energy technology has gained significant traction in recent years as a clean and sustainable alternative to traditional fossil fuels. By harnessing the power of sunlight, solar cells produce electricity without emitting harmful greenhouse gases or other pollutants that contribute to climate change. Additionally, advancements in solar cell technology have led to increased efficiency and affordability, making it a viable option for widespread adoption in residential, commercial, and industrial applications. As the demand for clean energy solutions continues to grow, solar cells represent a promising avenue for reducing dependence on fossil fuels and mitigating the impacts of climate change. There are different types of solar cells. They are :

- Monocrystalline solar cell
- Polycrystalline solar cell
- Thin film solar cell

1.4.1a MONOCRYSTALLINE SOLAR CELL

Monocrystalline solar cells are a type of photovoltaic cell that is manufactured using single crystal silicon. These cells are known for their high efficiency levels, typically ranging from 15-20%, making them one of the most efficient types of solar cells available on the market. The purity and uniformity of the silicon crystal structure in monocrystalline cells allows for better electron movement, resulting in higher energy conversion rates. Although monocrystalline solar cells are more expensive to produce compared to other types of solar cells, their efficiency and longevity make them a popular choice for residential and commercial solar installations.

1.4.1b POLYCRYSTALLINE SOLAR CELL

Polycrystalline solar cells are a type of solar photovoltaic technology that utilizes multiple silicon crystals to convert sunlight into electricity. These cells are known for their cost-effectiveness and efficiency, making them a popular choice for residential and commercial solar installations. The unique structure of polycrystalline cells allows for higher power output and improved performance in varying lighting conditions.

1.4.1c THIN FILM SOLAR CELL

Thin film solar cells are a promising technology in the field of renewable energy due to their potential for cost-effectiveness and versatility. These solar cells are made by depositing a thin layer of photovoltaic material onto a substrate, allowing for flexibility in design and application. With advancements in materials science and manufacturing techniques, thin film solar cells have shown improved efficiency and durability, making them a viable option for solar energy generation. Research in this area continues to push the boundaries of efficiency and affordability, with the goal of making thin film solar cells a competitive alternative to traditional silicon-based solar panels.

1.4.2 GLASS

Solar cell glass, also known as photovoltaic glass, is a specialized type of glass that is designed to harness solar energy and convert it into electricity. This innovative technology integrates photovoltaic cells directly into the glass, allowing buildings and structures to generate their own renewable energy while maintaining a sleek and modern aesthetic. By utilizing solar cell glass, not only can we reduce our reliance on fossil fuels and decrease our carbon footprint, but we can also create more sustainable and energy-efficient buildings. With advancements in solar cell technology and the increasing demand for renewable energy sources, solar cell glass presents a promising solution for transitioning towards a cleaner and more sustainable future.

1.4.3 ALUMINIUM FRAME

Solar aluminium frames play a crucial role in the construction and installation of solar panels, as they provide structural support and protection for the panels. The use of aluminium in these frames is advantageous due to its lightweight nature, corrosion resistance, and high strength-to-weight ratio. These properties make aluminium frames ideal for withstanding harsh environmental conditions and ensuring the longevity of the solar panel system. Additionally, aluminium frames can be easily recycled, aligning with the sustainability goals of the solar industry. Overall, the use of aluminium frames in solar panel systems represents a smart and practical choice for achieving energy efficiency and environmental sustainability.

1.4.5 JUNCTION BOX

A solar junction box is a crucial component in a solar panel system, serving as the connection point between the solar panels themselves and the rest of the system. This junction box houses the wiring, connectors, and diodes necessary to ensure the efficient and safe transmission of electricity generated by the solar panels. By directing the flow of electricity and protecting against potential damage from overloading or short circuits, the junction box plays a critical role in ensuring the overall performance and longevity of the solar panel system. Additionally, junction boxes often come equipped with monitoring capabilities that provide valuable data on the performance of the system, allowing for timely maintenance and troubleshooting. Overall, the solar junction box is a small but essential component that contributes significantly to the success of solar energy systems.

1.5 SOLAR SYSTEM INSTALLATION

Solar system installation is an intricate process that requires careful planning and execution to ensure optimal performance and efficiency. The first step in the installation process is site assessment, where factors such as roof angle, shading, and available sunlight are evaluated to determine the best location for solar panels. Once the site has been chosen, the next step is system design, where the size and layout of the solar array are determined based on the energy needs of the property. Finally, the actual installation involves mounting the solar panels on the roof or ground, connecting them to the electrical system, and testing the system to ensure everything is functioning properly.

Once the site assessment is complete and the system design has been finalized, the next step is the actual installation of the solar panels. This involves mounting the panels on the roof or ground, connecting them to the electrical system, and ensuring that everything is properly aligned and secured. The installation process requires careful attention to detail and precision toensure that the system operates efficiently and safely. It is also important to comply with local building codes and regulations to ensure that the installation meets all necessary requirements.After the panels are installed, the final step in the process is commissioning and testing the system to ensure it is functioning properly. This involves checking all connections, testing the performance of the system, and verifying that it is producing the expected amount of energy. Once the system has been commissioned, the installer will provide the property owner with information on how to monitor and maintain the system to ensure its long-term performance. Solar system installation requires expertise and attention to detail to ensure that the system operates efficiently and effectively, providing clean and renewable energy for years to come.

1.6 SIGNIFICANCE OF SOLAR MOBILE CHARGERS

In today's fast-paced world, staying connected is essential. Mobile phones have become a crucial tool for communication, work, and entertainment. However, with the constant use of mobile phones, it is important to ensure that they remain charged throughout the day. This is where the significance of solar mobile chargers comes into play. These chargers allow users to charge their phones on-the-go, without the need for a traditional power source. This is especially useful for individuals who are constantly on the move or in areas where access to electricity is limited.

Furthermore, solar mobile chargers are not only convenient but also environmentally friendly. By harnessing the power of the sun, these chargers eliminate the need for electricity generated from fossil fuels. This helps reduce our carbon footprint and promotes sustainable practices. As the world becomes more conscious of the impact of climate change, solar mobile chargers are a small but important step towards a cleaner and greener future.

Moreover, solar mobile chargers are also a cost-effective solution in the long run. While the initial investment may be higher compared to traditional chargers, the savings on electricity bills can be significant over time. Additionally, with advancements in technology, solar chargers have become more efficient and reliable, making them a practical choice for individuals looking to reduce their energy consumption and save money. In conclusion, the significance of solar mobile chargers lies in their ability to provide a sustainable and convenient charging solution for mobile devices, while also contributing to a greener environment and offering long-term cost savings.

1.7 SOLAR PANELS CONNECTED IN SERIES

The concept of parallel connected solar panels refers to the configuration in which multiple solar panels are connected side by side to combine their individual output currents, thus increasing the overall system's power capacity and efficiency. This arrangement allows for a more flexible design and greater scalability in solar power systems, as it enables the integration of additional panels without significantly affecting the performance of the entire system. Moreover, parallel connection also offers advantages in terms of fault tolerance and maintenance, as the failure of one panel does not necessarily result in the loss of power generation from the entire system. Overall, the parallel connected solar panel configuration represents a sophisticated and effective approach to harnessing solar energy for sustainable power generation.

1.8 COMPARISON BETWEEN NORMAL AND SOLAR MOBILE CHARGES

As technology continues to evolve and become increasingly integrated into our daily lives, the need for convenient and efficient charging solutions for our mobile devices is more important than ever. When comparing normal mobile chargers to solar mobile chargers, several key differences arise. Normal chargers rely on traditional electricity sources, which can be limiting in terms of availability and sustainability. On the other hand, solar chargers harness the power of the sun to generate electricity, providing a renewable and environmentally-friendly alternative. While normal chargers may offer faster charging speeds, solar chargers are ideal for outdoor activities or in areas where access to electricity is limited. Ultimately, the choice between a normal and solar mobile charger depends on individual needs and priorities, with sustainability and convenience playing key roles in the decision-making process.

CHAPTER 2
VI CHARACTERISTICS OF SOLAR CELL

2.1 VI CHARACTERISTICS OF SOLAR CELL

The V-I characteristics of a solar cell refer to the relationship between the voltage applied across the cell and the current produced by it. This relationship is crucial in understanding the behaviour and efficiency of a solar cell. Typically, the V-I curve of a solar cell shows that as the voltage increases, the current also increases until it reaches a maximum value known as the short-circuit current. Beyond this point, the current starts to decrease as the voltage increases, leading to the open-circuit voltage. The shape of the V-I curve can provide valuable information about the performance and quality of a solar cell, helping researchers and engineers optimize its efficiency and output. Understanding and analysing the V-I characteristics of solar cells is essential in the development of more efficient and reliable solar energy technologies. Some parameters are given below,

Isc = Short circuited current
Voc = Open circuited voltage
Im = Maximum current
Vm = Maximum voltage

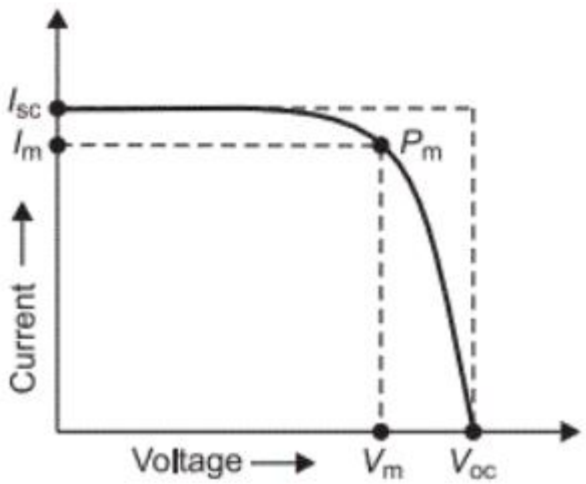
In order to find the efficiency of solar panel we need to find fill factor

Fill factor :- It is the ratio of maximum possible power to the actual power output

$$\text{Fill factor} = \frac{\text{Imax X Vmax}}{\text{Voc X Isc}}$$

$$\text{Efficiency} = \frac{\text{Imax X Vmax}}{\text{l X b X 10}}$$

where l and b are the length and breadth of the solar panel

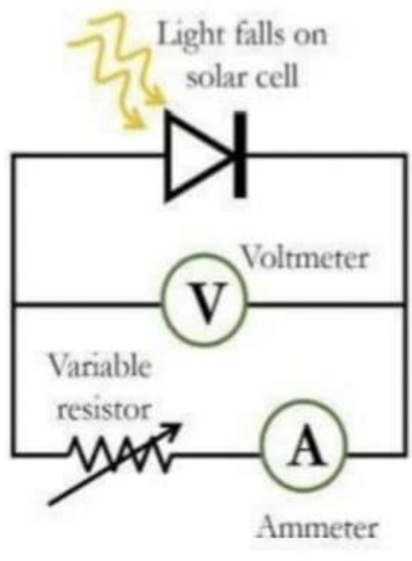


2.2 METHODOLOGY:-

The determination of the solar panel that has the highest current output was done using a 6v solar panel , a 9v solar , and two panels connected in parallel and their fill factor and efficiency was also determined.

