Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEM

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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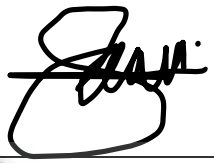
DECRALARATION

I declare that this project report entitled Development Of Solar Photovoltaic Water Pumping System is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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Date : 23.12.2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours.

Signature : 

Supervisor Name : DR. MOHD HATTA BIN JOPRI

Date : 23.12.2022

Signature :

Co-Supervisor Name :

Date :

DEDICATION

To my beloved supervisor, Ts. Dr. Mohd Hatta bin Jopri, who helped me throughout this final year project 2. To my beloved parents, family, and friends that helped me to complete this report

ACKNOWLEDGEMENT

In the name of Allah S.W.T, thankfulness to the Almighty who gave me the ability to carry out and completes this Final Year Project 2. First of all, I would like to thanks my family for all their support and prayer for me for 14 weeks for me to complete my report for this Final Year Project 2.

Next, I would like to thanks and appreciate to my respect supervisor Ts. Dr. Mohd Hatta bin Jopri for giving me the chance to do this project under him. A big respect and thanks to Ts. Dr. Mohd Hatta bin Jopri for his guidance, encouragement, advice and a lot of ideas that have been devoted to me during the time that had been given to me to complete this Final Year Project 2. A very helpful supervisor that always help me and my other members to complete this report. All the knowledge and lot of experience in engineer technologist field that has been given to me and all my members even though he also busy with his work really help me to overcome my problem and create something very useful for my project. Thank you for willing to take me as his candidate under his wings. Without his help and guidance, I will not get this lot of knowledge and experience about this project that I had done.

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ABSTRACT

Agriculture has taken the role of being the backbone and driving force behind Malaysia's economic strength and prosperity. The agriculture sector has experienced a new trend in the development on off-grid solar powered construction concepts throughout the world over the last decade, with significant endorsement from influential organisations and the implementation of PV powered solar panels. Nowadays, the conventional ways has switched over to renewable sources such as solar system. A benefit of using solar energy to power agricultural water pump systems is that increased water requirements for livestock and irrigation tend to coincide with the seasonal increase of incoming solar energy. When properly designed, these PV systems can also result in significant long-term cost savings and a smaller environmental footprint compared to conventional power systems. A prototype of this PV water pumping system will be demonstrated throughout this project as the load to the system. In this research, a monocrystalline solar panel will be used to measure their efficiency and determine the best installation of solar panel semiconductor type. A solar energy storage plays an important role as an dependency for the supply during the unavailabilty of sunlight. Hence, the installation of solar energy storage leads to identify the best solar controller in order to get a maximum electrical generation output from the solar panel to charge the battery.

ABSTRAK

Pertanian telah mengambil peranan sebagai tulang belakang dan penggerak di sebalik kekuatan ekonomi dan kemakmuran Malaysia. Sektor pertanian telah mengalami norma baharu dalam pembangunan konsep pembinaan kuasa solar luar grid di seluruh dunia sepanjang dekad yang lalu, dengan sokongan daripada organisasi berpengaruh dan pelaksanaan panel solar berkuasa PV. Pada masa kini, cara konvensional telah beralih kepada sumber boleh diperbaharui seperti sistem solar. Faedah menggunakan tenaga suria untuk menggerakkan sistem pam air pertanian ialah peningkatan keperluan air untuk ternakan dan pengairan cenderung bertepatan dengan peningkatan bermusim tenaga suria yang masuk. Apabila sistem direka dengan betul, sistem PV ini juga boleh menghasilkan penjimatan kos jangka panjang yang ketara dan jejak alam sekitar yang lebih kecil berbanding sistem kuasa konvensional. Prototaip sistem pam air PV akan ditunjukkan di dalam projek ini sebagai bebanan sistem. Dalam penyelidikan ini, sebuah monohablur akan digunakan untuk mengukur kecekapannya dan menentukan pemasangan terbaik jenis semikonduktor panel solar. Storan tenaga suria memainkan peranan penting sebagai pergantungan untuk bekalan semasa ketiadaan cahaya matahari. Oleh itu, pemasangan storan tenaga suria membawa kepada mengenalpasti pengawal cas suria yang terbaik untuk mendapatkan pengeluaran tenaga yang maksimum daripada panel suria untuk mengecas bateri.

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LIST OF SYMBOLS

η	-	Efficiency
$\bar{X}$	-	Mean

LIST OF ABBREVIATIONS

V	-	Voltage
A	-	Ampere
W	-	Watt
PV	-	Photovoltaic
W_p	-	Watt peak
Si	-	Silicon
DC	-	Direct Current
AC	-	Alternating Current
PWM	-	Pulse Width Modulation
MPPT	-	Maximum Power Point Tracking
COM	-	Common
NC	-	Normally Closed
NO	-	Normally Opened

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CHAPTER 1

INTRODUCTION

1.1 Background

All around the world, farmers have struggled to water their crops during the dry season since they must utilize well-water. Farmers' work in creating agricultural items is ineffective when it comes to irrigating farmland by using his power to lift water to agricultural grounds. Many people are unable to utilize water pumps on their farmland because they are without access to electricity. Alternative energy sources such as solar water pumps can help solve these problems. This article is going to calculate the solar data in comparison of two main solar panels which commonly used nowadays. In this comparison, some analysis will be conducted to observe their efficiency during the availability of sunlight. A types of mainstream PV modules were selected in this study which is Monocrystalline to measure their efficiency. Mainly, this project purposes to draw water from underground source to fill up the tank storage without using utility grid. This project also pre-built with the connection to battery so that during the night, user still has an option to run the system normally.[1]

1.2 Problem Statement

There are some problems faced during the study of solar energy. The distribution of water resources is a critical challenge in improving such agriculture or crop result. Small-scale farmers desire to start with a low-cost, dependable technology for irrigating crops and increasing production. For many farmers around the world, a solar-powered water pump could be the answer for this solution.[2]

But, there is a problem would be faced when implementing this system which is the location factor. Nowadays, many peoples are desire to start their business in agriculture sector. But when it comes into a location factor, usually the farm or land is located far from the electrical grid supply. Besides that, at inner state people used water from well and pump it manually using their own energy. But, this method is not efficiently, waste time and it is not user friendly. That's why solar water pumping is important to replace this work to draw the water from the resource.[3]

The unpredictability of how much of the sun's rays will receive in solar panel, as weather might change at any time, poses a barrier for solar PV and during the night, while there is still a demand for electricity, sunlight is clearly unavailable. This would make a solar energy storage is so much dependable. The sizing of storage is needed to determine how much energy to store for future usage. Hence, a proper sizing of storage is also an important thing to provide a sufficient energy storage for a continuous usage to the users.[4] There's so much water pumping system available out there, where its operation doesn't have a self-monitoring system. When the motor pump either requires a manually switching on or off by the users, this creates an inconsistent situation where users cannot fully deal with the time to monitor the level of the water inside the storage. Hence, an automatic level monitoring system is so important to install towards this system.

A solar data without a statistical analysis would deteriorate the future estimation on the system. This is because, solar panel performance mostly effected from the weather changes. Hence, knowing the pattern weather based on the statistical data is very crucial as a preparation of system sizing in term of solar storage and solar controller needed.[5]

1.3 Project Objective

The main aim of this project is to propose a comparative analysis of solar cell efficiency between Mono-crystalline and Poly-crystalline toward the water pump system. Specifically, the objectives are as follows:

1. To design a dependable of solar energy storage based on its supply longevity**.** This project will calculate the sizing of minimum battery needed for load depend on the daily usage.
2. To install a self-monitoring water pumping system using solar photovoltaic powered. This project mainly to setup a standalone water pumping system without any supply from the electrical grid supply.
3. To analyze the solar data collection using the statistical method.

CHAPTER 2

LITERATURE REVIEW

2.1 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scopes of the project are defined as follows:

a) Calculate the solar efficiency which can be generated by 50W_p Monocrystalline solar cell panel.

b) Generate the power supply from the solar panel into the load in direct current.

c) Coding the operation of relay as a switch using Arduino UNO R3.

2.2 Overview

This research uses a direct measurement method to compare the performance of a mono-crystalline with a peak power of 50 W_p. Mono-crystalline materials were compared in terms of efficiency to achieve this goal. To observe the characteristics of different Si-based solar PV systems under various conditions, environmental parameters such as solar radiation and temperature are varies from time to time.[6]

Solar panels with a power capacity and a peak power capacity of 50 W_p is using a direct measurement approach in this study. These areas are arranged in order to show the information about the process of decision making about the project. It is important to obtain clear data and must use the precise and strong database. This chapter was divided as below into Section 2.2 Type of Solar Panel, Section 2.3 Type of Water Motor Pump, Section 2.4

Type of Microcontroller, Section 2.5 Type of Charge Controller, Section 2.6 Type of Sensor, Section 2.7 Type of Battery, Section 2.8 Type of Switch.

2.3 Type of Solar Panel

2.3.1 Monocrystalline Solar Panel

Figure 2.1: Monocrystalline Solar Panel

Most photovoltaic cells are made of crystalline silicon because it is non-toxic, unlike cadmium or selenium. It also has high conversion efficiencies and makes up about 28% of the bark of terrestrial plants in the form of compounds (silicates and silica), making it a source that is almost impossible to run out of.

When exposed to light, the semiconductor solar cell is a device that sends an electric current to an outside load. The way it works is when a photovoltaic cell is exposed to sunlight, the energy of the photons that pass through the cell and into the junction is transferred to the atoms of the junction. If this energy is high enough, it can move the electrons from the valence band to the conduction band of the semiconductor material, making electron-hole pairs.

Then, an electric field, which is a potential barrier, keeps the electrons (which have N charges) and the holes (which have P charges) apart. If a charge is put across the cell, the

electrons in zone N connect to the holes in zone P through the external connection. This creates a potential difference, which makes an electric current flow.[7]

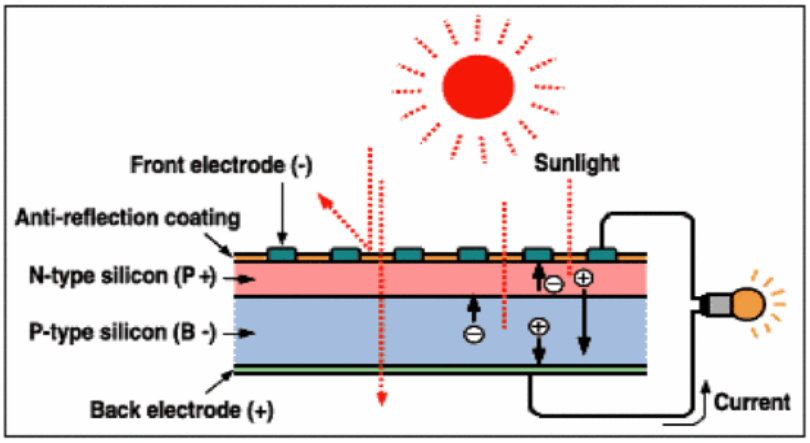


Figure 2.2: Cross-section of Monocrystalline Solar Panel

Monocrystalline solar panels contain monocrystalline solar cells. The term comes from a cylindrical silicon ingot made from high purity single-crystal silicon. As a single crystal cell, electrons have greater space to move, improving electrical flow. Ingots are broken into wafers and assembled into cells. Circular wafers are wire-cut into octagonal shapes to improve cell usefulness.

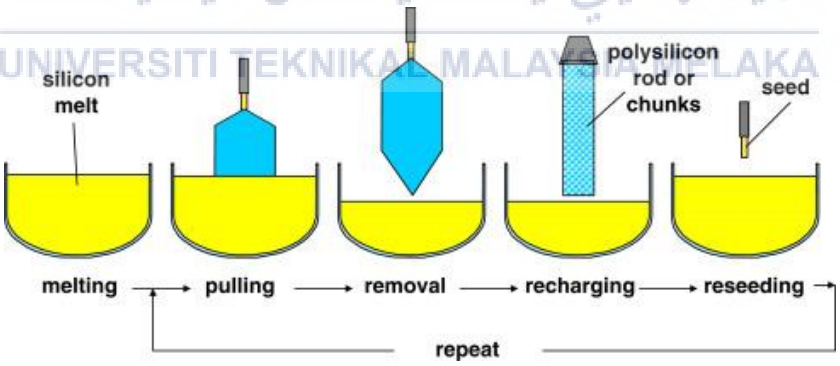


Figure 2.3: Czochralski method

Monocrystalline solar panels are built differently. Each solar cell has a single-crystal silicon wafer. The Czochralski procedure requires inserting a 'seed' crystal in liquid pure silicon at a high temperature. Molten silicon produces a single crystal around the seed. The ingot is

carved into thin wafers for solar cells. Figure 2.3 shows an illustration of how Czochralski method of crystal growth used to obtain single crystals of semiconductors. Monocrystalline panels have 60 or 72 solar cells, depending on size. Most homes use 60-cell monocrystalline silicon panels. In comparison to polycrystalline, both monocrystalline and polycrystalline have vary and different current-voltage graph characteristics. Depends on the irradiance. By increasing the value of irradiance, short circuit current for all these technologies of solar panels increases which causes the increase of power and so maximum power point gets changed. Typically, Maximum voltage is similar for both mono and polycrystalline solar panels, however mono-crystalline has higher current.[8]

2.3.2 Polycrystalline Solar Panel

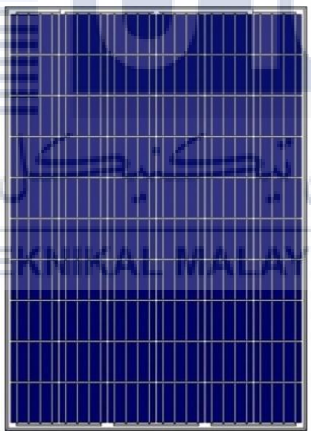


Figure 2.4: Polycrystalline Solar Panel

Polycrystalline solar panels also known as multicrystalline solar panels, are a type of solar panel that has many crystals of silicon within a single PV cell. The surface of these photovoltaic panels is designed to seem like a mosaic. Because they are constructed of numerous different types of polycrystalline silicon, they are formed in square shape and blue colour. Due to the presence of several silicon crystals in each cell, polycrystalline panels

allow minimal electron mobility within the cells. These solar panels are able to transform the energy that is received from the sun into usable electricity.

