ULTRACAPACITORS FOR BETTER BATTERY PERFORMANCE

by

MOHD LUQMAN BIN RUSAIDI

A project dissertation submitted to the Electrical & Electronics Programme

in partial fulfilment of the requirements

for the Degree

Bachelor of Engineering (Hons)

(Electrical & Electronics Engineering)

UNIVERSITI TEKNOLOGI PETRONAS

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CERTIFICATION OF APPROVAL

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Approved by,

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(Pn. Azizan Binti Zainal Abidin)

Project Supervisor

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Mohd Luqman Bin Rusaidi

ABSTRACT

Portability in devices is ever increasing as the technology nowadays is moving forward to be in line with human lifestyles which prefer multitasking in daily routine. As the portable devices are consuming battery as a main source of electricity, battery with long lasting performance is preferable. Battery contains heavy metals such as mercury, lead, nickel, zinc and manganese which are hazardous to environment and humankind. Battery with short runtime will need for a frequent replacement which leads to more heavy metals waste. Eventually, a new industrial revolution of nanotechnology has a great impact on the development of ultracapacitor. Ultracapacitor has been an interest in electrical and electronic field as its capability has an obvious improvement which can contribute for further development of electrical devices. Therefore, The objective of this project is to study the effects of ultracapacitor on the battery performance in terms of its ability to sustain voltage of the battery over time and provide enough current to the load for a longer time Throughout this project, the circuit of standalone battery, battery in parallel with ultracapacitor and battery in series with ultracapacitor are tested. Ultracapacitors used with the capacitance of 0.5F, 1.0F, 1.5F and 2.0F give the different voltage and current at the load over time. The results in this project will be a comparison of graph of voltage and current for each circuit arrangement over the time. In conclusion, ultracapacitor with the capacitance 0.5F connected in parallel with battery give the best improvement to the battery performance. However, the larger capacitance value of ultracapacitor is not a factor which will give a better performance of the battery

ACKNOWLEDGEMENTS

First and foremost, praise to Allah the Almighty for giving me the strength and courage in completing the Final Year Project (FYP). Without His permission, this FYP will not be a success.

I would like to take this opportunity to express my deepest gratitude to all parties involved in conducting this project ranging from UTP lecturers, technician and external organizations who have put a large effort in making this project a success.

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Besides, special thanks to my parent and classmates for giving me the continuous support and motivation throughout completing this project. Last but not least, so many thanks to others whose name are not mentioned in this page but have in one way or another contribution to the accomplishment of this project. Thank you very much.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Ultracapacitor, supercapacitor or EDLC (Electric Double Layer Capacitor) is the same thing which is a capacitor where its ability has been improved over a conventional capacitor. As the advance of technology nowadays, nano size particle of materials have opened up brilliant ideas among researcher to develop the existing capacitor in to a better capacitor. Ultracapacitor has a higher energy density in comparison with conventional capacitor where it can store more energy over time [1]. Due to its advantages, it is applicable in numerous applications such as lighting system, uninterruptible power supply (UPS), Hybrid electric vehicles (HEV), electronic devices, power tools, industrial equipment and telecommunication systems.

1.2 Problem Statement

AC supply is a major supply current used all over the world. But with the new era of technology, DC supply is turning up as an important current source for electrical devices. Sophisticated devices such as laptops, PDAs and cell phones which are using batteries as their storage devices have contribute to a mass produced of batteries. Batteries which are containing heavy metals such as mercury, lead, cadmium, and nickel are hazardous to environment if its' were improperly disposed [2]. Furthermore, batteries with short runtime and lifespan will result a frequent replacement and leads to more heavy metals waste.

1.3 Objectives and Scope of Study

This project is aimed to study the effects of ultracapacitors on the battery performance in terms of its ability to sustain the battery voltage and provide enough current to the loads for a longer time. As the earlier research done by other researcher, it has been proved that the combination of battery with ultracapacitors can prolong battery run time [3]. Thus, this project will be on more details experimentation to analyze the performance of both battery and ultracapacitor based on the recommendations from the previous researcher.

This project will show the variations resulted as more ultracapacitor with different capacitance value are used in that particular combinations. In order to get a convincing result of ultracapacitor capability, comparison of result on standalone battery, battery with combination of ultra capacitor which will indicate how far the performance does improved.

This project covers in designing and building up a simple circuit of a working prototype consisting ultracapacitor and battery which will be connected to a bulb as the load.

CHAPTER 2
LITERATURE REVIEW

2.1 Capacitor in General

Generally, capacitor is a passive electronic component that can store energy in the form of an electrostatic field. Over the decade, many types of capacitors such as vacuum capacitors, metalized mica capacitors, tantalum capacitors and ultra capacitors are appeared to be fixed with various applications of electrical devices. These capacitors can be classified as in the Figure 1 [4].

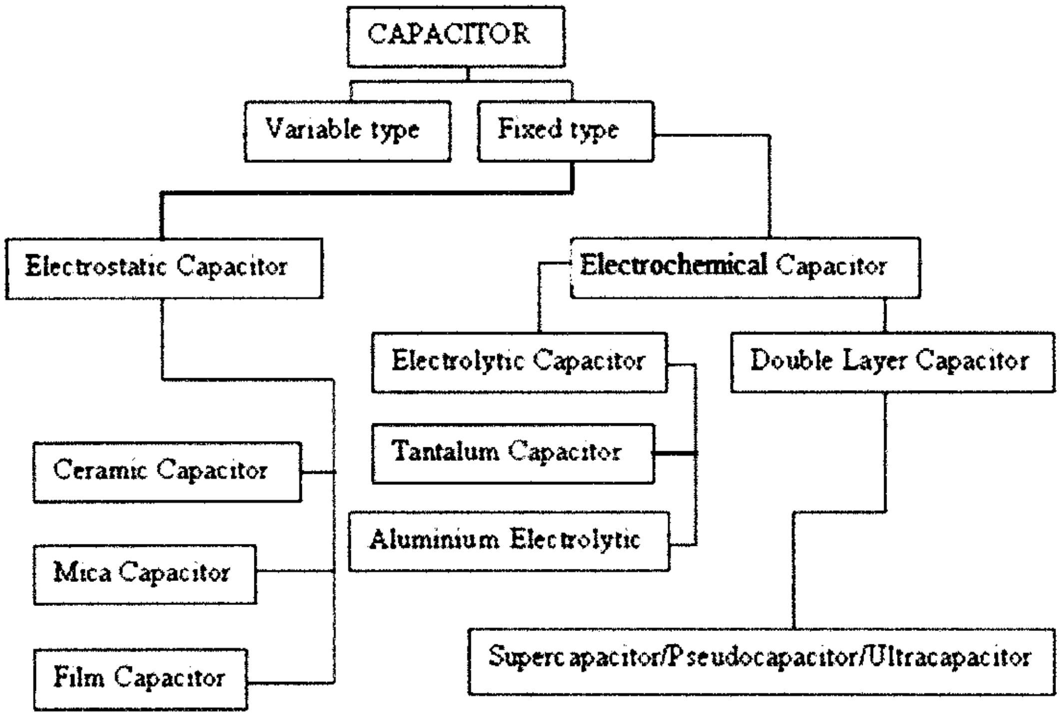


Figure 1: Classification of Capacitor

A simplest classic capacitor is constructed by two metal plates which are sandwiched close together with an insulator such as a vacuum, paper or other insulating material in between them. Two plates are connected to them which one plate to the positive pole of a power source and the other to the negative pole. Theoretically, the greater the surface area of the plates and the smaller gap between the plates then the higher charge can be stored. Typical modern capacitors usually feature a rolled construction with the used of metalized plastic film to store the charge. However, the common values of capacitors available do not even approach 1F and are actually measured in microfarads, picofarads and nanofarads [5].

2.2 Capacitance

Capacitors hold a certain electrical pressure or voltage. The amount of electricity or electrical size of a capacitor is much known as capacitance. Capacity may be commonly expressed as follows [6]:

$$C = Q/V \tag{1}$$

Q = quantity of electricity

C = capacity of capacitor

V = electrical voltage

The capacity of a capacitor is dependent on the size and space of the conducting plates and the type of insulating or dielectric medium between the plates. The capacitance equation is as below [7]:

$$C = \varepsilon A / d \qquad (2)$$

C = Capacitance in farad, F

ε = dielectric constant ($\varepsilon_o \varepsilon_r$)

ε_o = space permittivity (8.854×10^{-12} F/m^2)

ε_r = relative permittivity

A = area of one plate in square meters, m^2

d = distance between plates and electrolyte.

Capacitance is directly proportional to the plates' surface area but inversely proportional to the separation between plates. Through this equation, it is clear that by maximizing the surface area of the plats will give higher capacitance.

2.3 Introduction of Ultracapacitor

The use of capacitors as the energy storage devices only became possible with the invention of supercapacitors in late 1960. Supercapacitors are electrochemical capacitor which are sometimes also known as 'ultracapacitors' or 'Electrolytic Double Layer Capacitor (EDLC)'. In contrast to ordinary capacitors, their capacitance is measured in the value of Farads (F), and even approaching kiloFarads (kF), they can store a million times of the electrical energy [8].

Supercapacitors can be classified by the electrode material occupied as the collectors [9].The first type of supercapacitor is basically replaces the metal sheets of its construction with activated carbon electrodes. A few nanometres in size of pores in the carbon provide an enormously increased internal surface area. In order to utilise the additional active surface area, the liquid electrolyte is used as an electrically conductive which allows double layer of charge to be formed between the carbon and the electrolyte ions. The second type of supercapacitor uses transition metal oxides such as ruthenium or iridium as electrode material with an aqueous electrolyte. While the third type of supercapacitor is based on the use of electronic conducting polymers such as polypyrrole, polythiophene or polyaniline as the electrodes.

2.4 Concept of Ultracapacitor

The double layer concept is realized when two electrodes immersed in an electrolyte,are polarized. The polarized charges at both the positive and negative electrodes resemble two capacitors connected in series as shown in Figure 2. In ultracapacitor, Helmholtz double layer structure are commonly used which is a structure of charge accumulation and charge separation that always occurs at the interface when an electrode is immersed into an electrolyte solution.This layer is formed as the solvated ions are blocked and accumulated at the electrode and electrolyte interface [10].

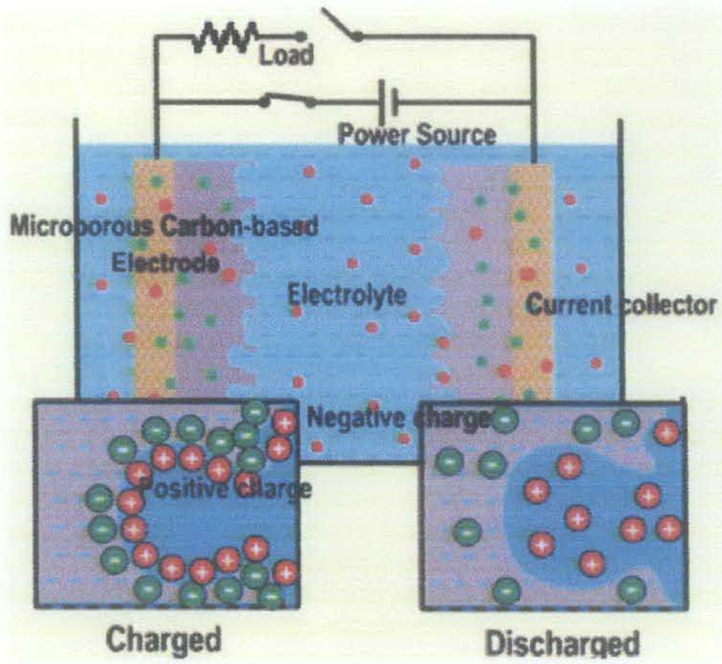


Figure 2: Behavior of electrolyte in ion (positive charge) in the pore when charged and discharge [11]

2.5 Working Principle

The ultracapacitor works just like a normal capacitor. A battery or a power source will charge up the current collector which are the electrodes.. The electrodes will then be charged up with one side as positive and the other side is negative. As the electrodes being charged, the positive and negative ions in the electrolyte will move to the respective opposite charge electrodes. This is how the ultracapacitor collects charges or energy.

The discharging process of a ultracapacitorr is when the battery is taken out and it is connected to the load in a close circuit. The highly positive and negative charged plats will start to act like the positive and negative charge of battery. The negative plat will be the source of electrons and positive plat will attract the electrons. The ions in the electrolyte will be released back into to electrolyte. . As there is a moving of electrons, there is current flowing from positive plat of the ultracapacitor

2.6 Ultracapacitor Advantages

As a revolutionary of nanotechnology ultra capacitors which are now growing well in the market as its capability are believed to give huge developments of electrical device.In last few years, a great attention has been focused ont these ultracapacitors in the United States, Europe and Japan. Several companies, such as Maxwell, Siemens Matsushita (EPCOS), NEC,Tokin are now commercializing ultracapacitor as there are more responsive demands in the market.As nano materials are widely used in manufacturing ultracapacitors, surface area of plates of the ultracapacitor is increased which proportionally increase its capability of storing more charge [12]. In addition, ultracapacitors have their unique advantages as below [13]:-

- low ESR (Equivalent Series Resistance)
- long life cycle
- high charging and discharging rate
- high capacitance density
- wide range of operating temperature
- lightweight
- environmental friendly
- free-operation maintenance

Due to these advantages, the global market for ultracapacitors is expected to reach $560 million in 2011 with 15.3% average annual growth rate based on A Global Industry and Market Analysis (ETP-101) [14]. In conjunctions with Irap (Innovative Research and Products) forecast, a study shows that automotive, consumer electronics and industrial power management are the major markets where ultra capacitors are needed [15].

2.7 Current Application of Ultracapacitors

A bundle of advantages of ultracapacitors have spread the used of ultracapacitors in various applications. The advantages of ultracapacitors seems to be aware by most of manufacturer in the industry which start to applied the used of ultracapacitors in their products. Among of the products which are using ultracapacitors are listed as below [16]:-

- Hybrid Electrical Car (HEV)
- Uninterruptible Power Supply (UPS)
- *E- Bike*
- Memory Backup in electronic device
- Camera
- Electric Valve
- Torch Light

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

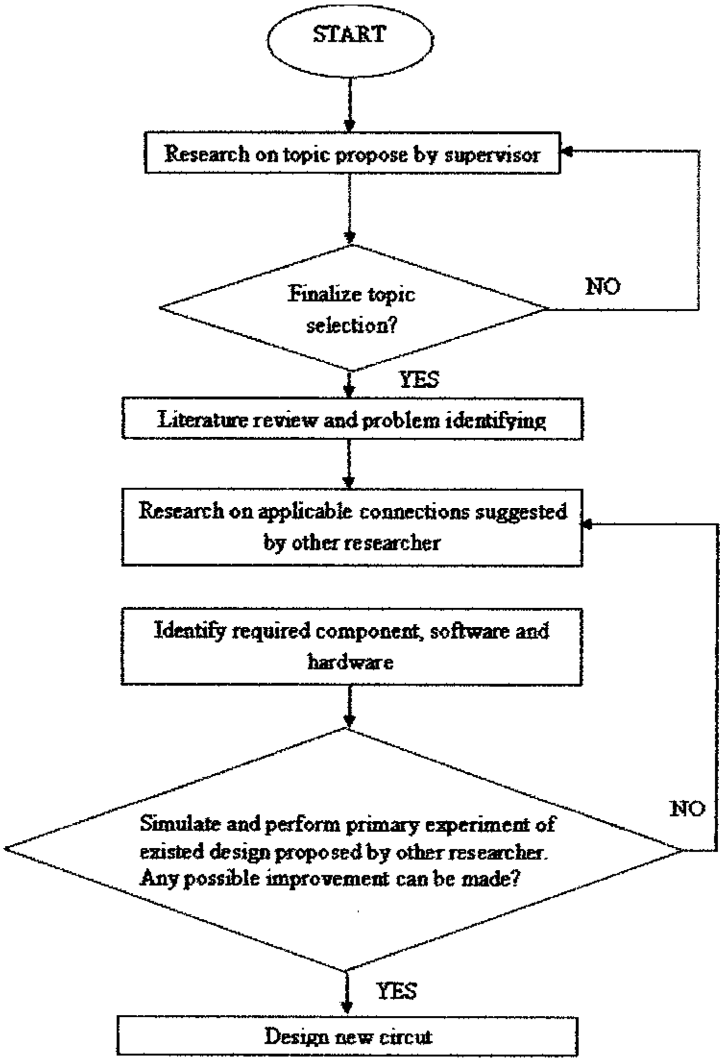


Figure 3: Flow of Project

3.2 Tools and Equipments Required

Throughout the progress of this project, the suitable tools have been identified to be used for the completion of the project. Recently, some of the tools are already been used and familiarized before, but some of them are identified to be used later based on the needs, functions and its availability. The following details in table 1 provide the information on tools and software that required performing all stage of process for this project:-

3.2.1 Hardware

Table 1: Tools and Equipments

No.	**Tools and Equipments Name**	**Description**
2.	Science Workshop 750 Interface	This hardware is used together with Data Studio Software in order to fetch data from the prototype onto the PC for further simulations.
3.	Ultracapacitor	Ultra Capacitor is expected to use is based on their availability in the local market. Small size and less cost of ultra capacitor is the priority as the project is focusing to the portable electrical devices. Currently a Panasonic ultracapacitor with rating 5.5V and 1F is used in this project.
4.	Battery	Various type, size and capacity of battery is planned to be used as this will produce the variation of results. At the primary stage, AA battery with 1.5V is used for each experiment.
	Bulb	A bulb used in this experiment as the load to discharge the battery and ultracapacitor. Bulb used is rated with 2.5V.

- ***Ultracapacitors***

The ultacapacitors used in this project is based on the availability of its in the Malaysia's market. Currently in Malaysia, ultracapacitor with the range of 0.33mF to 1.5F are available in the market. Thus, ultracapacitors with value of 0.5F, 1F and 1.5F are used in this project. These ultracapacitors are manufactured by MATSUSHITA from Japan and ELNA from USA. These ultracapacitors are stacked coin shape and have 5.5V rated voltage as shown in FIGURE below

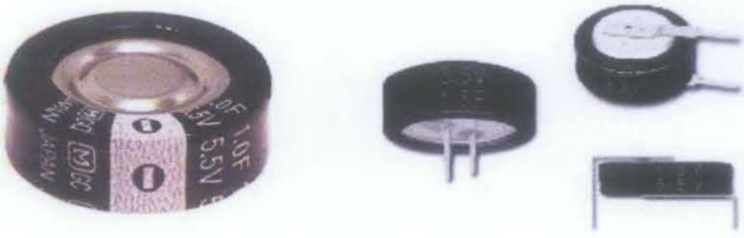


Figure 4: Ultracapacitors [17]

- ***Batteries***

Batteries used in this project is AA battery R6NPT which rated 1.5V manufactured by Panasonic. This kind of battery is available everywhere in the market and can be obtained at affordable price. AA size batteries are among the batteries which are used widely by consumers in application of torchlight, mp3s, clocks and toys.

Figure 5: AA battery [18]

- ***Science Workshop 750 Interface***

Science Workshop750 Interface as in the Figure 4 very well known at university level as a physics interface. This device offers built-in function generator and DC power supply, plus a total of 7 channels which allow an efficient data acquisition. This interface offer various of probe sensors to be used for data collection such as voltages, currents, lights, sounds, forces, motion, pH and etc. This hardware is available in Physics Lab with four probes of voltage, current, light and sound.

By using this device, the voltage and current from a tested circuit can be collected simultaneously which ensure the data collected is accurate rather than testing the circuit twice, to collect the data of current and voltage. Furthermore, this device is operated with 240V AC power supply which allows it to be used anywhere outside the laboratory. This device is so simple has only one switch embedded, thus no complex steps should be taken get it be operated. Besides, this device is also available with USB cable to connect between ScienceWorkshop 750 Interface and computer. Thus, this device can be used with any kind of computers since there is no special or unique port required to let it be connected with computer.

Figure 6: ScienceWorkshop 750 Interface [19]

The PASCO CI-6556 Current Sensor as in Figure 5 is an analogue channel plug designed to interface to measure currents of ±1.5 amperes. The setup and rating for this sensor has been familiarized to avoid critical error on data collection due to inefficiency of dealing with this sensor.

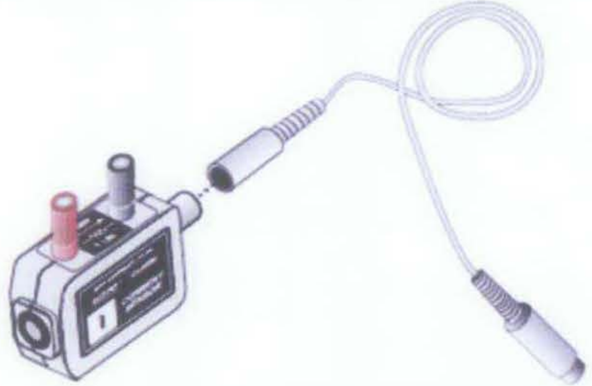


Figure 7: PASCO CI-6556 Current Sensor [20]

While for voltages recording, PASCO Model CI-6503 Voltage Sensor is to be used despite of a voltmeter. This sensor allows details monitoring of AC and DC voltage from –10 volts to +10 volts even as per mille second which will allow the accurate analysis. The probe ends are standard stackable banana plugs with detachable alligator clip adapters which will ease the connection to be made on particular circuit.

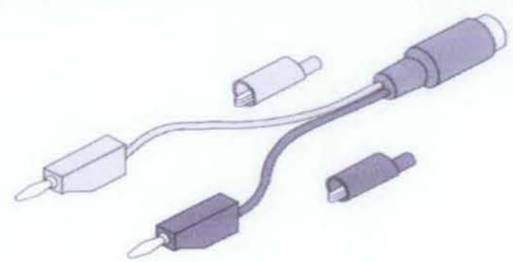


Figure 8: PASCO CI-6503 Voltage Sensor [21]

3.2.2 Software

- **Data Studio**

Data Studio is a data acquisition, display and analysis program which is works with ScienceWorkshop 750 Interface. The data collected from ScienceWorkshop 750 Interface through voltage sensor and current sensor will display, recorded and analyzed onto Data Studio program. The currents and voltages collected from the circuit will be automatically uploaded to the DataStudio with graphical display and tabling display. The required setup and calibration between ScienceWorkshop 750 Interface and DataStudio Program has been studied as well as practical used of those hardware and software.

Figure 9: User Interface of Data Studio

- **NI Multisim Analog Devices Edition**

NI Multisim Analog Devices Edition is an analog circuit and digital logic simulation software that runs on personal computers. This software is a powerful program that is used in integrated circuit and board level design to check the integrity of circuit designs and to predict circuit behavior. The software used is the latest version NI Multisim 11.0 which is released on 2010. This software is open source software which is available on the internet. In comparison to PSPICE, there are more components available in Multisim which suit with the real component. For instance, ELDCs with the range of 1 to 5000 Farads is available in Multisim but in PSPICE only the conventional capacitors are available.

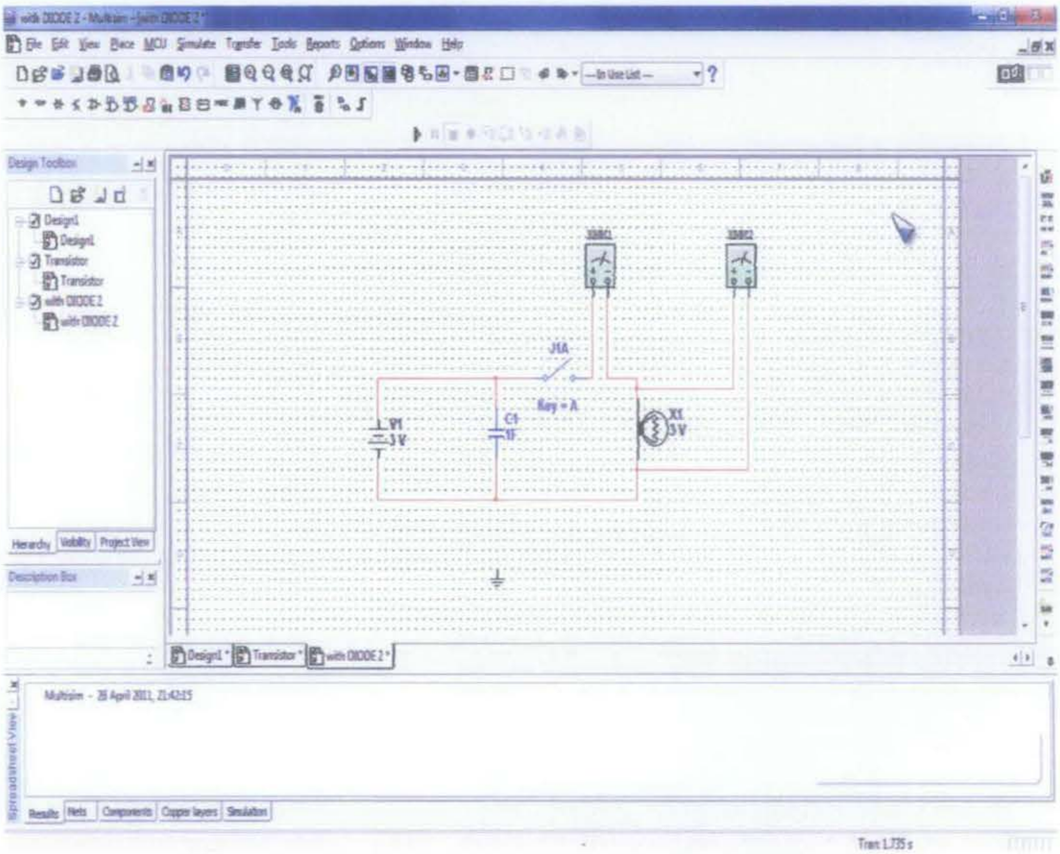


Figure 10: User Interface of NI Multisim Analog Devices Edition

3.3 Circuit Arrangement

Throughout this project, a few types of circuit arrangement have been utilized to get the combination between ultracapacitors and battery which will produce different results. These circuit arrangements which involve stand alone battery circuit arrangement, series connection between ultracapacitor and battery circuit arrangement and parallel connection between ultracapacitor and battery circuit arrangement have been used as the manipulated variable. Besides, different capacitance value of ultracapacitor is varied to examine whether the capacitance values does affect the performance of the battery and overall circuit.

In each circuit arrangement, the same rated battery and bulb used to make sure the results are more reliable. AA Panasonic batteries with rated voltage 1.5V are chosen to be used throughout the project regarding it cost and availability in market. Each experiment to be ran, brand new batteries will be used to ensure that the results are not affected due to different batteries condition. While a bulb with rated voltage 3.8V will be replaced after 5 times used to make sure there is no side effect regarding less efficiency of the bulb after many cycles used.

While for the ultracapacitors, each of it is having different capacitance value which is 0.5F, 1F, and 1.5F. Since there is no single 2F ultracapacitor, two 1F ultracapacitors are parallel to give 2F capacitance value. Due to the advantages of ultracapacitors its can be used for many cycles without effecting its capability.

a) Stand alone battery

In this arrangement a 3.8V rated bulb is being supplied by two 1.5V battery which are connected in series to give a total voltage of 3V. XMM2 and XMM1 do represent voltage and current sensor from ScienceWorkshop 750 Interface which measure and collect the voltage value across the bulb and the flowing current from batteries to the bulb. Figure 11 below shows battery stand alone circuit arrangement

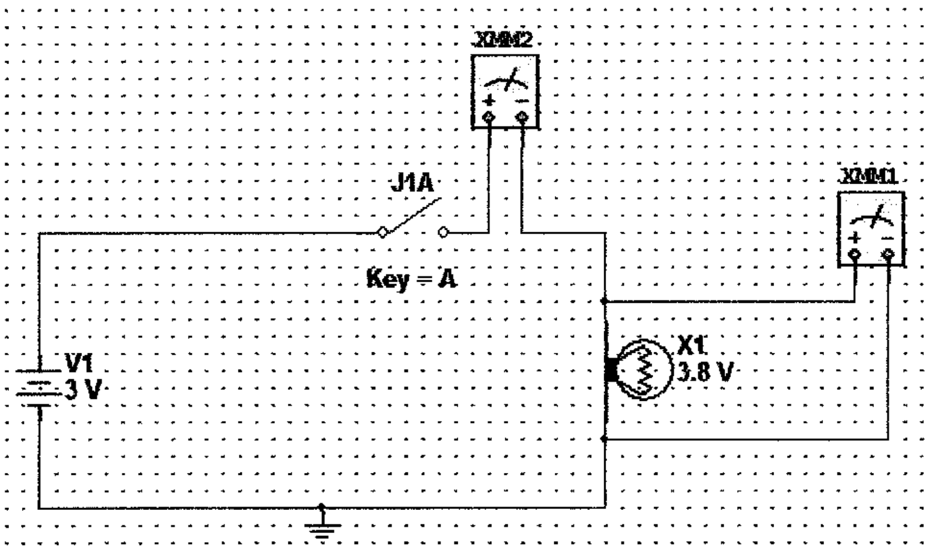


Figure 11: Battery Standalone

b) Series connection between ultracapacitor and battery

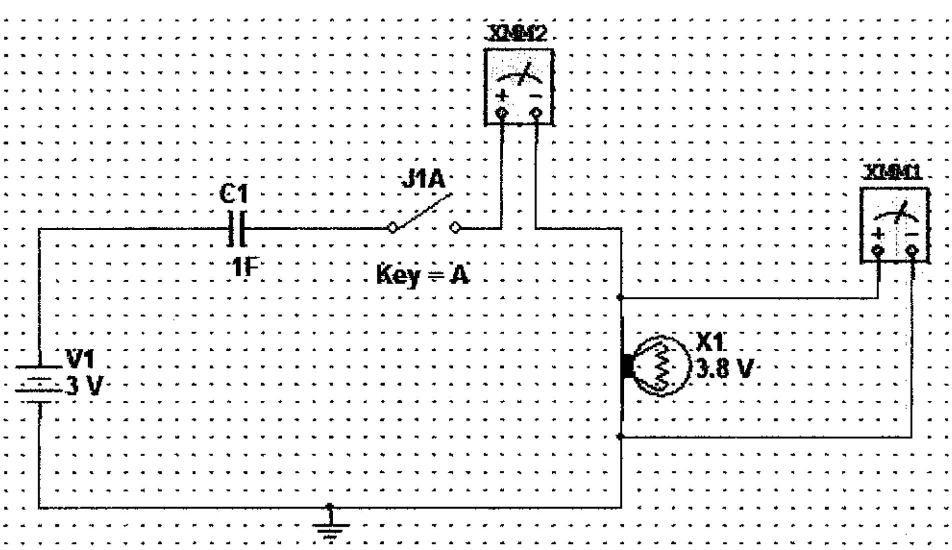


Figure 12: Battery in Series with 1F Ultracapacitor

c) Parallel connection between ultracapacitor and battery

In this arrangement, an ultracapacitor is connected in parallel with two 1.5V rated voltage batteries. By paralleling them, the bulb is now powered by both batteries and ultracapacitor as shown in Figure 13 below. During turn OFF of the switch, the ultracapacitor will be charged by the batteries at the total voltage of two batteries which is 3V. The charging of the ultracapacitor will be stopped automatically. Therefore, the ultracapacitor is left to be charged by the batteries for a moment before the experiment to be carried out. During turn ON, the bulb will consume current from both batteries and ultracapacitor. At the same time ultracapacitor is charged by the batteries.

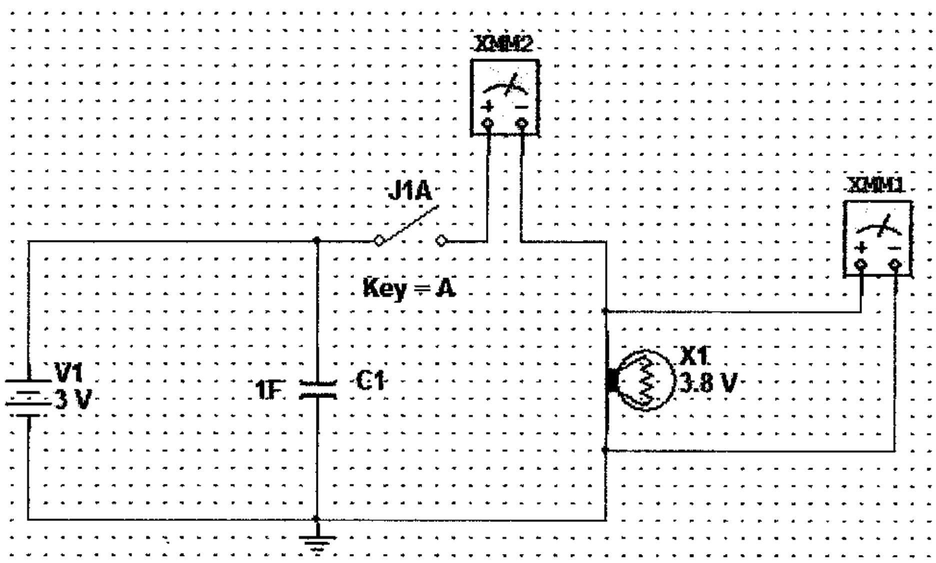


Figure 13: Battery in Parallel with 1F Ultracapacitor

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Results

In this project, the results are basically showing the plotted graph of voltages and currenst which are obtained from the circuit those have been set up earlier . These voltages and current are actually obtained from the bulb which is left to be operated in the continuos operation with 3V batteries as a power supply. Voltages and currents are collected from voltage and current sensors which is connected to ScienceWorkshop 750 Interface. Then, the DataStudio program will automatically plot the data into graphical display. In the results, there will be some delays of the time where data start to be collected since the sensors do not trigger automaticaaly as the switch of the tested circuit is turned ON. Thus, the DataStudio is left to be operated earlier before the batteries start to give current the bulb. The delay of a few seconds in each result is aware and taken into consideration for the final results.

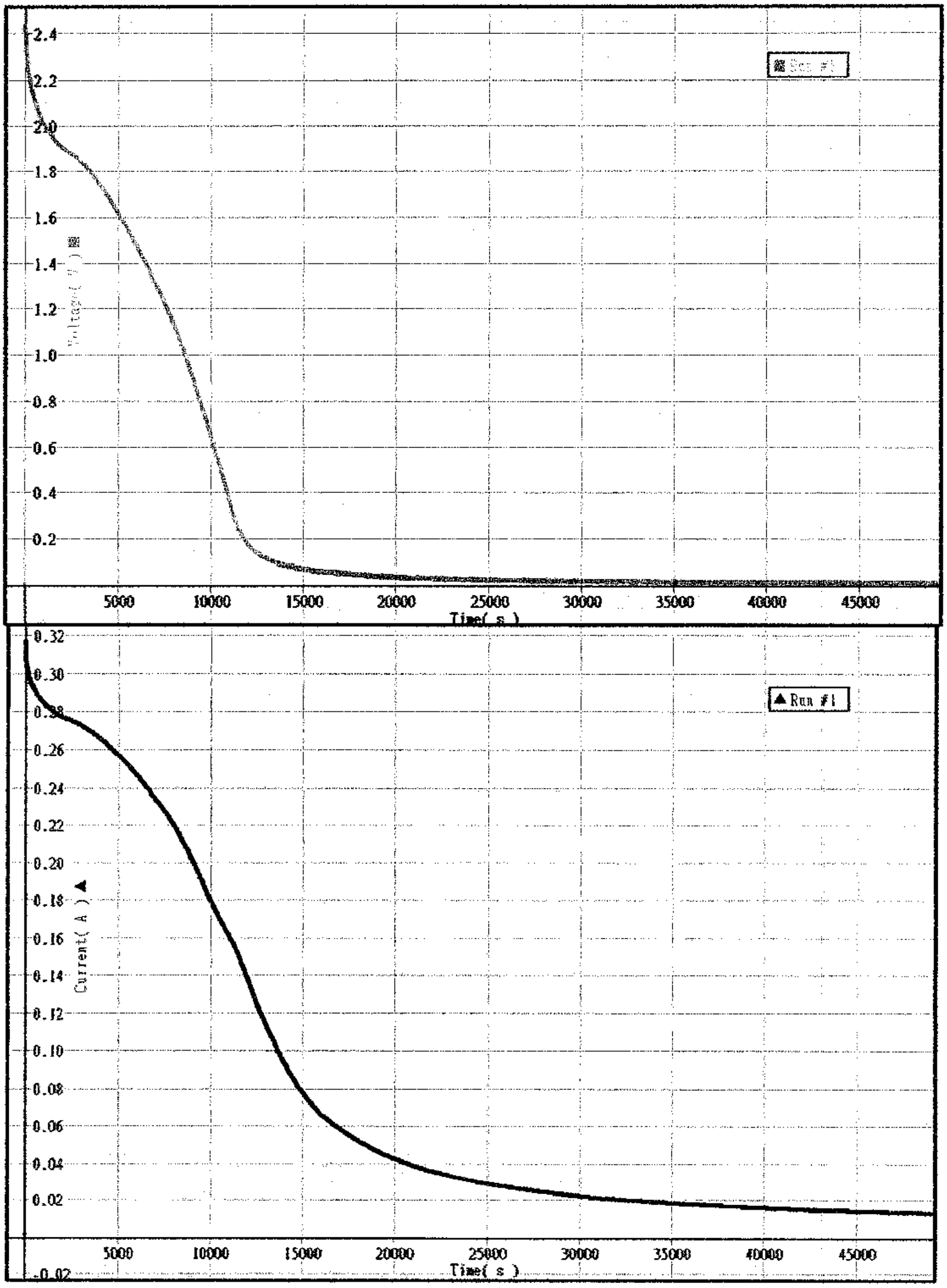


Figure 14: Voltage and current Waveform of Standalone Battery.

For this stand alone battery, the starting voltage gives the reading of 2.422V and the current of 0.317A. The voltage at the bulb in the beginning, does not give exactly 3V voltage as supplied by the batteries due to voltage drops in the circuit.