The following procedure is used during each case:

- Connect the solar panel to the circuit.
- Connect the ammeter in series with the solar panel to measure the current flowing through the circuit.
- Connect the voltmeter in parallel with the solar panel to measure the voltage across the panel.
- Connect a variable resistor (potentiometer) in series with the solar panel. This allows you to vary the resistance in the circuit, which in turn affects the current flow.
- The solar panel is connected to a load resistor and a voltmeter and ammeter are connected in series to the circuit to measure the voltage and current output of the panel. The solar panel is then placed under sunlight or a light source with a known intensity to simulate real-world conditions. The voltage and current readings are then recorded at different intervals to create a V-I curve, which shows the relationship between voltage and current output of the panel.



2.3 SELECTION OF SOLAR PANEL

SOLAR PANEL OF 4.9V		
VOLTAGE(V)	CURRENT(mA)	POWER
0	42	0
0.5	42	0.021
1	40.5	0.0405
1.2	40.26	0.048
2	40	0.08
2.26	40.1	0.09
2.9	40.3	0.116
3.6	40.1	0.114
3.89	39	0.15
4.3	34.4	0.14
4.6	30.4	0.139
4.7	30.1	0.145
4.8	28.6	0.137
4.9	20.3	0.099

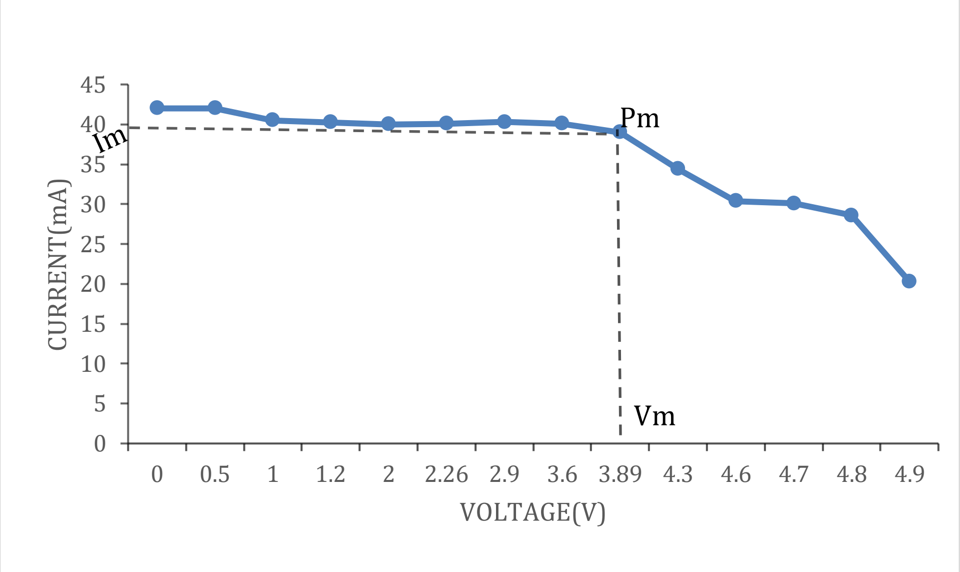


Figure:2.3.1 V-I CHARACTERISTIC CURVE OF 4.9V PANEL

SOLAR PANEL OF 10V		
VOLTAGE(V)	CURRENT(mA)	POWER(W)
0.2	100	0.02
2.8	84	0.235
3	76	0.228
5.3	74	0.392
5.9	73.5	0.4307
6.9	72.6	0.5
7.2	72	0.518
6.65	65	0.432
7.8	57	0.44
8.4	54	0.453

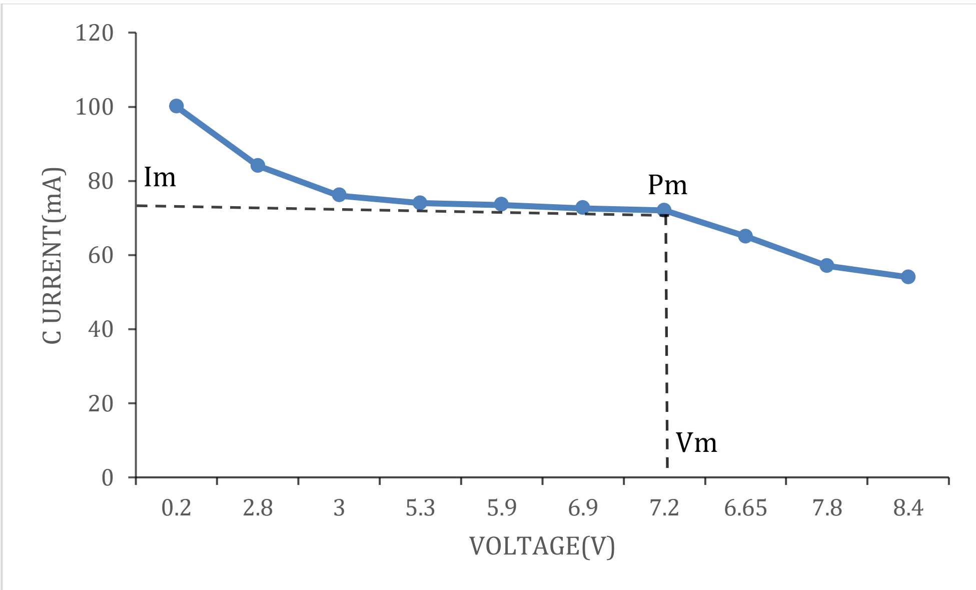


Figure 2.3.2 VI CHARCTERSTIC CURVE OF 10V

SOLAR PANEL OF 10V AND 4.9V CONNECTED PARALLEL		
VOLTAGE(V)	CURRENT(mA)	POWER(W)
1	0.52	0.52
2.2	0.5	1.1
2.8	0.47	1.32
3	0.45	1.23
3.6	0.41	1.404
4	0.39	1.4
4.4	0.35	1.408
5	0.32	1
5.4	0.15	0.81
5.6	0.01	0.056

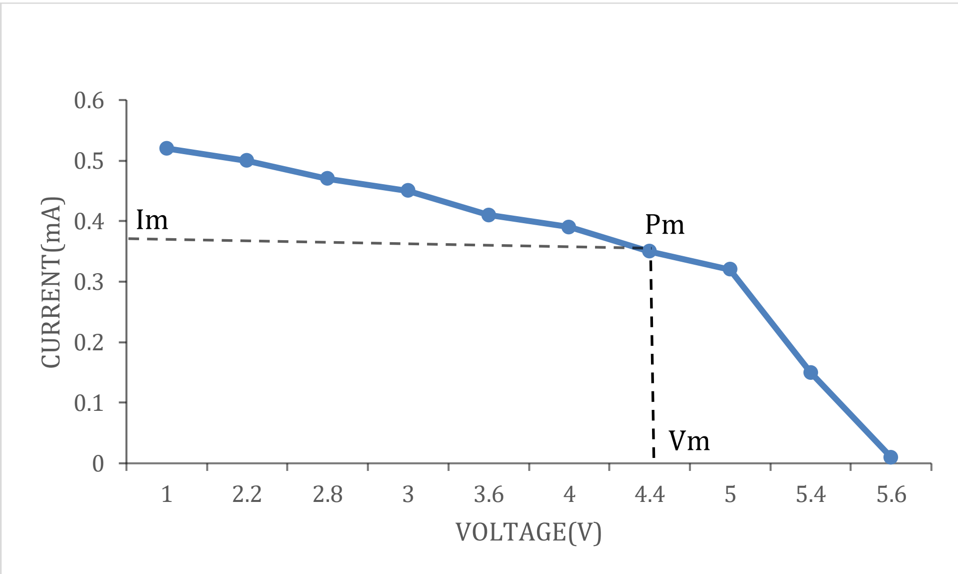


Figure 2.3.3 V-I CHARACTERISTIC CURVE OF 4.9V AND 10V CONNECTED IN PARALLEL

SOLAR PANEL OF 12V		
VOLTAGE(V)	CURRENT(mA)	POWER(W)
0.1	0.75	0.75
0.2	0.7	1.4
4.4	0.65	2.86
5	0.5	2.5
5.4	0.3	1.62
6	0.2	1.2
6.2	0	0

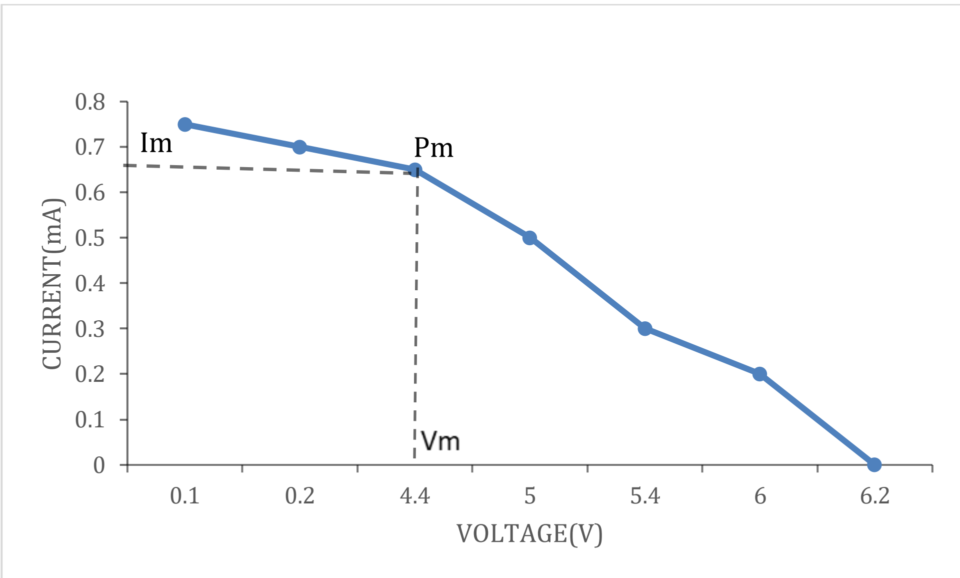


Figure 2.3.4 V-I CHARACTERISTIC CURVE OF 12V PANEL

CHAPTER 3
EXPERIMENTATION AND RESULTS

3.1 DETERMINATION OF TILT ANGLE FOR MAXIMUM EFFICIENCY USING SUNLIGHT

First solar panel is placed in direct sunlight. Initially the solar panel is positioned at 1 degree Celsius from ground, and the V-I characteristics are taken. Experiment is repeated by increasing the angle from 0 to 15 degree Celsius.