Cutting a molten and re-crystallized silicon ingot is the first step in the production of polycrystalline silicon, which is also known as multicrystalline silicon. In order to create polycrystalline solar panels, the ingots of silicon must first be sliced into extremely thin layers before being accumulated in solar cells. This has made it possible to use a more straightforward manufacturing method, which has in turn led to reduced production costs in comparison to monocrystalline cells. Having said that, solar panels made out of this material are considered to have a lower efficiency, with an efficiency that is normally anywhere between 12 and 15 percent. In comparison to monocrystalline, this type of solar panel actually is having an advantage in which it is better in a higher temperature. This is because each area has its unique meteorological parameters (temperature, sun irradiance, and dust density) that make a particular PV panel appropriate for that environment.[9] Hence the selection of solar panel regarding to the meteorological factor. Polycrystalline solar panels were utilised by Peng et al. in an investigation into the impact that temperature has on the efficiency of the module. The researchers came to the conclusion that the system is capable of producing a maximum efficiency that is greater than 7 percent. The figure 2.3 as illustration shown above, is a polycrystalline panel. In contrast to monocrystalline panels, polycrystalline panels are made mostly in the colour blue, and the cells in these panels are often cut into rectangular or square forms.[10] Figure 2.4 below shows the differences of how monocrystalline and polycrystalline is made.

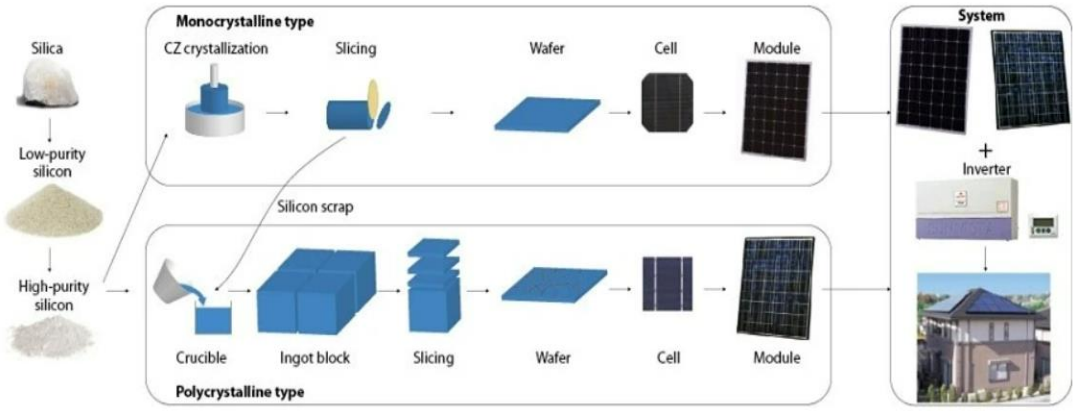


Figure 2.5: Comparison method in producing solar panel

2.4 Type of Motor Pump

2.4.1 Centrifugal Motor Pump

Figure 2.6: Centrifugal Motor Pump

The components of a DC photovoltaic water pump system are a PV generator, a DC motor, and a mechanical load. The working conditions of the system are governed by the relevant parameters of components such as the I/V characteristics of the PV generator at various temperatures and solar isolations, the kind of motor, and the torque/speed relationship for a given mechanical load.[11] Every centrifugal pump has a part called an impeller that is driven by a shaft and rotates inside of a casing. The impeller is completely

submerged in water at all times, and it spins whenever the pump is in operation. The rotation causes a centrifugal force to be exerted on the water, which compels the water to be forced push outside of the casing, where it then escapes through a discharge port. Additional liquid is drawn in by a suction port, also known as an inlet. The impeller transfers its velocity to the liquid, which results in the liquid gaining pressure energy, also known as "head."

As the fluid moves faster, the fluid's dynamic pressure rises. When the liquid exits the impeller, it is again slowed down by the collected liquid at the discharge port. As a result, the liquid's dynamic pressure is changed to static pressure. Ultimately, the static pressure at the discharge port rises dramatically. This high pressure permits the liquid to overcome a particular geodetic head. A challenge of this motor type is the cavitation if the impeller is operating in absence of liquid. If this type of pump runs under cavitation circumstances, vapour enters the impeller passage along the blades, reducing pump suction pressure. When the suction pressure drops to a specific level, the pump's cavity capacity expands rapidly, disrupting normal energy transformation and causing failure to the motor.[12] Figure 2.7 below shows centrifugal pump working principle with diagram.

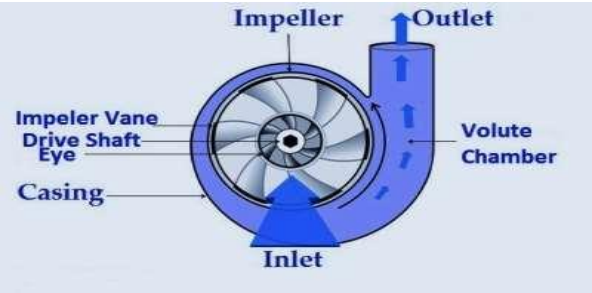


Figure 2.7: Centrifugal Pump working principle

2.4.2 Diaphragm Motor Pump

Figure 2.8: Diaphragm Motor Pump

A diaphragm pump is a displacement pump that uses two flexible membranes to operate. A central shaft connects the membranes, which form a barrier between compressed air and the fluid. An air valve in the center alternately pulls one of the membranes to the side. As a result, one membrane expels fluid while the other suck the intake of fluid. When the air behind the barrier is pushed into the atmosphere, a partial vacuum is created, and atmospheric pressure drives the liquid into the empty chamber. In the following stroke, the process is reversed, one membrane pushes liquid out of the filled chamber, while air pressure fills the empty chamber.

Diaphragm pumps can be employed in these circumstances. The ability to pump viscous, abrasive, and hostile liquids exists as well. Benefit of this design undoubtedly include high duration to failure of the diaphragm and the absence of driving sucker rods, which limit the possibility of lowering the pumping equipment into directional wells. However, diaphragm motor pump has more internal parts than the other types. Any malfunction parts affect the normal operation. During operation, diaphragm fracture, diaphragm elastic failure due to their material has a shorter lifespan, and inlet and outlet pipeline blockage are commonly happened. The motor won't work if the diaphragm fails.[13] In addition, diaphragm pump has a restricted applicability due to its small feed range, complexity of regulation, and low

mechanical transmission gearbox reliability, which results in low energy efficiency.[14] Figure below shows how diaphragm motor pump works.

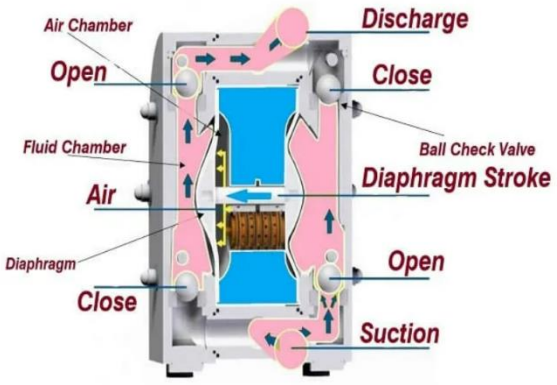


Figure 2.9: Working principle of diaphragm motor pump

2.4.3 Submersible Motor Pump

Figure 2.10: Submersible DC Motor Pump

A submersible is a mechanical device that is used to transfer a fluid underground from a low-pressure area into a high-pressure area. This is accomplished by placing the device in an area of low pressure underneath. A submersible pump, sometimes known as an electric submersible pump, is a pump that is capable of being completely submerged in water. The motor is hermetically sealed and tightly connected to the pump's body. In a submersible

pump, an electric cable powers is sealed inside the motor. Which the energy is converted into mechanical by the motor, then drives the centrifugal pump, then transfers the energy to the fluid. This first gains speed as it approaches the pump impeller blades, and then its kinetic energy is converted into potential and conducted as pressure.[15]

A submersible pump forces water to the surface by transforming rotary energy into kinetic energy and then pressure energy. This is accomplished by water being drawn into the pump. Firstly is the intake, where the impeller's rotation forces water through the diffuser. The water then draw to the surface. The primary benefit of a submersible pump is that it does not require priming, as it is already submerged in the fluid. Submersible pumps are also incredibly energy-efficient since they do not need to expend much energy to move water into the pump. The water pressure is then forces water into a submersible pump, resulting "saving" a significant amount of energy.

Moreover, although the pumps are not versatile in the selection. Some submersible pumps can handle solids with ease, while others are best only apply for the liquid suction. Because they are submerged into water, submersible pumps are silent, and cavitation is never a concern because there is no pressure "spike" as water runs through the pump. The submersible pump was selected for the creation of a more portable system due to its low energy consumption and ease of installation while drawing water into the pump.[16] There are so many type of submersible motor pump in market for selection regarding to the applications.

Table 1: Type of submersible pumps and its application

Type of submersible pumps	Application
Bladder Pump	Used for fluid sampling because of the low-flow pneumatic devices
Grinder Pump	Used for the transport of dirty water that cointain partially solid and contamination substances
Deep Well Pump	Deepwell pumps pump groundwater for process water, drinking water, irrigation systems, and fire fighting. These pumps draw liquid from below-water sources through a discharge pipe.
Stainless Steel Pump	Typically installed into highly chemical substances. Because they can handle chemicals better, stainless steel submersible pumps don't rust as quickly.
Down Suction Pump	Used to absorb groundwater in lakes, rivers, and mines.
Water Cooler Pump	Typically installed in small or large cooler households to provide the cold water.
Oil-filled Pump	Used in irrigation or industrial drainage systems. motor inside the pump can be cooled by filling it with oil so that the motor does not get hot and heat up.

2.5 Type of Microcontroller

2.5.1 Arduino UNO R3

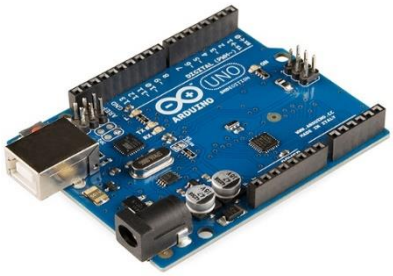


Figure 2.11: Arduino UNO R3

In Arduino Uno R3, programming, erasing, and reprogramming is possible at any time. Arduino is a microcontroller that is open source and free to use. The Arduino platform was developed to provide hobbyists, professionals, and also provide students with an accessible, low-cost, and straightforward method of building devices that interact with their environments through the use of sensors and actuators. Arduino boards not only be used for programming and the construction of electronic devices, but they also serve the function of a minicomputer by collecting input and controlling output for a wide variety of electronic gadgets.[17] C or C++ is used as the programming language for the Arduino, and the Arduino IDE (Integrated Development Environment) serves as the software for the programming process.

The Arduino Integrated Development Environment (IDE) is composed of three distinct sections, the command area, text area, and message window area.[18] Arduino uses the Arduino board as its programmer, and the Arduino board is responsible for designing many of the system's components in order to ensure that they work effectively. A microcontroller,

an external power source, a USB socket, an internal programmer, a reset button, analogue pins, digital I/O pins, as well as power and GND pins are all included in an Arduino board.

It's common practice to utilize an Arduino board as the "brain" of a project, and there are many other kinds of boards available, such the Arduino Uno (R3). Because of its extensive support community, the Arduino platform provides a straightforward entry point into the world of embedded electronics. The Arduino Uno R3 is the third and recent iteration. An ATmega328-based microcontroller board is what can be found on an Arduino Uno. On this board there are, a reset button, as well as 20 digital input/output pins, a 16 MHz resonator, a USB connector, a power connector, an ICSP header, and a connector for the power supply.

