Energy Conservation of Electric Hybrid Rickshaw with PV Support

A Thesis
Submitted to the Department of Electrical and Electronic Engineering
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DECLARATION

We do hereby declare that the thesis titled "*Energy Conservation of Electric Hybrid Rickshaw with PV Support* ", a thesis submitted to the Department of Electrical and Electronics Engineering of BRAC University in partial fulfillment of the Bachelors of Science in Electrical and Electronics Engineering. This is our original work and was not submitted elsewhere for the award of any other degree or any other publication.

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ABSTRACT

In Bangladesh, the most used mode of public transportation is the rickshaw. This is because of its itinerary, time flexibility and door-to-door services. Since, considerable fraction of population in Bangladesh uses the rickshaw and a major part of underprivileged population are either directly or indirectly dependent upon the rickshaw-pulling profession, the necessity of modernizing this mode is evident.

Newly designed green electric rickshaw was invented which eliminated manual labor of rickshaw puller and increased their daily income but one of the main disadvantages of these rickshaws is that it has to recharged almost everyday. These vehicles use up the energy stored in the battery, at the end of the day the battery has to be recharged from the national grid. Due to present deficiency of power already prevailing in the country, the government has banned this rickshaw due to its high power consumption.

Our thesis describes a research and development project of Control and Applications Research Centre (CARC), BRAC University, aiming to show the conservation of energy for these green fuel-free vehicles by PV assistance. This involves the installation of PV panels on top of the vehicles so that, when at rest, the battery can be charged by this panel. During motion, the PV panel and the battery will simultaneously run the motor. Thus, this also involves the development design and algorithmic implementation of a charge controller. Additionally, the structure for panel installation is also sought. The goal being the overall power needed from the 'mother' grid being reduced.

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ABBREVIATIONS

GDP- Gross Domestic Product

SOC- State of Charge

CU- Controller Unit

CARC- Control and Applications Research Centre

PV- Photovoltaic

BLDC- Brushless Direct Current

TPS- Throttle Position Sensor

Chapter 1

INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

Rickshaws are the most popular source of transportation in Bangladesh, especially Dhaka, mainly because of its short-trip suitability, lower road-space occupancy, and mobility in narrow-roads, route-flexibility, door-to-door services and relative cost-effectiveness compared to other public transports.

In Dhaka, the average trip-length is of 3.8 km [1] and the number of people traveling together is also usually very short, thus, rickshaws become the ideal mode of transport. The statistics indicate that in Dhaka, women and children are using 40% of the loaded rickshaws, or people with goods about 30% of other users are students. [1] They also provide a beneficial alternative to the higher charge of taxis, auto-rickshaws and other mode of transports.

In terms of the GDP of Bangladesh, a contribution of 34% [2] of the transport sector comes through rickshaws. In Dhaka alone, approximately $300,000 is exchanged between rickshaw-pullers and passengers everyday. It is estimated that there are about 2 million rickshaw pullers in Bangladesh and around 19.6 million people (14% of total population) [3] indirectly relies on rickshaw-pulling business, that is, their families, manufacturers, garage owners, painters, repair-men. [5] An astonishing fact is revealed by a research that shows that an average income is decreased by 15% for a job shift from rickshaw pulling to others. Furthermore, 20% of the population in Dhaka directly or indirectly relies on rickshaw pulling sector, that adds up to about 2.5 million people. [2] These statistics clearly suggest that enough importance should be given to this sector and improvements through technological advancements in this matter could be vital to the development of the country.

In many parts of Dhaka, roads that can hardly bear three lanes for cars; have rickshaws, private cars and buses clustering and causing traffic jam. There are minor road accidents on a regular basis. Being a slow-speed, muscle driven vehicle; Rickshaws are often blamed to be the cause of traffic jams. Additionally, it doesn’t provide enough earnings for the pullers in contrast to the immense physical strain involved with the occupation. In this modern day, the need to renovate the traditional design of rickshaws is evident since it could speed up the roads in this country, simultaneously, it could curtail the physical and financial strain of the rickshaw-pullers. Thus, these fuel-free transports should more convincingly be brought under a massive modernization rather than abolition.

The motivation for working on this research and development program was originated initially by CARC in collaboration with BEEVATECH ltd. A request by BEEVATECH obliged CARC to undertake the projects. It came from the view that a massive modernization in this sector will not only improve the living standard of a huge number of people involved in rickshaw pulling, but also improve the quality of life of upper and lower-middle income groups of urban inhabitants. Since, the government banned the green electric rickshaw; our focal motive in working on this project is to find a way of conserving power for these electric hybrid rickshaws by the means of PV (Photovoltaic) support. Proving the government that sufficient percentage of power can be saved by adapting other methods and eventually demonstrating that, the pros of using electric rickshaws are greater than its cons is our ultimate goal. This project might also create opportunity for further RND (Research and Development), this could include the 'Central Solar Battery Charging Station.' Additionally, relieving the Rickshaw-pullers from tremendous physical exhaustion by assisting them electrically; using the available resources (present rickshaws) for transformation into a perfectly "hybrid" vehicle, rather than manufacturing brand-new ones; creating a charging infrastructure primarily powered by renewable energy; and ultimately, decentralizing people from Dhaka city will also be served.

1.2 PROJECT SYNOPSIS

Initially, the development of the electric hybrid rickshaws was carried out by CARC, where they used a torque sensor based technique to improve the system. We have done a further RND of this electric hybrid rickshaw, bringing in a new concept.

Thus, the rickshaw was already available to us, hence, we could avoid the mechanical hassle with motor mounting, battery installation and most importantly, we already had all the components together without having to import from abroad. Hence, valuable time was saved ,since these processes can be complicated, and we could avoid them.

The first stage of our job was to understand the existing system. The CARC report, thus, made it much easier for us to grasp how the model worked. Even then, we had to learn all the different connections that were part of the system, i.e. how the motor was mounted, the controller connections and the battery installations.

The next phase of our task was to identify the proper algorithm for a charge controller that will help us achieve our goals. Thus, we started working on finding the perfect algorithm and successfully attained that.

After this, our experimental processes began. Firstly, we proposed the required algorithm for the charge controller and bought the specific one. We used the charge controller, to see whether our goals can be achieved by its use. We successfully found out that, the controller could be used to share current according to our needs. This was a lab simulation experiment, as neither the real motor, batteries nor the panels where used. Instead power supplies where used along with variable resistors as load.

Once, we found that the controllers were good to go; we researched on the solar panels. The dimensions and other specific ratings were taken into consideration and the required solar panels were bought. Now, a vivid study of the panel performances were to be done. Experiments were carried out on roof-top, to find the variation of the panel performances. This experiment helped us to understand how the panels work and in turn helped us to find an efficient and considerable angle of installation.

The next phase of our job included the structural design over the rickshaw and solar panel installation. Once again, the specifics were studied with scrutiny, and the necessary structure was built. We decided to put the panels in an inclined manner initially, so this process was a bit time consuming. Once, the structure was formed and the panels were installed, the final step was to carry out the, most important, 'Field tests.'

The field tests were then carried out. Data were recorded and used to compile a numerical and graphical illustration of our project. The results allowed to us to understand that there was nevertheless, room for further increment of efficiency. Hence, we changed the overhead structure of the rickshaw and used a flat panel position.

Finally, the flat panel structured prototype was used to carry out the field tests, after which the recorded data were used to finalize the entire project.

1.3 OVERVIEW OF CONTENTS

The following chapter includes the portrayal on the work going on the existing electrical rickshaws. The restraints and further development opportunities are also mentioned. The third chapter explains the exiting model, right from scratch; it includes the description of all the involved components. The forth chapter includes the charge control algorithm along with a brief description of the pros and cons of using such a controller. The reasons behind the ratings and the controller developments are mentioned. Chapter five illustrates the solar panel installation process in details. Firstly, it recognizes the particular motives for which the panels are designed the way they are, and then it illustrates the different experiments carried out to come to a conclusion. The advantages and disadvantages of the two different types of states we used, are also cited.

The most important chapter follows next, the one that includes the field tests. The data, graph and reasoning behind the experiments are elucidated. A comparative study is done to clarify the importance of PV support on the electrical rickshaw. Finally, the seventh chapter provides the resulting conclusion for the project. It also mentions valuable scope on improvement through future RND. The ‘Appendix’ at the end is very essential, as it contains the detailed record of all the data collected during the field tests.

Chapter 2

SYNOPSIS OF PRESENT ELECTRICAL DEVELOPMENTS ON RICKSHAWS

2.1 Overview

Since rickshaws are used vastly in Bangladesh there have been a lot of ideas as well as implementation to electrically improve it. Another reason is that rickshaws are fuel free and sustainable. Most concepts basically share the idea to reduce the muscular power of puller. In Bangladesh two major models have been prototyped and implemented which are developed by Beevatech Limited and Boraq limited. Further RND works have been carried out by the Control and Applications Research Cnetre (CARC), BRAC University for additional developments. In this chapter, their major drawbacks and scope for further improvements will be discussed.

2.2 Beevatech (Porag)

FIG. 2.1 PORAG ELECTRIC PEDICAB

2.2.1 Outline

The first professional electric auto rickshaw manufacturer, Beevatech Limited, was established in 2001 as a group company of Prime Logistics Ltd. PORAG electric Pedi cap rickshaws were introduced which reduced the manual labor of the puller thus increasing their daily income since the puller could ride for longer period. The look of this new rickshaw is different from the normal available rickshaws. This new rickshaw has a steel body platform that differentiates it with the older ones.

It includes 48V, 500W brushless DC motor drive systems with throttle position sensor to control motor speed. Which implies, by using the hand throttle the motor drive mechanism is controlled. Here, the traditional chain-wheel system is almost untouched or rarely used through the running time. The puller might pedal it when the battery gets discharged.48v is achieved by using four 12V 20Ah lead acid batteries in the system and batteries are charged by the national power-grid which is the main source. [7]

Beevatech Ltd. again introduced a second model in 2012 that included four 75-watt solar panels placed on top of the rickshaw for charging the battery along with the national grid. [7] However, it was seen that the panels were not sufficient to charge the batteries to run the motor and it needed the power from national grid to charge the batteries all time.

FIG. 2.2 PORAG ELECTRIC PEDICAB WITH SOLAR PANELS

2.2.2 Restraints and Possibilities of Development

- In throttle-control mechanism, more electrical energy is consumed since it racticaly makes the whole system is fully motor controlled and battery needs 5/6 hours to discharge fully in regular running conditions.
- Frequent flow of high current from the battery to the motor can lower the life expectancy of the battery.
- Since the model of this new rickshaw is different the old model of the rickshaws will still be unused thus old ones will still populate the city.

- By using the solar panel cost of the rickshaw is increased without any noticeable change in the power saving issue.

In this model the major scope for development is to develop a mechanism to reduce power consumption, yet providing comfortable assistance to the rickshaw puller and also reduce the use of the motor and protect it from consistent exposure to high current from the batteries.

2.3 The *Boraq* Model of Electric Rickshaw

2.3.1 Outline

Boraq Limited is a small company compared to BEEVATECH Limited, introduced some improvements and came up with some solutions to the previous limitations. Their main feature was that the 'altered' some old rickshaw to fit their power assist model. They managed to place the battery by mechanical means into the old rickshaws underneath the seats. The motor was also accommodated like the previous rickshaws. [4]

Basically they used a different type of battery that is an expensive version of lead-acid battery. It is used to increase the running period. Brushed DC motors were also used to lower the cost. Since the control system was not changed the consequences remained in their model.

2.3.2 Restraints

- Since the batteries are expensive, the overall cost increased.
- The weight is too much which makes it very difficult for the puller to pull the rickshaw manually.
- The drawbacks for the throttle-control mechanism remained.

2.4 CARC

FIG. 2.3 CARC WORKING ON PORAG ELECTRIC RICKSHAW

2.4.1 Outline

The Control and Research Centre (CARC), BRAC University took a substantial step in improving Beevatech's model of the rickshaw with their very own electrical and electronic development of the project *Torque Sensor Based Electrically Assisted Hybrid Rickshaw* that was a success after twelve months of research. They key objective of this project was to design and develop all technical aspects for the system and end up with a final prototype. The entire control system and other supporting modernizations were designed and developed over the platform of an existing model of electric rickshaw. The prototype also came across a field test and proved its significant efficiency over all other commercial models. This efficiency paves the way to think about its future involvement with renewable energy. It finally numerically proved the efficiency of the implemented system using practical field test data. It was also evident from the fact that after four long hours of field test more than 80% [10] charge was still left in the battery (as the battery-level indicator showed). The system also lengthen the battery life as a consequence of using the sensor—that means by not letting close to rated current flow for a longer time, which is frequent in the throttle controlled system.

2.4.2 Restraints

- Frequent flow of high current from the battery to the motor can lower the life expectancy of the battery.
- Since the model of this new rickshaw is different the old model of the rickshaws will still be unused thus old ones will still populate the city.
- Not cost effective due to the additional cost of the torque sensor, additionally the rickshaw puller still needed to provide muscular power.

Chapter 3

THE EXISTING MODEL

3.1 Introduction

3.1.1 Overview of the System

The product that was under research and development was a throttle-controlled rickshaw with a modern steel-body and a slightly different architecture. Beevatech Limited, the first professional electric auto rickshaw manufacturer in Bangladesh, established in 2001 as a group company of Prime Logistics Ltd first introduced this kind of rickshaw in Dhaka city. However, the company is now facing problems to gain government approval to run legally throughout Dhaka city because of its higher level of power consumption from the national grid. As a result, the company is now working to make it fully or partially solar powered. This is the reason why we are trying to find how effective it is by fixing a solar panel on it to reduce the higher power consumption from the national grid. The manufacturer used architecture to accommodate the batteries to run the motor that is mounted inside. A brushless DC motor is used, accommodated underneath the vehicle with batteries and controller unit accommodated inside the seat. A detail description will be given in the following "Components" section. They used a 48V, 500W, 13.5A, 500rpm rated brushless DC gear motor, a corresponding controller unit, a throttle, a main power-on key, and an emergency ‘motor-stopper’ brake. Four 12V Dry-cell batteries, connected in series, along with the controller were accommodated under the passenger seat. [10]

3.2 Components Used

3.2.1 The Motor:

FIG. 3.1 DC GEAR MOTOR

A 48V, 500W, 13.5A, 500rpm [9] rated brushless DC gear motor was used in the system mounted underneath the seat and it was attached with the main frame. In a brushless DC motor (BLDC), the rotor has permanent magnets and the stator has an electronically controlled rotating field, using sensors (rotary encoder or back-EMF) to detect rotor position. Brushless motors develop a maximum torque when stationary and linearly decrease as velocity increases. BLDC motors are most suitable for these kind of vehicles because of their more torque per weight, more torque per watt (increased efficiency), increased reliability, reduced noise, longer lifetime (no brush and commutator erosion), elimination of ionizing sparks from the commutator, and overall reduction of electromagnetic interference (EMI). [10]

3.2.2 The Controller Box

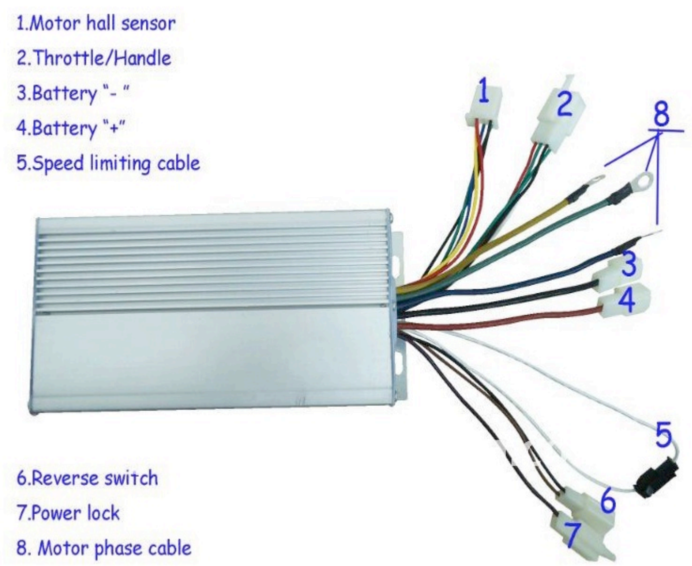

FIG. 3.2 CONTROLLER BOX

The manufacturer integrated all the complicated electronics the brushless motor needs into a black box. But due to the unavailability of proper resources, the controller wires were identified using some online resources, experiments, and exploring the connections in the system. [10]

3.2.3 The Batteries

FIG. 3.3 4, 12V BATTERIES IN SERIES

The batteries were accommodated inside the seats. Four 12V, 20Ah Rechargeable batteries were used in series, which provides 48 Volts to the BLDC motor. These were lead-acid batteries. Each weighs 7.1 kg and 181 X 77 X 171 mm [10] in dimension. Each fully charged battery shows 12.9 volts across their terminals and 51.6 volts [4] after connecting those in a series combination. [10]

3.2.4 The Throttle Position Sensor (TPS)

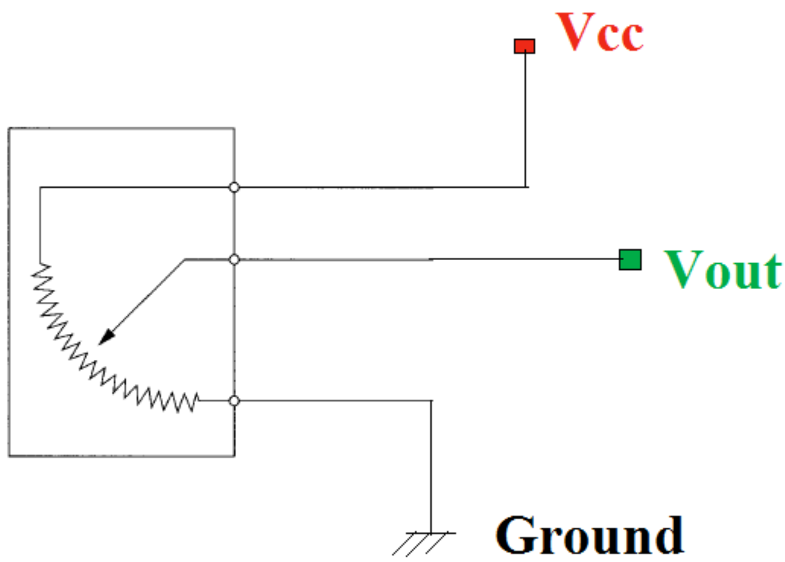

FIG. 3.4 TPS SYSTEM

Throttles are generally used to control the motor speed. BLDC motor controllers are designed in such a way that a voltage signals usually not more than 5V controls the minimum-maximum speed of the motor. A throttle is nothing but a specially designed potentiometer where a specific Vcc (biasing voltage) is always provided

From the main controller unit and outputs voltages corresponding to rotations of the throttle, which is supplied to the controller where it is processed to deliver corresponding speed by the motor. The circuit diagram of a throttle position sensor (TPS), and the throttle position, along with the hand-clutch and power-key. In the following sections the behavior of the motor corresponding to the voltage signal provided by the TPS will be described in details. [10]

3.2.5 The Hand-Clutch and Power-Key

FIG. 3.5 HAND-CLUTCH AND POWER KEY

A power key was used in the system to turn the whole system ‘on’ or ‘off’ manually. The rickshaw-pullers have to turn it on before they can use the throttle to drive the motor. It was actually a mechanism to ‘short’ two wires that go directly to the controller unit. Normally the wires are open switching ‘off’ the whole system. When it is keyed, the wires get ‘shorted’.
On the other hand, there is hand-clutch, which looks like a manual-brake, is mounted in the left handle of the rickshaw, along with the brake-system. The hand clutch is used to stop the motor at-once when needed. It is usually kept for an emergency.[10]

3.2.6 Speed Limiting Cable

There are two wires coming out of the (CU) which were connected by default called the ‘speed-limiting-cables’. The speed of the motor increases significantly if the wires are ‘opened’. [10]

Chapter 4

THE CONTROL ALGORITHM AND APPLICATION

4.1 CHARGE CONTROLLER

4.1.1 Development of the charge controller

RATINGS

- **48V**
- **Max current allowed: 20A**

The charge controller was a very important component in the overall system. It made sure that the terminal voltage level always remained constant. The effective voltage of the panels was 69.84 V (34.92*2), but the required voltage across the battery and motor terminals was 48 V. Thus, the effect of the charge controller was very significant.

First, we developed a control algorithm, by the use of flow charts to clarify the entire idea. Then we established the ratings required. The maximum current allowed is 20 Amperes. Then, the whole idea was proposed to a producer who eventually made the custom made controller according to our needs. The type of controller used was a PWM charge controller. The flow chart of the algorithm and the diagram below explains the thorough manner with which the controller is automated.

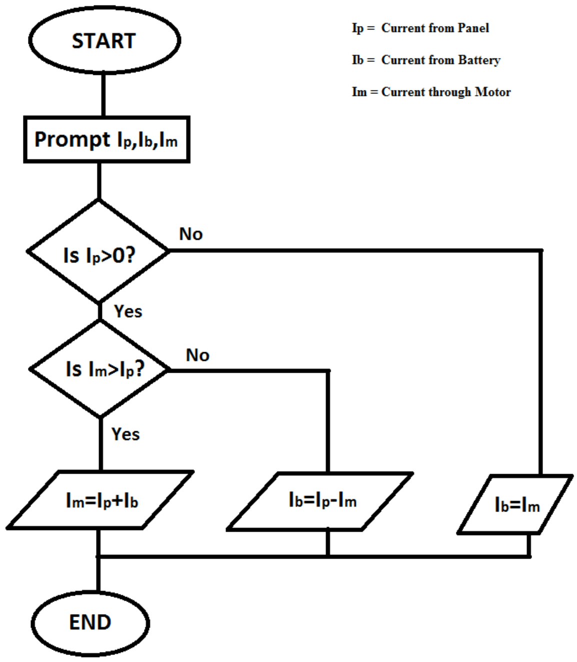

FIG. 4.1 FLOW-CHART FOR THE CHARGE CONTROLLER

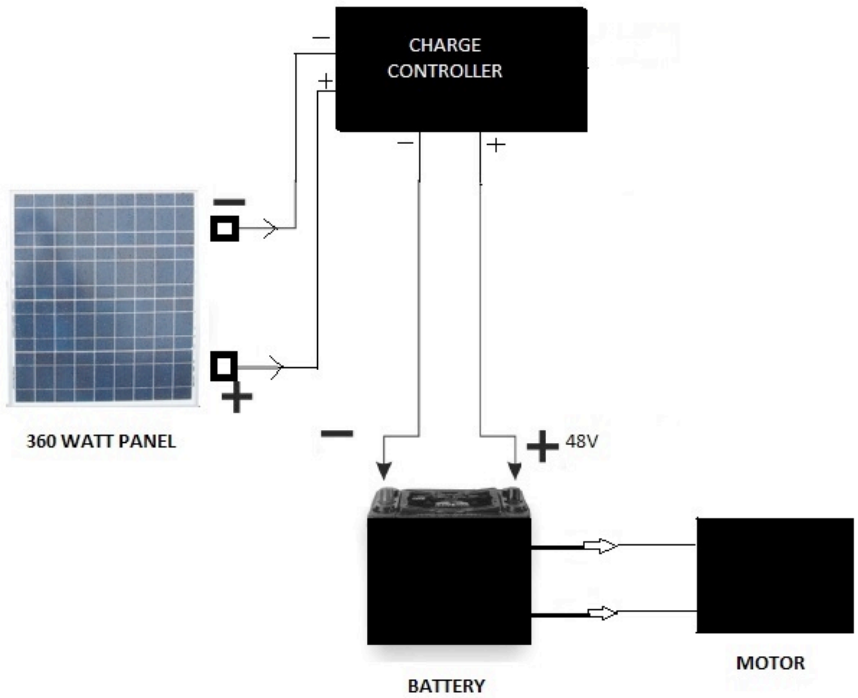

FIG. 4.2 THE CHARGE CONTROLLER ALGORTHIM

FIG. 4.3 THE SOLAR IC CHARGE CONTOLLER

The purpose of using the PWM charge controller is to run the motor using the power supplied by the solar panel as well as the battery. Pulse Width Modulated (PWM) charge controllers force the solar panels to operate at the same voltage as the battery bank during charging.

4.2 What is PWM charge controller?

Pulse Width Modulation (PWM) is the most effective means to achieve constant voltage battery charging by switching the solar system controller's power devices. When in PWM regulation, the current from the solar array tapers according to the battery's condition and recharging needs. [12]

4.3 Charge controller ratings and usage

In our project we used a 48v charge controller, as our purpose is to keep the voltage of the entire system constant. This 48v charge controller is used because we are using 48v battery which is built in function in solar powered rickshaws .The charge controller draws power from the two solar panels (which are rated 180watt each) used in series to the motor (rated 500watt).The solar panels total nominal voltage is 68.8v but through the help of the charge controller solar panels are forced to operate at a constant voltage which is 48v. Since the power of the solar panel is not enough to run the motor along, the charge controller helps to draw the extra-required power from the 48v battery (20AH) used.

When the motor is running, power would be supplied to the motor by both the solar panel and the battery. Which means in case when the motor is running the battery is discharging and supplying its power to the motor. Motor is driving by sharing the power coming from both the battery as well as the solar panel. However, when the motor is at rest power from the solar panel would be used to charge the battery only. This implies that the charge controller is used to charge as well as discharge the battery.

FIG. 4.4 THE CHARGE CONTROLLER RATINGS

The Charge Controller was bought from SOLAR IC ltd. The controller provided contained 5 terminals as shown in fig. 4.4. The 'PV+' and 'PV-' terminals were to be connected with the positive and negative terminals of the 360-Watts Panel. The '48V+' and '48V-' were to be connected across the 48V battery terminals. The '12V+' is the power supply for the controller. This connection was to be taken from one of the 4 12V batteries in series.

4.4 How does a charge controller Work?

The purpose of charge controller is to ensure efficient charging of system battery and also supplying power to the load (which is the motor). PWM help to regulate the often-inconsistent voltage put out by solar panels in order to protect the system batteries from overcharging. The charge controller handles the job of battery charging by constantly checking the current battery state and self-adjusting accordingly to send only the right amount of charge to the battery. [12]

In essence, the charge controller works by reducing the current from the power source(solar panels) according to the battery's condition and recharging requirements, which is in contrast to on/off charge controllers which suddenly cut off power transfer to minimize battery overcharging. According to the ratings of the battery used only an optimum of 3A current can pass through the battery. With the help of the charge controller the current passed through the battery is kept within 3A range.
The PWM charge controller does this by checking the state of the battery to determine both how long (wide) the pulses should be as well as how fast they should come.

With that information, the charge controller then self-adjusts and sends the appropriate pulse to charge the battery – it varies the length and speed of the pulses sent to the battery as needed. This is essentially a rapid on and off switch. When the battery is nearly discharged, the pulses may be long and continuous, and as it becomes charged, the pulses become shorter or trickled off.

4.5 Advantages of using charge controller:

Charge controller will keep the voltage of the entire system constant without any complicacy. It would also increase charging efficiency, allow for rapid recharging, and maintain healthy battery life. In all, a PWM charge controller comes with the following advantages:

• Battery Aging Adjustments: By automatically adjusting to the battery's needs, a PWM charge controller will overcome traditional problems with charge acceptance seen in older batteries.

• Battery Gassing and Heating Reductions: By recharging more quickly than other charge controllers, a PWM avoids problems with gassing and heating which damage the battery.

• Charge Acceptance Increase: Charge acceptance is a necessity with solar system batteries, though this has typically been a problem in solar arrays. A PWM algorithm, however, increases the charge acceptance of the battery so that more of the energy generated by the array gets captured.

• Drifting Battery Cell Equalization: Many PWM charge controllers hold battery cells in better balance through equalization, which evens out the acceptance of charge to avoid capacity deterioration.

• High Battery Capacity Maintenance: The state-of-charge should remain high in order to maintain a healthy system and preserve the life of the battery. PWM algorithms provide better battery capacity maintenance due to the increased number of charge/discharge cycles.

• Lost Battery Recovery: Sulfation of lead-acid batteries in solar systems is a significant problem due to extended undercharging, which results in grid corrosion and sulfate crystal formation on the battery's positive plates. PWM charge controllers have been shown to recover lost capacity over time by deterring sulfate deposit formation, and pushing through corrosion at the interface.

• Self-Regulation with Drops in Voltage or Temperature: Older charge controllers can be negatively impacted by temperature effects or voltage drops, creating problems with the final charge of the battery. But a PWM charge controller will taper the charge to minimize these impacts.

Chapter 5

ACCESSORIES INSTALLATIONS

5.1 Solar panel installation

SOLAR PANELS

RATINGS:

- **Number of components required: 2**
- **Maximum Power: 180 W**
- **Nominal voltage: 34.92V**
- **Nominal current: 5.15A**
- **Open circuit voltage: 44.64V**
- **Short circuit current: 5.6A**
- **Number of cells: 72**
- **Weight: 13kg**
- **Dimensions: 1550*808(MM*MM)**
- **Max system voltage: 600DC**
- **Power tolerance: +-3%**

5.2 Research and selection of solar panels

Solar panel mounting systems are used to hold the solar panels in proper place, secure them from wind damage and most importantly to ensure the maximum output from the solar panel. There are mounting systems for just about any potential installation scenario from roof mounting systems, pole-mounting systems, RV mounting systems and even boat mounting systems. Many of the pole mounted systems can also be modified to support both active and passive modules that allow the panels to more closely follow the sun which increases the efficiency of the panel. [13]

In our case we are mounting solar panel on the top of an electrical rickshaw. Hence, in order to hold the solar panels in proper place and secure them from damage we have to develop a proper structure. Furthermore, we also have to find a way to get the maximum efficiency from the solar panel.

5.4 Research on installation angles

In order to find the angle at which the panels supply the maximum current, we had to carry out range of experiments. We took the panels to the rooftop for the experiments. We carried out two different types of experiment. First, we varied the angle of the panel with the horizontal surface, and recorded the respective current supplied. Second and finally, we changed the position of the panels according to direction. The corresponding current values were once again recorded. The results from this experiment assisted us to come to a reliable conclusion. The experiment is illustrated below:

Experimental setup: :

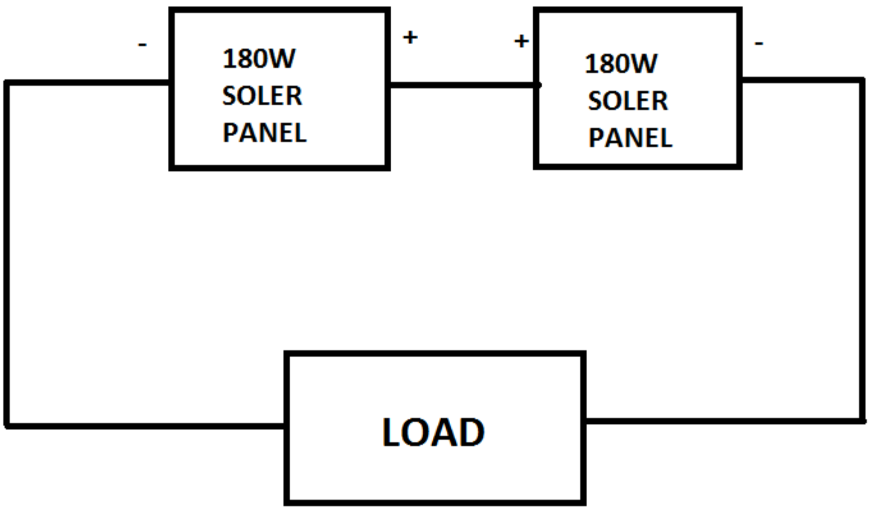

FIG. 5.1 EXPERIMENTAL SETUP

Table- 5.1:

Effect of variation in angle:

Effect of change in angle:			
Angle	Voltage	Current	Power
1. 0 Degrees	66	3.8	250.8
2. 40 Degrees	38.2	2.36	90.152
3. 60 Degrees	20.1	1.26	25.326
4. 90 Degrees	15.1	0.9	13.59

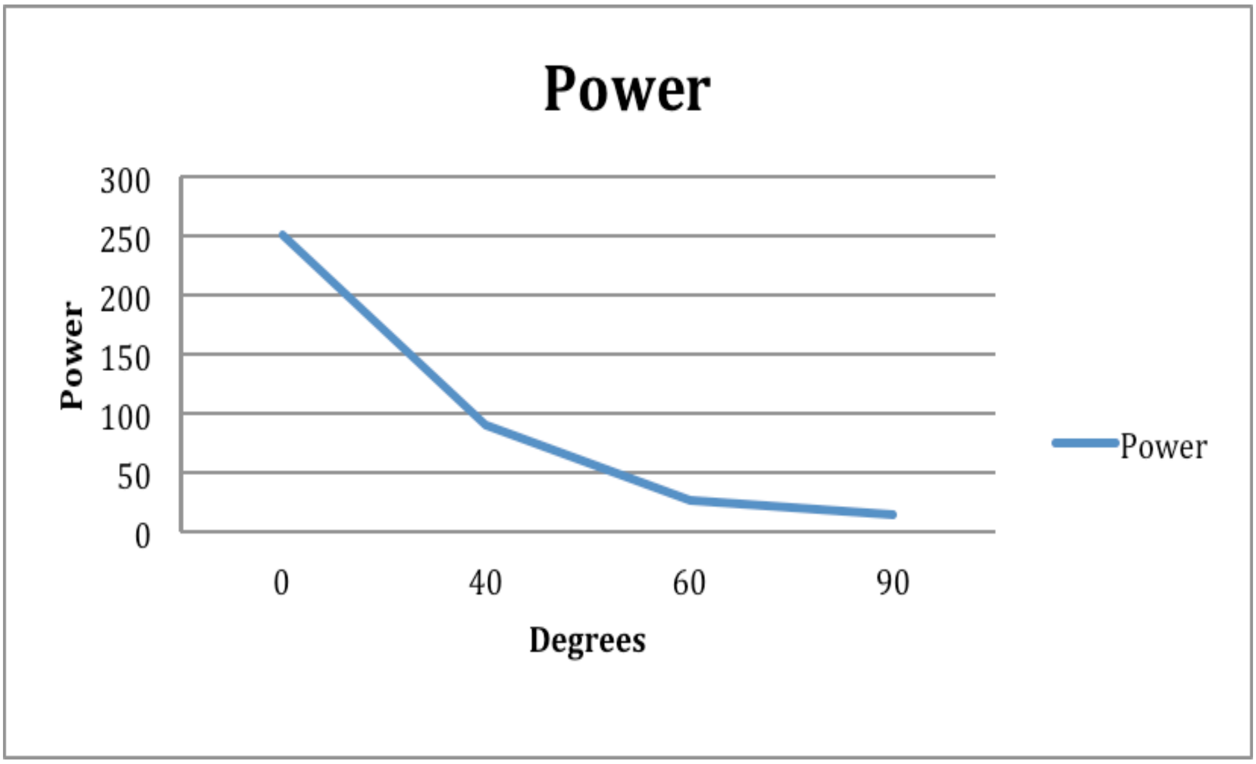

FIG. 5.1 POWER (WATTS) VS. ANGLE (DEGREES)

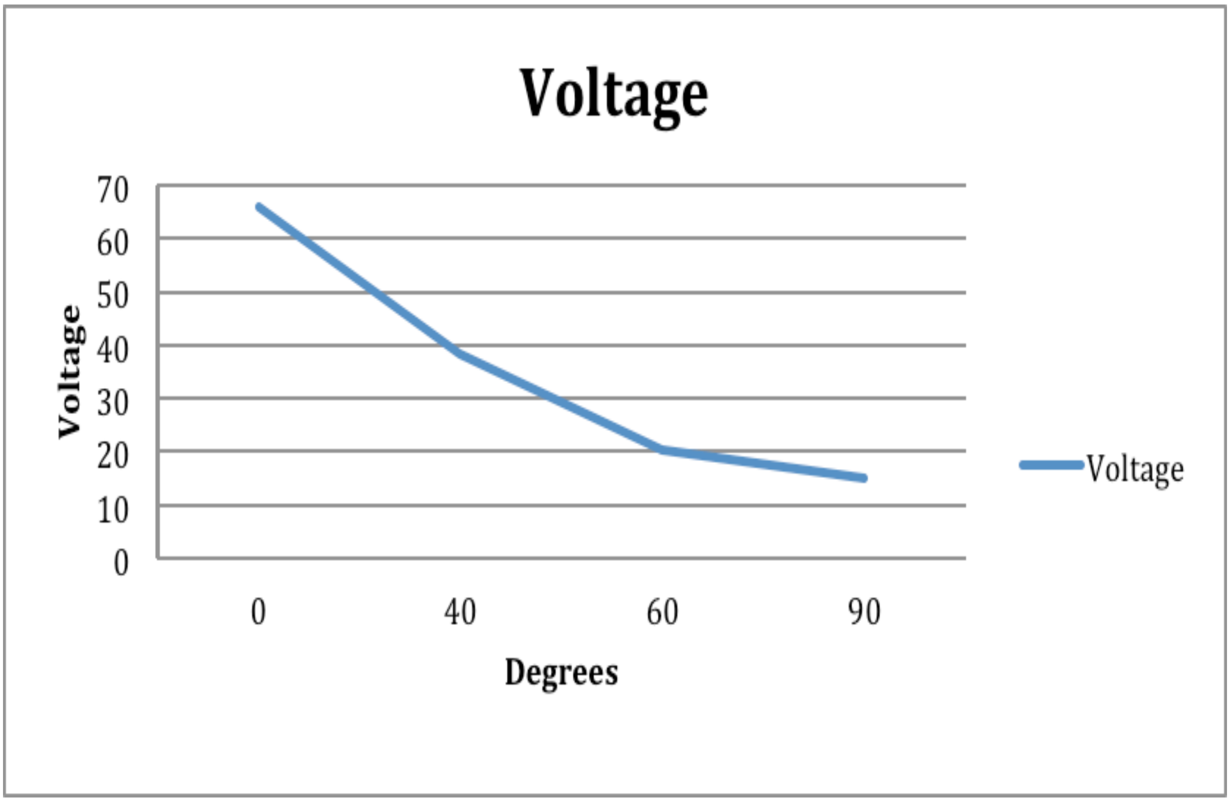

FIG. 5.2 VOLTAGE (VOLTS) VS. ANGLE (DEGREES)

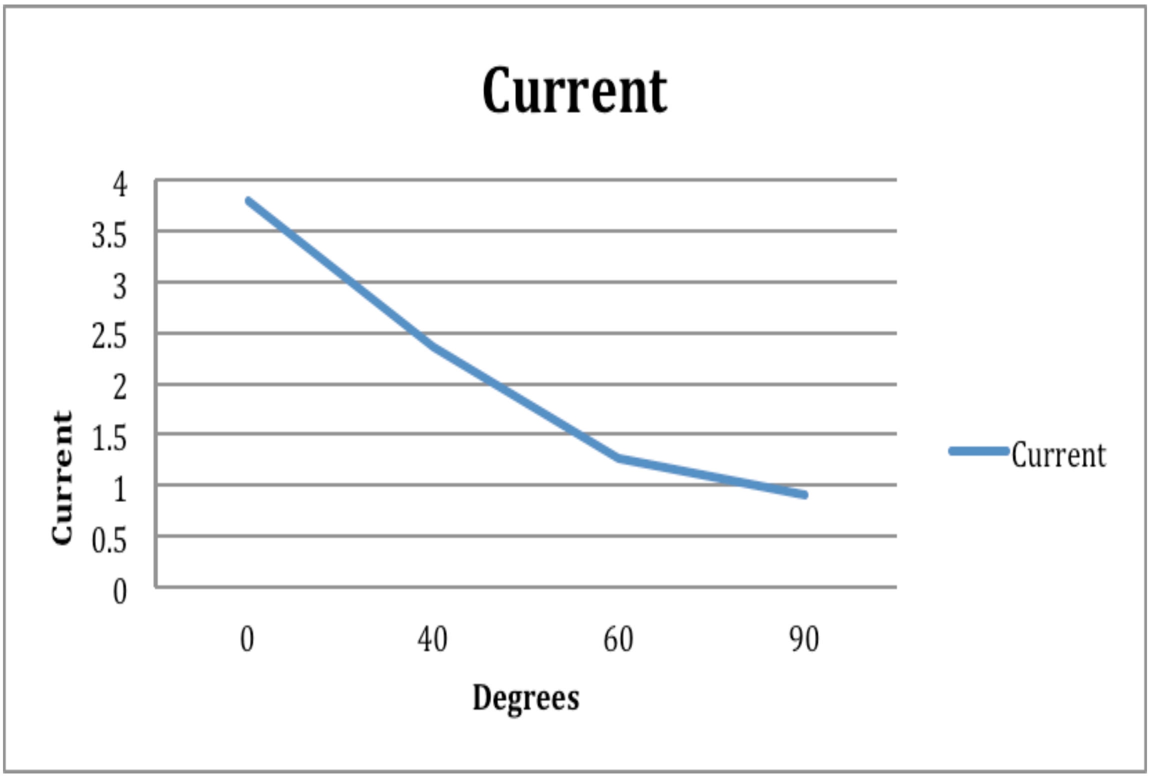

FIG. 5.3 CURRENT (AMPERES) VS. ANGLE (DEGREES)

We further experimented the performance of the panels by switching the panels in different directions. We also took data keeping one panel shaded while the other received sunlight and vice versa. The following table represents the concluded results.