By equation,

Sin x=h/l

x= tilt angle

h= height

l= length of panel

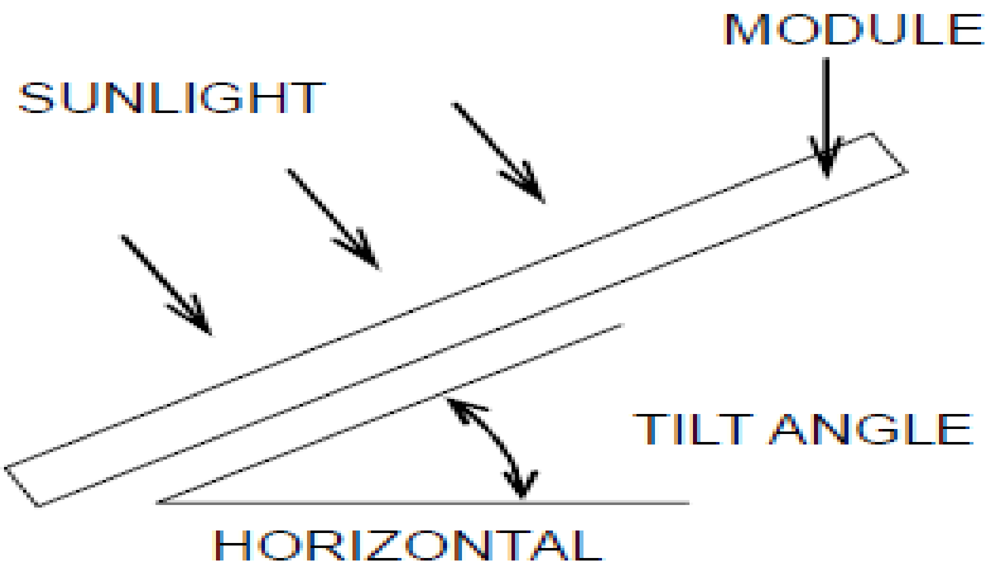


FIGURE 3.1

3.2 At Angle = 15 degree

At Height = 12.4 cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.1	0.75	0.75
0.2	0.7	1.4
4.4	0.65	2.86
5	0.5	2.5
5.4	0.3	1.62
6	0.2	1.2
6.2	0	0

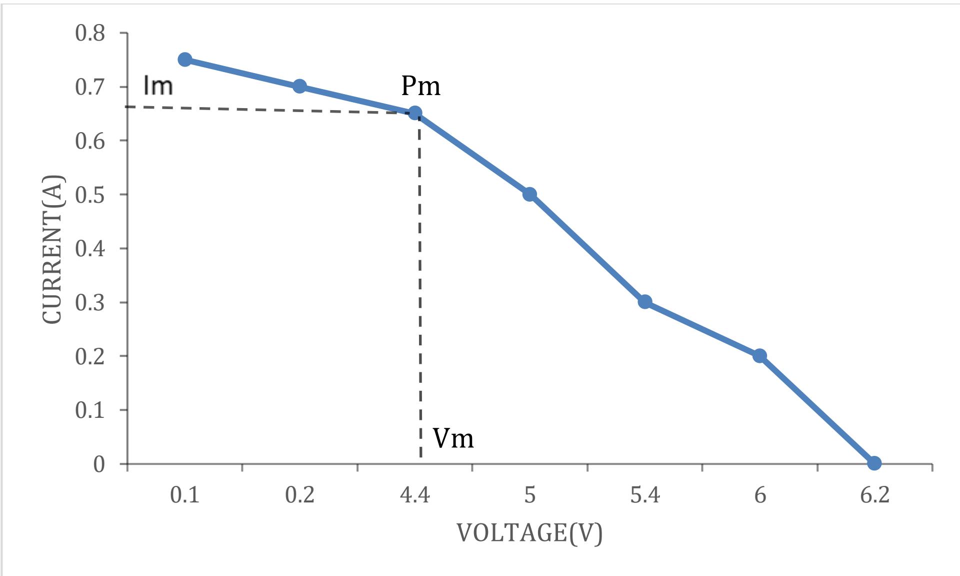


Figure 3.2.1 V-I CHARCTERISTIC CURVE AT 15 DEGREE

3.3 At Angle = 14 degree

At Height =11.6cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.75	1.5
4	0.7	2.8
5	0.6	3
5.2	0.5	2.6
5.4	0.4	2.16
5.4	0.35	1.89
5.6	0.25	1.4
5.8	0.15	0.87
5.8	0.1	0.58
6	0.05	0.3

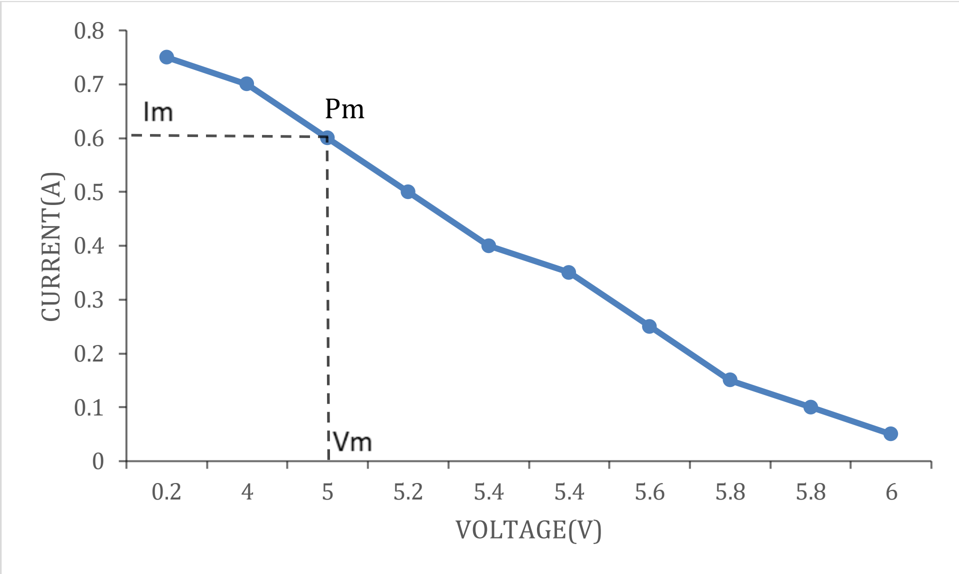


Figure 3.3.1 V-I CHARACTERISTIC CURVE AT 14 DEGREE

3.4 At Angle = 13 degree

At Height =10.7cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.65	0.13
4.4	0.6	2.64
5	0.5	2.5
5	0.45	2.25
5.2	0.35	1.82
5.4	0.25	1.35
5.6	0.15	0.81
5.6	0.1	0.56
5.8	0.05	0.29

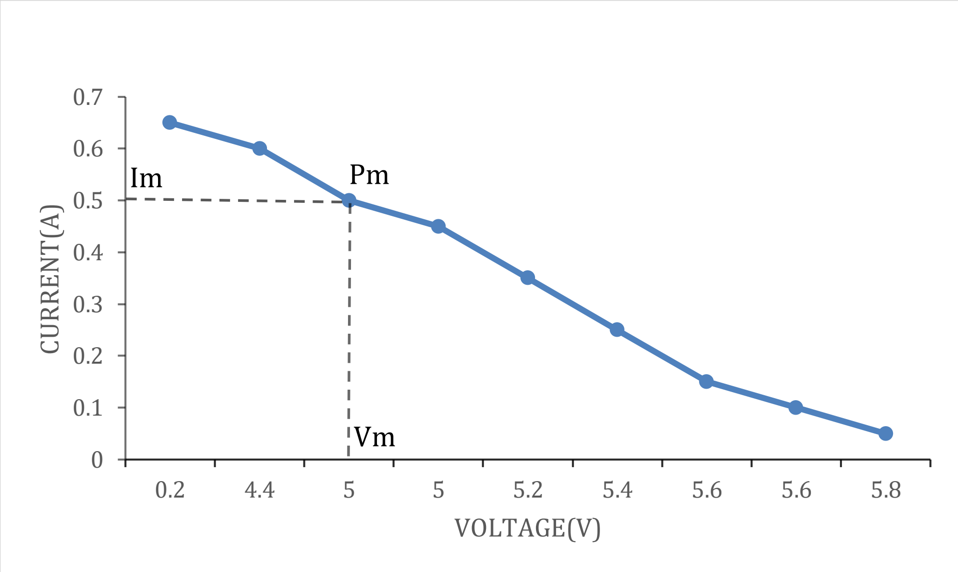


Figure 3.4.1 V-I CHARACTERISTIC CURVE AT 13 DEGREE

3.5 At Angle = 12 degree

At Height =9.97cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.7	0.14
4.6	0.6	2.74
5	0.5	2.5
5	0.45	2.25
5.2	0.4	2.08
5.4	0.35	1.89
5.4	0.3	1.62
5.6	0.25	1.4
5.6	0.2	1.12
5.8	0.1	0.58
5.8	0.05	0.28