2.5.2 Raspberry Pi

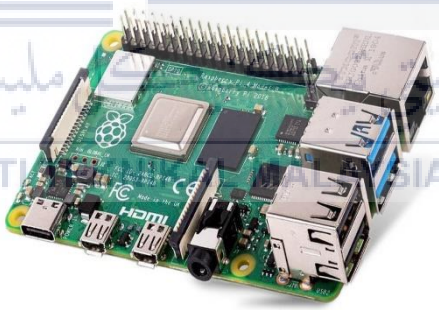


Figure 2.12: Raspberry Pi

The Raspberry Pi is a credit card sized low-cost computer that connects to a computer monitor or television and uses a standard keyboard and mouse. It's a powerful little device that teaches people of all ages about computers and programming languages like Scratch and Python. Python was chosen as the major programming language because it is widely recognised as easy to learn while also being a full-featured programming language suitable

for real-world applications. Python is now be used for computational mathematics, as well as the analysis of experimental data and control systems, due to the availability of software such as NumPy, SciPy, Matplotlib, IPython, and PyLab.[19] Raspberry pi OS as known as Raspbian is one of the operating systems that can be installed on a Raspberry Pi, along with the other operating systems that are available. Rufus is free software that can be used to install the operational system into micro SD cards. Raspbian is the operating system that is based on Linux. Once the operating system is functioning, some programmes and features are able to be installed and utilised by the user.[20]

2.6 Type of Charge Controller

2.6.1 PWM Solar Charge Controller

Figure 2.13: PWM Solar Charge Controller

The PWM solar charge controller monitors the battery voltage and decides how much current it can safely feed into the battery. PWM as known as pulse width modulation, is a technique that is utilized in modern charge controllers. This technique is used to gradually reduce the proportion of energy that is supplied to the battery while it is being charged, which improves the controller's efficiency and extends the battery's life. At the same time, it guarantees that the batteries will be periodically recharged. Hence, charge controller is designed to regulate

the voltage of the device. When the voltage of the battery reaches the set value, the charge controller open the circuit and stop the charging process. The exceeding charge controllers will be utilized the mechanical relay to open or shut the circuit, stopping or beginning power heading off to the electric storage devices.[21] Figure 2.4 below shows how the PWM is connected to the system.

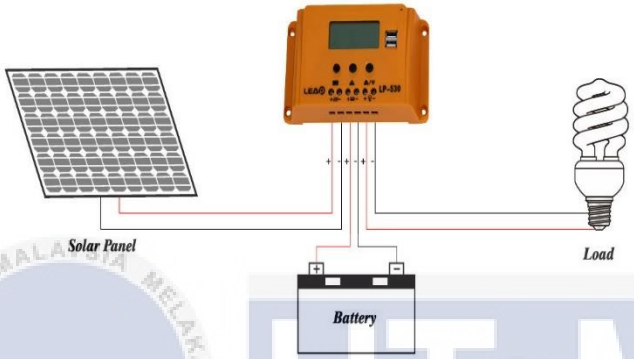


Figure 2.14: Connection PWM Controller to the system

Typically, solar power system uses the 12V of batteries. Solar panels are capable of delivering higher voltage than the necessary of battery to be charged. It is possible to maintain the charge voltage at the optimal level while also shortening the amount of time to fully charge the electric storage devices. As the result, the solar systems are able to function at their highest potential continuously. By increasing the voltage that is carried through the wires that connect the solar panels and the charge controller, power dissipation in wires is diminished fundamentally.

PWM charge controllers implement technologies that are similar to those found in modern high-performance battery chargers. The ability to recognise lost battery capacity and desulfate of battery, reduce battery heating, and self-regulate for voltage drops and temperature effects to the solar systems are the unique benefits of PWM pulsing.[22] The

solar charge controllers also have the ability to control the flow of power in the reverse flow. The charge controllers are able to recognize when there is no power coming from the solar panels, at which point they open the circuit, which disconnects the solar panels from the battery devices and halts the flow of current in the opposite direction.

2.6.2 MPPT Solar Chrge Controller

Figure 2.15: MPPT Solar Charge Controller

A selection of solar charge also is need to be concerned into the account. In order to utilize the battery charging phase in any condition. An MPPT control is essential towards PV production systems and has an ability to generate maximum output power despite changes in the weather conditions.[23] A charge controller, which is also called a charge regulator, limits how much electricity can be drawn into or taken out of solar batteries. Solar PV MPPT charge controller have

MPPT tracker and a battery charge controller. The MPPT monitors and transmits the maximum power from the PV panel to the battery charge controller. The charge controller uses a multi-stage charging method to successfully charge the battery while avoiding overcharging and overheating, which can damage the battery.[24]The goal is to keep the batteries charged as much as possible without overcharging them. Due to changes in

irradiance, the voltage and current of a solar system can change quickly, so the charge controller needs to act quickly to adapt.

A unique properties of DC/DC converters are applied in order to transmit the most amount of power from PV modules to loads or batteries. MPPT techniques are utilised in order to extract the highest amount of output power from PV modules.[25] Maximum power point, also known as peak power voltage, is the voltage at which PV panels make the most power. When charging batteries, the maximum power depends on many factors, such as the amount of solar radiation, the length of the wire, the state of charge of the battery, and the temperatures of the environment and the panel. Direct current (DC) input from solar modules is converted to alternating current (AC) using MPPT charge controllers (AC). Next, the charge controller transforms the DC voltage and current back to a DC voltage and current that is compatible with the battery and solar panels. A greater DC output voltage from solar modules is converted down to a smaller DC output required for battery recharging. Figure below shows the flowchart of the MPPT working.

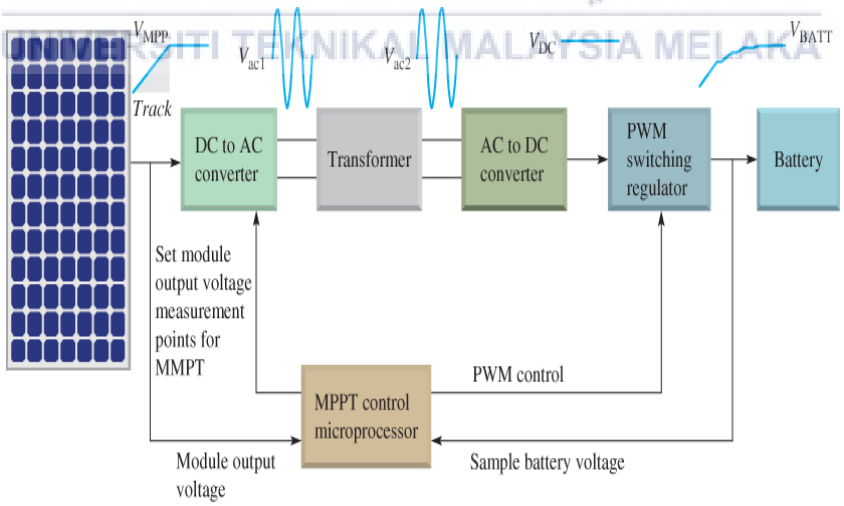


Figure 2.16: MPPT Working Principle

2.7 Type of Sensor

2.7.1 Water Level Sensor (HW-038)

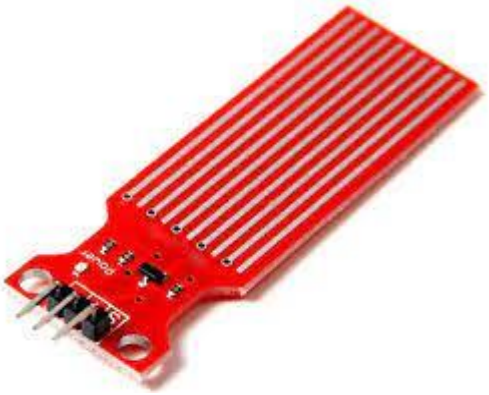


Figure 2.17: Water Level Sensor HW-038

The resistance is inversely proportional to the height of the water. The more water the sensor is submerged in, the better the conductivity and the lower the resistance. The less water the sensor is immersed in, the worse its conductivity will be and the higher its resistance will be. The sensor generates an output voltage based on the resistance, which can be used to detect the water level by measuring it. In principle, the water level sensor has a measurement threshold in range from minimum to maximum value. Which this threshold is the amount of measurement required by its internal instrument to change in output measurement or result.[26]

Components needed so that the system is made according to the design, consists of a water level sensor with an output range of 0 to 3 V and a resolution of 1 mm for a sensor with a length of 1 m, this sensor requires a low power consumption at 1.2 mA so suitable for remote data recording systems. This sensor consists of a piece of wire which is insulated so that it does not in direct contact with water.[27]

The water level sensor is so easy to be installed to the Arduino. It only has 3 pins in connection. But, one of the most prevalent complaints about these sensors is that they have

a short lifespan in damp environments. The rate of corrosion is quicker when the probe is powered on at all times.

Table 2: Connection of water level sensor

S(Signal)	Signal analog output pin will be connected to the analog input of the Arduino board.
+(VCC)	This pin supply power to the sensor. The power for this sensor has the range between 3.3V to 5V that is available in the market.
-(Ground)	Ground connection.

2.8 Type of Battery

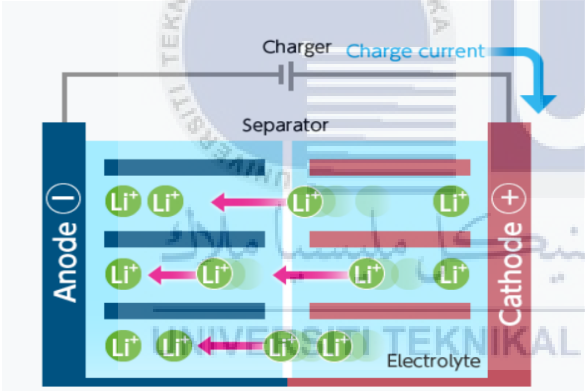
2.8.1 Lithium-Ion Battery

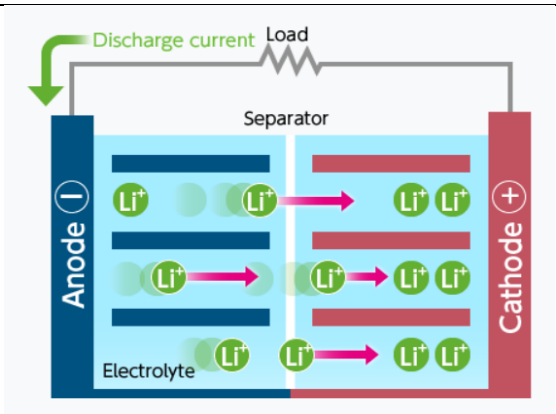
Figure 2.18: Li-Ion Battery

A lithium-ion (Li-ion) battery is a high-performance battery that contains lithium ions as a key component of its electrochemistry. In lithium-ion battery, the transfer of electrons from anode to cathode is followed by the extraction of Li-ions from the anode material and their insertion into the cathode material to balance the charge. As a result, a Li-ion containing must be used to connect the anode and cathode ionically.[28] Lithium atoms in the anode are ionized and separated from their electrons during a discharge cycle. The lithium ions move from the anode through the electrolyte to the cathode, where they recombine with their

electrons and become neutral. Between the anode and the cathode, the lithium ions are tiny enough to pass through a micro-permeable separator. Li-ion batteries can have a very high voltage and charge storage per unit mass and volume, due to lithium's tiny size. However, every time a Li-ion battery is charged and discharged, it loses some of its capacity. The cycle life of a battery can be improved by keeping the temperature in nominal temperature or room temperature, but it reduces dramatically when the temperature is either extremely high or extremely low. The depth-of-discharge (DOD) and the current are two factors that influence the lifespan of a cycle.[29]

Table 3: Working principle of Li-Ion battery

Condition	Operation
During charging 	• Supply from the charger draws the current and charging up the battery. • Li-ion is transferred and move from cathode to the anode through the electrolyte. • battery is charged by a potential difference between the two electrodes.
During discharging	• Forming discharge circuit by the connection between anode and cathode.

	• The process is reversed which the Li-ion stored in anode move back to the cathode side. • Consumption of energy phase from the battery.

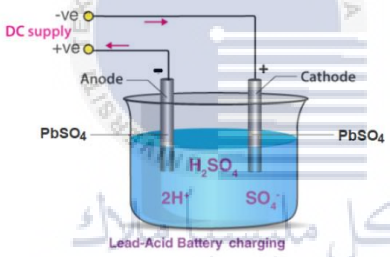
2.8.2 Lead-Acid Battery

Figure 2.19: Sealed Lead-Acid Battery

Lead-acid batteries are the most popular form of energy storage technology utilized in electric power system applications. These batteries are well-known in the automotive and industrial industries, and they've been successfully used for utility storage.[30] The negative electrode of a lead-acid battery is made of spongy or porous lead. The lead is porous to allow the formation and dissolution of lead. Lead oxide makes up the positive electrode. Both electrodes are put into a solution of sulfuric acid and water that is used in electrolysis. If the electrodes contact each other due the physical movement of the battery or through changes of electrode thickness, an electrically insulating, but chemically permeable membrane separates the two electrodes. This membrane also keeps the electrolyte from

becoming a short circuit. Yet, the usage of lead-acid batteries is associated with a number of safety issues that should be considered. Loss of power, downtime, and even major accidents can be caused by old lead-acid batteries that are not operated correctly or adequately. For instance, overcharging lead-acid batteries can lead to increases in the temperature of the electrolyte as well as the production of hydrogen gas, both of which can cause to explosions and fires. Therefore, it is crucial to evaluate the stage of ageing that lead-acid batteries have reached in order to prevent incidents and the losses.[31] Lead-acid batteries store energy through the chemical reaction below.