Table- 5.2:

Effect of shading:

	Panel				
Panel Position	Voltage	Current	Power	Remarks	Sun condition
Facing north south	38.7	2.36	91.332	1.Both side open	Sunny
	24.1	1.2	28.92	2.One side shaded(south side)	Sunny
	26.3	1.9	49.97	3.One side shaded(north side)	Sunny
	12.1	0.69	8.349	4.Both side shaded	Sunny
Facing north-west	27.3	2.98	81.354	1.Both side open	Sunny
and south-east	36.1	2.31	83.391	2.One side shaded(north-west)	Sunny
	21.6	1.41	30.456	3.One side shaded(south-east)	Sunny
	10.6	0.65	6.89	4.Both side shaded	Sunny
Facing east west	15.4	1.1	16.94	1.Both side open	cloudy
	15.6	0.98	15.28	2.One side	cloud

				8	shaded(west side)		y	
		15	0.96	14.4	3.One side shaded(east side)		cloudy	
		3.6	0.24	0.864	4.Both side shaded		cloudy	
Facing south-west		5.7	3.63	20.691	1.Both side open		Sunny	
and north-east		17	1.07	18.19	2.One side shaded(south-west)		Sunny	
		25.5	1.51	38.505	3.One side shaded(north-east)		Sunny	
		5.5	0.34	1.87	4.Both side shaded		Sunny	

**Here all the data are taken at the minimum load condition

**All voltages are in volt, currents are in amp and powers are in watt.

****ALL THE DATA ARE TAKEN FROM 10:00a.m. To 3:00p.m.**

The following graphs shows the power variations with respect to variations in directio Current variations with respect to variations in direction and Voltage variations with r Variations in direction respectively..

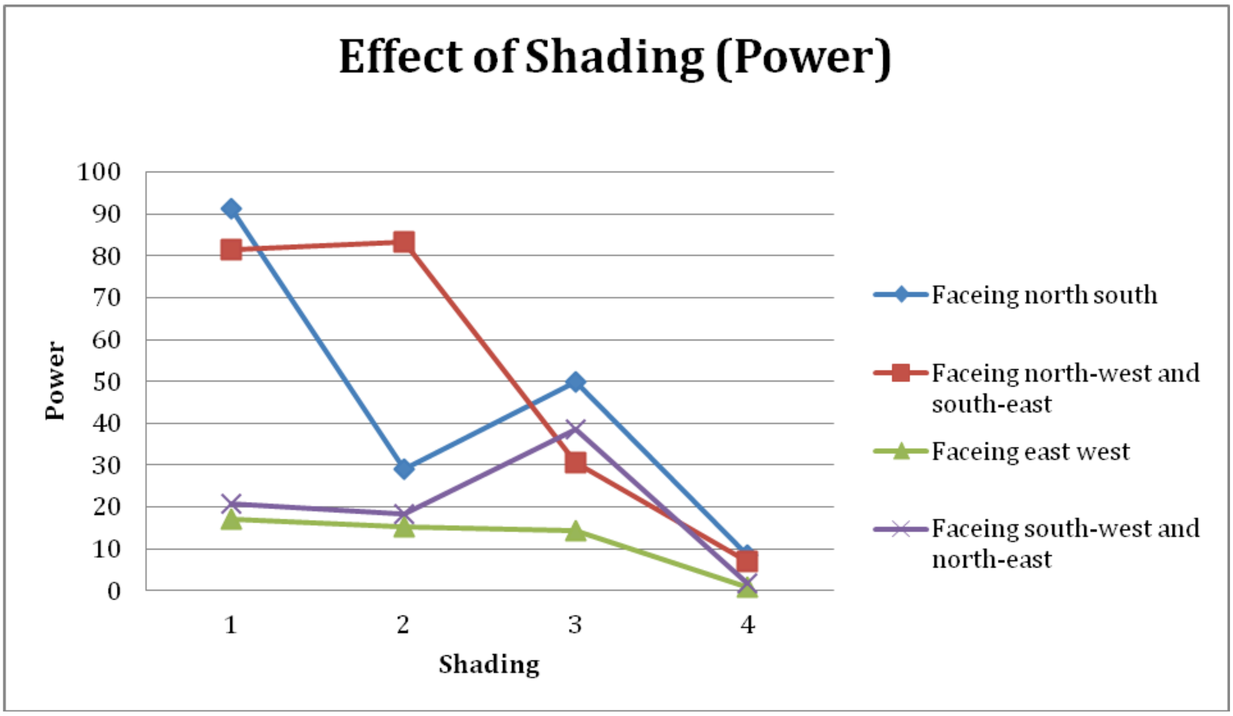

FIG. 5.4 POWER (WATTS) WITH RESPECT TO POSITIONS

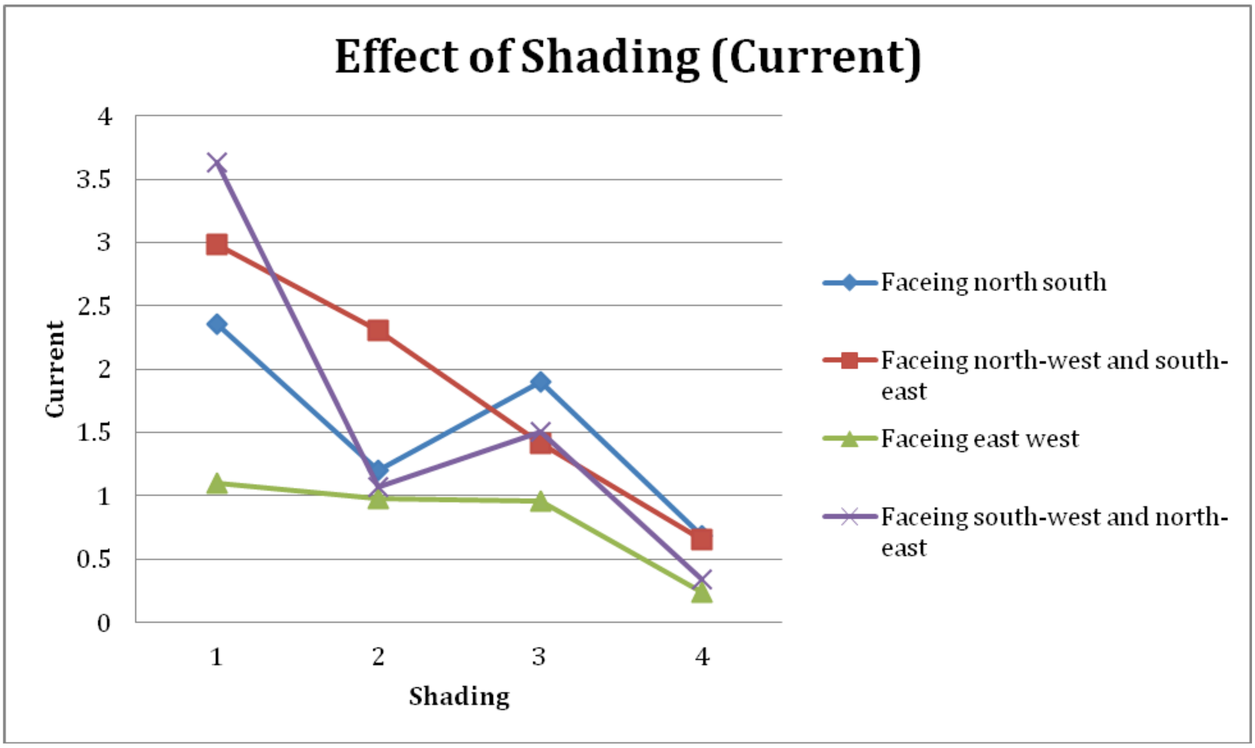

FIG. 5.5 CURRENT (AMPERES) WITH RESPECT TO POSITIONS

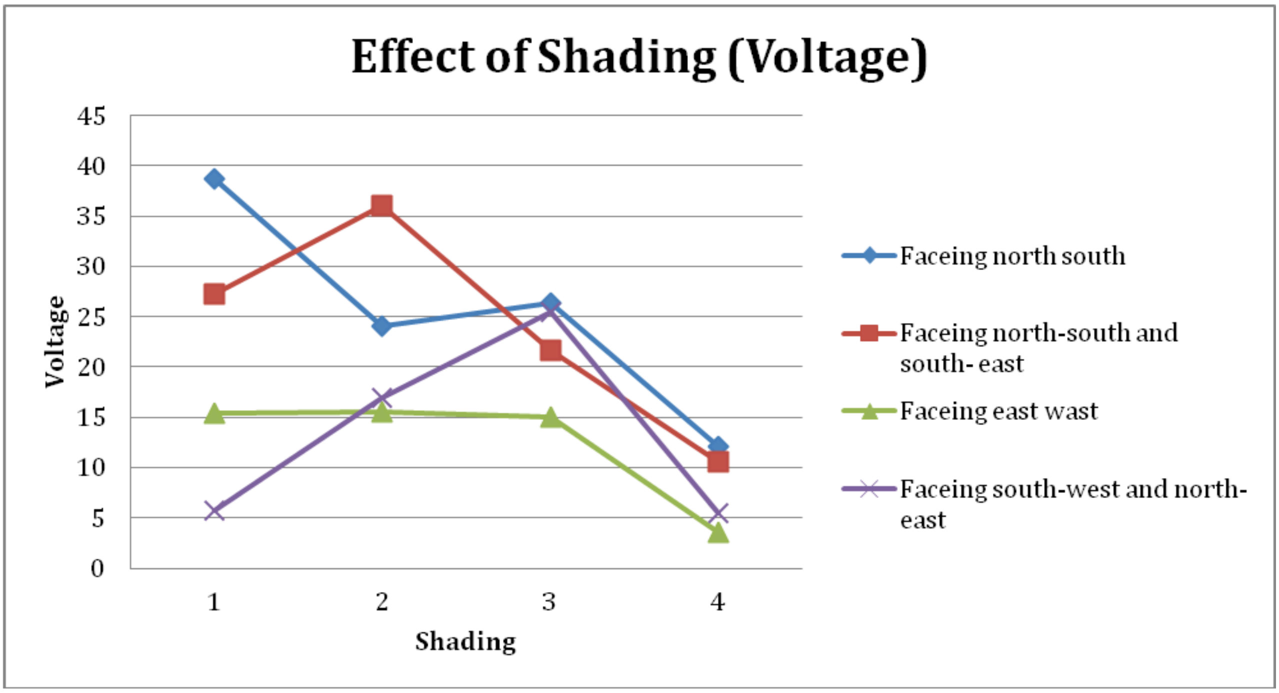

FIG. 5.6 VOLTAGE (VOLTS) WITH RESPECT TO POSITIONS

Table-1 data clearly shows that, as the angle with the horizontal surface decreases, the current from the panel increases. Thus, lower the angle, higher is the current supplied by the panels. Another important conclusion that we can get from the data of Table-2 and graphs is that shadow over any one or both panel can cause huge decrease in current.

5.3 Inclined installation of panel:

FIG. 5.7 INCLINED PANEL STRUCTURE

As mentioned above, since as angle decreases, current from the panel increases. Hence, lowest angle we can compromise is 43 degrees. The resulting width is almost 120cm, which is close to the width of the rickshaw (118cm). Finally, we decided to install the panels at the top of the rickshaw in 43 degrees angle facing opposite to each other.
This is safer in the road and more feasible structure for the solar rickshaw, but the drawback is that efficiency is low in this case.

Width of rickshaw = 1.16m
Width of solar panel=0.805m
Thus, angle =43 degree

The angle of the solar panel is selected at 43-degree angle.

Voltage rating of each panel is 34.92V, but the terminal voltage is 48V across the DC motor and also the batteries. We decided to use two panels in series to match this requirement, thus, giving us more than the required 48V, in this case 69.84V(34.92*2).

5.5 Flat installation of the panel:

FIG. 5.8 FLAT PANEL STRUCTURE

Since the efficiency of the panel is lower in inclined position, we decided to flatten the panels although the surface area of the panels, in this case, exceeds the maximum surface area of the rickshaw, but on the bright side, it increases efficiency greatly which will be proved in the later chapters. Thus, our opportunity cost of increasing performance would be the safety issue but this is one issue that can be worked on in the future.

Major problem of the flat position is the width of the structure. As mentioned before width of the rickshaw is only 118cm and on the other hand flat structure has width of 160cm. So we have to extend almost 20cm in both side of the rickshaw. So it is less safe in the road of Dhaka city.

From the data of table- 5.2 mentioned above it is obvious that we can get highest current from the flat position. That means in flat structure panels are most efficient. So this position is less feasible but the efficiency of the panel is much higher.

‘

Chapter 6

THE FIELD TESTS

6.1 Objectives

As mentioned before, the primary objective of carrying out the field tests is to show the percentage of power that can be saved from the national grid. In order to calculate this, we needed to show the sharing between the panel and the battery. The more the panel can supply current; the better would be our outcome. Hence, as we previously stated, there were two different panel states, the inclined panel state and the flat panel state. We recorded our data from three different days, and considered the peak sun hours from 11 30 AM to 1 30 PM. Data were taken throughout the day, so that, we can calculate our desired results, not only during the peak sun hours but also for a few hours before and after, this lead to more accurate approximation of the results.

Voltage readings across battery and panel were taken in order to see the fall in voltage level with respect to time. This helped us to determine the state of charge of the lead-acid batteries, which in turn assisted us in comparing the different states in terms of efficiency.

Current readings of the battery and the panel were taken in order to clearly understand the sharing of current. This was the most important reading, simply because it allowed us to achieve our primary goal.

Furthermore, a GPS tracking system was used to calculate the average speed of the rickshaw and more importantly, the distance travelled. The objective would be to compare the distances the rickshaw could travel with the battery SOC up to 50%. This result would put more emphasis on how important the panels' effect has on the overall system.

6.2 Acquisition techniques

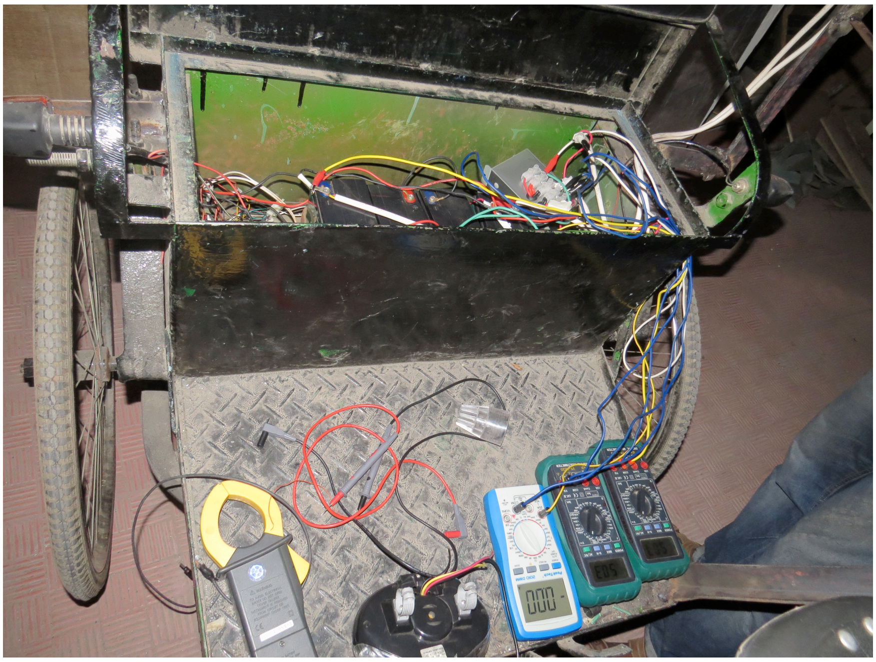

FIG. 6.1 EXPERIMENTAL ACQUISITION SETUP

During the three days of field-tests, common readings of voltage and current were taken. Two multi-meters were used as voltmeters, one in parallel across the 48V batteries and the other in parallel across the nodes that connected the charge controller with the panels. A multi-meter was used as an ammeter in series with the panel in order to measure the amount of current supplied by the panel, while a clamp meter was connected in series with the motor and the battery to see the current flowing to the motor. A clamp-meter was used in this case because the maximum current that could flow into the motor was 32 Amperes. The ammeters available to us only had a maximum current rating to 20 Amperes. Hence, it was important for us to use the clamp meter for this purpose.

While travelling on the rickshaw during the tests, we always had the GPS tracking system with us. The measuring device would automatically calculate the average speed of the rickshaw and the distance that it travelled.

Finally, all these readings were recorded by a video camera throughout the field tests. The next section includes all the data collected during the field tests. These were retrieved from the video camera at a 5 seconds time interval between each data.

Note: All the graphs shown in the later parts of this chapter are not continuous. The graphs are compiled as continuous for convenience. The time duration of some of the graphs are mentioned, this means that the data where taken during that span. It does not necessarily mean that the results in that duration are continuous.

6.3 Inclined Panel State

On the first day of our field tests, we measured data for the inclined panel state. The data is attached in the **APPENDIX** section: **TABLE 1**

The data was used to compile the following graph:

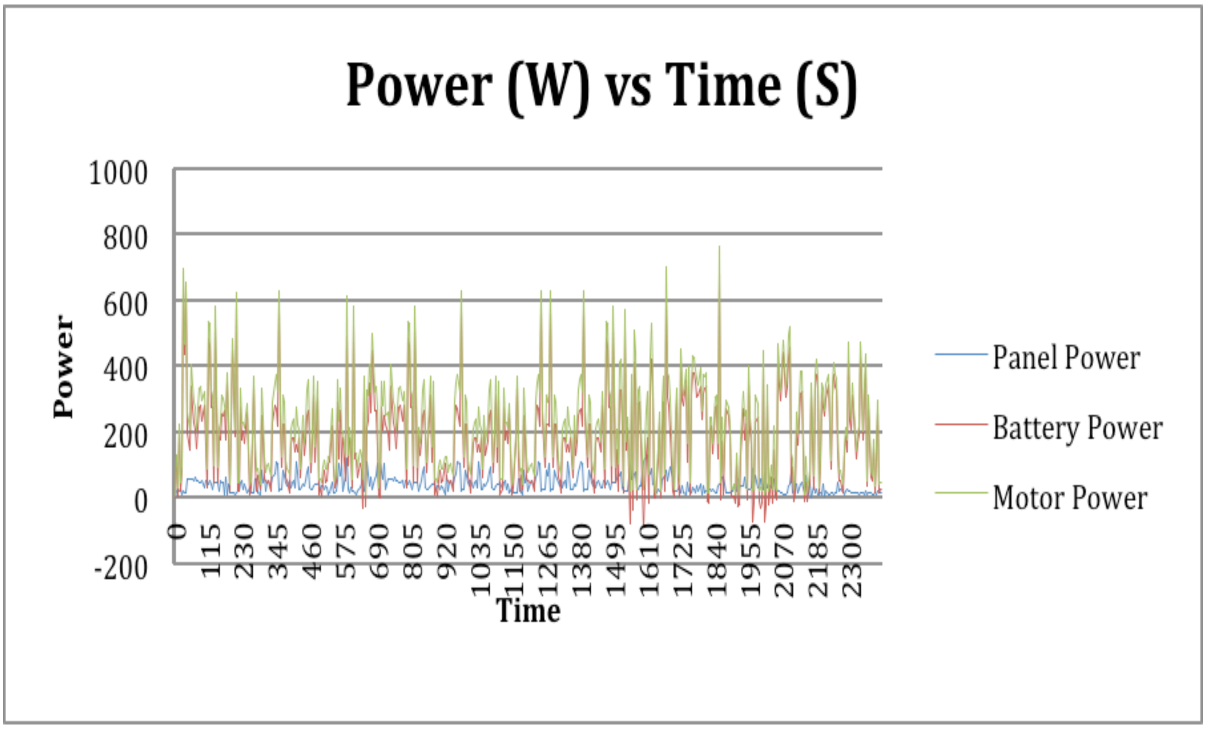

FIG. 6.2 INCLINED PANEL POWER (WATTS) VS. TIME (SECONDS)

The above graph was used to calculate the total energy used up by the motor and the energies supplied by the panel and batteries. This was done by calculating the area under the curve. The area under the power against time graph gives us energy [E=P*T] Thus the area under the motor power against time gave us the total energy sued up by the motor. This turned out to be **538673.12 Joules**. Similarly, the area under the battery power against time, and the panel power against time was calculated. The corresponding results were **442630 Joules** and **96043.12 Joules** respectively. Thus, these results allowed us to calculate the sharing of total power supplied by the panel and the batteries. The final result showed **17.8 %** of total power being supplied by the panel while the remaining **82.2 %** being supplied by the batteries. The following pie chart is a more clear representation of the above calculations:

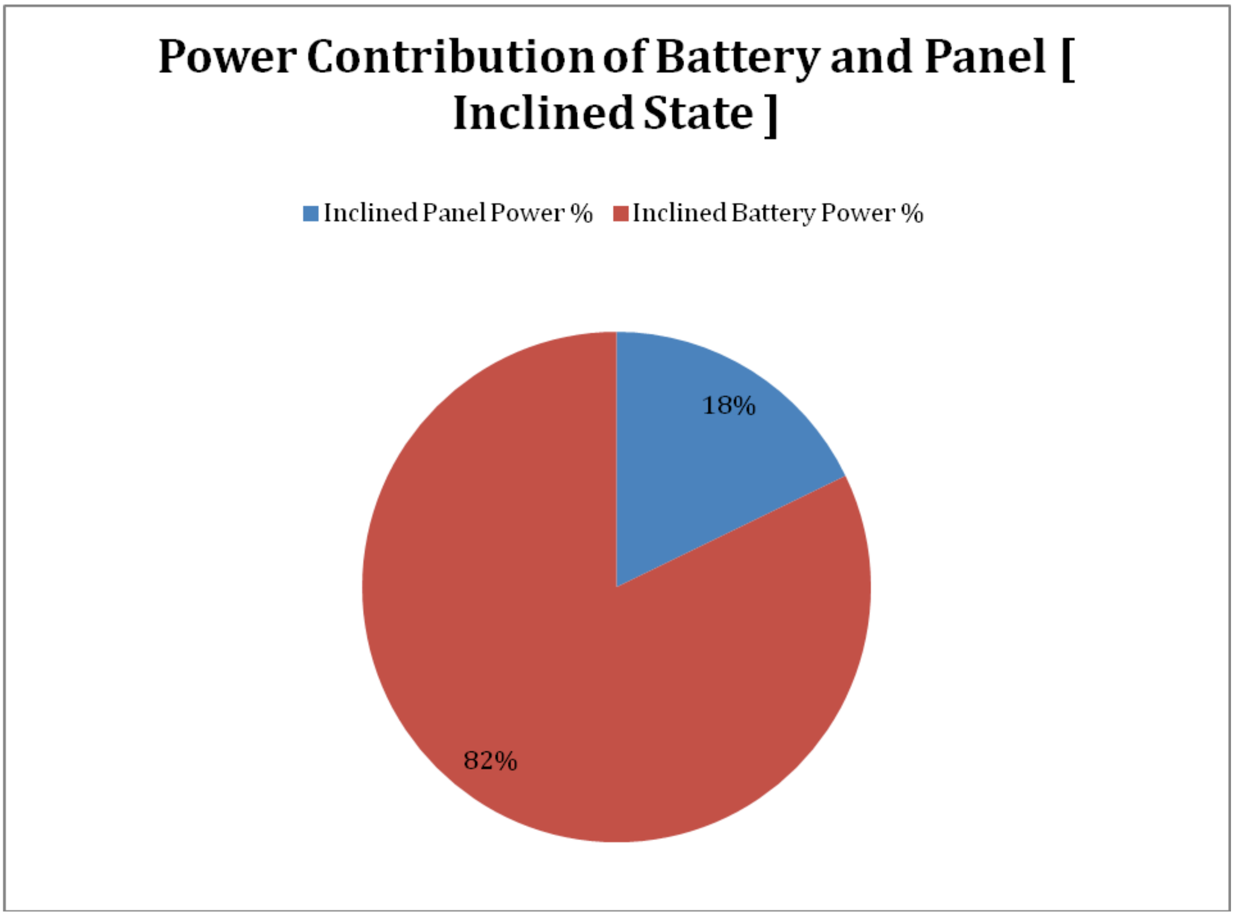

FIG. 6.3 POWER CONTRIBUTION (INCLINED STATE)

The Battery voltage decreased from **51.8 V** to **47.1 V**. This meant that the SOC of battery went down from **100%** to **50%**. The total distance travelled by the rickshaw was **26.8 Km** during this time (as measured by the GPS tracking device) and it ran at an average moving speed of 8.23 **Km/Hr.** The total duration of experiment in this case (Inclined panel state) was approximately **4 Hours and 30 Minute.**

6.4 Flat Panel State

On the second day, our experiment was with the rickshaw in flat panel condition. The following data were recorded and attached in the **APPENDIX** section: **TABLE 2**

Now, the data is used to compile the following graphs :

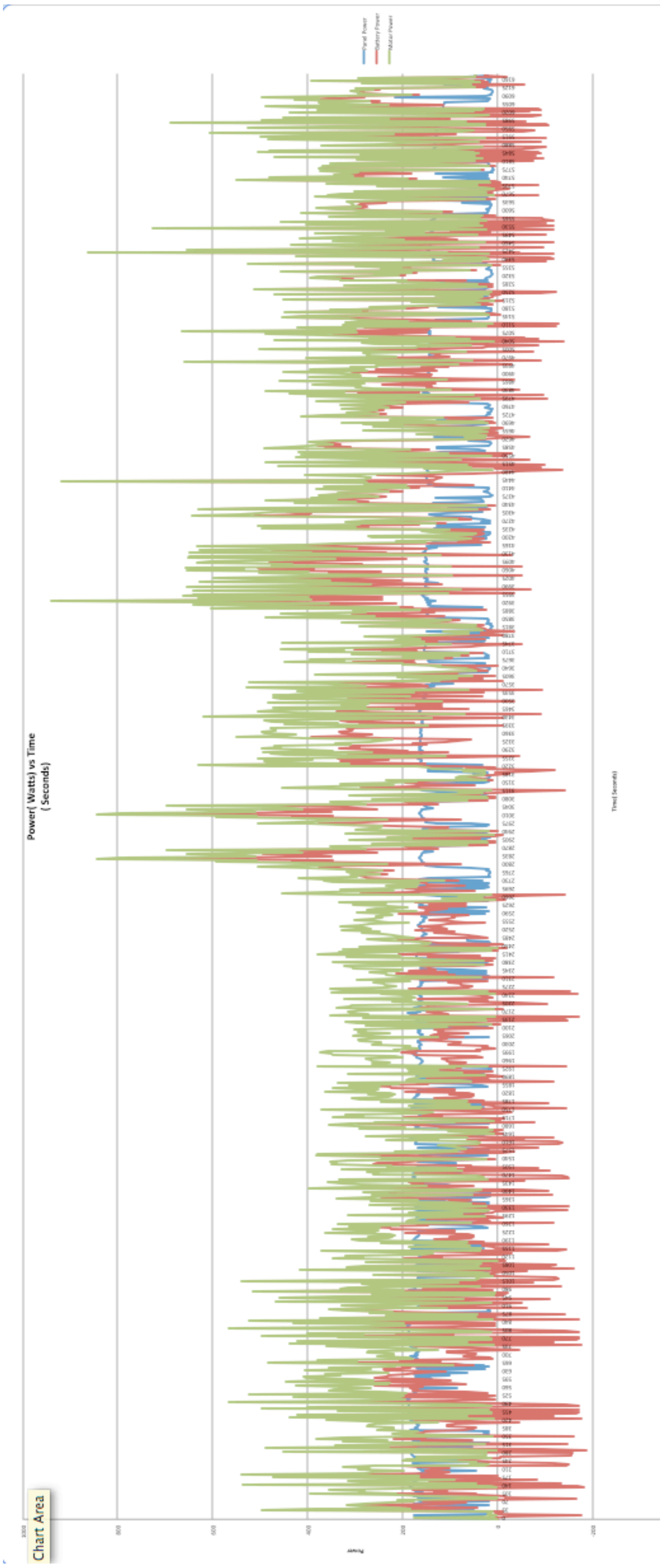

FIG. 6.4 FLAT PANEL POWER (WATTS) VS. TIME (SECONDS)

As previously done, the area under the graph was used to calculate the energies involved. The area under the motor power against time gave us the total energy supplied by the motor. This was found to be **1568455.095 Joules**. Similarly, the area under the battery power against time, and the panel power against time was calculated. The corresponding results were **849581.83 Joules** and **718873.265 Joules** respectively. Thus, these results allowed us to calculate the sharing of total power supplied by the panel and the batteries. The final result showed **45.83%** of total power being supplied by the panel while the remaining **54.17%** being supplied by the batteries. The following pie chart is a more clear representation of the above calculations:

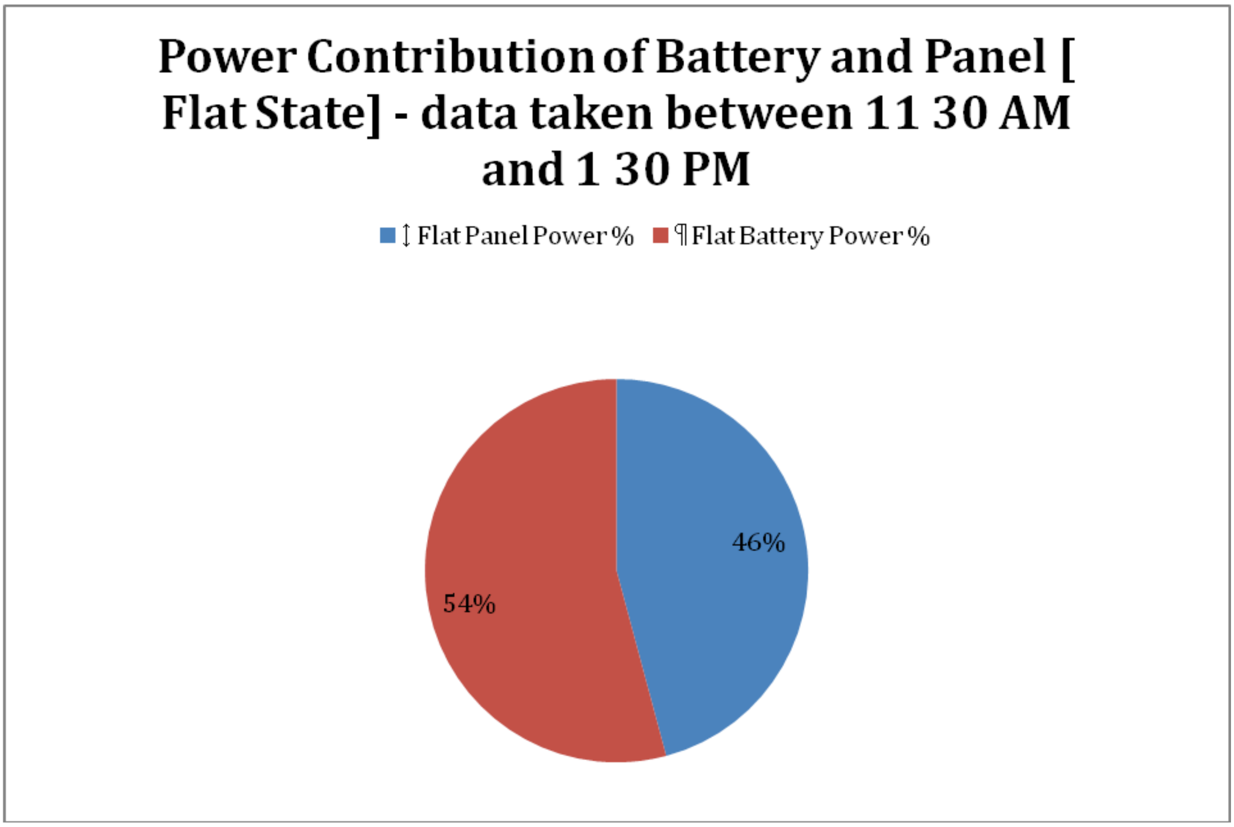

FIG. 6.5 POWER CONTRIBUTION

If we consider the peak sun hours from **11 30 AM** to **1 30 PM**, then the results are significantly different. In this case, the total energy consumed by the motor is **511913.6 Joules**. The energy from the batteries counted to be **183058.39 Joules** and from panel it was the remaining **328855.21 Joules**. Thus, the percentage of power supplied by the panel, in this case turned out to be **64.24%** (far greater than previous **45.83%**) The pie chart below clearly shows that:

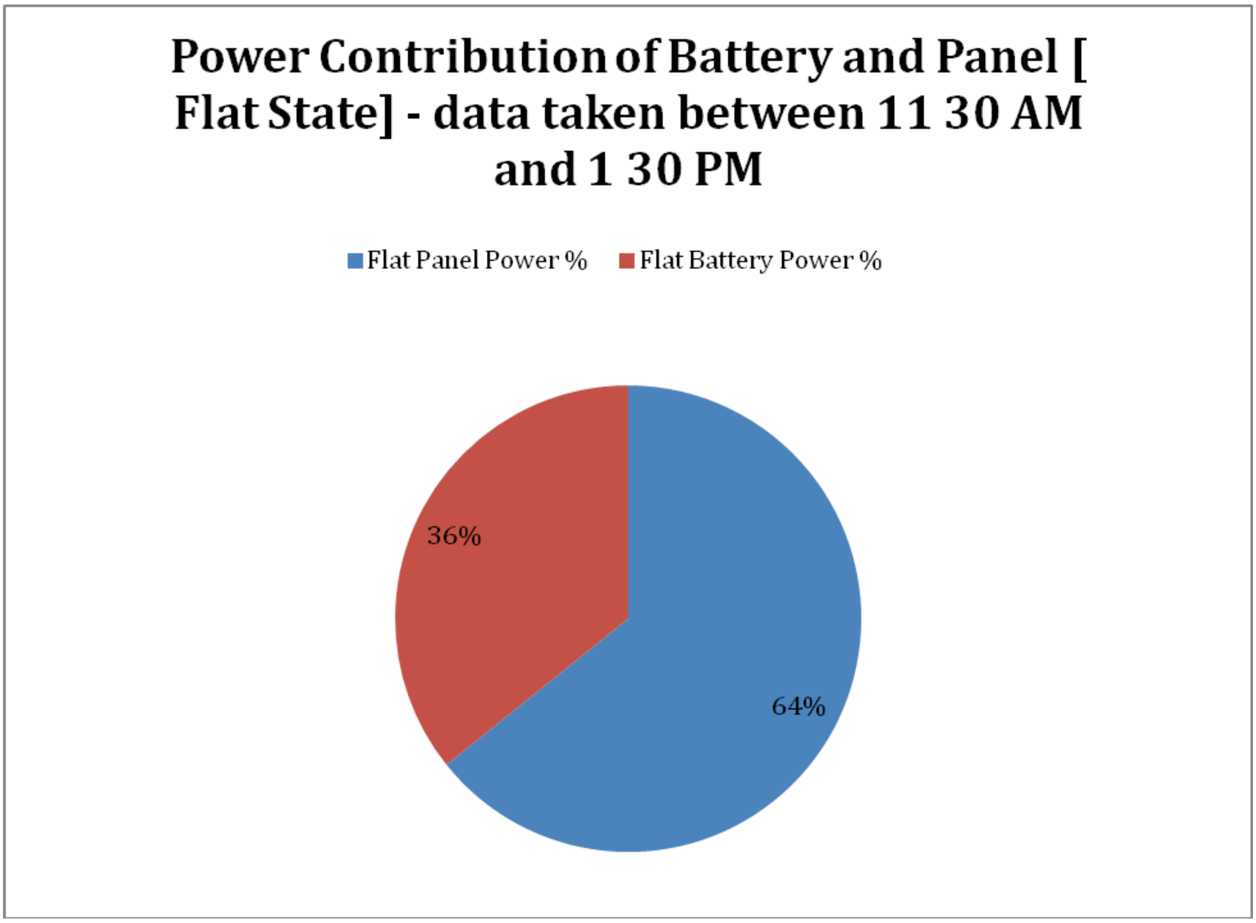

FIG. 6.6 POWER CONTRIBUTION (PEAK HOURS)

The Battery voltage decreased from **54.8 V** to **51.8 V**. This meant that the SOC of battery did not go down and remained unchanged at **100%**. The total distance travelled by the rickshaw was **22.3 Km** during this time (as measured by the GPS tracking device) and it ran at an average moving speed of **8.35 Km/Hr.** The total duration of experiment in this case (Flat panel state) was approximately **4 Hours.**

6.5 Without-Panel State

On the final day of the field tests, the readings were taken with the rickshaw without any panel support. In this case, the results are as follows and attached in the **APPENDIX** section: **TABEL 3**

The data were used to compile the following graph:

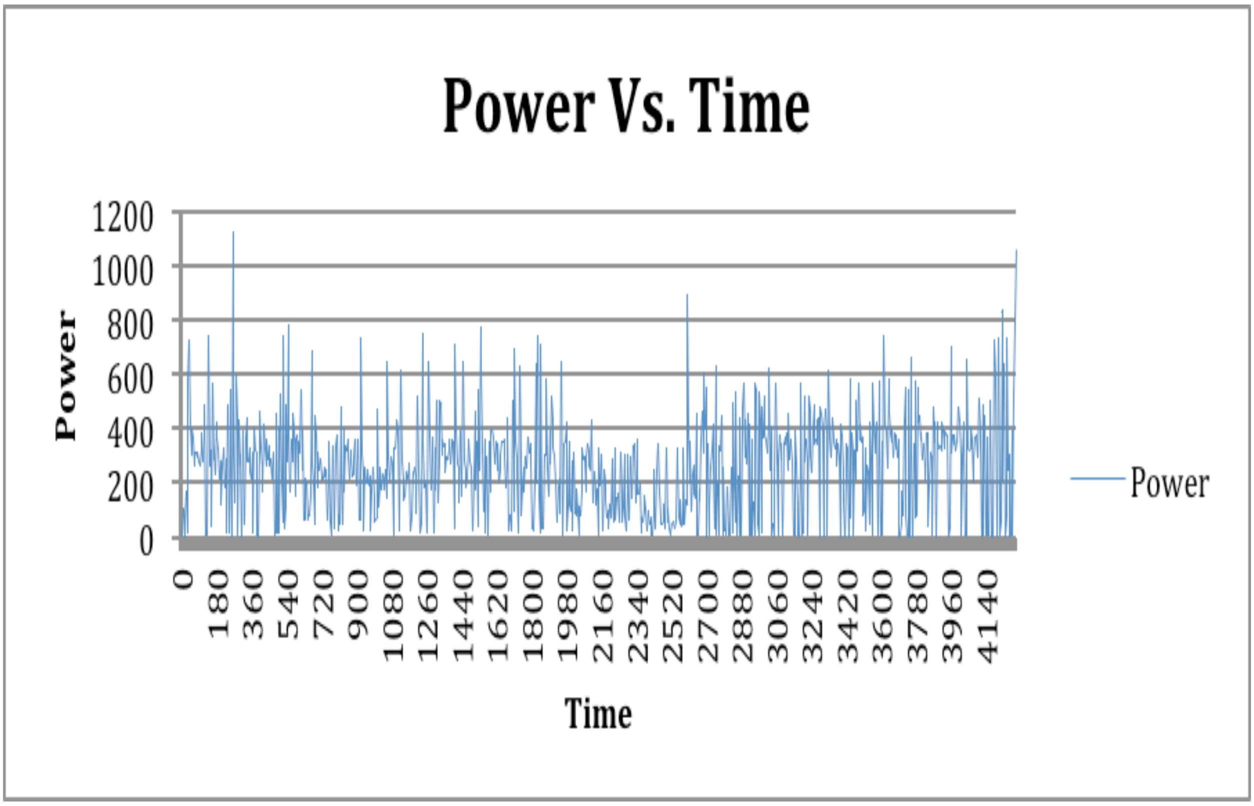

FIG. 6.7 POWER (WATTS) VS. TIME (SECONDS)

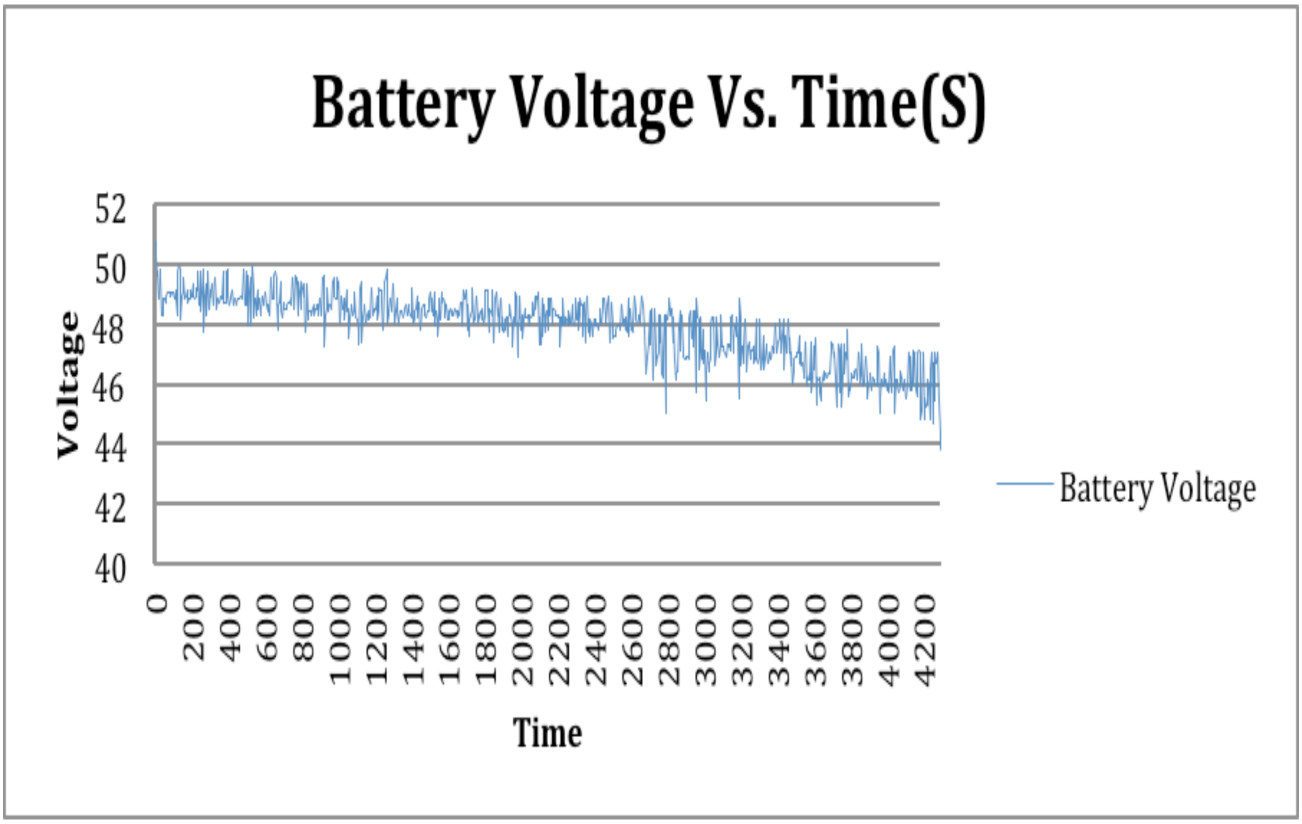

FIG. 6.8 BATTERY VOLTAGE (VOLTS) VS. TIME (SECONDS)

In this state, the batteries supply all the energy consumed by the motor, since there is no PV support. The total energy was found to be **1115643.04 Joules**. The battery voltage fell from **50.8 V** to **47 V**, as shown in the above graph. This meant the Battery SOC reduced from **100%** to **50%**. The total distance travelled during this test was **18.8 Km** and the duration of travel was approximately 2 hours.

6.6 Comparative Study

In order to find the relative differences between the different experimental conditions, comparative analysis is very essential. This is why; we decided to analyze the comparisons in two different ways. Firstly, we compared the readings between 'Inclined Panel State' and 'Flat Panel State', in order to find which state would be the better choice for further experiments. Finally, another comparison was made between 'With Panel State' and 'Without Panel State, in order to find how effective the panels can be. The following contents would finally prove the significant effect the panels have on the overall system.
First, we will look at the comparisons between 'Inclined State' and 'Flat State.'

6.6.1 Inclined Panel State Vs. Flat Panel State

As previously stated, we carried out the experiments with the electric rickshaw in two different states. The first graph shows a comparison between the powers from the panels. These data are only for the peak sun hours, i.e. from 11 30 AM to 1 30 PM.

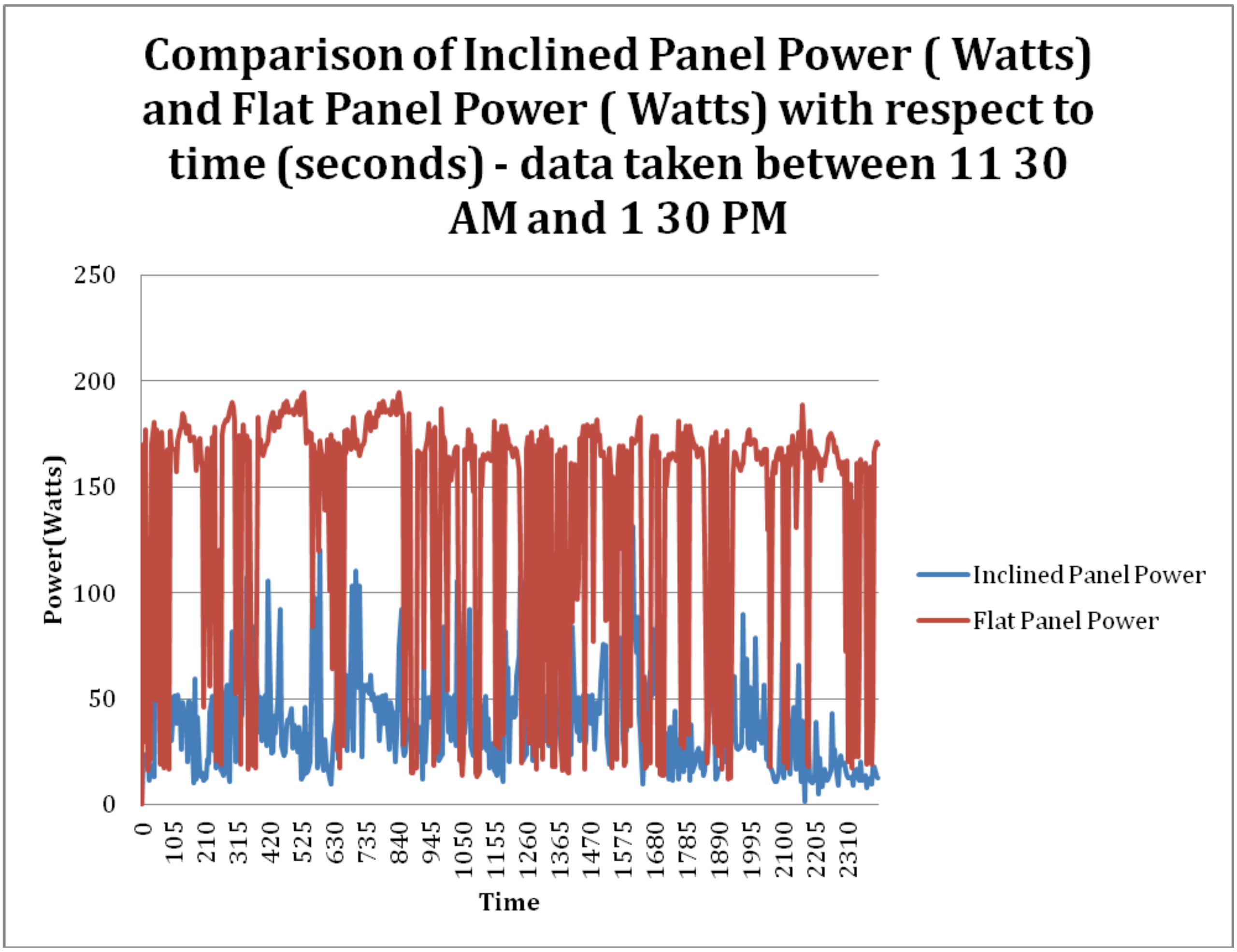

FIG. 6.9 INCLINED PANEL POWER (WATTS) AND FLAT PANEL POWER (WATTS) WITH RESPECT TO TIME (SECONDS)

The above graph clearly shows that the power supplied in 'Flat State' is almost three times compared to that of 'Inclined State.' The power is much more consistent, with rare fluctuations. This clearly indicated that flat panels are much more efficient.

Now, the second graph shows the comparative power supplied by the batteries. In ‘Inclined State’, the power supplied by the 48V batteries is much greater compared to that of ‘Flat State’. A rare negative power can be seen in the graph for ‘Inclined State’. On the other hand, the ‘Flat State’ shows that almost 30-40 % time, the battery is being charged rather than supplying. This is a big difference, in terms of power being saved between the two states.

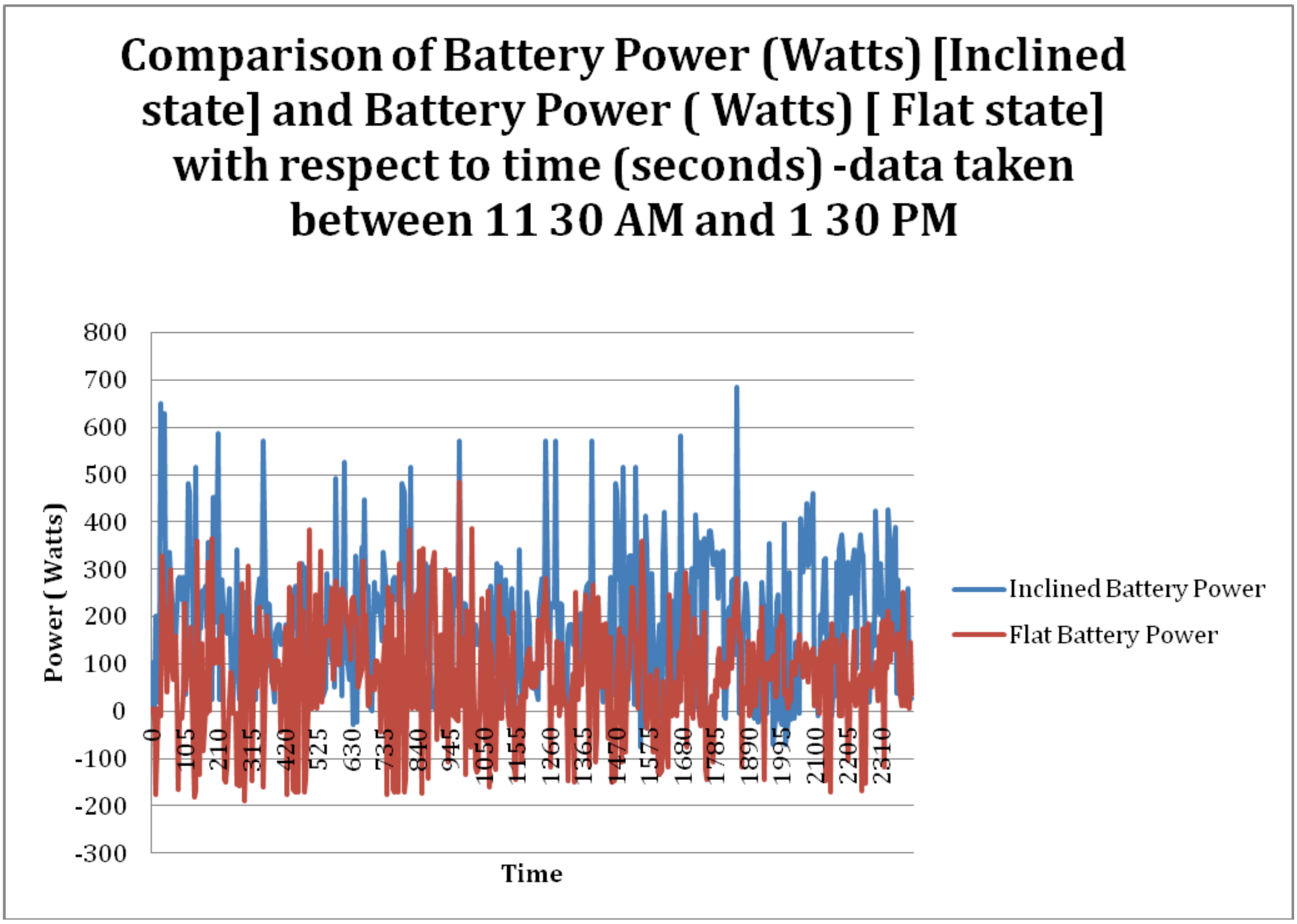

FIG. 6.10 COMPARIOSN OF BATTERY POWER (WATTS)

The following bar chart shows the percentage of power supplied by the battery and the panel in “Inclined State.’ The sharing is at a ratio of approximately **4: 1** with a massive **82.2%** coming from the batteries and the remaining **17.8 %** coming from the panels.

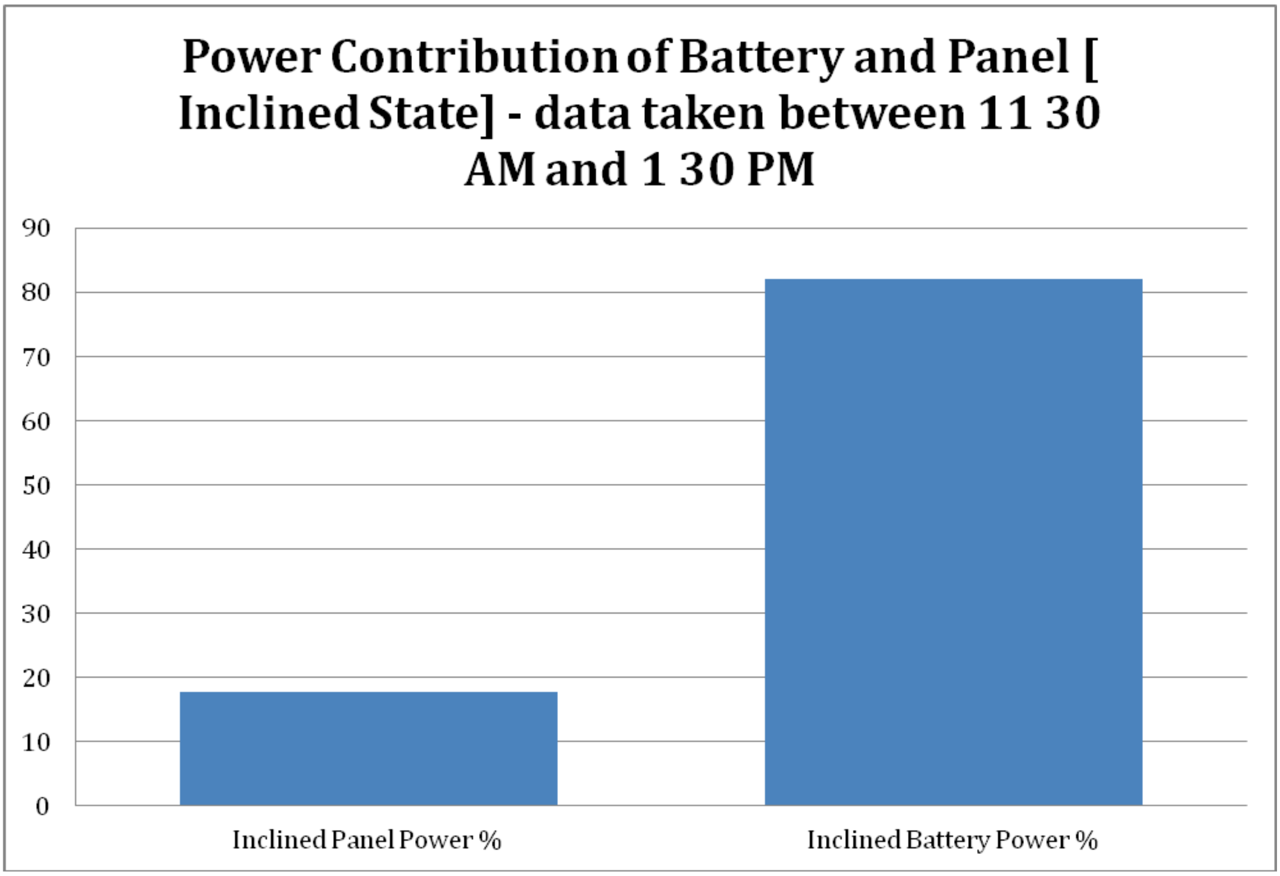

FIG. 6.11 POWER CONTRIBUTION (INCLINED STATE)

The next bar chart shows the power contribution of the panels and the batteries in the “Flat State’. This time, there is a substantial difference compared to the previous chart. This time, **64%** of the power is supplied by the panels while only **36%** comes from the Batteries. The corresponding ratio being **2: 1** in favour of the panels.

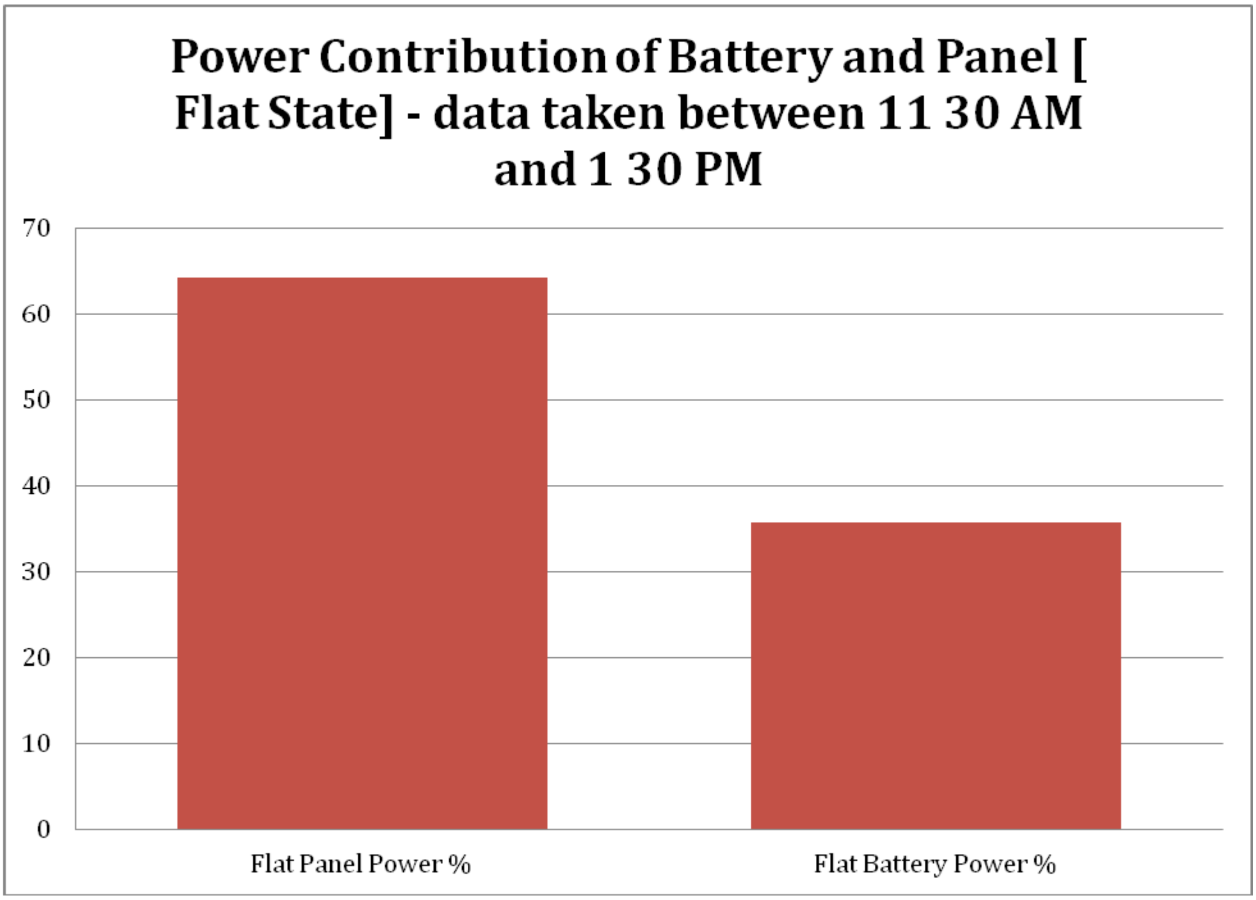

FIG. 6.12 POWER CONTRIBUTION (FLAT STATE)

The following line graphs show the change in battery voltage level during the two states. ‘Inclined State’ shows that the voltage level falls from **51.8 V** to **47.1 V** in approximately 4 hours while ‘Flat State’ indicates that the level decreases from **54.8V** to **51.9 V** within the same duration. This specially affects the battery SOC. The second graph shows the change n battery SOC. It remains at **100%** for the ‘Flat State’ while for the ‘Inclined State’; the level falls to **50%**. The third graph illustrates how the battery SOC is related to the voltage. The experiment was carried out by us in order to compile the information for that graph.

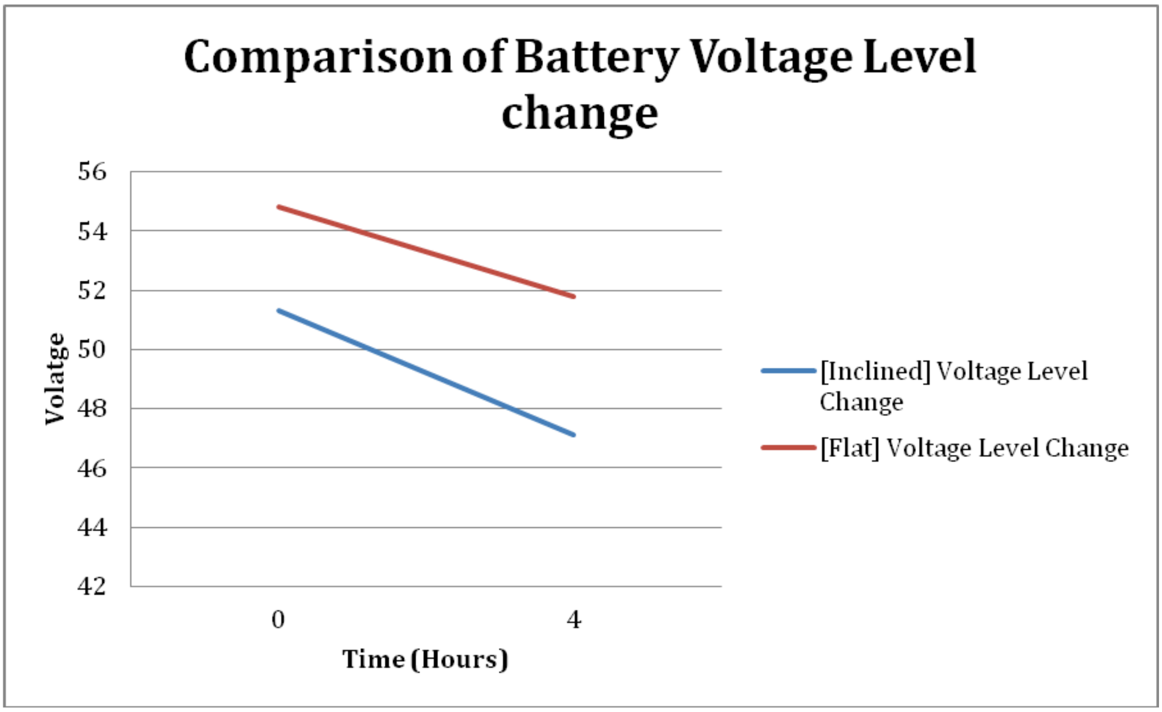

FIG. 6.13 CHANGE IN BATTERY VOLTAGE LEVEL

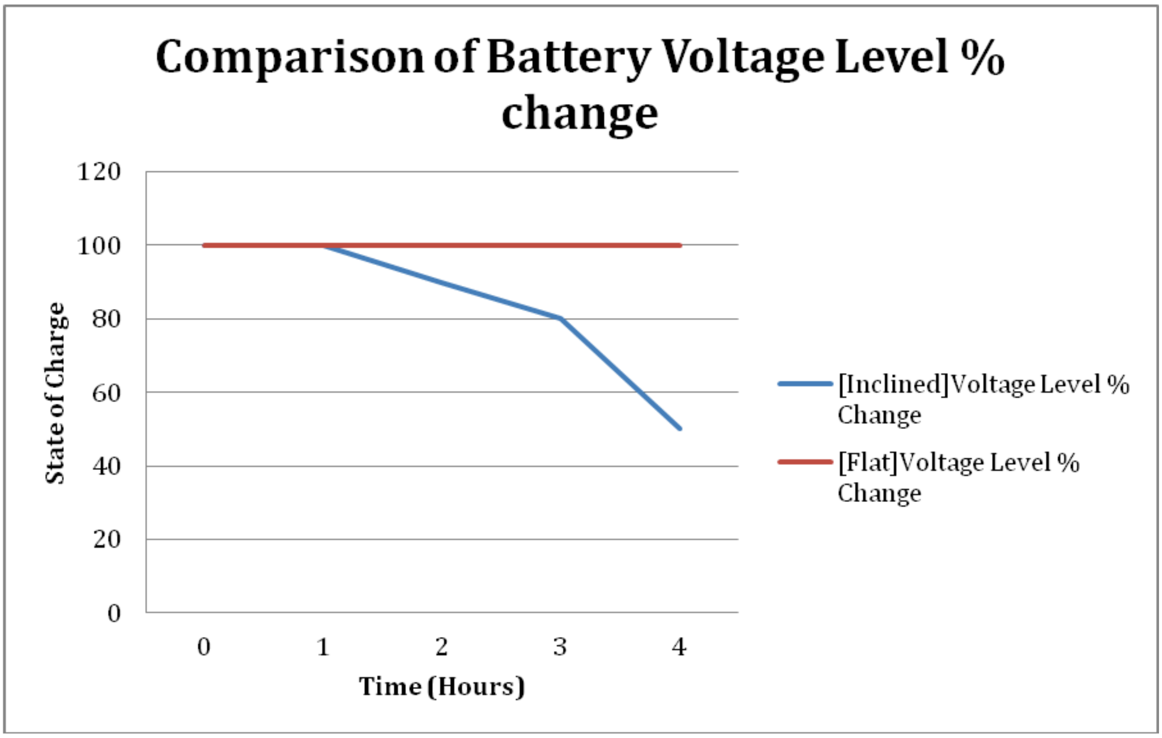

FIG. 6.14 CHANGE ON BATTERY SOC

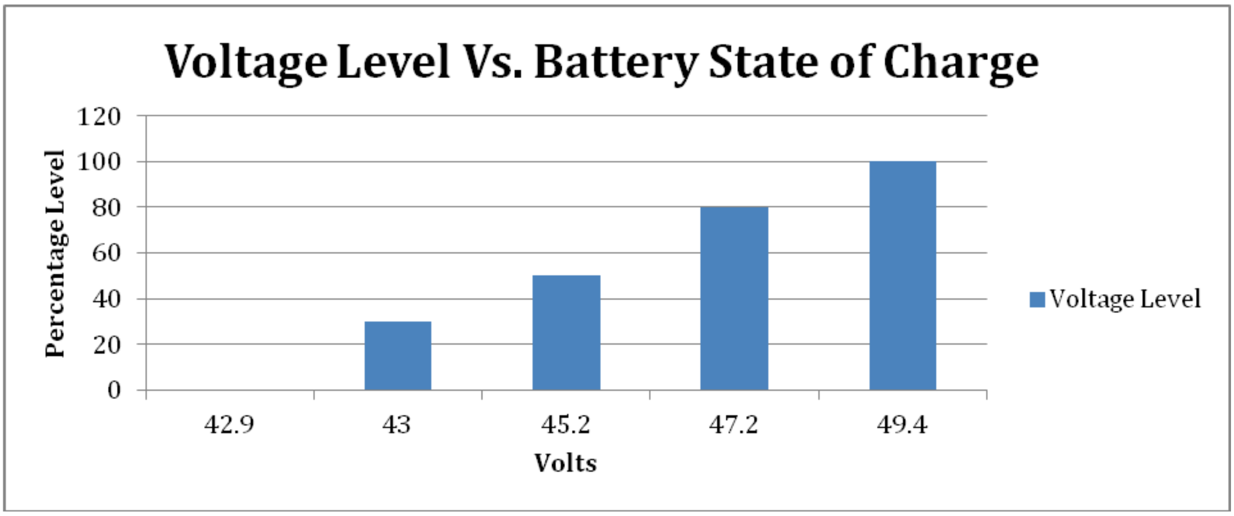

FIG. 6.15 BATTERY SOC GRAPH

The two following graphs are very important in signifying the effect of the panels, in the two different states. During our 'Inclined State' field test, the rickshaw travelled approximately **26.8 Km** in **4 hours 30 minutes**. While, during the 'Flat State' experiment, the rickshaw travelled **22 Km** in **4 hours**. The noteworthy difference is the battery SOC. As the previous graphs implied, the fall in voltage level for the two states is different. We considered a change up to **50%** battery SOC. Thus, we made a projection mathematically and found that that when the rickshaw will travel in 'Inclined Panel State', it can travel up to **38.9 Km** with the battery SOC falling from **100%** to **50%**. Whereas, in the 'Flat Panel State' the rickshaw can travel **70.4 Km** with the same SOC change. This proved out to be one of the most important facts, as it proves that in 'Flat Panel State' the rickshaw can travel almost double the distance that it can travel in the 'Inclined State.'