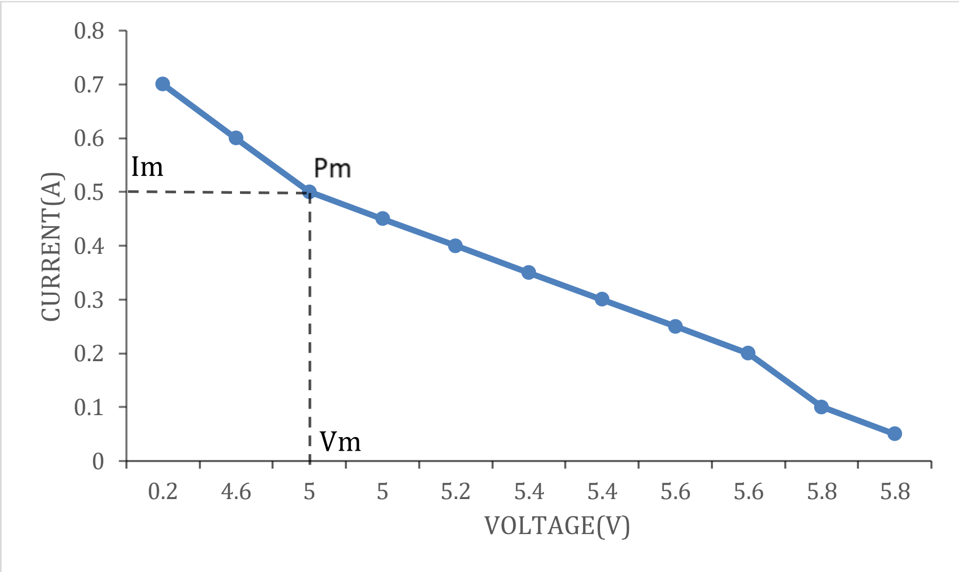


Figure 3.5.1 V-I CHARACTERISTIC CURVE AT 12 DEGREE

3.6 At Angle = 11 degree

At Height = 9.15cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.7	0.14
4.6	0.65	2.99
4.8	0.5	2.5
5	0.45	2.34
5.2	0.4	2.08
5.2	0.35	1.89
5.4	0.3	1.62
5.4	0.25	1.35
5.4	0.2	1.12
5.6	0.1	0.56
5.8	0.05	0.29

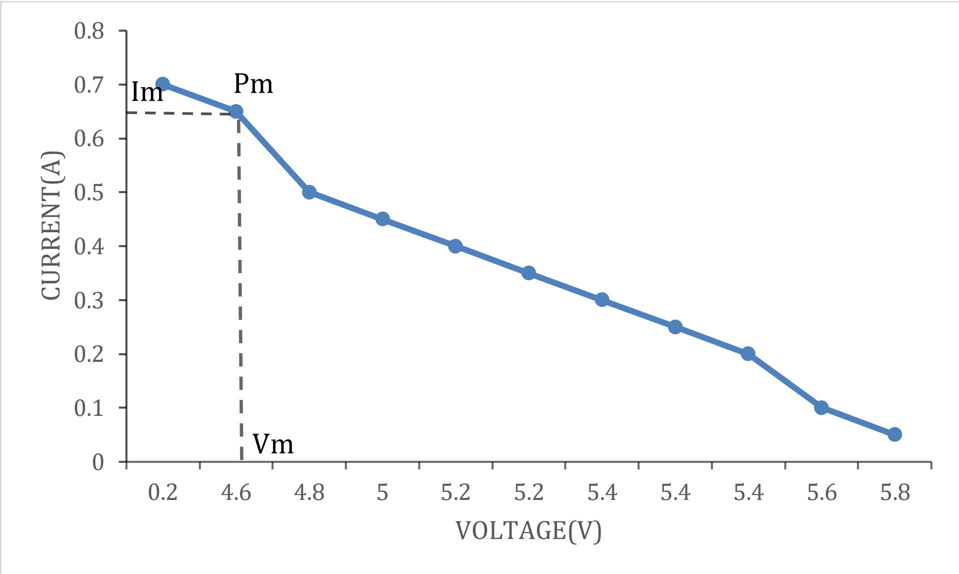


Figure 3.6.1 V-I CHARACTERISTIC CURVE AT 11 DEGREE

3.7 At Angle = 10 degree

At Height = 8.33cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.7	0.14
4.6	0.65	2.99
5	0.5	2.25
5.2	0.4	2.08
5.4	0.3	1.62
5.6	0.2	1.12
5.6	0.1	0.56
5.8	0.05	0.29

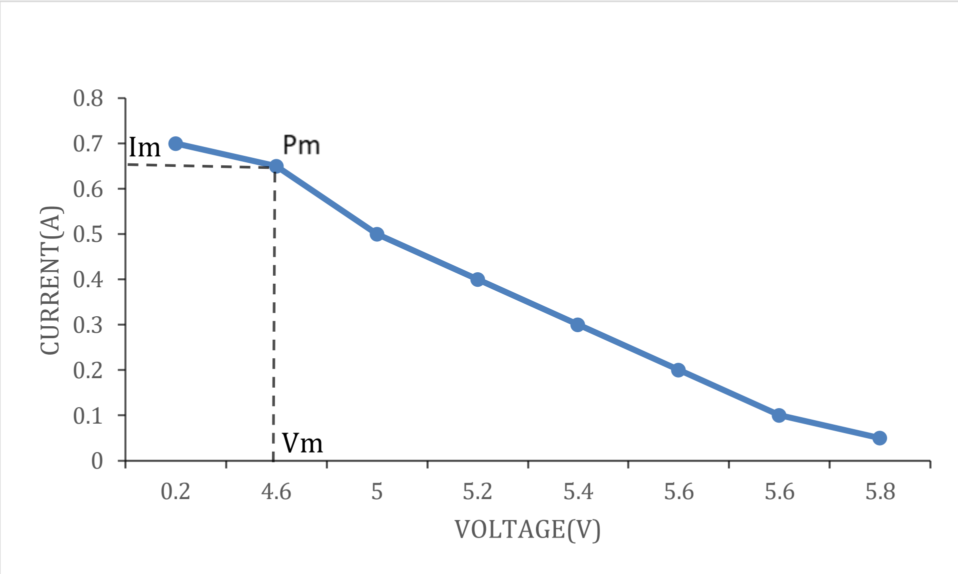


Figure 3.7.1 V-I CHARACTERISTIC CURVE AT 10 DEGREE

3.8 At Angle = 9 degree

At Height = 7.5cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.6	0.12
5	0.45	2.25
5.2	0.35	1.82
5.2	0.3	1.56
5.4	0.25	1.35
5.4	0.15	0.81
5.6	0.1	0.56
5.6	0.05	0.29

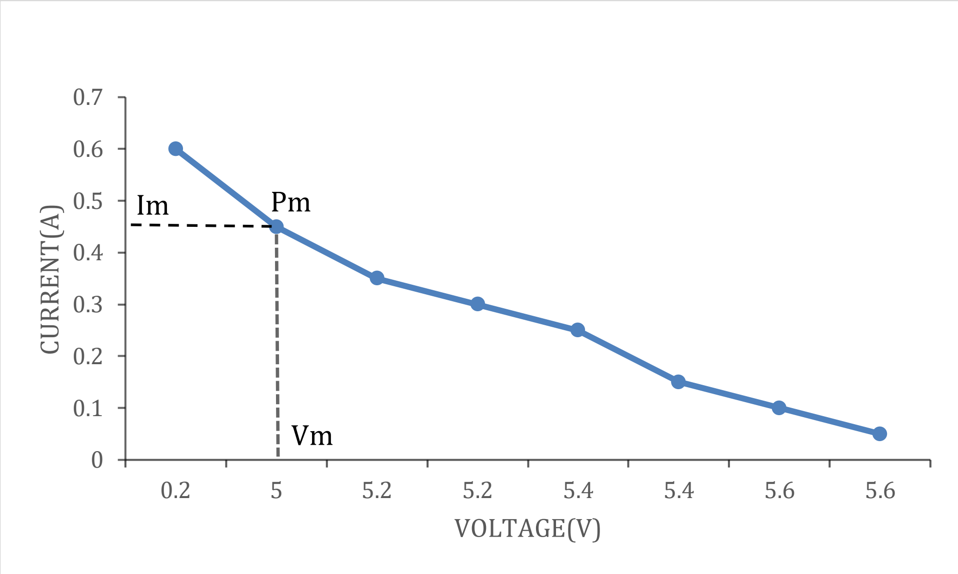


Figure 3.8.1 V-I CHARACTERISTIC CURVE AT 9 DEGREE

3.9 At Angle = 8 degree

At Height = 6.68cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.6	0.12
4.6	0.5	2.3
5	0.4	2
5.2	0.35	1.82
5.4	0.25	1.35
5.4	0.2	1.08
5.4	0.15	0.81
5.6	0.15	0.56
5.6	0.05	0.29

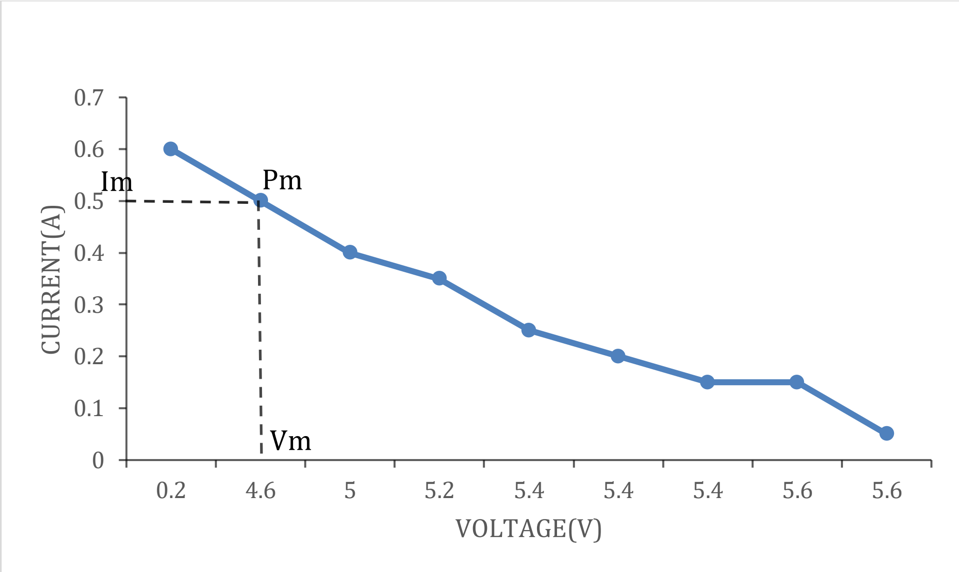


Figure 3.9.1 V-I CHARACTERISTIC CURVE AT 8 DEGREE

3.10 At Angle = 7 degree

At Height = 5.84cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.55	0.11
4.6	0.5	2.3
4.8	0.48	2.304
5	0.45	2.25
5	0.4	2
5.2	0.35	1.82
5.2	0.25	1.3
5.4	0.2	1.08
5.4	0.15	0.81
5.4	0.1	0.54
5.6	0.05	0.28