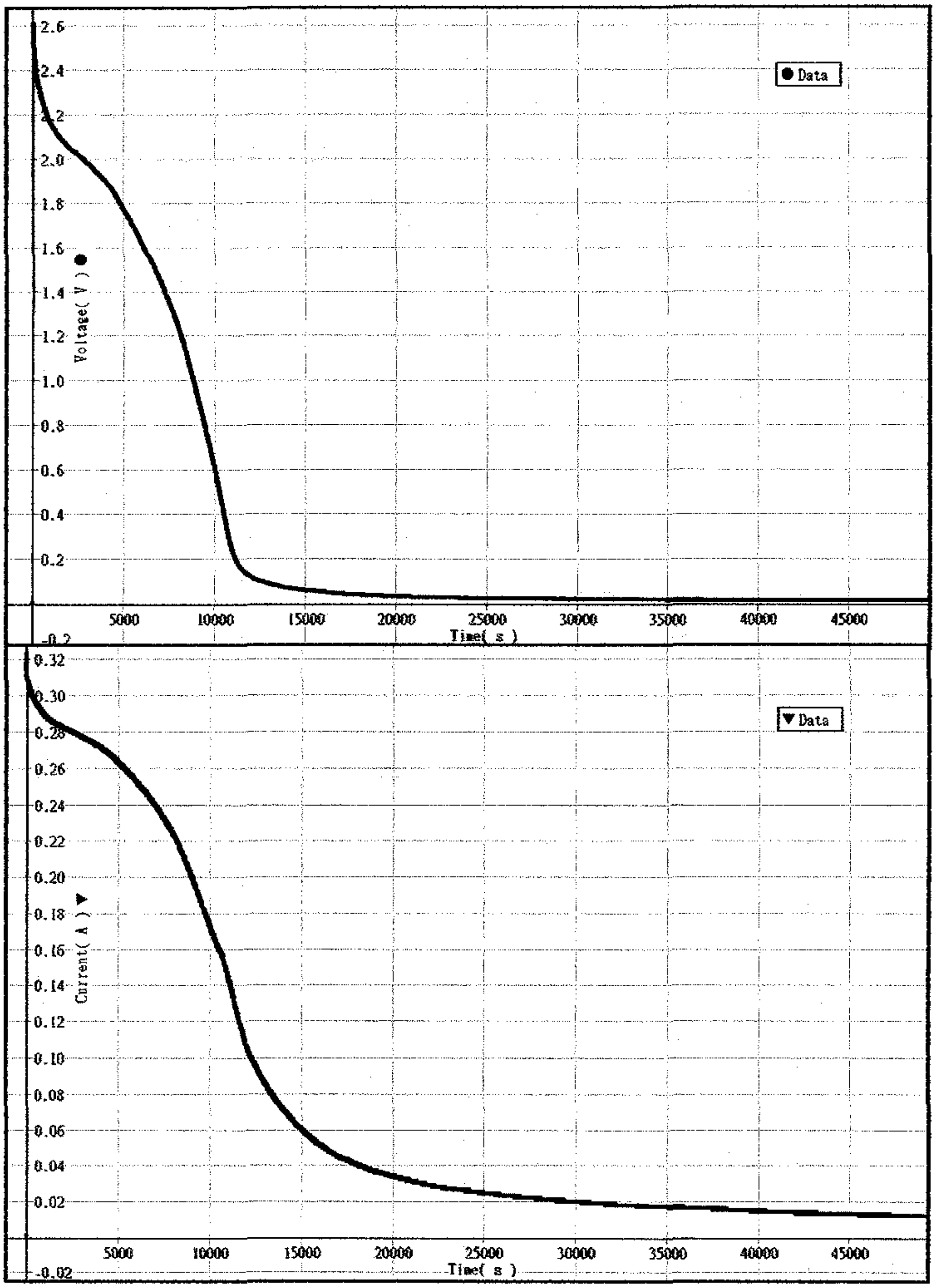


Figure 15: Voltage and current Waveform of Battery Parallel with 0.5F Ultracapacitor

In this circuit of battery paralleled with 0.5F ultracapacitor, the voltage across the bulb at starting point gives 2.611V and the current of 0.322A.

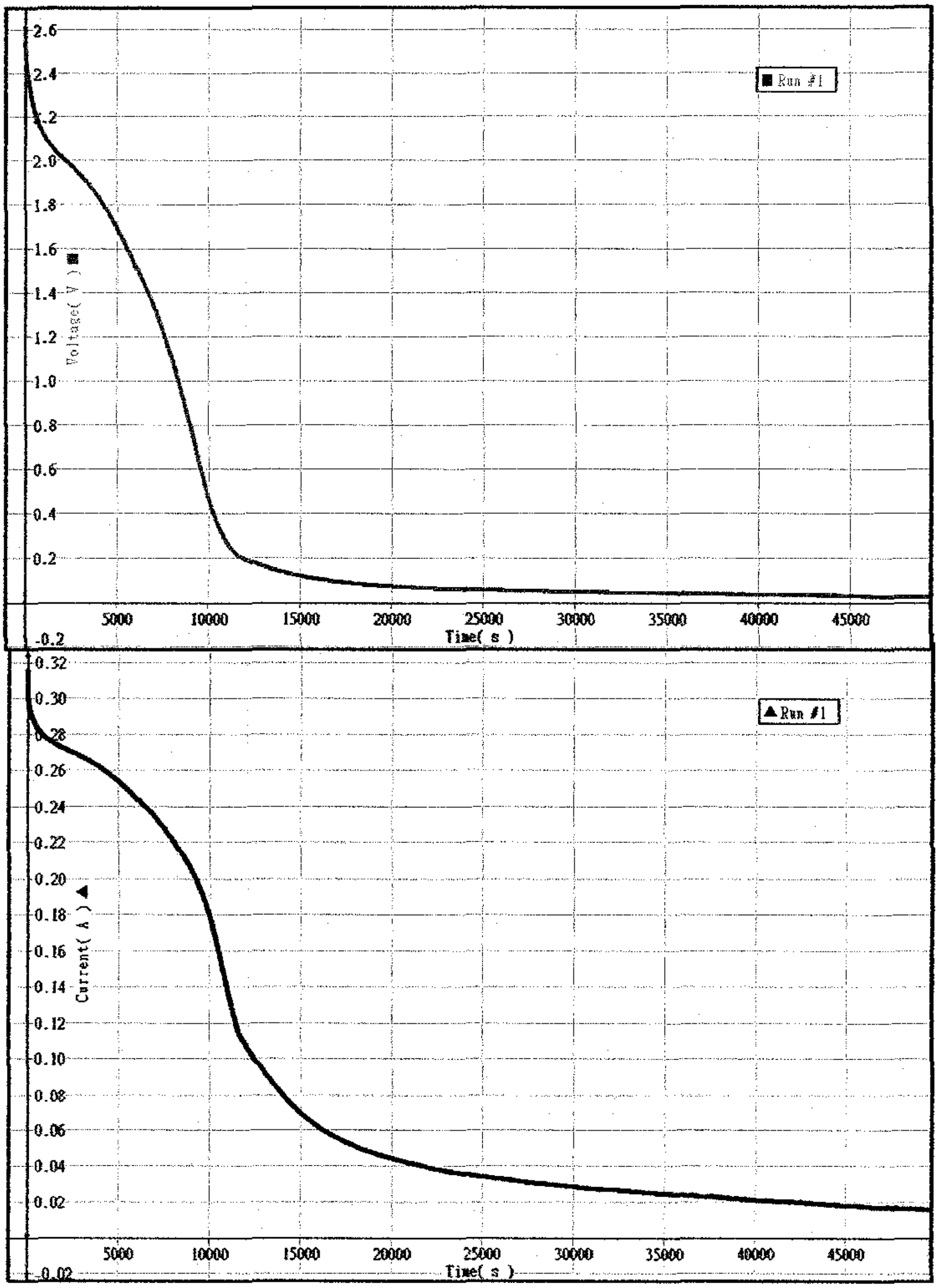


Figure 16: Voltage and current Waveform of Battery Parallel with 1F Ultracapacitor

As the graph above, the starting voltage for batteries in parallel with 1F ultracapacitor is 2.61V while the current is 0.322A

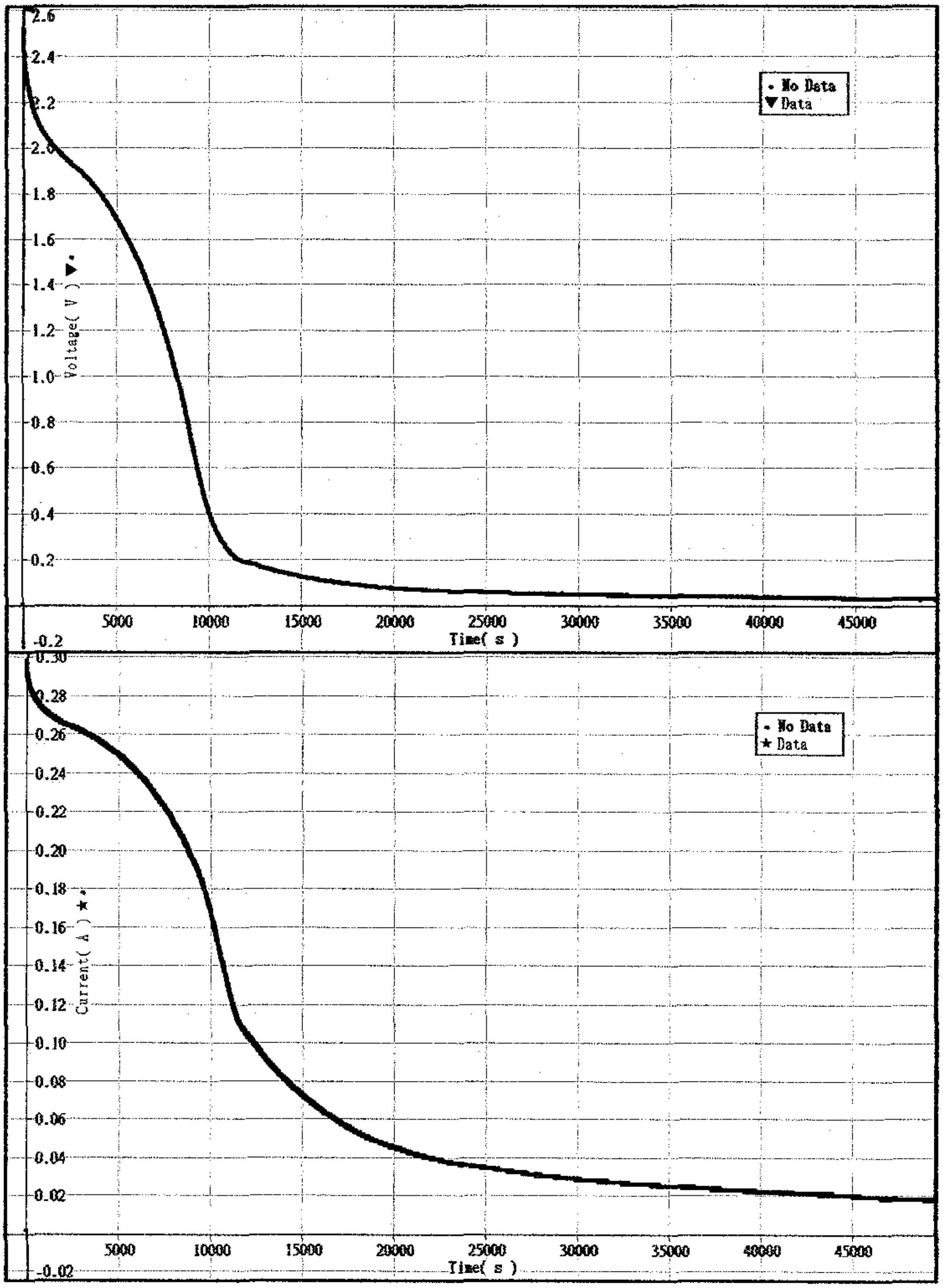


Figure 17: Voltage and current Waveform of Battery Parallel with 1.5F Ultracapacitor

As the graph shown, when batteries in parallel with 1.5F ultracapacitor, the voltage across the bulb at starting point gives 2.52V and the current of 0.298A.

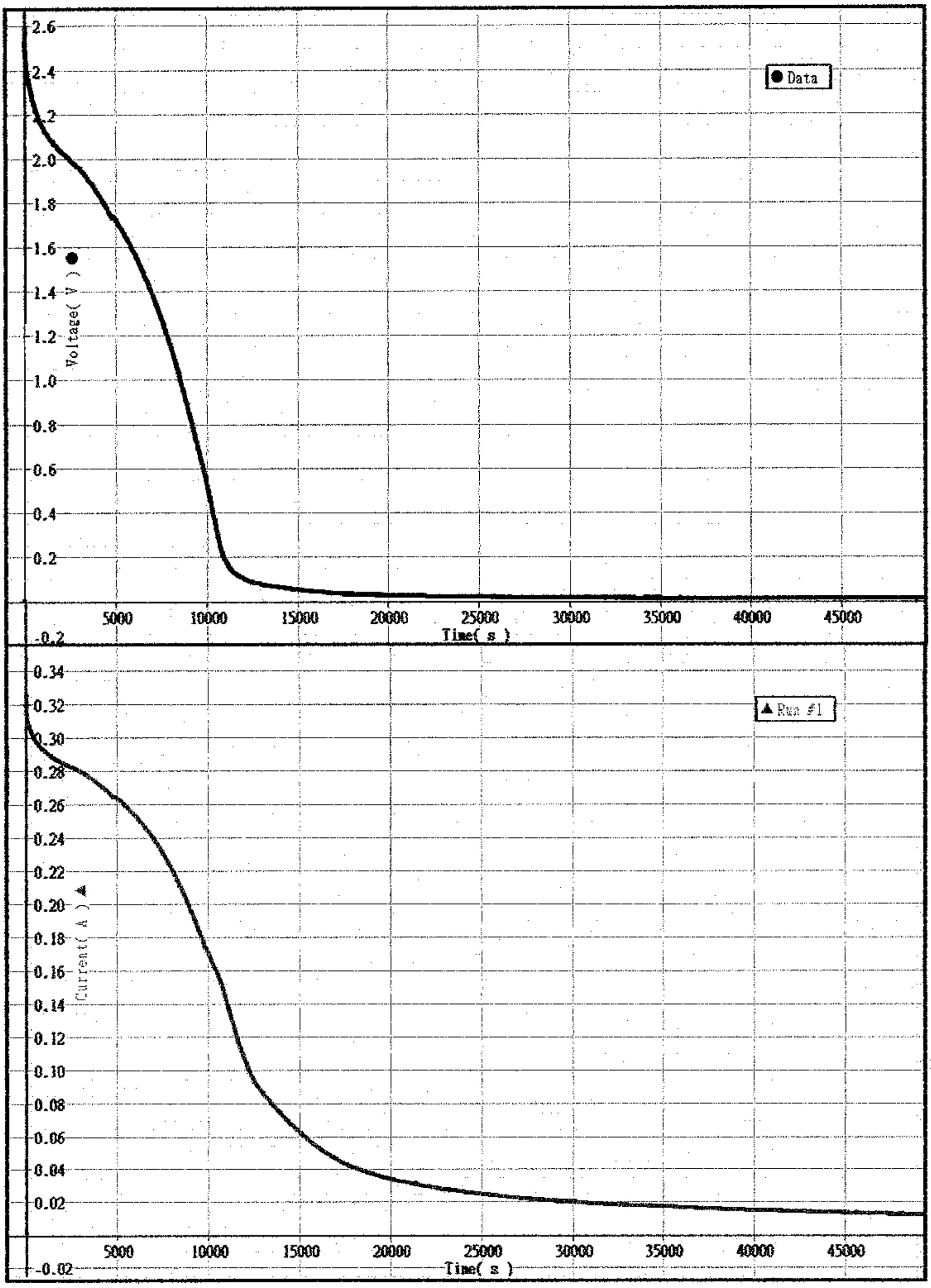


Figure 18: Voltage and current Waveform of Battery Parallel with 2F Ultracapacitor

In this circuit of batteries paralleled with 2F ultracapacitor, the voltage across the bulb at starting point gives 2.593 V and the current of 0.324 A.

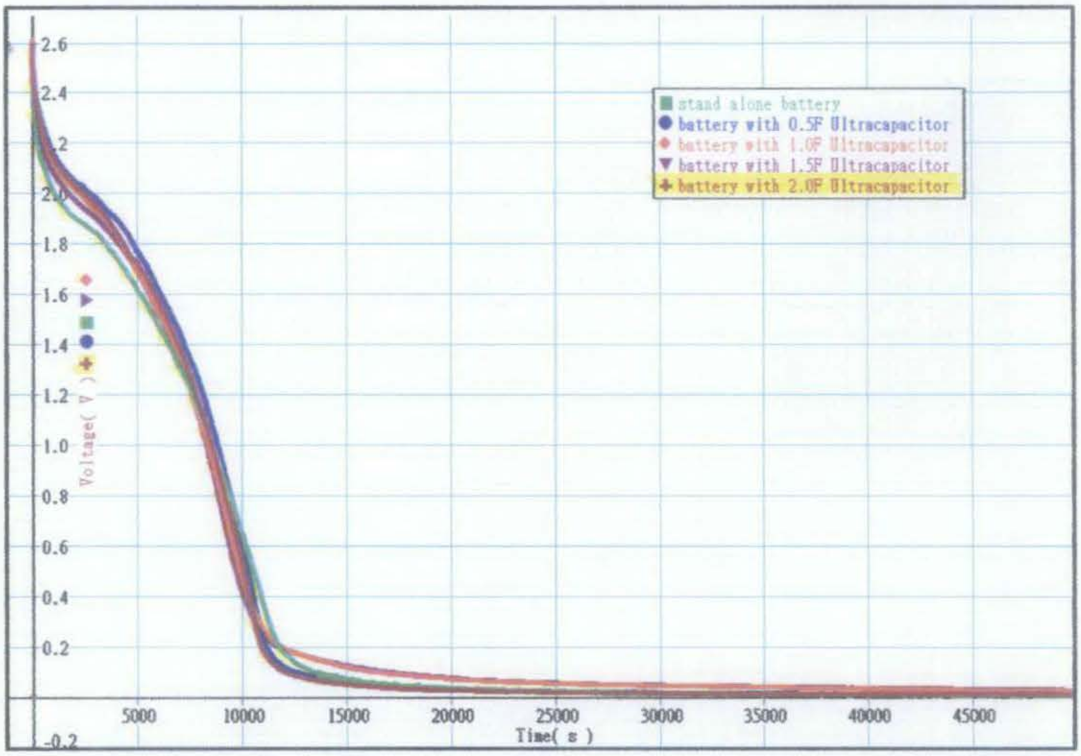


Figure 19: Voltage Waveforms of Standalone Battery and Battery Parallel with 0.5F, 1F, 1.5F and 2F Ultracapacitor

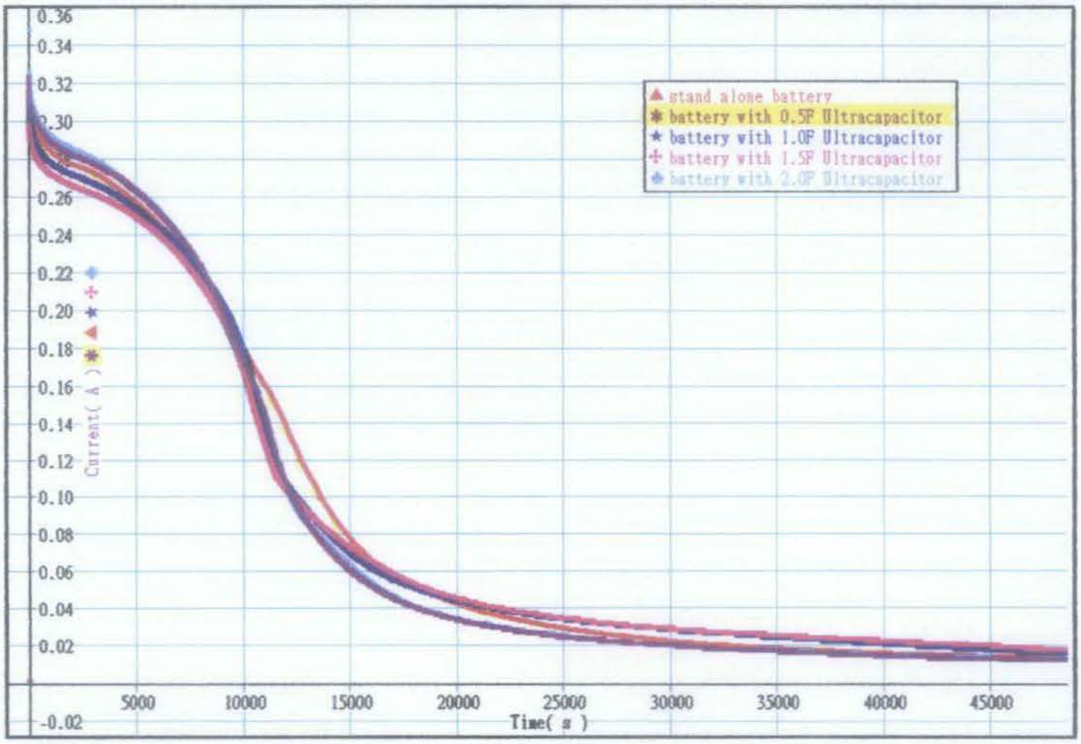


Figure 20: Current Waveforms of Standalone Battery and Battery Parallel with 0.5F, 1F, 1.5F and 2F Ultracapacitor

4.2 Discussions

As the results shown, each arrangement of the circuit will give almost the same shape of voltage waveform which the voltage continuosly drop approaching zero voltage. But the voltages value of all circuit arrangementsare not exactly the same at each point due to the different value of capacitor used in each circuit. Based on the results, in a particular time interval, rate of voltage drop across the bulb is fast but at a certain interval the voltage drops slowly. As shown in Figure 17 we can see that the most of the graph are having a quick drop at the interval of 0 to 1000s. At this interval the bulb illuminate with the highest intensity. This situation happened because, there is charges let to be stored in the ultracapacitor before the batteries and ultracapacitor giving supply to the bulb. Thus, the behaviour of ultracapacitor which discharges quickly caused a quick drop of the voltage.

At the interval of 5000s to 10000s the voltage seems decreasing almost in a linear form. This behaviour occurs because the ultracapacitor is charging and discharging constantly. The ultracapacitor get charged by the batteries and discharge the energy within itself to produce current for the load at the same rate. Thus, the voltage decreased slowly over time.

While at the range of 12000s onward, the voltage decrease in a vey small value thus at that particular range, the slope of the graph is almost flat. At his range, the batteries are reaching at its cut off volatge. Instead, the bulb is not producing any light but there is still current flowing through the bulb. Without disconnecting the bulb from the circuit, the batteries will be drained to 0 voltage.

In this section, datas are analyzed in terms of factor ratio. From the each result, data at hour1, hour 2 and hour 3 are taken to be compared. The data for stand alone battery circuit arrangemant will be set as the base value which is placed as the denominator while the value for other circuit arrangements are set as the numerator. If the factor give the value greater thean 1, it shows some improvement while if the factor less than 1 it shos that there is no improvement given by combining ultracapacitor with batteries

$$\text{Factor} = \frac{\text{Value of the others circuit arrangements}}{\text{Value of the stand alone battery circuit arrangement}}$$

The data of voltage and current at the 3600s, 7200, and 10800s for all circuit arrangements are summarized in the all Table 2 and Table 3 below.

Table 2 : Voltage across the bulb for battery in parallel with ultracapacitor

Voltage across the bulb (V)			
Parallel connection between ultracapacitor and batteries	At 3600s	At 7200s	At 10800s
0 F	1.787	1.281	0.432
0.5 F	1.931	1.411	0.295
1.0 F	1.882	1.304	0.303
1.5 F	1.854	1.304	0.274
2.0 F	1.896	1.350	0.234

Table 3 : Current produced from the battery in parallel with ultracapacitor

Current to the bulb (A)			
Parallel connection between ultracapacitor and batteries	At 3600s	At 7200s	At 10800s
0 F	0.269	0.232	0.165
0.5 F	0.274	0.237	0.154
1.0 F	0.264	0.232	0.147
1.5 F	0.259	0.227	0.138
2.0 F	0.276	0.237	0.150

As a comparison between stand alone circuit and battery in parallel with ultracapacitor, Table 4, 5 and 6 below have been construct to show the comparison factor of those circuits in terms of voltage.

Table 4: The factor of the runtime of voltage across the bulb for battery in parallel with ultracapacitor compared to stand alone battery at 3600s

Voltage across the bulb (V) at 3600s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	1.931	1.787	1.081
1.0 F	1.882	1.787	1.053
1.5 F	1.854	1.787	1.037
2.0 F	1.896	1.787	1.061

Table 5: The factor of the runtime of voltage across the bulb for battery in parallel with ultracapacitor compared to stand alone battery at 7200s

Voltage across the bulb (V) at 7200s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	1.411	1.281	1.305
1.0 F	1.304	1.281	1.018
1.5 F	1.304	1.281	1.018
2.0 F	1.350	1.281	1.054

Table 6: The factor of the runtime of voltage across the bulb for battery in parallel with ultracapacitor compared to stand alone battery at 10800s

Voltage across the bulb (V) at 10800s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	0.295	0.432	0.683
1.0 F	0.303	0.432	0.701
1.5 F	0.274	0.432	0.634
2.0 F	0.234	0.432	0.542

As a comparison between stand alone circuit and battery in parallel with ultracapacitor, Table 7, 8 and 9 below have been construct to show the comparison factor of those circuits in terms of current supplied to the bulb.

Table 7: The factor of the runtime current supply by battery in parallel with ultracapacitor compared to stand alone battery at 3600s

Current to the bulb (A) at 3600s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	0.274	0.269	1.019
1.0 F	0.264	0.269	0.981
1.5 F	0.259	0.269	0.963
2.0 F	0.276	0.269	1.026

Table 8: The factor of the runtime current supply by battery in parallel with ultracapacitor compared to stand alone battery at 7200s

Current to the bulb (A) at 7200s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	0.237	0.232	1.022
1.0 F	0.232	0.232	1.000
1.5 F	0.227	0.232	0.978
2.0 F	0.237	0.232	1.022

Table 9: The factor of the runtime current supply by battery in parallel with ultracapacitor compared to stand alone battery at 10800s

Current to the bulb (A) at 10800s			
Parallel connection between ultracapacitor and batteries		Stand alone battery	Factor
0.5 F	0.154	0.165	0.933
1.0 F	0.147	0.165	0.891
1.5 F	0.138	0.165	0.836
2.0 F	0.150	0.165	0.909

From the Table 4 to Table 9, it is shown that the performances of the overall circuit are varied as the values of ultracapacitor combined with the batteries are varied. Instead, the performance of the batteries supplying power to the bulb is inconstant over time. After a first hour or at 3600s, there is an improvement in terms of voltage for each circuit arrangement with the different values of ultracapacitor. But in term of current, the circuit with 1.0 F and 1.5 F ultracapacitor seems does not give enough current to the load compared to others.

After 2 hours the performance of the batteries supplying power to the bulb is still the same as the first 1 hour. In terms of voltage, all circuit arrangements showing some improvement by having the factor greater than 1. In terms of current, the circuit with 1.0F and 1.5F ultracapacitor showing that in parallel with batteries less current supplied to the load.

After 3 hours all circuit which are with ultracapacitor does not shows any improvement in terms of both voltage and current.

CHAPTER 5

CONCLUSION

5.1 Conclusion

For this context of project, a few complete circuit of a working prototype using ultrcapacitors and batteries as the power supply were experimentally validated. When the batteries are connected in series with ultracapacitor, the ultracapacitor does not give any benefit in assisting the batteries to give power supply to the load with a better performance. This is proven as the bulb does not produce any light when it is connected to the circuit.

Besides, for the batteries connected in parallel with ultracapacitor, the ultracapacitor is giving a slight improvement onto the batteries performance in terms of minimizing the voltage drop and supplying enough current to the load over time. Instead, only for a certain length of time seems the voltage decreased at slower rate and the current provided to the load is higher than the current supplied by the battery alone. Even so the objective of the project is achieved with some limiting factor revealed.

From this project a limiting factor of ultracapacitor in assisting the battery for a better performance is revealed. The larger capacitance value of ultracapacitor *is not a factor which will give a better performance of the battery. Otherwise, an* equation or a guideline should be derived in order to select the best capacitance value of ultracapacitor to suit with the different batteries used for various applications. It is best to optimize the load with the built in ultracapacitor to suit the battery rather than producing a new battery to suit the load.

5.2 Recommendations

Throughout the project, some factors and problems encountered have been identified which affect the results and giving delay onto this project. Thus, a few modifications and improvements should be taken for the future work. Some of those modifications and improvements are:-

- The experimentation should be conducted at the place where is free from any disturbance. A slight disturbance such a vibration will affect the result obtained as the sensors are very sensitive.
- This experimentation should be tested on the load with discontinuous operation.
- The setting of the computer used should be changed earlier to avoid sudden shutdown

REFERENCES

[1] M Jayalakshmi and K Balasubramaniam, 2008 "Simple Capacitors to Supercapacitors" *International Journal Electrochemical Science,* Vol 3:1196-1217.

[2] EHSO
http://www.ehso.com/ehshome/batteries.php
Retrieved on17th September 2010.

[3] Wan Zulfadhli bin Wan Zaki, 'Improving the Voltage Runtime with the Combination of Manganese Battery and Ultracapacitor" Final Year Project, University of Technology PETRONAS. 2010.

[4] Teressa A/P Ludu Nathan, "Comparison of Mesoporous Carbon/Carbon Supercapacitor and Nio / Mesoporous Carbon Hybrid Electrochemical Capacitor", Universiti Sains Malaysia, 2008.

[5] Christophe Jehoulet, Jun 2002 "Charged for Success",
http://www.powergenworldwide.com/index/display/articledisplay/146580/articles/power-engineering-international/volume-10/issue-6/features/charged-for-success.html

[6] Paul Shcherz 2000, *Practical Electronics for Inventors,* US, McGraw-Hill

[7] Ezzat G. Bakhoum, "New Mega-Farad Ultracapacitors" (2009)
Http://ieeexplore.ieee.org//search/srchabstract.jsp?arnumber=4775259&isnumber=4775250&punumber=58&k2dockey=4775259@ieeejrns&query=((ultracapacitor)%3Cin%Emetedata)&pos=20&acess=no
Retrieved on 20th October 2010.

[8] M Jayalakshmi and K Balasubramaniam, 2008 "Simple Capacitors to Supercapacitors" *International Journal Electrochemical Science,* Vol 3:1196-1217.

[9] Teressa A/P Ludu Nathan, "Comparison of Mesoporous Carbon/Carbon Supercapacitor and Nio / Mesoporous Carbon Hybrid Electrochemical Capacitor", Universiti Sains Malaysia, 2008.

[10] Teressa A/P Ludu Nathan, "Comparison of Mesoporous Carbon/Carbon Supercapacitor and Nio / Mesoporous Carbon Hybrid Electrochemical Capacitor", Universiti Sains Malaysia, 2008.

[11] Teressa A/P Ludu Nathan, "Comparison of Mesoporous Carbon/Carbon Supercapacitor and Nio / Mesoporous Carbon Hybrid Electrochemical Capacitor", Universiti Sains Malaysia, 2008.

[12] A Burke ,2000 "Ultracapacitors: why, how, where is the technology", *Journal of Power Sources*, pp. 37-50.

[13] John Dispennette, 2005 "Ultracapacitors Bring Portability to Power",

http://powerelectronics.com/portable_power_management/batteries/power_ultracapacitors_bring_portability/

Retrieved on 22th October 2010.

[14] 2006, "Ultracapacitors Market to Reach $560 Million in 2011",

http://powerelectronics.com/passive_components_packaging interconnects/capacitors/power_ultracapacitors_market_reach/

Retrieved on 25th October 2010.

[15] 2006, "Ultracapacitors Market to Reach $560 Million in 2011",
http://powerelectronics.com/passive_components_packaging
interconnects/capacitors/power_ultracapacitors_market_reach/
Retrieved on 25th October 2010.

[16] VINATECH
www.vinatech.com
Retrieved on 15th August 2010.

[17] INSTRUCTABLES
http://www.instructables.com/id/Hand-Cranked-Flashlight-Mod/step1/The-Back-Up-Super-Capacitor/
Retrieved on 19th April 2011.

[18] ELECTRONICS BUS
http://electronicsbus.com/carbon-aerogel-capacitor/
Retrieved on 19th April 2011.

[19] PASCO
www.pasco.com
Retrieved on 12 October 2010 .

[20] PASCO
www.pasco.com
Retrieved on 12 October 2010.

[21] PASCO
www.pasco.com
Retrieved on 12 October 2010

APPENDIX A

THE DATA SHEETS OF VOLTAGE AND CURRENT ACROSS THE LOAD FOR THE FIRST ONE HOUR

APPENDIX A.1

STAND ALONE BATTERY(VOLTAGE)

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
0	0	174	2.228	348	2.158	522	2.105	696	2.065	870	2.028
2	2.422	176	2.228	350	2.157	524	2.105	698	2.065	872	2.029
4	2.432	178	2.227	352	2.155	526	2.105	700	2.065	874	2.027
6	2.423	180	2.227	354	2.155	528	2.105	702	2.065	876	2.028
8	2.423	182	2.227	356	2.153	530	2.105	704	2.065	878	2.026
10	2.416	184	2.227	358	2.153	532	2.104	706	2.064	880	2.026
12	2.412	186	2.227	360	2.152	534	2.103	708	2.065	882	2.025
14	2.406	188	2.225	362	2.151	536	2.103	710	2.062	884	2.025
16	2.402	190	2.223	364	2.152	538	2.103	712	2.062	886	2.025
18	2.396	192	2.222	366	2.149	540	2.102	714	2.062	888	2.025
20	2.388	194	2.222	368	2.149	542	2.102	716	2.061	890	2.023
22	2.383	196	2.221	370	2.149	544	2.1	718	2.061	892	2.023
24	2.379	198	2.217	372	2.149	546	2.1	720	2.061	894	2.022
26	2.378	200	2.217	374	2.148	548	2.1	722	2.061	896	2.022
28	2.373	202	2.217	376	2.147	550	2.1	724	2.061	898	2.022
30	2.372	204	2.214	378	2.145	552	2.1	726	2.061	900	2.022
32	2.365	206	2.213	380	2.145	554	2.1	728	2.059	902	2.022
34	2.363	208	2.214	382	2.144	556	2.1	730	2.059	904	2.022
36	2.358	210	2.213	384	2.144	558	2.098	732	2.059	906	2.022
38	2.354	212	2.212	386	2.144	560	2.098	734	2.059	908	2.022
40	2.354	214	2.211	388	2.143	562	2.097	736	2.056	910	2.02
42	2.349	216	2.21	390	2.144	564	2.097	738	2.056	912	2.02
44	2.345	218	2.21	392	2.143	566	2.095	740	2.056	914	2.019
46	2.338	220	2.21	394	2.143	568	2.095	742	2.056	916	2.021
48	2.335	222	2.208	396	2.142	570	2.095	744	2.055	918	2.02
50	2.336	224	2.207	398	2.139	572	2.095	746	2.055	920	2.018
52	2.334	226	2.207	400	2.139	574	2.095	748	2.055	922	2.018
54	2.331	228	2.206	402	2.139	576	2.095	750	2.053	924	2.018
56	2.329	230	2.203	404	2.139	578	2.094	752	2.053	926	2.018
58	2.324	232	2.202	406	2.139	580	2.094	754	2.053	928	2.018
60	2.322	234	2.202	408	2.137	582	2.094	756	2.053	930	2.018
62	2.319	236	2.202	410	2.136	584	2.094	758	2.052	932	2.017
64	2.316	238	2.201	412	2.135	586	2.092	760	2.053	934	2.017
66	2.315	240	2.199	414	2.134	588	2.093	762	2.051	936	2.017
68	2.315	242	2.197	416	2.134	590	2.091	764	2.051	938	2.017
70	2.315	244	2.197	418	2.134	592	2.092	766	2.051	940	2.017
72	2.313	246	2.197	420	2.134	594	2.09	768	2.051	942	2.017
74	2.311	248	2.197	422	2.132	596	2.09	770	2.051	944	2.017
76	2.31	250	2.195	424	2.131	598	2.09	772	2.051	946	2.017
78	2.305	252	2.194	426	2.13	600	2.09	774	2.05	948	2.017
80	2.305	254	2.193	428	2.13	602	2.09	776	2.051	950	2.016
82	2.304	256	2.192	430	2.129	604	2.09	778	2.049	952	2.014
84	2.304	258	2.192	432	2.129	606	2.09	780	2.048	954	2.015
86	2.301	260	2.192	434	2.129	608	2.089	782	2.046	956	2.014
88	2.298	262	2.192	436	2.128	610	2.087	784	2.046	958	2.013
90	2.294	264	2.189	438	2.128	612	2.087	786	2.046	960	2.012
92	2.294	266	2.189	440	2.128	614	2.086	788	2.046	962	2.012
94	2.292	268	2.188	442	2.129	616	2.085	790	2.046	964	2.012
96	2.291	270	2.188	444	2.128	618	2.085	792	2.045	966	2.012
98	2.291	272	2.188	446	2.126	620	2.085	794	2.045	968	2.012
100	2.29	274	2.188	448	2.125	622	2.084	796	2.044	970	2.012
102	2.29	276	2.187	450	2.124	624	2.081	798	2.045	972	2.011
104	2.288	278	2.187	452	2.124	626	2.081	800	2.043	974	2.012
106	2.285	280	2.186	454	2.124	628	2.083	802	2.044	976	2.011
108	2.285	282	2.184	456	2.122	630	2.081	804	2.042	978	2.012
110	2.281	284	2.183	458	2.121	632	2.08	806	2.041	980	2.011
112	2.279	286	2.181	460	2.12	634	2.08	808	2.041	982	2.011
114	2.276	288	2.178	462	2.122	636	2.08	810	2.041	984	2.01
116	2.275	290	2.178	464	2.12	638	2.08	812	2.041	986	2.008
118	2.272	292	2.178	466	2.119	640	2.08	814	2.041	988	2.008
120	2.271	294	2.178	468	2.119	642	2.08	816	2.041	990	2.007
122	2.27	296	2.177	470	2.119	644	2.08	818	2.04	992	2.007
124	2.268	298	2.175	472	2.119	646	2.078	820	2.039	994	2.007
126	2.266	300	2.173	474	2.118	648	2.078	822	2.039	996	2.007
128	2.263	302	2.173	476	2.117	650	2.076	824	2.037	998	2.007
130	2.262	304	2.172	478	2.117	652	2.076	826	2.037	1000	2.006
132	2.261	306	2.172	480	2.117	654	2.075	828	2.036	1002	2.007
134	2.26	308	2.17	482	2.116	656	2.075	830	2.036	1004	2.006
136	2.257	310	2.169	484	2.116	658	2.075	832	2.036	1006	2.006
138	2.256	312	2.169	486	2.116	660	2.075	834	2.036	1008	2.006
140	2.256	314	2.168	488	2.115	662	2.074	836	2.036	1010	2.005
142	2.253	316	2.168	490	2.115	664	2.073	838	2.035	1012	2.006
144	2.251	318	2.168	492	2.114	666	2.072	840	2.036	1014	2.004
146	2.25	320	2.164	494	2.114	668	2.071	842	2.034	1016	2.004
148	2.248	322	2.167	496	2.113	670	2.072	844	2.034	1018	2.004
150	2.25	324	2.166	498	2.112	672	2.072	846	2.034	1020	2.003
152	2.246	326	2.166	500	2.111	674	2.07	848	2.034	1022	2.003
154	2.246	328	2.164	502	2.111	676	2.07	850	2.033	1024	2.003
156	2.243	330	2.163	504	2.109	678	2.07	852	2.031	1026	2.002
158	2.241	332	2.163	506	2.11	680	2.07	854	2.031	1028	2.002
160	2.237	334	2.163	508	2.109	682	2.07	856	2.031	1030	2.002
162	2.237	336	2.163	510	2.109	684	2.07	858	2.031	1032	2.002
164	2.236	338	2.161	512	2.109	686	2.07	860	2.031	1034	2.002
166	2.235	340	2.159	514	2.108	688	2.069	862	2.031	1036	2.002
168	2.232	342	2.158	516	2.108	690	2.068	864	2.031	1038	2.002
170	2.232	344	2.159	518	2.107	692	2.067	866	2.031	1040	2.002
172	2.232	346	2.158	520	2.105	694	2.066	868	2.03	1042	2.001