Table 4: Working principle of Lead-Acid battery

Condition	Chemical Reaction
During charging 	When the battery is discharged, it acts as a galvanic cell and the following chemical reaction occurs. **Negative:** $Pb(s) + HSO_4^- + H_2O(l) \rightarrow 2e^- + PbSO_4(s) + H_3O^+(aq)$ [Oxidation] **Positive:** $PbO_2(s) + HSO_4^-(aq) + 3H_3O^+(aq) + 2e^- \rightarrow PbSO_4(s) + 5H_2O(l)$ [Reduction]
During discharging 	The chemical reaction that takes place when the lead-acid battery is recharging can be found below. **Negative:** $2e^- + PbSO_4(s) + H_3O^+(aq) \rightarrow Pb(s) + HSO_4^- + H2O(l)$ [Reduction] **Positive:** $PbSO_4(s) + 5H_2O(l) \rightarrow PbO_2(s) + HSO_4^-(aq) + 3H_3O^+(aq) + 2e^-$ [Oxidation]

2.9 Type of Switch

2.9.1 1 Channel 5V Relay

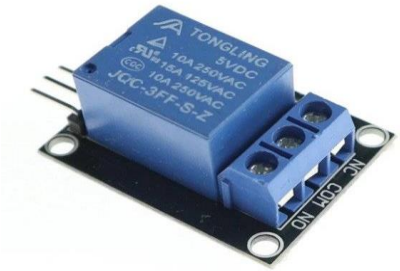


Figure 2.20: 1 Channel 5V Relay

The relay is a switch that is powered by electromagnetic. Many relays use an electromagnet to move a switch mechanically. Other types of relays, like solid-state relays which work in a different way. Relays are used to control a circuit with a separate, low-power signal or to control more than one circuit with a single signa. For a relay to work, the coil requires the right amount of pull-in and holding current. Relay coils are made to work with a certain voltage, usually 5V or 12V.[32]

A relay is a straightforward electrical device that comprises of a switch, an electromagnetic field from the wire coil and an iron shaft. Once electric current flows through the coil, the surrounding magnetic field shifts, which in turn causes the switch to be in a different position and produces a greater electric current. This device begins to function when the electric current flows through the coil.[33] In principle, initially the first circuit is turned off, and there is no flow of current through it. This state remains until the circuit is activated by something (either a sensor or the closing of a switch), at which point it becomes active. The second circuit is also switched off then. When there is just a trace amount of current flowing through the first circuit, it triggers the electromagnet, which then creates a magnetic field in all directions around it.

The activated electromagnet triggers a contact from the second circuit toward it to be attracted, which causes the switch to be closed and enables a greater amount of current flow through the second circuit. When the flow of current is stopped, the contact will move back to its starting position, which will result in the reactivation of the second circuit into off condition. The relay's common (COM) terminal is supply input. While the selection of NC & NO terminals depends upon whether the option to turn the device ON or OFF.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The sun is one of a stars become the main source of energy for human being to be utilized. This energy comes from the fusion reaction of atoms, which the produce a high pressure and temperature. Because of this fusion reaction, the sun can generate a vast amount of energy. Electromagnetic waves are the form in which this type of energy is transmitted to the surface of the earth. The sun emits light radiation of varying wavelengths from the electromagnetic spectrum, ranging from ultraviolet radiation to visible light to infrared. The amount of solar radiation energy received per unit area per unit time, expressed as a function of wavelength. The development of this system hardware is based on the selection of PV panel either Monocrystalline or Polycrystalline solar panel through the analysis. The angle of incidence, which is the angle between the direction of the incident rays and the perpendicular component to the plane of the panel, has a major influence on the amount of radiation absorbed by the solar panel.

This project is about the off-grid system relying on the PV supply. The electrical energy produced from the PV panel is then connected to the PWM solar charge to monitor the battery voltage and decides how much current it can safely feed into the battery. The PWM is then connects to the battery for the energy storage to be charged. Means that if the battery still has charge, it able to supply the power to load during the unavailability of sun. From the PWM also is connected to the load which is DC motor pump. PWM plays an important role as the interface of this system by regulating the supply towards the load is from the battery.

In addition, this project implemented with a microcontroller which is Arduino Uno to manage the switching mode of the relay. The relay is installed within the battery and the motor pump in order to regulate the switching mode of the motor. Operational of the relay depends on the water level indicator which has been set to be cut the supply if it detects the level of water inside the tank storage reached its maximum volume.

3.2 Circuit Design

50 Wp of Monocrystalline solar panel is used to supply the power to load as a standalone water pumping system. MPPT is used as interconnector from DC power to the load. The MPPT monitors and transmits the maximum power from the PV panel to the battery charge controller. Firstly, the solar panel will be connected to the MPPT charge controller to supply DC power to the battery. Secondly, the battery is connected to the MPPT charge controller for the charging or discharging phase for the water motor pump. Lastly, the DC diaphragm motor pump is connected to the MPPT charge controller at its load port.

The external system of water drainage protection is using Arduino UNO will be used as the microcontroller for control the input and output for the relay as a automatic switch operation. The water level in the water storage is equipped with a water level sensor and connects to the Arduino UNO as a monitoring water level system.

In this parameter, if the water level sensor indicates high signal to the Arduino UNO, the signal is then triggering the NC relay to become NO. As the result then water motor pump will unoperated. Otherwise, if the water level sensor indicates the level of water is low or medium, the water motor pump works as usual as the relay is in NC condition.

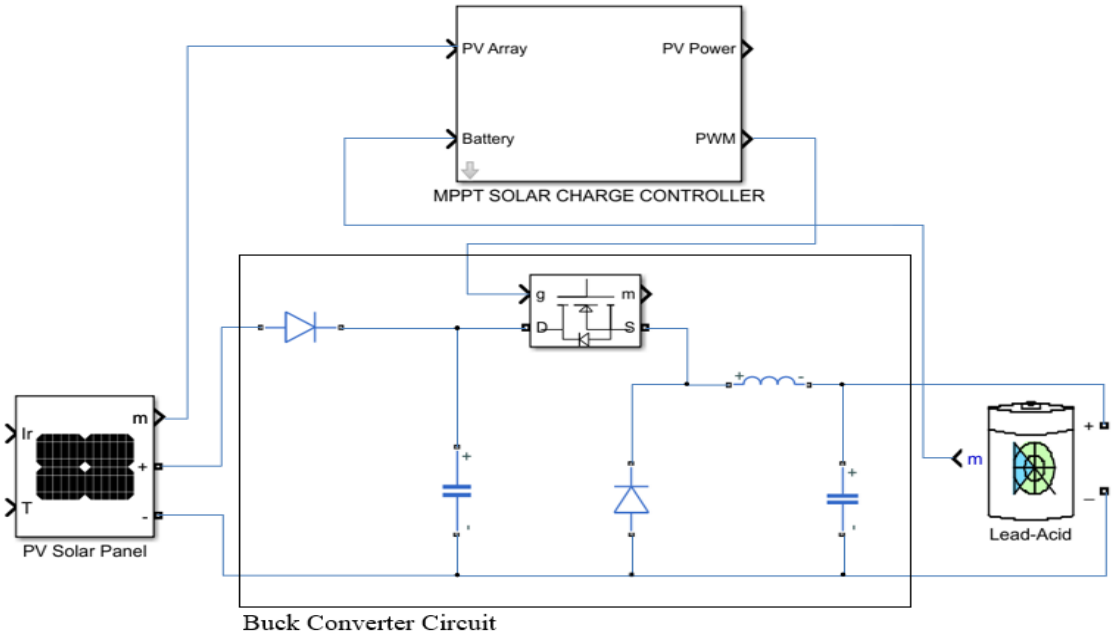


Figure 3.1: Circuit design of the system

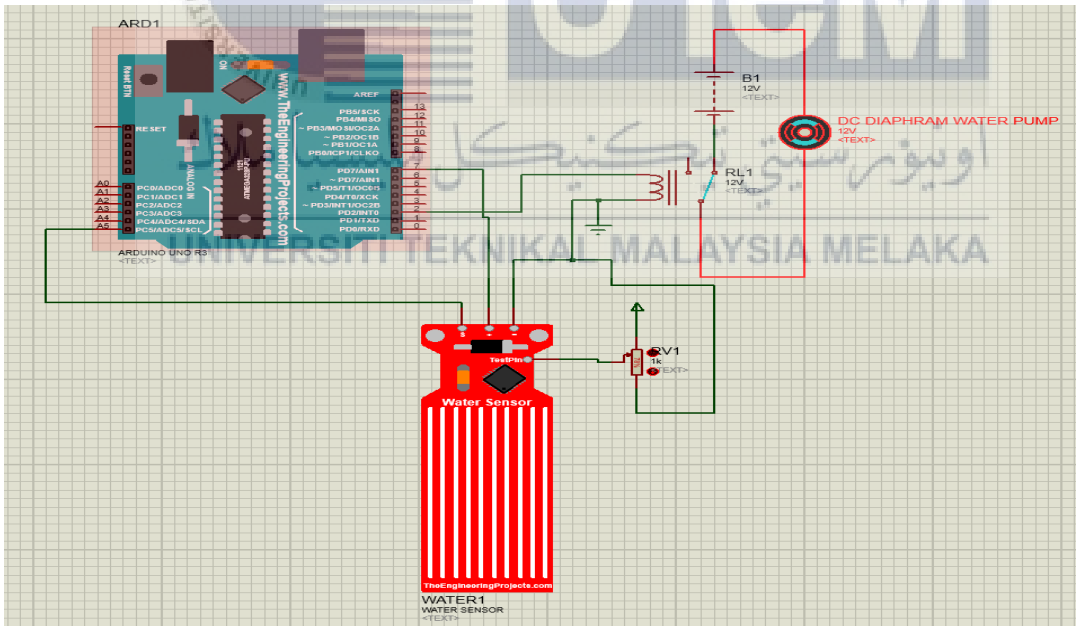


Figure 3.2: Circuit design of the external water level sensor

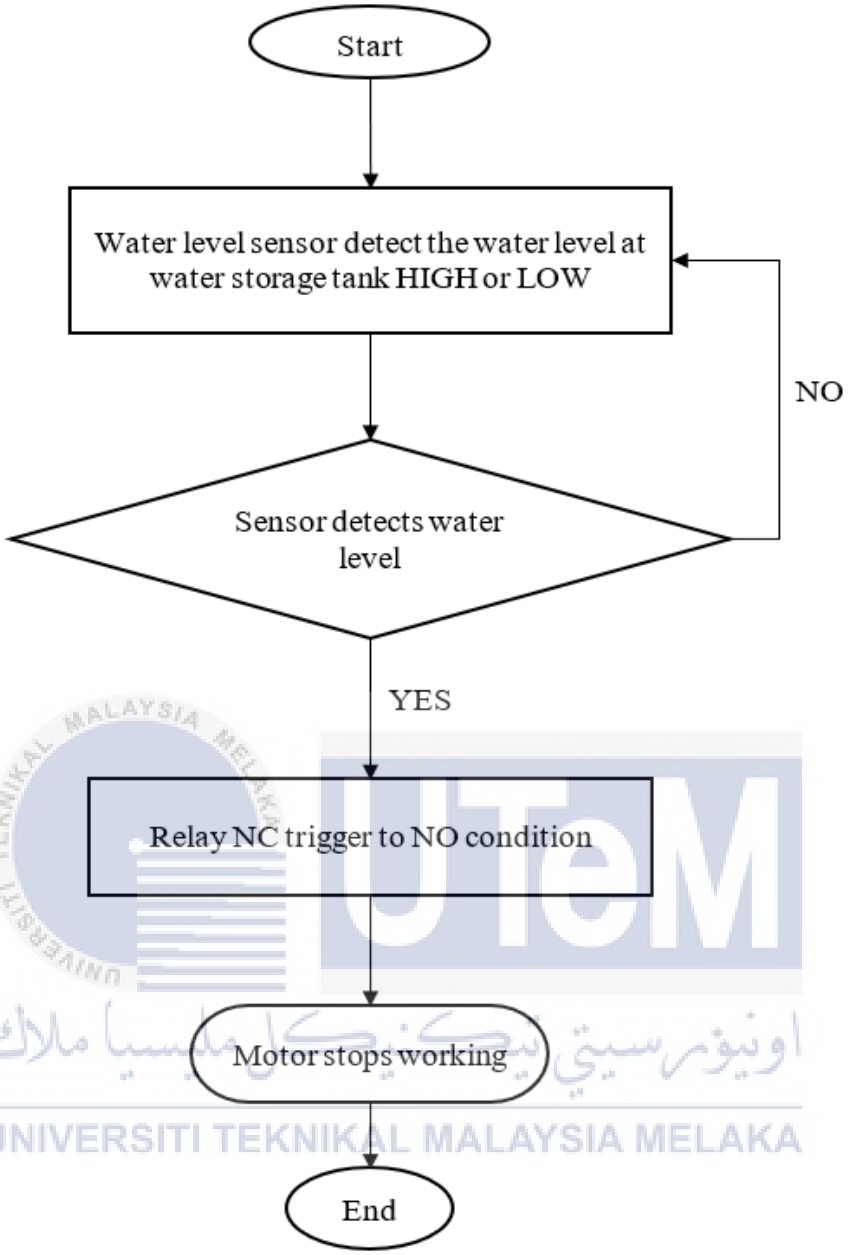


Figure 3.3: Overall Project Flowchart

3.3 Calculation in sizing the equipment specifications

3.3.1 Estimate Load Wattage

DC diaphragm water motor pump = 100W, 12V DC

Let's say the pump need to operate = 3 hours/daily

Absolute power necessary from panel = 100W x 3 hours= 300W

3.3.2 Determining Approximate Solar Panel Dimension

Assume the availability of sunlight per daily = 6 hours

$$\frac{300W}{6\ hours\ sunlight\ available} = 50\ \text{Wp solar panel}$$

Hence, 50Wp solar panel is required to install for the system

3.3.3 Calculation Battery (Ah)

As the battery rated used is 12V

reserved battery power = $\frac{300W}{12V}$ = 25 Amp hour

Hence, at least 25Ah battery is required or more and it will be used daily from the battery storage.