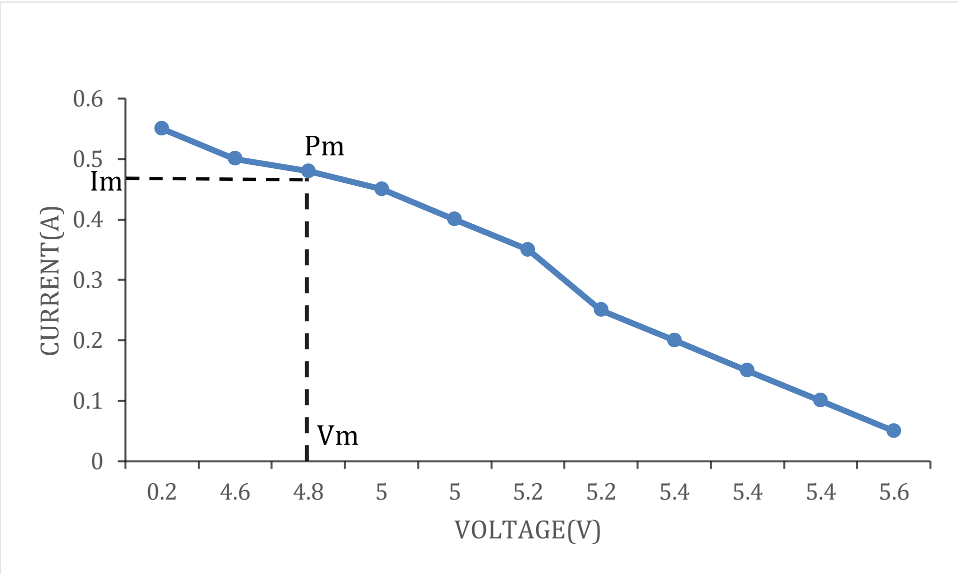


Figure 3.10.1 V-I CHARACTERISTIC CURVE AT 7 DEGREE

3.11 At Angle = 6 degree

At Height = 5.02cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
2.8	0.5	1.4
4.6	0.5	2.4
4.6	0.45	2.07
4.8	0.4	1.92
5	0.35	1.75
5.2	0.3	1.56
5.2	0.25	1.3
5.4	0.2	1.08
5.4	0.15	0.81
5.4	0.1	0.54
5.6	0.05	0.29

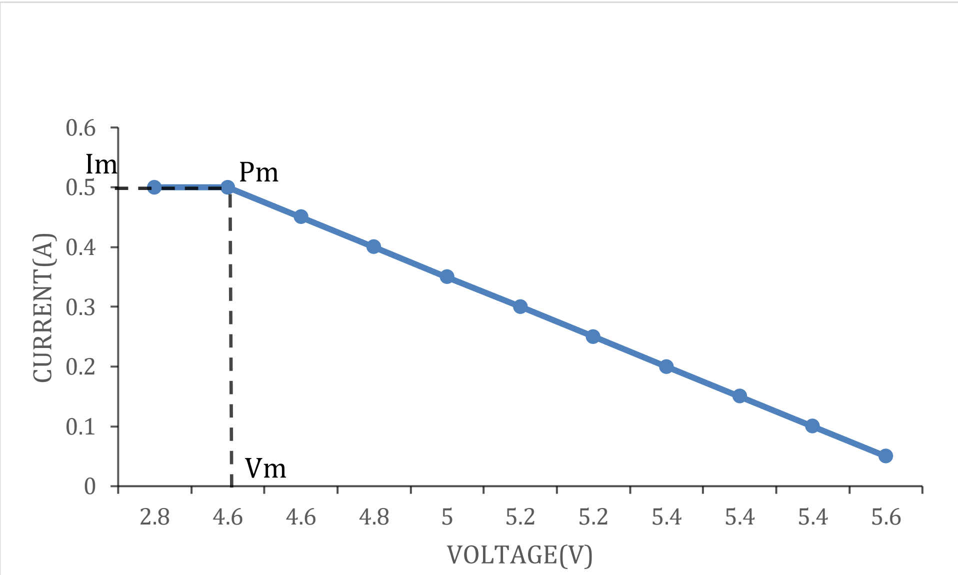


Figure 3.11.1 V-I CHARACTERISTIC CURVE AT 6 DEGREE

3.12 At Angle = 5 degree

At Height = 4.18cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.6	0.12
4.2	0.55	2.31
4.6	0.5	2.3
4.8	0.45	2.16
5	0.4	2
5.2	0.3	1.56
5.2	0.25	1.3
5.4	0.23	1.08
5.4	0.15	0.81
5.6	0.1	0.56
5.6	0.05	0.29

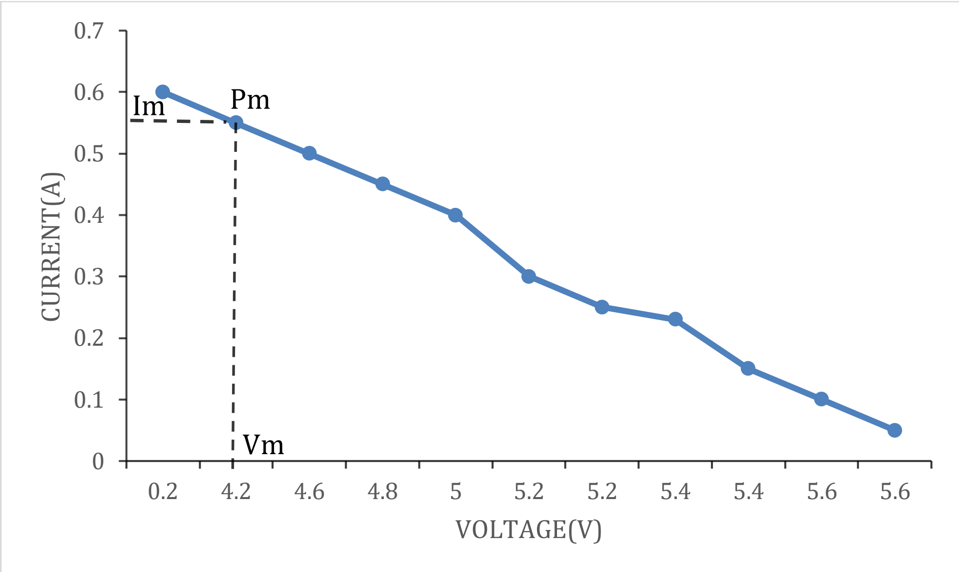


Figure 3.12.1 V-I CHARACTERISTIC CURVE AT 5 DEGREE

3.13 At Angle = 4 degree

At Height = 3.35cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.55	0.11
4.6	0.5	2.3
4.8	0.48	2.304
5	0.45	2.25
5.2	0.4	2.08
5.2	0.34	1.768
5.2	0.28	1.456
5.4	0.23	1.242
5.4	0.15	0.81
5.4	0.1	0.54
5.4	0.05	0.27

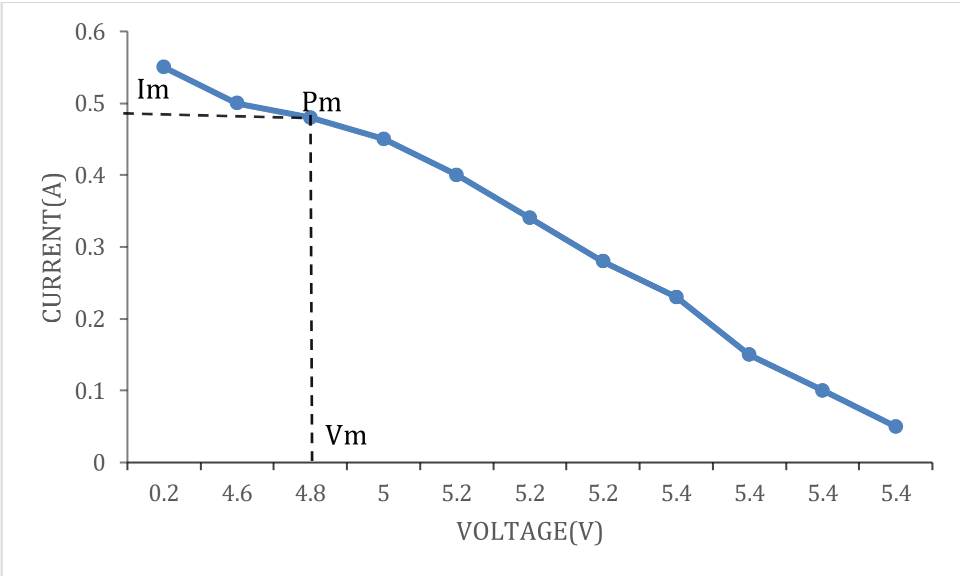


Figure 3.13.1 V-I CHARACTERISTIC CURVE AT 4 DEGREE

3.14 At Angle = 3 degree

At Height = 2.81cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.5	0.1
5	0.46	2.3
5	0.42	2.1
5.2	0.38	1.976
5.2	0.31	1.612
5.2	0.28	1.456
5.2	0.2	1.04
5.4	0.15	0.81
5.4	0.1	0.54
5.4	0.05	0.29