0F voltage

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
1044	2.002	1218	1.977	1392	1.958	1566	1.939	1740	1.921	1914	1.909
1046	2.002	1220	1.978	1394	1.958	1568	1.939	1742	1.92	1916	1.907
1048	2.001	1222	1.978	1396	1.958	1570	1.939	1744	1.92	1918	1.908
1050	2	1224	1.977	1398	1.958	1572	1.939	1746	1.919	1920	1.906
1052	1.999	1226	1.976	1400	1.958	1574	1.939	1748	1.92	1922	1.906
1054	2	1228	1.975	1402	1.958	1576	1.939	1750	1.92	1924	1.907
1056	2	1230	1.975	1404	1.957	1578	1.939	1752	1.919	1926	1.908
1058	1.999	1232	1.974	1406	1.957	1580	1.939	1754	1.919	1928	1.907
1060	1.998	1234	1.975	1408	1.957	1582	1.939	1756	1.919	1930	1.906
1062	1.999	1236	1.975	1410	1.955	1584	1.938	1758	1.919	1932	1.906
1064	1.998	1238	1.974	1412	1.955	1586	1.939	1760	1.919	1934	1.907
1066	1.997	1240	1.973	1414	1.955	1588	1.938	1762	1.919	1936	1.907
1068	1.997	1242	1.973	1416	1.956	1590	1.937	1764	1.919	1938	1.904
1070	1.997	1244	1.973	1418	1.955	1592	1.937	1766	1.919	1940	1.906
1072	1.997	1246	1.973	1420	1.955	1594	1.938	1768	1.919	1942	1.906
1074	1.997	1248	1.973	1422	1.954	1596	1.937	1770	1.919	1944	1.905
1076	1.996	1250	1.973	1424	1.953	1598	1.934	1772	1.918	1946	1.906
1078	1.996	1252	1.973	1426	1.953	1600	1.934	1774	1.918	1948	1.904
1080	1.996	1254	1.973	1428	1.953	1602	1.934	1776	1.918	1950	1.905
1082	1.995	1256	1.973	1430	1.953	1604	1.933	1778	1.918	1952	1.904
1084	1.995	1258	1.973	1432	1.953	1606	1.933	1780	1.919	1954	1.904
1086	1.993	1260	1.973	1434	1.953	1608	1.933	1782	1.918	1956	1.904
1088	1.992	1262	1.972	1436	1.953	1610	1.934	1784	1.918	1958	1.905
1090	1.993	1264	1.972	1438	1.953	1612	1.932	1786	1.916	1960	1.904
1092	1.992	1266	1.971	1440	1.953	1614	1.932	1788	1.917	1962	1.904
1094	1.992	1268	1.972	1442	1.953	1616	1.933	1790	1.917	1964	1.904
1096	1.992	1270	1.971	1444	1.953	1618	1.933	1792	1.917	1966	1.904
1098	1.992	1272	1.97	1446	1.953	1620	1.931	1794	1.917	1968	1.904
1100	1.992	1274	1.968	1448	1.953	1622	1.931	1796	1.916	1970	1.904
1102	1.992	1276	1.97	1450	1.953	1624	1.931	1798	1.916	1972	1.904
1104	1.992	1278	1.969	1452	1.951	1626	1.93	1800	1.915	1974	1.904
1106	1.992	1280	1.97	1454	1.952	1628	1.93	1802	1.915	1976	1.904
1108	1.99	1282	1.968	1456	1.95	1630	1.929	1804	1.916	1978	1.904
1110	1.991	1284	1.968	1458	1.95	1632	1.929	1806	1.914	1980	1.904
1112	1.99	1286	1.969	1460	1.95	1634	1.929	1808	1.915	1982	1.904
1114	1.99	1288	1.968	1462	1.949	1636	1.929	1810	1.915	1984	1.904
1116	1.989	1290	1.968	1464	1.95	1638	1.929	1812	1.915	1986	1.904
1118	1.989	1292	1.968	1466	1.949	1640	1.929	1814	1.914	1988	1.904
1120	1.988	1294	1.967	1468	1.948	1642	1.929	1816	1.914	1990	1.904
1122	1.987	1296	1.967	1470	1.95	1644	1.929	1818	1.914	1992	1.904
1124	1.987	1298	1.968	1472	1.948	1646	1.929	1820	1.915	1994	1.904
1126	1.987	1300	1.967	1474	1.948	1648	1.929	1822	1.914	1996	1.904
1128	1.987	1302	1.967	1476	1.948	1650	1.928	1824	1.914	1998	1.904
1130	1.987	1304	1.967	1478	1.948	1652	1.929	1826	1.914	2000	1.902
1132	1.987	1306	1.967	1480	1.948	1654	1.929	1828	1.914	2002	1.903
1134	1.987	1308	1.967	1482	1.948	1656	1.929	1830	1.914	2004	1.903
1136	1.986	1310	1.967	1484	1.948	1658	1.929	1832	1.914	2006	1.901
1138	1.986	1312	1.966	1486	1.948	1660	1.928	1834	1.914	2008	1.901
1140	1.986	1314	1.965	1488	1.948	1662	1.928	1836	1.914	2010	1.902
1142	1.986	1316	1.964	1490	1.946	1664	1.928	1838	1.914	2012	1.901
1144	1.984	1318	1.964	1492	1.946	1666	1.927	1840	1.914	2014	1.901
1146	1.984	1320	1.964	1494	1.946	1668	1.926	1842	1.914	2016	1.899
1148	1.985	1322	1.964	1496	1.946	1670	1.926	1844	1.914	2018	1.9
1150	1.984	1324	1.964	1498	1.946	1672	1.925	1846	1.914	2020	1.899
1152	1.982	1326	1.963	1500	1.947	1674	1.926	1848	1.914	2022	1.899
1154	1.982	1328	1.963	1502	1.947	1676	1.926	1850	1.914	2024	1.899
1156	1.982	1330	1.963	1504	1.945	1678	1.926	1852	1.914	2026	1.899
1158	1.982	1332	1.963	1506	1.945	1680	1.926	1854	1.914	2028	1.899
1160	1.982	1334	1.963	1508	1.945	1682	1.924	1856	1.914	2030	1.899
1162	1.982	1336	1.963	1510	1.944	1684	1.924	1858	1.914	2032	1.899
1164	1.982	1338	1.963	1512	1.944	1686	1.924	1860	1.914	2034	1.899
1166	1.982	1340	1.963	1514	1.945	1688	1.924	1862	1.912	2036	1.899
1168	1.982	1342	1.963	1516	1.945	1690	1.924	1864	1.912	2038	1.899
1170	1.981	1344	1.963	1518	1.944	1692	1.924	1866	1.912	2040	1.899
1172	1.98	1346	1.963	1520	1.943	1694	1.924	1868	1.912	2042	1.899
1174	1.982	1348	1.963	1522	1.943	1696	1.924	1870	1.91	2044	1.898
1176	1.981	1350	1.963	1524	1.943	1698	1.924	1872	1.911	2046	1.898
1178	1.981	1352	1.963	1526	1.943	1700	1.924	1874	1.91	2048	1.897
1180	1.98	1354	1.963	1528	1.943	1702	1.924	1876	1.91	2050	1.898
1182	1.979	1356	1.963	1530	1.943	1704	1.924	1878	1.91	2052	1.896
1184	1.978	1358	1.962	1532	1.943	1706	1.924	1880	1.91	2054	1.898
1186	1.978	1360	1.962	1534	1.943	1708	1.923	1882	1.91	2056	1.897
1188	1.978	1362	1.961	1536	1.943	1710	1.924	1884	1.91	2058	1.898
1190	1.979	1364	1.962	1538	1.943	1712	1.923	1886	1.909	2060	1.896
1192	1.979	1366	1.961	1540	1.943	1714	1.923	1888	1.909	2062	1.897
1194	1.979	1368	1.96	1542	1.943	1716	1.923	1890	1.909	2064	1.896
1196	1.978	1370	1.962	1544	1.943	1718	1.923	1892	1.909	2066	1.896
1198	1.978	1372	1.961	1546	1.943	1720	1.923	1894	1.909	2068	1.896
1200	1.978	1374	1.959	1548	1.943	1722	1.923	1896	1.908	2070	1.895
1202	1.978	1376	1.959	1550	1.943	1724	1.922	1898	1.909	2072	1.895
1204	1.978	1378	1.959	1552	1.942	1726	1.921	1900	1.909	2074	1.895
1206	1.978	1380	1.958	1554	1.942	1728	1.921	1902	1.908	2076	1.895
1208	1.978	1382	1.958	1556	1.941	1730	1.921	1904	1.909	2078	1.895
1210	1.978	1384	1.958	1558	1.94	1732	1.921	1906	1.907	2080	1.895
1212	1.978	1386	1.958	1560	1.939	1734	1.921	1908	1.908	2082	1.895
1214	1.978	1388	1.959	1562	1.94	1736	1.921	1910	1.909	2084	1.895
1216	1.978	1390	1.958	1564	1.939	1738	1.921	1912	1.908	2086	1.895

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
2088	1.895	2298	1.885	2472	1.876	2646	1.865	2820	1.853	2994	1.841
2090	1.895	2300	1.885	2474	1.876	2648	1.865	2822	1.852	2996	1.841
2092	1.895	2302	1.885	2476	1.875	2650	1.865	2824	1.854	2998	1.841
2094	1.895	2304	1.885	2478	1.875	2652	1.865	2826	1.853	3000	1.841
2096	1.895	2306	1.885	2480	1.875	2654	1.865	2828	1.855	3002	1.841
2098	1.895	2308	1.885	2482	1.875	2656	1.865	2830	1.852	3004	1.841
2100	1.895	2310	1.885	2484	1.875	2658	1.865	2832	1.854	3006	1.841
2102	1.895	2312	1.885	2486	1.875	2660	1.865	2834	1.852	3008	1.841
2104	1.894	2314	1.885	2488	1.875	2662	1.865	2836	1.852	3010	1.841
2106	1.895	2316	1.885	2490	1.875	2664	1.865	2838	1.852	3012	1.841
2108	1.895	2318	1.885	2492	1.875	2666	1.865	2840	1.852	3014	1.841
2110	1.895	2320	1.885	2494	1.875	2668	1.865	2842	1.851	3016	1.841
2112	1.895	2322	1.885	2496	1.875	2670	1.865	2844	1.851	3018	1.84
2114	1.892	2324	1.885	2498	1.875	2672	1.865	2846	1.851	3020	1.84
2116	1.893	2326	1.885	2500	1.875	2674	1.864	2848	1.851	3022	1.84
2118	1.895	2328	1.885	2502	1.875	2676	1.863	2850	1.851	3024	1.841
2120	1.895	2330	1.885	2504	1.875	2678	1.863	2852	1.851	3026	1.841
2122	1.895	2332	1.885	2506	1.875	2680	1.863	2854	1.851	3028	1.84
2124	1.893	2334	1.885	2508	1.875	2682	1.863	2856	1.851	3030	1.84
2126	1.893	2336	1.885	2510	1.875	2684	1.862	2858	1.851	3032	1.84
2128	1.893	2338	1.885	2512	1.875	2686	1.862	2860	1.851	3034	1.839
2130	1.893	2340	1.885	2514	1.875	2688	1.862	2862	1.851	3036	1.838
2132	1.894	2342	1.884	2516	1.874	2690	1.862	2864	1.851	3038	1.838
2134	1.894	2344	1.884	2518	1.875	2692	1.862	2866	1.851	3040	1.838
2136	1.894	2346	1.884	2520	1.875	2694	1.862	2868	1.851	3042	1.837
2138	1.894	2348	1.884	2522	1.873	2696	1.861	2870	1.85	3044	1.837
2140	1.894	2350	1.884	2524	1.874	2698	1.861	2872	1.85	3046	1.837
2142	1.893	2352	1.884	2526	1.874	2700	1.861	2874	1.851	3048	1.837
2144	1.893	2354	1.884	2528	1.874	2702	1.86	2876	1.85	3050	1.837
2146	1.893	2356	1.882	2530	1.874	2704	1.86	2878	1.849	3052	1.837
2148	1.893	2358	1.882	2532	1.874	2706	1.861	2880	1.849	3054	1.837
2150	1.893	2360	1.884	2534	1.873	2708	1.861	2882	1.849	3056	1.837
2152	1.893	2362	1.882	2536	1.872	2710	1.861	2884	1.849	3058	1.837
2154	1.892	2364	1.882	2538	1.871	2712	1.861	2886	1.849	3060	1.836
2156	1.891	2366	1.882	2540	1.87	2714	1.861	2888	1.849	3062	1.836
2158	1.892	2368	1.882	2542	1.87	2716	1.86	2890	1.849	3064	1.836
2160	1.893	2370	1.881	2544	1.871	2718	1.86	2892	1.848	3066	1.836
2162	1.892	2372	1.882	2546	1.871	2720	1.86	2894	1.846	3068	1.836
2164	1.892	2374	1.881	2548	1.871	2722	1.86	2896	1.848	3070	1.836
2166	1.892	2376	1.881	2550	1.871	2724	1.86	2898	1.849	3072	1.836
2168	1.892	2378	1.881	2552	1.871	2726	1.86	2900	1.848	3074	1.836
2170	1.89	2380	1.881	2554	1.871	2728	1.86	2902	1.847	3076	1.836
2172	1.89	2382	1.881	2556	1.87	2730	1.86	2904	1.847	3078	1.836
2174	1.89	2384	1.881	2558	1.87	2732	1.86	2906	1.846	3080	1.836
2176	1.892	2386	1.88	2560	1.87	2734	1.86	2908	1.848	3082	1.836
2178	1.891	2388	1.88	2562	1.87	2736	1.86	2910	1.847	3084	1.835
2180	1.89	2390	1.88	2564	1.87	2738	1.86	2912	1.846	3086	1.836
2182	1.891	2392	1.88	2566	1.87	2740	1.86	2914	1.847	3088	1.835
2184	1.891	2394	1.88	2568	1.87	2742	1.859	2916	1.846	3090	1.836
2186	1.89	2396	1.88	2570	1.87	2744	1.858	2918	1.846	3092	1.836
2188	1.89	2398	1.88	2572	1.87	2746	1.859	2920	1.846	3094	1.835
2190	1.891	2400	1.88	2574	1.868	2748	1.859	2922	1.846	3096	1.835
2192	1.89	2402	1.88	2576	1.87	2750	1.857	2924	1.846	3098	1.836
2194	1.89	2404	1.881	2578	1.87	2752	1.857	2926	1.846	3100	1.835
2196	1.89	2406	1.88	2580	1.87	2754	1.857	2928	1.846	3102	1.835
2198	1.89	2408	1.88	2582	1.87	2756	1.857	2930	1.846	3104	1.834
2200	1.89	2410	1.88	2584	1.87	2758	1.857	2932	1.846	3106	1.834
2202	1.89	2412	1.88	2586	1.87	2760	1.857	2934	1.846	3108	1.834
2204	1.89	2414	1.88	2588	1.87	2762	1.857	2936	1.846	3110	1.834
2206	1.89	2416	1.88	2590	1.87	2764	1.857	2938	1.846	3112	1.833
2244	1.887	2418	1.879	2592	1.869	2766	1.857	2940	1.846	3114	1.832
2246	1.888	2420	1.88	2594	1.87	2768	1.857	2942	1.846	3116	1.833
2248	1.888	2422	1.879	2596	1.87	2770	1.856	2944	1.845	3118	1.832
2250	1.888	2424	1.879	2598	1.869	2772	1.856	2946	1.846	3120	1.832
2252	1.888	2426	1.879	2600	1.87	2774	1.857	2948	1.845	3122	1.832
2254	1.888	2428	1.879	2602	1.868	2776	1.856	2950	1.845	3124	1.832
2256	1.887	2430	1.877	2604	1.868	2778	1.856	2952	1.846	3126	1.831
2258	1.887	2432	1.877	2606	1.867	2780	1.856	2954	1.845	3128	1.831
2260	1.887	2434	1.877	2608	1.868	2782	1.856	2956	1.845	3130	1.831
2262	1.886	2436	1.877	2610	1.866	2784	1.856	2958	1.844	3132	1.831
2264	1.887	2438	1.877	2612	1.867	2786	1.856	2960	1.843	3134	1.831
2266	1.886	2440	1.877	2614	1.867	2788	1.856	2962	1.843	3136	1.831
2268	1.887	2442	1.876	2616	1.866	2790	1.856	2964	1.845	3138	1.831
2270	1.886	2444	1.876	2618	1.867	2792	1.856	2966	1.845	3140	1.831
2272	1.887	2446	1.876	2620	1.867	2794	1.856	2968	1.844	3142	1.831
2274	1.887	2448	1.876	2622	1.866	2796	1.856	2970	1.844	3144	1.831
2276	1.887	2450	1.876	2624	1.865	2798	1.856	2972	1.843	3146	1.831
2278	1.887	2452	1.876	2626	1.866	2800	1.856	2974	1.842	3148	1.831
2280	1.886	2454	1.876	2628	1.866	2802	1.856	2976	1.842	3150	1.831
2282	1.885	2456	1.876	2630	1.865	2804	1.856	2978	1.841	3152	1.828
2284	1.885	2458	1.876	2632	1.865	2806	1.856	2980	1.842	3154	1.828
2286	1.885	2460	1.876	2634	1.865	2808	1.856	2982	1.841	3156	1.83
2288	1.885	2462	1.876	2636	1.865	2810	1.856	2984	1.843	3158	1.83
2290	1.885	2464	1.876	2638	1.865	2812	1.855	2986	1.843	3160	1.831
2292	1.885	2466	1.876	2640	1.865	2814	1.854	2988	1.841	3162	1.828
2294	1.885	2468	1.875	2642	1.865	2816	1.855	2990	1.841	3164	1.828
2296	1.885	2470	1.875	2644	1.865	2818	1.854	2992	1.841	3166	1.828

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
3168	1.827	3342	1.814	3516	1.797
3170	1.829	3344	1.814	3518	1.797
3172	1.828	3346	1.813	3520	1.797
3174	1.827	3348	1.812	3522	1.797
3176	1.827	3350	1.812	3524	1.797
3178	1.826	3352	1.813	3526	1.796
3180	1.827	3354	1.813	3528	1.797
3182	1.827	3356	1.812	3530	1.796
3184	1.826	3358	1.812	3532	1.797
3186	1.826	3360	1.812	3534	1.796
3188	1.826	3362	1.812	3536	1.796
3190	1.826	3364	1.812	3538	1.796
3192	1.826	3366	1.812	3540	1.796
3194	1.826	3368	1.812	3542	1.796
3196	1.826	3370	1.811	3544	1.794
3198	1.826	3372	1.812	3546	1.794
3200	1.826	3374	1.812	3548	1.794
3202	1.826	3376	1.811	3550	1.793
3204	1.826	3378	1.812	3552	1.793
3206	1.826	3380	1.81	3554	1.792
3208	1.826	3382	1.81	3556	1.792
3210	1.825	3384	1.811	3558	1.792
3212	1.826	3386	1.81	3560	1.792
3214	1.826	3388	1.809	3562	1.792
3216	1.826	3390	1.809	3564	1.792
3218	1.826	3392	1.809	3566	1.791
3220	1.825	3394	1.807	3568	1.791
3222	1.825	3396	1.808	3570	1.791
3224	1.825	3398	1.809	3572	1.791
3226	1.824	3400	1.809	3574	1.791
3228	1.823	3402	1.807	3576	1.79
3230	1.823	3404	1.807	3578	1.79
3232	1.823	3406	1.807	3580	1.789
3234	1.823	3408	1.807	3582	1.788
3236	1.824	3410	1.807	3584	1.789
3238	1.823	3412	1.807	3586	1.788
3240	1.822	3414	1.807	3588	1.788
3242	1.822	3416	1.807	3590	1.788
3244	1.821	3418	1.807	3592	1.788
3246	1.821	3420	1.807	3594	1.787
3248	1.821	3422	1.807	3596	1.787
3250	1.822	3424	1.807	3598	1.787
3252	1.821	3426	1.807	3600	1.787
3254	1.821	3428	1.807		
3256	1.821	3430	1.807		
3258	1.821	3432	1.807		
3260	1.821	3434	1.806		
3262	1.821	3436	1.806		
3264	1.821	3438	1.806		
3266	1.821	3440	1.806		
3268	1.821	3442	1.806		
3270	1.821	3444	1.805		
3272	1.821	3446	1.805		
3274	1.821	3448	1.805		
3276	1.821	3450	1.803		
3278	1.819	3452	1.804		
3280	1.819	3454	1.802		
3282	1.819	3456	1.803		
3284	1.818	3458	1.803		
3286	1.82	3460	1.802		
3288	1.817	3462	1.802		
3290	1.817	3464	1.802		
3292	1.818	3466	1.802		
3294	1.818	3468	1.802		
3296	1.818	3470	1.802		
3298	1.818	3472	1.802		
3300	1.816	3474	1.802		
3302	1.816	3476	1.802		
3304	1.816	3478	1.801		
3306	1.816	3480	1.801		
3308	1.816	3482	1.801		
3310	1.816	3484	1.802		
3312	1.816	3486	1.801		
3314	1.817	3488	1.801		
3316	1.816	3490	1.799		
3318	1.816	3492	1.8		
3320	1.816	3494	1.799		
3322	1.816	3496	1.798		
3324	1.816	3498	1.799		
3326	1.816	3500	1.798		
3328	1.816	3502	1.798		
3330	1.816	3504	1.797		
3332	1.814	3506	1.798		
3334	1.813	3508	1.797		
3336	1.815	3510	1.797		
3338	1.813	3512	1.797		
3340	1.815	3514	1.797		

APPENDIX A.2

STAND ALONE BATTERY(CURRENT)

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
0	1.47E-03	174	0.299	348	0.294	522	0.291	696	0.288	870	0.286
2	0.317	176	0.299	350	0.294	524	0.291	698	0.288	872	0.286
4	0.315	178	0.299	352	0.294	526	0.291	700	0.288	874	0.286
6	0.314	180	0.299	354	0.294	528	0.291	702	0.288	876	0.286
8	0.314	182	0.299	356	0.294	530	0.291	704	0.288	878	0.286
10	0.313	184	0.299	358	0.294	532	0.291	706	0.288	880	0.286
12	0.312	186	0.299	360	0.294	534	0.291	708	0.288	882	0.286
14	0.312	188	0.299	362	0.294	536	0.291	710	0.288	884	0.286
16	0.311	190	0.299	364	0.294	538	0.291	712	0.288	886	0.286
18	0.311	192	0.299	366	0.294	540	0.291	714	0.288	888	0.286
20	0.31	194	0.299	368	0.294	542	0.291	716	0.288	890	0.286
22	0.31	196	0.299	370	0.294	544	0.291	718	0.288	892	0.286
24	0.31	198	0.299	372	0.294	546	0.291	720	0.288	894	0.286
26	0.309	200	0.298	374	0.294	548	0.291	722	0.288	896	0.285
28	0.309	202	0.298	376	0.294	550	0.291	724	0.288	898	0.286
30	0.309	204	0.298	378	0.294	552	0.291	726	0.288	900	0.285
32	0.308	206	0.298	380	0.294	554	0.291	728	0.288	902	0.285
34	0.308	208	0.298	382	0.294	556	0.291	730	0.288	904	0.285
36	0.308	210	0.298	384	0.294	558	0.29	732	0.288	906	0.285
38	0.308	212	0.298	386	0.294	560	0.29	734	0.288	908	0.285
40	0.308	214	0.298	388	0.294	562	0.29	736	0.288	910	0.285
42	0.307	216	0.298	390	0.293	564	0.29	738	0.288	912	0.285
44	0.307	218	0.298	392	0.293	566	0.29	740	0.288	914	0.285
46	0.307	220	0.298	394	0.293	568	0.29	742	0.288	916	0.285
48	0.306	222	0.298	396	0.293	570	0.29	744	0.288	918	0.285
50	0.306	224	0.298	398	0.293	572	0.29	746	0.287	920	0.285
52	0.306	226	0.298	400	0.293	574	0.29	748	0.288	922	0.285
54	0.306	228	0.298	402	0.293	576	0.29	750	0.288	924	0.285
56	0.306	230	0.298	404	0.293	578	0.29	752	0.287	926	0.285
58	0.306	232	0.298	406	0.293	580	0.29	754	0.287	928	0.285
60	0.306	234	0.297	408	0.293	582	0.29	756	0.288	930	0.285
62	0.305	236	0.297	410	0.293	584	0.29	758	0.287	932	0.285
64	0.305	238	0.297	412	0.293	586	0.29	760	0.287	934	0.285
66	0.305	240	0.297	414	0.293	588	0.29	762	0.287	936	0.285
68	0.305	242	0.297	416	0.293	590	0.29	764	0.287	938	0.285
70	0.305	244	0.297	418	0.293	592	0.29	766	0.287	940	0.285
72	0.305	246	0.297	420	0.293	594	0.29	768	0.287	942	0.285
74	0.305	248	0.297	422	0.293	596	0.29	770	0.287	944	0.285
76	0.305	250	0.297	424	0.293	598	0.29	772	0.287	946	0.285
78	0.305	252	0.297	426	0.293	600	0.29	774	0.287	948	0.285
80	0.304	254	0.297	428	0.293	602	0.29	776	0.287	950	0.285
82	0.304	256	0.297	430	0.293	604	0.29	778	0.287	952	0.285
84	0.304	258	0.297	432	0.293	606	0.29	780	0.287	954	0.285
86	0.304	260	0.297	434	0.293	608	0.29	782	0.287	956	0.285
88	0.304	262	0.297	436	0.293	610	0.29	784	0.287	958	0.285
90	0.304	264	0.297	438	0.292	612	0.29	786	0.287	960	0.285
92	0.303	266	0.297	440	0.292	614	0.29	788	0.287	962	0.285
94	0.303	268	0.297	442	0.292	616	0.29	790	0.287	964	0.285
96	0.303	270	0.297	444	0.292	618	0.29	792	0.287	966	0.285
98	0.303	272	0.296	446	0.292	620	0.29	794	0.287	968	0.285
100	0.303	274	0.296	448	0.292	622	0.289	796	0.287	970	0.285
102	0.303	276	0.296	450	0.292	624	0.289	798	0.287	972	0.285
104	0.303	278	0.296	452	0.292	626	0.289	800	0.287	974	0.285
106	0.303	280	0.296	454	0.292	628	0.289	802	0.287	976	0.285
108	0.303	282	0.296	456	0.292	630	0.289	804	0.287	978	0.285
110	0.303	284	0.296	458	0.292	632	0.289	806	0.287	980	0.285
112	0.303	286	0.296	460	0.292	634	0.289	808	0.287	982	0.284
114	0.302	288	0.296	462	0.292	636	0.289	810	0.287	984	0.285
116	0.302	290	0.296	464	0.292	638	0.289	812	0.287	986	0.284
118	0.302	292	0.296	466	0.292	640	0.289	814	0.287	988	0.285
120	0.302	294	0.296	468	0.292	642	0.289	816	0.287	990	0.284
122	0.302	296	0.296	470	0.292	644	0.289	818	0.287	992	0.284
124	0.302	298	0.296	472	0.292	646	0.289	820	0.287	994	0.284
126	0.302	300	0.295	474	0.292	648	0.289	822	0.287	996	0.284
128	0.302	302	0.295	476	0.292	650	0.289	824	0.287	998	0.284
130	0.301	304	0.295	478	0.292	652	0.289	826	0.287	1000	0.284
132	0.301	306	0.295	480	0.292	654	0.289	828	0.287	1002	0.284
134	0.301	308	0.295	482	0.292	656	0.289	830	0.286	1004	0.284
136	0.301	310	0.295	484	0.292	658	0.289	832	0.286	1006	0.284
138	0.301	312	0.295	486	0.292	660	0.289	834	0.286	1008	0.284
140	0.301	314	0.295	488	0.292	662	0.289	836	0.286	1010	0.284
142	0.301	316	0.295	490	0.292	664	0.289	838	0.286	1012	0.284
144	0.301	318	0.295	492	0.292	666	0.289	840	0.286	1014	0.284
146	0.301	320	0.295	494	0.291	668	0.289	842	0.286	1016	0.284
148	0.301	322	0.295	496	0.291	670	0.289	844	0.286	1018	0.284
150	0.301	324	0.295	498	0.291	672	0.289	846	0.286	1020	0.284
152	0.3	326	0.295	500	0.291	674	0.289	848	0.286	1022	0.284
154	0.3	328	0.295	502	0.291	676	0.289	850	0.286	1024	0.284
156	0.3	330	0.295	504	0.291	678	0.289	852	0.286	1026	0.284
158	0.3	332	0.295	506	0.291	680	0.289	854	0.286	1028	0.284
160	0.3	334	0.295	508	0.291	682	0.289	856	0.286	1030	0.284
162	0.3	336	0.295	510	0.291	684	0.289	858	0.286	1032	0.284
164	0.3	338	0.295	512	0.291	686	0.289	860	0.286	1034	0.284
166	0.3	340	0.295	514	0.291	688	0.288	862	0.286	1036	0.284
168	0.3	342	0.295	516	0.291	690	0.288	864	0.286	1038	0.284
170	0.299	344	0.295	518	0.291	692	0.288	866	0.286	1040	0.284
172	0.299	346	0.294	520	0.291	694	0.288	868	0.286	1042	0.284

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
1044	0.284	1218	0.282	1392	0.281	1566	0.28	1740	0.278	1914	0.278
1046	0.284	1220	0.282	1394	0.281	1568	0.28	1742	0.278	1916	0.278
1048	0.284	1222	0.282	1396	0.281	1570	0.28	1744	0.278	1918	0.278
1050	0.284	1224	0.282	1398	0.281	1572	0.28	1746	0.278	1920	0.277
1052	0.284	1226	0.282	1400	0.281	1574	0.28	1748	0.278	1922	0.278
1054	0.284	1228	0.282	1402	0.281	1576	0.28	1750	0.278	1924	0.278
1056	0.284	1230	0.282	1404	0.281	1578	0.28	1752	0.278	1926	0.278
1058	0.284	1232	0.282	1406	0.281	1580	0.28	1754	0.278	1928	0.277
1060	0.284	1234	0.282	1408	0.281	1582	0.28	1756	0.278	1930	0.277
1062	0.284	1236	0.282	1410	0.281	1584	0.28	1758	0.278	1932	0.278
1064	0.284	1238	0.282	1412	0.281	1586	0.28	1760	0.278	1934	0.278
1066	0.284	1240	0.282	1414	0.281	1588	0.28	1762	0.278	1936	0.277
1068	0.284	1242	0.282	1416	0.281	1590	0.28	1764	0.278	1938	0.277
1070	0.284	1244	0.282	1418	0.281	1592	0.28	1766	0.278	1940	0.277
1072	0.284	1246	0.282	1420	0.281	1594	0.28	1768	0.278	1942	0.277
1074	0.284	1248	0.282	1422	0.281	1596	0.28	1770	0.278	1944	0.278
1076	0.284	1250	0.282	1424	0.281	1598	0.279	1772	0.278	1946	0.277
1078	0.284	1252	0.282	1426	0.281	1600	0.279	1774	0.278	1948	0.277
1080	0.284	1254	0.282	1428	0.281	1602	0.279	1776	0.278	1950	0.277
1082	0.284	1256	0.282	1430	0.281	1604	0.279	1778	0.278	1952	0.277
1084	0.284	1258	0.282	1432	0.281	1606	0.279	1780	0.278	1954	0.277
1086	0.284	1260	0.282	1434	0.281	1608	0.279	1782	0.278	1956	0.277
1088	0.284	1262	0.282	1436	0.281	1610	0.279	1784	0.278	1958	0.277
1090	0.283	1264	0.282	1438	0.281	1612	0.279	1786	0.278	1960	0.277
1092	0.283	1266	0.282	1440	0.281	1614	0.279	1788	0.278	1962	0.277
1094	0.284	1268	0.282	1442	0.281	1616	0.279	1790	0.278	1964	0.277
1096	0.284	1270	0.282	1444	0.281	1618	0.279	1792	0.278	1966	0.277
1098	0.283	1272	0.282	1446	0.281	1620	0.279	1794	0.278	1968	0.277
1100	0.283	1274	0.282	1448	0.281	1622	0.279	1796	0.278	1970	0.277
1102	0.283	1276	0.282	1450	0.28	1624	0.279	1798	0.278	1972	0.277
1104	0.283	1278	0.282	1452	0.281	1626	0.279	1800	0.278	1974	0.277
1106	0.283	1280	0.282	1454	0.281	1628	0.279	1802	0.278	1976	0.277
1108	0.283	1282	0.282	1456	0.28	1630	0.279	1804	0.278	1978	0.277
1110	0.283	1284	0.282	1458	0.28	1632	0.279	1806	0.278	1980	0.277
1112	0.283	1286	0.282	1460	0.28	1634	0.279	1808	0.278	1982	0.277
1114	0.283	1288	0.282	1462	0.28	1636	0.279	1810	0.278	1984	0.277
1116	0.283	1290	0.282	1464	0.28	1638	0.279	1812	0.278	1986	0.277
1118	0.283	1292	0.282	1466	0.281	1640	0.279	1814	0.278	1988	0.277
1120	0.283	1294	0.282	1468	0.281	1642	0.279	1816	0.278	1990	0.277
1122	0.283	1296	0.282	1470	0.28	1644	0.279	1818	0.278	1992	0.277
1124	0.283	1298	0.282	1472	0.28	1646	0.279	1820	0.278	1994	0.277
1126	0.283	1300	0.282	1474	0.28	1648	0.279	1822	0.278	1996	0.277
1128	0.283	1302	0.282	1476	0.28	1650	0.279	1824	0.278	1998	0.277
1130	0.283	1304	0.282	1478	0.28	1652	0.279	1826	0.278	2000	0.277
1132	0.283	1306	0.282	1480	0.28	1654	0.279	1828	0.278	2002	0.277
1134	0.283	1308	0.282	1482	0.28	1656	0.279	1830	0.278	2004	0.277
1136	0.283	1310	0.282	1484	0.28	1658	0.279	1832	0.278	2006	0.277
1138	0.283	1312	0.282	1486	0.28	1660	0.279	1834	0.278	2008	0.277
1140	0.283	1314	0.282	1488	0.28	1662	0.279	1836	0.278	2010	0.277
1142	0.283	1316	0.282	1490	0.28	1664	0.279	1838	0.278	2012	0.277
1144	0.283	1318	0.282	1492	0.28	1666	0.279	1840	0.278	2014	0.277
1146	0.283	1320	0.282	1494	0.28	1668	0.279	1842	0.278	2016	0.277
1148	0.283	1322	0.282	1496	0.28	1670	0.279	1844	0.278	2018	0.277
1150	0.283	1324	0.282	1498	0.28	1672	0.279	1846	0.278	2020	0.277
1152	0.283	1326	0.282	1500	0.28	1674	0.279	1848	0.278	2022	0.277
1154	0.283	1328	0.282	1502	0.28	1676	0.279	1850	0.278	2024	0.277
1156	0.283	1330	0.282	1504	0.28	1678	0.279	1852	0.278	2026	0.277
1158	0.283	1332	0.282	1506	0.28	1680	0.279	1854	0.278	2028	0.277
1160	0.283	1334	0.282	1508	0.28	1682	0.279	1856	0.278	2030	0.277
1162	0.283	1336	0.282	1510	0.28	1684	0.279	1858	0.278	2032	0.277
1164	0.283	1338	0.282	1512	0.28	1686	0.279	1860	0.278	2034	0.277
1166	0.283	1340	0.282	1514	0.28	1688	0.279	1862	0.278	2036	0.277
1168	0.283	1342	0.282	1516	0.28	1690	0.279	1864	0.278	2038	0.277
1170	0.283	1344	0.281	1518	0.28	1692	0.279	1866	0.278	2040	0.277
1172	0.283	1346	0.282	1520	0.28	1694	0.279	1868	0.278	2042	0.277
1174	0.283	1348	0.282	1522	0.28	1696	0.279	1870	0.278	2044	0.277
1176	0.283	1350	0.282	1524	0.28	1698	0.279	1872	0.278	2046	0.277
1178	0.283	1352	0.282	1526	0.28	1700	0.279	1874	0.278	2048	0.277
1180	0.283	1354	0.281	1528	0.28	1702	0.279	1876	0.278	2050	0.277
1182	0.283	1356	0.281	1530	0.28	1704	0.279	1878	0.278	2052	0.277
1184	0.283	1358	0.281	1532	0.28	1706	0.279	1880	0.278	2054	0.277
1186	0.283	1360	0.281	1534	0.28	1708	0.279	1882	0.278	2056	0.277
1188	0.283	1362	0.281	1536	0.28	1710	0.279	1884	0.278	2058	0.277
1190	0.283	1364	0.281	1538	0.28	1712	0.279	1886	0.278	2060	0.277
1192	0.283	1366	0.281	1540	0.28	1714	0.279	1888	0.278	2062	0.277
1194	0.283	1368	0.281	1542	0.28	1716	0.279	1890	0.278	2064	0.277
1196	0.283	1370	0.281	1544	0.28	1718	0.279	1892	0.278	2066	0.277
1198	0.283	1372	0.281	1546	0.28	1720	0.279	1894	0.278	2068	0.277
1200	0.283	1374	0.281	1548	0.28	1722	0.279	1896	0.278	2070	0.277
1202	0.282	1376	0.281	1550	0.28	1724	0.279	1898	0.278	2072	0.277
1204	0.283	1378	0.281	1552	0.28	1726	0.279	1900	0.278	2074	0.277
1206	0.282	1380	0.281	1554	0.28	1728	0.278	1902	0.278	2076	0.277
1208	0.282	1382	0.281	1556	0.28	1730	0.279	1904	0.278	2078	0.277
1210	0.282	1384	0.281	1558	0.28	1732	0.279	1906	0.278	2080	0.277
1212	0.282	1386	0.281	1560	0.28	1734	0.279	1908	0.278	2082	0.277
1214	0.282	1388	0.281	1562	0.28	1736	0.278	1910	0.278	2084	0.277
1216	0.282	1390	0.281	1564	0.28	1738	0.278	1912	0.278		