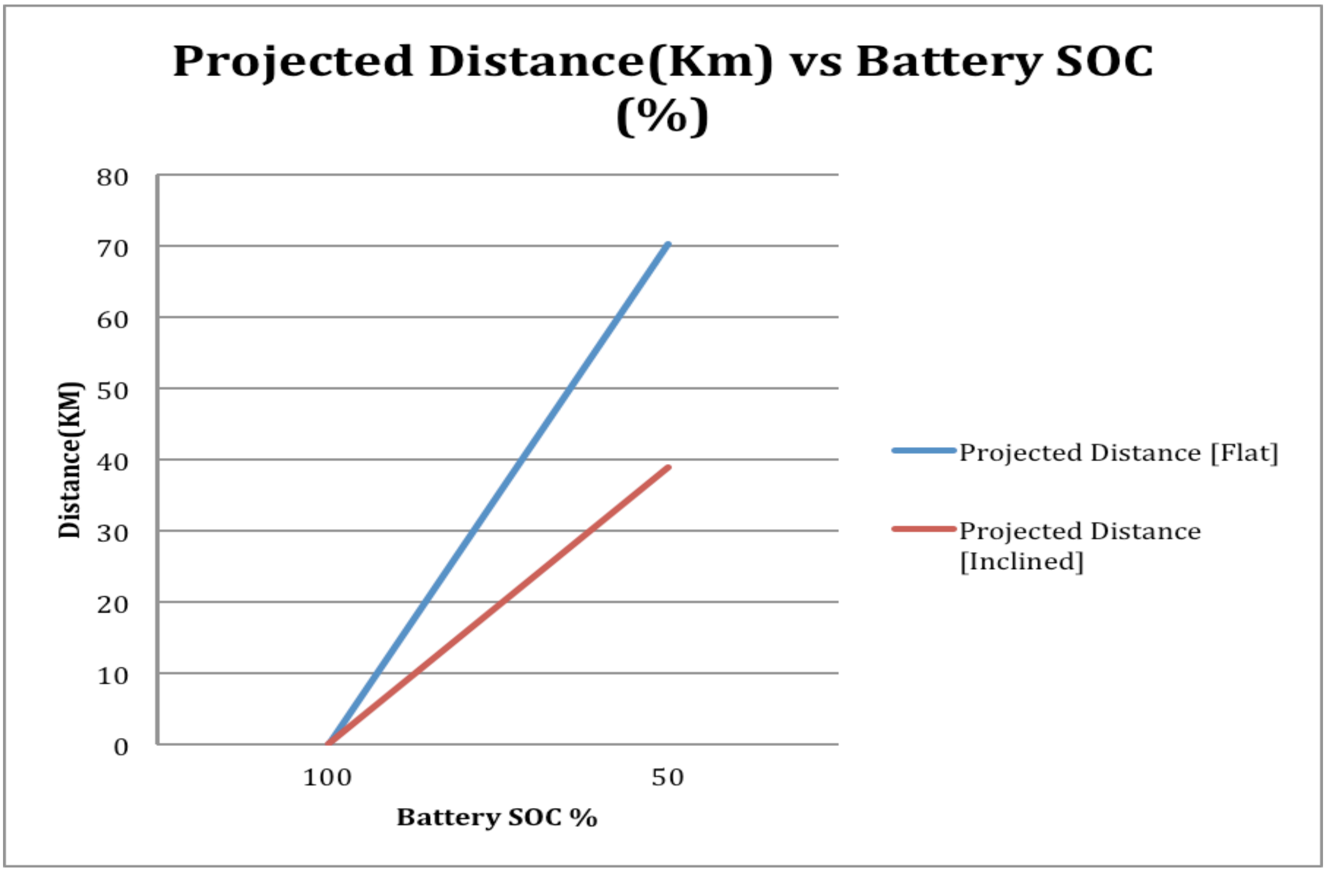

FIG. 6.16 PROJECTED DISTANCE COMPARISON 1

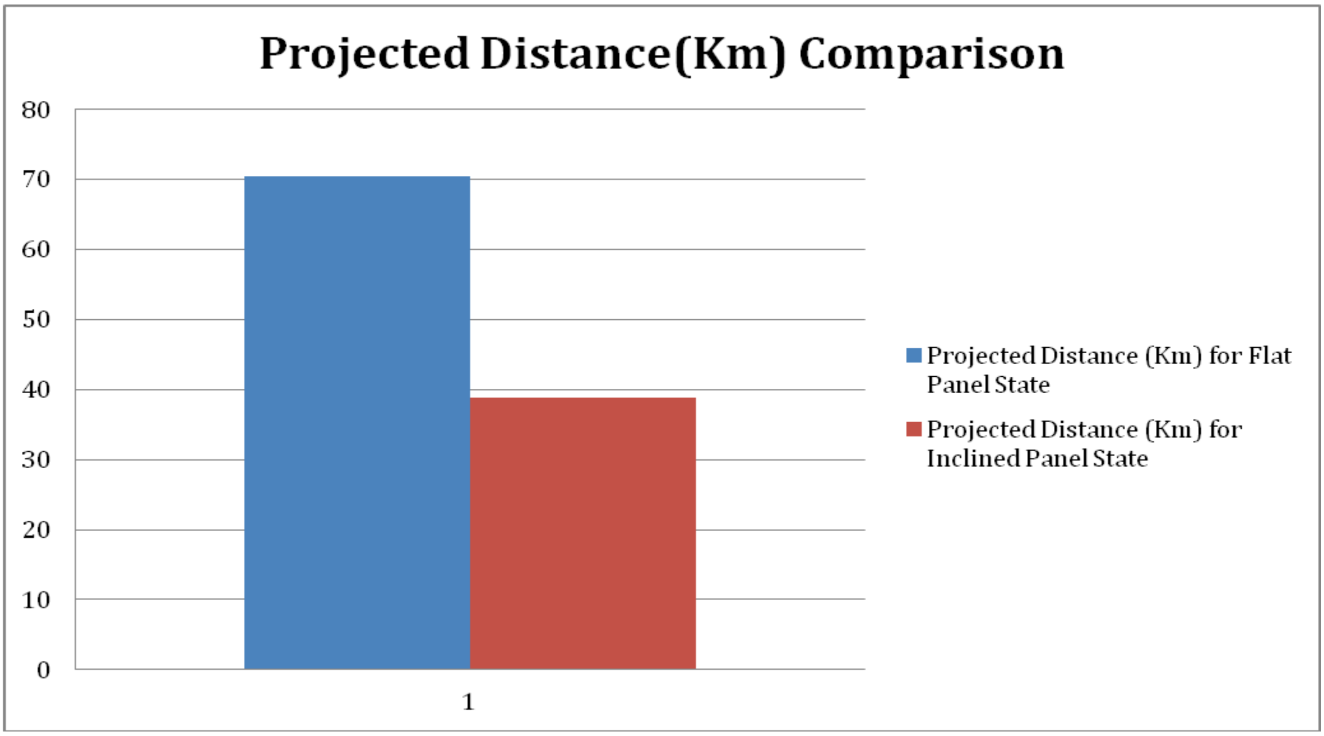

FIG. 6.17 PROJECTED DISTANCE COMPARISON 2

Considering all the graphs in this section, we can come to a blatant conclusion that 'Flat Panel State' is much more efficient that the 'Inclined Panel State.' In terms of power supplied by the panel, the amount to which the batteries are charged, the voltage level change and finally the projected distance, it is blemished that choosing the 'Flat Panel State' is the more efficient solution.

6.6.2 With Panel Vs. Without Panel

Now, the second part of our comparative study includes 'With Panel' Vs. 'Without Panel' conditions. The previous section proved that 'Flat Panel State' is more efficient than the 'Inclined Panel State'; hence, we will use only the 'Flat Panel State' for comparisons in this section. The first two graphs show the projected distance the rickshaw can travel in the two conditions. As previously mentioned, the rickshaw travelled **22 Km** 'With Panel' and it travelled **18.9 Km** 'Without Panel' in about **2 hours 30 minutes**. The change in voltage level, for 'Without Panel' condition was from **50.8V** (**100%** SOC) to **47V**(**50%**). Thus, we used the previous projection methods and applied them in this section also. The final result showed that 'Without Panel', the rickshaw can travel only **25.6 Km** compared to **70.4 Km** that can be travelled in 'With Panel' state.

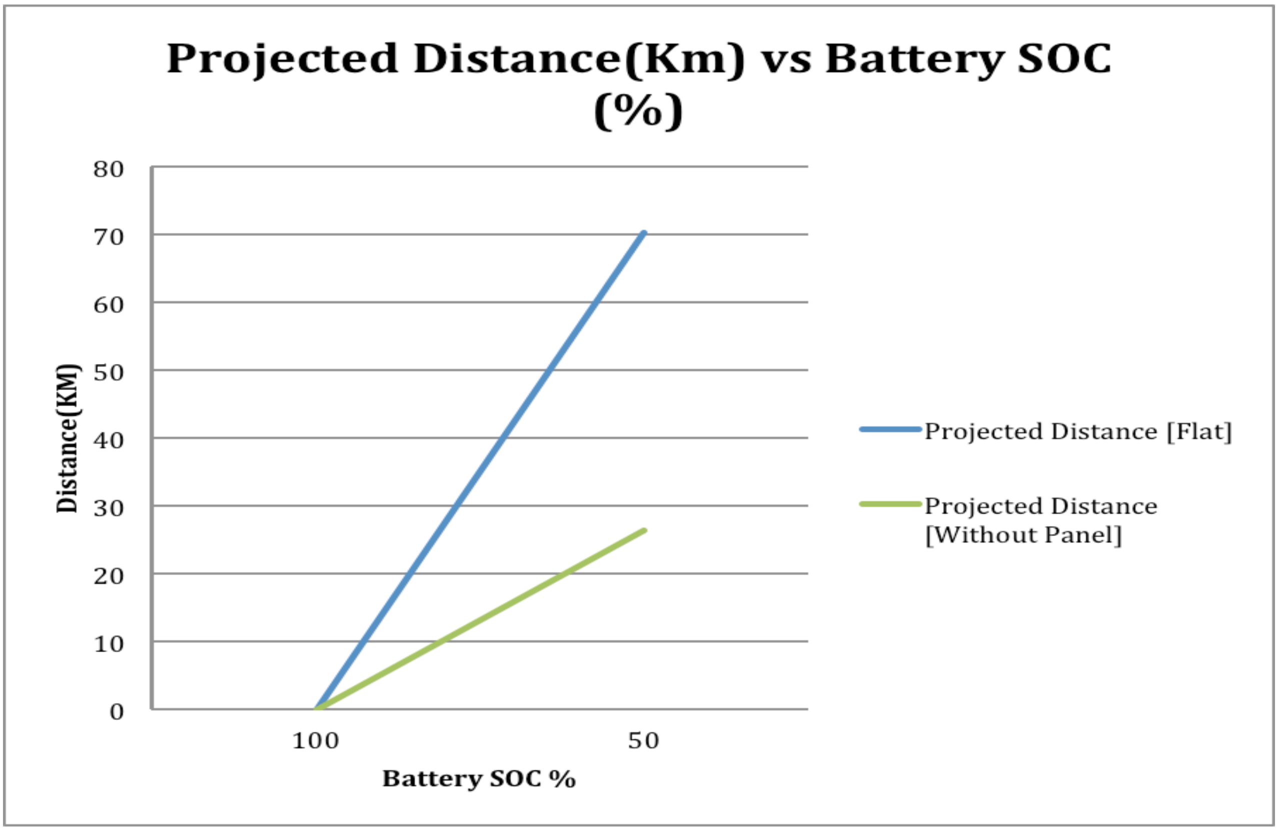

FIG. 6.17 PROJECTED DISTANCE VS. BATTERY SOC

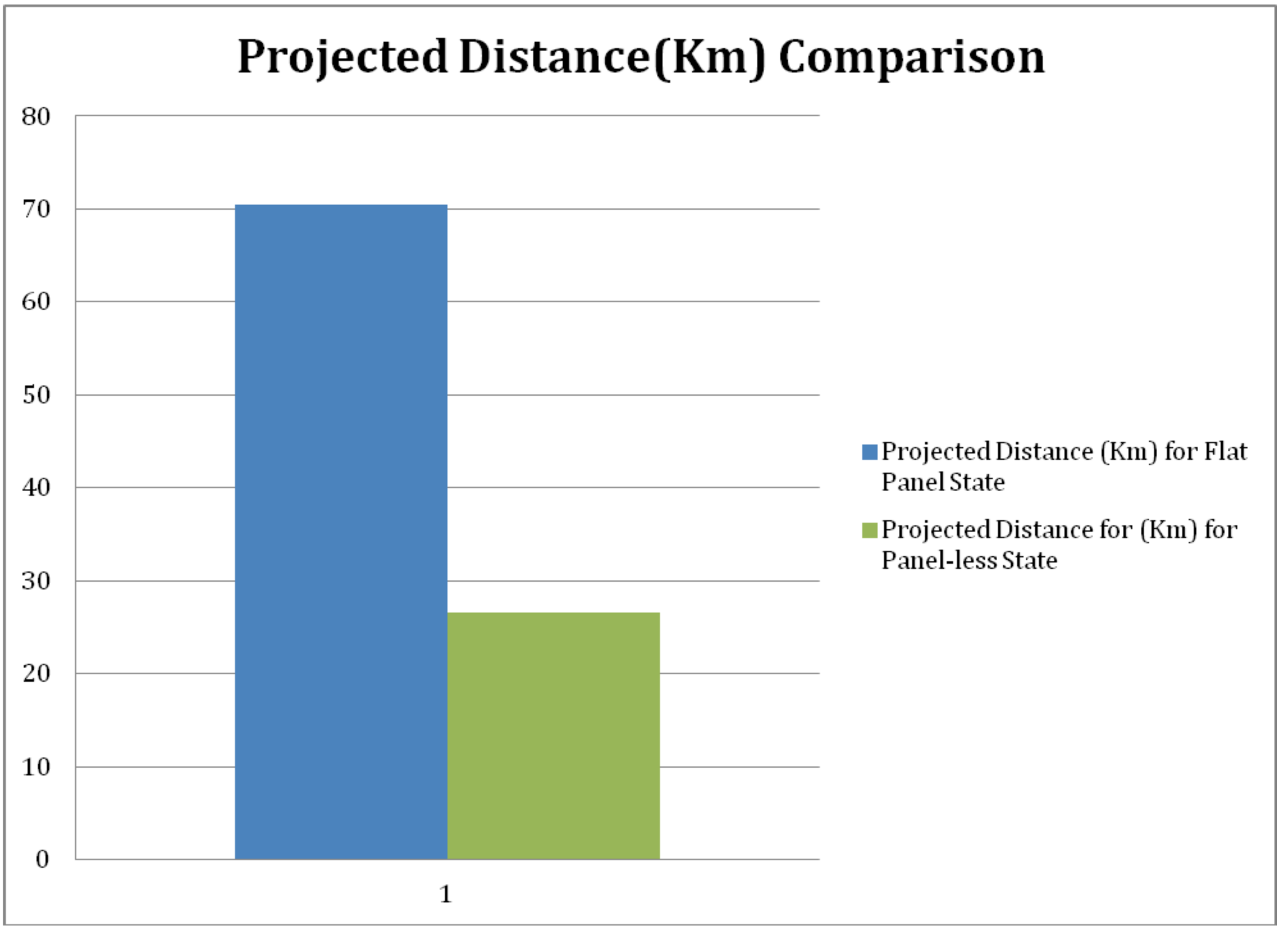

FIG. 6.18 PROJECTED DISTANCE COMPARISON 3

The following graph shows the comparison between the powers supplied by the batteries in the two different conditions. The significant effect that the panels have is very transparent.

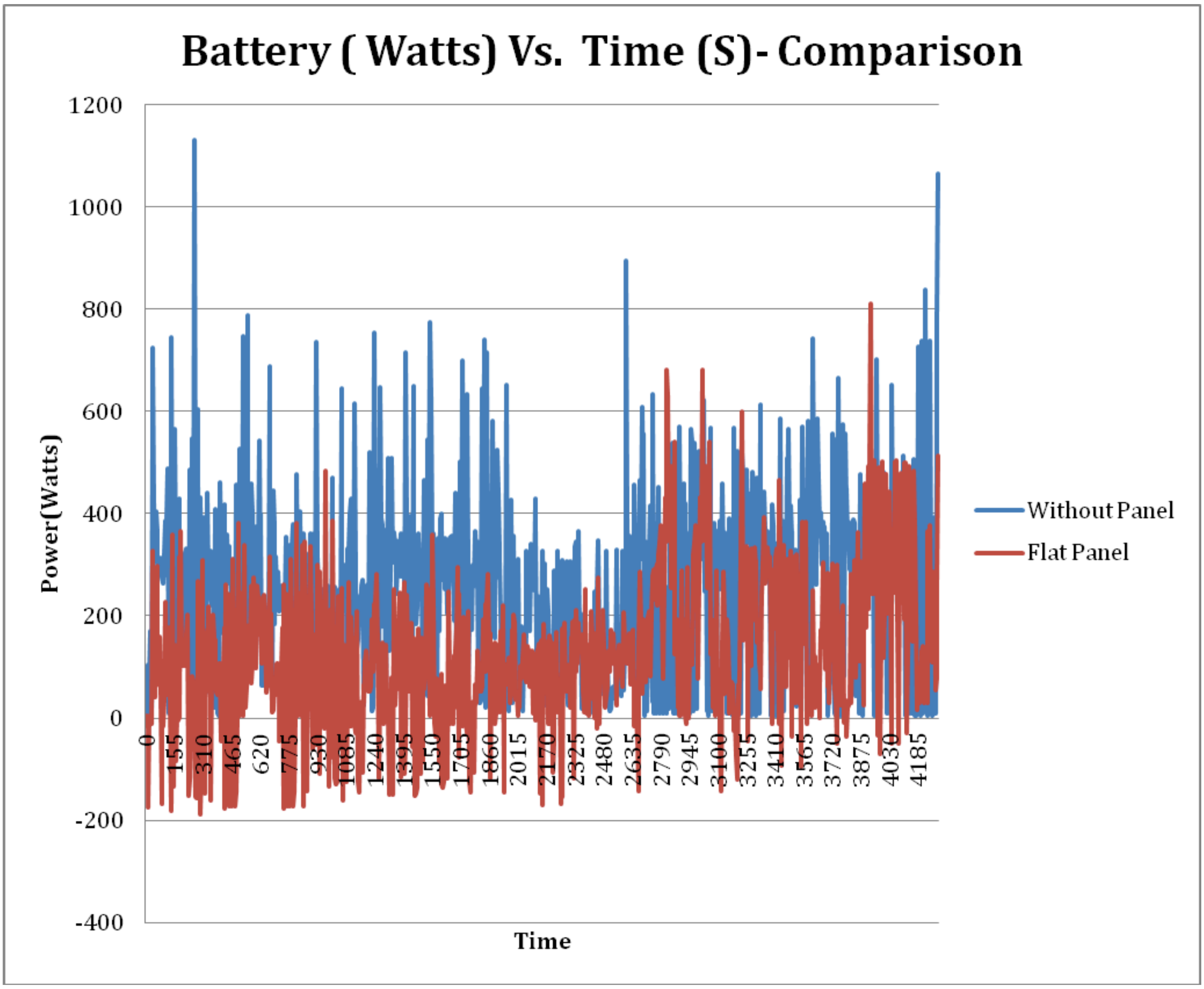

FIG. 6.19 COMPARISON OF BATTERY (WATTS) VS. TIME (SECONDS)

The next three graphs represent the voltage level change and the battery SOC change. All the changes have been already mentioned beforehand.

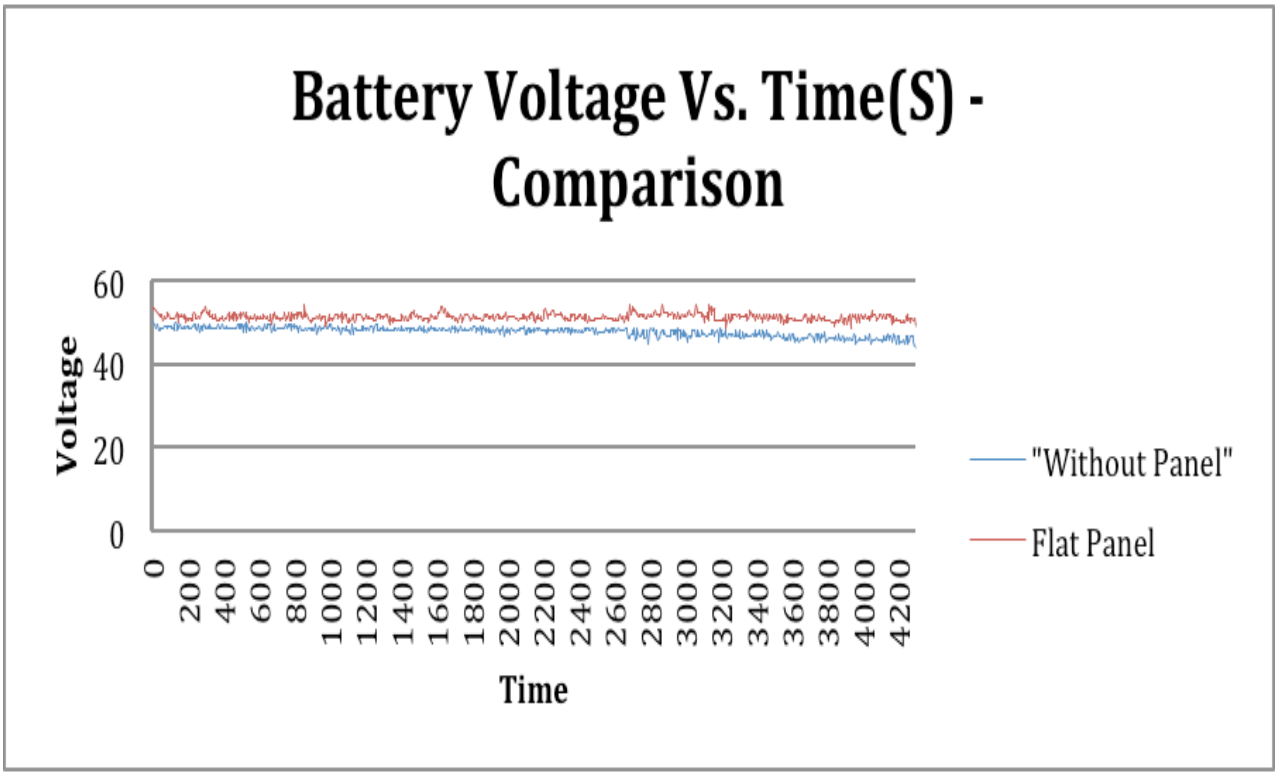

FIG. 6.20 BATTERY VOLTAGE (VOLTS) VS. TIME (SECONDS)

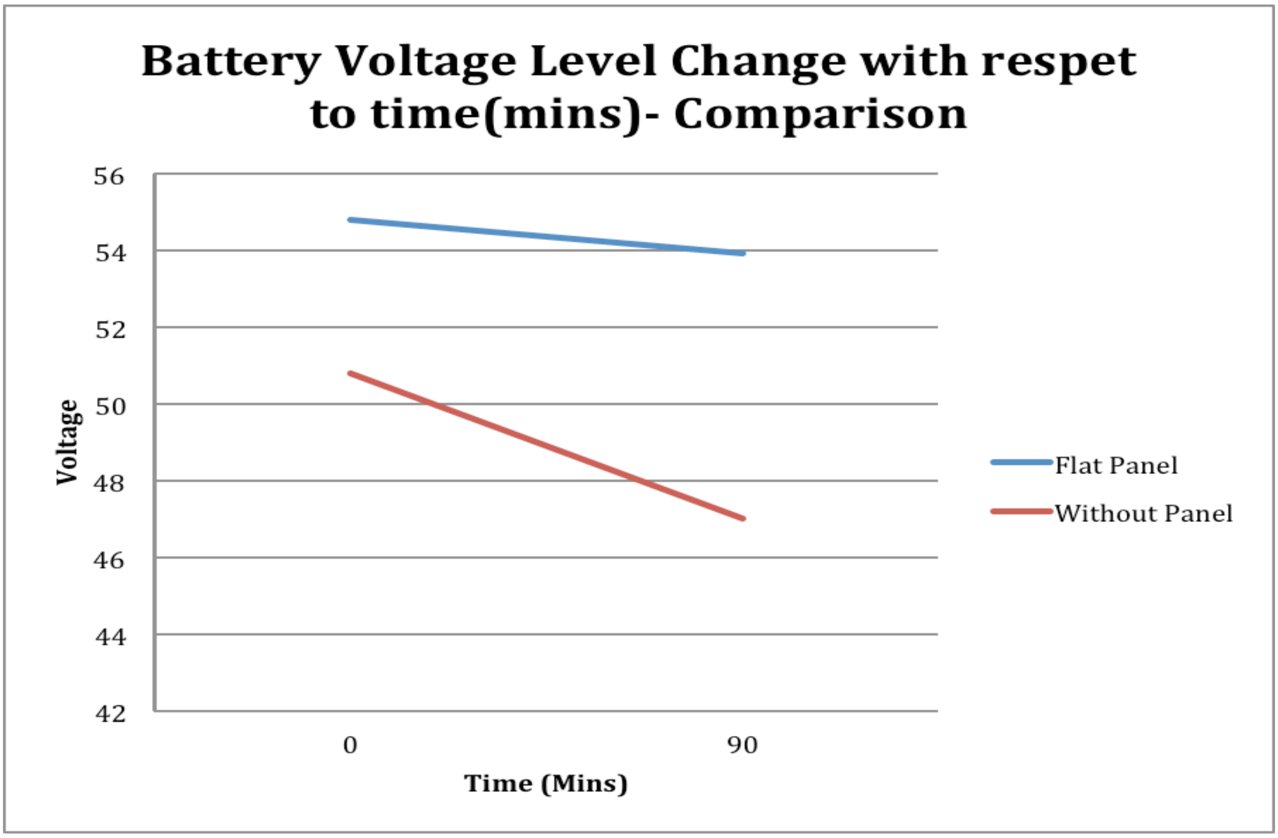

FIG. 6.21 BATTERY VOLTAGE LEVEL VS. TIME (MINUTES.)

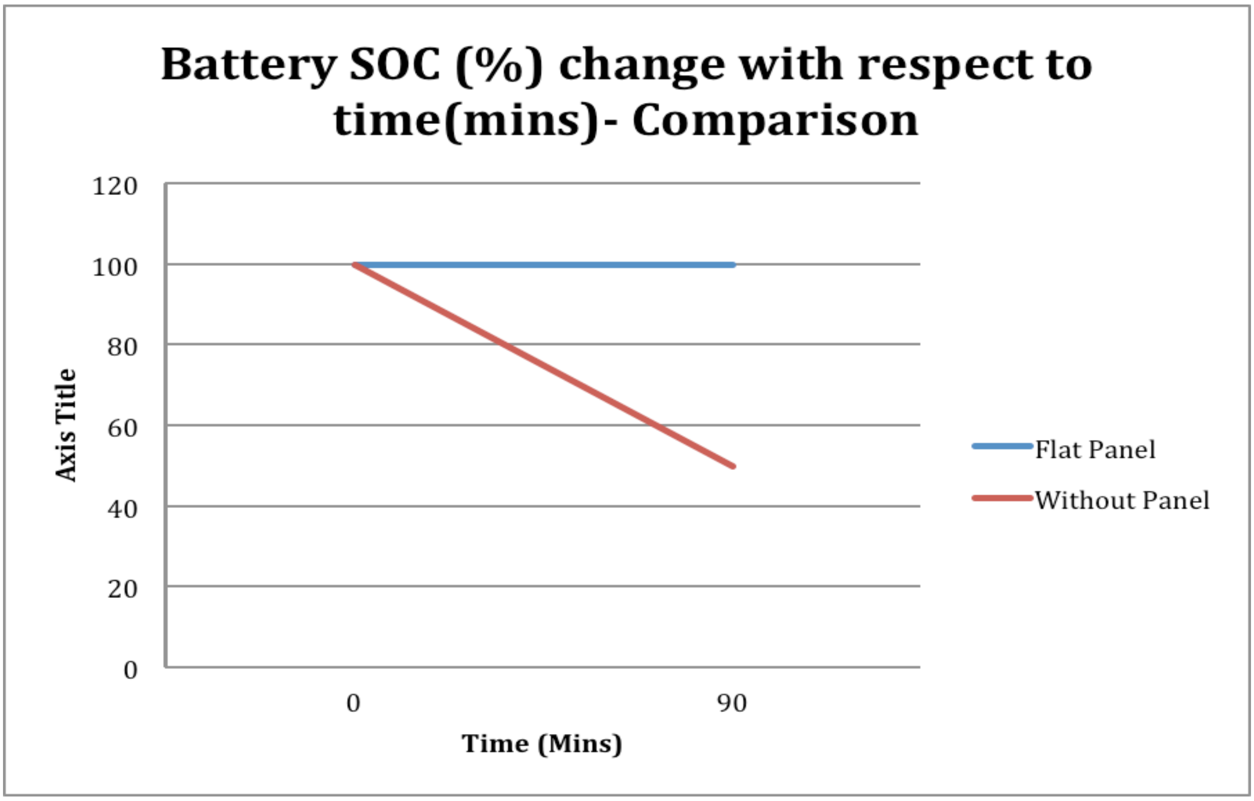

FIG. 6.22 BATTERY SOC VS TIME (MINUTES)

Finally, the comparison between the energy supplied by the battery in the two states are represented by the following bar charts. ‘With Panel’, the energy needed to be supplied by the batteries is less than half compared to that of ‘Without Panel.’

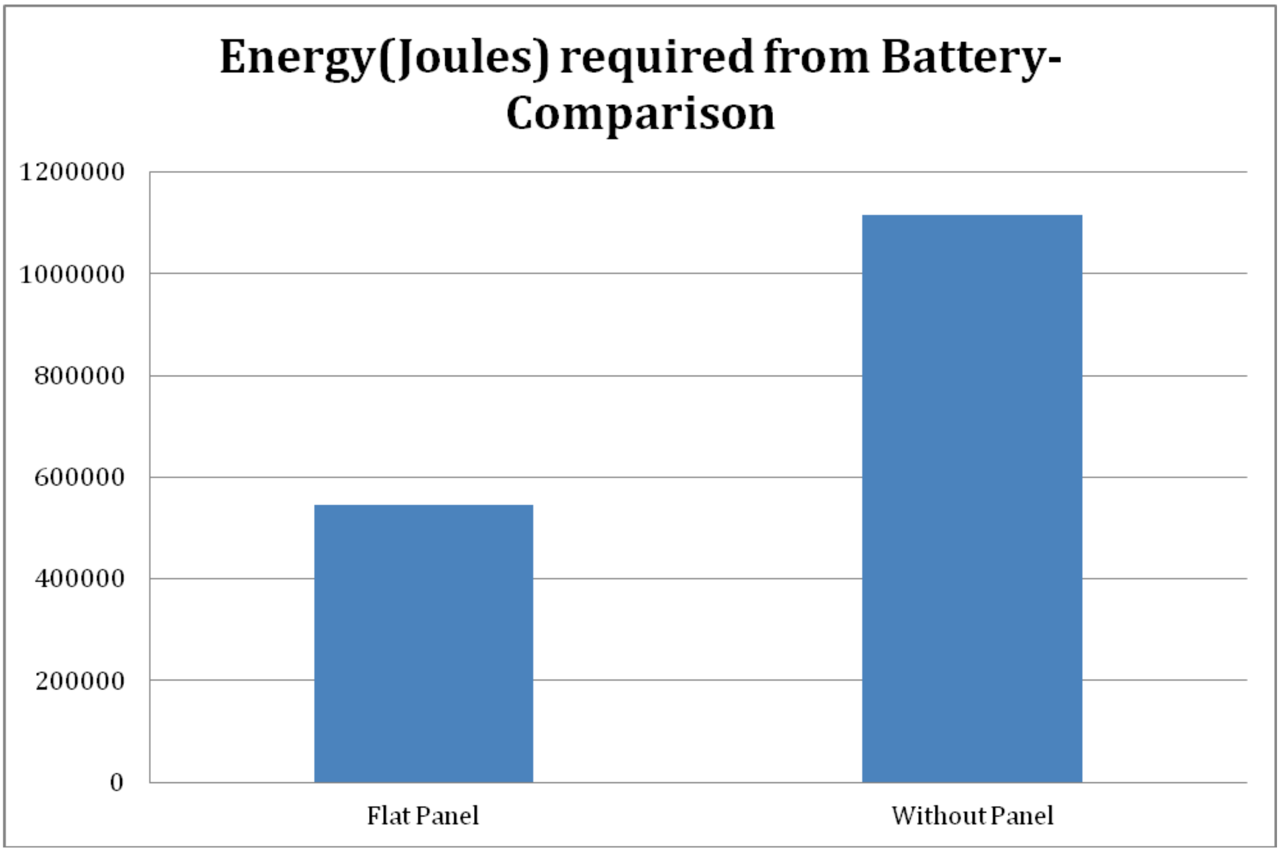

FIG. 6.23 BATTERY ENERGY (JOULES)

The above bar chart shows the aggregate result of our objective. In the flat panel state, energy required from the batteries is approximately **550000 joules** compared to the **1100000 joules** required from batteries without panel (for the battery SOC to drop down from **100%** to **50%**) This signifies that almost double energy is required from the batteries if panels are not used. Thus, it suggests that almost **50%** power is saved from the national grid, with PV support.

6.7 Results

Conclusively, to summarize this chapter we can imply that the **360W** panels have a massive impact on the efficiency of the rickshaw. The comparative studies were the ultimate verification that using panels, in flat state, reduces the amount of power supplied by the batteries to a significant amount, which in turn reduces the power needed from the national grid. Overall percentage of power saved is massive.

First, the comparison between ‘Flat State’ and ‘Inclined State’ was made, which proved that ‘Flat State’ is the better., more reliable, option. Simply because, it provides almost three times the current supplied by the ‘Inclined State’. Furthermore, the rickshaw can travel up to a projected distance of **70.4Km** compared to **38.9 Km**, with the battery SOC reducing from **100%** to **50%**. Finally, the power sharing for 'Flat State' is **64%** to **36%** in favour of the panels compared to **17.8%** to **82.8%** in case of the 'Inclined State.' Thus, we concluded tat future research and development work should be done in 'Flat State'.

Second and finally, the comparisons between the 'With Panel' and 'Without Panel' conditions were taken into account. This time, it showed that projected distance that the rickshaw can travel is almost 3 times in case of 'With Panels.' **70.4Km** compared to **25.6 Km**. The gradient with which the voltage level drops, in case of 'Without Panels' is much greater that 'With Panels', hence, using panels is much more resourceful and competent. Although, during the peak sun hours (**11 30 AM to 1 30 PM**), the percentage of power supplied by the panels is **64%**, but it reduces to **45%** if readings up to **4 PM** is considered. Finally, the ultimate results suggest that almost **50%** of the energy from the national grid is conserved. Hence, we think that the panels have an immense contribution to the power that can be saved from the national grid, which was our original ambition.

Chapter 7

CONCLUSION

7.1 Summary

Our project *Power Conservation of Electric Hybrid Rickshaw with PV Support* was a success after a year of research. The main objective of the project was to reduce the power required from the national grid to a significant amount, and the final results backed that up to an abundant stature. It proved to be more efficient than any other form of commercial and researched models. The prototype was developed and results from the field tests signifies the effect that the PV panels have on the electric rickshaw, not only in terms of power being reduced, but also it increases the life time of the lead acid batteries, diminishes any muscular power required from a rickshaw puller and further enhances opportunities of future work.

7.2 Future works

CARC is already working on a concept known as Solar Battery Charging Station (SBCS).

The goals that we established for the design of the recharging infrastructure are:

- There should be a battery-swapping process rather than using solar-panels attached over the vehicle; because that is firstly inefficient, secondly vulnerable to unexpected social problems like getting theft etc.
- The battery swapping process should be as efficient and effective as possible and should be a role model for the next generation sustainable refueling infrastructure.
- Maximize the amount of energy to be produced by renewable energy sources.

To establish the above mentioned goals, it was decided to go for a "*Central Solar Battery Charging Station"* concept. The batteries charged at a central location ensure better maintenance by trained people thus longevity of the battery packs. Moreover, it is not wise to overload the national grid for this purpose, as the power grid in Bangladesh is weak in the urban areas other than the capital.

The idea is, various types of batteries including the 12V Solar Home System (SHS) may be charged using sophisticated technologies and advanced protection techniques in the multipurpose central SBCS. A diesel generator may be used as a backup for cases like days with insufficient sunlight.

The rickshaw pullers will bring their rickshaw to the central SBCS and swap their discharged batteries with a recharged one from the station just like petrol refueling.