3.3.4 Evaluate Charger Controller Amperage

From the solar panel specifications:

$W_p = 50W$

$V_{mp} = 18V$

Solar charger controller current rated = $\frac{50W}{18V}$ = 2.78A

Hence at least 2.78 A for solar charger controller is needed, but the variant available in the market is 30A rated solar charge controller at minimum.

3.4 Equipment and Component

3.4.1 50Wp Monocrystalline Solar Panel

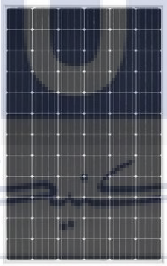


Figure 3.4: 50Wp Monocrystalline solar panel

Table 5: Specification of Monocrystalline solar panel

Parameter	**Monocrystalline PV Panel 50Wp**
Maximum Power (W)	50
Tolerance (%)	± 3%
V_{OC}	21.6
I_{SC}	3.07

Max Power Voltage (V_{mp})	18
Max Power Current (I_{mp})	2.78
Operating Temperature (°C)	-40°C ~ 85°C
Terminal Box	IP65
Max System Voltage (V)	DC1000
Weight (Kg)	3.5
Dimension (mm)	630 x 540 x 30
Application class	Grade A

3.4.2 30A MPPT Solar Charge Controller

Figure 3.5: MPPT Solar Charge Controller

An MPPT charge controller is a direct current to direct current converter that improves the overall performance of a solar power system. It accomplishes this by maximising the voltage match between the array of solar panels and the batteries in the system. The maximum power point tracking (MPPT) applies the algorithm method into controllers and able to maximise the amount of power drawn from solar panels and the amount of power transferred from PV modules to loads. Maximum Power Point Tracking is an electrical system that alters the module's electrical operating point in order to supply the maximum amount of available power.[34]

Table 6: Specification of MPPT

Specification	Range/Type
Battery voltage	12V/24V Auto adapt
Material	ROHS+ABS
Charge current	30A
USB output	5V 2A
Size	170mm x 95mm x 40mm
Weight	260g

3.4.3 12V Battery 30Ah (Lead-Acid)

Figure 3.6: 12V Battery 30Ah (Lead-Acid)

A type of rechargeable lead acid battery stores electrical energy by the use of chemical reactions involving lead, water, and sulfuric acid. This type of battery can be recharged multiple times. Deep cycle battery type is the best storage device for solar systems and can be characterised by of their high power density, high discharge rate, flat discharge curves, and good low-temperature performance in operation. This battery will be fully regulated by the MPPT for the charging and discharging phase. Deep-cycle lead-acid battery is the famous for off-grid or solar systems because they can be fully discharged and don't

damaged quickly as normal batteries can be. For instance, an lead-acid battery, can only be discharged at a maximum of 50% to extend its lifespan.

3.4.4 1 Signal Relay (5V)

Figure 3.7: 1 Signal Relay (5V)

Table 7: Specification of 1 Signal 5V Relay

Specification	**Range/Type**
Type of signal	AC/DC,
Type of contact	Normally Open (NO) and Normally Close (NC)
Channel	Single channel
Operating voltage	5Vdc
Operating current	76mA
Relay contact rating	10A 250Vac
Pinout	Vcc= 5V GND= Ground IN= Control input
Dimension	17mm x 43mm x 18mm
Weight	15g

3.4.5 Water Level Sensor (HW-038)

Figure 3.8: Water Level Sensor (WH-038)

The water level sensor is essential to monitor the water level volume inside the water tank storage. If this sensor detects the high volume inside the water tank storage, it gives a signal to the Arduino UNO to be interpret. Then the signal will be sent to the relay in order switch to Normally Open. Hence, stop the operation of water motor pump. Otherwise, if this sensor doesn't detects the HIGH volume of water in tank storage, it doesn't gives the signal to the relay to be Normally Open.

3.4.6 Arduino UNO R3

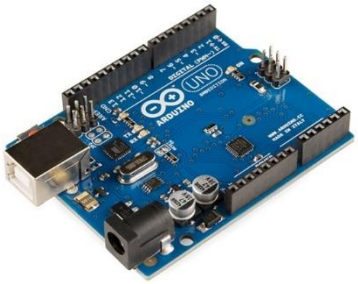


Figure 3.9: Arduino UNO R3

For good reason, the Arduino platform has grown highly popular among those who are just beginning their careers in the field of electronics. To upload the code into an Arduino board,

all that is required is a USB cable. In contrast, majority of programmable circuit boards previously existed, which required a separate piece of hardware known as a programmer in order to do so. In addition, the Arduino IDE uses a simple version of C++ language, which makes it less difficult to learn the basics of computer programming. The Arduino UNO R3 microcontroller features a reset switch, ICSP download, 14 digital I/O ports which six pin from these pins can give PWM outputs, 6 analog I/O ports. Additionally, it has 14 digital I/O ports. It also equipped with a USB connection and provide power through the USB interface.[35]

Table 8: Specification of Arduino UNO R3

Microcontroller	**Microchip Atmega328P**
Operating Voltage	5 V
Input Voltage	7 V to 20 V
Digital I/O Pins	14 pins. 6 from them provides PWM
UART	1
12C	1
SPPI	1
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50 mA
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

3.4.7 12V DC Diaphragm Electric Motor Water Pump

Figure 3.10: Diaphragm Electric Motor Water Pump

Diaphragm pump type has chosen for this project because it is easy and low-cost installation. The diaphragm pump is a type of pump that works by changing the size of a chamber, expanding and contracting, in order to create pressure differences between the chamber.

Table 9: Specification of Diaphragm motor pump

Specifications	**Type/Range**
Material	ABS Shell
Voltage	12V DC
Power(max)	100W
Pressure(max)	1.1Mpa/160psi (145psi=1Mpa)
Flow(max)	8 litre/minute
Protection valve type	Intelligent valve (with pressure switch)
Head	70 meters
Range	9 meters
Suction distance	1.5 meters
Size	18.3cm x 4.7cm x 4.8cm

Suitable inlet/outlet hose size	12mm outer diameter, 8mm inner diameter

3.5 Summary

In conclusion, sizing the specification of the equipment is very crucial to determine the total expenses. Calculation of the solar panel is also an important role as it comes to budgetary constraint.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The intensity of solar radiation, also known as solar irradiation, is the amount of solar power coming to the surface per area and is the most critical parameter in the performance of a solar panel. The solar constant, which is 1365 W/m2, is the intensity of solar radiation outside the Earth's atmosphere. Some light is lost when it passes through the earth's atmosphere, and the peak radiation intensity is roughly 1000 W/m2. In sunny day, this value represents a typical radiation intensity on the surface perpendicular to the sun. The magnitude of the solar irradiance value will determine the amount of power which can be generated by a solar panel. The data of analysis is recorded within the range of availability of sunlight from 11am to 6pm. Some parameters were recorded into account from the charging phase and discharging phase.

4.2 Water Level Monitoring

To operate the external circuit as a water level monitoring, Arduino UNO R3 is used as a device that functions to control the system. This system comprises of an Arduino UNO R3 as a microcontroller, 1 signal 5V relay and water level sensor. In principle, the system is working when the water level sensor detects the HIGH signal in water level inside the storage. If the signal is HIGH, the sensor sent the signal to the Arduino UNO R3. Hence, triggering the NC condition of the relay to the NO condition. The relay is connected in series

from the solar charge controller to its NC terminal and the output COM terminal is connected to the DC motor water pump.

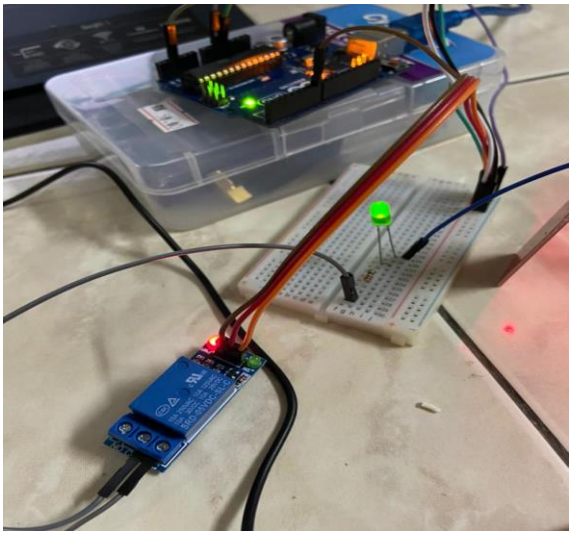


Figure 4.1: Arduino Connection With Relay

As shown above in figure 4.1, the LED light up indicates the DC motor water pump is always running initially as the relay is set in NC condition. Meanwhile, Red light on the relay indicated the relay is not being triggered yet. Figure 4.2 below shows the full connection from the laptop as the supply to the Arduino and then connected to the relay and water level sensor. The battery 9V 6LR61 is the illustration as the solar battery storage in the system which supply to the LED light which is as the DC motor water pump.

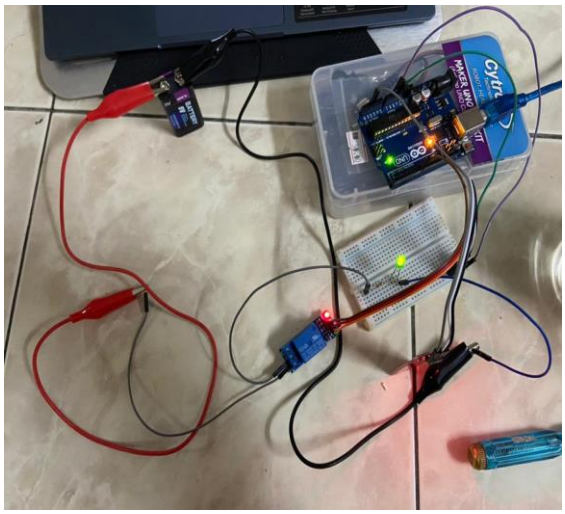


Figure 4.2: Arduino Connection of Water Level Monitoring

Figure 4.3 below shows the water level sensor is immersed into the liquid until it reached its' heighest threshold. In a result, Arduino UNO R3 send the signal to the relay hence triggering the NC to NO condition. As can be seen the LED is now has been light off due to the cut off connection from the relay. The green light indicator on the relay also is turned on due to the triggering condition occured inside the relay. This experiment illustrates how this external circuit of level monitoring system regulate water level inside the storage wether it is fully occupied or low capacity of water.

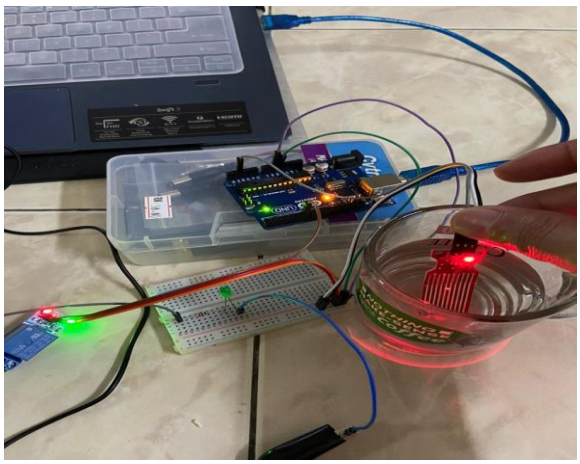


Figure 4.3: Immersion of Water Level Sensor HW 038

For the coding part of this Arduino UNO R3, its coding is obstructed using Arduino IDE software which can be downloaded from google just for free. The output and input are defined and the coding was compiled and then transferred to the arduino board.