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
2086	0.277	2260	0.276	2432	0.275	2606	0.275	2780	0.274	2952	0.273
2088	0.276	2262	0.276	2434	0.275	2608	0.275	2782	0.274	2954	0.273
2090	0.277	2264	0.276	2436	0.275	2610	0.275	2784	0.274	2956	0.273
2092	0.276	2266	0.276	2438	0.275	2612	0.275	2786	0.274	2958	0.273
2094	0.277	2268	0.276	2440	0.275	2614	0.275	2788	0.274	2960	0.273
2096	0.277	2270	0.276	2442	0.275	2616	0.275	2790	0.274	2962	0.273
2098	0.277	2272	0.276	2444	0.275	2618	0.275	2792	0.274	2964	0.273
2100	0.276	2274	0.276	2446	0.275	2620	0.275	2794	0.274	2966	0.273
2102	0.277	2276	0.276	2448	0.275	2622	0.275	2796	0.274	2968	0.273
2104	0.277	2278	0.276	2450	0.275	2624	0.275	2798	0.274	2970	0.273
2106	0.276	2280	0.276	2452	0.275	2626	0.275	2800	0.274	2972	0.273
2108	0.277	2282	0.276	2454	0.275	2628	0.275	2802	0.274	2974	0.273
2110	0.276	2284	0.276	2456	0.275	2630	0.275	2804	0.274	2976	0.273
2112	0.276	2286	0.276	2458	0.275	2632	0.275	2806	0.274	2978	0.273
2114	0.276	2288	0.276	2460	0.275	2634	0.275	2808	0.274	2980	0.273
2116	0.276	2290	0.276	2462	0.275	2636	0.275	2810	0.274	2982	0.273
2118	0.277	2292	0.276	2464	0.275	2638	0.275	2812	0.274	2984	0.273
2120	0.276	2294	0.276	2466	0.275	2640	0.275	2814	0.274	2986	0.273
2122	0.277	2296	0.276	2468	0.275	2642	0.275	2816	0.274	2988	0.273
2124	0.277	2298	0.276	2470	0.275	2644	0.275	2818	0.274	2990	0.273
2126	0.277	2300	0.276	2472	0.275	2646	0.275	2820	0.274	2992	0.273
2128	0.276	2302	0.276	2474	0.275	2648	0.275	2822	0.274	2994	0.273
2130	0.276	2304	0.276	2476	0.275	2650	0.275	2824	0.274	2996	0.273
2132	0.276	2306	0.276	2478	0.275	2652	0.275	2826	0.274	2998	0.273
2134	0.276	2308	0.276	2480	0.275	2654	0.275	2828	0.274	3000	0.273
2136	0.276	2310	0.276	2482	0.275	2656	0.275	2830	0.274	3002	0.273
2138	0.276	2312	0.276	2484	0.275	2658	0.275	2832	0.274	3004	0.273
2140	0.276	2314	0.276	2486	0.275	2660	0.274	2834	0.274	3006	0.273
2142	0.277	2316	0.276	2488	0.275	2662	0.275	2836	0.274	3008	0.273
2144	0.276	2318	0.276	2490	0.275	2664	0.274	2838	0.274	3010	0.273
2146	0.276	2320	0.276	2492	0.275	2666	0.275	2840	0.274	3012	0.273
2148	0.276	2322	0.276	2494	0.275	2668	0.275	2842	0.274	3014	0.273
2150	0.277	2324	0.276	2496	0.275	2670	0.275	2844	0.274	3016	0.273
2152	0.276	2326	0.276	2498	0.275	2672	0.274	2846	0.274	3018	0.273
2154	0.276	2328	0.276	2500	0.275	2674	0.274	2848	0.274	3020	0.273
2156	0.276	2330	0.276	2502	0.275	2676	0.274	2850	0.274	3022	0.273
2158	0.276	2332	0.276	2504	0.275	2678	0.274	2852	0.274	3024	0.273
2160	0.276	2334	0.276	2506	0.275	2680	0.274	2854	0.274	3026	0.273
2162	0.276	2336	0.276	2508	0.275	2682	0.274	2856	0.274	3028	0.273
2164	0.276	2338	0.276	2510	0.275	2684	0.274	2858	0.274	3030	0.273
2166	0.276	2340	0.276	2512	0.275	2686	0.274	2860	0.274	3032	0.273
2168	0.276	2342	0.276	2514	0.275	2688	0.274	2862	0.274	3034	0.273
2170	0.276	2344	0.276	2516	0.275	2690	0.274	2864	0.274	3036	0.273
2172	0.276	2346	0.276	2518	0.275	2692	0.274	2866	0.274	3038	0.273
2174	0.276	2348	0.276	2520	0.275	2694	0.274	2868	0.274	3040	0.273
2176	0.276	2350	0.276	2522	0.275	2696	0.274	2870	0.274	3042	0.273
2178	0.276	2352	0.276	2524	0.275	2698	0.274	2872	0.274	3044	0.273
2180	0.276	2354	0.276	2526	0.275	2700	0.274	2874	0.274	3046	0.273
2182	0.276	2356	0.276	2528	0.275	2702	0.274	2876	0.274	3048	0.273
2184	0.276	2358	0.276	2530	0.275	2704	0.274	2878	0.274	3050	0.273
2186	0.276	2360	0.276	2532	0.275	2706	0.274	2880	0.274	3052	0.273
2188	0.276	2362	0.276	2534	0.275	2708	0.274	2882	0.274	3054	0.273
2190	0.276	2364	0.276	2536	0.275	2710	0.274	2884	0.274	3056	0.273
2192	0.276	2366	0.276	2538	0.275	2712	0.274	2886	0.273	3058	0.273
2194	0.276	2368	0.276	2540	0.275	2714	0.274	2888	0.273	3060	0.272
2196	0.276	2370	0.276	2542	0.275	2716	0.274	2890	0.273	3062	0.273
2198	0.276	2372	0.276	2544	0.275	2718	0.274	2892	0.273	3064	0.272
2200	0.276	2374	0.276	2546	0.275	2720	0.274	2894	0.273	3066	0.272
2202	0.276	2376	0.276	2548	0.275	2722	0.274	2896	0.273	3068	0.272
2204	0.276	2378	0.276	2550	0.275	2724	0.274	2898	0.273	3070	0.272
2206	0.276	2380	0.276	2552	0.275	2726	0.274	2900	0.273	3072	0.272
2208	0.276	2382	0.276	2554	0.275	2728	0.274	2902	0.273	3074	0.273
2210	0.276	2384	0.276	2556	0.275	2730	0.274	2904	0.273	3076	0.272
2212	0.276	2386	0.276	2558	0.275	2732	0.274	2906	0.273	3078	0.273
2214	0.276	2388	0.276	2560	0.275	2734	0.274	2908	0.273	3080	0.272
2216	0.276	2390	0.276	2562	0.275	2736	0.274	2910	0.273	3082	0.273
2218	0.276	2392	0.276	2564	0.275	2738	0.274	2912	0.273	3084	0.272
2220	0.276	2394	0.276	2566	0.275	2740	0.274	2914	0.273	3086	0.272
2222	0.276	2396	0.276	2568	0.275	2742	0.274	2916	0.273	3088	0.272
2224	0.276	2398	0.276	2570	0.275	2744	0.274	2918	0.273	3090	0.272
2226	0.276	2400	0.276	2572	0.275	2746	0.274	2920	0.273	3092	0.272
2228	0.276	2402	0.276	2574	0.275	2748	0.274	2922	0.273	3094	0.272
2230	0.276	2404	0.276	2576	0.275	2750	0.274	2924	0.273	3096	0.272
2232	0.276	2406	0.276	2578	0.275	2752	0.274	2926	0.273	3098	0.272
2234	0.276	2408	0.276	2580	0.275	2754	0.274	2928	0.273	3100	0.272
2236	0.276	2410	0.276	2582	0.275	2756	0.274	2930	0.273	3102	0.272
2238	0.276	2412	0.276	2584	0.275	2758	0.274	2932	0.273	3104	0.272
2240	0.276	2414	0.276	2586	0.275	2760	0.274	2934	0.273	3106	0.272
2242	0.276	2416	0.276	2588	0.275	2762	0.274	2936	0.273	3108	0.272
2244	0.276	2418	0.276	2590	0.275	2764	0.274	2938	0.273	3110	0.272
2246	0.276	2420	0.276	2592	0.275	2766	0.274	2940	0.273	3112	0.272
2248	0.276	2422	0.276	2594	0.275	2768	0.274	2942	0.273	3114	0.272
2250	0.276	2424	0.275	2596	0.275	2770	0.274	2944	0.273	3116	0.272
2252	0.276	2426	0.276	2598	0.275	2772	0.274	2946	0.273	3118	0.272
2254	0.276	2428	0.275	2600	0.275	2774	0.274	2948	0.273	3120	0.272
2256	0.276	2430	0.275	2602	0.275	2776	0.274	2950	0.273	3122	0.272
2258	0.276			2604	0.275	2778	0.274			3124	0.272

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
3126	0.272	3298	0.271	3458	0.27
3128	0.272	3300	0.271	3460	0.27
3130	0.272	3302	0.271	3462	0.27
3132	0.272	3304	0.271	3464	0.27
3134	0.272	3306	0.271	3466	0.27
3136	0.272	3308	0.271	3468	0.27
3138	0.272	3310	0.271	3470	0.27
3140	0.272	3298	0.271	3472	0.27
3142	0.272	3300	0.271	3474	0.27
3144	0.272	3302	0.271	3476	0.27
3146	0.272	3304	0.271	3478	0.27
3148	0.272	3306	0.271	3480	0.27
3150	0.272	3308	0.271	3482	0.27
3152	0.272	3310	0.271	3484	0.27
3154	0.272	3312	0.271	3486	0.27
3156	0.272	3314	0.271	3488	0.27
3158	0.272	3316	0.271	3490	0.27
3160	0.272	3318	0.271	3492	0.27
3162	0.272	3320	0.271	3494	0.27
3164	0.272	3322	0.271	3496	0.27
3166	0.272	3324	0.271	3498	0.27
3168	0.272	3326	0.271	3500	0.27
3170	0.272	3328	0.271	3502	0.27
3172	0.272	3330	0.271	3504	0.27
3174	0.272	3332	0.271	3506	0.27
3176	0.272	3334	0.271	3508	0.27
3178	0.272	3336	0.271	3510	0.27
3180	0.272	3338	0.271	3512	0.27
3182	0.272	3340	0.271	3514	0.27
3184	0.272	3342	0.271	3516	0.27
3186	0.272	3344	0.271	3518	0.27
3188	0.272	3346	0.271	3520	0.27
3190	0.272	3348	0.271	3522	0.27
3192	0.272	3350	0.271	3524	0.27
3194	0.272	3352	0.271	3526	0.27
3196	0.272	3354	0.271	3528	0.27
3198	0.272	3356	0.271	3530	0.27
3200	0.272	3358	0.271	3532	0.27
3202	0.272	3360	0.271	3534	0.27
3204	0.272	3362	0.271	3536	0.27
3206	0.272	3364	0.271	3538	0.27
3208	0.272	3366	0.271	3540	0.27
3210	0.272	3368	0.271	3542	0.27
3212	0.272	3370	0.271	3544	0.27
3214	0.272	3372	0.271	3546	0.27
3216	0.272	3374	0.271	3548	0.27
3218	0.272	3376	0.271	3550	0.27
3220	0.272	3378	0.271	3552	0.27
3222	0.272	3380	0.271	3554	0.27
3224	0.272	3382	0.271	3556	0.269
3226	0.272	3384	0.271	3558	0.269
3228	0.272	3386	0.271	3560	0.269
3230	0.272	3388	0.271	3562	0.269
3232	0.272	3390	0.271	3564	0.269
3234	0.272	3392	0.271	3566	0.269
3236	0.272	3394	0.271	3568	0.269
3238	0.272	3396	0.271	3570	0.269
3240	0.271	3398	0.271	3572	0.269
3242	0.272	3400	0.271	3574	0.269
3244	0.272	3402	0.271	3576	0.269
3246	0.272	3404	0.27	3578	0.269
3248	0.272	3406	0.27	3580	0.269
3250	0.272	3408	0.271	3582	0.269
3252	0.271	3410	0.271	3584	0.269
3254	0.271	3412	0.271	3586	0.269
3256	0.271	3414	0.271	3588	0.269
3258	0.271	3416	0.271	3590	0.269
3260	0.271	3418	0.27	3592	0.269
3262	0.271	3420	0.27	3594	0.269
3264	0.271	3422	0.27	3596	0.269
3266	0.271	3424	0.27	3598	0.269
3268	0.271	3426	0.27	3600	0.269
3270	0.271	3428	0.27		
3272	0.271	3430	0.27		
3274	0.271	3432	0.27		
3276	0.271	3434	0.27		
3278	0.271	3436	0.27		
3280	0.271	3438	0.27		
3282	0.271	3440	0.27		
3284	0.271	3442	0.27		
3286	0.271	3444	0.27		
3288	0.271	3446	0.27		
3290	0.271	3448	0.27		
3292	0.271	3450	0.27		
3294	0.271	3452	0.27		
3296	0.271	3454	0.27		
		3456	0.27		

APPENDIX A.3

BATTERY PARALLEL WITH 0.5F ULTRACAPACITOR(VOLTAGE)

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
0	0	174	2.393	348	2.319	522	2.266	696	2.222	870	2.179
2	0	176	2.392	350	2.317	524	2.265	698	2.22	872	2.178
4	2.611	178	2.39	352	2.316	526	2.264	700	2.219	874	2.179
6	2.604	180	2.389	354	2.315	528	2.264	702	2.219	876	2.178
8	2.598	182	2.388	356	2.315	530	2.264	704	2.217	878	2.178
10	2.589	184	2.387	358	2.315	532	2.263	706	2.218	880	2.178
12	2.582	186	2.387	360	2.315	534	2.261	708	2.217	882	2.178
14	2.576	188	2.385	362	2.315	536	2.26	710	2.217	884	2.178
16	2.568	190	2.383	364	2.314	538	2.261	712	2.217	886	2.178
18	2.564	192	2.383	366	2.313	540	2.26	714	2.217	888	2.177
20	2.559	194	2.383	368	2.313	542	2.26	716	2.217	890	2.177
22	2.554	196	2.382	370	2.31	544	2.259	718	2.216	892	2.177
24	2.549	198	2.382	372	2.31	546	2.257	720	2.215	894	2.176
26	2.544	200	2.379	374	2.31	548	2.257	722	2.215	896	2.174
28	2.539	202	2.378	376	2.309	550	2.257	724	2.213	898	2.174
30	2.536	204	2.376	378	2.309	552	2.256	726	2.213	900	2.174
32	2.532	206	2.376	380	2.309	554	2.256	728	2.212	902	2.173
34	2.529	208	2.375	382	2.308	556	2.256	730	2.212	904	2.173
36	2.524	210	2.374	384	2.306	558	2.256	732	2.212	906	2.173
38	2.52	212	2.373	386	2.305	560	2.256	734	2.212	908	2.173
40	2.518	214	2.372	388	2.305	562	2.254	736	2.211	910	2.173
42	2.515	216	2.371	390	2.305	564	2.255	738	2.212	912	2.173
44	2.51	218	2.368	392	2.305	566	2.254	740	2.211	914	2.173
46	2.51	220	2.368	394	2.304	568	2.252	742	2.209	916	2.172
48	2.505	222	2.368	396	2.304	570	2.251	744	2.21	918	2.172
50	2.502	224	2.368	398	2.302	572	2.251	746	2.208	920	2.171
52	2.5	226	2.366	400	2.3	574	2.251	748	2.208	922	2.171
54	2.496	228	2.365	402	2.3	576	2.251	750	2.207	924	2.17
56	2.493	230	2.365	404	2.3	578	2.251	752	2.207	926	2.17
58	2.491	232	2.363	406	2.299	580	2.251	754	2.207	928	2.169
60	2.488	234	2.363	408	2.299	582	2.25	756	2.207	930	2.169
62	2.485	236	2.362	410	2.296	584	2.248	758	2.207	932	2.168
64	2.484	238	2.362	412	2.297	586	2.248	760	2.206	934	2.168
66	2.481	240	2.359	414	2.296	588	2.247	762	2.206	936	2.168
68	2.479	242	2.36	416	2.296	590	2.247	764	2.204	938	2.168
70	2.476	244	2.358	418	2.295	592	2.246	766	2.204	940	2.168
72	2.473	246	2.358	420	2.295	594	2.246	768	2.203	942	2.168
74	2.471	248	2.356	422	2.295	596	2.246	770	2.203	944	2.168
76	2.47	250	2.355	424	2.293	598	2.246	772	2.202	946	2.168
78	2.468	252	2.354	426	2.293	600	2.246	774	2.202	948	2.167
80	2.466	254	2.354	428	2.292	602	2.245	776	2.202	950	2.167
82	2.463	256	2.354	430	2.29	604	2.246	778	2.201	952	2.167
84	2.461	258	2.354	432	2.29	606	2.244	780	2.201	954	2.166
86	2.46	260	2.352	434	2.29	608	2.243	782	2.2	956	2.166
88	2.456	262	2.351	436	2.29	610	2.241	784	2.199	958	2.164
90	2.456	264	2.351	438	2.288	612	2.242	786	2.197	960	2.164
92	2.452	266	2.349	440	2.289	614	2.241	788	2.197	962	2.164
94	2.451	268	2.349	442	2.287	616	2.241	790	2.197	964	2.163
96	2.449	270	2.349	444	2.286	618	2.241	792	2.197	966	2.163
98	2.448	272	2.347	446	2.285	620	2.241	794	2.197	968	2.163
100	2.446	274	2.346	448	2.285	622	2.239	796	2.197	970	2.163
102	2.446	276	2.346	450	2.285	624	2.238	798	2.197	972	2.163
104	2.442	278	2.345	452	2.285	626	2.236	800	2.197	974	2.163
106	2.441	280	2.344	454	2.285	628	2.237	802	2.197	976	2.163
108	2.44	282	2.344	456	2.285	630	2.236	804	2.194	978	2.161
110	2.437	284	2.344	458	2.281	632	2.236	806	2.194	980	2.161
112	2.436	286	2.343	460	2.282	634	2.236	808	2.194	982	2.162
114	2.434	288	2.342	462	2.28	636	2.236	810	2.192	984	2.16
116	2.432	290	2.341	464	2.28	638	2.236	812	2.193	986	2.159
118	2.432	292	2.339	466	2.28	640	2.235	814	2.192	988	2.159
120	2.429	294	2.339	468	2.28	642	2.235	816	2.192	990	2.159
122	2.427	296	2.336	470	2.278	644	2.235	818	2.192	992	2.158
124	2.426	298	2.336	472	2.279	646	2.233	820	2.192	994	2.158
126	2.426	300	2.336	474	2.277	648	2.232	822	2.191	996	2.158
128	2.424	302	2.335	476	2.277	650	2.232	824	2.191	998	2.158
130	2.422	304	2.334	478	2.276	652	2.232	826	2.189	1000	2.158
132	2.422	306	2.334	480	2.275	654	2.232	828	2.188	1002	2.158
134	2.419	308	2.334	482	2.275	656	2.232	830	2.188	1004	2.158
136	2.417	310	2.333	484	2.275	658	2.232	832	2.188	1006	2.158
138	2.415	312	2.332	486	2.275	660	2.23	834	2.188	1008	2.158
140	2.414	314	2.33	488	2.275	662	2.229	836	2.188	1010	2.158
142	2.412	316	2.329	490	2.272	664	2.229	838	2.188	1012	2.158
144	2.412	318	2.329	492	2.272	666	2.229	840	2.188	1014	2.157
146	2.41	320	2.329	494	2.271	668	2.228	842	2.188	1016	2.156
148	2.407	322	2.328	496	2.271	670	2.227	844	2.188	1018	2.155
150	2.407	324	2.327	498	2.271	672	2.227	846	2.186	1020	2.155
152	2.406	326	2.325	500	2.271	674	2.227	848	2.184	1022	2.155
154	2.406	328	2.324	502	2.271	676	2.227	850	2.185	1024	2.154
156	2.403	330	2.324	504	2.269	678	2.226	852	2.184	1026	2.154
158	2.402	332	2.324	506	2.269	680	2.227	854	2.185	1028	2.153
160	2.401	334	2.324	508	2.268	682	2.226	856	2.183	1030	2.153
162	2.399	336	2.324	510	2.268	684	2.224	858	2.183	1032	2.153
164	2.398	338	2.323	512	2.266	686	2.224	860	2.182	1034	2.153
166	2.398	340	2.321	514	2.266	688	2.222	862	2.182	1036	2.153
168	2.396	342	2.319	516	2.266	690	2.222	864	2.182	1038	2.153
170	2.393	344	2.321	518	2.266	692	2.222	866	2.18	1040	2.153
172	2.393	346	2.319	520	2.266	694	2.222	868	2.179	1042	2.153

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
1044	2.153	1218	2.129	1392	2.109	1566	2.089	1740	2.071	1914	2.056
1046	2.151	1220	2.129	1394	2.108	1568	2.089	1742	2.07	1916	2.056
1048	2.151	1222	2.129	1396	2.108	1570	2.087	1744	2.072	1918	2.056
1050	2.151	1224	2.129	1398	2.107	1572	2.089	1746	2.07	1920	2.056
1052	2.152	1226	2.129	1400	2.106	1574	2.089	1748	2.07	1922	2.056
1054	2.15	1228	2.128	1402	2.105	1576	2.087	1750	2.07	1924	2.055
1056	2.149	1230	2.128	1404	2.105	1578	2.087	1752	2.07	1926	2.056
1058	2.149	1232	2.128	1406	2.106	1580	2.086	1754	2.07	1928	2.056
1060	2.149	1234	2.128	1408	2.106	1582	2.086	1756	2.07	1930	2.056
1062	2.149	1236	2.126	1410	2.105	1584	2.086	1758	2.07	1932	2.055
1064	2.149	1238	2.125	1412	2.105	1586	2.085	1760	2.07	1934	2.056
1066	2.149	1240	2.125	1414	2.105	1588	2.085	1762	2.07	1936	2.055
1068	2.149	1242	2.126	1416	2.105	1590	2.085	1764	2.07	1938	2.055
1070	2.149	1244	2.125	1418	2.104	1592	2.085	1766	2.07	1940	2.056
1072	2.149	1246	2.125	1420	2.105	1594	2.085	1768	2.07	1942	2.055
1074	2.149	1248	2.124	1422	2.103	1596	2.085	1770	2.07	1944	2.053
1076	2.149	1250	2.124	1424	2.103	1598	2.085	1772	2.069	1946	2.055
1078	2.149	1252	2.124	1426	2.104	1600	2.084	1774	2.07	1948	2.053
1080	2.148	1254	2.124	1428	2.103	1602	2.085	1776	2.069	1950	2.052
1082	2.149	1256	2.124	1430	2.103	1604	2.085	1778	2.069	1952	2.053
1084	2.147	1258	2.123	1432	2.102	1606	2.084	1780	2.069	1954	2.051
1086	2.147	1260	2.123	1434	2.101	1608	2.084	1782	2.069	1956	2.052
1088	2.146	1262	2.123	1436	2.102	1610	2.084	1784	2.069	1958	2.053
1090	2.145	1264	2.123	1438	2.1	1612	2.084	1786	2.067	1960	2.052
1092	2.145	1266	2.122	1440	2.1	1614	2.083	1788	2.067	1962	2.052
1094	2.144	1268	2.122	1442	2.1	1616	2.083	1790	2.068	1964	2.052
1096	2.144	1270	2.121	1444	2.1	1618	2.083	1792	2.065	1966	2.051
1098	2.144	1272	2.12	1446	2.1	1620	2.083	1794	2.066	1968	2.051
1100	2.144	1274	2.121	1448	2.1	1622	2.083	1796	2.065	1970	2.052
1102	2.144	1276	2.12	1450	2.1	1624	2.081	1798	2.065	1972	2.051
1104	2.144	1278	2.12	1452	2.1	1626	2.081	1800	2.066	1974	2.051
1106	2.143	1280	2.12	1454	2.1	1628	2.081	1802	2.065	1976	2.051
1108	2.144	1282	2.12	1456	2.1	1630	2.08	1804	2.065	1978	2.051
1110	2.143	1284	2.12	1458	2.1	1632	2.081	1806	2.065	1980	2.051
1112	2.142	1286	2.119	1460	2.1	1634	2.081	1808	2.065	1982	2.051
1114	2.142	1288	2.119	1462	2.1	1636	2.081	1810	2.065	1984	2.051
1116	2.142	1290	2.119	1464	2.099	1638	2.08	1812	2.065	1986	2.051
1118	2.141	1292	2.119	1466	2.099	1640	2.08	1814	2.065	1988	2.051
1120	2.141	1294	2.119	1468	2.099	1642	2.08	1816	2.065	1990	2.051
1122	2.14	1296	2.119	1470	2.098	1644	2.08	1818	2.065	1992	2.051
1124	2.139	1298	2.119	1472	2.098	1646	2.08	1820	2.065	1994	2.051
1126	2.139	1300	2.119	1474	2.098	1648	2.08	1822	2.064	1996	2.051
1128	2.139	1302	2.119	1476	2.097	1650	2.08	1824	2.065	1998	2.05
1130	2.14	1304	2.119	1478	2.097	1652	2.08	1826	2.065	2000	2.05
1132	2.139	1306	2.119	1480	2.096	1654	2.08	1828	2.062	2002	2.05
1134	2.139	1308	2.118	1482	2.097	1656	2.08	1830	2.062	2004	2.05
1136	2.139	1310	2.118	1484	2.095	1658	2.08	1832	2.062	2006	2.05
1138	2.139	1312	2.117	1486	2.096	1660	2.08	1834	2.062	2008	2.048
1140	2.139	1314	2.117	1488	2.095	1662	2.08	1836	2.062	2010	2.048
1142	2.139	1316	2.116	1490	2.095	1664	2.08	1838	2.061	2012	2.048
1144	2.139	1318	2.116	1492	2.096	1666	2.08	1840	2.062	2014	2.048
1146	2.139	1320	2.116	1494	2.095	1668	2.078	1842	2.062	2016	2.048
1148	2.139	1322	2.115	1496	2.095	1670	2.078	1844	2.062	2018	2.048
1150	2.138	1324	2.114	1498	2.095	1672	2.078	1846	2.061	2020	2.047
1152	2.138	1326	2.114	1500	2.095	1674	2.076	1848	2.061	2022	2.047
1154	2.138	1328	2.114	1502	2.095	1676	2.078	1850	2.061	2024	2.048
1156	2.136	1330	2.114	1504	2.095	1678	2.076	1852	2.061	2026	2.047
1158	2.136	1332	2.114	1506	2.095	1680	2.076	1854	2.061	2028	2.046
1160	2.136	1334	2.114	1508	2.094	1682	2.076	1856	2.061	2030	2.047
1162	2.136	1336	2.114	1510	2.094	1684	2.076	1858	2.061	2032	2.046
1164	2.136	1338	2.114	1512	2.094	1686	2.075	1860	2.061	2034	2.046
1166	2.134	1340	2.114	1514	2.094	1688	2.076	1862	2.061	2036	2.046
1168	2.134	1342	2.114	1516	2.094	1690	2.076	1864	2.061	2038	2.046
1170	2.134	1344	2.114	1518	2.093	1692	2.075	1866	2.061	2040	2.046
1172	2.134	1346	2.114	1520	2.094	1694	2.075	1868	2.061	2042	2.047
1174	2.134	1348	2.113	1522	2.093	1696	2.075	1870	2.061	2044	2.046
1176	2.134	1350	2.112	1524	2.092	1698	2.075	1872	2.061	2046	2.046
1178	2.134	1352	2.111	1526	2.092	1700	2.075	1874	2.061	2048	2.046
1180	2.134	1354	2.11	1528	2.091	1702	2.075	1876	2.061	2050	2.046
1182	2.133	1356	2.112	1530	2.09	1704	2.075	1878	2.059	2052	2.045
1184	2.133	1358	2.111	1532	2.091	1706	2.075	1880	2.061	2054	2.046
1186	2.133	1360	2.11	1534	2.091	1708	2.075	1882	2.059	2056	2.045
1188	2.133	1362	2.11	1536	2.091	1710	2.075	1884	2.058	2058	2.044
1190	2.133	1364	2.11	1538	2.09	1712	2.075	1886	2.059	2060	2.044
1192	2.133	1366	2.109	1540	2.09	1714	2.074	1888	2.058	2062	2.044
1194	2.131	1368	2.109	1542	2.09	1716	2.075	1890	2.057	2064	2.044
1196	2.131	1370	2.11	1544	2.09	1718	2.073	1892	2.058	2066	2.044
1198	2.13	1372	2.109	1546	2.09	1720	2.075	1894	2.057	2068	2.043
1200	2.13	1374	2.109	1548	2.09	1722	2.074	1896	2.057	2070	2.044
1202	2.131	1376	2.109	1550	2.09	1724	2.073	1898	2.057	2072	2.044
1204	2.13	1378	2.109	1552	2.09	1726	2.072	1900	2.058	2074	2.042
1206	2.13	1380	2.109	1554	2.09	1728	2.072	1902	2.056	2076	2.042
1208	2.129	1382	2.109	1556	2.09	1730	2.072	1904	2.057	2078	2.042
1210	2.129	1384	2.109	1558	2.09	1732	2.072	1906	2.056	2080	2.042
1212	2.129	1386	2.109	1560	2.09	1734	2.071	1908	2.056	2082	2.042
1214	2.129	1388	2.109	1562	2.089	1736	2.071	1910	2.056	2084	2.041
1216	2.129	1390	2.109	1564	2.09	1738	2.072	1912	2.056		

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
2086	2.042	2260	2.033	2432	2.023	2606	2.012	2780	1.997	2952	1.983
2088	2.041	2262	2.035	2434	2.023	2608	2.012	2782	1.997	2954	1.983
2090	2.041	2264	2.034	2436	2.022	2610	2.012	2784	1.997	2956	1.982
2092	2.041	2266	2.034	2438	2.022	2612	2.012	2786	1.997	2958	1.982
2094	2.041	2268	2.033	2440	2.022	2614	2.011	2788	1.997	2960	1.983
2096	2.041	2270	2.033	2442	2.022	2616	2.012	2790	1.997	2962	1.982
2098	2.041	2272	2.033	2444	2.022	2618	2.011	2792	1.997	2964	1.982
2100	2.041	2274	2.033	2446	2.022	2620	2.011	2794	1.997	2966	1.982
2102	2.041	2276	2.032	2448	2.022	2622	2.011	2796	1.997	2968	1.982
2104	2.041	2278	2.033	2450	2.022	2624	2.011	2798	1.997	2970	1.982
2106	2.041	2280	2.033	2452	2.022	2626	2.011	2800	1.996	2972	1.982
2108	2.041	2282	2.034	2454	2.022	2628	2.009	2802	1.995	2974	1.982
2110	2.041	2284	2.033	2456	2.022	2630	2.009	2804	1.995	2976	1.982
2112	2.041	2286	2.032	2458	2.022	2632	2.009	2806	1.997	2978	1.982
2114	2.041	2288	2.033	2460	2.022	2634	2.009	2808	1.995	2980	1.982
2116	2.04	2290	2.032	2462	2.022	2636	2.009	2810	1.996	2982	1.982
2118	2.04	2292	2.033	2464	2.022	2638	2.008	2812	1.995	2984	1.982
2120	2.04	2294	2.033	2466	2.022	2640	2.008	2814	1.995	2986	1.982
2122	2.04	2296	2.032	2468	2.021	2642	2.009	2816	1.993	2988	1.982
2124	2.039	2298	2.031	2470	2.022	2644	2.009	2818	1.995	2990	1.981
2126	2.039	2300	2.031	2472	2.022	2646	2.007	2820	1.995	2992	1.981
2128	2.037	2302	2.031	2474	2.02	2648	2.008	2822	1.993	2994	1.98
2130	2.038	2304	2.031	2476	2.021	2650	2.007	2824	1.992	2996	1.979
2132	2.04	2306	2.031	2478	2.022	2652	2.007	2826	1.993	2998	1.981
2134	2.038	2308	2.031	2480	2.019	2654	2.007	2828	1.993	3000	1.981
2136	2.038	2310	2.031	2482	2.02	2656	2.007	2830	1.993	3002	1.98
2138	2.037	2312	2.031	2484	2.02	2658	2.007	2832	1.993	3004	1.979
2140	2.037	2314	2.031	2486	2.02	2660	2.007	2834	1.992	3006	1.979
2142	2.037	2316	2.031	2488	2.019	2662	2.007	2836	1.992	3008	1.978
2144	2.037	2318	2.031	2490	2.02	2664	2.007	2838	1.992	3010	1.979
2146	2.036	2320	2.031	2492	2.02	2666	2.007	2840	1.992	3012	1.979
2148	2.037	2322	2.031	2494	2.018	2668	2.006	2842	1.992	3014	1.979
2150	2.036	2324	2.031	2496	2.018	2670	2.007	2844	1.992	3016	1.978
2152	2.037	2326	2.031	2498	2.02	2672	2.006	2846	1.992	3018	1.978
2154	2.037	2328	2.031	2500	2.017	2674	2.007	2848	1.992	3020	1.978
2156	2.036	2330	2.031	2502	2.017	2676	2.007	2850	1.992	3022	1.978
2158	2.036	2332	2.031	2504	2.017	2678	2.006	2852	1.992	3024	1.978
2160	2.036	2334	2.031	2506	2.017	2680	2.004	2854	1.992	3026	1.978
2162	2.036	2336	2.031	2508	2.018	2682	2.004	2856	1.992	3028	1.978
2164	2.036	2338	2.031	2510	2.017	2684	2.004	2858	1.992	3030	1.978
2166	2.036	2340	2.031	2512	2.017	2686	2.003	2860	1.992	3032	1.979
2168	2.036	2342	2.031	2514	2.017	2688	2.004	2862	1.992	3034	1.979
2170	2.036	2344	2.031	2516	2.017	2690	2.004	2864	1.992	3036	1.979
2172	2.036	2346	2.031	2518	2.017	2692	2.003	2866	1.992	3038	1.978
2174	2.036	2348	2.031	2520	2.017	2694	2.002	2868	1.992	3040	1.979
2176	2.036	2350	2.031	2522	2.017	2696	2.003	2870	1.992	3042	1.979
2178	2.034	2352	2.03	2524	2.017	2698	2.003	2872	1.992	3044	1.978
2180	2.035	2354	2.029	2526	2.017	2700	2.002	2874	1.991	3046	1.978
2182	2.034	2356	2.031	2528	2.017	2702	2.003	2876	1.991	3048	1.978
2184	2.035	2358	2.028	2530	2.017	2704	2.002	2878	1.99	3050	1.978
2186	2.034	2360	2.028	2532	2.017	2706	2.002	2880	1.991	3052	1.978
2188	2.033	2362	2.028	2534	2.017	2708	2.002	2882	1.989	3054	1.978
2190	2.034	2364	2.03	2536	2.017	2710	2.002	2884	1.991	3056	1.978
2192	2.034	2366	2.028	2538	2.016	2712	2.002	2886	1.99	3058	1.978
2194	2.034	2368	2.029	2540	2.016	2714	2.002	2888	1.989	3060	1.978
2196	2.033	2370	2.026	2542	2.017	2716	2.002	2890	1.988	3062	1.978
2198	2.033	2372	2.027	2544	2.015	2718	2.002	2892	1.988	3064	1.978
2200	2.032	2374	2.026	2546	2.016	2720	2.002	2894	1.989	3066	1.978
2202	2.033	2376	2.028	2548	2.017	2722	2.002	2896	1.988	3068	1.978
2204	2.032	2378	2.026	2550	2.017	2724	2.002	2898	1.988	3070	1.978
2206	2.032	2380	2.026	2552	2.016	2726	2.002	2900	1.987	3072	1.978
2208	2.031	2382	2.027	2554	2.016	2728	2.001	2902	1.987	3074	1.978
2210	2.031	2384	2.026	2556	2.014	2730	2.002	2904	1.988	3076	1.978
2212	2.032	2386	2.026	2558	2.015	2732	2.002	2906	1.988	3078	1.978
2214	2.031	2388	2.026	2560	2.014	2734	2.002	2908	1.987	3080	1.978
2216	2.031	2390	2.026	2562	2.015	2736	2	2910	1.987	3082	1.976
2218	2.031	2392	2.026	2564	2.013	2738	2	2912	1.987	3084	1.976
2220	2.031	2394	2.026	2566	2.012	2740	2.001	2914	1.987	3086	1.976
2222	2.031	2396	2.026	2568	2.014	2742	2.001	2916	1.987	3088	1.975
2224	2.031	2398	2.026	2570	2.014	2744	2	2918	1.987	3090	1.975
2226	2.031	2400	2.025	2572	2.014	2746	2	2920	1.987	3092	1.976
2228	2.031	2402	2.026	2574	2.012	2748	1.999	2922	1.987	3094	1.975
2230	2.031	2404	2.025	2576	2.013	2750	2.001	2924	1.986	3096	1.976
2232	2.031	2406	2.024	2578	2.012	2752	1.998	2926	1.986	3098	1.975
2234	2.031	2408	2.025	2580	2.012	2754	1.999	2928	1.986	3100	1.975
2236	2.031	2410	2.025	2582	2.013	2756	1.999	2930	1.986	3102	1.975
2238	2.031	2412	2.023	2584	2.012	2758	1.998	2932	1.986	3104	1.975
2240	2.031	2414	2.023	2586	2.012	2760	1.998	2934	1.986	3106	1.975
2242	2.031	2416	2.024	2588	2.012	2762	1.998	2936	1.984	3108	1.974
2244	2.031	2418	2.023	2590	2.012	2764	1.998	2938	1.985	3110	1.974
2246	2.031	2420	2.023	2592	2.012	2766	1.998	2940	1.986	3112	1.973
2248	2.031	2422	2.023	2594	2.012	2768	1.997	2942	1.984	3114	1.973
2250	2.031	2424	2.022	2596	2.012	2770	1.997	2944	1.984	3116	1.973
2252	2.032	2426	2.023	2598	2.012	2772	1.997	2946	1.985	3118	1.973
2254	2.033	2428	2.022	2600	2.012	2774	1.997	2948	1.984	3120	1.973
2256	2.032	2430	2.022	2602	2.012	2776	1.997	2950	1.984296615	3122	1.973
2258	2.033			2604	2.012	2778	1.997			3124	1.973