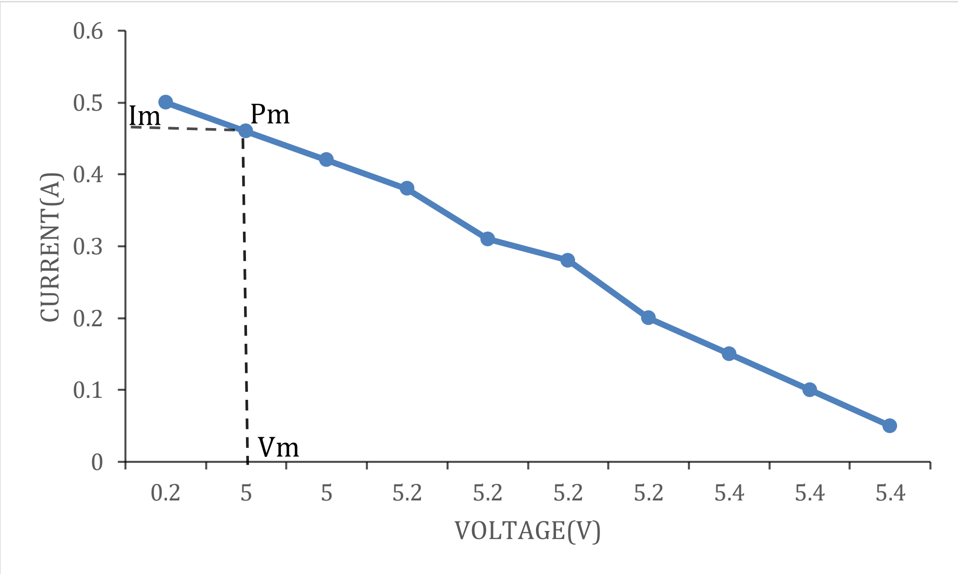


Figure 3.14.1 V-I CHARACTERISTIC CURVE AT 3 DEGREE

3.15 At Angle = 2 degree

At Height = 1.67cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.55	0.11
4.4	0.5	2.2
4.6	0.48	2.208
4.8	0.46	2.208
5	0.4	2
5.2	0.34	1.768
5.2	0.3	1.56
5.2	0.2	1.04
5.4	0.15	0.81
5.4	0.1	0.54

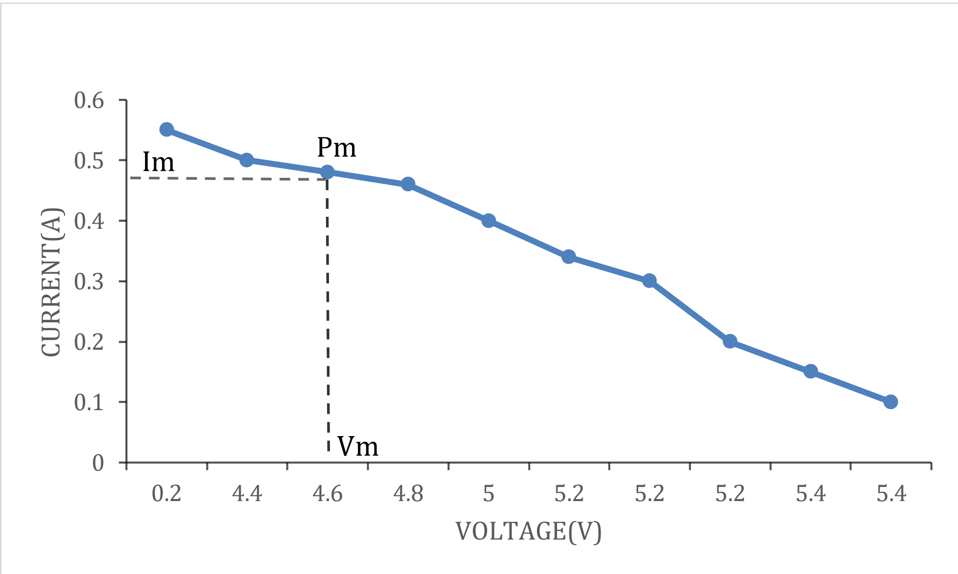


Figure 3.15.1 V-I CHARACTERISTIC CURVE AT 2 DEGREE

3.16 At Angle = 1 degree

At Height = 0.83cm

VOLTAGE(V)	CURRENT(A)	POWER(W)
0.2	0.55	0.11
0.2	0.52	0.104
4.6	0.5	2.3
4.6	0.47	2.162
4.8	0.44	2.112
5	0.38	1.9
5.2	0.34	1.768
5.2	0.28	1.456
5.4	0.2	1.08
5.4	0.15	0.81
5.4	0.1	0.54
5.4	0.05	0.29

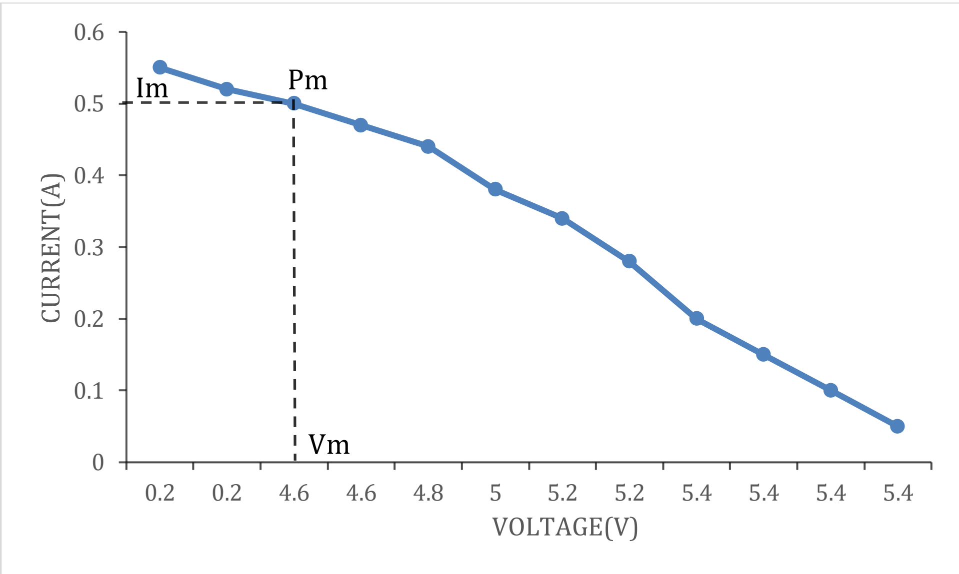


Figure 3.16.1 V-I CHARACTERISTIC CURVE AT 1 DEGREE

3.17 OBSERVATIONS

THE VERTICAL DISTANCE FROM THE GROUND(cm)	THE ANGLE BETWEEN GROUND AND SOLAR PANEL(degree)	MAXIMUM POWER OBTAINED (watts)
0.83	1	2.16
1.67	2	2.208
2.81	3	2.3
3.35	4	2.304
4.18	5	2.31
5.02	6	2.4
5.84	7	2.304
6.68	8	2.3
7.5	9	2.25
8.33	10	2.99
9.15	11	2.99
9.97	12	2.64
10.7	13	2.74
11.6	14	3
12.4	15	2.86

3.18 RESULT

This experiment shows that 3W is the maximum power obtained from the panel at 11.6 degree

CHAPTER-4

SOLAR ASSISTED MOBILE CHARGER

4.1 SOLAR CHARGER CIRCUIT

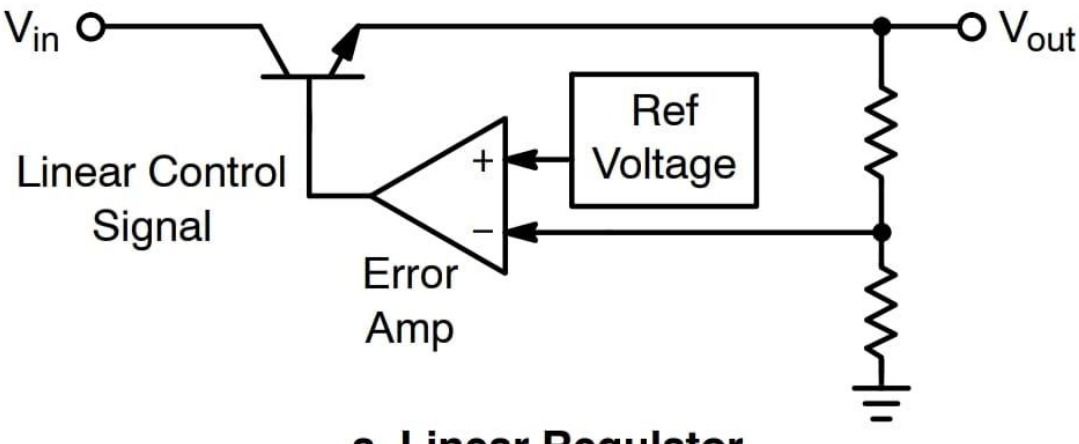
Here we have designed a circuit to get a varied input voltage . A solar charge controller manages the power going into the battery bank from the solar array. It ensures that the deep cycle batteries are not overcharged during the day, and that the power doesn't run backward to the solar panels overnight and drain the batteries . Some charge controllers are available with the additional capabilities ,like the lighting and load control , but managing the power is its primary job.

A solar charge controller is available in two different technologies , PWMand MPPT. How they perform in a system is very different from each other . An MPPT charge controller is more expensive than a PWM charge controller, and it is often worth it to pay the extra money.

There are 2 types of regulators , linear regulator and switching regulator.

4.1.1 LINEAR REGULATOR

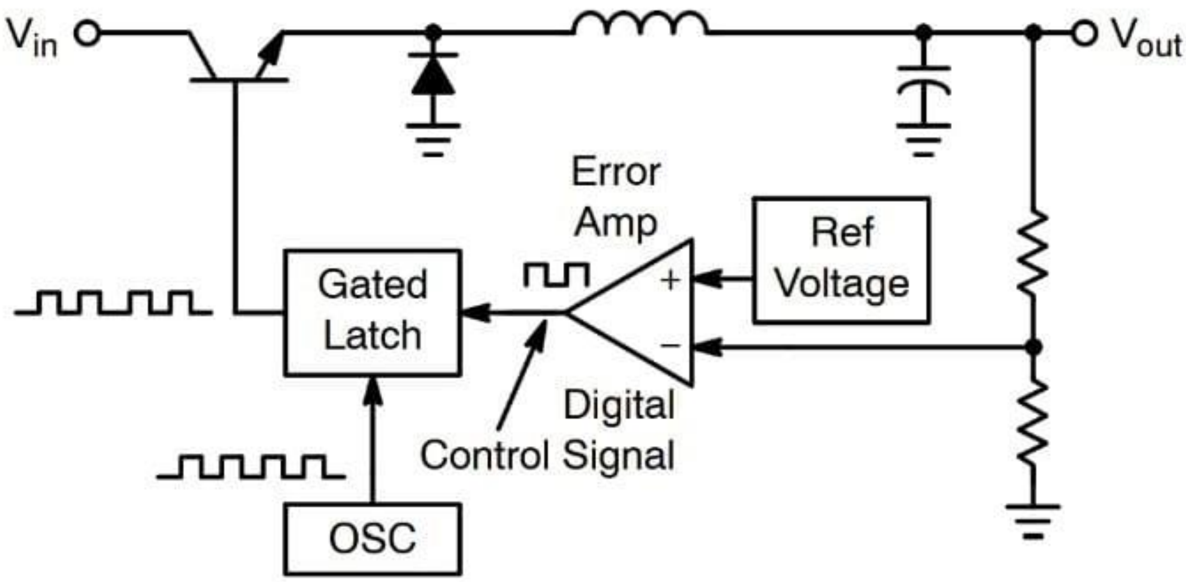
The linear regulator consists of a stable reference , a high gain error amplifier , and a variable resistance series -pass element . The error amplifier monitors the output voltage the output voltage level, compares it to the reference and generates a linear control signal that varies between two extremes , saturation and cutoff. This signal is used to vary the resistance of the series -pass element in a corrective fashion inorder to maintain a constant output voltage under varying input voltage and output load conditions.