HW_083

```
#define POWER_PIN  7
#define SIGNAL_PIN A5
#define THRESHOLD 260 //need calibration

int value = 0; // variable to store the sensor value
const int RELAY_PIN = 2;
void setup() {
  Serial.begin(9600);
  pinMode(POWER_PIN, OUTPUT);   // configure D7 pin as an OUTPUT
  digitalWrite(POWER_PIN, LOW); // turn the sensor OFF
  pinMode(RELAY_PIN, OUTPUT);
}

void loop() {
  digitalWrite(POWER_PIN, HIGH);  // turn the sensor ON
  delay(10);                      // wait 10 milliseconds
  value = analogRead(SIGNAL_PIN); // read the analog value from sensor
  digitalWrite(POWER_PIN, LOW);   // turn the sensor OFF

  // relay on off depend NC/NO type
  if(value > THRESHOLD){
    digitalWrite(RELAY_PIN, LOW); // on relay
  }
  else{
    digitalWrite(RELAY_PIN, HIGH); //off relay,
  }

  // Check value untuk water calibration
  Serial.print("Sensor value: ");
  Serial.println(value);

  delay(1000);
}
```

Figure 4.4: Water Level Monitoring Coding

For the hardware part, the water level sensor intially need to be calibrated as required threshold. In this experiment, the water level sensor is set at threshold value of 200. As can be seen, this threshold detects the water about its maximum immersion of the sensor. This means, the signal is send to the Arduino as the water is reached at its highest level of sensor immersion and it will cut off the supply through the relay energization of NC to NO condition. HW 038 comprises of 3 pins which first pin is Signal (S) is connected to pin A5 on the Arduino board, second pin Positive (+) is connected to pin 7 on the Arduino board, while third pin is Negative (-) is connected to Ground (GND) of the Arduino board.

Meanwhile, for the 1 signal 5V relay connection need to be determined whether it is NO or NC in intial condition. In this experiment, Normally Closed (NC) is selected in relay

connection as it is always allowing the flow of current unless it is energized to be opened the circuit connection. In this hardware part, the VCC pin of relay is connected to the 5V power pin of the Arduino board, Ground (GND) of the relay to the GND of the Arduino board, and the IN pin of the relay is connected to the pin 2 of the Arduino board.

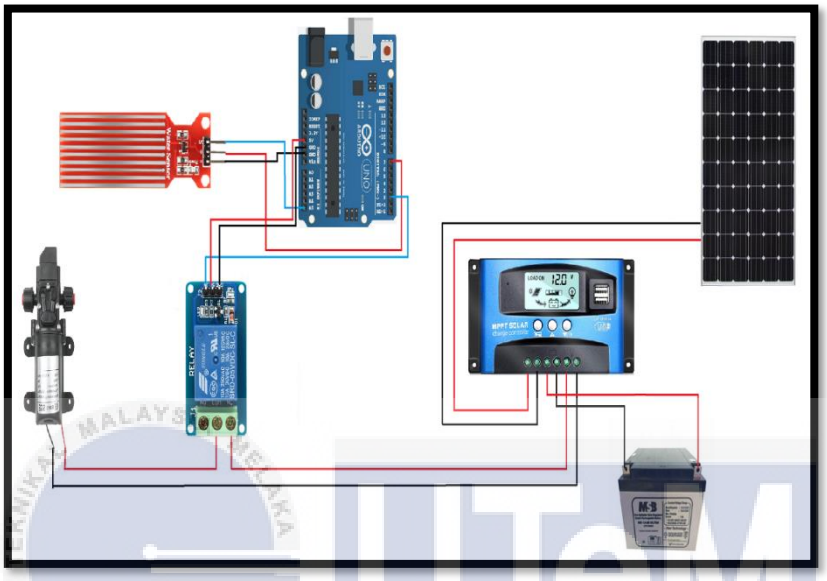


Figure 4.5: Full Circuit Connection

4.3 Circuit Design as A Stand-Alone Solar System

The connection of the circuit as can be seen in Figure 4.5, shows the power system is a stand- alone system which completely not connects or involves from local power grid. This concept is shown by the battery as a backup that provides power to the system when the primary source of power is unavailable. Solar battery plays an important role as it will stores the excess electricity which can shift the usage option by the moment of unavailability in electricity supply from solar panel.

A solar charge controller which Maximum Power Point Tracking type is used in this experiment acts as an interface of the project to regulate both incoming voltage and current

from the solar panel to the battery storage and from the battery storage to the DC load of water pump.

PV modules with MPPT solar charge controllers may utilize PV modules output voltage is greater than the battery system's operational voltage. Otherwise, this device also can regulate the voltage range's option which drawn into the battery either lower or higher than the system nominal voltage. In this project, a 12V Seal-Lead Acid 26Ah battery is used to ensure the longevity of supply into the DC water pump. Related to this type of battery, the nominal voltage is 12V. Hence the adjustment of voltage drawn into the battery need to be adjusted by the MPPT solar controller display. The setting should not be greater than 13V which can cause a damage to the battery's health.

One of an advantage of using MPPT controller is to avoid voltage loss. For a water pumping PV powered usually both panel and water pump must be situated far from the charge controller and battery. To sustain the electricity to the 12V battery system, users can wire a PV module for 24 or 48 V (depending on the charge controller and PV modules). This translates to a smaller cable size requirement while maintaining the PV module's full output. Other than that, MPPT is managed to disconnect voltage supplied to the battery as well to secure the battery health from overcharging or over discharging of the battery. The display of MPPT controller is shown in the figure 4.7 and 4.8 below.

Figure 4.6: Main Display of MPPT Solar Controller

The main display of MPPT solar controller always display and monitor real-time voltage of battery. As can be seen in Figure 4.6 above, real-time voltage being monitored is at 13.0V which battery voltage capacity is still in a good condition. Meanwhile, over charging protection can be seen in Figure 4.7 is set to 14.4V means that the incoming supply is cut off from the solar panel to the solar battery when the battery voltage capacity about to reach 14.4V. The lower the value of over charging disconnect is set, allowing a more secure of the battery health it can be.

Figure 4.7: Over Charging Protection Setting Display

Despite of maintaining the maximum of battery voltage capacity, over discharging protection from the MPPT is important as well to avoid the battery charge is depleted completely from the battery. Hence, a range of nominal voltage need to be observed properly

in order to ensure the long lasting of the battery charging and discharging phase. Figure 4.8 below shows the third display of MPPT Solar Controller of over discharging protection. In this experiment, the disconnect voltage of overcharge is set when the battery reaches 11.0V.

Figure 4.8: Over Discharging Protection Setting Display

Regarding to the MPPT display in Figure 4.6, users can simply access to any parameter's adjustment by clicking either of these 3 buttons, which first button is to change the display, second and third button with the sign of Positive (+) and Negative (-) respectively acts as adjustment button to increase or decrease the set value.

Moving on to next part, which is solar battery storage. As calculated and sizing the capacity of battery in the part 3.3 in methodology, the average of usage during the night is about 3 hours. Thus, an accurate sizing of battery and PV panel need to be pre-determined to maintain both charging and discharging phase of the battery sufficiently. Theoretically, the photovoltaic power from the solar panel is not directly supply to the DC water pump otherwise the charge from the panel is stored into the battery first and then the MPPT solar controller acts as a switching to charge and discharge in a various situation. With these 3 main components in the system which comprises of 50Wp Monocrystalline solar panel,

MPPT solar charge controller and SLA battery as a standby supply just sufficient for this system to be said as a stand-alone system.

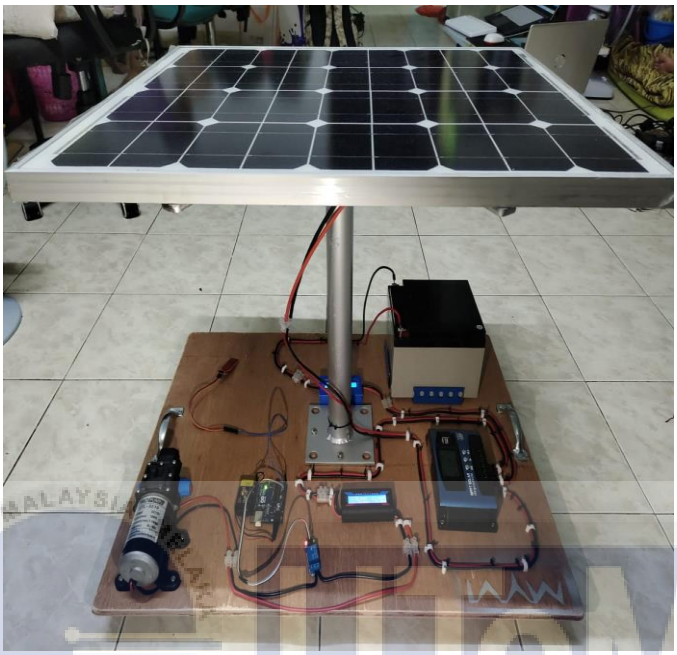


Figure 4.9: Overview of Solar Photovoltaic Powered Water Pumping System

4.4 Variables and Location of Data Collection throughout the Experiment

There are some factors which may affect the solar panel production. In this part, a few of variables is going to be identified that is important to know which variable is the cause (independent variable) and which is the effect (dependent variable). A solar cell's maximum capacity changes over time, and output often deteriorates because of many variables. Hence, variables need to be identified to fix or maximizing the output of the solar panel. There are so many types of variables occurred from the internal of the solar system itself as well from the external and surrounding factors. But in this experiment will only cover some of the external and surrounding factor that affects this solar system

.

Firstly, a constant variable needs to be determined. Constant variable is any of parameters that remain the same throughout or between experiments. For instance, this project has a constant variable on its location. The location plays an important role as different places will have a different latitude and may experience a different climate and weather pattern. These factors mentioned may vary the results of data collection from one place compared to another place. Hence, a selected location should be remained along the process of data collection.

Regarding to the project construction and how is the solution to rapid the phase of collecting the supply from the solar panel, hence an independent variable is being measured. Independent variable is called as the cause. Its value is unaffected by the other study variables. For example, of independent variable in this experiment is the sizing of solar panel power that can be generated, the capacity of battery and type of solar controller were used.

Following is the effect which called as dependent variable. Changes in the independent variable affect this value. To identify each of dependent variables, all the independent variables cause need to be determined. To answer all the dependent variables mentioned above, increasing the sizing of solar panel power can generate a higher supply of electricity. Using a different type of solar panel may affect the efficiency and performance of the cell into the system. Next, upgrading the capacity of battery enable the system storage to store higher electricity for the future usage whenever unavailability of solar energy and lastly using a different type of solar controller may affects the regulation of voltage losses from the solar panel into the battery.

For this project, a location is set at a coordinate of *2.2794545972865055, 102.27994845561892*. This location is selected in the data collection throughout the

November of 2022. Figure 4.9 below shows an exact pinned location and address of the experiment site.

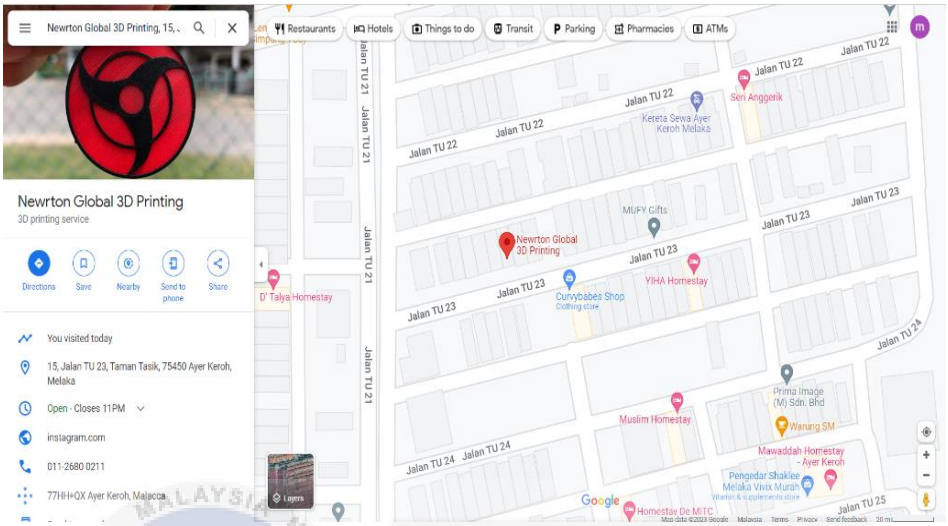


Figure 4.10: View of experiment location via Google Maps

Table 10 Below is the list of variables consisted in this experiment: -

Table 10: Variables in Solar Experiment

Constant variable	**Independent variable**	**Dependent variable**
Tilation of solar panel of 0°.	Shaded region or shadow covered on the solar panel	Reduce the electrical supply
Location of solar data collection	Unpredictable weather like raining	Pausing the charging phase due to unavalability of sunlight

Collecting data from 11am to 6pm	Stain from the surrounding or dirtiness left after rain or on the solar panel	Slowing the rate of charging rate of the battery

4.5 Experimental Setup

The solar photovoltaic water pumping circuit is constructed as mentioned the connection before, to ease the illustration of the circuit connection, Figure 4.5 can assist to show the complete connection.

To ease the monitoring of solar data, a DC watt meter with a data logger system is used to record the voltage and current measurement throughtout the November of 2022. There are 2 DC watt meter were used in this solar connection, which located within the solar controller to battery and also from solar controller to DC water pump. For the first watt meter connected within the solar controller to battery is to record the incoming current and voltage from the panel into the battery. For the second one, is to measure and record the current and voltage consumed by the DC water pump.

The measurement of the day is collected everyday from the charging phase and discharging phase. For the charging phase, the measurement is taken for every 5 minutes intervally from 11am to 6pm in order to obtain a more accurate data collection. In charging phase, 30 days of data in November 2022 is collected altogether in the Appendix B section.