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
3126	1.973	3298	1.958	3472	1.942
3128	1.973	3300	1.958	3474	1.942
3130	1.973	3302	1.957	3476	1.94
3132	1.973	3304	1.957	3478	1.94
3134	1.973	3306	1.957	3480	1.939
3136	1.973	3308	1.956	3482	1.939
3138	1.973	3310	1.955	3484	1.94
3140	1.973	3312	1.955	3486	1.939
3142	1.973	3314	1.956	3488	1.939
3144	1.972	3316	1.956	3490	1.939
3146	1.972	3318	1.955	3492	1.939
3148	1.972	3320	1.955	3494	1.939
3150	1.973	3322	1.954	3496	1.939
3152	1.971	3324	1.955	3498	1.939
3154	1.971	3326	1.954	3500	1.939
3156	1.971	3328	1.954	3502	1.939
3158	1.971	3330	1.953	3504	1.939
3160	1.97	3332	1.953	3506	1.939
3162	1.97	3334	1.953	3508	1.939
3164	1.97	3336	1.953	3510	1.939
3166	1.968	3338	1.953	3512	1.939
3168	1.97	3340	1.953	3514	1.939
3170	1.968	3342	1.953	3516	1.938
3172	1.968	3344	1.953	3518	1.938
3174	1.968	3346	1.953	3520	1.938
3176	1.968	3348	1.953	3522	1.936
3178	1.968	3350	1.953	3524	1.937
3180	1.968	3352	1.953	3526	1.937
3182	1.968	3354	1.953	3528	1.936
3184	1.968	3356	1.953	3530	1.937
3186	1.968	3358	1.953	3532	1.936
3188	1.968	3360	1.953	3534	1.935
3190	1.968	3362	1.953	3536	1.937
3192	1.968	3364	1.953	3538	1.935
3194	1.967	3366	1.952	3540	1.935
3196	1.967	3368	1.951	3542	1.935
3198	1.967	3370	1.951	3544	1.934
3200	1.967	3372	1.951	3546	1.934
3202	1.966	3374	1.951	3548	1.934
3204	1.965	3376	1.952	3550	1.934
3206	1.965	3378	1.949	3552	1.934
3208	1.965	3380	1.951	3554	1.934
3210	1.964	3382	1.95	3556	1.934
3212	1.964	3384	1.949	3558	1.934
3214	1.964	3386	1.949	3560	1.934
3216	1.964	3388	1.95	3562	1.934
3218	1.964	3390	1.948	3564	1.934
3220	1.964	3392	1.948	3566	1.934
3222	1.963	3394	1.948	3568	1.934
3224	1.963	3396	1.948	3570	1.934
3226	1.963	3398	1.948	3572	1.933
3228	1.963	3400	1.947	3574	1.934
3230	1.963	3402	1.947	3576	1.933
3232	1.963	3404	1.946	3578	1.934
3234	1.963	3406	1.948	3580	1.932
3236	1.963	3408	1.948	3582	1.933
3238	1.963	3410	1.948	3584	1.933
3240	1.963	3412	1.948	3586	1.932
3242	1.963	3414	1.946	3588	1.932
3244	1.963	3416	1.945	3590	1.933
3246	1.963	3418	1.946	3592	1.932
3248	1.962	3420	1.945	3594	1.93
3250	1.963	3422	1.944	3596	1.93
3252	1.963	3424	1.944	3598	1.93
3254	1.962	3426	1.945	3600	1.931
3256	1.962	3428	1.945		
3258	1.961	3430	1.944		
3260	1.96	3432	1.943		
3262	1.961	3434	1.943		
3264	1.961	3436	1.943		
3266	1.961	3438	1.943		
3268	1.959	3440	1.943		
3270	1.959	3442	1.943		
3272	1.959	3444	1.943		
3274	1.958	3446	1.943		
3276	1.959	3448	1.943		
3278	1.959	3450	1.943		
3280	1.958	3452	1.943		
3282	1.958	3454	1.943		
3284	1.958	3456	1.943		
3286	1.958	3458	1.943		
3288	1.958	3460	1.943		
3290	1.957	3462	1.943		
3292	1.958	3464	1.942		
3294	1.957	3466	1.943		
3296	1.958	3468	1.941		
		3470	1.942		

APPENDIX A.4

BATTERY PARALLEL WITH 0.5F ULTRACAPACITOR(CURRENT)

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
0	9.16E-04	174	0.305	348	0.3	522	0.296	696	0.293	870	0.291
2	7.32E-04	176	0.304	350	0.3	524	0.296	698	0.293	872	0.291
4	0.322	178	0.304	352	0.3	526	0.296	700	0.293	874	0.291
6	0.32	180	0.304	354	0.299	528	0.296	702	0.293	876	0.29
8	0.319	182	0.304	356	0.3	530	0.296	704	0.293	878	0.29
10	0.319	184	0.304	358	0.299	532	0.296	706	0.293	880	0.29
12	0.318	186	0.304	360	0.299	534	0.296	708	0.293	882	0.291
14	0.317	188	0.304	362	0.299	536	0.296	710	0.293	884	0.29
16	0.317	190	0.304	364	0.299	538	0.296	712	0.293	886	0.29
18	0.316	192	0.304	366	0.299	540	0.296	714	0.293	888	0.29
20	0.316	194	0.304	368	0.299	542	0.296	716	0.293	890	0.29
22	0.315	196	0.304	370	0.299	544	0.296	718	0.293	892	0.29
24	0.315	198	0.304	372	0.299	546	0.296	720	0.293	894	0.29
26	0.314	200	0.304	374	0.299	548	0.296	722	0.293	896	0.29
28	0.314	202	0.303	376	0.299	550	0.296	724	0.293	898	0.29
30	0.314	204	0.303	378	0.299	552	0.296	726	0.293	900	0.29
32	0.314	206	0.303	380	0.299	554	0.296	728	0.293	902	0.29
34	0.313	208	0.303	382	0.299	556	0.296	730	0.293	904	0.29
36	0.313	210	0.303	384	0.299	558	0.295	732	0.293	906	0.29
38	0.313	212	0.303	386	0.299	560	0.295	734	0.293	908	0.29
40	0.313	214	0.303	388	0.299	562	0.295	736	0.293	910	0.29
42	0.312	216	0.303	390	0.299	564	0.295	738	0.293	912	0.29
44	0.312	218	0.303	392	0.299	566	0.295	740	0.292	914	0.29
46	0.312	220	0.303	394	0.299	568	0.295	742	0.292	916	0.29
48	0.312	222	0.303	396	0.299	570	0.295	744	0.292	918	0.29
50	0.311	224	0.303	398	0.299	572	0.295	746	0.292	920	0.29
52	0.311	226	0.303	400	0.298	574	0.295	748	0.292	922	0.29
54	0.311	228	0.303	402	0.298	576	0.295	750	0.292	924	0.29
56	0.311	230	0.303	404	0.298	578	0.295	752	0.292	926	0.29
58	0.311	232	0.303	406	0.298	580	0.295	754	0.292	928	0.29
60	0.311	234	0.302	408	0.298	582	0.295	756	0.292	930	0.29
62	0.31	236	0.302	410	0.298	584	0.295	758	0.292	932	0.29
64	0.31	238	0.302	412	0.298	586	0.295	760	0.292	934	0.29
66	0.31	240	0.302	414	0.298	588	0.295	762	0.292	936	0.29
68	0.31	242	0.302	416	0.298	590	0.295	764	0.292	938	0.29
70	0.31	244	0.302	418	0.298	592	0.295	766	0.292	940	0.29
72	0.31	246	0.302	420	0.298	594	0.295	768	0.292	942	0.29
74	0.309	248	0.302	422	0.298	596	0.295	770	0.292	944	0.29
76	0.309	250	0.302	424	0.298	598	0.295	772	0.292	946	0.29
78	0.309	252	0.302	426	0.298	600	0.295	774	0.292	948	0.29
80	0.309	254	0.302	428	0.298	602	0.295	776	0.292	950	0.29
82	0.309	256	0.302	430	0.298	604	0.295	778	0.292	952	0.29
84	0.309	258	0.302	432	0.298	606	0.295	780	0.292	954	0.29
86	0.309	260	0.302	434	0.298	608	0.295	782	0.292	956	0.29
88	0.308	262	0.302	436	0.298	610	0.295	784	0.292	958	0.29
90	0.309	264	0.302	438	0.298	612	0.295	786	0.292	960	0.29
92	0.308	266	0.302	440	0.298	614	0.295	788	0.292	962	0.29
94	0.308	268	0.302	442	0.298	616	0.295	790	0.292	964	0.29
96	0.308	270	0.302	444	0.298	618	0.295	792	0.292	966	0.289
98	0.308	272	0.301	446	0.298	620	0.294	794	0.292	968	0.289
100	0.308	274	0.301	448	0.297	622	0.294	796	0.292	970	0.29
102	0.308	276	0.301	450	0.297	624	0.294	798	0.292	972	0.289
104	0.308	278	0.301	452	0.297	626	0.294	800	0.292	974	0.289
106	0.308	280	0.301	454	0.297	628	0.294	802	0.292	976	0.29
108	0.307	282	0.301	456	0.297	630	0.294	804	0.292	978	0.289
110	0.307	284	0.301	458	0.297	632	0.294	806	0.291	980	0.289
112	0.307	286	0.301	460	0.297	634	0.294	808	0.291	982	0.289
114	0.307	288	0.301	462	0.297	636	0.294	810	0.291	984	0.289
116	0.307	290	0.301	464	0.297	638	0.294	812	0.291	986	0.289
118	0.307	292	0.301	466	0.297	640	0.294	814	0.291	988	0.289
120	0.307	294	0.301	468	0.297	642	0.294	816	0.291	990	0.289
122	0.307	296	0.301	470	0.297	644	0.294	818	0.291	992	0.289
124	0.307	298	0.301	472	0.297	646	0.294	820	0.291	994	0.289
126	0.307	300	0.301	474	0.297	648	0.294	822	0.291	996	0.289
128	0.307	302	0.301	476	0.297	650	0.294	824	0.291	998	0.289
130	0.306	304	0.301	478	0.297	652	0.294	826	0.291	1000	0.289
132	0.306	306	0.301	480	0.297	654	0.294	828	0.291	1002	0.289
134	0.306	308	0.301	482	0.297	656	0.294	830	0.291	1004	0.289
136	0.306	310	0.301	484	0.297	658	0.294	832	0.291	1006	0.289
138	0.306	312	0.301	486	0.297	660	0.294	834	0.291	1008	0.289
140	0.306	314	0.3	488	0.297	662	0.294	836	0.291	1010	0.289
142	0.306	316	0.3	490	0.297	664	0.294	838	0.291	1012	0.289
144	0.306	318	0.3	492	0.297	666	0.294	840	0.291	1014	0.289
146	0.305	320	0.3	494	0.297	668	0.294	842	0.291	1016	0.289
148	0.305	322	0.3	496	0.297	670	0.294	844	0.291	1018	0.289
150	0.305	324	0.3	498	0.297	672	0.294	846	0.291	1020	0.289
152	0.305	326	0.3	500	0.296	674	0.294	848	0.291	1022	0.289
154	0.305	328	0.3	502	0.296	676	0.294	850	0.291	1024	0.289
156	0.305	330	0.3	504	0.296	678	0.293	852	0.291	1026	0.289
158	0.305	332	0.3	506	0.296	680	0.294	854	0.291	1028	0.289
160	0.305	334	0.3	508	0.296	682	0.294	856	0.291	1030	0.289
162	0.305	336	0.3	510	0.296	684	0.293	858	0.291	1032	0.289
164	0.305	338	0.3	512	0.296	686	0.293	860	0.291	1034	0.289
166	0.305	340	0.3	514	0.296	688	0.293	862	0.291	1036	0.289
168	0.305	342	0.3	516	0.296	690	0.293	864	0.291	1038	0.289
170	0.305	344	0.3	518	0.296	692	0.293	866	0.291	1040	0.289
172	0.304	346	0.3	520	0.296	694	0.293	868	0.291	1042	0.289

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
1044	0.289	1218	0.287	1392	0.286	1566	0.285	1740	0.284	1914	0.283
1046	0.289	1220	0.287	1394	0.286	1568	0.285	1742	0.284	1916	0.282
1048	0.289	1222	0.287	1396	0.286	1570	0.285	1744	0.284	1918	0.283
1050	0.289	1224	0.287	1398	0.286	1572	0.285	1746	0.284	1920	0.283
1052	0.289	1226	0.287	1400	0.286	1574	0.285	1748	0.284	1922	0.283
1054	0.289	1228	0.287	1402	0.286	1576	0.284	1750	0.284	1924	0.283
1056	0.289	1230	0.287	1404	0.286	1578	0.285	1752	0.283	1926	0.282
1058	0.289	1232	0.287	1406	0.286	1580	0.285	1754	0.284	1928	0.283
1060	0.289	1234	0.287	1408	0.286	1582	0.285	1756	0.284	1930	0.282
1062	0.289	1236	0.287	1410	0.286	1584	0.284	1758	0.284	1932	0.283
1064	0.289	1238	0.287	1412	0.286	1586	0.284	1760	0.284	1934	0.282
1066	0.289	1240	0.287	1414	0.286	1588	0.284	1762	0.284	1936	0.282
1068	0.289	1242	0.287	1416	0.286	1590	0.284	1764	0.284	1938	0.283
1070	0.289	1244	0.287	1418	0.286	1592	0.284	1766	0.283	1940	0.282
1072	0.288	1246	0.287	1420	0.286	1594	0.285	1768	0.283	1942	0.282
1074	0.288	1248	0.287	1422	0.286	1596	0.284	1770	0.284	1944	0.282
1076	0.288	1250	0.287	1424	0.286	1598	0.284	1772	0.283	1946	0.282
1078	0.288	1252	0.287	1426	0.286	1600	0.284	1774	0.284	1948	0.282
1080	0.288	1254	0.287	1428	0.286	1602	0.284	1776	0.283	1950	0.282
1082	0.288	1256	0.287	1430	0.286	1604	0.284	1778	0.283	1952	0.282
1084	0.288	1258	0.287	1432	0.285	1606	0.284	1780	0.283	1954	0.282
1086	0.288	1260	0.287	1434	0.286	1608	0.284	1782	0.283	1956	0.282
1088	0.288	1262	0.287	1436	0.286	1610	0.284	1784	0.283	1958	0.282
1090	0.288	1264	0.287	1438	0.285	1612	0.284	1786	0.283	1960	0.282
1092	0.288	1266	0.287	1440	0.285	1614	0.284	1788	0.283	1962	0.282
1094	0.288	1268	0.287	1442	0.286	1616	0.284	1790	0.283	1964	0.282
1096	0.288	1270	0.287	1444	0.285	1618	0.284	1792	0.283	1966	0.282
1098	0.288	1272	0.287	1446	0.286	1620	0.284	1794	0.283	1968	0.282
1100	0.288	1274	0.287	1448	0.285	1622	0.284	1796	0.283	1970	0.282
1102	0.288	1276	0.287	1450	0.285	1624	0.284	1798	0.283	1972	0.282
1104	0.288	1278	0.287	1452	0.285	1626	0.284	1800	0.283	1974	0.282
1106	0.288	1280	0.287	1454	0.285	1628	0.284	1802	0.283	1976	0.282
1108	0.288	1282	0.287	1456	0.285	1630	0.284	1804	0.283	1978	0.282
1110	0.288	1284	0.287	1458	0.285	1632	0.284	1806	0.283	1980	0.282
1112	0.288	1286	0.287	1460	0.285	1634	0.284	1808	0.283	1982	0.282
1114	0.288	1288	0.287	1462	0.285	1636	0.284	1810	0.283	1984	0.282
1116	0.288	1290	0.287	1464	0.285	1638	0.284	1812	0.283	1986	0.282
1118	0.288	1292	0.287	1466	0.285	1640	0.284	1814	0.283	1988	0.282
1120	0.288	1294	0.287	1468	0.285	1642	0.284	1816	0.283	1990	0.282
1122	0.288	1296	0.287	1470	0.285	1644	0.284	1818	0.283	1992	0.282
1124	0.288	1298	0.287	1472	0.285	1646	0.284	1820	0.283	1994	0.282
1126	0.288	1300	0.287	1474	0.285	1648	0.284	1822	0.283	1996	0.282
1128	0.288	1302	0.287	1476	0.285	1650	0.284	1824	0.283	1998	0.282
1130	0.288	1304	0.287	1478	0.285	1652	0.284	1826	0.283	2000	0.282
1132	0.288	1306	0.286	1480	0.285	1654	0.284	1828	0.283	2002	0.282
1134	0.288	1308	0.287	1482	0.285	1656	0.284	1830	0.283	2004	0.282
1136	0.288	1310	0.286	1484	0.285	1658	0.284	1832	0.283	2006	0.282
1138	0.288	1312	0.286	1486	0.285	1660	0.284	1834	0.283	2008	0.282
1140	0.288	1314	0.286	1488	0.285	1662	0.284	1836	0.283	2010	0.282
1142	0.288	1316	0.286	1490	0.285	1664	0.284	1838	0.283	2012	0.282
1144	0.288	1318	0.286	1492	0.285	1666	0.284	1840	0.283	2014	0.282
1146	0.288	1320	0.287	1494	0.285	1668	0.284	1842	0.283	2016	0.282
1148	0.288	1322	0.287	1496	0.285	1670	0.284	1844	0.283	2018	0.282
1150	0.288	1324	0.286	1498	0.285	1672	0.284	1846	0.283	2020	0.282
1152	0.288	1326	0.286	1500	0.285	1674	0.284	1848	0.283	2022	0.282
1154	0.288	1328	0.286	1502	0.285	1676	0.284	1850	0.283	2024	0.282
1156	0.288	1330	0.286	1504	0.285	1678	0.284	1852	0.283	2026	0.282
1158	0.288	1332	0.286	1506	0.285	1680	0.284	1854	0.283	2028	0.282
1160	0.288	1334	0.286	1508	0.285	1682	0.284	1856	0.283	2030	0.282
1162	0.288	1336	0.286	1510	0.285	1684	0.284	1858	0.283	2032	0.282
1164	0.288	1338	0.286	1512	0.285	1686	0.284	1860	0.283	2034	0.282
1166	0.288	1340	0.286	1514	0.285	1688	0.284	1862	0.283	2036	0.282
1168	0.288	1342	0.286	1516	0.285	1690	0.284	1864	0.283	2038	0.282
1170	0.288	1344	0.286	1518	0.285	1692	0.284	1866	0.283	2040	0.282
1172	0.288	1346	0.286	1520	0.285	1694	0.284	1868	0.283	2042	0.282
1174	0.288	1348	0.286	1522	0.285	1696	0.284	1870	0.283	2044	0.282
1176	0.288	1350	0.286	1524	0.285	1698	0.284	1872	0.283	2046	0.282
1178	0.288	1352	0.286	1526	0.285	1700	0.284	1874	0.283	2048	0.282
1180	0.288	1354	0.286	1528	0.285	1702	0.284	1876	0.283	2050	0.282
1182	0.288	1356	0.286	1530	0.285	1704	0.284	1878	0.283	2052	0.282
1184	0.288	1358	0.286	1532	0.285	1706	0.284	1880	0.283	2054	0.282
1186	0.287	1360	0.286	1534	0.285	1708	0.284	1882	0.283	2056	0.282
1188	0.287	1362	0.286	1536	0.285	1710	0.284	1884	0.283	2058	0.282
1190	0.287	1364	0.286	1538	0.285	1712	0.284	1886	0.283	2060	0.282
1192	0.287	1366	0.286	1540	0.285	1714	0.284	1888	0.283	2062	0.282
1194	0.287	1368	0.286	1542	0.285	1716	0.284	1890	0.283	2064	0.282
1196	0.287	1370	0.286	1544	0.285	1718	0.284	1892	0.283	2066	0.282
1198	0.287	1372	0.286	1546	0.285	1720	0.284	1894	0.283	2068	0.282
1200	0.287	1374	0.286	1548	0.285	1722	0.284	1896	0.283	2070	0.282
1202	0.287	1376	0.286	1550	0.285	1724	0.284	1898	0.283	2072	0.282
1204	0.287	1378	0.286	1552	0.285	1726	0.284	1900	0.283	2074	0.282
1206	0.287	1380	0.286	1554	0.285	1728	0.284	1902	0.283	2076	0.282
1208	0.287	1382	0.286	1556	0.285	1730	0.284	1904	0.283	2078	0.282
1210	0.287	1384	0.286	1558	0.285	1732	0.284	1906	0.283	2080	0.282
1212	0.287	1386	0.286	1560	0.285	1734	0.284	1908	0.283	2082	0.282
1214	0.287	1388	0.286	1562	0.285	1736	0.284	1910	0.283	2084	0.282
1216	0.287	1390	0.286	1564	0.284	1738	0.284	1912	0.283		

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
2086	0.282	2262	0.281	2434	0.28	2608	2.012	2782	1.997	2954	1.983
2088	0.282	2264	0.281	2436	0.28	2610	2.012	2784	1.997	2956	1.982
2090	0.282	2266	0.281	2438	0.28	2612	2.012	2786	1.997	2958	1.982
2092	0.282	2268	0.281	2440	0.28	2614	2.011	2788	1.997	2960	1.983
2094	0.282	2270	0.281	2442	0.28	2616	2.012	2790	1.997	2962	1.982
2096	0.282	2272	0.281	2444	0.28	2618	2.011	2792	1.997	2964	1.982
2098	0.282	2274	0.281	2446	0.28	2620	2.011	2794	1.997	2966	1.982
2100	0.282	2276	0.281	2448	0.28	2622	2.011	2796	1.997	2968	1.982
2102	0.282	2278	0.281	2450	0.28	2624	2.011	2798	1.997	2970	1.982
2104	0.282	2280	0.281	2452	0.28	2626	2.011	2800	1.996	2972	1.982
2106	0.282	2282	0.281	2454	0.28	2628	2.009	2802	1.995	2974	1.982
2108	0.281	2284	0.281	2456	0.28	2630	2.009	2804	1.995	2976	1.982
2110	0.282	2286	0.281	2458	0.28	2632	2.009	2806	1.997	2978	1.982
2112	0.282	2288	0.281	2460	0.28	2634	2.009	2808	1.995	2980	1.982
2114	0.282	2290	0.281	2462	0.28	2636	2.009	2810	1.996	2982	1.982
2116	0.282	2292	0.281	2464	0.28	2638	2.008	2812	1.995	2984	1.982
2118	0.281	2294	0.281	2466	0.28	2640	2.008	2814	1.995	2986	1.982
2120	0.281	2296	0.281	2468	0.28	2642	2.009	2816	1.993	2988	1.982
2122	0.282	2298	0.281	2470	0.28	2644	2.009	2818	1.995	2990	1.981
2124	0.281	2300	0.281	2472	0.28	2646	2.007	2820	1.995	2992	1.981
2126	0.281	2302	0.281	2474	0.28	2648	2.008	2822	1.993	2994	1.98
2128	0.281	2304	0.281	2476	0.28	2650	2.007	2824	1.992	2996	1.979
2130	0.281	2306	0.281	2478	0.28	2652	2.007	2826	1.993	2998	1.981
2132	0.282	2308	0.281	2480	0.28	2654	2.007	2828	1.993	3000	1.981
2134	0.281	2310	0.281	2482	0.28	2656	2.007	2830	1.993	3002	1.98
2136	0.281	2312	0.281	2484	0.28	2658	2.007	2832	1.993	3004	1.979
2138	0.281	2314	0.281	2486	0.28	2660	2.007	2834	1.992	3006	1.979
2140	0.281	2316	0.281	2488	0.28	2662	2.007	2836	1.992	3008	1.978
2142	0.281	2318	0.281	2490	0.28	2664	2.007	2838	1.992	3010	1.979
2144	0.281	2320	0.281	2492	0.28	2666	2.007	2840	1.992	3012	1.979
2146	0.281	2322	0.281	2494	0.28	2668	2.006	2842	1.992	3014	1.979
2148	0.281	2324	0.281	2496	0.28	2670	2.007	2844	1.992	3016	1.978
2150	0.281	2326	0.281	2498	0.28	2672	2.006	2846	1.992	3018	1.978
2152	0.281	2328	0.281	2500	0.28	2674	2.007	2848	1.992	3020	1.978
2154	0.281	2330	0.281	2502	0.28	2676	2.007	2850	1.992	3022	1.978
2156	0.281	2332	0.281	2504	0.28	2678	2.006	2852	1.992	3024	1.978
2158	0.281	2334	0.281	2506	0.28	2680	2.004	2854	1.992	3026	1.978
2160	0.281	2336	0.281	2508	0.28	2682	2.004	2856	1.992	3028	1.978
2162	0.281	2338	0.281	2510	0.28	2684	2.004	2858	1.992	3030	1.978
2164	0.281	2340	0.281	2512	0.28	2686	2.003	2860	1.992	3032	1.979
2166	0.281	2342	0.281	2514	0.28	2688	2.004	2862	1.992	3034	1.979
2168	0.281	2344	0.281	2516	0.28	2690	2.004	2864	1.992	3036	1.979
2170	0.281	2346	0.281	2518	0.28	2692	2.003	2866	1.992	3038	1.978
2172	0.281	2348	0.281	2520	0.28	2694	2.002	2868	1.992	3040	1.979
2174	0.281	2350	0.281	2522	0.28	2696	2.003	2870	1.992	3042	1.979
2176	0.281	2352	0.281	2524	0.28	2698	2.003	2872	1.992	3044	1.978
2178	0.281	2354	0.281	2526	0.28	2700	2.002	2874	1.991	3046	1.978
2180	0.281	2356	0.281	2528	0.28	2702	2.003	2876	1.991	3048	1.978
2182	0.281	2358	0.281	2530	0.28	2704	2.002	2878	1.99	3050	1.978
2184	0.281	2360	0.281	2532	0.28	2706	2.002	2880	1.991	3052	1.978
2186	0.281	2362	0.281	2534	0.28	2708	2.002	2882	1.989	3054	1.978
2188	0.281	2364	0.281	2536	0.28	2710	2.002	2884	1.991	3056	1.978
2190	0.281	2366	0.281	2538	0.28	2712	2.002	2886	1.99	3058	1.978
2192	0.281	2368	0.281	2540	0.28	2714	2.002	2888	1.989	3060	1.978
2194	0.281	2370	0.28	2542	0.28	2716	2.002	2890	1.988	3062	1.978
2196	0.281	2372	0.281	2544	0.28	2718	2.002	2892	1.988	3064	1.978
2198	0.281	2374	0.281	2546	0.28	2720	2.002	2894	1.989	3066	1.978
2200	0.281	2376	0.281	2548	0.28	2722	2.002	2896	1.988	3068	1.978
2202	0.281	2378	0.28	2550	0.28	2724	2.002	2898	1.988	3070	1.978
2204	0.281	2380	0.281	2552	0.28	2726	2.002	2900	1.987	3072	1.978
2208	0.281	2382	0.281	2554	0.28	2728	2.001	2902	1.987	3074	1.978
2210	0.281	2384	0.281	2556	0.28	2730	2.002	2904	1.988	3076	1.978
2212	0.281	2386	0.28	2558	0.28	2732	2.002	2906	1.988	3078	1.978
2214	0.281	2388	0.28	2560	0.28	2734	2.002	2908	1.987	3080	1.978
2216	0.281	2390	0.28	2562	0.28	2736	2	2910	1.987	3082	1.976
2218	0.281	2392	0.281	2564	0.28	2738	2	2912	1.987	3084	1.976
2220	0.281	2394	0.28	2566	0.28	2740	2.001	2914	1.987	3086	1.976
2222	0.281	2396	0.28	2568	0.28	2742	2.001	2916	1.987	3088	1.975
2224	0.281	2398	0.28	2570	0.28	2744	2	2918	1.987	3090	1.975
2226	0.281	2400	0.28	2572	0.28	2746	2	2920	1.987	3092	1.976
2228	0.281	2402	0.28	2574	0.28	2748	1.999	2922	1.987	3094	1.975
2230	0.281	2404	0.28	2576	2.013	2750	2.001	2924	1.986	3096	1.976
2232	0.281	2406	0.28	2578	2.012	2752	1.998	2926	1.986	3098	1.975
2234	0.281	2408	0.28	2580	2.012	2754	1.999	2928	1.986	3100	1.975
2236	0.281	2410	0.28	2582	2.013	2756	1.999	2930	1.986	3102	1.975
2238	0.281	2412	0.28	2584	2.012	2758	1.998	2932	1.986	3104	1.975
2240	0.281	2414	0.28	2586	2.012	2760	1.998	2934	1.986	3106	1.975
2242	0.281	2416	0.28	2588	2.012	2762	1.998	2936	1.984	3108	1.974
2244	0.281	2418	0.28	2590	2.012	2764	1.998	2938	1.985	3110	1.974
2246	0.281	2420	0.28	2592	2.012	2766	1.998	2940	1.986	3112	1.973
2248	0.281	2422	0.28	2594	2.012	2768	1.997	2942	1.984	3114	1.973
2250	0.281	2424	0.28	2596	2.012	2770	1.997	2944	1.984	3116	1.973
2252	0.281	2426	0.28	2598	2.012	2772	1.997	2946	1.985	3118	1.973
2254	0.281	2428	0.28	2600	2.012	2774	1.997	2948	1.984	3120	1.973
2256	0.281	2430	0.28	2602	2.012	2776	1.997	2950	1.983	3122	1.973
2258	0.281	2432	0.28	2604	2.012	2778	1.997	2952	1.983	3124	1.973
2260	0.281			2606	2.012	2780	1.997			3126	1.973

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
3128	1.973	3300	1.958	3474	1.942
3130	1.973	3302	1.957	3476	1.94
3132	1.973	3304	1.957	3478	1.94
3134	1.973	3306	1.957	3480	1.939
3136	1.973	3308	1.956	3482	1.939
3138	1.973	3310	1.955	3484	1.94
3140	1.973	3312	1.955	3486	1.939
3142	1.973	3314	1.956	3488	1.939
3144	1.972	3316	1.956	3490	1.939
3146	1.972	3318	1.955	3492	1.939
3148	1.972	3320	1.955	3494	1.939
3150	1.973	3322	1.954	3496	1.939
3152	1.971	3324	1.955	3498	1.939
3154	1.971	3326	1.954	3500	1.939
3156	1.971	3328	1.954	3502	1.939
3158	1.971	3330	1.953	3504	1.939
3160	1.97	3332	1.953	3506	1.939
3162	1.97	3334	1.953	3508	1.939
3164	1.97	3336	1.953	3510	1.939
3166	1.968	3338	1.953	3512	1.939
3168	1.97	3340	1.953	3514	1.939
3170	1.968	3342	1.953	3516	1.938
3172	1.968	3344	1.953	3518	1.938
3174	1.968	3346	1.953	3520	1.938
3176	1.968	3348	1.953	3522	1.936
3178	1.968	3350	1.953	3524	1.937
3180	1.968	3352	1.953	3526	1.937
3182	1.968	3354	1.953	3528	1.936
3184	1.968	3356	1.953	3530	1.937
3186	1.968	3358	1.953	3532	1.936
3188	1.968	3360	1.953	3534	1.935
3190	1.968	3362	1.953	3536	1.937
3192	1.968	3364	1.953	3538	1.935
3194	1.967	3366	1.952	3540	1.935
3196	1.967	3368	1.951	3542	1.935
3198	1.967	3370	1.951	3544	1.934
3200	1.967	3372	1.951	3546	1.934
3202	1.966	3374	1.951	3548	1.934
3204	1.965	3376	1.952	3550	1.934
3206	1.965	3378	1.949	3552	1.934
3208	1.965	3380	1.951	3554	1.934
3210	1.964	3382	1.95	3556	1.934
3212	1.964	3384	1.949	3558	1.934
3214	1.964	3386	1.949	3560	1.934
3216	1.964	3388	1.95	3562	1.934
3218	1.964	3390	1.948	3564	1.934
3220	1.964	3392	1.948	3566	1.934
3222	1.963	3394	1.948	3568	1.934
3224	1.963	3396	1.948	3570	1.934
3226	1.963	3398	1.948	3572	1.933
3228	1.963	3400	1.947	3574	1.934
3230	1.963	3402	1.947	3576	1.933
3232	1.963	3404	1.946	3578	1.934
3234	1.963	3406	1.948	3580	1.932
3236	1.963	3408	1.948	3582	1.933
3238	1.963	3410	1.948	3584	1.933
3240	1.963	3412	1.948	3586	1.932
3242	1.963	3414	1.946	3588	1.932
3244	1.963	3416	1.945	3590	1.933
3246	1.963	3418	1.946	3592	1.932
3248	1.962	3420	1.945	3594	1.93
3250	1.963	3422	1.944	3596	1.93
3252	1.963	3424	1.944	3598	1.93
3254	1.962	3426	1.945	3600	1.931
3256	1.962	3428	1.945		
3258	1.961	3430	1.944		
3260	1.96	3432	1.943		
3262	1.961	3434	1.943		
3264	1.961	3436	1.943		
3266	1.961	3438	1.943		
3268	1.959	3440	1.943		
3270	1.959	3442	1.943		
3272	1.959	3444	1.943		
3274	1.958	3446	1.943		
3276	1.959	3448	1.943		
3278	1.959	3450	1.943		
3280	1.958	3452	1.943		
3282	1.958	3454	1.943		
3284	1.958	3456	1.943		
3286	1.958	3458	1.943		
3288	1.958	3460	1.943		
3290	1.957	3462	1.943		
3292	1.958	3464	1.942		
3294	1.957	3466	1.943		
3296	1.958	3468	1.941		
3298	1.958	3470	1.942		
		3472	1.942		

APPENDIX A.5

BATTERY PARALLEL WITH 1.5F ULTRACAPACITOR(VOLTAGE)

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
0	0	174	2.315	348	2.239	522	2.182	696	2.134	870	2.101
2	0	176	2.315	350	2.236	524	2.181	698	2.134	872	2.102
4	2.521	178	2.315	352	2.236	526	2.181	700	2.134	874	2.1
6	2.524	180	2.314	354	2.237	528	2.178	702	2.134	876	2.101
8	2.52	182	2.311	356	2.236	530	2.179	704	2.133	878	2.1
10	2.514	184	2.31	358	2.236	532	2.178	706	2.133	880	2.1
12	2.507	186	2.309	360	2.235	534	2.178	708	2.133	882	2.1
14	2.501	188	2.308	362	2.235	536	2.178	710	2.131	884	2.1
16	2.495	190	2.306	364	2.232	538	2.178	712	2.133	886	2.1
18	2.49	192	2.305	366	2.232	540	2.177	714	2.131	888	2.1
20	2.484	194	2.305	368	2.232	542	2.175	716	2.131	890	2.099
22	2.481	196	2.305	370	2.232	544	2.175	718	2.13	892	2.098
24	2.474	198	2.305	372	2.232	546	2.175	720	2.129	894	2.098
26	2.47	200	2.302	374	2.23	548	2.174	722	2.129	896	2.098
28	2.466	202	2.301	376	2.229	550	2.174	724	2.129	898	2.097
30	2.461	204	2.3	378	2.228	552	2.173	726	2.129	900	2.096
32	2.457	206	2.297	380	2.227	554	2.173	728	2.128	902	2.096
34	2.452	208	2.297	382	2.227	556	2.172	730	2.129	904	2.096
36	2.449	210	2.295	384	2.227	558	2.172	732	2.128	906	2.096
38	2.446	212	2.295	386	2.227	560	2.171	734	2.128	908	2.095
40	2.442	214	2.294	388	2.227	562	2.17	736	2.127	910	2.095
42	2.438	216	2.293	390	2.226	564	2.169	738	2.127	912	2.095
44	2.435	218	2.292	392	2.223	566	2.168	740	2.125	914	2.095
46	2.432	220	2.291	394	2.223	568	2.169	742	2.124	916	2.095
48	2.429	222	2.29	396	2.222	570	2.168	744	2.125	918	2.094
50	2.427	224	2.29	398	2.222	572	2.168	746	2.124	920	2.094
52	2.424	226	2.289	400	2.221	574	2.168	748	2.124	922	2.094
54	2.422	228	2.287	402	2.221	576	2.167	750	2.124	924	2.094
56	2.417	230	2.286	404	2.218	578	2.167	752	2.123	926	2.093
58	2.415	232	2.285	406	2.217	580	2.164	754	2.123	928	2.092
60	2.412	234	2.285	408	2.217	582	2.164	756	2.123	930	2.092
62	2.412	236	2.284	410	2.217	584	2.163	758	2.122	932	2.091
64	2.407	238	2.283	412	2.217	586	2.164	760	2.122	934	2.091
66	2.406	240	2.282	414	2.217	588	2.163	762	2.12	936	2.091
68	2.402	242	2.28	416	2.217	590	2.163	764	2.12	938	2.091
70	2.402	244	2.28	418	2.216	592	2.163	766	2.12	940	2.091
72	2.398	246	2.279	420	2.215	594	2.16	768	2.119	942	2.09
74	2.395	248	2.279	422	2.214	596	2.159	770	2.119	944	2.09
76	2.393	250	2.276	424	2.213	598	2.159	772	2.119	946	2.09
78	2.393	252	2.276	426	2.212	600	2.158	774	2.119	948	2.09
80	2.389	254	2.275	428	2.212	602	2.158	776	2.119	950	2.09
82	2.387	256	2.275	430	2.212	604	2.158	778	2.119	952	2.09
84	2.385	258	2.274	432	2.211	606	2.158	780	2.119	954	2.09
86	2.383	260	2.274	434	2.21	608	2.158	782	2.119	956	2.09
88	2.382	262	2.271	436	2.209	610	2.158	784	2.119	958	2.089
90	2.379	264	2.271	438	2.208	612	2.157	786	2.117	960	2.088
92	2.377	266	2.271	440	2.208	614	2.155	788	2.116	962	2.09
94	2.373	268	2.271	442	2.207	616	2.153	790	2.116	964	2.087
96	2.373	270	2.268	444	2.207	618	2.154	792	2.115	966	2.087
98	2.372	272	2.268	446	2.207	620	2.154	794	2.114	968	2.086
100	2.369	274	2.267	448	2.207	622	2.153	796	2.114	970	2.086
102	2.368	276	2.266	450	2.205	624	2.153	798	2.114	972	2.086
104	2.367	278	2.266	452	2.203	626	2.153	800	2.114	974	2.085
106	2.364	280	2.266	454	2.203	628	2.152	802	2.114	976	2.085
108	2.363	282	2.265	456	2.202	630	2.15	804	2.114	978	2.085
110	2.361	284	2.264	458	2.202	632	2.152	806	2.113	980	2.085
112	2.358	286	2.261	460	2.202	634	2.149	808	2.114	982	2.085
114	2.358	288	2.262	462	2.202	636	2.149	810	2.113	984	2.085
116	2.356	290	2.261	464	2.199	638	2.149	812	2.112	986	2.084
118	2.354	292	2.26	466	2.199	640	2.149	814	2.112	988	2.083
120	2.354	294	2.259	468	2.199	642	2.149	816	2.111	990	2.084
122	2.352	296	2.258	470	2.197	644	2.149	818	2.111	992	2.084
124	2.35	298	2.257	472	2.197	646	2.149	820	2.111	994	2.083
126	2.349	300	2.256	474	2.197	648	2.147	822	2.11	996	2.081
128	2.348	302	2.256	476	2.197	650	2.147	824	2.109	998	2.081
130	2.344	304	2.256	478	2.197	652	2.145	826	2.109	1000	2.081
132	2.344	306	2.255	480	2.196	654	2.145	828	2.109	1002	2.081
134	2.344	308	2.253	482	2.194	656	2.144	830	2.109	1004	2.081
136	2.341	310	2.252	484	2.193	658	2.144	832	2.109	1006	2.081
138	2.339	312	2.251	486	2.193	660	2.144	834	2.109	1008	2.08
140	2.337	314	2.251	488	2.192	662	2.142	836	2.109	1010	2.08
142	2.334	316	2.251	490	2.192	664	2.142	838	2.109	1012	2.08
144	2.334	318	2.251	492	2.191	666	2.142	840	2.108	1014	2.08
146	2.333	320	2.249	494	2.19	668	2.141	842	2.108	1016	2.08
148	2.332	322	2.248	496	2.19	670	2.141	844	2.106	1018	2.08
150	2.33	324	2.247	498	2.19	672	2.139	846	2.106	1020	2.08
152	2.329	326	2.246	500	2.189	674	2.139	848	2.106	1022	2.079
154	2.329	328	2.246	502	2.188	676	2.139	850	2.105	1024	2.08
156	2.326	330	2.246	504	2.188	678	2.139	852	2.105	1026	2.08
158	2.324	332	2.246	506	2.188	680	2.139	854	2.105	1028	2.078
160	2.324	334	2.245	508	2.188	682	2.139	856	2.104	1030	2.078
162	2.324	336	2.242	510	2.188	684	2.138	858	2.105	1032	2.078
164	2.321	338	2.243	512	2.187	686	2.138	860	2.104	1034	2.076
166	2.319	340	2.243	514	2.186	688	2.137	862	2.103	1036	2.076
168	2.319	342	2.241	516	2.183	690	2.136	864	2.102	1038	2.076
170	2.319	344	2.241	518	2.183	692	2.135	866	2.102	1040	2.076
172	2.315	346	2.24	520	2.183	694	2.134	868	2.102	1042	2.076