Apart from SBCS, there is scope for further development. The Solar panels can be custom built with the required dimensions and ratings. This enhances safety in roads simultaneously provides enough power to run the model efficiently. Better-equipped panels can be imported from abroad, thus, further increasing the efficiency of the overall power saving system. Another important point is that, the field tests data we took are in the month of November. This is considered as winter in Bangladesh. Hence, we believe that if experiments are done during spring or summer, a much better approximation will be acquired and we strongly believe that it will show a much greater efficiency rating. Furthermore, the existing rickshaw does not have rear wheel brakes. Introducing this system into the whole structure will in turn ensure greater safety. Additionally, as previously mentioned, if a torque sensor based system is also integrated, the whole system will be even more efficient with simultaneous safety concerns solved.

The *Control and Applications Research Centre* has a vision towards continuing the development on this electric rickshaw and implementing the technology in few more rickshaws for taking real feedback. Moreover, an elementary purpose of the project to convert the prevailing resources of traditional rickshaws to this new model is yet to be done. These will be done by professional mechanics in future to develop a cost-effective and firmly transformed architecture in order to ensure the use of existing resources.
Using this technology, there are also scopes of future research to develop more power-assisted models of different other vehicles like rickshaw-vans, bicycles, and even power-assisted wheelchairs for paraplegic patients.

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APPENDIX

TABLE 1: INCLINED PANEL STATE

Time (S)	Panel Voltage (V)	Panel Current (Amp.)	Panel Power (Watts)	Battery Voltage (V)	Battery Current (Amp.)	Battery Power (Watts)
0	0	0	0	0	0	0
5	48.3	0.41	19.803	47.6	2.2	104.72
10	48.6	0.49	23.814	48	0.1	4.8
15	48	0.38	18.24	48	4.2	201.6
20	48.3	0.51	24.633	48.1	0.4	19.24
25	48.3	0.23	11.109	48	1.8	86.4
30	46.6	0.39	18.174	46.2	14.1	651.42
35	46.9	0.29	13.601	46.6	9.4	438.04
40	46.5	0.28	13.02	47.3	13.3	629.09
45	47.6	1.18	56.168	47.4	4.2	199.08
50	48	1.12	53.76	47.8	3.1	148.18
55	47.1	1.18	55.578	46.8	7.2	336.96
60	47.4	1.19	56.406	47.2	5.9	278.48
65	47.9	1.09	52.211	47.2	4.9	231.28
70	47.4	1.29	61.146	47.3	4.4	208.12
75	48.1	1.03	49.543	48	3.2	153.6
80	47.7	1.1	52.47	47.6	4.5	214.2
85	47.4	0.93	44.082	47.2	5.9	278.48
90	47.6	0.98	46.648	47.2	6	283.2
95	47.5	1.06	50.35	47.4	5	237
100	47.5	0.63	29.925	47.2	6	283.2
105	47.8	1.07	51.146	47.5	3.4	161.5
110	48.6	1.05	51.03	48.3	0.7	33.81
115	47	0.81	38.07	46.8	10.3	482.04
120	46.8	1.11	51.948	46.9	9.9	464.31
125	47.3	0.89	42.097	47.1	5.9	277.89
130	47.2	0.55	25.96	47	5.9	277.3
135	48.5	0.99	48.015	48.3	1	48.3
140	46.8	0.95	44.46	46.5	11.1	516.15
145	46.5	0.93	43.245	46.3	1	46.3
150	47.6	0.42	19.992	47	4	188
155	47.8	1.02	48.756	47.5	3.7	175.75
160	47.5	1.01	47.975	47.2	5.4	254.88
165	47.4	0.92	43.608	47.2	5.3	250.16
170	47.1	0.22	10.362	47.1	5.6	263.76
175	47	1.26	59.22	46.8	3.8	177.84

180	47.2	0.25	11.8	46.9	7.6	356.44
185	47.6	0.87	41.412	47.3	3.9	184.47
190	48.4	0.29	14.036	48.1	0.5	24.05
195	46.9	0.28	13.132	46.7	9.7	452.99
200	47.2	0.31	14.632	46.9	7	328.3
205	47.4	0.24	11.376	47.3	4	189.2
210	46.3	0.27	12.501	46.2	12.7	586.74
215	48.2	0.44	21.208	48	0.5	24
220	48.4	0.4	19.36	48.1	0.5	24.05
225	47.3	0.92	43.516	47.1	5.9	277.89
230	48.4	1.06	51.304	48.2	3.7	178.34
235	48.4	0.53	25.652	48.1	4.2	202.02
240	47.5	0.85	40.375	47.3	3.5	165.55
245	47.2	0.36	16.992	47	5.5	258.5
250	47.8	0.41	19.598	47.6	2.9	138.04
255	48.3	0.6	28.98	48.1	0.2	9.62
260	47.2	0.34	16.048	47	0.7	32.9
265	47.6	0.32	15.232	47.4	3.5	165.9
270	46.9	0.29	13.601	46.6	7.3	340.18
275	47.3	1.13	53.449	47	2.5	117.5
280	47.4	1.19	56.406	47.1	0.5	23.55
285	47.1	0.31	14.601	46.8	1.5	70.2
290	47.5	0.23	10.925	47.3	0.6	28.38
295	48.5	1.68	81.48	48.2	5.2	250.64
300	46.8	1	46.8	46.6	3.9	181.74
305	47.6	1.36	64.736	47.2	1.2	56.64
310	47.4	0.42	19.908	47.2	1.1	51.92
315	47.5	0.97	46.075	47.3	1	47.3
320	47.5	1.06	50.35	47.3	1.1	52.03
325	47.5	0.87	41.325	47.1	0.8	37.68
330	47.5	0.89	42.275	47.3	0.5	23.65
335	48.4	1.25	60.5	48.2	4.8	231.36
340	48.6	1.45	70.47	48.3	5.8	280.14
345	48.8	2.2	107.36	49.6	5.5	272.8
350	48.9	2.15	105.135	48.6	4.5	218.7
355	45.5	0.45	20.475	45.3	12.6	570.78
360	48.1	0.48	23.088	47.9	5	239.5
365	47.8	0.5	23.9	47.5	2	95
370	48.5	1.73	83.905	48.2	4.7	226.54
375	48.4	1.34	64.856	48	4.7	225.6
380	47.5	0.99	47.025	47.1	1.3	61.23
385	47.5	0.72	34.2	47.3	1.1	52.03
390	47.4	1.07	50.718	47.1	0.4	18.84
395	46.7	0.64	29.888	46.6	3.6	167.76

400	48.3	0.95	45.885	48	3.8	182.4
405	48.3	1.07	51.681	48	3.8	182.4
410	48.4	0.57	27.588	48.1	2.9	139.49
415	47.8	2.21	105.638	46.9	3.5	164.15
420	46.9	1.65	77.385	47.1	3	141.3
425	48.3	0.5	24.15	48.1	3.8	182.78
430	47.3	0.53	25.069	47.1	1.3	61.23
435	48.2	0.87	41.934	47.9	4.3	205.97
440	48	0.7	33.6	47.7	2.7	128.79
445	48.2	1.03	49.646	47.9	3.6	172.44
450	48.3	1.54	74.382	48	5.2	249.6
455	48.6	1.9	92.34	48.3	5.5	265.65
460	48.2	0.58	27.956	47.9	3.9	186.81
465	47.5	0.49	23.275	47.3	1.7	80.41
470	48.3	0.51	24.633	48.1	3.7	177.97
475	46.3	0.8	37.04	46	6.8	312.8
480	47.1	0.85	40.035	46.8	2.3	107.64
485	47.2	0.82	38.704	46.7	6.5	303.55
490	47.1	0.96	45.216	46.8	0.2	9.36
495	47.3	0.56	26.488	47	0.6	28.2
500	47.5	0.79	37.525	47.2	0.1	4.72
505	47.1	0.76	35.796	46.9	1.1	51.59
510	47.1	0.53	24.963	46.6	1.8	83.88
515	47	0.78	36.66	46.8	1	46.8
520	47.2	0.68	32.096	46.9	1.1	51.59
525	46.8	0.25	11.7	46.5	2.3	106.95
530	46.7	0.3	14.01	46.5	2.4	111.6
535	48.1	0.95	45.695	47.9	4.6	220.34
540	47.1	0.31	14.601	46.8	1.9	88.92
545	47.1	0.33	15.543	46.9	0.7	32.83
550	47	0.43	20.21	46.8	1	46.8
555	46	1.05	48.3	45.6	6.4	291.84
560	46.7	2.23	104.141	46.3	2.6	120.38
565	48.2	1.37	66.034	47.9	5.5	263.45
570	48.5	2.01	97.485	48.2	2.2	106.04
575	48.3	0.36	17.388	48	3.8	182.4
580	46.6	1.47	68.502	46.2	1.1	50.82
585	48.4	2.48	120.032	48.2	10.2	491.64
590	46.9	0.5	23.45	46.6	2.1	97.86
595	46.6	0.34	15.844	46.3	4	185.2
600	48	0.64	30.72	47.8	2.9	138.62
605	46.7	0.45	21.015	46.6	0.7	32.62
610	45.4	0.4	18.16	45	11.7	526.5
615	46.7	0.26	12.142	46.5	2.6	120.9

620	46.9	0.21	9.849	46.4	2.5	116
625	46.8	0.45	21.06	46.7	1.4	65.38
630	46.1	0.7	32.27	46.2	2.3	106.26
635	46.8	0.85	39.78	46.5	1.8	83.7
640	47.3	1.78	84.194	47.1	-0.6	-28.26
645	45.9	0.47	21.573	45.7	7.2	329.04
650	47.4	0.62	29.388	47.1	-0.5	-23.55
655	46.8	2.29	107.172	47.1	4.5	211.95
660	48	1.52	72.96	47.7	4.9	233.73
665	46	0.74	34.04	45.7	7.6	347.32
670	48.2	1.27	61.214	47.9	5.4	258.66
675	45.8	0.56	25.648	45.5	9.8	445.9
680	48.2	1.11	53.502	47.9	5.5	263.45
685	48	1.39	66.72	47.3	5.6	264.88
690	46	2.24	103.04	45.7	3.4	155.38
695	47.2	0.54	25.488	46.9	0.1	4.69
700	47.4	2.33	110.442	46.9	0	0
705	48.2	1.57	75.674	48	5.7	273.6
710	45.7	1.21	55.297	45.5	4.6	209.3
715	48.4	2.13	103.092	48.1	5.2	250.12
720	47.9	0.47	22.513	47.7	4.7	224.19
725	47.6	1.18	56.168	47.4	4.2	199.08
730	48	1.12	53.76	47.8	3.1	148.18
735	47.1	1.18	55.578	46.8	7.2	336.96
740	47.4	1.19	56.406	47.2	5.9	278.48
745	47.9	1.09	52.211	47.2	4.9	231.28
750	47.4	1.29	61.146	47.3	4.4	208.12
755	48.1	1.03	49.543	48	3.2	153.6
760	47.7	1.1	52.47	47.6	4.5	214.2
765	47.4	0.93	44.082	47.2	5.9	278.48
770	47.6	0.98	46.648	47.2	6	283.2
775	47.5	1.06	50.35	47.4	5	237
780	47.5	0.63	29.925	47.2	6	283.2
785	47.8	1.07	51.146	47.5	3.4	161.5
790	48.6	1.05	51.03	48.3	0.7	33.81
795	47	0.81	38.07	46.8	10.3	482.04
800	46.8	1.11	51.948	46.9	9.9	464.31
805	47.3	0.89	42.097	47.1	5.9	277.89
810	47.2	0.55	25.96	47	5.9	277.3
815	48.5	0.99	48.015	48.3	1	48.3
820	46.8	0.95	44.46	46.5	11.1	516.15
825	46.5	0.93	43.245	46.3	1	46.3
830	47.6	0.42	19.992	47	4	188
835	48	0.7	33.6	47.7	2.7	128.79

840	48.2	1.03	49.646	47.9	3.6	172.44
845	48.3	1.54	74.382	48	5.2	249.6
850	48.6	1.9	92.34	48.3	5.5	265.65
855	48.2	0.58	27.956	47.9	3.9	186.81
860	47.5	0.49	23.275	47.3	1.7	80.41
865	48.3	0.51	24.633	48.1	3.7	177.97
870	46.3	0.8	37.04	46	6.8	312.8
875	47.1	0.85	40.035	46.8	2.3	107.64
880	47.2	0.82	38.704	46.7	6.5	303.55
885	47.1	0.96	45.216	46.8	0.2	9.36
890	47.3	0.56	26.488	47	0.6	28.2
895	47.5	0.79	37.525	47.2	0.1	4.72
900	47.1	0.76	35.796	46.9	1.1	51.59
905	47.1	0.53	24.963	46.6	1.8	83.88
910	47	0.78	36.66	46.8	1	46.8
915	47.2	0.68	32.096	46.9	1.1	51.59
920	46.8	0.25	11.7	46.5	2.3	106.95
925	47.6	1.36	64.736	47.2	1.2	56.64
930	47.4	0.42	19.908	47.2	1.1	51.92
935	47.5	0.97	46.075	47.3	1	47.3
940	47.5	1.06	50.35	47.3	1.1	52.03
945	47.5	0.87	41.325	47.1	0.8	37.68
950	47.5	0.89	42.275	47.3	0.5	23.65
955	48.4	1.25	60.5	48.2	4.8	231.36
960	48.6	1.45	70.47	48.3	5.8	280.14
965	48.8	2.2	107.36	49.6	5.5	272.8
970	48.9	2.15	105.135	48.6	4.5	218.7
975	45.5	0.45	20.475	45.3	12.6	570.78
980	48.1	0.48	23.088	47.9	5	239.5
985	47.8	0.5	23.9	47.5	2	95
990	48.5	1.73	83.905	48.2	4.7	226.54
995	48.4	1.34	64.856	48	4.7	225.6
1000	47.5	0.99	47.025	47.1	1.3	61.23
1005	47.5	0.72	34.2	47.3	1.1	52.03
1010	47.4	1.07	50.718	47.1	0.4	18.84
1015	46.7	0.64	29.888	46.6	3.6	167.76
1020	48.3	0.95	45.885	48	3.8	182.4
1025	48.3	1.07	51.681	48	3.8	182.4
1030	48.4	0.57	27.588	48.1	2.9	139.49
1035	47.8	2.21	105.638	46.9	3.5	164.15
1040	46.9	1.65	77.385	47.1	3	141.3
1045	48.3	0.5	24.15	48.1	3.8	182.78
1050	47.3	0.53	25.069	47.1	1.3	61.23
1055	48.2	0.87	41.934	47.9	4.3	205.97

1060	48	0.7	33.6	47.7	2.7	128.79
1065	48.2	1.03	49.646	47.9	3.6	172.44
1070	48.3	1.54	74.382	48	5.2	249.6
1075	48.6	1.9	92.34	48.3	5.5	265.65
1080	48.2	0.58	27.956	47.9	3.9	186.81
1085	47.5	0.49	23.275	47.3	1.7	80.41
1090	48.3	0.51	24.633	48.1	3.7	177.97
1095	46.3	0.8	37.04	46	6.8	312.8
1100	47.1	0.85	40.035	46.8	2.3	107.64
1105	47.2	0.82	38.704	46.7	6.5	303.55
1110	47.1	0.96	45.216	46.8	0.2	9.36
1115	47.3	0.56	26.488	47	0.6	28.2
1120	47.3	0.92	43.516	47.1	5.9	277.89
1125	48.4	1.06	51.304	48.2	3.7	178.34
1130	48.4	0.53	25.652	48.1	4.2	202.02
1135	47.5	0.85	40.375	47.3	3.5	165.55
1140	47.2	0.36	16.992	47	5.5	258.5
1145	47.8	0.41	19.598	47.6	2.9	138.04
1150	48.3	0.6	28.98	48.1	0.2	9.62
1155	47.2	0.34	16.048	47	0.7	32.9
1160	47.6	0.32	15.232	47.4	3.5	165.9
1165	46.9	0.29	13.601	46.6	7.3	340.18
1170	47.3	1.13	53.449	47	2.5	117.5
1175	47.4	1.19	56.406	47.1	0.5	23.55
1180	47.1	0.31	14.601	46.8	1.5	70.2
1185	47.5	0.23	10.925	47.3	0.6	28.38
1190	48.5	1.68	81.48	48.2	5.2	250.64
1195	46.8	1	46.8	46.6	3.9	181.74
1200	47.6	1.36	64.736	47.2	1.2	56.64
1205	47.4	0.42	19.908	47.2	1.1	51.92
1210	47.5	0.97	46.075	47.3	1	47.3
1215	47.5	1.06	50.35	47.3	1.1	52.03
1220	47.5	0.87	41.325	47.1	0.8	37.68
1225	47.5	0.89	42.275	47.3	0.5	23.65
1230	48.4	1.25	60.5	48.2	4.8	231.36
1235	48.6	1.45	70.47	48.3	5.8	280.14
1240	48.8	2.2	107.36	49.6	5.5	272.8
1245	48.9	2.15	105.135	48.6	4.5	218.7
1250	45.5	0.45	20.475	45.3	12.6	570.78
1255	48.1	0.48	23.088	47.9	5	239.5
1260	47.8	0.5	23.9	47.5	2	95
1265	48.5	1.73	83.905	48.2	4.7	226.54
1270	48.4	1.34	64.856	48	4.7	225.6
1275	48.9	2.15	105.135	48.6	4.5	218.7

1280	45.5	0.45	20.475	45.3	12.6	570.78
1285	48.1	0.48	23.088	47.9	5	239.5
1290	47.8	0.5	23.9	47.5	2	95
1295	48.5	1.73	83.905	48.2	4.7	226.54
1300	48.4	1.34	64.856	48	4.7	225.6
1305	47.5	0.99	47.025	47.1	1.3	61.23
1310	47.5	0.72	34.2	47.3	1.1	52.03
1315	47.4	1.07	50.718	47.1	0.4	18.84
1320	46.7	0.64	29.888	46.6	3.6	167.76
1325	48.3	0.95	45.885	48	3.8	182.4
1330	48.3	1.07	51.681	48	3.8	182.4
1335	48.4	0.57	27.588	48.1	2.9	139.49
1340	47.8	2.21	105.638	46.9	3.5	164.15
1345	46.9	1.65	77.385	47.1	3	141.3
1350	48.3	0.5	24.15	48.1	3.8	182.78
1355	47.3	0.53	25.069	47.1	1.3	61.23
1360	48.2	0.87	41.934	47.9	4.3	205.97
1365	48	0.7	33.6	47.7	2.7	128.79
1370	48.2	1.03	49.646	47.9	3.6	172.44
1375	48.3	1.54	74.382	48	5.2	249.6
1380	48.6	1.9	92.34	48.3	5.5	265.65
1385	48.8	2.2	107.36	49.6	5.5	272.8
1390	48.9	2.15	105.135	48.6	4.5	218.7
1395	45.5	0.45	20.475	45.3	12.6	570.78
1400	48.1	0.48	23.088	47.9	5	239.5
1405	47.8	0.5	23.9	47.5	2	95
1410	48.5	1.73	83.905	48.2	4.7	226.54
1415	48.4	1.34	64.856	48	4.7	225.6
1420	47.5	0.99	47.025	47.1	1.3	61.23
1425	47.5	0.72	34.2	47.3	1.1	52.03
1430	47.4	1.07	50.718	47.1	0.4	18.84
1435	46.7	0.64	29.888	46.6	3.6	167.76
1440	48.3	0.95	45.885	48	3.8	182.4
1445	48.3	1.07	51.681	48	3.8	182.4
1450	48.4	0.57	27.588	48.1	2.9	139.49
1455	47.5	0.63	29.925	47.2	6	283.2
1460	47.8	1.07	51.146	47.5	3.4	161.5
1465	48.6	1.05	51.03	48.3	0.7	33.81
1470	47	0.81	38.07	46.8	10.3	482.04
1475	46.8	1.11	51.948	46.9	9.9	464.31
1480	47.3	0.89	42.097	47.1	5.9	277.89
1485	47.2	0.55	25.96	47	5.9	277.3
1490	48.5	0.99	48.015	48.3	1	48.3
1495	46.8	0.95	44.46	46.5	11.1	516.15

1500	46.5	0.93	43.245	46.3	1	46.3
1505	47.5	1.21	57.475	47.2	3.1	146.32
1510	47.7	1.59	75.843	47.5	0.5	23.75
1515	46.6	1.43	66.638	46.2	7.1	328.02
1520	46.6	1.61	75.026	46.3	7.1	328.73
1525	47	0.69	32.43	46.7	4.7	219.49
1530	47.8	0.4	19.12	47.6	0.3	14.28
1535	45.5	0.48	21.84	45.3	11.4	516.42
1540	47.1	0.46	21.666	46.9	3.1	145.39
1545	46.8	0.46	21.528	46.1	4.6	212.06
1550	48.2	1.98	95.436	47.8	-1.6	-76.48
1555	46.1	1.22	56.242	45.8	6.5	297.7
1560	48	1.16	55.68	47.7	-0.7	-33.39
1565	46.4	1.53	70.992	45.8	9	412.2
1570	46.5	1.69	78.585	46.2	7.5	346.5
1575	47.8	0.63	30.114	47.6	-0.1	-4.76
1580	47.6	0.55	26.18	46.6	6.2	288.92
1585	46.4	0.73	33.872	46.2	6.3	291.06
1590	47	0.75	35.25	46.7	3.7	172.79
1595	48.2	2.27	109.414	47.9	-1.8	-86.22
1600	47.1	2.5	117.75	47.5	0.64	30.4
1605	45.7	2.54	116.078	45.6	2.9	132.24
1610	47.6	2.76	131.376	46.8	3.9	182.52
1615	47.8	1.74	83.172	47.5	-0.3	-14.25
1620	46.4	1.55	71.92	46.2	7.3	337.26
1625	46.5	1.91	88.815	46.1	9.1	419.51
1630	46.4	0.92	42.688	46.3	6.6	305.58
1635	47.6	0.7	33.32	47.4	0	0
1640	47.8	0.2	9.56	47.3	0	0
1645	45.6	0.53	24.168	45.3	2.5	113.25
1650	46.7	0.41	19.147	46.7	5	233.5
1655	47.8	0.39	18.642	47.5	0	0
1660	45.5	1.27	57.785	45.3	4.6	208.38
1665	46.5	1.35	62.775	46.3	6.3	291.69
1670	47.9	1.07	51.253	47.6	0.4	19.04
1675	45.9	1.81	83.079	45.4	12.8	581.12
1680	46.3	1.13	52.319	46	6.7	308.2
1685	46.5	1.52	70.68	46.2	6.1	281.82
1690	45.7	1.97	90.029	45.5	4.3	195.65
1695	48	1.27	60.96	47.8	0.4	19.12
1700	47.9	0.43	20.597	47.6	0.1	4.76
1705	47.3	0.45	21.285	47.1	4.6	216.66
1710	46.8	0.41	19.188	46.6	6.5	302.9
1715	46.2	0.51	23.562	46.7	1.2	56.04

1720	47.6	0.71	33.796	47.4	0.1	4.74
1725	45.9	0.26	11.934	45.7	9.1	415.87
1730	46.5	0.79	36.735	46.3	6.4	296.32
1735	46.7	0.31	14.477	46.3	6.1	282.43
1740	46.1	0.25	11.525	45.9	7.8	358.02
1745	45.8	0.96	43.968	45.5	2.4	109.2
1750	46.7	0.38	17.746	46.1	7.9	364.19
1755	47.2	0.65	30.68	46.9	0.28	13.132
1760	46.4	0.26	12.064	46.2	6.8	314.16
1765	46.2	0.64	29.568	45.9	8.3	380.97
1770	46.8	0.48	22.464	45.9	8.3	380.97
1775	46.1	0.34	15.674	45.9	7.7	353.43
1780	46.3	0.78	36.114	46.1	6.7	308.87
1785	46.4	0.39	18.096	46.3	6.7	310.21
1790	46.5	0.9	41.85	46.1	7.3	336.53
1795	46.4	0.25	11.6	46	5.2	239.2
1800	46.3	0.81	37.503	46.1	6.9	318.09
1805	46.3	0.33	15.279	46	7.3	335.8
1810	45.8	0.41	18.778	45.8	7.4	338.92
1815	47.5	0.49	23.275	47.3	-0.2	-9.46
1820	47.7	0.52	24.804	47.5	-0.3	-14.25
1825	46.7	0.57	26.619	46.5	4.5	209.25
1830	46.7	0.37	17.279	46.5	4.7	218.55
1835	47.1	0.52	24.492	46.8	2.9	135.72
1840	46.3	0.3	13.89	46.1	6	276.6
1845	46.4	0.35	16.24	46.1	6.1	281.21
1850	45.8	0.79	36.182	45.6	2.6	118.56
1855	45.2	0.91	41.132	45.6	15	684
1860	47	1.02	47.94	47	-0.1	-4.7
1865	46.8	1.35	63.18	46.5	3.7	172.05
1870	47.4	1.31	62.094	47.2	0.2	9.44
1875	46.1	0.84	38.724	46.1	3.5	161.35
1880	46.7	0.26	12.142	46.5	5.8	269.7
1885	46.5	0.28	13.02	46.2	5.4	249.48
1890	46.6	0.36	16.776	46.4	4.1	190.24
1895	47.5	0.36	17.1	47.3	0.1	4.73
1900	49.2	0.36	17.712	46.7	0.1	4.67
1905	47.6	0.7	33.32	47.4	0.1	4.74
1910	47.8	0.42	20.076	47.5	-0.3	-14.25
1915	46.2	0.48	22.176	45.9	2.3	105.57
1920	47.6	1.15	54.74	47.3	-0.5	-23.65
1925	47.4	0.58	27.492	47	-0.4	-18.8
1930	47	0.78	36.66	46.7	2.8	130.76
1935	46.9	0.78	36.582	46.2	5.9	272.58

1940	46.8	1.3	60.84	46.5	3.8	176.7
1945	46.6	0.63	29.358	46.3	4.8	222.24
1950	47.6	0.56	26.656	47.4	-0.1	-4.74
1955	46.1	0.56	25.816	46	7.7	354.2
1960	46.5	0.58	26.97	46.4	4.5	208.8
1965	46.9	0.62	29.078	46.6	3.5	163.1
1970	47.9	1.87	89.573	47.6	-1.5	-71.4
1975	47.6	0.78	37.128	47.3	-0.3	-14.19
1980	46.6	1.48	68.968	46.3	5	231.5
1985	46.5	0.61	28.365	46.4	5.3	245.92
1990	47.9	0.55	26.345	47.2	-0.2	-9.44
1995	47.6	1.16	55.216	47.3	-0.6	-28.38
2000	47	0.66	31.02	47	-0.3	-14.1
2005	46	0.55	25.3	45.7	8.7	397.59
2010	47.9	1.64	78.556	47.6	-1.5	-71.4
2015	47.5	0.96	45.6	47.1	-0.5	-23.55
2020	46.1	0.67	30.887	46	6.4	294.4
2025	47.7	0.82	39.114	47.4	-0.4	-18.96
2030	45.6	0.64	29.184	45.4	1.4	63.56
2035	47.6	0.82	39.032	47.3	-0.3	-14.19
2040	45.4	1.24	56.296	45.2	3.2	144.64
2045	47.4	0.45	21.33	47.1	0.1	4.71
2050	47.6	0.48	22.848	47.3	-0.1	-4.73
2055	43.9	0.41	17.999	43.9	9.3	408.27
2060	44.1	0.41	18.081	43.9	7.8	342.42
2065	46.3	0.32	14.816	46	6.4	294.4
2070	46.8	0.26	12.168	45.5	7.9	359.45
2075	45.6	0.23	10.488	45.4	9.7	440.38
2080	46	0.24	11.04	45.7	6.7	306.19
2085	45.7	0.33	15.081	45.6	7.4	337.44
2090	45.4	0.78	35.412	45.2	9.4	424.88
2095	46.6	0.84	39.144	46.4	9.9	459.36
2100	45.8	1.67	76.486	45.5	1.1	50.05
2105	45.3	0.28	12.684	45.1	2.1	94.71
2110	47	0.66	31.02	46.3	-0.2	-9.26
2115	47.4	0.85	40.29	47.2	0.4	18.88
2120	45.8	0.83	38.014	45.3	4.5	203.85
2125	44.5	0.32	14.24	44.1	3.7	163.17
2130	45.4	0.88	39.952	45.1	7.1	320.21
2135	46.1	0.99	45.639	46	7	322
2140	44.7	0.72	32.184	44.5	3.3	146.85
2145	46.7	0.35	16.345	46.8	-0.2	-9.36
2150	44.5	1.48	65.86	44.2	1.1	48.62
2155	47.2	0.49	23.128	46.9	-0.2	-9.38

2160	46	0.23	10.58	45.8	0.72	32.976
2165	47.3	0.83	39.259	47.1	0.9	42.39
2170	4.1	0.32	1.312	45.8	6.9	316.02
2175	46	0.75	34.5	45.7	0.64	29.248
2180	45.9	0.26	11.934	45.7	7.5	342.75
2185	46.2	0.58	26.796	46.1	8.1	373.41
2190	45.8	0.25	11.45	45.6	7.3	332.88
2195	45.4	0.23	10.442	45.1	0.4	18.04
2200	45.8	0.29	13.282	45.5	2.3	104.65
2205	45.9	0.25	11.475	45.8	6.9	316.02
2210	46.1	0.84	38.724	45.9	6	275.4
2215	46	0.11	5.06	45.9	5.4	247.86
2220	46	0.48	22.08	45.7	6.6	301.62
2225	45.9	0.25	11.475	45.6	7.5	342
2230	45.7	0.18	8.226	45.4	5	227
2235	46.1	0.36	16.596	45.8	2	91.6
2240	46	0.26	11.96	45.7	6.8	310.76
2245	45.7	0.25	11.425	45.5	8.2	373.1
2250	45.6	0.28	12.768	45.3	7.5	339.75
2255	45.7	0.35	15.995	45.5	7.2	327.6
2260	45.5	0.95	43.225	45.3	3.1	140.43
2265	47	0.42	19.74	46.7	1.1	51.37
2270	47.2	0.55	25.96	46.9	1.1	51.59
2275	47.3	0.38	17.974	47	0.4	18.8
2280	45.8	0.2	9.16	44.6	2.9	129.34
2285	46.5	0.43	19.995	46.4	4	185.6
2290	45.2	0.51	23.052	44.9	3.1	139.19
2295	45.5	0.42	19.11	45.1	9.4	423.94
2300	45	0.44	19.8	45	5.2	234
2305	45.4	0.35	15.89	45.2	4.6	207.92
2310	45.5	0.3	13.65	45.1	6.9	311.19
2315	46.2	0.27	12.474	46.1	5.4	248.94
2320	45.6	0.28	12.768	45.3	2.7	122.31
2325	45.5	0.29	13.195	45.3	3.7	167.61
2330	44.7	0.2	8.94	44.5	4.3	191.35
2335	45.3	0.36	16.308	45.2	9.4	424.88
2340	45.6	0.37	16.872	45.4	7.4	335.96
2345	46.3	0.27	12.501	46	3.9	179.4
2350	45.7	0.25	11.425	45.6	6.8	310.08
2355	45.7	0.44	20.108	45.3	8.6	389.58
2360	47	0.24	11.28	46.7	0.8	37.36
2365	45.8	0.29	13.282	45.6	6.1	278.16
2370	44.8	0.31	13.888	44.7	1.4	62.58
2375	45.8	0.17	7.786	46.1	1.2	55.32

2380	46.3	0.24	11.112	46	3.4	156.4
2385	47.1	0.27	12.717	46.8	0.4	18.72
2390	44.7	0.22	9.834	44.4	2.9	128.76
2395	45.8	0.39	17.862	45.7	5.7	260.49
2400	47.1	0.38	17.898	46.9	0.4	18.76
2405	47.2	0.28	13.216	47	0.6	28.2
2410	47.2	0.27	12.744	47	0.6	28.2

TABLE 2: FLAT PANEL STATE

Time (Seconds)	Panel Voltage (Volts)	Panel Current (Amperes)	Panel Power (Watts)	Battery Voltage (Volts)	Battery Current (Amperes)	Battery Power (Watts
0	54	0	0	53.8	0	0
5	53.9	3.16	170.324	53.1	0.1	5.31
10	53.3	0.55	29.315	53	-0.4	-21.2
15	53.6	3.3	176.88	53.3	-3.3	-175.89
20	53.2	0.3	15.96	52.9	0.1	5.29
25	52.6	0.4	21.04	52.3	-0.1	-5.23
30	52.6	0.4	21.04	52.3	-0.2	-10.46
35	52.6	3.24	170.424	51.9	6.3	326.97
40	52.1	3.47	180.787	51.6	4	206.4
45	51.8	0.95	49.21	51.5	2.6	133.9
50	52.2	3.39	176.958	51.7	0.8	41.36
55	51.6	1.93	99.588	51.3	3.7	189.81
60	50.8	0.37	18.796	50.6	5.9	298.54
65	51.6	3.41	175.956	51.3	2.1	107.73
70	51.6	3.16	163.056	51.3	1.3	66.69
75	51.3	0.33	16.929	51	3.1	158.1
80	51.7	3.18	164.406	51.2	0.9	46.08
85	52.5	3.2	168	52.2	-3.2	-167.04
90	52.1	0.32	16.672	51.8	-0.32	-16.576
95	52	3.39	176.28	51.7	-0.3	-15.51
100	51.6	3.26	168.216	51.1	0.7	35.77
105	51.1	3.28	167.608	50.7	4.5	228.15
110	51.3	3.27	167.751	51	0.9	45.9
115	51.1	3.08	157.388	51.1	2.6	132.86
120	51.5	3.34	172.01	51	2.1	107.1
125	51	3.47	176.97	50.7	3.5	177.45
130	51.5	3.46	178.19	51.2	0.7	35.84
135	52.5	3.52	184.8	52.2	-3.5	-182.7

140	52.8	3.48	183.744	52.4	-3.2	-167.68
145	50.3	3.49	175.547	50	7.2	360
150	52.3	3.42	178.866	51.9	-2.6	-134.94
155	51.8	3.45	178.71	51.5	1.7	87.55
160	51.6	3.33	171.828	51.3	2.8	143.64
165	52.3	3.31	173.113	52	-1.6	-83.2
170	51.9	3.35	173.865	51.4	0.1	5.14
175	51.9	3.29	170.751	51.6	-0.1	-5.16
180	51.3	3.07	157.491	50.9	6.2	315.58
185	51.4	3.23	166.022	51.2	0	0
190	50.9	3.4	173.06	50.1	7.3	365.73
195	51	3.19	162.69	50.8	2.3	116.84
200	51	3.12	159.12	50.8	2	101.6
205	50.9	0.9	45.81	50.6	3	151.8
210	51.1	3.16	161.476	50.8	2.6	132.08
215	51.2	3.29	168.448	50.7	2	101.4
220	51	3.12	159.12	50.6	3.3	166.98
225	50.9	1.1	55.99	50.5	4	202
230	52.2	3.32	173.304	51.9	-2.8	-145.32
235	52.4	3.21	168.204	52.1	-2.9	-151.09
240	52.2	3.41	178.002	51.9	-2.3	-119.37
245	51.1	0.4	20.44	51.1	0.5	25.55
250	51.4	2.32	119.248	51	1.6	81.6
255	51.7	2.33	120.461	51.4	1.4	71.96
260	51.7	0.37	19.129	51.4	-0.1	-5.14
265	51	3.43	174.93	50.9	-0.1	-5.09
270	52.3	3.42	178.866	51.8	-3	-155.4
275	52.5	3.46	181.65	52.1	-3	-156.3
280	52.8	3.43	181.104	52.5	-3	-157.5
285	53	3.45	182.85	52.7	5.1	268.77
290	53.2	3.49	185.668	52.8	2	105.6
295	54.2	3.51	190.242	53.9	-3.5	-188.65
300	53.9	3.48	187.572	53.6	-1.8	-96.48
305	52.6	3.44	180.944	52.2	5.9	307.98
310	52.2	1	52.2	51.9	3.4	176.46
315	52.3	3.33	174.159	52.1	3.2	166.72
320	53.1	3.28	174.168	52.8	-2.8	-147.84
325	51.6	0.37	19.092	51.5	3	154.5
330	51.8	3.2	165.76	51.4	3.1	159.34
335	52	3.45	179.4	51.7	1	51.7
340	51.3	3.17	162.621	50.9	4.3	218.87
345	51.3	3.4	174.42	51	3	153
350	51	0.33	16.83	50.8	3	152.4
355	52.3	3.28	171.544	52	-3.1	-161.2