For the discharging phase, the data is taken for every 5 minutes intervally for 3 hours of

DC water pump usage after 7pm to 10pm and the data is collected as well in the Appendix C section for 30 days. Figure 4.10 below shows the repetitive experimental setup in everyday along in November 2022.

Figure 4.11: Collecting the Solar Data for Charging Phase

Figure 4.12: Collecting the data for Discharging Phase

4.6 Battery Voltage monitoring

The battery voltage is being monitored before and after in the charging phase. Meanwhile, in the discharging phase also need to measure the same steps before and after the discharging.

These steps indicate the battery health before and after usage. It shows how much voltage is depleted from the battery towards the load, and most importantly the battery health can be secured to avoid the battery from over-charging or over-discharging condition. Table 11 below shows the battery voltage capacity in each day from (before and after) charging and discharging. Since we set the disconnect voltage in MPPT solar controller is cut off when it reaches 11.0V of discharging process and disconnect voltage when continuously charging until the battery reaches 14.4V. We assume that 11.0V is low in voltage capacity and when it reaches 14.4V then the battery is said to be fully charged.

Table 11: Battery Voltage Capacity

Days	Charging		Discharging		Battery Status Remaining
	Before	After	Before	After	
1	12.00	12.62	12.60	12.17	84.51%
2	12.17	12.88	12.87	12.39	86.04%
3	12.38	12.75	12.75	12.28	85.28%
4	12.28	12.91	12.91	12.44	86.39%
5	12.43	13.28	13.28	12.81	88.96%
6	12.80	13.54	13.54	13.08	90.83%
7	13.07	13.45	13.45	12.98	90.14%
8	12.98	13.24	13.23	12.77	88.68%
9	12.76	13.15	13.15	12.68	88.06%
10	12.68	13.15	13.14	12.68	88.06%
11	12.68	13.42	13.42	12.95	89.93%

12	12.94	13.24	13.24	12.97	90.07%
13	12.94	13.51	13.51	13.04	90.56%
14	13.04	13.74	13.73	13.27	92.15%
15	13.27	13.67	13.66	13.19	91.60%
16	13.19	13.58	13.57	13.11	91.04%
17	13.11	13.43	13.43	12.97	90.07%
18	12.97	13.33	13.32	12.87	89.38%
19	12.87	13.08	13.07	12.61	87.57%
20	12.61	13.13	13.13	12.66	87.92%
21	12.66	13.29	13.29	12.82	89.03%
22	12.81	13.49	13.48	13.02	90.42%
23	13.02	13.73	13.73	13.26	92.08%
24	13.26	13.73	13.73	13.24	91.94%
25	13.25	13.73	13.73	13.26	92.08%
26	13.26	13.95	13.95	13.48	93.61%
27	13.48	14.26	14.25	13.79	95.76%
28	13.79	14.28	14.27	13.81	95.90%
29	13.79	14.15	14.14	13.68	95.00%
30	13.68	14.40	14.40	13.97	97.01%

4.7 Statistical Analysis in Charging Phase

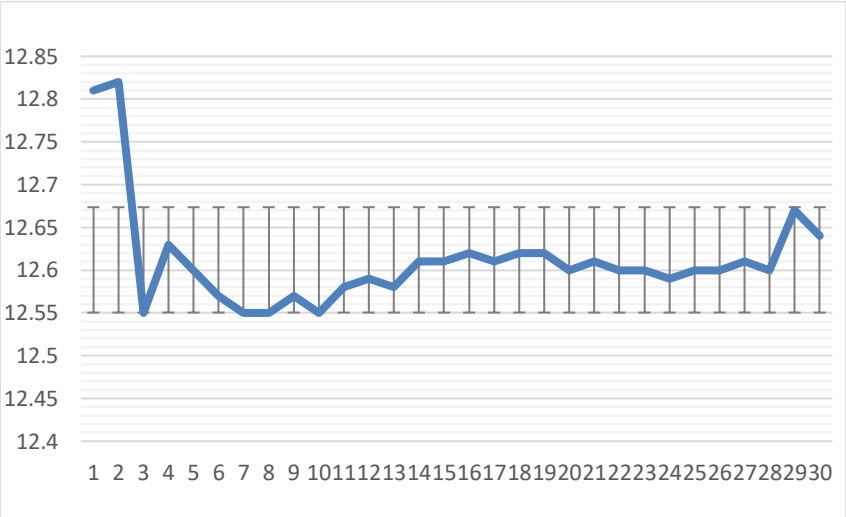


Figure 4.13: Mean Charging Voltage Graph

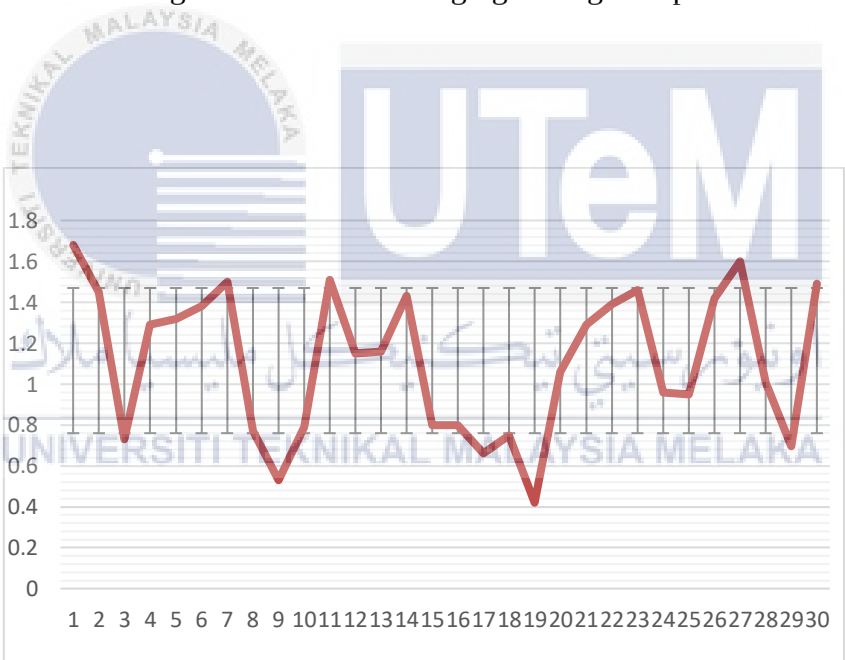


Figure 4.14: Mean Charging Current Graph

Once successfully obtaining daily data along in November 2022, data is then simplified into a simpler form. Thus, a better view of graphical form would be observed in November 2022. To have a simpler trend from the first day, attaining the mean voltage and current value is a key to achieve this trend of graph. From the Figure 4.10 and Figure 4.11, the mean

charging voltage and current can be observed from the day 1 until day 30 of November in 2022. As can be seen the trend in voltage mean graph is dramatically drop from the first day until third day of November. This is because as it comes in early of November the surrounding temperature is getting higher as a result in sudden drop in voltage supply from the solar panel. When the module temperature increases, voltage decreases. In this case, the voltage is being regulated by the MPPT solar controller to maximize the output of voltage from the solar panel as shown in Figure 4.10.

Meanwhile, the trend of mean current obtained is mostly relied on the weather condition. Throughout November, the experiment location experienced a few day of light rain, thunderstorm and heavy rain. This phase mostly influenced the performance of the solar panel. From the mean charging current graph, it can be observed these drop patterns may effected from a certain of weather changes such as mention previously. From the Appendix B: Charging Phase, there is a few days experiencing of heavily cloud, heavily rain and scatter rain. Which all of these slowing down or freezing up the rate of charging process into the battery.

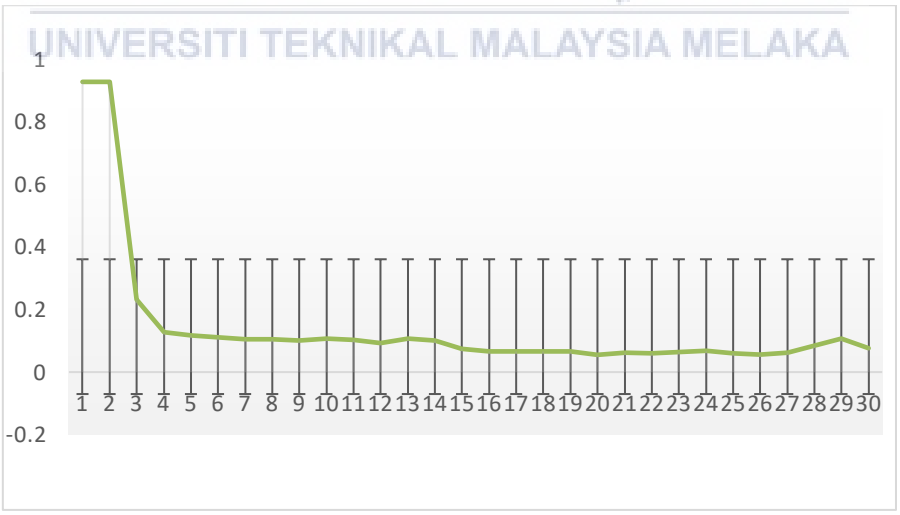


Figure 4.15: Standard Deviation of Charging Voltage

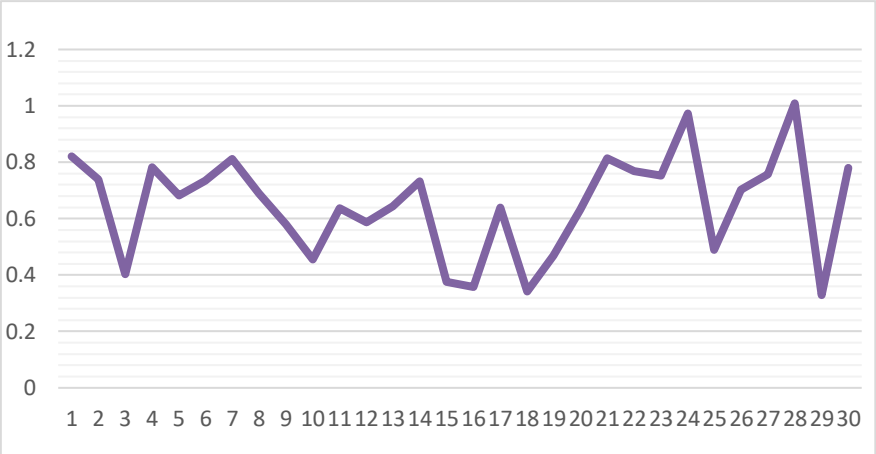


Figure 4.16: Standard Deviation of Charging Current

Obtaining the standard deviation of both voltage and current is a concept to inspect how scattered the data from the mean value. From here, it can be observed if the standard deviation is higher, means a certain graph is experiencing a lot of weather changes or something that affect the performance of solar panel. In this case, the standard deviation is highest in early of November which stated at 1.0 standard deviation of voltage. This means from the first day until fourth days there are many factors affecting the voltage range until it stagnant and stable in the fourth day and onwards.

4.8 Statistical Analysis in Discharging Phase

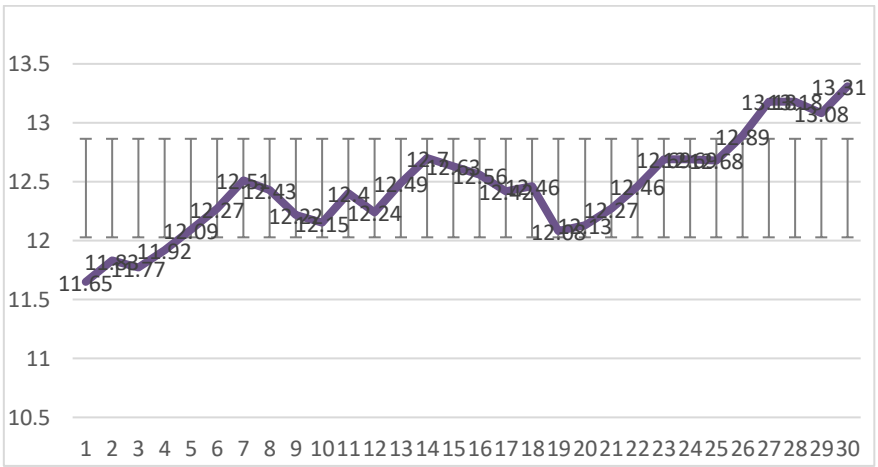


Figure 4.17: Mean Discharge Voltage Graph

In this pattern of graph, the voltage consumed by the DC water pump load is mostly influenced by the capacity of the battery. This graph is mostly related to the battery voltage capacity from the Table 11: Battery Voltage Capacity. As the voltage of battery capacity is higher initially before the comsumption of DC water pump load, the starting voltage of DC water pump also is increased. This is because, the battery's power capacity is the amount of energy it can hold. Watt-hours are frequently used to measure this power (Wh). A Watt-hour is equal to the voltage (V) and current (Amps) that a battery can produce for a specific period of time (generally in hours). Wh = Voltage * Amps * Hours. Hence, the performance of DC load is vary from the higher capacity of battery voltage until lower in capacity of battery voltage. In theoretical, the performance in Wh of DC load is dropping out as the capacity of voltage is decreases as well.