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
1044	2.076	1218	2.055	1392	2.036	1566	2.017	1740	2	1914	1.984
1046	2.075	1220	2.055	1394	2.034	1568	2.017	1742	1.999	1916	1.983
1048	2.075	1222	2.054	1396	2.035	1570	2.017	1744	1.999	1918	1.982
1050	2.075	1224	2.055	1398	2.033	1572	2.015	1746	1.998	1920	1.983
1052	2.075	1226	2.055	1400	2.033	1574	2.017	1748	1.998	1922	1.982
1054	2.075	1228	2.053	1402	2.033	1576	2.016	1750	1.998	1924	1.982
1056	2.075	1230	2.052	1404	2.034	1578	2.016	1752	1.998	1926	1.983
1058	2.075	1232	2.051	1406	2.032	1580	2.014	1754	1.997	1928	1.983
1060	2.075	1234	2.051	1408	2.032	1582	2.014	1756	1.997	1930	1.982
1062	2.074	1236	2.051	1410	2.033	1584	2.015	1758	1.997	1932	1.982
1064	2.073	1238	2.053	1412	2.032	1586	2.013	1760	1.998	1934	1.982
1066	2.072	1240	2.051	1414	2.031	1588	2.012	1762	1.997	1936	1.982
1068	2.072	1242	2.051	1416	2.031	1590	2.013	1764	1.997	1938	1.982
1070	2.072	1244	2.051	1418	2.032	1592	2.014	1766	1.997	1940	1.982
1072	2.072	1246	2.051	1420	2.031	1594	2.012	1768	1.997	1942	1.982
1074	2.072	1248	2.051	1422	2.031	1596	2.012	1770	1.997	1944	1.981
1076	2.071	1250	2.051	1424	2.031	1598	2.013	1772	1.997	1946	1.982
1078	2.071	1252	2.051	1426	2.031	1600	2.012	1774	1.997	1948	1.982
1080	2.071	1254	2.051	1428	2.031	1602	2.012	1776	1.997	1950	1.981
1082	2.07	1256	2.051	1430	2.031	1604	2.012	1778	1.996	1952	1.981
1084	2.07	1258	2.05	1432	2.031	1606	2.012	1780	1.997	1954	1.982
1086	2.07	1260	2.05	1434	2.031	1608	2.012	1782	1.996	1956	1.981
1088	2.07	1262	2.048	1436	2.031	1610	2.012	1784	1.997	1958	1.981
1090	2.07	1264	2.049	1438	2.03	1612	2.012	1786	1.997	1960	1.981
1092	2.07	1266	2.048	1440	2.031	1614	2.012	1788	1.995	1962	1.979
1094	2.07	1268	2.05	1442	2.031	1616	2.012	1790	1.995	1964	1.979
1096	2.07	1270	2.049	1444	2.031	1618	2.012	1792	1.996	1966	1.979
1098	2.07	1272	2.048	1446	2.031	1620	2.012	1794	1.995	1968	1.979
1100	2.07	1274	2.046	1448	2.029	1622	2.011	1796	1.994	1970	1.979
1102	2.07	1276	2.047	1450	2.028	1624	2.012	1798	1.994	1972	1.979
1104	2.069	1278	2.047	1452	2.028	1626	2.011	1800	1.995	1974	1.978
1106	2.069	1280	2.047	1454	2.029	1628	2.011	1802	1.994	1976	1.979
1108	2.067	1282	2.047	1456	2.028	1630	2.011	1804	1.992	1978	1.978
1110	2.067	1284	2.047	1458	2.028	1632	2.011	1806	1.992	1980	1.978
1112	2.067	1286	2.046	1460	2.028	1634	2.01	1808	1.992	1982	1.978
1114	2.067	1288	2.046	1462	2.027	1636	2.011	1810	1.993	1984	1.978
1116	2.065	1290	2.046	1464	2.026	1638	2.008	1812	1.993	1986	1.978
1118	2.065	1292	2.046	1466	2.026	1640	2.009	1814	1.993	1988	1.978
1120	2.065	1294	2.045	1468	2.026	1642	2.008	1816	1.992	1990	1.978
1122	2.065	1296	2.045	1470	2.026	1644	2.008	1818	1.993	1992	1.978
1124	2.065	1298	2.046	1472	2.026	1646	2.008	1820	1.992	1994	1.978
1126	2.065	1300	2.045	1474	2.025	1648	2.008	1822	1.992	1996	1.978
1128	2.065	1302	2.044	1476	2.026	1650	2.008	1824	1.992	1998	1.978
1130	2.065	1304	2.045	1478	2.026	1652	2.007	1826	1.992	2000	1.978
1132	2.065	1306	2.044	1480	2.025	1654	2.007	1828	1.992	2002	1.978
1134	2.065	1308	2.044	1482	2.025	1656	2.007	1830	1.992	2004	1.978
1136	2.064	1310	2.043	1484	2.024	1658	2.008	1832	1.992	2006	1.977
1138	2.064	1312	2.044	1486	2.023	1660	2.007	1834	1.992	2008	1.977
1140	2.064	1314	2.042	1488	2.023	1662	2.007	1836	1.992	2010	1.976
1142	2.063	1316	2.042	1490	2.022	1664	2.006	1838	1.992	2012	1.976
1144	2.062	1318	2.042	1492	2.024	1666	2.006	1840	1.992	2014	1.976
1146	2.061	1320	2.041	1494	2.023	1668	2.007	1842	1.992	2016	1.976
1148	2.062	1322	2.041	1496	2.022	1670	2.007	1844	1.992	2018	1.976
1150	2.061	1324	2.041	1498	2.022	1672	2.006	1846	1.991	2020	1.975
1152	2.062	1326	2.041	1500	2.022	1674	2.004	1848	1.991	2022	1.975
1154	2.061	1328	2.041	1502	2.022	1676	2.006	1850	1.991	2024	1.974
1156	2.061	1330	2.041	1504	2.022	1678	2.005	1852	1.99	2026	1.975
1158	2.061	1332	2.041	1506	2.022	1680	2.004	1854	1.99	2028	1.974
1160	2.061	1334	2.041	1508	2.022	1682	2.004	1856	1.988	2030	1.974
1162	2.06	1336	2.04	1510	2.022	1684	2.004	1858	1.989	2032	1.973
1164	2.061	1338	2.041	1512	2.022	1686	2.004	1860	1.989	2034	1.974
1166	2.061	1340	2.041	1514	2.022	1688	2.003	1862	1.988	2036	1.974
1168	2.061	1342	2.04	1516	2.022	1690	2.003	1864	1.989	2038	1.973
1170	2.061	1344	2.04	1518	2.022	1692	2.003	1866	1.989	2040	1.973
1172	2.06	1346	2.041	1520	2.022	1694	2.003	1868	1.988	2042	1.973
1174	2.059	1348	2.04	1522	2.022	1696	2.003	1870	1.987	2044	1.973
1176	2.059	1350	2.04	1524	2.021	1698	2.003	1872	1.988	2046	1.973
1178	2.059	1352	2.039	1526	2.02	1700	2.002	1874	1.987	2048	1.973
1180	2.058	1354	2.039	1528	2.021	1702	2.002	1876	1.987	2050	1.973
1182	2.058	1356	2.038	1530	2.02	1704	2.003	1878	1.987	2052	1.973
1184	2.058	1358	2.039	1532	2.02	1706	2.003	1880	1.987	2054	1.973
1186	2.058	1360	2.038	1534	2.02	1708	2.002	1882	1.987	2056	1.973
1188	2.058	1362	2.037	1536	2.019	1710	2.002	1884	1.987	2058	1.973
1190	2.057	1364	2.038	1538	2.019	1712	2.002	1886	1.987	2060	1.973
1192	2.056	1366	2.037	1540	2.018	1714	2.002	1888	1.987	2062	1.973
1194	2.056	1368	2.037	1542	2.018	1716	2.002	1890	1.987	2064	1.973
1196	2.057	1370	2.037	1544	2.017	1718	2.002	1892	1.986	2066	1.972
1198	2.056	1372	2.037	1546	2.017	1720	2.002	1894	1.986	2068	1.973
1200	2.056	1374	2.036	1548	2.017	1722	2.002	1896	1.986	2070	1.972
1202	2.056	1376	2.036	1550	2.017	1724	2.002	1898	1.986	2072	1.972
1204	2.056	1378	2.036	1552	2.017	1726	2.001	1900	1.986	2074	1.971
1206	2.056	1380	2.036	1554	2.017	1728	2.001	1902	1.984	2076	1.972
1208	2.056	1382	2.036	1556	2.017	1730	2.002	1904	1.985	2078	1.971
1210	2.056	1384	2.036	1558	2.017	1732	2	1906	1.984	2080	1.971
1212	2.056	1386	2.036	1560	2.017	1734	2.001	1908	1.984	2082	1.971
1214	2.056	1388	2.036	1562	2.017	1736	2.001	1910	1.985	2084	1.971
1216	2.055	1390	2.036	1564	2.017	1738	2	1912	1.982		

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
2086	1.97	2260	1.956	2432	1.943	2606	1.931	2780	1.919	2952	1.906
2088	1.97	2262	1.957	2434	1.943	2608	1.931	2782	1.919	2954	1.906
2090	1.97	2264	1.958	2436	1.943	2610	1.929	2784	1.919	2956	1.906
2092	1.969	2266	1.956	2438	1.943	2612	1.929	2786	1.919	2958	1.905
2094	1.97	2268	1.956	2440	1.943	2614	1.932	2788	1.919	2960	1.906
2096	1.968	2270	1.957	2442	1.943	2616	1.929	2790	1.919	2962	1.905
2098	1.968	2272	1.956	2444	1.943	2618	1.931	2792	1.919	2964	1.904
2100	1.968	2274	1.956	2446	1.942	2620	1.93	2794	1.919	2966	1.905
2102	1.968	2276	1.955	2448	1.943	2622	1.929	2796	1.919	2968	1.905
2104	1.968	2278	1.955	2450	1.943	2624	1.929	2798	1.919	2970	1.904
2106	1.968	2280	1.955	2452	1.943	2626	1.929	2800	1.918	2972	1.904
2108	1.968	2282	1.954	2454	1.942	2628	1.929	2802	1.919	2974	1.904
2110	1.968	2284	1.954	2456	1.942	2630	1.929	2804	1.918	2976	1.904
2112	1.968	2286	1.954	2458	1.942	2632	1.929	2806	1.917	2978	1.904
2114	1.967	2288	1.953	2460	1.941	2634	1.929	2808	1.917	2980	1.904
2116	1.968	2290	1.954	2462	1.94	2636	1.929	2810	1.918	2982	1.904
2118	1.967	2292	1.954	2464	1.941	2638	1.929	2812	1.916	2984	1.904
2120	1.968	2294	1.953	2466	1.94	2640	1.929	2814	1.917	2986	1.904
2122	1.967	2296	1.953	2468	1.94	2642	1.929	2816	1.917	2988	1.904
2124	1.967	2298	1.954	2470	1.941	2644	1.929	2818	1.917	2990	1.904
2126	1.968	2300	1.953	2472	1.94	2646	1.929	2820	1.916	2992	1.904
2128	1.967	2302	1.954	2474	1.94	2648	1.929	2822	1.915	2994	1.904
2130	1.968	2304	1.953	2476	1.939	2650	1.928	2824	1.916	2996	1.904
2132	1.967	2306	1.953	2478	1.94	2652	1.929	2826	1.916	2998	1.904
2134	1.967	2308	1.953	2480	1.939	2654	1.929	2828	1.916	3000	1.903
2136	1.967	2310	1.953	2482	1.939	2656	1.929	2830	1.915	3002	1.903
2138	1.966	2312	1.953	2484	1.939	2658	1.928	2832	1.915	3004	1.904
2140	1.965	2314	1.953	2486	1.939	2660	1.928	2834	1.915	3006	1.903
2142	1.965	2316	1.953	2488	1.939	2662	1.928	2836	1.914	3008	1.903
2144	1.965	2318	1.953	2490	1.939	2664	1.928	2838	1.914	3010	1.902
2146	1.965	2320	1.953	2492	1.939	2666	1.927	2840	1.915	3012	1.903
2148	1.965	2322	1.953	2494	1.939	2668	1.928	2842	1.914	3014	1.902
2150	1.964	2324	1.953	2496	1.939	2670	1.927	2844	1.914	3016	1.903
2152	1.964	2326	1.953	2498	1.939	2672	1.928	2846	1.915	3018	1.901
2154	1.964	2328	1.953	2500	1.939	2674	1.928	2848	1.914	3020	1.9
2156	1.964	2330	1.953	2502	1.939	2676	1.927	2850	1.914	3022	1.901
2158	1.964	2332	1.953	2504	1.939	2678	1.926	2852	1.914	3024	1.899
2160	1.963	2334	1.952	2506	1.939	2680	1.924	2854	1.914	3026	1.901
2162	1.964	2336	1.951	2508	1.939	2682	1.925	2856	1.914	3028	1.901
2164	1.964	2338	1.951	2510	1.937	2684	1.925	2858	1.914	3030	1.901
2166	1.963	2340	1.952	2512	1.938	2686	1.924	2860	1.914	3032	1.9
2168	1.963	2342	1.951	2514	1.939	2688	1.925	2862	1.914	3034	1.899
2170	1.963	2344	1.952	2516	1.936	2690	1.924	2864	1.914	3036	1.901
2172	1.963	2346	1.951	2518	1.937	2692	1.924	2866	1.914	3038	1.899
2174	1.963	2348	1.95	2520	1.935	2694	1.924	2868	1.914	3040	1.9
2176	1.963	2350	1.95	2522	1.937	2696	1.924	2870	1.914	3042	1.899
2178	1.963	2352	1.949	2524	1.936	2698	1.924	2872	1.914	3044	1.899
2180	1.963	2354	1.949	2526	1.935	2700	1.924	2874	1.913	3046	1.899
2182	1.963	2356	1.949	2528	1.936	2702	1.924	2876	1.914	3048	1.899
2184	1.963	2358	1.949	2530	1.936	2704	1.924	2878	1.914	3050	1.899
2186	1.962	2360	1.949	2532	1.934	2706	1.924	2880	1.913	3052	1.899
2188	1.963	2362	1.948	2534	1.935	2708	1.924	2882	1.913	3054	1.899
2190	1.962	2364	1.948	2536	1.934	2710	1.924	2884	1.914	3056	1.899
2192	1.962	2366	1.948	2538	1.934	2712	1.924	2886	1.912	3058	1.899
2194	1.962	2368	1.948	2540	1.935	2714	1.924	2888	1.912	3060	1.899
2196	1.962	2370	1.948	2542	1.934	2716	1.924	2890	1.913	3062	1.899
2198	1.962	2372	1.948	2544	1.934	2718	1.924	2892	1.913	3064	1.899
2200	1.962	2374	1.948	2546	1.934	2720	1.924	2894	1.91	3066	1.898
2202	1.962	2376	1.948	2548	1.934	2722	1.924	2896	1.91	3068	1.899
2204	1.962	2378	1.948	2550	1.934	2724	1.924	2898	1.911	3070	1.897
2206	1.961	2380	1.948	2552	1.934	2726	1.924	2900	1.911	3072	1.898
2208	1.961	2382	1.948	2554	1.934	2728	1.924	2902	1.91	3074	1.897
2210	1.961	2384	1.947	2556	1.934	2730	1.923	2904	1.91	3076	1.898
2212	1.96	2386	1.946	2558	1.934	2732	1.923	2906	1.909	3078	1.896
2214	1.961	2388	1.947	2560	1.934	2734	1.923	2908	1.91	3080	1.898
2216	1.961	2390	1.947	2562	1.934	2736	1.923	2910	1.909	3082	1.898
2218	1.959	2392	1.947	2564	1.934	2738	1.922	2912	1.909	3084	1.897
2220	1.959	2394	1.946	2566	1.934	2740	1.923	2914	1.909	3086	1.896
2222	1.959	2396	1.946	2568	1.934	2742	1.923	2916	1.909	3088	1.896
2224	1.959	2398	1.945	2570	1.934	2744	1.921	2918	1.909	3090	1.895
2226	1.958	2400	1.945	2572	1.934	2746	1.921	2920	1.909	3092	1.896
2228	1.959	2402	1.946	2574	1.934	2748	1.921	2922	1.909	3094	1.895
2230	1.958	2404	1.945	2576	1.934	2750	1.922	2924	1.909	3096	1.895
2232	1.959	2406	1.944	2578	1.934	2752	1.922	2926	1.909	3098	1.895
2234	1.958	2408	1.945	2580	1.934	2754	1.921	2928	1.909	3100	1.896
2236	1.958	2410	1.945	2582	1.934	2756	1.92	2930	1.909	3102	1.895
2238	1.958	2412	1.944	2584	1.933	2758	1.922	2932	1.909	3104	1.895
2240	1.958	2414	1.943	2586	1.933	2760	1.921	2934	1.908	3106	1.895
2242	1.958	2416	1.943	2588	1.934	2762	1.92	2936	1.907	3108	1.895
2244	1.958	2418	1.944	2590	1.934	2764	1.92	2938	1.908	3110	1.895
2246	1.958	2420	1.943	2592	1.933	2766	1.92	2940	1.907	3112	1.895
2248	1.958	2422	1.943	2594	1.933	2768	1.92	2942	1.907	3114	1.895
2250	1.958	2424	1.943	2596	1.932	2770	1.92	2944	1.907	3116	1.895
2252	1.958	2426	1.943	2598	1.931	2772	1.919	2946	1.907	3118	1.895
2254	1.957	2428	1.943	2600	1.932	2774	1.919	2948	1.907	3120	1.895
2256	1.957	2430	1.943	2602	1.932	2776	1.919	2950	1.906	3122	1.895
2258	1.957			2604	1.932	2778	1.919			3124	1.895

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
3126	1.895	3298	1.88	3472	1.865
3128	1.895	3300	1.881	3474	1.865
3130	1.895	3302	1.88	3476	1.865
3132	1.895	3304	1.88	3478	1.865
3134	1.895	3306	1.88	3480	1.865
3136	1.894	3308	1.88	3482	1.865
3138	1.893	3310	1.88	3484	1.865
3140	1.894	3312	1.879	3486	1.865
3142	1.893	3314	1.879	3488	1.865
3144	1.893	3316	1.88	3490	1.865
3146	1.892	3318	1.88	3492	1.865
3148	1.891	3320	1.879	3494	1.864
3150	1.891	3322	1.877	3496	1.862
3152	1.891	3324	1.879	3498	1.863
3154	1.892	3326	1.879	3500	1.862
3156	1.891	3328	1.878	3502	1.862
3158	1.891	3330	1.878	3504	1.862
3160	1.892	3332	1.878	3506	1.861
3162	1.89	3334	1.877	3508	1.862
3164	1.89	3336	1.876	3510	1.862
3166	1.89	3338	1.876	3512	1.861
3168	1.89	3340	1.877	3514	1.861
3170	1.89	3342	1.876	3516	1.86
3172	1.89	3344	1.877	3518	1.86
3174	1.89	3346	1.875	3520	1.86
3176	1.89	3348	1.876	3522	1.86
3178	1.89	3350	1.876	3524	1.86
3180	1.89	3352	1.876	3526	1.86
3182	1.89	3354	1.875	3528	1.86
3184	1.89	3356	1.875	3530	1.86
3186	1.89	3358	1.875	3532	1.86
3188	1.888	3360	1.875	3534	1.86
3190	1.89	3362	1.875	3536	1.86
3192	1.888	3364	1.875	3538	1.86
3194	1.889	3366	1.875	3540	1.86
3196	1.888	3368	1.875	3542	1.86
3198	1.888	3370	1.875	3544	1.86
3200	1.888	3372	1.875	3546	1.859
3202	1.888	3374	1.875	3548	1.86
3204	1.888	3376	1.875	3550	1.859
3206	1.886	3378	1.875	3552	1.858
3208	1.886	3380	1.874	3554	1.859
3210	1.885	3382	1.875	3556	1.859
3212	1.886	3384	1.875	3558	1.857
3214	1.886	3386	1.875	3560	1.857
3216	1.887	3388	1.875	3562	1.857
3218	1.885	3390	1.875	3564	1.857
3220	1.886	3392	1.873	3566	1.857
3222	1.885	3394	1.874	3568	1.857
3224	1.885	3396	1.873	3570	1.856
3226	1.885	3398	1.873	3572	1.856
3228	1.887	3400	1.871	3574	1.856
3230	1.885	3402	1.871	3576	1.856
3232	1.885	3404	1.871	3578	1.856
3234	1.885	3406	1.871	3580	1.856
3236	1.885	3408	1.871	3582	1.856
3238	1.885	3410	1.87	3584	1.856
3240	1.885	3412	1.87	3586	1.856
3242	1.885	3414	1.87	3588	1.855
3244	1.885	3416	1.87	3590	1.856
3246	1.885	3418	1.87	3592	1.856
3248	1.885	3420	1.87	3594	1.856
3250	1.885	3422	1.87	3596	1.855
3252	1.885	3424	1.87	3598	1.856
3254	1.885	3426	1.87	3600	1.854
3256	1.885	3428	1.87		
3258	1.884	3430	1.868		
3260	1.885	3432	1.869		
3262	1.884	3434	1.869		
3264	1.884	3436	1.868		
3266	1.882	3438	1.868		
3268	1.884	3440	1.868		
3270	1.884	3442	1.867		
3272	1.882	3444	1.868		
3274	1.882	3446	1.867		
3276	1.882	3448	1.867		
3278	1.881	3450	1.865		
3280	1.881	3452	1.866		
3282	1.881	3454	1.865		
3284	1.881	3456	1.865		
3286	1.881	3458	1.865		
3288	1.881	3460	1.865		
3290	1.88	3462	1.865		
3292	1.881	3464	1.865		
3294	1.881	3466	1.865		
3296	1.881	3468	1.865		
		3470	1.865		

APPENDIX A.6

BATTERY PARALLEL WITH 1.5F ULTRACAPACITOR(CURRENT)

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
0	1.28E-03	174	0.286	348	0.281	522	0.278	696	0.275	870	0.273
2	1.10E-03	176	0.286	350	0.281	524	0.278	698	0.275	872	0.273
4	0.298	178	0.286	352	0.281	526	0.278	700	0.275	874	0.273
6	0.297	180	0.286	354	0.281	528	0.278	702	0.275	876	0.273
8	0.297	182	0.285	356	0.281	530	0.278	704	0.275	878	0.273
10	0.296	184	0.285	358	0.281	532	0.278	706	0.275	880	0.273
12	0.296	186	0.285	360	0.281	534	0.278	708	0.275	882	0.273
14	0.296	188	0.285	362	0.281	536	0.278	710	0.275	884	0.273
16	0.295	190	0.285	364	2.86E-01	538	0.278	712	0.275	886	0.273
18	0.295	192	0.285	366	2.86E-01	540	0.278	714	0.275	888	0.273
20	0.295	194	0.285	368	0.281	542	0.278	716	0.275	890	0.273
22	0.294	196	0.285	370	0.281	544	0.278	718	0.275	892	0.273
24	0.294	198	0.285	372	0.281	546	0.277	720	0.275	894	0.273
26	0.294	200	0.285	374	0.281	548	0.277	722	0.275	896	0.273
28	0.294	202	0.285	376	0.281	550	0.277	724	0.275	898	0.273
30	0.294	204	0.285	378	0.281	552	0.277	726	0.275	900	0.273
32	0.293	206	0.285	380	0.281	554	0.277	728	0.275	902	0.273
34	0.293	208	0.285	382	0.281	556	0.277	730	0.275	904	0.273
36	0.293	210	0.284	384	0.28	558	0.277	732	0.275	906	0.273
38	0.293	212	0.284	386	0.28	560	0.277	734	0.275	908	0.273
40	0.293	214	0.284	388	0.28	562	0.277	736	0.275	910	0.273
42	0.292	216	0.284	390	0.28	564	0.277	738	0.275	912	0.273
44	0.292	218	0.284	392	0.28	566	0.277	740	0.275	914	0.273
46	0.292	220	0.284	394	0.28	568	0.277	742	0.275	916	0.273
48	0.292	222	0.284	396	0.28	570	0.277	744	0.275	918	0.273
50	0.292	224	0.284	398	0.28	572	0.277	746	0.275	920	0.273
52	0.291	226	0.284	400	0.28	574	0.277	748	0.275	922	0.273
54	0.291	228	0.284	402	0.28	576	0.277	750	0.275	924	0.273
56	0.291	230	0.284	404	0.28	578	0.277	752	0.275	926	0.273
58	0.291	232	0.284	406	0.28	580	0.277	754	0.275	928	0.273
60	0.291	234	0.284	408	0.28	582	0.277	756	0.274	930	0.273
62	0.291	236	0.284	410	0.28	584	0.277	758	0.274	932	0.273
64	0.291	238	0.284	412	0.28	586	0.277	760	0.274	934	0.273
66	0.291	240	0.284	414	0.28	588	0.277	762	0.274	936	0.273
68	0.29	242	0.284	416	0.28	590	0.277	764	0.274	938	0.273
70	0.29	244	0.284	418	0.28	592	0.277	766	0.274	940	0.273
72	0.29	246	0.284	420	0.28	594	0.277	768	0.274	942	0.273
74	0.29	248	0.283	422	0.28	596	0.277	770	0.274	944	0.273
76	0.29	250	0.283	424	0.28	598	0.277	772	0.274	946	0.273
78	0.29	252	0.283	426	0.28	600	0.277	774	0.274	948	0.273
80	0.29	254	0.283	428	0.28	602	0.277	776	0.274	950	0.273
82	0.29	256	0.283	430	0.28	604	0.277	778	0.274	952	0.272
84	0.289	258	0.283	432	0.28	606	0.276	780	0.274	954	0.272
86	0.289	260	0.283	434	0.279	608	0.276	782	0.274	956	0.273
88	0.289	262	0.283	436	0.279	610	0.276	784	0.274	958	0.272
90	0.289	264	0.283	438	0.279	612	0.276	786	0.274	960	0.272
92	0.289	266	0.283	440	0.279	614	0.276	788	0.274	962	0.272
94	0.289	268	0.283	442	0.279	616	0.276	790	0.274	964	0.272
96	0.289	270	0.283	444	0.279	618	0.276	792	0.274	966	0.272
98	0.289	272	0.283	446	0.279	620	0.276	794	0.274	968	0.272
100	0.289	274	0.283	448	0.279	622	0.276	796	0.274	970	0.272
102	0.288	276	0.283	450	0.279	624	0.276	798	0.274	972	0.272
104	0.289	278	0.283	452	0.279	626	0.276	800	0.274	974	0.272
106	0.288	280	0.283	454	0.279	628	0.276	802	0.274	976	0.272
108	0.288	282	0.283	456	0.279	630	0.276	804	0.274	978	0.272
110	0.288	284	0.283	458	0.279	632	0.276	806	0.274	980	0.272
112	0.288	286	0.283	460	0.279	634	0.276	808	0.274	982	0.272
114	0.288	288	0.282	462	0.279	636	0.276	810	0.274	984	0.272
116	0.288	290	0.283	464	0.279	638	0.276	812	0.274	986	0.272
118	0.288	292	0.282	466	0.279	640	0.276	814	0.274	988	0.272
120	0.288	294	0.282	468	0.279	642	0.276	816	0.274	990	0.272
122	0.288	296	0.282	470	0.279	644	0.276	818	0.274	992	0.272
124	0.288	298	0.282	472	0.279	646	0.276	820	0.274	994	0.272
126	0.287	300	0.282	474	0.279	648	0.276	822	0.274	996	0.272
128	0.287	302	0.282	476	0.279	650	0.276	824	0.274	998	0.272
130	0.287	304	0.282	478	0.279	652	0.276	826	0.274	1000	0.272
132	0.287	306	0.282	480	0.279	654	0.276	828	0.274	1002	0.272
134	0.287	308	0.282	482	0.279	656	0.276	830	0.274	1004	0.272
136	0.287	310	0.282	484	0.279	658	0.276	832	0.274	1006	0.272
138	0.287	312	0.282	486	0.279	660	0.276	834	0.274	1008	0.272
140	0.287	314	0.282	488	0.278	662	0.276	836	0.274	1010	0.272
142	0.287	316	0.282	490	0.278	664	0.276	838	0.274	1012	0.272
144	0.287	318	0.282	492	0.278	666	0.276	840	0.274	1014	0.272
146	0.287	320	0.282	494	0.278	668	0.276	842	0.274	1016	0.272
148	0.287	322	0.282	496	0.278	670	0.276	844	0.274	1018	0.272
150	0.287	324	0.282	498	0.278	672	0.276	846	0.274	1020	0.272
152	0.287	326	0.282	500	0.278	674	0.276	848	0.274	1022	0.272
154	0.286	328	0.282	502	0.278	676	0.276	850	0.274	1024	0.272
156	0.286	330	0.282	504	0.278	678	0.275	852	0.274	1026	0.272
158	0.286	332	0.282	506	0.278	680	0.275	854	0.273	1028	0.272
160	0.286	334	0.282	508	0.278	682	0.276	856	0.273	1030	0.272
162	0.286	336	0.282	510	0.278	684	0.275	858	0.274	1032	0.272
164	0.286	338	0.282	512	0.278	686	0.275	860	0.273	1034	0.272
166	0.286	340	0.282	514	0.278	688	0.275	862	0.273	1036	0.272
168	0.286	342	0.281	516	0.278	690	0.275	864	0.273	1038	0.272
170	0.286	344	0.281	518	0.278	692	0.275	866	0.273	1040	0.272
172	0.286	346	0.281	520	0.278	694	0.275	868	0.273	1042	0.272

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
1044	0.272	1218	0.27	1392	0.269	1566	0.268	1740	0.267	1914	0.266
1046	0.272	1220	0.271	1394	0.269	1568	0.268	1742	0.267	1916	0.266
1048	0.272	1222	0.27	1396	0.269	1570	0.268	1744	0.267	1918	0.266
1050	0.272	1224	0.27	1398	0.269	1572	0.268	1746	0.267	1920	0.266
1052	0.272	1226	0.27	1400	0.269	1574	0.268	1748	0.267	1922	0.266
1054	0.272	1228	0.27	1402	0.269	1576	0.268	1750	0.267	1924	0.266
1056	0.272	1230	0.27	1404	0.269	1578	0.268	1752	0.267	1926	0.266
1058	0.272	1232	0.27	1406	0.269	1580	0.268	1754	0.267	1928	0.266
1060	0.272	1234	0.27	1408	0.269	1582	0.268	1756	0.267	1930	0.266
1062	0.272	1236	0.27	1410	0.269	1584	0.268	1758	0.267	1932	0.266
1064	0.272	1238	0.27	1412	0.269	1586	0.268	1760	0.267	1934	0.266
1066	0.272	1240	0.27	1414	0.269	1588	0.268	1762	0.267	1936	0.266
1068	0.272	1242	0.27	1416	0.269	1590	0.268	1764	0.267	1938	0.266
1070	0.272	1244	0.27	1418	0.269	1592	0.268	1766	0.267	1940	0.266
1072	0.272	1246	0.27	1420	0.269	1594	0.268	1768	0.267	1942	0.266
1074	0.272	1248	0.27	1422	0.269	1596	0.268	1770	0.267	1944	0.266
1076	0.272	1250	0.27	1424	0.269	1598	0.268	1772	0.267	1946	0.266
1078	0.272	1252	0.27	1426	0.269	1600	0.268	1774	0.267	1948	0.266
1080	0.272	1254	0.27	1428	0.269	1602	0.268	1776	0.267	1950	0.266
1082	0.271	1256	0.27	1430	0.269	1604	0.268	1778	0.267	1952	0.266
1084	0.271	1258	0.27	1432	0.269	1606	0.268	1780	0.267	1954	0.266
1086	0.271	1260	0.27	1434	0.269	1608	0.268	1782	0.267	1956	0.266
1088	0.271	1262	0.27	1436	0.269	1610	0.268	1784	0.267	1958	0.266
1090	0.271	1264	0.27	1438	0.269	1612	0.268	1786	0.267	1960	0.266
1092	0.271	1266	0.27	1440	0.269	1614	0.268	1788	0.267	1962	0.266
1094	0.271	1268	0.27	1442	0.269	1616	0.268	1790	0.267	1964	0.266
1096	0.271	1270	0.27	1444	0.269	1618	0.268	1792	0.267	1966	0.266
1098	0.271	1272	0.27	1446	0.269	1620	0.268	1794	0.267	1968	0.266
1100	0.271	1274	0.27	1448	0.269	1622	0.268	1796	0.267	1970	0.266
1102	0.271	1276	0.27	1450	0.269	1624	0.268	1798	0.267	1972	0.266
1104	0.271	1278	0.27	1452	0.269	1626	0.268	1800	0.267	1974	0.266
1106	0.271	1280	0.27	1454	0.269	1628	0.268	1802	0.267	1976	0.266
1108	0.271	1282	0.27	1456	0.269	1630	0.268	1804	0.267	1978	0.266
1110	0.271	1284	0.27	1458	0.269	1632	0.268	1806	0.267	1980	0.266
1112	0.271	1286	0.27	1460	0.269	1634	0.268	1808	0.267	1982	0.266
1114	0.271	1288	0.27	1462	0.269	1636	0.268	1810	0.267	1984	0.266
1116	0.271	1290	0.27	1464	0.269	1638	0.268	1812	0.267	1986	0.266
1118	0.271	1292	0.27	1466	0.269	1640	0.268	1814	0.267	1988	0.266
1120	0.271	1294	0.27	1468	0.269	1642	0.268	1816	0.267	1990	0.266
1122	0.271	1296	0.27	1470	0.269	1644	0.268	1818	0.267	1992	0.266
1124	0.271	1298	0.27	1472	0.269	1646	0.268	1820	0.267	1994	0.266
1126	0.271	1300	0.27	1474	0.269	1648	0.268	1822	0.267	1996	0.266
1128	0.271	1302	0.27	1476	0.269	1650	0.268	1824	0.267	1998	0.266
1130	0.271	1304	0.27	1478	0.269	1652	0.268	1826	0.267	2000	0.266
1132	0.271	1306	0.27	1480	0.269	1654	0.268	1828	0.267	2002	0.266
1134	0.271	1308	0.27	1482	0.269	1656	0.268	1830	0.267	2004	0.266
1136	0.271	1310	0.27	1484	0.269	1658	0.268	1832	0.267	2006	0.266
1138	0.271	1312	0.27	1486	0.269	1660	0.268	1834	0.267	2008	0.266
1140	0.271	1314	0.27	1488	0.269	1662	0.268	1836	0.267	2010	0.266
1142	0.271	1316	0.27	1490	0.269	1664	0.268	1838	0.267	2012	0.266
1144	0.271	1318	0.27	1492	0.269	1666	0.268	1840	0.267	2014	0.266
1146	0.271	1320	0.27	1494	0.269	1668	0.268	1842	0.267	2016	0.266
1148	0.271	1322	0.27	1496	0.269	1670	0.268	1844	0.267	2018	0.266
1150	0.271	1324	0.27	1498	0.269	1672	0.268	1846	0.267	2020	0.266
1152	0.271	1326	0.27	1500	0.269	1674	0.268	1848	0.267	2022	0.266
1154	0.271	1328	0.27	1502	0.269	1676	0.268	1850	0.267	2024	0.266
1156	0.271	1330	0.27	1504	0.269	1678	0.268	1852	0.267	2026	0.266
1158	0.271	1332	0.27	1506	0.269	1680	0.268	1854	0.267	2028	0.266
1160	0.271	1334	0.27	1508	0.269	1682	0.268	1856	0.267	2030	0.266
1162	0.271	1336	0.27	1510	0.269	1684	0.268	1858	0.267	2032	0.266
1164	0.271	1338	0.27	1512	0.269	1686	0.268	1860	0.267	2034	0.266
1166	0.271	1340	0.27	1514	0.269	1688	0.267	1862	0.267	2036	0.266
1168	0.271	1342	0.27	1516	0.269	1690	0.268	1864	0.267	2038	0.266
1170	0.271	1344	0.27	1518	0.268	1692	0.267	1866	0.267	2040	0.266
1172	0.271	1346	0.27	1520	0.269	1694	0.268	1868	0.267	2042	0.266
1174	0.271	1348	0.27	1522	0.268	1696	0.267	1870	0.267	2044	0.266
1176	0.271	1350	0.27	1524	0.268	1698	0.267	1872	0.267	2046	0.266
1178	0.271	1352	0.27	1526	0.268	1700	0.268	1874	0.267	2048	0.266
1180	0.271	1354	0.27	1528	0.268	1702	0.268	1876	0.266	2050	0.266
1182	0.271	1356	0.27	1530	0.268	1704	0.267	1878	0.266	2052	0.266
1184	0.271	1358	0.269	1532	0.268	1706	0.268	1880	0.266	2054	0.266
1186	0.271	1360	0.27	1534	0.268	1708	0.267	1882	0.266	2056	0.266
1188	0.271	1362	0.27	1536	0.268	1710	0.267	1884	0.266	2058	0.266
1190	0.271	1364	0.27	1538	0.268	1712	0.267	1886	0.266	2060	0.266
1192	0.271	1366	0.269	1540	0.268	1714	0.267	1888	0.266	2062	0.266
1194	0.271	1368	0.269	1542	0.268	1716	0.267	1890	0.267	2064	0.266
1196	0.271	1370	0.269	1544	0.268	1718	0.267	1892	0.266	2066	0.266
1198	0.271	1372	0.269	1546	0.269	1720	0.267	1894	0.266	2068	0.266
1200	0.271	1374	0.269	1548	0.268	1722	0.267	1896	0.266	2070	0.266
1202	0.271	1376	0.269	1550	0.268	1724	0.267	1898	0.266	2072	0.266
1204	0.271	1378	0.269	1552	0.268	1726	0.267	1900	0.266	2074	0.266
1206	0.271	1380	0.269	1554	0.268	1728	0.267	1902	0.266	2076	0.266
1208	0.271	1382	0.269	1556	0.268	1730	0.267	1904	0.266	2078	0.266
1210	0.27	1384	0.269	1558	0.268	1732	0.267	1906	0.266	2080	0.266
1212	0.271	1386	0.269	1560	0.268	1734	0.267	1908	0.266	2082	0.266
1214	0.271	1388	0.269	1562	0.268	1736	0.267	1910	0.266	2084	0.266
1216	0.271	1390	0.269	1564	0.268	1738	0.267	1912	0.266		