360	50.8	0.39	19.812	50.5	2	101
365	50.3	0.36	18.108	50.6	4	202.4
370	50.7	0.59	29.913	50.5	3.1	156.55
375	50.8	0.34	17.272	50.5	3	151.5
380	51.2	3.57	182.784	50.9	1.4	71.26
385	51.4	3.28	168.592	51.1	1	51.1
390	51.5	3.35	172.525	51.3	0.9	46.17
395	51.3	3.27	167.751	50.9	2.1	106.89
400	51	3.23	164.73	50.5	2.1	106.05
405	51.2	3.31	169.472	50.9	1.7	86.53
410	51	3.33	169.83	50.8	-0.9	-45.72
415	51.4	3.34	171.676	51.1	0.4	20.44
420	51.3	3.48	178.524	50.9	2	101.8
425	52.3	3.51	183.573	51.9	3.4	176.46
430	52.6	3.52	185.152	52.3	-3.4	-177.82
435	50.7	3.48	176.436	50.4	5.2	262.08
440	51.8	3.53	182.854	51.4	-2.3	-118.22
445	50.6	3.52	178.112	50.8	4.8	243.84
450	52.3	3.41	178.343	52	-3.2	-166.4
455	52.6	3.53	185.678	52.3	-3.3	-172.59
460	51.1	3.59	183.449	50.6	3	151.8
465	52.6	3.6	189.36	52.2	-3.3	-172.26
470	50.7	3.65	185.055	50.3	6.2	311.86
475	51.8	3.68	190.624	51.8	1.8	93.24
480	51.8	3.63	188.034	50.7	4.2	212.94
485	52.4	3.54	185.496	52	-3.3	-171.6
490	52.3	3.55	185.665	51.9	-2.8	-145.32
495	52.5	3.55	186.375	52.1	0	0
500	51.5	3.57	183.855	51	7.5	382.5
505	51.9	3.59	186.321	51.6	2	103.2
510	52.8	3.61	190.608	52.5	0.1	5.25
515	52.6	3.52	185.152	52.3	0.4	20.92
520	51.5	3.57	183.855	51.2	4.8	245.76
525	52.7	3.66	192.882	52.4	0.1	5.24
530	51.8	3.76	194.768	51.1	2.5	127.75
535	51.5	3.59	184.885	51.3	6.6	338.58
540	50.2	3.4	170.68	49.8	0.4	19.92
545	51	3.46	176.46	50.8	1.2	60.96
550	51.4	3.41	175.274	51.1	3.5	178.85
555	51.3	3.42	175.446	51.2	3.3	168.96
560	51	1.65	84.15	50.8	3.6	182.88
565	51.3	3.32	170.316	51	3.1	158.1
570	51.2	3.24	165.888	50.9	5.1	259.59
575	52	3.19	165.88	51.8	1.3	67.34

580	50.7	2.36	119.652	50.5	2.1	106.05
585	51.4	3.34	171.676	51	5.4	275.4
590	51.3	3.25	166.725	50.9	4	203.6
595	51.5	3.17	163.255	51.2	1.9	97.28
600	51.2	2.71	138.752	51.1	3.1	158.41
605	51.1	2.81	143.591	50.9	5.1	259.59
610	51.5	3.35	172.525	51.2	4.6	235.52
615	51.1	1.98	101.178	50.8	4.5	228.6
620	51.4	3.4	174.76	51	3.7	188.7
625	51.9	1.23	63.837	51.7	3.2	165.44
630	51.8	3.32	171.976	51.4	2.1	107.94
635	51.8	3.25	168.35	51.4	4.6	236.44
640	51.4	0.5	25.7	51.1	4.7	240.17
645	51.5	3.31	170.465	51.2	3.6	184.32
650	51.5	0.33	16.995	51.1	3.9	199.29
655	50.9	3.32	168.988	50.6	1	50.6
660	50.8	0.55	27.94	50.6	1.3	65.78
665	52.2	3.38	176.436	51.9	1.7	88.23
670	49.7	3.34	165.998	49.5	6.4	316.8
675	52	3.41	177.32	51.7	2.3	118.91
680	51.3	3.4	174.42	51	4	204
685	52	3.23	167.96	51.8	0.2	10.36
690	52.6	3.24	170.424	52.2	0.3	15.66
695	51.2	3.57	182.784	50.9	1.4	71.26
700	51.4	3.28	168.592	51.1	1	51.1
705	51.5	3.35	172.525	51.3	0.9	46.17
710	51.3	3.27	167.751	50.9	2.1	106.89
715	51	3.23	164.73	50.5	2.1	106.05
720	51.2	3.31	169.472	50.9	1.7	86.53
725	51	3.33	169.83	50.8	-0.9	-45.72
730	51.4	3.34	171.676	51.1	0.4	20.44
735	51.3	3.48	178.524	50.9	2	101.8
740	52.3	3.51	183.573	51.9	3.4	176.46
745	52.6	3.52	185.152	52.3	-3.4	-177.82
750	50.7	3.48	176.436	50.4	5.2	262.08
755	51.8	3.53	182.854	51.4	-2.3	-118.22
760	50.6	3.52	178.112	50.8	4.8	243.84
765	52.3	3.41	178.343	52	-3.2	-166.4
770	52.6	3.53	185.678	52.3	-3.3	-172.59
775	51.1	3.59	183.449	50.6	3	151.8
780	52.6	3.6	189.36	52.2	-3.3	-172.26
785	50.7	3.65	185.055	50.3	6.2	311.86
790	51.8	3.68	190.624	51.8	1.8	93.24
795	51.8	3.63	188.034	50.7	4.2	212.94

800	52.4	3.54	185.496	52	-3.3	-171.6
805	52.3	3.55	185.665	51.9	-2.8	-145.32
810	52.5	3.55	186.375	52.1	0	0
815	51.5	3.57	183.855	51	7.5	382.5
820	51.9	3.59	186.321	51.6	2	103.2
825	52.8	3.61	190.608	52.5	0.1	5.25
830	52.6	3.52	185.152	52.3	0.4	20.92
835	51.5	3.57	183.855	51.2	4.8	245.76
840	52.7	3.66	192.882	52.4	0.1	5.24
845	51.8	3.76	194.768	51.1	2.5	127.75
850	51.5	3.59	184.885	51.3	6.6	338.58
855	54.3	3.39	184.077	54	-3.2	-172.8
860	51.6	0.55	28.38	51.4	6.7	344.38
865	52.6	0.75	39.45	52.3	0.1	5.23
870	52.2	3.33	173.826	51.7	1.2	62.04
875	51.3	3.6	184.68	51	-2.8	-142.8
880	51.4	3.16	162.424	51.1	2.1	107.31
885	51	0.29	14.79	50.6	4.1	207.46
890	50.4	0.29	14.616	50.3	6	301.8
895	50.5	0.4	20.2	50.1	6.7	335.67
900	50.7	0.34	17.238	50.4	3.8	191.52
905	51.1	3.27	167.097	50.8	-1.2	-60.96
910	51.3	3.25	166.725	51	1.3	66.3
915	51.2	3.23	165.376	50.9	3.2	162.88
920	51.2	3.16	161.792	50.8	0.2	10.16
925	51.8	1.25	64.75	51.5	-1	-51.5
930	51	3.28	167.28	50.7	5.9	299.13
935	51.2	3.38	173.056	50.9	2.2	111.98
940	52.2	3.45	180.09	51.9	-2.1	-108.99
945	50.6	3.41	172.546	50.4	5.7	287.28
950	51.1	3.46	176.806	50.8	3.3	167.64
955	51.5	0.36	18.54	51.2	-0.2	-10.24
960	50.6	3.52	178.112	50.8	1.7	86.36
965	51.6	0.47	24.252	51.4	-0.3	-15.42
970	51.8	0.5	25.9	51.5	-0.4	-20.6
975	49.2	0.66	32.472	48.9	9.9	484.11
980	50.1	3.73	186.873	49.8	0.2	9.96
985	50.9	3.42	174.078	50.6	3.1	156.86
990	50.9	3.41	173.569	50.5	2.8	141.4
995	52.7	3.25	171.275	51.8	-2.6	-134.68
1000	50.7	1.07	54.249	50.4	4.2	211.68
1005	51	3.22	164.22	50.7	2.4	121.68
1010	51.8	3.07	159.026	50.7	-1.5	-76.05
1015	50.5	3.03	153.015	50.2	7.7	386.54

1020	51.2	3.2	163.84	50.8	2.3	116.84
1025	52	3.21	166.92	51.7	-2.3	-118.91
1030	52	3.25	169	51.7	-2.5	-129.25
1035	52.2	3.24	169.128	51.8	-2.4	-124.32
1040	51.8	0.4	20.72	51.7	-0.2	-10.34
1045	50.9	0.46	23.414	50.7	4.7	238.29
1050	51.7	0.26	13.442	51.5	0.1	5.15
1055	51.5	0.47	24.205	51.2	0.2	10.24
1060	51.9	3.23	167.637	51.7	-1.2	-62.04
1065	50.7	3.22	163.254	49.8	5.1	253.98
1070	52.4	3.38	177.112	52.1	-3.1	-161.51
1075	51.9	3.36	174.384	51.1	2.8	143.08
1080	52.1	3.36	175.056	51.8	2.1	108.78
1085	52.3	2.83	148.009	52	-2.1	-109.2
1090	51.9	3.27	169.713	51.7	-2.4	-124.08
1095	51.6	0.29	14.964	51.3	0.4	20.52
1100	50.3	0.26	13.078	50.1	5.3	265.53
1105	51.3	0.3	15.39	51.1	-0.3	-15.33
1110	50.3	3.24	162.972	50	-0.3	-15
1115	50.9	2.96	150.664	50.5	3.9	196.95
1120	51.1	3.24	165.564	50.9	2.3	117.07
1125	51.2	3.18	162.816	50.8	3.1	157.48
1130	52	3.17	164.84	51.8	-0.17	-8.806
1135	51	3.26	166.26	50.7	-0.6	-30.42
1140	50.4	3.26	164.304	50	1.6	80
1145	51.1	3.18	162.498	50.8	4.1	208.28
1150	52.4	3.11	162.964	52	-2.4	-124.8
1155	52.3	3.47	181.481	51.9	-2.8	-145.32
1160	52.1	0.54	28.134	51.8	0.1	5.18
1165	52	3.37	175.24	51.7	0.2	10.34
1170	51.8	0.51	26.418	51.6	0.6	30.96
1175	51.6	3.35	172.86	51.3	-2.1	-107.73
1180	51.6	3.47	179.052	51.3	1.3	66.69
1185	50.5	0.65	32.825	50.2	0.6	30.12
1190	51.2	3.49	178.688	51	2.2	112.2
1195	51.2	3.41	174.592	50.8	2.6	132.08
1200	51.4	3.37	173.218	51.2	1.1	56.32
1205	52	3.24	168.48	51.6	1	51.6
1210	51.5	3.29	169.435	51.1	2	102.2
1215	51.4	3.19	163.966	51.2	1	51.2
1220	51.3	3.24	166.212	50.9	1.2	61.08
1225	51.2	3.29	168.448	51.1	3.8	194.18
1230	51.3	3.26	167.238	50.8	1.8	91.44
1235	51.1	3.1	158.41	50.8	1.8	91.44

1240	50.9	2.43	123.687	50.7	4.4	223.08
1245	50.6	0.39	19.734	50.5	4.5	227.25
1250	50.6	0.6	30.36	50.3	5.6	281.68
1255	50.8	1.19	60.452	50.5	2.9	146.45
1260	51	3.3	168.3	50.5	3.3	166.65
1265	52	3.34	173.68	51.8	-2.3	-119.14
1270	51.8	0.56	29.008	51.5	1	51.5
1275	51.9	3.39	175.941	51.6	0.3	15.48
1280	52	3.2	166.4	51.6	0.4	20.64
1285	51.1	0.45	22.995	51	2.9	147.9
1290	51.7	3.28	169.576	51.4	-0.2	-10.28
1295	51.6	0.32	16.512	51.4	0.2	10.28
1300	51.1	3.37	172.207	50.8	2.8	142.24
1305	51.4	0.54	27.756	51.2	0.9	46.08
1310	52.3	3.37	176.251	52	0.2	10.4
1315	51.9	0.41	21.279	51.6	0.1	5.16
1320	51.6	3.26	168.216	51.3	-2.9	-148.77
1325	52.2	3.41	178.002	51.8	-0.3	-15.54
1330	50.5	3.41	172.205	50.2	1	50.2
1335	49.6	0.58	28.768	49.4	1.6	79.04
1340	51.8	3.33	172.494	51.5	-2.9	-149.35
1345	50.6	0.35	17.71	50.4	5	252
1350	50.7	0.58	29.406	50.7	0.5	25.35
1355	50.1	0.36	18.036	49.9	1.6	79.84
1360	50.8	3.25	165.1	50.5	2	101
1365	51.2	2.2	112.64	51	1.1	56.1
1370	50.8	3.3	167.64	50.5	3.4	171.7
1375	50.5	0.52	26.26	50.2	4.9	245.98
1380	50.5	0.32	16.16	50.2	4.5	225.9
1385	50.9	3.32	168.988	50.6	-2.3	-116.38
1390	50.5	0.82	41.41	50.4	4.4	221.76
1395	50.6	0.31	15.686	50.3	4.3	216.29
1400	50.5	0.3	15.15	50.3	5.3	266.59
1405	51.9	3.11	161.409	51.6	-2.1	-108.36
1410	51.5	1.68	86.52	51.2	-1	-51.2
1415	50.7	3.08	156.156	50.4	4.8	241.92
1420	50.9	3.16	160.844	50.5	2.8	141.4
1425	51.6	1.88	97.008	51.3	1	51.3
1430	51	2.09	106.59	50.6	3.6	182.16
1435	50.9	3.4	173.06	50.5	3.1	156.55
1440	50.7	3.36	170.352	50.3	3.7	186.11
1445	52.1	3.43	178.703	51.7	-1.1	-56.87
1450	51.7	0.32	16.544	51.4	0.1	5.14
1455	51.1	3.42	174.762	50.8	3.1	157.48

1460	52.5	3.42	179.55	52.2	-2.9	-151.38
1465	52.7	3.31	174.437	52.4	-2.8	-146.72
1470	52.9	3.36	177.744	52.6	-2.6	-136.76
1475	52.7	3.39	178.653	51.8	1.6	82.88
1480	51.6	1.49	76.884	51.3	3.4	174.42
1485	51.7	3.4	175.78	51.6	1.9	98.04
1490	52.1	3.49	181.829	51.8	-2.1	-108.78
1495	51.1	3.36	171.696	50.7	3.1	157.17
1500	51.5	3.39	174.585	51.2	-1.7	-87.04
1505	51.5	3.2	164.8	51.2	1.3	66.56
1510	51.6	3.23	166.668	51.3	1.1	56.43
1515	51.5	3.17	163.255	51.2	1.8	92.16
1520	50.7	1.71	86.697	50.3	5.2	261.56
1525	50.7	1.72	87.204	50.5	5	252.5
1530	51.1	3.29	168.119	50.9	3.6	183.24
1535	51	3.09	157.59	50.7	3.1	157.17
1540	51.2	0.34	17.408	51	0.1	5.1
1545	51.4	3.01	154.714	51	1.7	86.7
1550	51.1	2.1	107.31	50.8	2.8	142.24
1555	50.2	0.43	21.586	50	7.2	360
1560	50.8	3.18	161.544	50.6	4.3	217.58
1565	52.1	3.25	169.325	51.7	-0.24	-12.408
1570	52.1	2.32	120.872	51.7	-0.7	-36.19
1575	51.8	3.27	169.386	51.5	0.9	46.35
1580	51.6	0.36	18.576	51	1.5	76.5
1585	51.7	0.39	20.163	50.9	0.9	45.81
1590	52	3.22	167.44	51.1	-1.7	-86.87
1595	51.6	1.71	88.236	51.4	0.2	10.28
1600	51.4	0.72	37.008	51.1	1.7	86.87
1605	52.2	3.31	172.782	51.8	-2.5	-129.5
1610	52.4	3.28	171.872	52.1	-2.6	-135.46
1615	52.6	3.24	170.424	52.3	-2.4	-125.52
1620	53.5	3.22	172.27	53.1	1.2	63.72
1625	53.9	3.3	177.87	53.6	-1	-53.6
1630	54	3.37	181.98	53.7	-1.1	-59.07
1635	54.1	3.38	182.858	53.9	-2.2	-118.58
1640	52.8	0.57	30.096	52.5	4.7	246.75
1645	52.8	1.15	60.72	52.6	1.8	94.68
1650	53.3	0.32	17.056	53.1	-0.2	-10.62
1655	51.8	0.36	18.648	51.5	0.1	5.15
1660	51.8	0.83	42.994	51.4	1.2	61.68
1665	52.6	0.37	19.462	52.3	-0.2	-10.46
1670	51.8	3.23	167.314	51.4	2.4	123.36
1675	52.2	3.34	174.348	51.9	0.4	20.76

1680	51.8	3.17	164.206	51.4	2.6	133.64
1685	51.5	3.38	174.07	51.3	3.5	179.55
1690	51.1	0.36	18.396	50.8	5.8	294.64
1695	51.5	3.23	166.345	51.2	-1.5	-76.8
1700	50.9	0.28	14.252	50.7	4.8	243.36
1705	50.8	0.27	13.716	50.5	-0.1	-5.05
1710	51.2	0.27	13.824	51.1	0.3	15.33
1715	50.3	3.24	162.972	50	-0.3	-15
1720	50.9	2.96	150.664	50.5	3.9	196.95
1725	51.1	3.24	165.564	50.9	2.3	117.07
1730	51.2	3.18	162.816	50.8	3.1	157.48
1735	52	3.17	164.84	51.8	-0.17	-8.806
1740	51	3.26	166.26	50.7	-0.6	-30.42
1745	50.4	3.26	164.304	50	1.6	80
1750	51.1	3.18	162.498	50.8	4.1	208.28
1755	52.4	3.11	162.964	52	-2.4	-124.8
1760	52.3	3.47	181.481	51.9	-2.8	-145.32
1765	52.1	0.54	28.134	51.8	0.1	5.18
1770	52	3.37	175.24	51.7	0.2	10.34
1775	51.8	0.51	26.418	51.6	0.6	30.96
1780	51.6	3.35	172.86	51.3	-2.1	-107.73
1785	51.6	3.47	179.052	51.3	1.3	66.69
1790	50.5	0.65	32.825	50.2	0.6	30.12
1795	51.2	3.49	178.688	51	2.2	112.2
1800	51.2	3.41	174.592	50.8	2.6	132.08
1805	51.4	3.37	173.218	51.2	1.1	56.32
1810	52	3.24	168.48	51.6	1	51.6
1815	51.5	3.29	169.435	51.1	2	102.2
1820	51.4	3.19	163.966	51.2	1	51.2
1825	51.3	3.24	166.212	50.9	1.2	61.08
1830	51.2	3.29	168.448	51.1	3.8	194.18
1835	51.3	3.26	167.238	50.8	1.8	91.44
1840	51.1	3.1	158.41	50.8	1.8	91.44
1845	50.9	2.43	123.687	50.7	4.4	223.08
1850	50.6	0.39	19.734	50.5	4.5	227.25
1855	50.6	0.6	30.36	50.3	5.6	281.68
1860	50.8	1.19	60.452	50.5	2.9	146.45
1865	51	3.3	168.3	50.5	3.3	166.65
1870	52	3.34	173.68	51.8	-2.3	-119.14
1875	51.8	0.56	29.008	51.5	1	51.5
1880	51.9	3.39	175.941	51.6	0.3	15.48
1885	52	3.2	166.4	51.6	0.4	20.64
1890	51.1	0.45	22.995	51	2.9	147.9
1895	51.7	3.28	169.576	51.4	-0.2	-10.28

1900	51.6	0.32	16.512	51.4	0.2	10.28
1905	51.1	3.37	172.207	50.8	2.8	142.24
1910	51.4	0.54	27.756	51.2	0.9	46.08
1915	52.3	3.37	176.251	52	0.2	10.4
1920	51.3	0.23	11.799	51	2.2	112.2
1925	50.4	0.36	18.144	50.2	3.4	170.68
1930	51.5	0.24	12.36	51.2	1.5	76.8
1935	50.3	3.13	157.439	51.4	4.3	221.02
1940	52.1	3.2	166.72	51.8	-2.8	-145.04
1945	51.7	3.21	165.957	51.7	1.8	93.06
1950	51.4	3.17	162.938	51.1	2	102.2
1955	51.6	3.12	160.992	51.2	1.3	66.56
1960	51.5	3.06	157.59	51.1	2.1	107.31
1965	51.4	3.11	159.854	51	2.1	107.1
1970	51.2	3.15	161.28	50.9	2.3	117.07
1975	51.6	3.3	170.28	51.2	0.6	30.72
1980	51.6	3.31	170.796	51.3	0.9	46.17
1985	52.4	3.36	176.064	52.1	3.3	171.93
1990	52.6	3.37	177.262	52.3	3.3	172.59
1995	50.8	3.35	170.18	50.6	4	202.4
2000	50.9	3.36	171.024	50.2	3.7	185.74
2005	51.7	3.33	172.161	51.3	0.7	35.91
2010	51.7	3.32	171.644	51.3	0.9	46.17
2015	51.8	3.15	163.17	51.4	0.1	5.14
2020	51.5	3.23	166.345	51.3	0.6	30.78
2025	51.6	3.18	164.088	51.3	0.4	20.52
2030	51.5	3.12	160.68	51.2	2	102.4
2035	51.6	3.17	163.572	51.4	1.6	82.24
2040	51.5	3.26	167.89	51.2	1.5	76.8
2045	51.4	3.26	167.564	51	2.4	122.4
2050	51.1	2.54	129.794	50.8	3.2	162.56
2055	51.4	2.99	153.686	51	2.1	107.1
2060	50.9	0.35	17.815	50.6	2.1	106.26
2065	51.3	3.06	156.978	51	1.4	71.4
2070	51.1	3.17	161.987	50.7	2.8	141.96
2075	51	3.07	156.57	50.8	2.6	132.08
2080	51.2	3.22	164.864	50.7	1.2	60.84
2085	52.1	3.23	168.283	51.8	2.4	124.32
2090	52	3.14	163.28	51.7	2.2	113.74
2095	51.3	3.28	168.264	51	2.6	132.6
2100	51.7	3.1	160.27	51.4	0.2	10.28
2105	50.4	0.4	20.16	50.2	1.7	85.34
2110	51.4	3.21	164.994	51	2.2	112.2
2115	51.6	0.33	17.028	51.4	-0.1	-5.14

2120	51.2	3.3	168.96	50.9	2.5	127.25
2125	51.9	3.09	160.371	51.7	2.6	134.42
2130	52.3	3.33	174.159	52	2.8	145.6
2135	52.6	3.22	169.372	52.3	-2.8	-146.44
2140	52.9	3.19	168.751	52.5	-2.7	-141.75
2145	50.9	2.57	130.813	50.5	3	151.5
2150	52.2	3.37	175.914	51.9	-3.3	-171.27
2155	50.4	3.33	167.832	49.9	3.7	184.63
2160	51.6	3.3	170.28	51.3	2	102.6
2165	51.2	3.69	188.928	50.8	2.3	116.84
2170	52.1	3.14	163.594	51.8	2.9	150.22
2175	51.8	3.23	167.314	50.8	2.5	127
2180	51.3	0.39	20.007	51.1	-0.2	-10.22
2185	51.5	0.35	18.025	51.2	-0.2	-10.24
2190	51.1	3.46	176.806	50.6	3.2	161.92
2195	51	3.25	165.75	50.6	2.9	146.74
2200	51.2	3.1	158.72	50.8	2.9	147.32
2205	53.1	3.17	168.327	52.9	-2	-105.8
2210	52.5	3.18	166.95	53.1	-0.9	-47.79
2215	52.5	3.13	164.325	52.2	1.1	57.42
2220	52.7	3.02	159.154	52.4	0.4	20.96
2225	51.6	2.97	153.252	51.1	3.3	168.63
2230	52.3	3.12	163.176	52	0.2	10.4
2235	52.3	3.06	160.038	52	0.4	20.8
2240	52.3	3.15	164.745	52	0.7	36.4
2245	52.2	3.2	167.04	52.1	1.5	78.15
2250	52.9	3.27	172.983	52.6	-3.2	-168.32
2255	53.1	3.3	175.23	52.8	3.3	174.24
2260	53.2	3.26	173.432	52.9	-2.9	-153.41
2265	51.7	3.34	172.678	51.5	3	154.5
2270	51.8	3.22	166.796	51.5	3.6	185.4
2275	52.1	3.24	168.804	51.8	1.2	62.16
2280	52	3.12	162.24	51.7	1	51.7
2285	52.1	3.05	158.905	51.7	1.5	77.55
2290	52	3.11	161.72	51.7	1.5	77.55
2295	52.5	2.97	155.925	52.2	2	104.4
2300	52.2	3.1	161.82	51.9	0.4	20.76
2305	51.8	1.4	72.52	51.6	3.09	159.444
2310	51.7	3.14	162.338	51.4	2.6	133.64
2315	51.1	0.39	19.929	50.8	3.7	187.96
2320	51.5	2.94	151.41	51.2	-2.3	-117.76
2325	50.9	0.34	17.306	50.6	3.8	192.28
2330	51.2	2.8	143.36	50.9	1.8	91.62
2335	50.8	0.44	22.352	50.5	4.2	212.1

2340	51.1	3.16	161.476	50.8	2.1	106.68
2345	50.6	0.45	22.77	50.4	3.7	186.48
2350	50.3	1.39	69.917	50.2	2.6	130.52
2355	52.1	3.13	163.073	51.8	2.7	139.86
2360	52.3	3.01	157.423	52	2.8	145.6
2365	51.4	3.11	159.854	51.2	3.2	163.84
2370	51.8	3.11	161.098	51.6	1	51.6
2375	51.9	0.36	18.684	51.7	0.2	10.34
2380	50.3	0.42	21.126	50.3	5	251.5
2385	51	3.13	159.63	50.7	3.7	187.59
2390	51.7	0.37	19.129	51.4	0.2	10.28
2395	51.1	0.81	41.391	50.9	2.1	106.89
2400	51.6	3.23	166.668	51.3	0.1	5.13
2405	52.3	3.27	171.021	52	2.8	145.6
2410	51.9	3.28	170.232	51.6	0.7	36.12
2415	51.2	3.33	170.496	51	4.1	209.1
2420	51.2	3.26	166.912	51	3.2	163.2
2425	51	1.62	82.62	50.8	2.4	121.92
2430	52.1	3.22	167.762	51.8	3.2	165.76
2435	51.1	0.27	13.797	50.2	0	0
2440	52	3.18	165.36	51.6	3.1	159.96
2445	51.3	0.4	20.52	51.1	-0.4	-20.44
2450	50	0.35	17.5	49.8	5.5	273.9
2455	51.1	3.17	161.987	50.7	0.5	25.35
2460	51.5	3.06	157.59	51.2	-0.2	-10.24
2465	50.8	0.31	15.748	50.5	2.5	126.25
2470	50.8	0.37	18.796	50.6	2.9	146.74
2475	50.6	1.25	63.25	50.4	3.5	176.4
2480	50.5	1.26	63.63	50.4	4.2	211.68
2485	50.6	1.26	63.756	50.3	2.8	140.84
2490	51	3.04	155.04	50.8	0.4	20.32
2495	51.3	3.11	159.543	51	0.8	40.8
2500	51.2	3.06	156.672	51	1.2	61.2
2505	51.1	2.93	149.723	50.8	1.8	91.44
2510	51.1	3.02	154.322	50.8	2.6	132.08
2515	51.2	3.06	156.672	50.8	1.8	91.44
2520	51	3.05	155.55	50.7	3.4	172.38
2525	51.1	3.13	159.943	50.8	2.1	106.68
2530	51	3.14	160.14	50.7	2.3	116.61
2535	52.2	3.18	165.996	51.9	3.2	166.08
2540	52.4	3.18	166.632	51.9	2.3	119.37
2545	51.3	3.17	162.621	51	2.1	107.1
2550	51.6	3.14	162.024	51.2	0.5	25.6
2555	51.7	3.15	162.855	51.3	1.3	66.69

2560	51.4	3	154.2	51	1.9	96.9
2565	51.5	3.06	157.59	51	2.8	142.8
2570	51.3	3	153.9	51	2.1	107.1
2575	51.2	2.93	150.016	50.9	1.8	91.62
2580	51.3	3.1	159.03	50.9	1.9	96.71
2585	51.2	3.13	160.256	50.9	1.2	61.08
2590	50.8	0.5	25.4	50.5	4.1	207.05
2595	51.1	2.94	150.234	50.7	2.9	147.03
2600	50.8	0.35	17.78	50.5	3	151.5
2605	51.1	2.88	147.168	50.7	2.5	126.75
2610	50.8	2.93	148.844	50.6	2.1	106.26
2615	50.7	1.75	88.725	50.5	3	151.5
2620	50.6	0.44	22.264	50.4	3.3	166.32
2625	51.1	3.21	164.031	50.7	1.3	65.91
2630	52	3.04	158.08	51.7	2.8	144.76
2635	52.3	3.17	165.791	52	1.3	67.6
2640	51.2	3.11	159.232	51	3.4	173.4
2645	51	0.39	19.89	50.8	1	50.8
2650	51.6	0.4	20.64	51.4	-0.3	-15.42
2655	50.1	0.94	47.094	49.9	1.4	69.86
2660	51.6	0.53	27.348	51.4	0.1	5.14
2665	51.6	2.49	128.484	51.5	-0.9	-46.35
2670	51.9	3.01	156.219	51.1	-2.8	-143.08
2675	52.5	3.16	165.9	52.2	2.9	151.38
2680	50.8	3.27	166.116	50.4	5.7	287.28
2685	54.7	3.22	176.134	54.4	3.4	184.96
2690	53.9	3.15	169.785	53.1	0.9	47.79
2695	52.3	3.15	164.745	52	3.2	166.4
2700	53.7	0.53	28.461	53.8	3.6	193.68
2705	52.8	0.33	17.424	52.7	2.9	152.83
2710	53.7	3.06	164.322	53.4	1.3	69.42
2715	53.1	0.39	20.709	52.8	2.8	147.84
2720	53	0.35	18.55	52.8	2.8	147.84
2725	51.9	2.9	150.51	51.8	3.8	196.84
2730	52.5	3.01	158.025	52.2	4	208.8
2735	51.3	0.6	30.78	51.2	1.6	81.92
2740	51.9	3.16	164.004	51.3	4	205.2
2745	52.1	2.79	145.359	51.6	5.3	273.48
2750	51.9	0.32	16.608	51.7	5.4	279.18
2755	52.1	0.36	18.756	51.8	5.6	290.08
2760	51.7	0.34	17.578	51.4	4.5	231.3
2765	51.8	0.29	15.022	51.6	5.7	294.12
2770	51.5	0.29	14.935	51.3	5.9	302.67
2775	51.3	0.46	23.598	51.1	4.3	219.73

2780	51.4	0.33	16.962	50.7	6.3	319.41
2785	51.5	1.08	55.62	51.3	6.7	343.71
2790	51.9	2.45	127.155	51.7	7.3	377.41
2795	51.6	2.92	150.672	51.3	5.4	277.02
2800	51.6	2.87	148.092	51.3	4.4	225.72
2805	51.8	2.98	154.364	51.9	1.5	77.85
2810	51.8	2.97	153.846	51.5	5.1	262.65
2815	51.9	3.06	158.814	51.5	8.4	432.6
2820	52	3.09	160.68	51.7	6.7	346.39
2825	52.7	3.09	162.843	52.4	13	681.2
2830	52.9	3.1	163.99	52.6	12	631.2
2835	52.3	3.11	162.653	52	6.7	348.4
2840	52	3.07	159.64	51.8	7.4	383.32
2845	52.3	3.05	159.515	52	9.5	494
2850	52	3.01	156.52	51.7	4.9	253.33
2855	51.8	2.62	135.716	51.5	5.7	293.55
2860	52.2	2.88	150.336	52	6.3	327.6
2865	52.9	2.93	154.997	52.5	10.3	540.75
2870	54.6	2.79	152.334	54.3	2.3	124.89
2875	52.9	3.01	159.229	52.7	3.1	163.37
2880	52.7	3.02	159.154	52.4	3.7	193.88
2885	52.6	0.81	42.606	52.3	0.38	19.874
2890	52.6	2.74	144.124	52.3	2.3	120.29
2895	52.6	0.3	15.78	52.4	0.1	5.24
2900	52.8	0.35	18.48	52.5	0.1	5.25
2905	51.7	0.45	23.265	51.5	5.6	288.4
2910	51.9	2.8	145.32	51.9	0.7	36.33
2915	51.7	0.31	16.027	51.9	3.7	192.03
2920	52.8	1.38	72.864	51.6	3.1	159.96
2925	52.4	2.92	153.008	52.1	0.1	5.21
2930	52.3	0.36	18.828	52	-0.2	-10.4
2935	51.1	0.47	24.017	50.9	5.8	295.22
2940	52.1	2.99	155.779	51.8	1.5	77.7
2945	52.1	0.37	19.277	51.8	0	0
2950	51.3	3.05	156.465	51	2.8	142.8
2955	52.2	3	156.6	51.9	2.2	114.18
2960	52.3	2.7	141.21	52.1	2	104.2
2965	51.3	0.46	23.598	51.1	4.3	219.73
2970	51.4	0.33	16.962	50.7	6.3	319.41
2975	51.5	1.08	55.62	51.3	6.7	343.71
2980	51.9	2.45	127.155	51.7	7.3	377.41
2985	51.6	2.92	150.672	51.3	5.4	277.02
2990	51.6	2.87	148.092	51.3	4.4	225.72
2995	51.8	2.98	154.364	51.9	1.5	77.85

3000	51.8	2.97	153.846	51.5	5.1	262.65
3005	51.9	3.06	158.814	51.5	8.4	432.6
3010	52	3.09	160.68	51.7	6.7	346.39
3015	52.7	3.09	162.843	52.4	13	681.2
3020	52.9	3.1	163.99	52.6	12	631.2
3025	52.3	3.11	162.653	52	6.7	348.4
3030	52	3.07	159.64	51.8	7.4	383.32
3035	52.3	3.05	159.515	52	9.5	494
3040	52	3.01	156.52	51.7	4.9	253.33
3045	51.8	2.62	135.716	51.5	5.7	293.55
3050	52.2	2.88	150.336	52	6.3	327.6
3055	52.9	2.93	154.997	52.5	10.3	540.75
3060	54.6	2.79	152.334	54.3	2.3	124.89
3065	52.9	3.01	159.229	52.7	3.1	163.37
3070	52.7	3.02	159.154	52.4	3.7	193.88
3075	52.6	0.81	42.606	52.3	0.38	19.874
3080	52.6	2.74	144.124	52.3	2.3	120.29
3085	52.6	0.3	15.78	52.4	0.1	5.24
3090	52.8	0.35	18.48	52.5	0.1	5.25
3095	51.7	0.45	23.265	51.5	5.6	288.4
3100	51.9	2.8	145.32	51.9	0.7	36.33
3105	50.1	0.94	47.094	49.9	1.4	69.86
3110	51.6	0.53	27.348	51.4	0.1	5.14
3115	51.6	2.49	128.484	51.5	-0.9	-46.35
3120	51.9	3.01	156.219	51.1	-2.8	-143.08
3125	52.5	3.16	165.9	52.2	2.9	151.38
3130	50.8	3.27	166.116	50.4	5.7	287.28
3135	54.7	3.22	176.134	54.4	3.4	184.96
3140	53.9	3.15	169.785	53.1	0.9	47.79
3145	52.3	3.15	164.745	52	3.2	166.4
3150	53.7	0.53	28.461	53.8	3.6	193.68
3155	52.8	0.33	17.424	52.7	2.9	152.83
3160	53.7	3.06	164.322	53.4	1.3	69.42
3165	50.6	0.26	13.156	50.4	0.2	10.08
3170	50.6	0.51	25.806	50.4	0.6	30.24
3175	50.6	0.36	18.216	50.5	1.4	70.7
3180	50.6	0.29	14.674	50.4	1.3	65.52
3185	50.6	0.36	18.216	50.3	0.2	10.06
3190	50.6	1.01	51.106	50.3	-0.5	-25.15
3195	50.6	0.41	20.746	50.4	0.1	5.04
3200	50.6	2.91	147.246	50.3	-1.5	-75.45
3205	50.6	2.92	147.752	50.4	-2.4	-120.96
3210	50.9	1.44	73.296	50.5	1.3	65.65
3215	50.11	2.8	140.308	50.7	0.1	5.07