a. Linear Regulator

4.1.2 SWITCHING REGULATORS

The switching regulator consist of a stable reference and a high gain error amplifier identical to that of the linear regulator . This system differs in that a free running oscillator and a gated latch have been added . The error amplifier again monitors the output voltage , compares it to the reference level and generates a control signal. If the output voltage is below nominal ,the control signal will go to a high state and turn on the gate , thus allowing the oscillator clock pulses to drive the series – pass element alternately from the cutoff to saturation . This will continue until the output voltage is pumped up slightly above the nominal value. At this time , the control signal will go low and turn of the gate , terminating any further switching of the series – pass element . The output voltage will eventually decrease to below nominal due to the presence of an external load , and will initiate the switching process again. The increase in conversion efficiency is primarily due to the operation of the series- pass element only in the saturated or cutoff state. The voltage drp across the element , when saturated , is small as is the dissipation . When in cutoff , the current through the element and likewise the power dissipation are also small. There are other variations of switching control. The most common are the fixed frequency pulse width modulator and the fixed on- time variable off- limits types , where the on-off switching is uninterrupted and regulation is achieved by the duty cycle control.



b. Switching Regulator

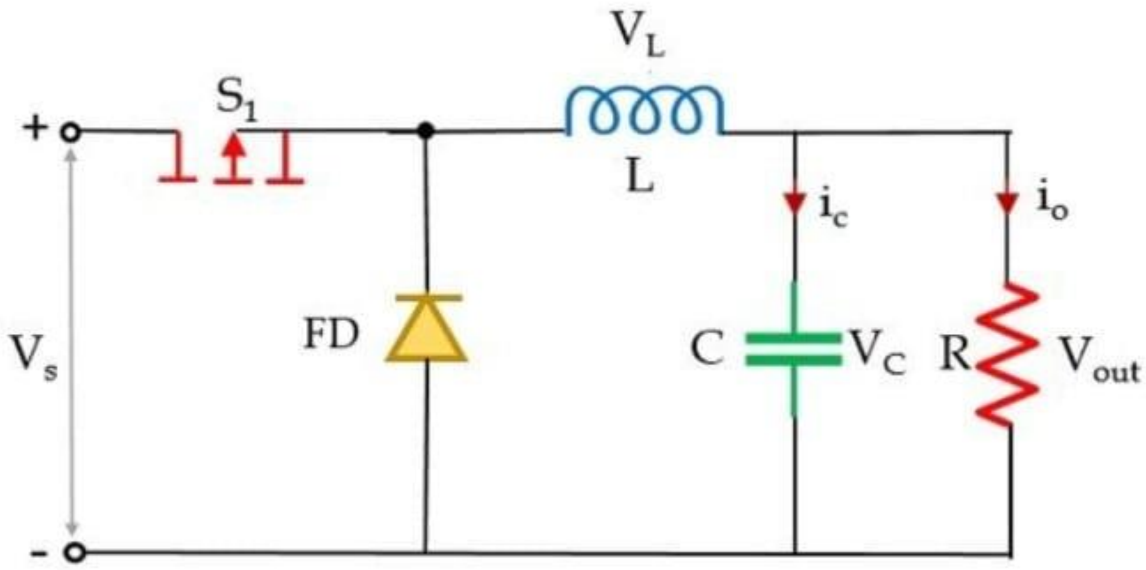
4.1.3 BUCK CONVERTER

Buck converter is a type of chopper circuit that is designed to perform step-down conversion of the applied dc input signal .In the case of buck converters , the fixed dc input signal is changed into another dc signal at the output which is of lower value . This means it is designed to produce a dc signal as its output that possesses a lowe magnitude than the applied input.

It is sometimes called the Step-down DC to DC converter or Step -down Chopper or Buck Regulator.

4.1.4 OPERATING PRINCIPLE OF BUCK CONVERTER

The figure given below shows the circuit representation of buck converter:



Buck Converter

In the above figure, it is clearly shown that along with the power electronics solid state device which acts as a switch for the circuit , there is another switch in the circuit which is a freewheeling diode . The combination of these two switches forms a connection with a low – pass LC filter in order to reduce current or voltage ripples . This helps in generating regulated dc output. A pure resistor is connected across this whole arrangement that acts as a load of the circuit.

The whole operation of the circuit takes place in two modes. The first mode is the one when the power MOSFET that is switch S1 is closed.

In this mode of operation , switch S1 is in closed condition thus allows the flow of current to take place through it.

Initially when a fixed dc voltage is applied across the input terminal of the circuit then in the closed condition of switch S1 current flows in the circuit in the manner shown above . Due to this flowing current , the inductor in the path stores energy in the form of a magnetic field . Also there is a capacitor in the circuit and the current flows through it also, therefore , it will store the charge and the voltage across it will appear across the load.

Now the second mode of operation takes place when switch S2 is closed and S1 is opened . However , you must be thinking about how automatically , the switch S2 will be closed. The inductor in the circuit will store energy so, once S1 will get open the inductor in the circuit will start acting as the source .

In this mode , the inductor releases the energy which is stored in the previous mode of operation . The polarity of the inductor will get reversed therefore this causes the freewheeling diode to come in a forward – biased state which was earlier present in a reverse – biased state due to the applied dc input. The flow of current will take place till the time the stored energy within the inductor gets completely discharged , the diode comes in reverse baised condition leading to cause opening of switch S2 , and instantly switch S1 will get closed and the cycle continues.

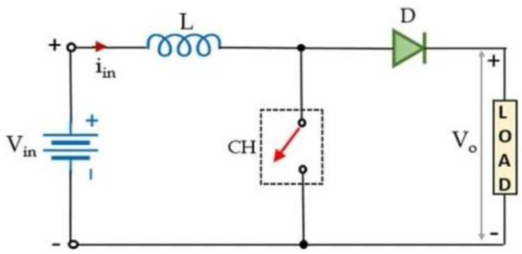
4.1.4 BOOST CONVERTERS

Boost converters sometimes , also known as step -up choppers are the type of chopper circuits that provides such an output voltage that is more than the supplied input voltage . In the case of boost converters , the dc to dc conversion takes place in a way that the circuit provides a high magnitude of output voltage than the magnitude of the supply input.

It is given the name boost because the obtained output voltage is higher than the input voltage .

OPERATING PRINCIPLE OF BOOST CONVERTER

The figure given below is the circuit representation of the boost converter:



Elementary Circuit of Boost Converter

The circuit here is an elementary form of step-up chopper which necessarily requires a large inductor L in series connection with the voltage source. The whole circuit arrangement operates in a way that it helps in maintaining a regulated dc signal at the output.

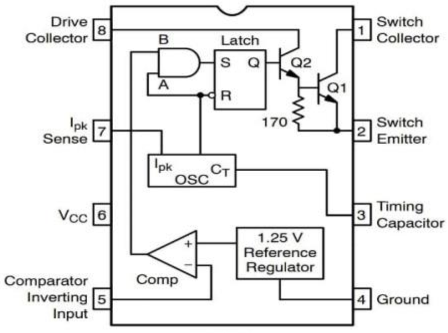
Initially , when the chopper CH is in on state, then in the presence of supply dc input current begins to flow through the closed path of the circuit that is passing through the inductor . Here the polarity of the inductor will be according to the direction of the flow of current . In this particular case, the diode in the configuration is in reverse biased condition and so the current will not be allowed to flow through that particular part of the circuit during on state of the chopper . Resultantly , the voltage across the chopper will appear across the load.

Furthermore , at the instant when CH is in the off state , then the part of the circuit through which the current was flowing earlier will not be active in this case. However as the inductor stores, the energy in the form of a magnetic field and so the current through it will not die out instantly.

Here we are using a regulator called MC34063

4.1.5 GENERAL DESCRIPTION OF MC34063

The MC34063 series is a monolithic control circuit containing all the active functions required for dc to dc converters . This device contains an internal temperature compensated reference , comparator , controlled duty cycle oscillator with an active peak current limit circuit , driver , and a high current output switch . This series was specifically designed to be incorporated in step-up , step-down and voltage- inverting converter applications . These functions are contained in an 8-pin dual-in-line package shown in figure.



a. MC34063

4.1.5a FUNCTIONAL DESCRIPTION

The oscillator is composed of a current source and sink which charges and discharges the external timing capacitor c_T between an upper and lower preset threshold . The typical charge and discharge currents are 35uA and 200uA respectively, yielding about a one to six ratio . Thus the ramp-up period is six times longer than that of the ramp-down. The upper threshold is equal to the internal reference voltage of 1.25V and the lower is approximately equal to 0.75V .The oscillator runs continuously at a rate controlled by the selected value of C_T .

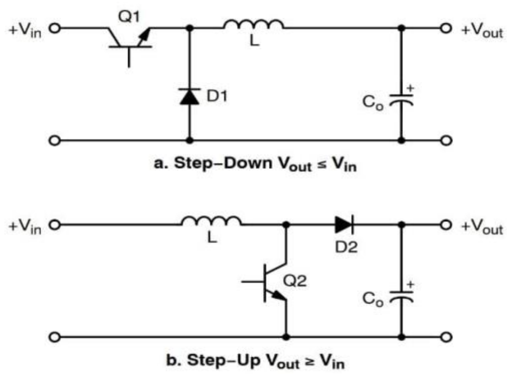
During the ramp-up portion of the cycle , a logic “1” is present at the “A” input of the AND gate. If the output voltage of the switching regulator is below nominal, a logic “1” will also be present at the “B” input. This condition will set the latch and cause the “Q” to go low , disabling the driver and the output switch .