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
2086	0.266	2260	0.265	2432	0.264	2606	0.263	2780	0.263	2952	0.262
2088	0.265	2262	0.265	2434	0.264	2608	0.263	2782	0.263	2954	0.262
2090	0.266	2264	0.265	2436	0.264	2610	0.263	2784	0.262	2956	0.262
2092	0.266	2266	0.265	2438	0.264	2612	0.263	2786	0.263	2958	0.262
2094	0.266	2268	0.265	2440	0.264	2614	0.263	2788	0.262	2960	0.262
2096	0.265	2270	0.265	2442	0.264	2616	0.263	2790	0.262	2962	0.262
2098	0.265	2272	0.265	2444	0.264	2618	0.263	2792	0.262	2964	0.262
2100	0.265	2274	0.265	2446	0.264	2620	0.263	2794	0.262	2966	0.262
2102	0.266	2276	0.265	2448	0.264	2622	0.263	2796	0.262	2968	0.262
2104	0.266	2278	0.265	2450	0.264	2624	0.263	2798	0.262	2970	0.261
2106	0.265	2280	0.265	2452	0.264	2626	0.263	2800	0.262	2972	0.262
2108	0.266	2282	0.265	2454	0.264	2628	0.263	2802	0.262	2974	0.262
2110	0.265	2284	0.265	2456	0.264	2630	0.263	2804	0.262	2976	0.262
2112	0.266	2286	0.265	2458	0.264	2632	0.263	2806	0.262	2978	0.262
2114	0.266	2288	0.265	2460	0.264	2634	0.263	2808	0.262	2980	0.262
2116	0.265	2290	0.265	2462	0.264	2636	0.263	2810	0.262	2982	0.262
2118	0.265	2292	0.265	2464	0.264	2638	0.263	2812	0.262	2984	0.262
2120	0.265	2294	0.264	2466	0.264	2640	0.263	2814	0.262	2986	0.262
2122	0.266	2296	0.265	2468	0.264	2642	0.263	2816	0.262	2988	0.262
2124	0.265	2298	0.265	2470	0.264	2644	0.263	2818	0.262	2990	0.261
2126	0.265	2300	0.265	2472	0.264	2646	0.263	2820	0.262	2992	0.261
2128	0.265	2302	0.264	2474	0.264	2648	0.263	2822	0.262	2994	0.262
2130	0.265	2304	0.264	2476	0.264	2650	0.263	2824	0.262	2996	0.261
2132	0.265	2306	0.264	2478	0.264	2652	0.263	2826	0.262	2998	0.262
2134	0.265	2308	0.264	2480	0.264	2654	0.263	2828	0.262	3000	0.261
2136	0.265	2310	0.264	2482	0.264	2656	0.263	2830	0.262	3002	0.262
2138	0.265	2312	0.264	2484	0.264	2658	0.263	2832	0.262	3004	0.261
2140	0.265	2314	0.264	2486	0.264	2660	0.263	2834	0.262	3006	0.262
2142	0.265	2316	0.265	2488	0.264	2662	0.263	2836	0.262	3008	0.262
2144	0.265	2318	0.265	2490	0.264	2664	0.263	2838	0.262	3010	0.262
2146	0.265	2320	0.264	2492	0.264	2666	0.263	2840	0.262	3012	0.261
2148	0.265	2322	0.264	2494	0.264	2668	0.263	2842	0.262	3014	0.261
2150	0.265	2324	0.264	2496	0.264	2670	0.263	2844	0.262	3016	0.262
2152	0.265	2326	0.264	2498	0.263	2672	0.263	2846	0.262	3018	0.262
2154	0.265	2328	0.264	2500	0.264	2674	0.263	2848	0.262	3020	0.261
2156	0.265	2330	0.264	2502	0.264	2676	0.263	2850	0.262	3022	0.261
2158	0.265	2332	0.264	2504	0.263	2678	0.263	2852	0.262	3024	0.261
2160	0.265	2334	0.264	2506	0.264	2680	0.263	2854	0.262	3026	0.262
2162	0.265	2336	0.264	2508	0.264	2682	0.263	2856	0.262	3028	0.261
2164	0.265	2338	0.264	2510	0.264	2684	0.263	2858	0.262	3030	0.261
2166	0.265	2340	0.264	2512	0.264	2686	0.263	2860	0.262	3032	0.261
2168	0.265	2342	0.264	2514	0.264	2688	0.263	2862	0.262	3034	0.261
2170	0.265	2344	0.264	2516	0.264	2690	0.263	2864	0.262	3036	0.261
2172	0.265	2346	0.264	2518	0.264	2692	0.263	2866	0.262	3038	0.261
2174	0.265	2348	0.264	2520	0.264	2694	0.263	2868	0.262	3040	0.261
2176	0.265	2350	0.264	2522	0.264	2696	0.263	2870	0.262	3042	0.261
2178	0.265	2352	0.264	2524	0.264	2698	0.263	2872	0.262	3044	0.261
2180	0.265	2354	0.264	2526	0.263	2700	0.263	2874	0.262	3046	0.261
2182	0.265	2356	0.264	2528	0.264	2702	0.263	2876	0.262	3048	0.261
2184	0.265	2358	0.264	2530	0.264	2704	0.263	2878	0.262	3050	0.261
2186	0.265	2360	0.264	2532	0.264	2706	0.263	2880	0.262	3052	0.261
2188	0.265	2362	0.264	2534	0.263	2708	0.263	2882	0.262	3054	0.261
2190	0.265	2364	0.264	2536	0.263	2710	0.263	2884	0.262	3056	0.261
2192	0.265	2366	0.264	2538	0.263	2712	0.263	2886	0.262	3058	0.261
2194	0.265	2368	0.264	2540	0.263	2714	0.263	2888	0.262	3060	0.261
2196	0.265	2370	0.264	2542	0.263	2716	0.263	2890	0.262	3062	0.261
2198	0.265	2372	0.264	2544	0.263	2718	0.263	2892	0.262	3064	0.261
2200	0.265	2374	0.264	2546	0.263	2720	0.263	2894	0.262	3066	0.261
2202	0.265	2376	0.264	2548	0.263	2722	0.263	2896	0.262	3068	0.261
2204	0.265	2378	0.264	2550	0.264	2724	0.263	2898	0.262	3070	0.261
2206	0.265	2380	0.264	2552	0.263	2726	0.263	2900	0.262	3072	0.261
2208	0.265	2382	0.264	2554	0.263	2728	0.263	2902	0.262	3074	0.261
2210	0.265	2384	0.264	2556	0.263	2730	0.263	2904	0.262	3076	0.261
2212	0.265	2386	0.264	2558	0.263	2732	0.263	2906	0.262	3078	0.261
2214	0.265	2388	0.264	2560	0.263	2734	0.263	2908	0.262	3080	0.261
2216	0.265	2390	0.264	2562	0.263	2736	0.263	2910	0.262	3082	0.261
2218	0.265	2392	0.264	2564	0.263	2738	0.263	2912	0.262	3084	0.261
2220	0.265	2394	0.264	2566	0.263	2740	0.263	2914	0.262	3086	0.261
2222	0.265	2396	0.264	2568	0.263	2742	0.263	2916	0.262	3088	0.261
2224	0.265	2398	0.264	2570	0.263	2744	0.263	2918	0.262	3090	0.261
2226	0.265	2400	0.264	2572	0.263	2746	0.263	2920	0.262	3092	0.261
2228	0.265	2402	0.264	2574	0.263	2748	0.263	2922	0.262	3094	0.261
2230	0.265	2404	0.264	2576	0.263	2750	0.263	2924	0.262	3096	0.261
2232	0.265	2406	0.264	2578	0.263	2752	0.263	2926	0.262	3098	0.261
2234	0.265	2408	0.264	2580	0.263	2754	0.263	2928	0.262	3100	0.261
2236	0.265	2410	0.264	2582	0.263	2756	0.263	2930	0.262	3102	0.261
2238	0.265	2412	0.264	2584	0.263	2758	0.263	2932	0.262	3104	0.261
2240	0.265	2414	0.264	2586	0.263	2760	0.263	2934	0.262	3106	0.261
2242	0.265	2416	0.264	2588	0.263	2762	0.263	2936	0.262	3108	0.261
2244	0.265	2418	0.264	2590	0.263	2764	0.263	2938	0.262	3110	0.261
2246	0.265	2420	0.264	2592	0.263	2766	0.263	2940	0.262	3112	0.261
2248	0.265	2422	0.264	2594	0.263	2768	0.263	2942	0.262	3114	0.261
2250	0.265	2424	0.264	2596	0.263	2770	0.263	2944	0.262	3116	0.261
2252	0.265	2426	0.264	2598	0.263	2772	0.263	2946	0.262	3118	0.261
2254	0.265	2428	0.264	2600	0.263	2774	0.263	2948	0.262	3120	0.261
2256	0.265	2430	0.264	2602	0.263	2776	0.263	2950	0.262	3122	0.261
2258	0.265			2604	0.263	2778	0.263			3124	0.261

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
3126	0.261	3298	0.26	3472	0.259
3128	0.261	3300	0.26	3474	0.259
3130	0.261	3302	0.26	3476	0.259
3132	0.261	3304	0.26	3478	0.259
3134	0.261	3306	0.26	3480	0.259
3136	0.261	3308	0.26	3482	0.259
3138	0.261	3310	0.26	3484	0.259
3140	0.261	3312	0.26	3486	0.259
3142	0.261	3314	0.26	3488	0.259
3144	0.261	3316	0.26	3490	0.259
3146	0.261	3318	0.26	3492	0.259
3147	0.261	3320	0.26	3494	0.259
3149	0.261	3322	0.26	3496	0.259
3150	0.261	3324	0.26	3498	0.259
3152	0.261	3326	0.26	3500	0.259
3154	0.261	3328	0.26	3502	0.259
3156	0.261	3330	0.26	3504	0.259
3158	0.261	3332	0.26	3506	0.259
3160	0.261	3334	0.26	3508	0.259
3162	0.261	3336	0.26	3510	0.259
3164	0.261	3338	0.26	3512	0.259
3166	0.261	3340	0.26	3514	0.259
3168	0.261	3342	0.26	3515	0.259
3170	0.261	3344	0.26	3517	0.259
3172	0.261	3346	0.26	3518	0.259
3174	0.261	3348	0.26	3520	0.259
3176	0.261	3350	0.26	3522	0.259
3178	0.261	3352	0.26	3524	0.259
3180	0.261	3354	0.26	3526	0.259
3182	0.261	3356	0.26	3528	0.259
3184	0.261	3358	0.26	3530	0.259
3186	0.261	3360	0.26	3532	0.259
3188	0.261	3362	0.26	3534	0.259
3190	0.261	3364	0.26	3536	0.259
3192	0.261	3366	0.26	3538	0.259
3194	0.261	3368	0.26	3540	0.259
3196	0.261	3370	0.26	3542	0.259
3198	0.261	3372	0.26	3544	0.259
3200	0.261	3374	0.26	3546	0.259
3202	0.261	3376	0.26	3548	0.259
3204	0.261	3378	0.26	3550	0.259
3206	0.261	3380	0.26	3552	0.259
3208	0.261	3382	0.26	3554	0.259
3210	0.261	3384	0.26	3556	0.259
3212	0.261	3386	0.26	3558	0.259
3214	0.261	3388	0.26	3560	0.259
3216	0.261	3390	0.26	3562	0.259
3218	0.26	3392	0.26	3564	0.259
3220	0.261	3394	0.26	3566	0.259
3222	0.26	3396	0.26	3568	0.259
3224	0.26	3398	0.26	3570	0.259
3226	0.261	3400	0.26	3572	0.259
3228	0.261	3402	0.26	3574	0.259
3230	0.26	3404	0.26	3576	0.259
3232	0.26	3406	0.26	3578	0.259
3234	0.261	3408	0.26	3580	0.259
3236	0.26	3410	0.26	3582	0.259
3238	0.26	3412	0.26	3584	0.259
3240	0.26	3414	0.26	3586	0.259
3242	0.26	3416	0.26	3588	0.259
3244	0.26	3418	0.26	3590	0.259
3246	0.26	3420	0.259	3592	0.259
3248	0.26	3422	0.26	3594	0.259
3250	0.26	3424	0.26	3596	0.259
3252	0.26	3426	0.26	3598	0.259
3254	0.26	3428	0.26	3600	0.259
3256	0.26	3430	0.26		
3258	0.26	3432	0.26		
3260	0.26	3434	0.26		
3262	0.26	3436	0.26		
3264	0.26	3438	0.26		
3266	0.26	3440	0.259		
3268	0.26	3442	0.26		
3270	0.26	3444	0.259		
3272	0.26	3446	0.259		
3274	0.26	3448	0.259		
3276	0.26	3450	0.259		
3278	0.26	3452	0.259		
3280	0.26	3454	0.259		
3282	0.26	3456	0.259		
3284	0.26	3458	0.26		
3286	0.26	3460	0.259		
3288	0.26	3462	0.259		
3290	0.26	3464	0.259		
3292	0.26	3466	0.259		
3294	0.26	3468	0.259		
3296	0.26	3470	0.259		

APPENDIX A.7

BATTERY PARALLEL WITH 2F ULTRACAPACITOR(VOLTAGE)

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
0	0	176	2.379	350	2.3	524	2.246	698	2.202	872	2.163
2	0	178	2.377	352	2.3	526	2.246	700	2.202	874	2.162
4	2.593	180	2.377	354	2.3	528	2.246	702	2.202	876	2.162
6	2.583	182	2.376	356	2.3	530	2.245	704	2.2	878	2.162
8	2.578	184	2.375	358	2.299	532	2.244	706	2.2	880	2.161
10	2.568	186	2.373	360	2.298	534	2.243	708	2.2	882	2.163
12	2.564	188	2.373	362	2.297	536	2.242	710	2.2	884	2.16
14	2.559	190	2.372	364	2.295	538	2.243	712	2.199	886	2.159
16	2.554	192	2.369	366	2.295	540	2.241	714	2.198	888	2.159
18	2.549	194	2.368	368	2.295	542	2.241	716	2.197	890	2.159
20	2.544	196	2.368	370	2.294	544	2.241	718	2.197	892	2.158
22	2.539	198	2.367	372	2.294	546	2.241	720	2.197	894	2.158
26	2.53	200	2.365	374	2.293	548	2.241	722	2.197	896	2.158
28	2.527	202	2.363	376	2.291	550	2.239	724	2.197	898	2.158
30	2.523	204	2.363	378	2.29	552	2.239	726	2.196	900	2.158
32	2.52	206	2.363	380	2.29	554	2.238	728	2.194	902	2.158
34	2.515	208	2.363	382	2.289	556	2.236	730	2.194	904	2.158
36	2.513	210	2.36	384	2.29	558	2.237	732	2.193	906	2.158
38	2.51	212	2.358	386	2.289	560	2.236	734	2.192	908	2.158
40	2.506	214	2.358	388	2.288	562	2.236	736	2.192	910	2.156
42	2.503	216	2.358	390	2.286	564	2.236	738	2.192	912	2.154
44	2.5	218	2.357	392	2.286	566	2.236	740	2.192	914	2.155
46	2.496	220	2.355	394	2.285	568	2.235	742	2.192	916	2.155
48	2.492	222	2.354	396	2.285	570	2.234	744	2.191	918	2.155
50	2.49	224	2.354	398	2.285	572	2.233	746	2.19	920	2.153
52	2.487	226	2.353	400	2.285	574	2.232	748	2.191	922	2.155
54	2.484	228	2.351	402	2.284	576	2.232	750	2.189	924	2.153
56	2.481	230	2.351	404	2.282	578	2.232	752	2.189	926	2.154
58	2.481	232	2.349	406	2.282	580	2.232	754	2.188	928	2.153
60	2.476	234	2.349	408	2.28	582	2.232	756	2.188	930	2.153
62	2.475	236	2.349	410	2.28	584	2.23	758	2.188	932	2.153
64	2.471	238	2.347	412	2.28	586	2.231	760	2.188	934	2.153
66	2.471	240	2.346	414	2.279	588	2.23	762	2.188	936	2.153
68	2.467	242	2.345	416	2.277	590	2.23	764	2.188	938	2.153
70	2.465	244	2.344	418	2.276	592	2.229	766	2.187	940	2.152
72	2.463	246	2.344	420	2.276	594	2.228	768	2.186	942	2.15
74	2.461	248	2.344	422	2.275	596	2.227	770	2.185	944	2.15
76	2.461	250	2.342	424	2.275	598	2.227	772	2.184	946	2.15
78	2.456	252	2.341	426	2.275	600	2.227	774	2.185	948	2.15
80	2.452	254	2.34	428	2.275	602	2.227	776	2.183	950	2.151
82	2.451	256	2.339	430	2.275	604	2.227	778	2.183	952	2.15
84	2.451	258	2.338	432	2.274	606	2.227	780	2.183	954	2.149
86	2.446	260	2.336	434	2.274	608	2.225	782	2.181	956	2.149
88	2.446	262	2.334	436	2.272	610	2.224	784	2.178	958	2.149
90	2.443	264	2.334	438	2.271	612	2.223	786	2.178	960	2.149
92	2.441	266	2.334	440	2.271	614	2.223	788	2.179	962	2.149
94	2.441	268	2.333	442	2.271	616	2.222	790	2.178	964	2.149
96	2.44	270	2.332	444	2.271	618	2.222	792	2.178	966	2.149
98	2.436	272	2.33	446	2.269	620	2.222	794	2.178	968	2.149
100	2.433	274	2.33	448	2.269	622	2.222	796	2.178	970	2.149
102	2.432	276	2.329	450	2.268	624	2.221	798	2.178	972	2.146
104	2.431	278	2.329	452	2.266	626	2.22	800	2.177	974	2.149
106	2.429	280	2.328	454	2.266	628	2.219	802	2.177	976	2.147
108	2.427	282	2.327	456	2.266	630	2.219	804	2.177	978	2.147
110	2.427	284	2.325	458	2.266	632	2.217	806	2.175	980	2.147
112	2.424	286	2.324	460	2.264	634	2.217	808	2.174	982	2.146
114	2.423	288	2.324	462	2.265	636	2.217	810	2.174	984	2.146
116	2.422	290	2.324	464	2.263	638	2.217	812	2.174	986	2.144
118	2.42	292	2.324	466	2.262	640	2.217	814	2.173	988	2.145
120	2.417	294	2.322	468	2.262	642	2.217	816	2.173	990	2.144
122	2.416	296	2.322	470	2.261	644	2.217	818	2.173	992	2.144
124	2.413	298	2.321	472	2.261	646	2.216	820	2.173	994	2.144
126	2.412	300	2.319	474	2.261	648	2.215	822	2.173	996	2.144
128	2.412	302	2.319	476	2.258	650	2.214	824	2.173	998	2.142
130	2.409	304	2.319	478	2.257	652	2.214	826	2.173	1000	2.144
132	2.408	306	2.317	480	2.257	654	2.213	828	2.172	1002	2.142
134	2.407	308	2.315	482	2.257	656	2.212	830	2.17	1004	2.141
136	2.405	310	2.315	484	2.256	658	2.212	832	2.169	1006	2.141
138	2.403	312	2.315	486	2.256	660	2.212	834	2.169	1008	2.139
140	2.402	314	2.315	488	2.256	662	2.212	836	2.168	1010	2.141
142	2.402	316	2.315	490	2.256	664	2.211	838	2.168	1012	2.139
144	2.4	318	2.314	492	2.256	666	2.21	840	2.169	1014	2.139
146	2.398	320	2.314	494	2.255	668	2.208	842	2.168	1016	2.139
148	2.397	322	2.312	496	2.253	670	2.208	844	2.168	1018	2.139
150	2.395	324	2.311	498	2.253	672	2.207	846	2.168	1020	2.139
152	2.393	326	2.31	500	2.252	674	2.208	848	2.168	1022	2.139
154	2.393	328	2.31	502	2.251	676	2.208	850	2.168	1024	2.139
156	2.393	330	2.308	504	2.251	678	2.207	852	2.168	1026	2.139
158	2.389	332	2.308	506	2.251	680	2.207	854	2.167	1028	2.139
160	2.388	334	2.306	508	2.251	682	2.207	856	2.165	1030	2.139
162	2.388	336	2.305	510	2.25	684	2.206	858	2.164	1032	2.139
164	2.387	338	2.305	512	2.25	686	2.206	860	2.164	1034	2.139
166	2.385	340	2.305	514	2.247	688	2.205	862	2.164	1036	2.138
168	2.383	342	2.305	516	2.248	690	2.205	864	2.164	1038	2.138
170	2.383	344	2.305	518	2.246	692	2.204	866	2.163	1040	2.137
172	2.383	346	2.304	520	2.246	694	2.204	868	2.163	1042	2.137
174	2.38	348	2.302	522	2.247	696	2.202	870	2.163	1044	2.136

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	2.041
1046	2.136	1220	2.111	1394	2.09	1568	2.072	1742	2.056	1916	2.041
1048	2.135	1222	2.111	1396	2.09	1570	2.074	1744	2.056	1918	2.041
1050	2.134	1224	2.111	1398	2.09	1572	2.072	1746	2.056	1920	2.041
1052	2.134	1226	2.111	1400	2.09	1574	2.072	1748	2.056	1922	2.041
1054	2.134	1228	2.11	1402	2.09	1576	2.07	1750	2.055	1924	2.041
1056	2.134	1230	2.111	1404	2.09	1578	2.07	1752	2.056	1926	2.04
1058	2.134	1232	2.11	1406	2.09	1580	2.07	1754	2.056	1928	2.041
1060	2.134	1234	2.109	1408	2.09	1582	2.07	1756	2.056	1930	2.04
1062	2.134	1236	2.109	1410	2.09	1584	2.07	1758	2.055	1932	2.041
1064	2.134	1238	2.109	1412	2.089	1586	2.07	1760	2.055	1934	2.04
1066	2.134	1240	2.109	1414	2.089	1588	2.07	1762	2.055	1936	2.04
1068	2.134	1242	2.109	1416	2.089	1590	2.07	1764	2.055	1938	2.041
1070	2.133	1244	2.109	1418	2.089	1592	2.07	1766	2.053	1940	2.04
1072	2.133	1246	2.109	1420	2.09	1594	2.07	1768	2.054	1942	2.04
1074	2.131	1248	2.109	1422	2.089	1596	2.07	1770	2.055	1944	2.039
1076	2.131	1250	2.109	1424	2.088	1598	2.07	1772	2.055	1946	2.039
1078	2.13	1252	2.109	1426	2.087	1600	2.07	1774	2.054	1948	2.039
1080	2.13	1254	2.109	1428	2.087	1602	2.069	1776	2.054	1950	2.038
1082	2.131	1256	2.109	1430	2.087	1604	2.07	1778	2.053	1952	2.037
1084	2.131	1258	2.109	1432	2.085	1606	2.07	1780	2.053	1954	2.038
1086	2.13	1260	2.108	1434	2.085	1608	2.07	1782	2.052	1956	2.038
1088	2.13	1262	2.107	1436	2.086	1610	2.07	1784	2.051	1958	2.038
1090	2.129	1264	2.106	1438	2.086	1612	2.07	1786	2.051	1960	2.037
1092	2.129	1266	2.105	1440	2.086	1614	2.07	1788	2.052	1962	2.037
1094	2.129	1268	2.105	1442	2.086	1616	2.07	1790	2.051	1964	2.037
1096	2.129	1270	2.106	1444	2.085	1618	2.069	1792	2.051	1966	2.037
1098	2.129	1272	2.106	1446	2.084	1620	2.068	1794	2.051	1968	2.037
1100	2.129	1274	2.106	1448	2.085	1622	2.067	1796	2.051	1970	2.036
1102	2.129	1276	2.106	1450	2.085	1624	2.067	1798	2.051	1972	2.036
1104	2.129	1278	2.105	1452	2.085	1626	2.067	1800	2.051	1974	2.036
1106	2.128	1280	2.105	1454	2.084	1628	2.066	1802	2.051	1976	2.036
1108	2.129	1282	2.104	1456	2.084	1630	2.065	1804	2.051	1978	2.036
1110	2.128	1284	2.105	1458	2.083	1632	2.066	1806	2.051	1980	2.036
1112	2.126	1286	2.105	1460	2.084	1634	2.066	1808	2.051	1982	2.036
1114	2.126	1288	2.104	1462	2.083	1636	2.066	1810	2.051	1984	2.036
1116	2.126	1290	2.105	1464	2.081	1638	2.065	1812	2.051	1986	2.036
1118	2.125	1292	2.103	1466	2.081	1640	2.065	1814	2.051	1988	2.036
1120	2.125	1294	2.102	1468	2.081	1642	2.065	1816	2.051	1990	2.036
1122	2.124	1296	2.1	1470	2.082	1644	2.065	1818	2.051	1992	2.035
1124	2.125	1298	2.101	1472	2.081	1646	2.065	1820	2.05	1994	2.036
1126	2.125	1300	2.101	1474	2.081	1648	2.065	1822	2.05	1996	2.035
1128	2.124	1302	2.1	1476	2.081	1650	2.065	1824	2.05	1998	2.036
1130	2.124	1304	2.1	1478	2.081	1652	2.065	1826	2.051	2000	2.035
1132	2.124	1306	2.1	1480	2.081	1654	2.064	1828	2.05	2002	2.034
1134	2.123	1308	2.1	1482	2.08	1656	2.063	1830	2.05	2004	2.034
1136	2.123	1310	2.1	1484	2.08	1658	2.064	1832	2.048	2006	2.034
1138	2.123	1312	2.1	1486	2.08	1660	2.062	1834	2.048	2008	2.035
1140	2.123	1314	2.1	1488	2.08	1662	2.062	1836	2.048	2010	2.034
1142	2.124	1316	2.1	1490	2.08	1664	2.061	1838	2.047	2012	2.034
1144	2.123	1318	2.1	1492	2.08	1666	2.061	1840	2.046	2014	2.033
1146	2.122	1320	2.1	1494	2.08	1668	2.061	1842	2.048	2016	2.033
1148	2.12	1322	2.1	1496	2.08	1670	2.062	1844	2.047	2018	2.031
1150	2.12	1324	2.1	1498	2.08	1672	2.061	1846	2.047	2020	2.032
1152	2.12	1326	2.1	1500	2.08	1674	2.061	1848	2.047	2022	2.032
1154	2.12	1328	2.1	1502	2.08	1676	2.062	1850	2.046	2024	2.032
1156	2.119	1330	2.099	1504	2.08	1678	2.061	1852	2.048	2026	2.032
1158	2.12	1332	2.098	1506	2.079	1680	2.061	1854	2.047	2028	2.032
1160	2.119	1334	2.097	1508	2.079	1682	2.061	1856	2.046	2030	2.031
1162	2.119	1336	2.098	1510	2.078	1684	2.061	.1858	2.046	2032	2.031
1164	2.119	1338	2.097	1512	2.08	1686	2.061	1860	2.045	2034	2.031
1166	2.119	1340	2.097	1514	2.078	1688	2.061	1862	2.045	2036	2.031
1168	2.119	1342	2.097	1516	2.078	1690	2.061	1864	2.045	2038	2.031
1170	2.119	1344	2.095	1518	2.078	1692	2.061	1866	2.046	2040	2.031
1172	2.119	1346	2.095	1520	2.076	1694	2.061	1868	2.045	2042	2.031
1174	2.118	1348	2.095	1522	2.076	1696	2.061	1870	2.045	2044	2.031
1176	2.119	1350	2.095	1524	2.075	1698	2.061	1872	2.045	2046	2.031
1178	2.117	1352	2.095	1526	2.076	1700	2.061	1874	2.045	2048	2.031
1180	2.119	1354	2.095	1528	2.075	1702	2.06	1876	2.045	2050	2.031
1182	2.118	1356	2.095	1530	2.075	1704	2.059	1878	2.045	2052	2.031
1184	2.117	1358	2.095	1532	2.075	1706	2.059	1880	2.043	2054	2.031
1186	2.116	1360	2.095	1534	2.075	1708	2.06	1882	2.044	2056	2.031
1188	2.116	1362	2.094	1536	2.075	1710	2.059	1884	2.044	2058	2.031
1190	2.115	1364	2.095	1538	2.075	1712	2.059	1886	2.043	2060	2.031
1192	2.116	1366	2.095	1540	2.075	1714	2.059	1888	2.044	2062	2.03
1194	2.116	1368	2.095	1542	2.075	1716	2.058	1890	2.044	2064	2.031
1196	2.114	1370	2.094	1544	2.075	1718	2.058	1892	2.043	2066	2.031
1198	2.114	1372	2.095	1546	2.075	1720	2.058	1894	2.042	2068	2.031
1200	2.114	1374	2.093	1548	2.075	1722	2.056	1896	2.042	2070	2.031
1202	2.114	1376	2.092	1550	2.075	1724	2.057	1898	2.042	2072	2.029
1204	2.114	1378	2.092	1552	2.074	1726	2.058	1900	2.042	2074	2.031
1206	2.114	1380	2.091	1554	2.075	1728	2.057	1902	2.043	2076	2.031
1208	2.114	1382	2.091	1556	2.074	1730	2.056	1904	2.042	2078	2.028
1210	2.114	1384	2.091	1558	2.073	1732	2.056	1906	2.042	2080	2.027
1212	2.114	1386	2.091	1560	2.073	1734	2.056	1908	2.042	2082	2.027
1214	2.114	1388	2.091	1562	2.073	1736	2.056	1910	2.042	2084	2.026
1216	2.113	1390	2.09	1564	2.074	1738	2.056	1912	2.041	2086	2.028
1218	2.113	1392	2.09	1566	2.072	1740	2.056	1914	2.041	2088	2.028

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
2090	2.027	2264	2.012	2438	2	2612	1.987	2786	1.973	2960	1.959
2092	2.027	2266	2.014	2440	2.001	2614	1.987	2788	1.973	2962	1.959
2094	2.027	2268	2.014	2442	2	2616	1.987	2790	1.973	2964	1.959
2096	2.026	2270	2.013	2444	2.001	2618	1.986	2792	1.973	2966	1.959
2098	2.027	2272	2.012	2446	2	2620	1.987	2794	1.973	2968	1.958
2100	2.026	2274	2.012	2448	2	2622	1.986	2796	1.973	2970	1.958
2102	2.026	2276	2.012	2450	1.999	2624	1.987	2798	1.973	2972	1.958
2104	2.026	2278	2.012	2452	1.999	2626	1.987	2800	1.973	2974	1.959
2106	2.026	2280	2.012	2454	1.998	2628	1.987	2802	1.973	2976	1.959
2108	2.026	2282	2.012	2456	1.999	2630	1.985	2804	1.973	2978	1.958
2110	2.026	2284	2.012	2458	1.998	2632	1.985	2806	1.973	2980	1.958
2112	2.026	2286	2.012	2460	1.999	2634	1.984	2808	1.973	2982	1.958
2114	2.024	2288	2.012	2462	1.998	2636	1.984	2810	1.973	2984	1.958
2116	2.024	2290	2.012	2464	1.998	2638	1.984	2812	1.972	2986	1.958
2118	2.024	2292	2.012	2466	1.998	2640	1.984	2814	1.973	2988	1.958
2120	2.024	2294	2.012	2468	1.998	2642	1.984	2816	1.973	2990	1.958
2122	2.025	2296	2.012	2470	1.997	2644	1.982	2818	1.973	2992	1.958
2124	2.024	2298	2.012	2472	1.997	2646	1.984	2820	1.973	2994	1.958
2126	2.023	2300	2.012	2474	1.997	2648	1.984	2822	1.972	2996	1.958
2128	2.023	2302	2.011	2476	1.998	2650	1.984	2824	1.971	2998	1.958
2130	2.023	2304	2.011	2478	1.997	2652	1.984	2826	1.973	3000	1.957
2132	2.022	2306	2.011	2480	1.997	2654	1.982	2828	1.972	3002	1.957
2134	2.022	2308	2.011	2482	1.997	2656	1.982	2830	1.971	3004	1.957
2136	2.022	2310	2.011	2484	1.997	2658	1.982	2832	1.971	3006	1.957
2138	2.022	2312	2.011	2486	1.997	2660	1.982	2834	1.971	3008	1.957
2140	2.022	2314	2.011	2488	1.997	2662	1.982	2836	1.971	3010	1.956
2142	2.022	2316	2.011	2490	1.997	2664	1.982	2838	1.971	3012	1.955
2144	2.022	2318	2.01	2492	1.996	2666	1.982	2840	1.969	3014	1.955
2146	2.022	2320	2.011	2494	1.997	2668	1.982	2842	1.97	3016	1.955
2148	2.022	2322	2.01	2496	1.997	2670	1.982	2844	1.97	3018	1.954
2150	2.022	2324	2.009	2498	1.997	2672	1.982	2846	1.97	3020	1.954
2152	2.022	2326	2.009	2500	1.997	2674	1.982	2848	1.968	3022	1.954
2154	2.022	2328	2.007	2502	1.996	2676	1.982	2850	1.968	3024	1.955
2156	2.022	2330	2.008	2504	1.997	2678	1.982	2852	1.968	3026	1.954
2158	2.022	2332	2.008	2506	1.995	2680	1.982	2854	1.968	3028	1.953
2160	2.022	2334	2.008	2508	1.995	2682	1.982	2856	1.968	3030	1.953
2162	2.022	2336	2.008	2510	1.995	2684	1.982	2858	1.969	3032	1.953
2164	2.022	2338	2.008	2512	1.994	2686	1.981	2860	1.968	3034	1.954
2166	2.022	2340	2.009	2514	1.994	2688	1.981	2862	1.968	3036	1.953
2168	2.022	2342	2.007	2516	1.995	2690	1.981	2864	1.968	3038	1.953
2170	2.02	2344	2.007	2518	1.994	2692	1.981	2866	1.968	3040	1.953
2172	2.021	2346	2.007	2520	1.995	2694	1.981	2868	1.968	3042	1.953
2174	2.02	2348	2.007	2522	1.995	2696	1.982	2870	1.967	3044	1.953
2176	2.02	2350	2.007	2524	1.994	2698	1.981	2872	1.967	3046	1.953
2178	2.02	2352	2.007	2526	1.993	2700	1.98	2874	1.967	3048	1.953
2180	2.02	2354	2.007	2528	1.993	2702	1.981	2876	1.967	3050	1.953
2182	2.02	2356	2.007	2530	1.992	2704	1.98	2878	1.968	3052	1.953
2184	2.02	2358	2.006	2532	1.993	2706	1.979	2880	1.968	3054	1.953
2186	2.018	2360	2.007	2534	1.992	2708	1.98	2882	1.967	3056	1.953
2188	2.019	2362	2.007	2536	1.992	2710	1.978	2884	1.967	3058	1.953
2190	2.02	2364	2.007	2538	1.992	2712	1.979	2886	1.966	3060	1.953
2192	2.019	2366	2.007	2540	1.992	2714	1.978	2888	1.965	3062	1.953
2194	2.018	2368	2.007	2542	1.993	2716	1.978	2890	1.966	3064	1.952
2196	2.018	2370	2.006	2544	1.992	2718	1.978	2892	1.966	3066	1.953
2198	2.017	2372	2.004	2546	1.992	2720	1.978	2894	1.965	3068	1.953
2200	2.017	2374	2.005	2548	1.992	2722	1.978	2896	1.965	3070	1.952
2202	2.018	2376	2.004	2550	1.992	2724	1.978	2898	1.965	3072	1.951
2204	2.018	2378	2.004	2552	1.992	2726	1.978	2900	1.964	3074	1.95
2206	2.018	2380	2.004	2554	1.992	2728	1.978	2902	1.963	3076	1.951
2208	2.017	2382	2.004	2556	1.992	2730	1.978	2904	1.964	3078	1.951
2210	2.017	2384	2.003	2558	1.992	2732	1.978	2906	1.963	3080	1.949
2212	2.017	2386	2.003	2560	1.992	2734	1.978	2908	1.963	3082	1.948
2214	2.017	2388	2.003	2562	1.992	2736	1.978	2910	1.964	3084	1.948
2216	2.017	2390	2.004	2564	1.992	2738	1.978	2912	1.964	3086	1.949
2218	2.017	2392	2.003	2566	1.991	2740	1.978	2914	1.964	3088	1.949
2220	2.017	2394	2.002	2568	1.992	2742	1.978	2916	1.964	3090	1.948
2222	2.017	2396	2.002	2570	1.992	2744	1.978	2918	1.963	3092	1.948
2224	2.017	2398	2.003	2572	1.991	2746	1.978	2920	1.963	3094	1.948
2226	2.017	2400	2.002	2574	1.991	2748	1.978	2922	1.963	3096	1.948
2228	2.017	2402	2.003	2576	1.99	2750	1.976	2924	1.963	3098	1.948
2230	2.017	2404	2.002	2578	1.991	2752	1.978	2926	1.963	3100	1.948
2232	2.016	2406	2.003	2580	1.989	2754	1.975	2928	1.963	3102	1.948
2234	2.016	2408	2.002	2582	1.99	2756	1.978	2930	1.963	3104	1.947
2236	2.016	2410	2.002	2584	1.989	2758	1.977	2932	1.963	3106	1.947
2238	2.015	2412	2.002	2586	1.989	2760	1.976	2934	1.963	3108	1.947
2240	2.016	2414	2.002	2588	1.989	2762	1.976	2936	1.963	3110	1.946
2242	2.015	2416	2.002	2590	1.989	2764	1.975	2938	1.963	3112	1.948
2244	2.015	2418	2.002	2592	1.989	2766	1.976	2940	1.963	3114	1.946
2246	2.015	2420	2.002	2594	1.988	2768	1.976	2942	1.963	3116	1.946
2248	2.014	2422	2.002	2596	1.987	2770	1.975	2944	1.963	3118	1.945
2250	2.015	2424	2.002	2598	1.987	2772	1.975	2946	1.963	3120	1.945
2252	2.013	2426	2.002	2600	1.987	2774	1.974	2948	1.962	3122	1.945
2254	2.014	2428	2.002	2602	1.987	2776	1.975	2950	1.962	3124	1.946
2256	2.014	2430	2.001	2604	1.987	2778	1.975	2952	1.961	3126	1.944
2258	2.012	2432	2.001	2606	1.987	2780	1.975	2954	1.961	3128	1.945
2260	2.013	2434	2.002	2608	1.987	2782	1.973	2956	1.961	3130	1.943
2262	2.012	2436	2.001	2610	1.987	2784	1.973	2958	1.96	3132	1.944