3220	50.7	1.6	81.12	50.3	1.8	90.54
3225	52	3	156	51.7	6.3	325.71
3230	48.5	0.66	32.01	48.3	12.4	598.92
3235	51	3.13	159.63	50.4	3	151.2
3240	51.5	3.17	163.255	50.8	6.3	320.04
3245	52.1	3.07	159.947	51.8	6.4	331.52
3250	50.4	3.16	159.264	50.1	4.6	230.46
3255	52.1	3.23	168.283	51.8	6.5	336.7
3260	50.8	3.26	165.608	50.5	1.5	75.75
3265	51.3	3.04	155.952	50.9	-0.9	-45.81
3270	51.9	3.07	159.333	51.6	5.6	288.96
3275	52.1	3.12	162.552	51.7	6.1	315.37
3280	51.7	3.12	161.304	51.6	2	103.2
3285	52	3.14	163.28	51.7	6.4	330.88
3290	51.8	3.01	155.918	51.4	3.7	190.18
3295	51.9	3.16	164.004	51.6	4.6	237.36
3300	52.3	3.12	163.176	52	6.4	332.8
3305	52.3	3.16	165.268	52	5.6	291.2
3310	50.6	3.17	160.402	50.7	6.1	309.27
3315	51.6	3.14	162.024	51.3	2.9	148.77
3320	51.6	3.16	163.056	51.3	3.5	179.55
3325	51.8	3.13	162.134	51.5	2.1	108.15
3330	51.6	3.15	162.54	51.4	1.6	82.24
3335	51.5	3.18	163.77	51.2	1.1	56.32
3340	52	3.18	165.36	51.6	4.7	242.52
3345	52.3	3.1	162.13	52	5.9	306.8
3350	50.6	3.14	158.884	50.3	7.8	392.34
3355	51	3.14	160.14	50.7	5.9	299.13
3360	52.1	3.07	159.947	51.8	5.1	264.18
3365	52.3	3.11	162.653	52.8	6.2	327.36
3370	52.4	3.11	162.964	52.1	6.4	333.44
3375	51.3	3.13	160.569	51.3	6	307.8
3380	52	3.1	161.2	51.7	5.9	305.03
3385	52.3	3.08	161.084	51.9	6.1	316.59
3390	50.9	3.12	158.808	50.6	2.4	121.44
3395	51.1	3.06	156.366	50.8	-0.2	-10.16
3400	52.1	3.03	157.863	51.8	5.6	290.08
3405	51.7	3.11	160.787	51.4	3.4	174.76
3410	50.9	3.08	156.772	51.1	4.3	219.73
3415	51.9	3.08	159.852	51.6	6.1	314.76
3420	52.2	3.03	158.166	51.9	6.4	332.16
3425	51.1	3.06	156.366	50.8	3	152.4
3430	51.3	2.89	148.257	50.9	-0.2	-10.18
3435	51	3.01	153.51	50.1	9.3	465.93

3440	52.3	3.08	161.084	52	6.1	317.2
3445	51.7	3.13	161.821	51.4	-1.8	-92.52
3450	51.5	3.18	163.77	51	5.1	260.1
3455	52.3	3.16	165.268	52	6.5	338
3460	52.3	3.12	163.176	52	5.9	306.8
3465	50.9	3.16	160.844	50.6	3.4	172.04
3470	51.1	3.1	158.41	50.9	1.2	61.08
3475	52.1	3.08	160.468	51.8	6	310.8
3480	51.5	3.09	159.135	51.2	2.3	117.76
3485	51.8	3.05	157.99	51.5	3.3	169.95
3490	51.4	3	154.2	51.1	2.3	117.53
3495	52.3	3	156.9	52	6.3	327.6
3500	51.3	3	153.9	50.9	-0.7	-35.63
3505	51.2	2.99	153.088	50.9	1.6	81.44
3510	52.1	2.92	152.132	51.8	5.9	305.62
3515	52.1	3.01	156.821	51.8	6.1	315.98
3520	51.2	3	153.6	50.6	0.6	30.36
3525	51.9	2.95	153.105	51.6	6.2	319.92
3530	52.2	2.96	154.512	51.9	5.5	285.45
3535	52	2.85	148.2	51.7	5	258.5
3540	49.7	2.94	146.118	49.9	0.6	29.94
3545	51.5	3	154.5	51.2	5.2	266.24
3550	50.4	3.07	154.728	50	-1.9	-95
3555	49.7	2.96	147.112	49.4	5.6	276.64
3560	50.8	2.85	144.78	50.5	7.6	383.8
3565	50.5	2.61	131.805	50.1	2.9	145.29
3570	51.6	2.95	152.22	51.3	3.1	159.03
3575	51.9	1.79	92.901	51.7	5.1	263.67
3580	50	2.78	139	49.8	7.7	383.46
3585	51.1	2.6	132.86	50.9	-0.2	-10.18
3590	51.3	2.66	136.458	50.9	1.7	86.53
3595	51	0.63	32.13	50.7	1.9	96.33
3600	51.1	1.09	55.699	50.9	0.6	30.54
3605	50.8	2.17	110.236	50.5	2	101
3610	50.8	0.94	47.752	50.5	0.1	5.05
3615	51.1	2.66	135.926	50.8	4.9	248.92
3620	51	2.82	143.82	50.6	1.7	86.02
3625	50.5	0.43	21.715	50.2	2.4	120.48
3630	50.7	0.5	25.35	50.4	0.4	20.16
3635	50.6	0.34	17.204	50.4	0.8	40.32
3640	50.6	0.29	14.674	50.4	1	50.4
3645	50.5	0.35	17.675	50.3	2.1	105.63
3650	50.9	2.74	139.466	50.6	0	0
3655	50.7	0.97	49.179	50.5	1.4	70.7

3660	51.3	0.52	26.676	51.1	3.4	173.74
3665	51.4	0.51	26.214	51.1	3.4	173.74
3670	52	2.77	144.04	51.7	5.9	305.03
3675	51.7	2.84	146.828	51.4	3.4	174.76
3680	52.1	2.73	142.233	51.7	4.9	253.33
3685	50.8	0.38	19.304	50.2	1.9	95.38
3690	50.2	0.52	26.104	50	3.4	170
3695	51.1	0.36	18.396	50.9	1.2	61.08
3700	50.3	0.45	22.635	50	5.7	285
3705	50.9	0.58	29.522	50.6	0.6	30.36
3710	52	2.98	154.96	51.7	4.7	242.99
3715	50.4	3.01	151.704	50.1	3.5	175.35
3720	51.7	2.98	154.066	51.4	3.3	169.62
3725	51.7	3	155.1	51.2	5.9	302.08
3730	51.1	3.03	154.833	50.8	3.1	157.48
3735	50.9	2.96	150.664	50.6	1.1	55.66
3740	50.9	2.98	151.682	50.6	0.6	30.36
3745	50.9	2.94	149.646	50.6	-1	-50.6
3750	52	2.95	153.4	51.7	5.8	299.86
3755	51	0.56	28.56	50.8	2.5	127
3760	51.4	0.53	27.242	51.1	3.7	189.07
3765	50.6	2.74	138.644	50.4	0.5	25.2
3770	51.3	0.49	25.137	51.1	3.3	168.63
3775	51.3	0.36	18.468	51.1	3.5	178.85
3780	51.6	1.16	59.856	51.3	4.3	220.59
3785	50.8	2.83	143.764	50.5	-0.2	-10.1
3790	50.6	0.52	26.312	50.2	0.7	35.14
3795	50.5	0.51	25.755	50.3	0.7	35.21
3800	50.9	2.95	150.155	50.6	-0.7	-35.42
3805	50.5	0.23	11.615	50.3	0.4	20.12
3810	50.6	0.3	15.18	50.3	0.5	25.15
3815	50.5	0.26	13.13	50.2	0.7	35.14
3820	50.4	0.22	11.088	50.1	5.6	280.56
3825	50.2	0.31	15.562	50	0.6	30
3830	50.4	0.25	12.6	50.1	2.7	135.27
3835	50.5	0.49	24.745	50.1	2.9	145.29
3840	49.4	0.39	19.266	49.1	6.3	309.33
3845	50.5	0.4	20.2	50.3	2.1	105.63
3850	50.4	0.36	18.144	50.1	1.6	80.16
3855	50.5	0.43	21.715	50.3	3.9	196.17
3860	51	2.44	124.44	49.9	7.3	364.27
3865	50.8	2.91	147.828	50.5	2.2	111.1
3870	50.9	2.89	147.101	50.6	4.5	227.7
3875	52	2.88	149.76	51.8	5.9	305.62

3880	51.9	2.78	144.282	51.6	2.6	134.16
3885	50.1	2.87	143.787	49.8	3.2	159.36
3890	49.7	2.76	137.172	49.3	0.5	24.65
3895	51.1	2.74	140.014	50.8	4	203.2
3900	52	2.74	142.48	51.1	9	459.9
3905	51	0.62	31.62	50.7	3.5	177.45
3910	49.7	2.82	140.154	49.5	7.5	371.25
3915	51.6	2.84	146.544	51.4	9.6	493.44
3920	50.9	2.78	141.502	50.6	4.2	212.52
3925	51.9	2.85	147.915	51.7	9.6	496.32
3930	48.5	2.68	129.98	48.3	16.8	811.44
3935	50.9	2.97	151.173	50.5	4.8	242.4
3940	51.9	2.8	145.32	51.6	9.4	485.04
3945	52.2	2.97	155.034	51.8	4.7	243.46
3950	51.8	3.02	156.436	51.5	9.8	504.7
3955	52	3.05	158.6	51	8.6	438.6
3960	52	3.09	160.68	51.7	9.3	480.81
3965	50.4	2.78	140.112	50.1	-0.7	-35.07
3970	51.7	2.87	148.379	51.4	2.9	149.06
3975	52	2.86	148.72	51.7	9.5	491.15
3980	50.2	2.93	147.086	49.8	-1.4	-69.72
3985	51.1	2.84	145.124	50.7	3.3	167.31
3990	52	2.93	152.36	51.7	9.7	501.49
3995	51.7	2.92	150.964	51.4	5.7	292.98
4000	51.1	2.95	150.745	50.9	2.3	117.07
4005	51.2	2.46	125.952	50.9	4.2	213.78
4010	52.1	2.9	151.09	51.8	9.2	476.56
4015	51.5	2.9	149.35	51.2	5.5	281.6
4020	51.2	2.9	148.48	50.9	4	203.6
4025	51.1	2.89	147.679	50.9	5.6	285.04
4030	51.8	2.98	154.364	51.5	8.6	442.9
4035	51.6	2.9	149.64	51.2	5.6	286.72
4040	50.7	2.87	145.509	50.3	-1	-50.3
4045	51.8	2.86	148.148	51.5	5.2	267.8
4050	52	2.87	149.24	52.8	6.7	353.76
4055	51.5	2.94	151.41	51.2	4.8	245.76
4060	52.1	2.93	152.653	51.8	9.7	502.46
4065	51.8	2.83	146.594	51.6	7.5	387
4070	52.2	2.92	152.424	51.9	9.7	503.43
4075	51.3	2.9	148.77	51	3.7	188.7
4080	50.8	2.92	148.336	50.5	-1	-50.5
4085	51.4	2.87	147.518	51.1	6.4	327.04
4090	51.5	2.85	146.775	51.2	5.6	286.72
4095	51.9	2.93	152.067	51.6	9.3	479.88

4100	52.2	2.94	153.468	51.9	8.7	451.53
4105	51.5	2.9	149.35	51.2	6	307.2
4110	51.1	2.92	149.212	50.8	3.8	193.04
4115	51.9	2.9	150.51	51.6	9.7	500.52
4120	52.2	2.89	150.858	52	9.6	499.2
4125	51.2	2.93	150.016	50.8	-0.6	-30.48
4130	51.2	2.92	149.504	51	2.4	122.4
4135	52.2	3.01	157.122	51.9	9.5	493.05
4140	51	3.09	157.59	52	4.5	234
4145	51.8	2.94	152.292	51.5	8.6	442.9
4150	51.8	2.93	151.774	51.6	9.2	474.72
4155	52.1	2.81	146.401	51.8	2.9	150.22
4160	49.8	2.55	126.99	49.5	5.5	272.25
4165	51.8	2.87	148.666	51.5	9.4	484.1
4170	51.7	0.64	33.088	51.5	7.3	375.95
4175	50.5	2.77	139.885	50.1	4.1	205.41
4180	50.5	2.7	136.35	50.2	0.3	15.06
4185	51.4	2.58	132.612	51	1.6	81.6
4190	50.7	0.86	43.602	50.5	0.9	45.45
4195	50.5	0.48	24.24	50.3	0.6	30.18
4200	50.5	0.48	24.24	50.3	1.2	60.36
4205	50.8	2.61	132.588	50.5	2.6	131.3
4210	50.5	2.6	131.3	50.2	2.8	140.56
4215	50.2	0.37	18.574	49.9	0.7	34.93
4220	50.3	0.3	15.09	50	0.6	30
4225	50.1	0.31	15.531	49.9	2.5	124.75
4230	50.4	2.48	124.992	50.2	0.7	35.14
4235	50.2	1.39	69.778	50	0.6	30
4240	51.4	2.57	132.098	50.7	7.2	365.04
4245	51.4	0.52	26.728	51.2	5.3	271.36
4250	51.9	2.47	128.193	51.6	7.3	376.68
4255	50.6	2.49	125.994	50.3	3.3	165.99
4260	51.3	0.32	16.416	51.1	5.3	270.83
4265	50.2	0.41	20.582	49.9	2.2	109.78
4270	51.3	0.69	35.397	51	5.6	285.6
4275	51.3	0.3	15.39	51.1	5.2	265.72
4280	50.6	0.56	28.336	50.4	1.1	55.44
4285	50.8	1.08	54.864	50.4	1.6	80.64
4290	51.4	1.1	56.54	51.1	5.3	270.83
4295	49.2	2.65	130.38	48.8	10.5	512.4
4300	51.6	2.77	142.932	51.3	7.8	400.14
4305	51.8	2.12	109.816	51.5	7.6	391.4
4310	51.7	0.59	30.503	51.4	8.6	442.04
4315	52	1.41	73.32	51.7	1.2	62.04

4320	51.4	0.53	27.242	51.1	0.3	15.33
4325	49.4	0.39	19.266	49.3	12.4	611.32
4330	50.1	2.06	103.206	50	7.9	395
4335	49.6	0.47	23.312	49.4	3.1	153.14
4340	51.3	0.35	17.955	51	0.1	5.1
4345	51.5	2.68	138.02	51.1	2.4	122.64
4350	50.5	2.71	136.855	50.2	5.8	291.16
4355	50.5	0.56	28.28	50.3	5.4	271.62
4360	50.2	0.62	31.124	49.7	9.2	457.24
4365	50.1	0.68	34.068	49.9	6.1	304.39
4370	50.7	2.59	131.313	50.2	5.2	261.04
4375	50.4	0.31	15.624	50.2	4.7	235.94
4380	50.2	0.2	10.04	50	5.3	265
4385	50	0.25	12.5	49.8	7.3	363.54
4390	49.9	0.31	15.469	49.5	6.4	316.8
4395	50.1	0.34	17.034	50	6.4	320
4400	50.4	0.56	28.224	50.2	4	200.8
4405	50.2	0.42	21.084	50	5	250
4410	50.2	0.36	18.072	49.8	7.3	363.54
4415	50.9	0.38	19.342	50.4	3.3	166.32
4420	50.3	2.6	130.78	50.1	4.7	235.47
4425	51.2	2.73	139.776	50.9	1	50.9
4430	51.9	2.8	145.32	51.6	2.6	134.16
4435	50.1	2.81	140.781	49.9	2.7	134.73
4440	48.9	2.87	140.343	48.9	15.9	777.51
4445	51.6	2.91	150.156	51.3	2.6	133.38
4450	51.9	2.82	146.358	51.6	2.6	134.16
4455	51.1	2.9	148.19	50.9	2.5	127.25
4460	51.5	2.89	148.835	51.2	2.3	117.76
4465	51.1	2.95	150.745	50.7	2.9	147.03
4470	50.8	3	152.4	50.5	5	252.5
4475	51.2	2.87	146.944	50.9	1	50.9
4480	51.6	2.81	144.996	51.3	-0.3	-15.39
4485	51.5	2.85	146.775	51.2	-0.9	-46.08
4490	51.7	2.87	148.379	51	-2.7	-137.7
4495	51.5	2.88	148.32	51.2	0.1	5.12
4500	51.8	2.86	148.148	51.4	-1.8	-92.52
4505	50.8	2.81	142.748	50.6	5.6	283.36
4510	50.8	2.83	143.764	50.5	6.3	318.15
4515	51.9	3.1	160.89	51.6	-1.9	-98.04
4520	51.2	3	153.6	50.8	1.2	60.96
4525	49.7	3.03	150.591	49.8	6.8	338.64
4530	51.3	2.82	144.666	50.9	1.7	86.53
4535	51.4	2.8	143.92	50.9	-1.3	-66.17

4540	50.9	2.54	129.286	50.5	3.8	191.9
4545	50.4	2.88	145.152	50	5.6	280
4550	51.5	0.64	32.96	51.2	-0.4	-20.48
4555	49.7	2.76	137.172	49.3	5.6	276.08
4560	50.8	2.66	135.128	50.5	-0.6	-30.3
4565	50.5	2.36	119.18	50.2	6	301.2
4570	50.4	0.55	27.72	50.1	5.1	255.51
4575	50.4	0.52	26.208	50.1	4.8	240.48
4580	50.1	0.77	38.577	49.8	2.9	144.42
4585	50.1	2.55	127.755	49.8	7.3	363.54
4590	50.1	2.54	127.254	49.9	6.2	309.38
4595	50	0.37	18.5	49.7	7.6	377.72
4600	50.2	0.32	16.064	50	6.6	330
4605	50.1	0.26	13.026	49.9	7.2	359.28
4610	50	0.31	15.5	49.8	7.7	383.46
4615	50.2	1.24	62.248	50	5.6	280
4620	50	0.54	27	49.7	0.8	39.76
4625	51.3	0.51	26.163	51	0	0
4630	51.4	0.57	29.298	51.1	0.1	5.11
4635	51.1	2.62	133.882	50.8	-1.3	-66.04
4640	51.4	0.36	18.504	51.1	0.1	5.11
4645	49.3	0.39	19.227	49	3.1	151.9
4650	50.9	0.9	45.81	50.6	0	0
4655	51.3	0.29	14.877	51.1	0.1	5.11
4660	50.2	1.48	74.296	49.9	4.2	209.58
4665	51.2	0.63	32.256	51	0.1	5.1
4670	51.4	0.56	28.784	51.1	-0.2	-10.22
4675	52	2.73	141.96	51.7	2.3	118.91
4680	50.6	1.08	54.648	50.2	2.9	145.58
4685	50.6	0.51	25.806	50.3	5.1	256.53
4690	54.4	0.27	14.688	51.2	0.1	5.12
4695	50.8	2.48	125.984	50.5	4	202
4700	51	0.36	18.36	50.8	0.2	10.16
4705	50.8	2.37	120.396	50.5	2.1	106.05
4710	51	2.53	129.03	50.7	1.7	86.19
4715	51.2	2.06	105.472	50.9	0.2	10.18
4720	50	0.49	24.5	49.8	7.8	388.44
4725	50.1	0.45	22.545	49.9	6.8	339.32
4730	50	0.29	14.5	50.2	4.7	235.94
4735	50.3	0.44	22.132	50.1	5.9	295.59
4740	50.3	0.26	13.078	50.1	5.4	270.54
4745	50.3	0.24	12.072	50.1	4.8	240.48
4750	50.1	0.23	11.523	50	5.1	255
4755	50.2	0.3	15.06	49.8	6.3	313.74

4760	50.4	0.54	27.216	50.2	4	200.8
4765	50.3	0.37	18.611	50.1	4.6	230.46
4770	50.1	0.33	16.533	49	6.4	313.6
4775	50.5	0.4	20.2	50.2	3.9	195.78
4780	50.5	2.64	133.32	50.4	1.2	60.48
4785	50.4	2.8	141.12	50.1	4.8	240.48
4790	51.6	2.82	145.512	51.4	2.6	133.64
4795	51.9	2.7	140.13	51.7	-2	-103.4
4800	52	2.78	144.56	51.8	2.8	145.04
4805	50.3	2.88	144.864	50	5.1	255
4810	50.8	2.85	144.78	50.4	-1.9	-95.76
4815	51.8	2.81	145.558	51.5	2.8	144.2
4820	50.2	2.86	143.572	50.5	5.8	292.9
4825	52	3.03	157.56	51.7	3.2	165.44
4830	50.4	2.96	149.184	50.1	6.8	340.68
4835	51.2	2.83	144.896	50.8	-0.9	-45.72
4840	51.6	2.76	142.416	51.2	2.4	122.88
4845	51.9	2.88	149.472	51.6	2.9	149.64
4850	51.8	2.89	149.702	51.5	2.7	139.05
4855	50.7	2.9	147.03	50.4	4.8	241.92
4860	52	2.91	151.32	51.8	2.5	129.5
4865	52	2.88	149.76	51.8	2.9	150.22
4870	50.7	2.89	146.523	50.6	6.2	313.72
4875	51	2.86	145.86	50.7	2.1	106.47
4880	51.3	2.78	142.614	50.9	-0.7	-35.63
4885	51.9	2.81	145.839	51.7	2.4	124.08
4890	50.6	2.87	145.222	50.3	5	251.5
4895	50.9	2.85	145.065	50.7	2.8	141.96
4900	52	2.89	150.28	51.7	2.7	139.59
4905	51.1	2.85	145.635	50.8	3.7	187.96
4910	50.4	2.85	143.64	50.2	6.1	306.22
4915	51.7	2.83	146.311	51.3	2.5	128.25
4920	50.2	2.8	140.56	50	5.1	255
4925	51.7	2.85	147.345	51.4	2.6	133.64
4930	51.9	2.88	149.472	51.6	3.1	159.96
4935	51.6	2.89	149.124	51.5	2	103
4940	51.6	2.69	138.804	51.2	2.3	117.76
4945	51.2	2.19	112.128	50.9	-0.6	-30.54
4950	51.8	2.77	143.486	51.5	2.6	133.9
4955	50.2	2.8	140.56	49.8	10.4	517.92
4960	50.9	2.83	144.047	50.6	-1.8	-91.08
4965	51.7	2.84	146.828	51.4	2.9	149.06
4970	50	2.82	141	50.6	5.2	263.12
4975	50.5	2.19	110.595	50.8	2	101.6

4980	51.5	2.81	144.715	51.8	2.5	129.5
4985	51.8	2.79	144.522	51.5	2.4	123.6
4990	51	2.77	141.27	50.8	2.8	142.24
4995	51.4	2.77	142.378	51.1	-1.5	-76.65
5000	51.6	2.86	147.576	51.2	1.5	76.8
5005	51.9	2.81	145.839	51.6	2.8	144.48
5010	50.3	2.84	142.852	50	7.2	360
5015	50.6	2.82	142.692	50.7	0.6	30.42
5020	51.8	2.78	144.004	51.5	0.4	20.6
5025	51.2	2.78	142.336	50.8	-1.7	-86.36
5030	51.4	2.77	142.378	51.1	2.3	117.53
5035	50.8	2.83	143.764	50.5	2.8	141.4
5040	51.9	2.82	146.358	51.6	-2.7	-139.32
5045	50.6	2.82	142.692	50.2	6.5	326.3
5050	51	2.81	143.31	50.7	-1.7	-86.19
5055	51.8	2.79	144.522	51.5	2.4	123.6
5060	51.3	2.83	145.179	51	-1.1	-56.1
5065	51.5	2.79	143.685	51.3	2.9	148.77
5070	50.6	2.85	144.21	50.6	4.6	232.76
5075	49.2	2.88	141.696	48.9	7.1	347.19
5080	51.6	2.85	147.06	51.1	2.9	148.19
5085	49.6	2.86	141.856	49.3	10.6	522.58
5090	51	2.96	150.96	50.8	2.9	147.32
5095	51.6	3.01	155.316	51.3	2.8	143.64
5100	50	2.83	141.5	50.9	5.5	279.95
5105	51.6	2.83	146.028	51.3	-2.4	-123.12
5110	50.5	2.87	144.935	50.2	3.6	180.72
5115	51	2.84	144.84	50.8	2.8	142.24
5120	51.7	2.66	137.522	51.3	-2.5	-128.25
5125	50.6	2.64	133.584	50.3	3.7	186.11
5130	51.1	2.62	133.882	50.9	1.1	55.99
5135	50.7	2.55	129.285	50.5	3.2	161.6
5140	50.2	0.43	21.586	49.9	5.8	289.42
5145	49.9	0.37	18.463	49.6	8.8	436.48
5150	49.9	0.36	17.964	49.7	7.8	387.66
5155	51.1	0.45	22.995	50.8	-0.1	-5.08
5160	51.2	0.34	17.408	50.9	0.2	10.18
5165	49.7	0.47	23.359	49.5	8.6	425.7
5170	50.1	0.26	13.026	49.9	5.5	274.45
5175	49.9	0.28	13.972	49.1	6.9	338.79
5180	50.1	0.25	12.525	49.9	6.1	304.39
5185	50.3	0.28	14.084	50.1	3.6	180.36
5190	50.5	2.47	124.735	50.3	2.9	145.87
5195	50.5	0.49	24.745	50.2	2.9	145.58

5200	51.1	0.51	26.061	50.9	0.2	10.18
5205	50.5	0.46	23.23	50.3	0.6	30.18
5210	51	2.58	131.58	50.8	1	50.8
5215	51.2	0.33	16.896	51	-0.2	-10.2
5220	49.8	0.43	21.414	49.5	8.7	430.65
5225	51.2	0.37	18.944	51	0.4	20.4
5230	49.5	0.42	20.79	49.3	0.2	9.86
5235	51.1	2.34	119.574	50.5	0.2	10.1
5240	51.2	0.47	24.064	51	-0.1	-5.1
5245	50	0.33	16.5	49.9	9.1	454.09
5250	51.1	2.54	129.794	50.8	-1.8	-91.44
5255	51.5	2.65	136.475	51.2	-2.4	-122.88
5260	50.9	2.65	134.885	50.7	2.5	126.75
5265	49.8	0.51	25.398	49.6	9.8	486.08
5270	50.5	0.47	23.735	50.3	3.4	171.02
5275	51.1	0.27	13.797	50.9	0.2	10.18
5280	49.8	1.03	51.294	49.4	5.5	271.7
5285	51.2	0.63	32.256	51	0.2	10.2
5290	50.6	0.34	17.204	50.1	2.2	110.22
5295	50.4	2.38	119.952	49.8	1.8	89.64
5300	50.9	2.5	127.25	50.6	1.3	65.78
5305	50	0.42	21	49.8	6.2	308.76
5310	50.1	0.53	26.553	49.8	6.1	303.78
5315	49.9	0.48	23.952	49.6	7.5	372
5320	49.9	0.32	15.968	49.6	7.3	362.08
5325	50.2	0.26	13.052	50	3.9	195
5330	50	0.19	9.5	49.8	5	249
5335	50.3	0.23	11.569	50.1	3.4	170.34
5340	49.6	0.26	12.896	49.4	9	444.6
5345	50.8	0.24	12.192	50.5	0.9	45.45
5350	50.3	0.45	22.635	50.1	4.45	222.945
5355	50.2	0.34	17.068	50	3.7	185
5360	50.2	0.35	17.57	50	5.4	270
5365	50.1	0.31	15.531	49.8	5.7	283.86
5370	50.8	0.37	18.796	50.3	-0.1	-5.03
5375	50.3	0.47	23.641	49.7	10.1	501.97
5380	50.4	0.54	27.216	50.2	3.9	195.78
5385	51.5	2.63	135.445	51.2	-2	-102.4
5390	51.4	2.61	134.154	51	-0.4	-20.4
5395	51.7	2.62	135.454	51.4	-2.3	-118.22
5400	52.3	2.59	135.457	52	-2.1	-109.2
5405	50.4	2.55	128.52	50.1	5.9	295.59
5410	51.5	2.66	136.99	51.1	2.1	107.31
5415	51.8	2.63	136.234	51.5	-2.3	-118.45

5420	49.8	2.72	135.456	49.5	14.7	727.65
5425	51.4	2.95	151.63	51.1	-0.9	-45.99
5430	50.8	2.87	145.796	50.3	4.7	236.41
5435	50.4	2.83	142.632	50.7	10.1	512.07
5440	50.8	2.76	140.208	50.4	1.3	65.52
5445	51.6	2.67	137.772	51.3	-1.9	-97.47
5450	50.7	2.78	140.946	50.5	3.7	186.85
5455	50.2	2.79	140.058	50	5.9	295
5460	51.5	2.79	143.685	51.2	2.4	122.88
5465	51.8	2.79	144.522	51.5	-2.3	-118.45
5470	50.7	2.76	139.932	50.3	4.1	206.23
5475	51	2.16	110.16	50.6	1.7	86.02
5480	51.8	2.67	138.306	51.5	2.1	108.15
5485	50.5	2.77	139.885	50.2	5.5	276.1
5490	50.5	2.8	141.4	50.2	4	200.8
5495	51.4	2.78	142.892	51.2	2.4	122.88
5500	51.9	2.78	144.282	51.6	-2	-103.2
5505	50.8	2.78	141.224	50.5	4.8	242.4
5510	51.1	2.75	140.525	50.8	0.3	15.24
5515	51.7	2.65	137.005	51.4	1.9	97.66
5520	51.8	2.74	141.932	51.5	-2.3	-118.45
5525	49.8	2.75	136.95	49.5	11.9	589.05
5530	51.5	2.73	140.595	51.2	-1	-51.2
5535	51.6	2.89	149.124	51.3	-2.3	-117.99
5540	51.1	2.85	145.635	50.7	5.1	258.57
5545	49.3	2.71	133.603	49.1	4.3	211.13
5550	51.4	2.74	140.836	51.2	-2	-102.4
5555	50	2.57	128.5	49.8	6.6	328.68
5560	51.5	2.73	140.595	51.2	-2.3	-117.76
5565	51.8	2.6	134.68	51.5	-1.9	-97.85
5570	51.9	2.52	130.788	51.6	-1.8	-92.88
5575	51.3	2.49	127.737	50.4	4.5	226.8
5580	51	0.52	26.52	50.8	0.1	5.08
5585	50	2.31	115.5	50.4	3	151.2
5590	49.9	0.43	21.457	49.6	7.9	391.84
5595	50.6	0.4	20.24	50.4	1.9	95.76
5600	50.1	0.36	18.036	49.9	5.3	264.47
5605	50.1	0.48	24.048	50	5.7	285
5610	50.1	0.49	24.549	49.8	6.2	308.76
5615	49.9	0.29	14.471	49.6	7.4	367.04
5620	50	0.29	14.5	49.8	5.5	273.9
5625	50	0.26	13	49.8	5.9	293.82
5630	50.1	0.28	14.028	49.8	5.8	288.84
5635	50.2	1.5	75.3	50	4.7	235

5640	50	0.29	14.5	49.8	6.1	303.78
5645	51.3	2.45	125.685	51	1.7	86.7
5650	51.1	0.41	20.951	50.9	0.1	5.09
5655	50.2	0.41	20.582	50.4	5.9	297.36
5660	50.3	2.43	122.229	50.5	5.2	262.6
5665	51.4	1.82	93.548	51.1	-1.7	-86.87
5670	50.2	0.34	17.068	49.9	6.8	339.32
5675	50.5	2.4	121.2	50.1	4.2	210.42
5680	51.1	0.25	12.775	50.9	0.2	10.18
5685	50.1	0.46	23.046	49.9	5.6	279.44
5690	51.1	0.47	24.017	50.8	0.1	5.08
5695	51.4	0.66	33.924	51.1	-0.5	-25.55
5700	51.3	0.45	23.085	51.1	0.1	5.11
5705	50.5	2.54	128.27	50.2	2.5	125.5
5710	51.4	2.51	129.014	51.1	-1.7	-86.87
5715	49.9	0.45	22.455	49.6	6.8	337.28
5720	50.8	0.43	21.844	50.6	-0.1	-5.06
5725	51	0.24	12.24	50.8	0.1	5.08
5730	50.6	2.33	117.898	50.3	3.4	171.02
5735	49.5	0.36	17.82	49.3	10.8	532.44
5740	50.3	0.36	18.108	50	3.4	170
5745	49.7	2.3	114.31	49.5	7.4	366.3
5750	50	0.42	21	49.7	5.7	283.29
5755	49.9	0.42	20.958	49.7	6.5	323.05
5760	51.8	2.51	130.018	50.7	3.6	182.52
5765	49.9	0.22	10.978	49.6	5.7	282.72
5770	49.8	0.25	12.45	49.5	7.3	361.35
5775	49.3	0.16	7.888	49.1	0.6	29.46
5780	49.7	0.21	10.437	49.5	7.4	366.3
5785	49.7	0.23	11.431	49.5	7.2	356.4
5790	49.7	0.23	11.431	49.5	7.2	356.4
5795	49.8	0.24	11.952	49.6	0.1	4.96
5800	50.7	0.38	19.266	50.5	1.5	75.75
5805	49.9	0.36	17.964	49.7	6.7	332.99
5810	50.5	0.49	24.745	50.3	2.1	105.63
5815	50.6	2.47	124.982	50.7	-1.5	-76.05
5820	50.5	2.49	125.745	50.2	3.4	170.68
5825	51.4	2.48	127.472	51.1	-1.9	-97.09
5830	50.8	2.51	127.508	51.2	6.7	343.04
5835	51.1	2.5	127.75	50.8	-1.6	-81.28
5840	50.6	2.82	142.692	50.3	2.9	145.87
5845	51.5	2.53	130.295	51.1	-1.8	-91.98
5850	49.7	2.63	130.711	49.3	7.6	374.68
5855	51.4	2.65	136.21	51.1	-1.7	-86.87

5860	49.6	2.74	135.904	49.4	7	345.8
5865	51.3	2.66	136.458	51	-1	-51
5870	51.4	2.55	131.07	51.1	-1.5	-76.65
5875	51.1	2.62	133.882	50.9	-2	-101.8
5880	50.6	2.56	129.536	50.3	4.8	241.44
5885	50.7	2.59	131.313	50.4	2.3	115.92
5890	50.8	2.6	132.08	50.5	1.3	65.65
5895	51.6	2.57	132.612	51.3	-1.8	-92.34
5900	48.7	2.59	126.133	48.5	3.9	189.15
5905	49.7	2.57	127.729	49.5	7.2	356.4
5910	51.4	2.45	125.93	51.1	-1.5	-76.65
5915	51.6	2.51	129.516	51.3	-2	-102.6
5920	50	2.53	126.5	49.8	7.5	373.5
5925	51.4	2.55	131.07	51.2	4.2	215.04
5930	51.6	2.53	130.548	51.2	1.7	87.04
5935	49.8	2.57	127.986	49.4	9.7	479.18
5940	50	2.57	128.5	49.9	-1.1	-54.89
5945	51.5	2.48	127.72	51.2	-1.5	-76.8
5950	50.8	2.57	130.556	50.6	-0.3	-15.18
5955	50.7	2.51	127.257	49.8	8	398.4
5960	50.3	2.57	129.271	50.1	4.7	235.47
5965	51.4	2.61	134.154	51.1	-2.1	-107.31
5970	51.5	2.52	129.78	51.2	-2	-102.4
5975	50	2.55	127.5	49.6	-1.7	-84.32
5980	49.4	2.52	124.488	49.1	11.5	564.65
5985	51	2.5	127.5	50	-1.2	-60
5990	50	2.46	123	49.8	7.5	373.5
5995	51.5	2.49	128.235	51.1	2	102.2
6000	49.8	2.53	125.994	50.7	6.4	324.48
6005	51.4	2.58	132.612	51.1	-1.4	-71.54
6010	51.6	2.12	109.392	51.3	-1.8	-92.34
6015	49.2	2.55	125.46	48.8	1.1	53.68
6020	49.9	2.46	122.754	49.9	6.3	314.37
6025	51.3	2.26	115.938	50.9	-1.3	-66.17
6030	50.1	2.51	125.751	49.8	5.1	253.98
6035	51.4	2.46	126.444	51.1	-1.8	-91.98
6040	51.8	2.22	114.996	51.2	-1.7	-87.04
6045	49.1	2.32	113.912	48.8	6.1	297.68
6050	50.1	2.28	114.228	49.9	7.5	374.25
6055	50.6	2.24	113.344	50.3	2.3	115.69
6060	50.3	2.23	112.169	50	5.2	260
6065	50.2	2.22	111.444	49.9	5.3	264.47
6070	50.1	0.41	20.541	49.8	5	249
6075	49.7	0.36	17.892	49.8	8.2	408.36

6080	49.7	0.31	15.407	49.5	7.3	361.35
6085	50.2	4.3	215.86	49.9	5.6	279.44
6090	49.6	0.45	22.32	49.5	6.3	311.85
6095	50.5	0.32	16.16	50.4	3.3	166.32
6100	50.1	0.28	14.028	49.9	4.5	224.55
6105	50.2	0.28	14.056	50	5.6	280
6110	49.9	0.22	10.978	49.7	5.7	283.29
6115	50	0.23	11.5	49.7	6	298.2
6120	50	0.25	12.5	49.8	5	249
6125	50	0.59	29.5	49.8	5.4	268.92
6130	50.9	0.42	21.378	50.6	0.5	25.3
6135	51	0.42	21.42	50.7	1	50.7
6140	51.4	2.15	110.51	51.1	-1.1	-56.21
6145	51.6	2.23	115.068	50.3	3.4	171.02
6150	51.1	0.31	15.841	50.8	0.4	20.32
6155	49.2	0.37	18.204	49.1	7.6	373.16
6160	50.6	0.42	21.252	50.3	0.6	30.18
6165	49.3	0.25	12.325	49	2.3	112.7
6170	50	0.4	20	49.8	5.5	273.9
6175	50.9	1.32	67.188	50.6	-0.4	-20.24
6180	51.1	0.42	21.462	50.8	0.5	25.4
6185	51.1	0.4	20.44	50.9	0.5	25.45