The output of the comparator can set the latch only during the ramp-up of C_T and can initiate a partial or full on-cycle of output switch conduction . Once the comparator has set the latch , it cannot reset it. The latch will remain set until C_T begins ramping down. Thus the comparator can initiate output switch conduction, cannot terminate it and the latch is always reset when C_T begins ramping down . The comparator’s output will be at a logic “0” when the output voltage of the switching regulator is above nominal. Under these conditions , the comparators output can inhibit a portion of the output switch-on cycle, a complete cycle , a complete cycle plus a portion of one cycle , multiple cycles , or multiple cycles plus a portion of one cycle.

Current limiting is accomplished by monitoring the voltage drop across an external sense resistor placed in series with V_{CC} and the output switch. The voltage drop developed across the resistor is monitored by the I_{PK} Sense pin. When this voltage becomes greater than 330mV , the current limit circuitry provides an additional current path to charge the timing capacitor C_T . This causes it to rapidly reach the upper oscillator threshold , thereby shortening the time of output switch conduction and thus reducing the amount of energy stored in the inductor . This can be observed as an increase in the slope of the charging portion of the C_T volatge waveform. Operation of the switching regulator in an overload or shorted condition will cause a very short but a finite time of output conduction followed by either a normal or extended off-time internal provided by the oscillator ramp-down time of C_T . The extended interval is the result of charging C_T beyond the upper oscillator threshold by overdriving the current limit sense input . This can be caused by operating the switching regulator with a severely overloaded or shorted output or having the input voltage grossly above the nominal design value.

4.1.6 STEP UP/DOWN SWITCHING REGULATOR OPERATION

When designing at the board level it sometimes becomes necessary to generate a constant output voltage that is less than that of the battery . The step-down circuit shown in a figure 16a will perform this function efficiently . However , as the battery discharges , its terminal voltage will eventually fall below the desired output , and in order to utilize the remaining battery energy the step-up circuit shown in figure 16b will be required.



4.1.6a GENERAL APPLICATIONS

By combining circuits a and b , a unique step -up/down configuration can be created which still employs a simple inductor for the voltage transformation . Energy is stored in the inductor during the time that transistors Q1 and Q2 are in the “on” state. Upon turn-off , the energy is transferred to the output filter capacitor and load forward biasing diodes D1 an d D2 . Note that during t_{on} this circuit is identical to the basic step-up, but during t_{off} the output voltage is derived only from the inductor and is with respect to ground instead of V_{in}. This allows the output voltage to be set at any value , thus it may be less than, equal to, or greater than that of the input. Current limit protection cannot be employed in the basic step-up circuit. If the output is severely loaded or shorted , L or D2 may be destroyed since they form a direct path from V_{in} to V_{out} .The step-up/down configuration allows the control circuit to implement current limiting because Q1 is now in series with V_{out} , as in the step-down circuit.

4.1.6b STEP-UP/DOWN SWITCHING REGULATOR DESIGN

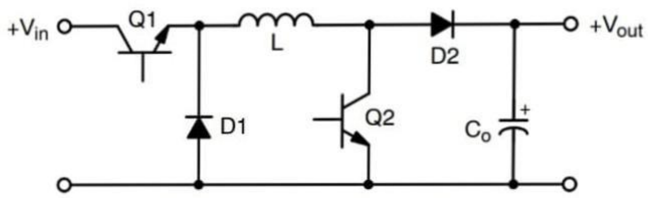
A complete step-up/down switching regulator design example is shown in figure 18 . This regulator was designed to operate from a standard 12 V battery pack with the following conditions :

V_{in} = 9V to 18V

V_{out} = 12.6V

F_{min}= 50 kHz

I_{out}= 250 mA



b. Step-Up/Down $V_{out} \le \ge V_{in}$

V_{ripple} =1% V_{OUT} = 120mV_{pp}

The following design procedure is provided so that the user can select proper component values for his specific converter application.

1. Determine the ratio of switch conduction t_{on} versus diode conduction t_{off} time .

   $t_{on}/t_{off} = V_{out}+v_{FD1}+V_{FD2}/V_{in(min)}-V_{satQ1}-V_{satQ2}$

   =12.6+0.6+0.6/9-0.8-0.8

   =1.8648

2. The cycle time of the LC network is equal to $t_{on(max)}+t_{off}$

   $t_{on(max)}+t_{off}=1/f_{min}$

   $=1/50x10^3$

   =20us per cycle

3. Calculate t_{on} and t_{off} from the ratio of t_{on}/t_{off} in #1 and the sum of $t_{on(max)}+t_{off}$ in #2

   $t_{off} = t_{on(max)}+t_{off}/t_{on}/t_{off}+1$

   $=20x10^{-6}/1.8648+1$

   =6.9812us

   t_{on} =13.0187us

4. The maximum on-time is set by selecting a value for C_T.

   C_T= 4.0x 10^{-5} x $t_{on(max)}$

   =4.0x 10^{-5}x13.0187x10^{-6}

   =520.748pf

   ~470pf+47pf

5. The peak switch current is:

I_{pk}(switch)=2xI_{OUT}x(t_{on}/t_{off}+1)

=2x250x10^{-3}x(1.8648+1)

=1.4324 A

6. A minimum value of inductance can now be calculated since the maximum on-time and peak switch current are known.

$L_{min}=(V_{in\ (min)} - V_{satQ1} - V_{satQ2}/I_{pk(switch)})t_{on}$

=(9-0.8-0.8/1.4324)x13.0187x10^{-6}

=67.25uH

~68uH

7. A value for the current limit resistor ,$R_{sc,}$ can be determined by using the current limit level of $I_{pk(switch)}$ when V_{in}=18V

$I'_{pk(switch)}=(v_{in}-v_{satQ1}-v_{satQ2}/L_{min})t_{on(max)}$

=(18-0.8-0.8/68x10^{-6})-13.0187x10^{-6}

=3.13980 A

R_{sc} =0.33/$I'_{pk(switch)}$

= 0.33/3.1398

=0.0971ohm~0.1 ohm

8. A minimum value for an output filter capacitor is:

C_O~($I_{out}/V_{ripple(p-p)}$)t_{on}

~(250x10^{-3}/120x10^{-3})13.0187x10^{-6}

= 27.12 uf

~33uf ~330uf=1000uf

9. The nominal output voltage is programmed by the R_1 and R_2 resistor divider

$R_2=R_1$x(V_{out}/V_{ref}-1)

=R_1x(12.6/1.25-1)

=R_1x9.08

Let R_1=1.5k

R_2=13.62k

~12k+1.5k

10. Transistor Q1 is driven into saturation with a forced gain of approximately 20 at an input voltage 7.5V. The required base drive is

$I_B=I_{PK(SWITCH)}$/Bf

=1.4324/20

=71.62mA

R_{BE}=10Bf/$I_{pk(switch)}$

=10x20/1.4324

=139.62ohm

~ 150ohm

$I_{RBE}=V_{BEQ1}/R_{BE}$

=0.8/150

=5.33mA

Base drive resistor

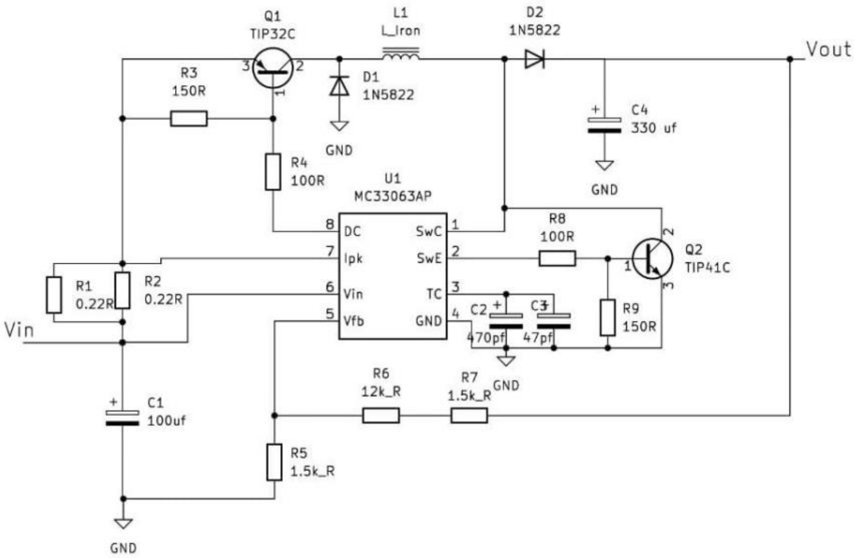
$R_B=V_{in(min)}-V_{sat}-V_{rsc}-V_{BEQ1}/I_B+I_{RBE}$

$=9-0.8-0.5-0.8/(71.62+5.33)X10^{-3}$

=94.217ohm

~100 ohm

With the given components we have constructed the circuit as shown below,



4.2 CONSTRUCTION

Here a circuit is constructed using the IC MC34063 which is a dc to dc converter. There is a BUCK-BOOST circuit which is connected to the IC MC34063.There are two transistors in the given circuit which acts as a switch .When low voltage passes through the circuit the pnp transistor of the buck circuit will be in its on state. The IC checks the input voltage and if it less than 12V then it is fed into the buck circuit. In the buck circuit when the voltage flows through it , the inductor and capacitor gets charged and then the voltage is passed to the output. Similarly when the high voltage passes through the npn transistor of the boost circuit ,it will be in its on state. The IC checks the input voltage and if it is more than 12V then it is fed into the boost circuit. In the boost circuit when the input voltage flows through the circuit the capacitor and inductor gets charged and the output voltage is obtained .This process takes place simultaneously and the mobile phone gets charged even varied voltage.

4.3 CONCLUSION

In this project,we built a solar assisted mobile charger out of 12V solar panel.It manages the power going into the battery bank from the solar array.First we measured the V-I characteristics of various solar panels and its combinations by connecting them in parallel.Then we taken the V-I characteristics of solar panel at various angles from 0 degree to 15 degree.From this,14 degree is found to be the optimal tilt angle for the best efficiency.Next we constructed solar assisted mobile charger that ensures the deep cycle batteries are not overcharged during the day,and that the power doesn't run backward to the solar panels overnight and drain the batteries

4.4 REFERENCE

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