Time (s)	Voltage (V)	Time (s)	Voltage (V)	Time (s)	Voltage (V)
3134	1.944	3308	1.929	3462	1.914
3136	1.944	3310	1.929	3464	1.914
3138	1.943	3312	1.929	3466	1.913
3140	1.943	3314	1.928	3468	1.912
3142	1.943	3316	1.927	3470	1.912
3144	1.943	3318	1.927	3472	1.912
3146	1.943	3320	1.927	3474	1.911
3148	1.943	3322	1.928	3476	1.91
3150	1.943	3324	1.927	3478	1.909
3152	1.943	3326	1.927	3480	1.91
3154	1.943	3328	1.926	3482	1.91
3156	1.943	3330	1.925	3484	1.909
3158	1.943	3332	1.926	3486	1.909
3160	1.943	3334	1.924	3488	1.909
3162	1.943	3336	1.925	3490	1.909
3164	1.942	3338	1.924	3492	1.909
3166	1.943	3340	1.924	3494	1.909
3168	1.941	3342	1.924	3496	1.909
3170	1.942	3344	1.924	3498	1.908
3172	1.94	3346	1.924	3500	1.907
3174	1.942	3348	1.924	3502	1.908
3176	1.942	3350	1.924	3504	1.906
3178	1.939	3352	1.924	3506	1.907
3180	1.94	3354	1.924	3508	1.906
3182	1.94	3356	1.924	3510	1.906
3184	1.939	3358	1.924	3512	1.906
3186	1.939	3360	1.924	3514	1.906
3188	1.939	3362	1.924	3516	1.905
3190	1.939	3364	1.924	3518	1.906
3192	1.939	3366	1.924	3520	1.904
3194	1.939	3368	1.923	3522	1.904
3196	1.939	3370	1.921	3524	1.904
3198	1.939	3372	1.921	3526	1.904
3200	1.939	3374	1.921	3528	1.904
3202	1.939	3376	1.921	3530	1.904
3204	1.939	3378	1.922	3532	1.904
3206	1.939	3380	1.921	3534	1.904
3208	1.938	3382	1.92	3536	1.904
3210	1.937	3384	1.921	3538	1.904
3212	1.937	3386	1.92	3540	1.904
3214	1.939	3388	1.919	3542	1.904
3216	1.937	3390	1.92	3544	1.904
3218	1.937	3392	1.919	3546	1.904
3220	1.937	3394	1.919	3548	1.903
3222	1.937	3396	1.919	3550	1.901
3224	1.936	3398	1.919	3552	1.902
3226	1.936	3400	1.919	3554	1.903
3228	1.935	3402	1.919	3556	1.904
3230	1.935	3404	1.919	3558	1.901
3232	1.935	3406	1.919	3560	1.901
3234	1.935	3408	1.919	3562	1.899
3236	1.935	3410	1.918	3564	1.899
3238	1.935	3412	1.918	3566	1.899
3240	1.935	3414	1.918	3568	1.899
3242	1.934	3416	1.917	3570	1.9
3244	1.934	3418	1.918	3572	1.899
3246	1.934	3420	1.918	3574	1.899
3248	1.934	3422	1.917	3576	1.899
3250	1.934	3424	1.917	3578	1.899
3252	1.934	3426	1.915	3580	1.899
3254	1.934	3428	1.916	3582	1.898
3256	1.934	3430	1.914	3584	1.899
3258	1.934	3432	1.914	3586	1.899
3260	1.934	3434	1.914	3588	1.899
3262	1.934	3436	1.914	3590	1.899
3264	1.933	3438	1.914	3592	1.899
3266	1.932	3440	1.914	3594	1.899
3268	1.932	3442	1.914	3596	1.898
3270	1.932	3444	1.914	3598	1.897
3272	1.933	3446	1.914	3600	1.896
3274	1.932	3448	1.914		
3276	1.931	3450	1.914		
3278	1.932	3452	1.914		
3280	1.931	3454	1.914		
3282	1.93	3456	1.914		
3284	1.93	3458	1.913		
3286	1.93	3460	1.914		
3288	1.931	3462	1.914		
3290	1.93	3464	1.914		
3292	1.93	3466	1.913		
3294	1.93	3468	1.912		
3296	1.929	3470	1.912		
3298	1.929	3452	1.914		
3300	1.929	3454	1.914		
3302	1.929	3456	1.914		
3304	1.929	3458	1.913		
3306	1.929	3460	1.914		

APPENDIX A.8

BATTERY PARALLEL WITH 2F ULTRACAPACITOR(CURRENT)

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
0	0.0008545	176	0.307	350	0.302	524	0.299	698	0.296	872	0.293
2	0.0008545	178	0.307	352	0.302	526	0.299	700	0.296	874	0.293
4	0.324	180	0.307	354	0.302	528	0.299	702	0.296	876	0.293
6	0.323	182	0.307	356	0.302	530	0.299	704	0.296	878	0.293
8	0.322	184	0.307	358	0.302	532	0.299	706	0.296	880	0.293
10	0.321	186	0.307	360	0.302	534	0.299	708	0.296	882	0.293
12	0.321	188	0.307	362	0.302	536	0.299	710	0.296	884	0.293
14	0.32	190	0.307	364	0.302	538	0.299	712	0.296	886	0.293
16	0.319	192	0.307	366	0.302	540	0.299	714	0.296	888	0.293
18	0.319	194	0.307	368	0.302	542	0.299	716	0.296	890	0.293
20	0.318	196	0.307	370	0.302	544	0.298	718	0.296	892	0.293
22	0.318	198	0.307	372	0.302	546	0.299	720	0.295	894	0.293
26	0.318	200	0.306	374	0.302	548	0.298	722	0.295	896	0.293
28	0.317	202	0.306	376	0.302	550	0.298	724	0.296	898	0.293
30	0.317	204	0.306	378	0.302	552	0.298	726	0.295	900	0.293
32	0.317	206	0.306	380	0.302	554	0.298	728	0.295	902	0.293
34	0.316	208	0.306	382	0.302	556	0.298	730	0.295	904	0.293
36	0.316	210	0.306	384	0.302	558	0.298	732	0.295	906	0.293
38	0.316	212	0.306	386	0.302	560	0.298	734	0.295	908	0.293
40	0.316	214	0.306	388	0.302	562	0.298	736	0.295	910	0.293
42	0.316	216	0.306	390	0.301	564	0.298	738	0.295	912	0.293
44	0.315	218	0.306	392	0.301	566	0.298	740	0.295	914	0.293
46	0.315	220	0.306	394	0.301	568	0.298	742	0.295	916	0.293
48	0.315	222	0.306	396	0.301	570	0.298	744	0.295	918	0.293
50	0.315	224	0.306	398	0.301	572	0.298	746	0.295	920	0.293
52	0.315	226	0.306	400	0.301	574	0.298	748	0.295	922	0.293
54	0.314	228	0.305	402	0.301	576	0.298	750	0.295	924	0.293
56	0.314	230	0.306	404	0.301	578	0.298	752	0.295	926	0.293
58	0.314	232	0.305	406	0.301	580	0.298	754	0.295	928	0.293
60	0.314	234	0.305	408	0.301	582	0.298	756	0.295	930	0.293
62	0.314	236	0.305	410	0.301	584	0.298	758	0.295	932	0.293
64	0.313	238	0.305	412	0.301	586	0.298	760	0.295	934	0.293
66	0.313	240	0.305	414	0.301	588	0.298	762	0.295	936	0.293
68	0.313	242	0.305	416	0.301	590	0.298	764	0.295	938	0.293
70	0.313	244	0.305	418	0.301	592	0.298	766	0.295	940	0.293
72	0.313	246	0.305	420	0.301	594	0.298	768	0.295	942	0.293
74	0.313	248	0.305	422	0.301	596	0.298	770	0.295	944	0.293
76	0.313	250	0.305	424	0.301	598	0.298	772	0.295	946	0.293
78	0.312	252	0.305	426	0.301	600	0.298	774	0.295	948	0.293
80	0.312	254	0.305	428	0.301	602	0.297	776	0.295	950	0.293
82	0.312	256	0.305	430	0.301	604	0.297	778	0.295	952	0.293
84	0.312	258	0.305	432	0.301	606	0.297	780	0.295	954	0.293
86	0.312	260	0.305	434	0.3	608	0.297	782	0.295	956	0.293
88	0.312	262	0.305	436	0.3	610	0.297	784	0.295	958	0.292
90	0.311	264	0.305	438	0.3	612	0.297	786	0.295	960	0.292
92	0.311	266	0.305	440	0.3	614	0.297	788	0.295	962	0.292
94	0.311	268	0.304	442	0.3	616	0.297	790	0.294	964	0.292
96	0.311	270	0.304	444	0.3	618	0.297	792	0.295	966	0.292
98	0.311	272	0.304	446	0.3	620	0.297	794	0.294	968	0.292
100	0.311	274	0.304	448	0.3	622	0.297	796	0.294	970	0.292
102	0.311	276	0.304	450	0.3	624	0.297	798	0.294	972	0.292
104	0.311	278	0.304	452	0.3	626	0.297	800	0.294	974	0.292
106	0.311	280	0.304	454	0.3	628	0.297	802	0.294	976	0.292
108	0.31	282	0.304	456	0.3	630	0.297	804	0.294	978	0.292
110	0.31	284	0.304	458	0.3	632	0.297	806	0.294	980	0.292
112	0.31	286	0.304	460	0.3	634	0.297	808	0.294	982	0.292
114	0.31	288	0.304	462	0.3	636	0.297	810	0.294	984	0.292
116	0.31	290	0.304	464	0.3	638	0.297	812	0.294	986	0.292
118	0.31	292	0.304	466	0.3	640	0.297	814	0.294	988	0.292
120	0.31	294	0.304	468	0.3	642	0.297	816	0.294	990	0.292
122	0.31	296	0.304	470	0.3	644	0.297	818	0.294	992	0.292
124	0.309	298	0.304	472	0.3	646	0.297	820	0.294	994	0.292
126	0.309	300	0.304	474	0.3	648	0.297	822	0.294	996	0.292
128	0.309	302	0.304	476	0.3	650	0.297	824	0.294	998	0.292
130	0.309	304	0.304	478	0.3	652	0.297	826	0.294	1000	0.292
132	0.309	306	0.303	480	0.3	654	0.297	828	0.294	1002	0.292
134	0.309	308	0.303	482	0.3	656	0.297	830	0.294	1004	0.292
136	0.309	310	0.303	484	0.3	658	0.297	832	0.294	1006	0.292
138	0.309	312	0.303	486	0.3	660	0.297	834	0.294	1008	0.292
140	0.309	314	0.303	488	0.299	662	0.297	836	0.294	1010	0.292
142	0.309	316	0.303	490	0.299	664	0.296	838	0.294	1012	0.292
144	0.309	318	0.303	492	0.299	666	0.297	840	0.294	1014	0.292
146	0.309	320	0.303	494	0.299	668	0.296	842	0.294	1016	0.292
148	0.308	322	0.303	496	0.299	670	0.296	844	0.294	1018	0.292
150	0.308	324	0.303	498	0.299	672	0.296	846	0.294	1020	0.292
152	0.308	326	0.303	500	0.299	674	0.296	848	0.294	1022	0.292
154	0.308	328	0.303	502	0.299	676	0.296	850	0.294	1024	0.292
156	0.308	330	0.303	504	0.299	678	0.296	852	0.294	1026	0.292
158	0.308	332	0.303	506	0.299	680	0.296	854	0.294	1028	0.292
160	0.308	334	0.303	508	0.299	682	0.296	856	0.294	1030	0.292
162	0.308	336	0.303	510	0.299	684	0.296	858	0.294	1032	0.292
164	0.308	338	0.303	512	0.299	686	0.296	860	0.294	1034	0.292
166	0.308	340	0.303	514	0.299	688	0.296	862	0.294	1036	0.292
168	0.308	342	0.303	516	0.299	690	0.296	864	0.293	1038	0.292
170	0.308	344	0.302	518	0.299	692	0.296	866	0.294	1040	0.292
172	0.307	346	0.303	520	0.299	694	0.296	868	0.293	1042	0.292
174	0.307	348	0.302	522	0.299	696	0.296	870	0.293	1044	0.292

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
1046	0.292	1220	0.29	1394	0.289	1568	0.287	1742	0.286	1916	0.286
1048	0.292	1222	0.29	1396	0.289	1570	0.288	1744	0.287	1918	0.286
1050	0.292	1224	0.29	1398	0.289	1572	0.287	1746	0.286	1920	0.285
1052	0.292	1226	0.29	1400	0.289	1574	0.287	1748	0.287	1922	0.286
1054	0.292	1228	0.29	1402	0.289	1576	0.287	1750	0.286	1924	0.285
1056	0.291	1230	0.29	1404	0.289	1578	0.287	1752	0.286	1926	0.285
1058	0.292	1232	0.29	1406	0.289	1580	0.288	1754	0.286	1928	0.285
1060	0.291	1234	0.29	1408	0.289	1582	0.287	1756	0.286	1930	0.285
1062	0.291	1236	0.29	1410	0.289	1584	0.287	1758	0.287	1932	0.285
1064	0.291	1238	0.29	1412	0.289	1586	0.287	1760	0.286	1934	0.285
1066	0.292	1240	0.29	1414	0.289	1588	0.287	1762	0.286	1936	0.285
1068	0.291	1242	0.29	1416	0.289	1590	0.287	1764	0.286	1938	0.285
1070	0.291	1244	0.29	1418	0.289	1592	0.287	1766	0.286	1940	0.285
1072	0.291	1246	0.29	1420	0.289	1594	0.287	1768	0.286	1942	0.285
1074	0.291	1248	0.29	1422	0.288	1596	0.287	1770	0.286	1944	0.285
1076	0.291	1250	0.29	1424	0.289	1598	0.287	1772	0.286	1946	0.285
1078	0.291	1252	0.29	1426	0.288	1600	0.287	1774	0.286	1948	0.285
1080	0.291	1254	0.29	1428	0.288	1602	0.287	1776	0.286	1950	0.285
1082	0.291	1256	0.29	1430	0.288	1604	0.287	1778	0.286	1952	0.285
1084	0.291	1258	0.29	1432	0.288	1606	0.287	1780	0.286	1954	0.285
1086	0.291	1260	0.29	1434	0.288	1608	0.287	1782	0.286	1956	0.285
1088	0.291	1262	0.29	1436	0.288	1610	0.287	1784	0.286	1958	0.285
1090	0.291	1264	0.29	1438	0.288	1612	0.287	1786	0.286	1960	0.285
1092	0.291	1266	0.29	1440	0.288	1614	0.287	1788	0.286	1962	0.285
1094	0.291	1268	0.29	1442	0.288	1616	0.287	1790	0.286	1964	0.285
1096	0.291	1270	0.29	1444	0.288	1618	0.287	1792	0.286	1966	0.285
1098	0.291	1272	0.29	1446	0.288	1620	0.287	1794	0.286	1968	0.285
1100	0.291	1274	0.29	1448	0.288	1622	0.287	1796	0.286	1970	0.285
1102	0.291	1276	0.29	1450	0.288	1624	0.287	1798	0.286	1972	0.285
1104	0.291	1278	0.29	1452	0.288	1626	0.287	1800	0.286	1974	0.285
1106	0.291	1280	0.29	1454	0.288	1628	0.287	1802	0.286	1976	0.285
1108	0.291	1282	0.29	1456	0.288	1630	0.287	1804	0.286	1978	0.285
1110	0.291	1284	0.29	1458	0.288	1632	0.287	1806	0.286	1980	0.285
1112	0.291	1286	0.29	1460	0.288	1634	0.287	1808	0.286	1982	0.285
1114	0.291	1288	0.29	1462	0.288	1636	0.287	1810	0.286	1984	0.285
1116	0.291	1290	0.289	1464	0.288	1638	0.287	1812	0.286	1986	0.285
1118	0.291	1292	0.289	1466	0.288	1640	0.287	1814	0.286	1988	0.285
1120	0.291	1294	0.289	1468	0.288	1642	0.287	1816	0.286	1990	0.285
1122	0.291	1296	0.289	1470	0.288	1644	0.287	1818	0.286	1992	0.285
1124	0.291	1298	0.289	1472	0.288	1646	0.287	1820	0.286	1994	0.285
1126	0.291	1300	0.289	1474	0.288	1648	0.287	1822	0.286	1996	0.285
1128	0.291	1302	0.289	1476	0.288	1650	0.287	1824	0.286	1998	0.285
1130	0.291	1304	0.289	1478	0.288	1652	0.287	1826	0.286	2000	0.285
1132	0.291	1306	0.289	1480	0.288	1654	0.287	1828	0.286	2002	0.285
1134	0.291	1308	0.289	1482	0.288	1656	0.287	1830	0.286	2004	0.285
1136	0.291	1310	0.289	1484	0.288	1658	0.287	1832	0.286	2006	0.285
1138	0.291	1312	0.289	1486	0.288	1660	0.287	1834	0.286	2008	0.285
1140	0.291	1314	0.289	1488	0.288	1662	0.287	1836	0.286	2010	0.285
1142	0.291	1316	0.289	1490	0.288	1664	0.287	1838	0.286	2012	0.285
1144	0.291	1318	0.289	1492	0.288	1666	0.287	1840	0.286	2014	0.285
1146	0.291	1320	0.289	1494	0.288	1668	0.287	1842	0.286	2016	0.285
1148	0.291	1322	0.289	1496	0.288	1670	0.287	1844	0.286	2018	0.285
1150	0.291	1324	0.289	1498	0.288	1672	0.287	1846	0.286	2020	0.285
1152	0.291	1326	0.289	1500	0.288	1674	0.287	1848	0.286	2022	0.285
1154	0.291	1328	0.289	1502	0.288	1676	0.287	1850	0.286	2024	0.285
1156	0.291	1330	0.289	1504	0.288	1678	0.287	1852	0.286	2026	0.285
1158	0.291	1332	0.289	1506	0.288	1680	0.287	1854	0.286	2028	0.285
1160	0.291	1334	0.289	1508	0.288	1682	0.287	1856	0.286	2030	0.285
1162	0.291	1336	0.289	1510	0.288	1684	0.287	1858	0.286	2032	0.285
1164	0.291	1338	0.289	1512	0.288	1686	0.287	1860	0.286	2034	0.285
1166	0.291	1340	0.289	1514	0.288	1688	0.287	1862	0.286	2036	0.285
1168	0.291	1342	0.289	1516	0.288	1690	0.287	1864	0.286	2038	0.285
1170	0.291	1344	0.289	1518	0.288	1692	0.287	1866	0.286	2040	0.285
1172	0.29	1346	0.289	1520	0.288	1694	0.287	1868	0.286	2042	0.285
1174	0.29	1348	0.289	1522	0.288	1696	0.287	1870	0.286	2044	0.285
1176	0.29	1350	0.289	1524	0.288	1698	0.287	1872	0.286	2046	0.285
1178	0.29	1352	0.289	1526	0.288	1700	0.287	1874	0.286	2048	0.285
1180	0.29	1354	0.289	1528	0.288	1702	0.287	1876	0.286	2050	0.285
1182	0.29	1356	0.289	1530	0.288	1704	0.287	1878	0.286	2052	0.285
1184	0.29	1358	0.289	1532	0.288	1706	0.287	1880	0.286	2054	0.285
1186	0.29	1360	0.289	1534	0.288	1708	0.287	1882	0.286	2056	0.285
1188	0.29	1362	0.289	1536	0.288	1710	0.287	1884	0.286	2058	0.285
1190	0.29	1364	0.289	1538	0.288	1712	0.287	1886	0.286	2060	0.285
1192	0.29	1366	0.289	1540	0.288	1714	0.287	1888	0.286	2062	0.285
1194	0.29	1368	0.289	1542	0.288	1716	0.287	1890	0.286	2064	0.285
1196	0.29	1370	0.289	1544	0.288	1718	0.287	1892	0.286	2066	0.285
1198	0.29	1372	0.289	1546	0.288	1720	0.286	1894	0.286	2068	0.285
1200	0.29	1374	0.289	1548	0.288	1722	0.287	1896	0.286	2070	0.285
1202	0.29	1376	0.289	1550	0.288	1724	0.287	1898	0.286	2072	0.285
1204	0.29	1378	0.289	1552	0.288	1726	0.287	1900	0.286	2074	0.285
1206	0.29	1380	0.289	1554	0.288	1728	0.287	1902	0.286	2076	0.284
1208	0.29	1382	0.289	1556	0.288	1730	0.287	1904	0.286	2078	0.285
1210	0.29	1384	0.289	1558	0.287	1732	0.287	1906	0.286	2080	0.285
1212	0.29	1386	0.289	1560	0.288	1734	0.286	1908	0.286	2082	0.285
1214	0.29	1388	0.289	1562	0.287	1736	0.286	1910	0.286	2084	0.285
1216	0.29	1390	0.289	1564	0.287	1738	0.286	1912	0.286	2086	0.285
1218	0.29	1392	0.289	1566	0.287	1740	0.286	1914	0.286	2088	0.285

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
2090	0.284	2264	0.284	2438	0.283	2612	0.282	2786	0.281	2960	0.28
2092	0.285	2266	0.284	2440	0.283	2614	0.282	2788	0.281	2962	0.28
2094	0.285	2268	0.284	2442	0.283	2616	0.282	2790	0.281	2964	0.28
2096	0.285	2270	0.284	2444	0.283	2618	0.282	2792	0.281	2966	0.28
2098	0.285	2272	0.284	2446	0.283	2620	0.282	2794	0.281	2968	0.28
2100	0.285	2274	0.284	2448	0.283	2622	0.282	2796	0.281	2970	0.28
2102	0.284	2276	0.284	2450	0.283	2624	0.282	2798	0.281	2972	0.28
2104	0.284	2278	0.284	2452	0.283	2626	0.282	2800	0.281	2974	0.28
2106	0.285	2280	0.283	2454	0.283	2628	0.282	2802	0.281	2976	0.28
2108	0.284	2282	0.284	2456	0.283	2630	0.282	2804	0.281	2978	0.28
2110	0.284	2284	0.284	2458	0.283	2632	0.282	2806	0.281	2980	0.28
2112	0.285	2286	0.284	2460	0.283	2634	0.282	2808	0.281	2982	0.28
2114	0.284	2288	0.284	2462	0.283	2636	0.282	2810	0.281	2984	0.28
2116	0.284	2290	0.284	2464	0.283	2638	0.282	2812	0.281	2986	0.28
2118	0.284	2292	0.284	2466	0.283	2640	0.282	2814	0.281	2988	0.28
2120	0.284	2294	0.284	2468	0.283	2642	0.282	2816	0.281	2990	0.28
2122	0.284	2296	0.284	2470	0.283	2644	0.282	2818	0.281	2992	0.28
2124	0.284	2298	0.284	2472	0.283	2646	0.282	2820	0.281	2994	0.28
2126	0.284	2300	0.284	2474	0.283	2648	0.282	2822	0.281	2996	0.28
2128	0.284	2302	0.284	2476	0.283	2650	0.282	2824	0.281	2998	0.28
2130	0.284	2304	0.284	2478	0.283	2652	0.282	2826	0.281	3000	0.28
2132	0.284	2306	0.283	2480	0.283	2654	0.282	2828	0.281	3002	0.28
2134	0.284	2308	0.283	2482	0.283	2656	0.282	2830	0.281	3004	0.28
2136	0.284	2310	0.284	2484	0.283	2658	0.282	2832	0.281	3006	0.28
2138	0.284	2312	0.283	2486	0.283	2660	0.282	2834	0.281	3008	0.28
2140	0.284	2314	0.283	2488	0.283	2662	0.282	2836	0.281	3010	0.28
2142	0.284	2316	0.283	2490	0.283	2664	0.282	2838	0.281	3012	0.28
2144	0.284	2318	0.283	2492	0.282	2666	0.282	2840	0.281	3014	0.28
2146	0.284	2320	0.283	2494	0.282	2668	0.282	2842	0.281	3016	0.28
2148	0.284	2322	0.283	2496	0.283	2670	0.282	2844	0.281	3018	0.28
2150	0.284	2324	0.283	2498	0.282	2672	0.282	2846	0.281	3020	0.28
2152	0.284	2326	0.283	2500	0.283	2674	0.282	2848	0.281	3022	0.28
2154	0.284	2328	0.283	2502	0.283	2676	0.282	2850	0.281	3024	0.28
2156	0.284	2330	0.283	2504	0.283	2678	0.282	2852	0.281	3026	0.28
2158	0.284	2332	0.283	2506	0.282	2680	0.282	2854	0.281	3028	0.28
2160	0.284	2334	0.283	2508	0.282	2682	0.282	2856	0.281	3030	0.28
2162	0.284	2336	0.283	2510	0.282	2684	0.282	2858	0.281	3032	0.28
2164	0.284	2338	0.283	2512	0.282	2686	0.282	2860	0.281	3034	0.28
2166	0.284	2340	0.283	2514	0.282	2688	0.282	2862	0.28	3036	0.28
2168	0.284	2342	0.283	2516	0.282	2690	0.282	2864	0.281	3038	0.28
2170	0.284	2344	0.283	2518	0.282	2692	0.282	2866	0.281	3040	0.28
2172	0.284	2346	0.283	2520	0.282	2694	0.282	2868	0.281	3042	0.28
2174	0.284	2348	0.283	2522	0.282	2696	0.282	2870	0.281	3044	0.279
2176	0.284	2350	0.283	2524	0.282	2698	0.282	2872	0.28	3046	0.279
2178	0.284	2352	0.283	2526	0.282	2700	0.282	2874	0.281	3048	0.279
2180	0.284	2354	0.283	2528	0.282	2702	0.282	2876	0.28	3050	0.279
2182	0.284	2356	0.283	2530	0.282	2704	0.282	2878	0.28	3052	0.279
2184	0.284	2358	0.283	2532	0.282	2706	0.281	2880	0.28	3054	0.28
2186	0.284	2360	0.283	2534	0.282	2708	0.281	2882	0.281	3056	0.28
2188	0.284	2362	0.283	2536	0.282	2710	0.281	2884	0.28	3058	0.279
2190	0.284	2364	0.283	2538	0.282	2712	0.281	2886	0.28	3060	0.279
2192	0.284	2366	0.283	2540	0.282	2714	0.281	2888	0.28	3062	0.279
2194	0.284	2368	0.283	2542	0.282	2716	0.281	2890	0.28	3064	0.279
2196	0.284	2370	0.283	2544	0.282	2718	0.281	2892	0.28	3066	0.279
2198	0.284	2372	0.283	2546	0.282	2720	0.281	2894	0.28	3068	0.279
2200	0.284	2374	0.283	2548	0.282	2722	0.282	2896	0.28	3070	0.279
2202	0.284	2376	0.283	2550	0.282	2724	0.282	2898	0.28	3072	0.279
2204	0.284	2378	0.283	2552	0.282	2726	0.281	2900	0.28	3074	0.279
2206	0.284	2380	0.283	2554	0.282	2728	0.281	2902	0.28	3076	0.279
2208	0.284	2382	0.283	2556	0.282	2730	0.281	2904	0.28	3078	0.279
2210	0.284	2384	0.283	2558	0.282	2732	0.281	2906	0.28	3080	0.279
2212	0.284	2386	0.283	2560	0.282	2734	0.281	2908	0.28	3082	0.279
2214	0.284	2388	0.283	2562	0.282	2736	0.281	2910	0.28	3084	0.279
2216	0.284	2390	0.283	2564	0.282	2738	0.281	2912	0.28	3086	0.279
2218	0.284	2392	0.283	2566	0.282	2740	0.281	2914	0.28	3088	0.279
2220	0.284	2394	0.283	2568	0.282	2742	0.281	2916	0.28	3090	0.279
2222	0.284	2396	0.283	2570	0.282	2744	0.281	2918	0.28	3092	0.279
2224	0.284	2398	0.283	2572	0.282	2746	0.281	2920	0.28	3094	0.279
2226	0.284	2400	0.283	2574	0.282	2748	0.281	2922	0.28	3096	0.279
2228	0.284	2402	0.283	2576	0.282	2750	0.281	2924	0.28	3098	0.279
2230	0.284	2404	0.283	2578	0.282	2752	0.281	2926	0.28	3100	0.279
2232	0.284	2406	0.283	2580	0.282	2754	0.281	2928	0.28	3102	0.279
2234	0.284	2408	0.283	2582	0.282	2756	0.281	2930	0.28	3104	0.279
2236	0.284	2410	0.283	2584	0.282	2758	0.281	2932	0.28	3106	0.279
2238	0.284	2412	0.283	2586	0.282	2760	0.281	2934	0.28	3108	0.279
2240	0.284	2414	0.283	2588	0.282	2762	0.281	2936	0.28	3110	0.279
2242	0.284	2416	0.283	2590	0.282	2764	0.281	2938	0.28	3112	0.279
2244	0.284	2418	0.283	2592	0.282	2766	0.281	2940	0.28	3114	0.279
2246	0.284	2420	0.283	2594	0.282	2768	0.281	2942	0.28	3116	0.279
2248	0.284	2422	0.283	2596	0.282	2770	0.281	2944	0.28	3118	0.279
2250	0.284	2424	0.283	2598	0.282	2772	0.281	2946	0.28	3120	0.279
2252	0.284	2426	0.283	2600	0.282	2774	0.281	2948	0.28	3122	0.279
2254	0.284	2428	0.283	2602	0.282	2776	0.281	2950	0.28	3124	0.279
2256	0.284	2430	0.283	2604	0.282	2778	0.281	2952	0.28	3126	0.279
2258	0.284	2432	0.283	2606	0.282	2780	0.281	2954	0.28	3128	0.279
2260	0.284	2434	0.283	2608	0.282	2782	0.281	2956	0.28	3130	0.279
2262	0.284	2436	0.283	2610	0.282	2784	0.281	2958	0.28	3132	0.279

Time (s)	Current (A)	Time (s)	Current (A)	Time (s)	Current (A)
3134	0.279	3308	0.278	3482	0.277
3136	0.279	3310	0.278	3484	0.277
3138	0.279	3312	0.278	3486	0.277
3140	0.279	3314	0.278	3488	0.277
3142	0.279	3316	0.278	3490	0.277
3144	0.279	3318	0.278	3492	0.276
3146	0.279	3320	0.278	3494	0.277
3148	0.279	3322	0.278	3496	0.277
3150	0.279	3324	0.278	3498	0.277
3152	0.279	3326	0.278	3500	0.276
3154	0.279	3328	0.278	3502	0.276
3156	0.279	3330	0.278	3504	0.276
3158	0.279	3332	0.278	3506	0.276
3160	0.279	3334	0.278	3508	0.276
3162	0.279	3336	0.278	3510	0.276
3164	0.279	3338	0.278	3512	0.276
3166	0.279	3340	0.278	3514	0.276
3168	0.279	3342	0.278	3516	0.276
3170	0.279	3344	0.278	3518	0.276
3172	0.279	3346	0.278	3520	0.276
3174	0.279	3348	0.278	3522	0.276
3176	0.279	3350	0.278	3524	0.276
3178	0.279	3352	0.278	3526	0.276
3180	0.279	3354	0.278	3528	0.276
3182	0.279	3356	0.278	3530	0.276
3184	0.279	3358	0.277	3532	0.276
3186	0.279	3360	0.278	3534	0.276
3188	0.279	3362	0.278	3536	0.276
3190	0.279	3364	0.278	3538	0.276
3192	0.279	3366	0.277	3540	0.276
3194	0.279	3368	0.277	3542	0.276
3196	0.279	3370	0.277	3544	0.276
3198	0.279	3372	0.277	3546	0.276
3200	0.279	3374	0.277	3548	0.276
3202	0.279	3376	0.277	3550	0.276
3204	0.279	3378	0.277	3552	0.276
3206	0.279	3380	0.277	3554	0.276
3208	0.279	3382	0.277	3556	0.276
3210	0.279	3384	0.277	3558	0.276
3212	0.278	3386	0.277	3560	0.276
3214	0.278	3388	0.277	3562	0.276
3216	0.278	3390	0.277	3564	0.276
3218	0.278	3392	0.277	3566	0.276
3220	0.278	3394	0.277	3568	0.276
3222	0.278	3396	0.277	3570	0.276
3224	0.278	3398	0.277	3572	0.276
3226	0.278	3400	0.277	3574	0.276
3228	0.278	3402	0.277	3576	0.276
3230	0.278	3404	0.277	3578	0.276
3232	0.278	3406	0.277	3580	0.276
3234	0.278	3408	0.277	3582	0.276
3236	0.278	3410	0.277	3584	0.276
3238	0.278	3412	0.277	3586	0.276
3240	0.278	3414	0.277	3588	0.276
3242	0.278	3416	0.277	3590	0.276
3244	0.278	3418	0.277	3592	0.276
3246	0.278	3420	0.277	3594	0.276
3248	0.278	3422	0.277	3596	0.276
3250	0.278	3424	0.277	3598	0.276
3252	0.278	3426	0.277	3600	0.276
3254	0.278	3428	0.277		
3256	0.278	3430	0.277		
3258	0.278	3432	0.277		
3260	0.278	3434	0.277		
3262	0.278	3436	0.277		
3264	0.278	3438	0.277		
3266	0.278	3440	0.277		
3268	0.278	3442	0.277		
3270	0.278	3444	0.277		
3272	0.278	3446	0.277		
3274	0.278	3448	0.277		
3276	0.278	3450	0.277		
3278	0.278	3452	0.277		
3280	0.278	3454	0.277		
3282	0.278	3456	0.277		
3284	0.278	3458	0.277		
3286	0.278	3460	0.277		
3288	0.278	3462	0.277		
3290	0.278	3464	0.277		
3292	0.278	3466	0.277		
3294	0.278	3468	0.277		
3296	0.278	3470	0.277		
3298	0.278	3472	0.277		
3300	0.278	3474	0.277		
3302	0.278	3476	0.277		
3304	0.278	3478	0.277		
3306	0.278	3480	0.277		

cked Coin Type

ɜs: SG

eatures

ndurance : 70 °C 1000 h
laximum height of 6 mm (H Terminal)
oHS directive compliant

ɛcommended Applications

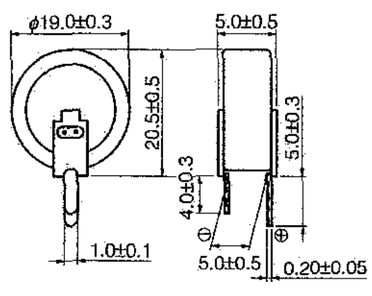
lemory back-up for video and audio equipment,
ameras, telephones, printers, data terminals,
ɔe cookers and intelligent remote controls

pecifications

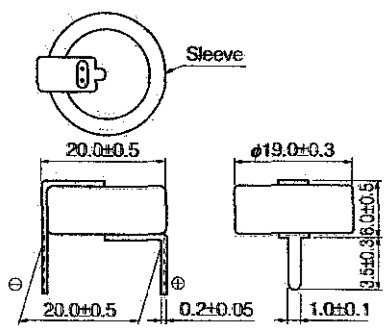
egory Temp. Range	–25 °C to +70 °C	
‹imum Operating Voltage	5.5 V.DC	
ninal Cap.Range	0.47 F to 1.5 F	
ıracteristics at Low ıperature	Capacitance change	±30 % of initial measured value at +20 °C (–25 °C to +70 °C)
	Internal resistance	≦5 times of initial measured value at +20 °C (at –25 °C)
lurance	After 1000 hours application of 5.5 V. DC at +70 °C, the capacitor shall meet the following limits.	
	Capacitance change	±30 % of initial measured value
	Internal resistance	≦4 times of initial specified value
lf Life	After 1000 hours storage at +70°C without load, the capacitor shall meet the specified limits for Endurance.	

imensions in mm(not to scale)

minal: V



Terminal: H



tandard Products

Maximum ɜrating Voltage (V.DC)	Capacitance (F)	Capacitance range (F)	Internal resistance (Ω) at 1kHz	Part number	Min. Packaging Q'ty (pcs)
5.5	0.47	0.376 to 1.41	≦ 30	EECS5R5( )474	100
	1.0	0.80 to 1.80	≦ 30	EECS5R5( )105	100
	1.5	1.20 to 2.70	≦ 30	EECS5R5( )155	100

ɜase use V or H, to indicate the terminal style.
: Do not use reflow soldering. (IR, Atmosphere heating methods, etc.)
ɛ refer to P197 "Mounting Specifications".