TABLE 3: WITHOUT PANEL STATE

Time (Seconds)	Battery Current (Amperes)	Battery Voltage (Volts)	Power (Watts)
0	0	50.8	0
5	0.2	50.2	10.04
10	2.1	49.6	104.16
15	0	49.7	0
20	1.4	48.8	68.32
25	3.4	49.8	169.32
30	0.4	49.5	19.8
35	11.9	48.3	574.77
40	15	48.3	724.5
45	8.6	48.8	419.68
50	6.3	48.8	307.44
55	8.3	48.7	404.21
60	7.5	48.9	366.75
65	5.4	49	264.6

70	6.4	49	313.6
75	6.4	49	313.6
80	6	49	294
85	6.4	48.9	312.96
90	5.7	49	279.3
95	5.4	49	264.6
100	6.6	49	323.4
105	7.9	48.8	385.52
110	5.7	49.1	279.87
115	7.9	48.8	385.52
120	10.1	48.3	487.83
125	0.2	49.7	9.94
130	0.3	49.9	14.97
135	0.2	49.8	9.96
140	15.5	48.1	745.55
145	5.4	48.9	264.06
150	6.5	49	318.5
155	0.8	49.5	39.6
160	11.6	48.8	566.08
165	5.9	48.9	288.51
170	6.8	48.9	332.52
175	4.8	49.1	235.68
180	8.8	48.7	428.56
185	7.5	48.8	366
190	6.7	48.8	326.96
195	4.5	49.1	220.95
200	5.7	48.9	278.73
205	2.4	49.3	118.32
210	5.4	48.9	264.06
215	6.6	48.8	322.08
220	6.8	48.9	332.52
225	3.8	49.2	186.96
230	5.9	49.1	289.69
235	0.3	49.7	14.91
240	10	48.6	486
245	0.3	49.7	14.91
250	11.3	48.4	546.92
255	5.6	49	274.4
260	0.1	49.8	4.98
265	23.7	47.7	1130.49
270	6.5	48.9	317.85
275	2.7	49.3	133.11
280	12.5	48.3	603.75
285	9.2	49.2	452.64

290	0.2	49.7	9.94
295	8.9	48.5	431.65
300	5.6	49.1	274.96
305	6.2	48.9	303.18
310	0.1	49.3	4.93
315	8.1	48.6	393.66
320	7.7	48.7	374.99
325	1	49.5	49.5
330	7.6	48.7	370.12
335	9.1	48.5	441.35
340	5.7	48.8	278.16
345	5.7	48.8	278.16
350	6.7	48.7	326.29
355	5	48.9	244.5
360	4.5	48.9	220.05
365	6.4	48.8	312.32
370	0.4	49.7	19.88
375	8.4	48.7	409.08
380	6.6	48.7	321.42
385	6.4	48.7	311.68
390	0.2	49.7	9.94
395	0.1	49.8	4.98
400	6.6	48.9	322.74
405	9.5	48.6	461.7
410	6.7	48.8	326.96
415	5.4	48.9	264.06
420	3.4	49.1	166.94
425	8.6	48.6	417.96
430	6.8	48.7	331.16
435	5.5	48.8	268.4
440	7.4	48.6	359.64
445	5.9	48.7	287.33
450	6.9	48.8	336.72
455	5.4	48.8	263.52
460	5.9	48.8	287.92
465	4.5	48.9	220.05
470	5	48.9	244.5
475	6.4	48.8	312.32
480	0.2	49.7	9.94
485	0.3	49.8	14.94
490	9.4	48.6	456.84
495	0.3	49.7	14.91
500	8.5	48.6	413.1
505	0.3	49.6	14.88

510	11	47.9	526.9
515	4.4	49	215.6
520	1.2	49.5	59.4
525	15.6	47.9	747.24
530	0.7	49.9	34.93
535	2.4	49.2	118.08
540	10.1	48.2	486.82
545	5.7	48.8	278.16
550	16.3	48.3	787.29
555	7.8	48.7	379.86
560	3.5	49.1	171.85
565	7.5	48.5	363.75
570	5.7	48.8	278.16
575	9.5	48.3	458.85
580	8.3	48.5	402.55
585	3.2	48.9	156.48
590	7.5	48.6	364.5
595	7.7	48.7	374.99
600	4.3	49	210.7
605	7.3	48.6	354.78
610	6.4	48.6	311.04
615	11.2	48.4	542.08
620	5.2	48.6	252.72
625	8.3	48.3	400.89
630	1.3	49.5	64.35
635	1.3	49.4	64.22
640	4.5	48.8	219.6
645	4.2	48.8	204.96
650	1.3	49.6	64.48
655	1.5	49.7	74.55
660	1.6	49.5	79.2
665	3.1	49	151.9
670	14.4	47.8	688.32
675	5.7	48.6	277.02
680	4.2	48.7	204.54
685	1	49.4	49.4
690	9.2	48.4	445.28
695	7.8	48.2	375.96
700	3.8	48.7	185.06
705	6.5	48.5	315.25
710	5.2	48.5	252.2
715	5.9	48.5	286.15
720	4.6	48.6	223.56
725	4.3	48.7	209.41

730	4.5	48.7	219.15
735	5.3	48.7	258.11
740	4.6	48.8	224.48
745	5.2	48.6	252.72
750	1.3	49.5	64.35
755	4.4	48.8	214.72
760	7.3	48.5	354.05
765	1.2	49.6	59.52
770	0.2	49.3	9.86
775	1.2	49.5	59.4
780	7	48.3	338.1
785	0.7	49.4	34.58
790	1.4	49	68.6
795	6.9	48.5	334.65
800	7.7	49.4	380.38
805	0.6	49.2	29.52
810	1.7	48.9	83.13
815	1	49.3	49.3
820	10	47.7	477
825	5	48.6	243
830	1	49.3	49.3
835	8.4	48.1	404.04
840	3.5	48.4	169.4
845	6.9	48.4	333.96
850	6.7	48.4	324.28
855	7.5	48.3	362.25
860	6.2	48.5	300.7
865	4.5	48.6	218.7
870	6.7	48.3	323.61
875	5.9	48.5	286.15
880	4.6	48.5	223.1
885	4.8	48.6	233.28
890	6.2	48.6	301.32
895	7.5	48.3	362.25
900	3.9	48.8	190.32
905	6.8	48.4	329.12
910	7.5	48.3	362.25
915	1.3	49.5	64.35
920	1.3	49.6	64.48
925	15.6	47.2	736.32
930	6.5	48.3	313.95
935	5	48.5	242.5
940	0.6	49.2	29.52
945	5.4	48.4	261.36

950	4.1	48.6	199.26
955	4.2	48.6	204.12
960	5.2	48.5	252.2
965	4	48.5	194
970	4.6	49.4	227.24
975	0.6	49.5	29.7
980	3.5	48.9	171.15
985	5.3	48.8	258.64
990	3.1	48.8	151.28
995	1.2	49.5	59.4
1000	1.3	49.2	63.96
1005	1.5	49.4	74.1
1010	9.8	48	470.4
1015	2.4	48.9	117.36
1020	3.9	48.9	190.71
1025	5.3	48.5	257.05
1030	3.6	48.8	175.68
1035	4.8	48.1	230.88
1040	4.5	48.6	218.7
1045	3.7	49.1	181.67
1050	5.2	48.4	251.68
1055	3	48.5	145.5
1060	13.6	47.5	646
1065	6.2	48.2	298.84
1070	4.3	48.5	208.55
1075	4.5	48.6	218.7
1080	6.2	48.3	299.46
1085	5.6	48.4	271.04
1090	0.2	49	9.8
1095	6.9	48.2	332.58
1100	6.8	48.1	327.08
1105	8.3	48.1	399.23
1110	9	47.8	430.2
1115	8.4	47.3	397.32
1120	0.6	49.2	29.52
1125	1.2	49.4	59.28
1130	13	47.4	616.2
1135	5.9	48.2	284.38
1140	4.5	48.5	218.25
1145	2.8	48.6	136.08
1150	3.2	48	153.6
1155	4.6	48.3	222.18
1160	5	48.3	241.5
1165	4.5	48.4	217.8

1170	5.4	48.1	259.74
1175	5.6	48.2	269.92
1180	0.5	49.2	24.6
1185	1.5	49.2	73.8
1190	5	48.3	241.5
1195	4.6	48.5	223.1
1200	5.4	48.4	261.36
1205	4.8	48.5	232.8
1210	1.8	48.9	88.02
1215	10.8	48.1	519.48
1220	5.4	48.4	261.36
1225	0.3	49.2	14.76
1230	0.4	49.1	19.64
1235	1.1	49.1	54.01
1240	15.5	48.7	754.85
1245	7.2	47.8	344.16
1250	3.7	49.2	182.04
1255	4	49.4	197.6
1260	4.1	49.5	202.95
1265	0.3	49.8	14.94
1270	13.5	48	648
1275	8.1	48.3	391.23
1280	7.8	48.4	377.52
1285	3.7	48.8	180.56
1290	6.4	48.5	310.4
1295	7.6	48.4	367.84
1300	0.4	49.3	19.72
1305	6.9	48.2	332.58
1310	3.7	48	177.6
1315	10.5	48.4	508.2
1320	2.7	48.8	131.76
1325	5.9	48.4	285.56
1330	10.6	48	508.8
1335	10.3	48.1	495.43
1340	6.3	48.4	304.92
1345	7.5	48.4	363
1350	7	48.4	338.8
1355	7.2	48.2	347.04
1360	5	48.4	242
1365	6.2	48.5	300.7
1370	6	48.6	291.6
1375	6.7	48.3	323.61
1380	7.5	48.3	362.25
1385	5.7	48.6	277.02

1390	6.9	48.4	333.96
1395	7.5	48.3	362.25
1400	7.3	48.2	351.86
1405	0.7	49.2	34.44
1410	14.9	48	715.2
1415	8.1	48.1	389.61
1420	5.6	48.4	271.04
1425	5.3	48.5	257.05
1430	2.6	48.9	127.14
1435	8.2	48.2	395.24
1440	3.2	48.7	155.84
1445	3.3	48.6	160.38
1450	13.6	47.8	650.08
1455	5.8	48.4	280.72
1460	5.2	48.5	252.2
1465	3.8	48.6	184.68
1470	4.5	48.6	218.7
1475	7.2	48.3	347.76
1480	7.5	48.2	361.5
1485	5.9	48.4	285.56
1490	5.4	48.4	261.36
1495	5.3	48.4	256.52
1500	0.6	48.8	29.28
1505	4.6	49	225.4
1510	9.6	48.4	464.64
1515	3.7	48.8	180.56
1520	7.3	48.3	352.59
1525	0.9	49	44.1
1530	11.4	47.9	546.06
1535	5.1	48.4	246.84
1540	16.1	48.1	774.41
1545	13.2	47.6	628.32
1550	6.8	48.3	328.44
1555	2	48.8	97.6
1560	7.5	48.1	360.75
1565	0.4	49	19.6
1570	6.1	48.7	297.07
1575	2	48.8	97.6
1580	0.2	48.7	9.74
1585	7.3	48.2	351.86
1590	3.5	48.6	170.1
1595	8.1	48.1	389.61
1600	8.3	48.1	399.23
1605	7.6	48.1	365.56

1610	5.6	48.4	271.04
1615	6.1	48.5	295.85
1620	7.3	48.3	352.59
1625	5.2	48.4	251.68
1630	7.2	48.3	347.76
1635	4.2	48.5	203.7
1640	5.2	48.5	252.2
1645	6.3	48.4	304.92
1650	7.3	48.2	351.86
1655	7.3	48.4	353.32
1660	7.4	48.3	357.42
1665	6.1	48.3	294.63
1670	3.9	48.7	189.93
1675	5.4	48.7	262.98
1680	9.2	47.9	440.68
1685	0.6	49.1	29.46
1690	1.7	48.9	83.13
1695	0.6	48.8	29.28
1700	0.6	49.1	29.46
1705	10.5	47.8	501.9
1710	2	48.6	97.2
1715	14.7	47.6	699.72
1720	7.3	48.1	351.13
1725	6.2	48.3	299.46
1730	4.6	48.4	222.64
1735	0.4	49.2	19.68
1740	13.2	48	633.6
1745	6.4	48.2	308.48
1750	1.7	48.1	81.77
1755	3.8	48.9	185.82
1760	5.4	48.2	260.28
1765	3.6	48	172.8
1770	6.2	48.2	298.84
1775	5.3	48.3	255.99
1780	5.4	48.4	261.36
1785	7.6	48.1	365.56
1790	6.4	48.5	310.4
1795	7.2	48	345.6
1800	5.9	48.2	284.38
1805	0.7	49.1	34.37
1810	0.6	49.1	29.46
1815	0.7	49.1	34.37
1820	4.2	48.5	203.7
1825	13.5	47.7	643.95

1830	4.1	48.5	198.85
1835	15.3	48.4	740.52
1840	3.1	48.3	149.73
1845	0.4	49.1	19.64
1850	15.1	47.4	715.74
1855	0.7	48.8	34.16
1860	0.7	48.8	34.16
1865	0.9	49	44.1
1870	6.3	48.3	304.29
1875	6.3	48.5	305.55
1880	12.2	47.7	581.94
1885	5.3	48.3	255.99
1890	3.2	48.8	156.16
1895	8.3	47.8	396.74
1900	5.7	48.2	274.74
1905	11	47.7	524.7
1910	9.2	47.8	439.76
1915	6.9	48.1	331.89
1920	6.3	48.2	303.66
1925	4.3	47.6	204.68
1930	1.2	48.2	57.84
1935	1.5	48.3	72.45
1940	3.9	48.6	189.54
1945	4.5	48.2	216.9
1950	1.8	48	86.4
1955	13.8	47.2	651.36
1960	0.7	48.2	33.74
1965	0.3	48	14.4
1970	7.1	49	347.9
1975	7.2	48.9	352.08
1980	9.1	46.9	426.79
1985	0.6	48	28.8
1990	2.3	48.2	110.86
1995	7.3	48.9	356.97
2000	2.6	47.8	124.28
2005	2.1	48.3	101.43
2010	6	47.5	285
2015	0.6	48.1	28.86
2020	6.4	48.5	310.4
2025	1.8	48.2	86.76
2030	1.7	48.2	81.94
2035	3.7	48.3	178.71
2040	2	48.2	96.4
2045	0.3	47.9	14.37

2050	2.4	48.3	115.92
2055	1.7	48.2	81.94
2060	3.5	48.3	169.05
2065	6.7	48.7	326.29
2070	6	48.3	289.8
2075	6.1	48.9	298.29
2080	3.5	48.5	169.75
2085	6.1	48.9	298.29
2090	7	48.8	341.6
2095	6.6	49	323.4
2100	5.6	47.3	264.88
2105	5.2	48.2	250.64
2110	9.1	47.3	430.43
2115	7.5	48.8	366
2120	2.7	47.6	128.52
2125	4.9	48.6	238.14
2130	3.5	47.7	166.95
2135	2.6	48.3	125.58
2140	3.6	48.4	174.24
2145	0.3	47.8	14.34
2150	6.7	48.8	326.96
2155	4	48.3	193.2
2160	6.2	48.8	302.56
2165	0.5	48.8	24.4
2170	0.5	48	24
2175	5.2	48.5	252.2
2180	4.3	48.5	208.55
2185	2.9	48.4	140.36
2190	1.5	48.3	72.45
2195	2.1	48.3	101.43
2200	0.7	48.2	33.74
2205	2.6	48.3	125.58
2210	1.5	48.2	72.3
2215	6.1	47.2	287.92
2220	3.1	48.2	149.42
2225	1.3	47.9	62.27
2230	6.7	48.8	326.96
2235	1.4	48	67.2
2240	3.1	48	148.8
2245	3.1	48.2	149.42
2250	3.4	48.1	163.54
2255	1.3	47.9	62.27
2260	6.4	48.4	309.76
2265	3.4	48.2	163.88

2270	1.2	48	57.6
2275	2.4	48	115.2
2280	6.3	48.6	306.18
2285	1.5	48.2	72.3
2290	0.5	47.9	23.95
2295	3.4	48.2	163.88
2300	6.3	48.8	307.44
2305	1.4	48.1	67.34
2310	6.1	48.7	297.07
2315	3.6	47.8	172.08
2320	3.1	48.3	149.73
2325	6.9	48.8	336.72
2330	7.1	48.6	345.06
2335	6.7	48.6	325.62
2340	2.7	47.6	128.52
2345	7.5	48.7	365.25
2350	3.5	47.4	165.9
2355	3.4	48.2	163.88
2360	4.2	48.9	205.38
2365	0.4	47.7	19.08
2370	1.5	48.1	72.15
2375	1.2	47.6	57.12
2380	2	48.1	96.2
2385	3.2	48	153.6
2390	2.3	47.6	109.48
2395	0.6	47.7	28.62
2400	2.1	48.1	101.01
2405	1.7	48.1	81.77
2410	1.1	47.9	52.69
2415	1.6	48	76.8
2420	0.3	47.8	14.34
2425	0.2	47.9	9.58
2430	1.7	48	81.6
2435	5.1	48.5	247.35
2440	0.8	48	38.4
2445	5	48.5	242.5
2450	7.1	48.8	346.48
2455	7	48.8	341.6
2460	3.5	48.3	169.05
2465	1.5	48	72
2470	1	48.6	48.6
2475	1.1	48.9	53.79
2480	1.2	48.9	58.68
2485	2.5	47.4	118.5

2490	0.8	47.6	38.08
2495	6.7	48.7	326.29
2500	1.3	48	62.4
2505	2.3	47.5	109.25
2510	0.8	47.6	38.08
2515	0.3	47.6	14.28
2520	0.4	47.8	19.12
2525	1	47.9	47.9
2530	1.2	47.9	57.48
2535	1.3	47.9	62.27
2540	0.8	47.9	38.32
2545	1.3	47.8	62.14
2550	6.8	48.6	330.48
2555	5.7	48.1	274.17
2560	1.5	48	72
2565	1.1	48.1	52.91
2570	2.9	47.8	138.62
2575	0.9	48.2	43.38
2580	1	47.7	47.7
2585	6.7	48.8	326.96
2590	1.13	47.6	53.788
2595	2.9	48.5	140.65
2600	2.6	48.5	126.1
2605	18.7	47.8	893.86
2610	8.2	47.7	391.14
2615	4.2	48	201.6
2620	7.3	48.9	356.97
2625	2	48.5	97
2630	4.8	48.1	230.88
2635	5.6	48	268.8
2640	3.3	48.1	158.73
2645	3	48.3	144.9
2650	9.5	48	456
2655	0.2	48.2	9.64
2660	0.2	48.9	9.78
2665	3.6	48.6	174.96
2670	2.9	48.6	140.94
2675	7.4	47.8	353.72
2680	10	46.5	465
2685	6.7	46.3	310.21
2690	13	46.9	609.7
2695	8.4	47.3	397.32
2700	11.7	47.5	555.75
2705	0.1	48.4	4.84

2710	7.3	47.3	345.29
2715	0.3	48.5	14.55
2720	2.7	46.1	124.47
2725	5.6	46.3	259.28
2730	6.7	48.5	324.95
2735	8.8	47.2	415.36
2740	5.3	46.6	246.98
2745	0.7	46.9	32.83
2750	13.5	47	634.5
2755	0.2	48.3	9.66
2760	4.3	47.4	203.82
2765	0.2	48.3	9.66
2770	7.3	46.3	337.99
2775	6.9	46.2	318.78
2780	9.6	47	451.2
2785	0.2	48.3	9.66
2790	5.7	45	256.5
2795	0.6	48.3	28.98
2800	0.5	48.1	24.05
2805	0.2	48.5	9.7
2810	3.8	48.8	185.44
2815	0.7	48.4	33.88
2820	0.2	48.3	9.66
2825	0.3	48.5	14.55
2830	5.4	47.4	255.96
2835	0.4	48.2	19.28
2840	10.6	46.8	496.08
2845	4.4	46.1	202.84
2850	1.3	46.3	60.19
2855	11.6	46.4	538.24
2860	0.2	47.9	9.58
2865	4.7	47.8	224.66
2870	0.2	48.4	9.68
2875	9.3	47.1	438.03
2880	0.2	48.3	9.66
2885	8.3	47.1	390.93
2890	10.3	46.9	483.07
2895	12.2	46.8	570.96
2900	6.3	46.8	294.84
2905	9.2	46.9	431.48
2910	5.8	46.9	272.02
2915	9.8	46.8	458.64
2920	0.2	48.2	9.64
2925	8.7	48.4	421.08

2930	0.2	48.4	9.68
2935	7.6	47.5	361
2940	0.2	48.4	9.68
2945	2.8	47.2	132.16
2950	0.2	48.4	9.68
2955	12.4	45.7	566.68
2960	11.1	48.8	541.68
2965	1.1	48.2	53.02
2970	0.3	48.1	14.43
2975	11.6	46.5	539.4
2980	9.2	47.1	433.32
2985	0.4	48.2	19.28
2990	10.3	46.8	482.04
2995	7.7	47.8	368.06
3000	11.2	46.7	523.04
3005	8	47.1	376.8
3010	7.9	45.4	358.66
3015	6.7	46.3	310.21
3020	8.7	47	408.9
3025	13.4	46.4	621.76
3030	5.3	46.7	247.51
3035	8.8	46.8	411.84
3040	0.3	48	14.4
3045	1.1	48.2	53.02
3050	0.1	48	4.8
3055	4.8	48.2	231.36
3060	12.2	46.6	568.52
3065	6.4	47	300.8
3070	0.3	48.2	14.46
3075	6.1	47.3	288.53
3080	8.1	47	380.7
3085	6.1	46.9	286.09
3090	7.3	47.2	344.56
3095	0.2	48.3	9.66
3100	7.3	47.2	344.56
3105	7.8	47.2	368.16
3110	7.4	47.1	348.54
3115	8.2	47	385.4
3120	5.4	46.9	253.26
3125	9.8	46.9	459.62
3130	6.1	47.3	288.53
3135	7.7	47.2	363.44
3140	7.3	47.3	345.29
3145	6	47.1	282.6

3150	0.2	48.2	9.64
3155	0.2	48.3	9.66
3160	8.3	47	390.1
3165	5.8	47.5	275.5
3170	2.5	47.9	119.75
3175	0.3	47.6	14.28
3180	0.1	48.2	4.82
3185	5	47.5	237.5
3190	12.5	45.5	568.75
3195	0.2	48.8	9.76
3200	0.4	48.2	19.28
3205	11.2	46.6	521.92
3210	5.9	47.2	278.48
3215	7.8	46.7	364.26
3220	6	47.2	283.2
3225	0.2	48.1	9.62
3230	11.1	46.7	518.37
3235	10.2	46.4	473.28
3240	6.4	47.2	302.08
3245	5.1	47.4	241.74
3250	8.3	47.2	391.76
3255	10.4	46.8	486.72
3260	7.3	47.1	343.83
3265	7.6	47.1	357.96
3270	7.4	47.2	349.28
3275	9.3	46.7	434.31
3280	9.4	46.8	439.92
3285	0.1	48.1	4.81
3290	10.3	46.8	482.04
3295	9.8	46.7	457.66
3300	8.8	46.9	412.72
3305	0.1	48.1	4.81
3310	8.3	46.5	385.95
3315	10.1	46.5	469.65
3320	8.4	46.8	393.12
3325	0.2	47.6	9.52
3330	13.2	46.5	613.8
3335	8.2	46.8	383.76
3340	7.8	47.3	368.94
3345	6.4	47.1	301.44
3350	9.5	46.7	443.65
3355	7.8	46.9	365.82
3360	7.6	47	357.2
3365	7	46.9	328.3

3370	7.8	46.8	365.04
3375	5.7	47.2	269.04
3380	7.4	47.1	348.54
3385	6.3	47	296.1
3390	0.1	48	4.8
3395	8.9	47	418.3
3400	8	47	376
3405	5.4	47.4	255.96
3410	2.9	47.5	137.75
3415	0.1	48.1	4.81
3420	4.8	47.4	227.52
3425	7.3	47	343.1
3430	6.9	47.6	328.44
3435	0.1	48.1	4.81
3440	12.6	46.5	585.9
3445	1.5	47.6	71.4
3450	8.2	47	385.4
3455	6.7	47.1	315.57
3460	0.3	48.1	14.43
3465	6.9	47	324.3
3470	4.6	47.5	218.5
3475	10.9	46.6	507.94
3480	6.9	47	324.3
3485	12.3	46	565.8
3490	7.8	46.4	361.92
3495	8.9	46.8	416.52
3500	7.6	46.9	356.44
3505	7.8	46.9	365.82
3510	1.7	47	79.9
3515	2.1	47	98.7
3520	6.9	47.6	328.44
3525	0.5	46.7	23.35
3530	5.7	47	267.9
3535	5.2	46.6	242.32
3540	1	46.7	46.7
3545	9.2	46.3	425.96
3550	6.3	46.2	291.06
3555	0.3	47.4	14.22
3560	12.4	45.9	569.16
3565	8.9	46.2	411.18
3570	6.8	46.1	313.48
3575	8.2	46.3	379.66
3580	9.2	46.1	424.12
3585	0.2	47.4	9.48

3590	12.7	45.7	580.39
3595	7.3	46.2	337.26
3600	0.3	47.2	14.16
3605	7.6	46.5	353.4
3610	0.2	47.5	9.5
3615	16.4	45.3	742.92
3620	8.9	46.2	411.18
3625	8.7	46.1	401.07
3630	8.3	46.2	383.46
3635	5.7	45.7	260.49
3640	12.9	45.4	585.66
3645	10.2	45.9	468.18
3650	8.3	46.1	382.63
3655	7.7	46.4	357.28
3660	8.7	46.1	401.07
3665	6.5	46.3	300.95
3670	8.3	46.2	383.46
3675	7.1	46.2	328.02
3680	8.1	46.3	375.03
3685	6.4	46.4	296.96
3690	7.8	46.3	361.14
3695	0.1	47.1	4.71
3700	0.2	47.4	9.48
3705	1.1	47.3	52.03
3710	3.6	46.9	168.84
3715	1.7	47	79.9
3720	9.2	46.2	425.04
3725	12.3	45.2	555.96
3730	1.8	45.7	82.26
3735	0.2	47.3	9.46
3740	0.1	47.1	4.71
3745	12	45.7	548.4
3750	0.1	47.3	4.73
3755	14.7	45.2	664.44
3760	7.2	46.2	332.64
3765	0.1	47.3	4.73
3770	7.5	46.3	347.25
3775	1.5	47	70.5
3780	12.3	46.8	575.64
3785	1.7	47.8	81.26
3790	12.2	45.6	556.32
3795	9.2	45.9	422.28
3800	9.8	45.8	448.84
3805	7.8	46.2	360.36

3810	8.3	46.3	384.29
3815	6.3	46.2	291.06
3820	7.4	46.2	341.88
3825	5.6	46.4	259.84
3830	4.6	46.5	213.9
3835	8.4	46.2	388.08
3840	8.3	46.1	382.63
3845	0.9	47	42.3
3850	4.3	46.5	199.95
3855	6.8	46	312.8
3860	6.4	46.3	296.32
3865	0.2	47.3	9.46
3870	10.4	45.9	477.36
3875	7.7	46	354.2
3880	9.2	46.1	424.12
3885	0.1	46.9	4.69
3890	9.2	46.2	425.04
3895	7.8	45.5	354.9
3900	7.1	46	326.6
3905	7.3	46.1	336.53
3910	7	46.3	324.1
3915	9.2	45.8	421.36
3920	8.8	45.9	403.92
3925	7.2	46.2	332.64
3930	8.6	46.1	396.46
3935	8.3	46	381.8
3940	8.1	46	372.6
3945	8.3	45.9	380.97
3950	0.1	47.2	4.72
3955	0.7	47	32.9
3960	15.6	45	702
3965	6.9	45.5	313.95
3970	8.2	46.1	378.02
3975	7.5	46	345
3980	8.2	45.9	376.38
3985	6.9	46.3	319.47
3990	7.6	46	349.6
3995	7.7	46.1	354.97
4000	10.5	45.8	480.9
4005	9.4	46	432.4
4010	6.7	45.7	306.19
4015	0.2	46.9	9.38
4020	6.3	46.4	292.32
4025	9.3	45.7	425.01

4030	7.4	46	340.4
4035	0.2	47.1	9.42
4040	0.1	47.2	4.72
4045	14.5	45	652.5
4050	7.1	46.1	327.31
4055	6.9	46.1	318.09
4060	7.1	45.9	325.89
4065	8.9	45.7	406.73
4070	7.8	45.9	358.02
4075	4.4	46.4	204.16
4080	6.2	46.2	286.44
4085	8.1	45.8	370.98
4090	8.3	45.9	380.97
4095	6.5	46.1	299.65
4100	6.4	46	294.4
4105	11.3	45.5	514.15
4110	8.6	45.9	394.74
4115	7.8	45.9	358.02
4120	0.1	47	4.7
4125	10.6	45.8	485.48
4130	0.3	46.9	14.07
4135	9.8	45.8	448.84
4140	0.2	47.1	9.42
4145	8.1	45.9	371.79
4150	0.2	47	9.4
4155	0.2	46.9	9.38
4160	8.8	45.8	403.04
4165	11.1	45.6	506.16
4170	0.1	47	4.7
4175	0.1	47.1	4.71
4180	0.2	47	9.4
4185	16.2	44.8	725.76
4190	13.1	45.1	590.81
4195	0.9	46.8	42.12
4200	0.1	47	4.7
4205	16.5	44.8	739.2
4210	3.5	45.5	159.25
4215	0.2	45.2	9.04
4220	1.3	45.3	58.89
4225	18.2	46.1	839.02
4230	4.5	45.9	206.55
4235	14.3	44.8	640.64
4240	0.1	46.5	4.65
4245	1.5	47	70.5

4250	16.5	44.7	737.55
4255	5.3	46.7	247.51
4260	6.8	45.4	308.72
4265	0.1	47	4.7
4270	0.2	46.7	9.34
4275	8.4	46.9	393.96
4280	0.2	47	9.4
4285	11.5	45.4	522.1
4290	17.9	44.4	794.76
4295	24.3	43.8	1064.34

ELECTRO SOLAR POWER LTD.

The First PV Module Manufacturer in Bangladesh

Electro SOLAR

ELECTRO SOLAR POWER LTD. AT A GLANCE:

Electro Solar Power Ltd. (ESPL), a sister concern of Electro Group, is the first solar PV module manufacturer in Bangladesh. ESPL is established in 2009 at Asulia, Savar, Dhaka, with a group of quality engineers and enriched R&D cell. Solar energy is green energy and ESPL is the pioneer in Bangladesh to reduce carbon footprint of our country to a great extent. One of the major missions of Electro Group is to develop local industries to reduce imported commodities and foreign currency expenditure and also create employment opportunity. ESPL is one step forward to achieve that goal along with Electro Mechanical Service Ltd., EM Power Ltd., Energy Meter Co. Ltd., and Electro Battery Co. Ltd.

Features:

- ✓ Nominal 6V, 12V, 24V, 36V DC system for standard output
- ✓ Maintain German Standard
- ✓ High Efficiency
- ✓ Outstanding performance at low light
- ✓ High transmission tempered glass
- ✓ Aesthetic Appearance
- ✓ Designed for unique demand of customers
- ✓ Warranty of Module for 20 years
- ✓ Wide range from 5Wp to 300Wp
- ✓ Both Mono & Poly Crystalline

Quality & Safety:

- ❖ Test Standard: CE, ICE 61215:2005
- ❖ ISO9001:2008 (Quality Management System) Certified factory
- ❖ Testing of Factory (Sun simulator tester)
- ❖ IDCOL approved for Solar Home System.

ISOQAR UKAS IEC CE IDCOL Electro SOLAR Factory Testing

For details visit **www.electrosolarbd.com**

OTHER PRODUCT:

- ➢ Battery
- ➢ Charge Controller
- ➢ Off-Grid Inverter
- ➢ On-Grid Inverter
- ➢ Solar Water Heater
- ➢ Electro Generator
- ➢ KWh Meter

WE PROVIDE:

- ➢ On-Grid Solar System
- ➢ Off-Grid Solar System
- ➢ Solar Pump System

OUR STRENGTH:

- ➢ Modern technology
- ➢ Quality Product
- ➢ Quick warranty support
- ➢ Team of experts
- ➢ Customer satisfaction

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Boro Rangamatia, Durgapur, Asulia, Savar, Dhaka.

Electro SOLAR

ELECTRO SOLAR PV MODULE

Model	ESM-P5	ESM-P10	ESM-P20	ESM-P30	ESM-P40	ESM-P50	ESM-P60	ESM-65	ESM-P75	ESM-P80	ESM-P85	ESM-P90	ESM-P100	ESM-P150	ESM-P180	ESM-P200
Maximum Power at STC	5W	10W	20W	30W	40W	50W	60W	65W	75W	80W	85W	90W	100W	150W	180W	200W
Nominal Voltage(Vmp)	8.6V	17V	17.2V	17.49V	17.2V	17.2	17.46V	17.2V	17.2V	17.2V	17.2V	17.2V	17.2V	34.4V	34.92V	34.4V
Nominal Current (Imp)	0.58A	0.58A	1.16A	1.72A	2.32A	2.91A	3.43A	3.37A	4.36A	4.65A	4.94A	5.23A	5.8A	4.36A	5.15A	5.81A
Open Circuit Voltage (Voc)	10.8V	21.6V	21.6V	22.32V	21.6V	21.6V	22.32V	21.6V	21.6V	21.6V	21.6V	21.6V	21.6V	43.2V	44.64V	43.2V
Short Circuit Current (Isc)	0.68A	0.68A	1.31A	1.86A	2.57A	3.23A	3.73A	4.17	4.74A	5.17A	5.46A	5.81A	6.46A	4.85A	5.6A	6.5A
No. of Cell	18	36	36	36	36	36	36	36	36	36	36	36	36	72	72	72
Weight (Kg)	1.2Kg	1.8Kg	2.5Kg	3.5Kg	4.5Kg	5.3Kg	6.0Kg	6.30Kg	6.5Kg	7.8Kg	7.8Kg	7.5Kg	8.6Kg	14.2Kg	17.5Kg	20Kg
Dimension(LxW), mm	210x280	291x351	528x363	376x669	495x670	602x670	758x670	757x668	835x668	935x670	934x670	1061x670	1160x668	1173x982	1382x983	1547x982
Operating Temperature	-40°C~80°C															
Cell Type	Poly Crystalline															
Frame	Anodized Aluminum															
NOCT	47±2°C															
Maximum System Voltage	600VDC															
Power Tolerance	±3%															

Model	ESM-M20	ESM-M30	ESM-M40	ESM-M50	ESM-M60	ESM-M80	ESM-M90	ESM-M100	ESM-M120	ESM-M150	ESM-M180	ESM-M200	ESM-M225	ESM-M300
Maximum Power at STC	20W	30W	40W	50W	60W	80W	90W	100W	120W	150W	180W	200W	225W	300W
Nominal Voltage(Vmp)	17.2V	17.49V	17.2V	17.2V	17.2V	17.2V	16.81V	17.2V	34.4V	34.4V	34.92V	34.92V	44.14V	34.92V
Nominal Current (Imp)	1.16A	1.74A	2.32A	2.91A	3.49A	4.65A	5.39A	5.8A	3.48A	4.36A	5.15A	5.7A	5.15A	5.7A
Open Circuit Voltage (Voc)	21.6V	22.32V	21.6V	21.6V	21.6V	21.6V	22.31V	21.6V	43.2V	43.2V	44.64V	44.64V	56.42V	44.64V
Short Circuit Current (Isc)	1.31A	1.86A	2.57A	3.23A	3.86A	5.17A	5.95A	6.46A	3.86A	4.85A	5.6A	6.2A	5.6A	6.2A
No. of Cell	36	36	36	36	36	36	36	36	72	72	72	72	91	72
Weight (Kg)	2.75Kg	3.16Kg	2.855Kg	4.41Kg	5.975Kg	7.825Kg	7.25Kg	8.65Kg	9.875Kg	12.95Kg	12.95Kg	14.5Kg	17.5Kg	22.95Kg
Dimension(LxW), mm	330x546	464x558	571x545	688x543	910x545	1206x545	1200x540	1205x544	1036X807	1297X809	1580x808	1580x808	1705X942	1955X991
Operating Temperature	-40°C~80°C													
Cell Type	Mono Crystalline													
Frame	Anodized Aluminum													
NOCT	47±2°C													
Maximum System Voltage	600VDC													
Power Tolerance	±3%													

STC: Irradiation 1000W/m^2, Module Temperature 25°C, AM=1.5

Solar Charge Controller

Solar Charge Controller is a highly efficient micro-controller based charge controller which has nominal froward voltage drop while charging. "Push Button", a unique feature designed to allow the user to push the button when it is required to monitor the battery level and charging status. This special feature saves the power consumed in the LED monitoring lights used in the device.

The micro-controller based monitoring system offers very accurate Low Volatge Disconnect (LVD) and High Voltage Disconnect (HVD) functions.

Features

- Push button based status
- Self current consumption is very low
- Low leakage current
- Micro-controller based accuracy
- High current capability
- Extremely low switching loss

Product Information

Sl	Model	System Type
01	SC20	12V system
02	SC20	48V system

Applications

- 3G-SHS
- Any 12V/48V solar system