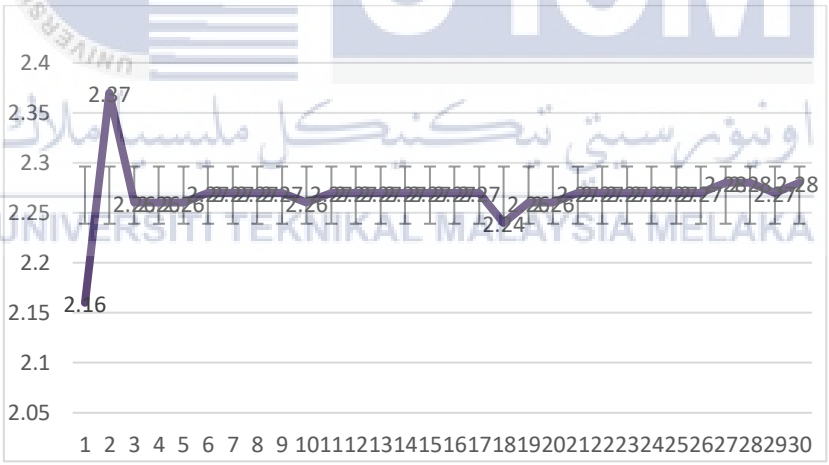


Figure 4.18: Mean Discharged Current Graph

As can be observed the mean discharged current is also vary with the capacity of the battery. But, the graph demonstrated here is suddenly increased in the first phase which from the first day to second day. Actually on the second day, the motor experienced with a blockage of solid particles such as tiny debris. Resulting the DC water pump to draw a

higher current from the battery. The problem is fixed on the third day by removing the stains clogged on the inlet filter of the DC water pump. Last but not least, for both mean discharged voltage and current, there is no influence by the weather and so on, the only factor that impacts the supply drawn into the DC water pump are such as undervoltage, motor has a short circuit, incorrect wiring or faulty electrical connections, viscosity or density of the pumped medium too high, or the pump is worn or blocked. Besides, the power consumed by the DC water pump is said to be constant from day to day without any technical problems.

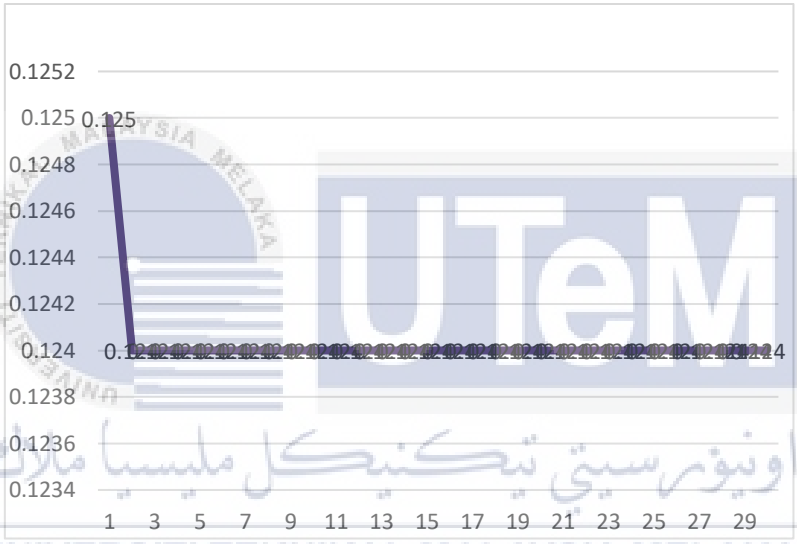


Figure 4.19: Standard Deviation of Discharging Voltage

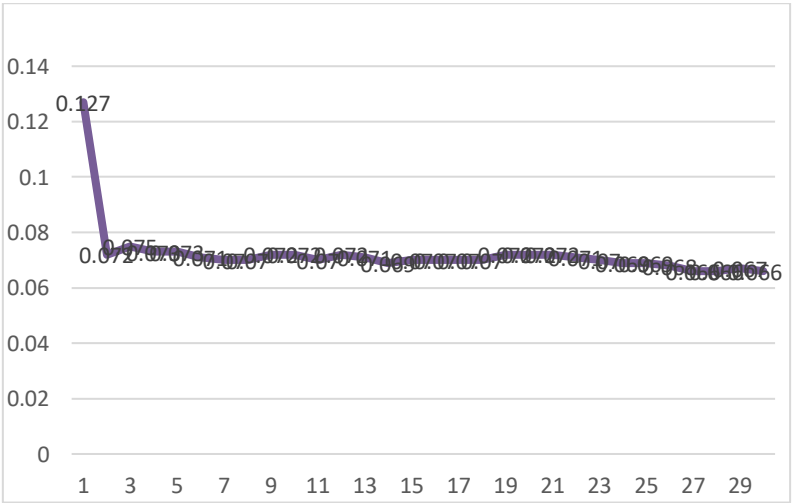


Figure 4.20: Standard Deviation of Discharging Current

As mention in the previous techinal problem experienced by the DC water pump, it also affect the standard deviation of voltage and current as well giving a dropping pattern on the graph pattern. Once the DC water pump is fixed up, the standard deviation for both current and voltage back in a stable range. As refer to the standard deviation of discharging voltage and current. A conclusion can be made from this pattern of graph where the DC water pump load draw a quite similar in term of power usage for the next day and onward as there is no disturbance put on the water pump.

4.9 Statistical Analysis in Power Consumed

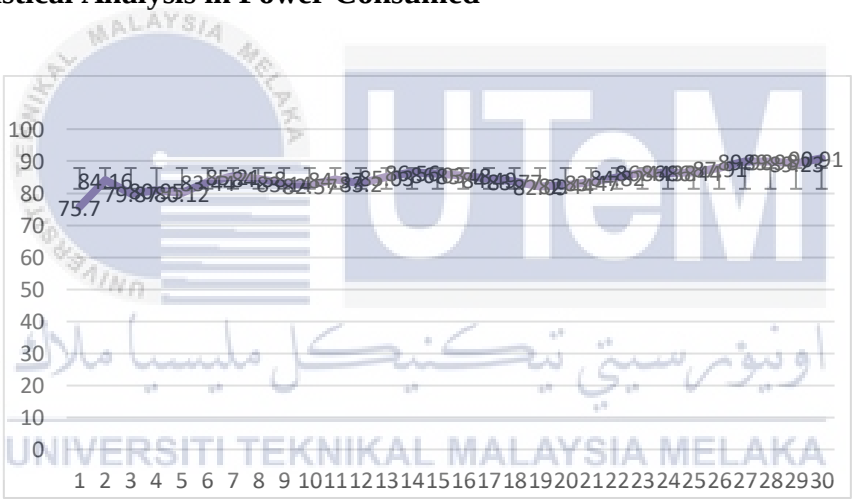


Figure 4.21: Daily Power Consumed by the DC water pump

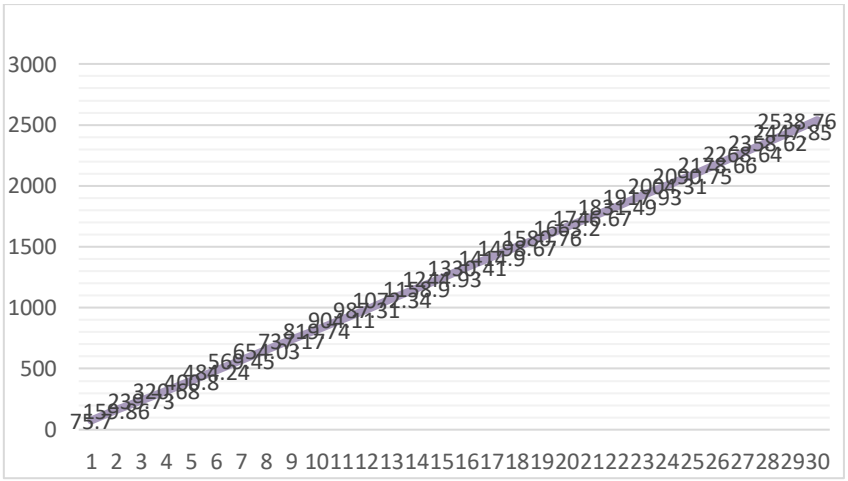


Figure 4.22: Total Power Consumed by the Load in November 2022

An overview of the graph trend is currently obtained when the daily power consumed by the load is sum up the throughout the days in November 2022. The power usage by the DC motor pump quite similar from day 1 compared to another day which estimately consumed 85 Wh/daily. Hence a design of total Wh along in November is now obtained and the highest point of the graph indicated the DC motor pump consumed estimately 2548.76 Wh in a month.

4.10 Return on Investment (ROI)

A performance metric known as return on investment (ROI) is used to assess or profitability. ROI aims to quantify the amount of return on a specific investment in relation to the cost of the investment. In this subtopic, all the list of materials are going to put into an account and summarization based on the statistical analysis would be assumed.

Considering this project still in a development. Thus, previous experiment purposely to estimate on how to size from a smaller concept of parameter to achieve an outcome in order a wider parameter in construction of DC water pumping can be accomplished. From the Figure 4.19, the total DC water pumped is observed from its total power consumed measures about 2548.74Wh for a month. In this subtopic, an assumption is going to be made from a side on how the project could pay back the cost of installation. Let this project parameter still being applied from its term of materials and sizing. Currently, a different situation is adjusted based on the duration of DC motor pump usage. Table 12 below list all the project installation cost.

Table 12: List of Materials

Material	Quantity	Price per quantity (RM)	Cost (RM)
Monocrystalline Solar Panel 50Wp	1	129	129
MPPT Solar Controller	1	49	30
26 Ah SLA 12V Battery	1	98	98
1 Signal 5V Relay	1	5.5	5
Arduino UNO R3	1	30	30
100W DC Motor Pump	1	55	55
Cable and Arduino Wiring	Based on project's sizing	10	10
Total of Investment (RM)			357

In this comparison an AC to DC converter is required to supply the DC water pump motor to compare the power consumed in a different condition. A straightforward presumption is applied from the data obtained in APPENDIX D: Discharging Phase Statistical Analysis Data which 2538.76Wh of power is consumed by the DC water pump. The total power consumed is then divided by 30 days to get an average daily power usage for the following days. An average from the total power which called as Mean, $\bar{X}$ is obtained about 84.63Wh. Noted that, average, $\bar{X}$ from power consumed is for 3 hours of total usage as demonstrated in a previous discussion. From this point, the constant variable of this experiment is being altered as table 13 below.

Table 13: Situation Concept for Future Work Dimension

Condition	Power consumed by DC water pump (W)
For the first 3 hours (From 7pm to 10pm) Based on current experiment	$\bar{X}$ of daily power consumed = 0.08464 kWh
Motor operates for 15 hours daily (From 7pm to10am)	0.42315 kWh per day
Motor operates for 15 hours daily in a month	12.694 kWh per month

From the table above, the power consumption calculation as follows: -

$\bar{X}$ of daily power consumption ≈ 84.63Wh

3 hours daily of motor operation is about 84.63 Wh

If the motor operates 15 hours daily from 7pm to 10am

$\frac{(15\ hours \times 84.63\ Wh)}{(3\ hours)}$ = 423.15 Wh/day

If the motor operates 15 hours daily in a month

423.15 Wh/day × 30 days = 12694.5 Wh = 12.694.5 kWh

As an observation, a total power about 12.69 kWh is required to operate the motor pump.

Now, the power consumed per month is measured using Tariff A – Domestic Tariff from a given rate from TNB.

For a typical household, the average electricity consumption for residential in Malaysia is about 345 kWh per month based on the survey of 348 samples in Malaysia.[36] If the DC motor pump is compared to power it up using AC to DC converter it might be drawn quite larger power consumption than the usual as the power from the grid doesn't drop as the DC supply from the battery. By referring to the TNB Tariff A – Domestic tariff provided from TNB as figure 4.20 below.

Table 14: TNB Tariff A - Domestic Tariff

Tariff Category	**Unit**	**Current Rate**
Tariff A – Domestic Tariff		
First 200 kWh (1-200 kWh) per month	sen/kWh	21.80
Next 100 kWh (201-300 kWh) per month	sen/kWh	33.40
Next 300 kWh (301-600 kWh) per month	sen/kWh	51.60
Next 300 kWh (601-900 kWh) per month	sen/kWh	54.60
Next kWh (901 kWh onwards) per month	sen/kWh	57.10

As mentioned previously, an average electricity consumption for Malaysian residential is about 345 kWh which current will be charged in the third rate of Tariff A. This is because

the power consumption is in a range within 301 kWh to 600 kWh per month. Thus, the calculation of current rate as follow converts the power usage into an electricity charge.

Power consumed per month = 12.69 kWh

Third rate of Tariff A = RM 0.516 per kWh

Hence, monthly electricity charge = 12.69 kWh × $\frac{RM\ 0.516}{kWh}$ = RM 6.55/month

From the total of investment, construction of project cost RM 357. To identify the return of investment period,

Return of investment = $\frac{RM\ 357}{RM\ 6.55\ per\ month} \approx 55$ months

55 months = 4 years and 7 months

In a nutshell, the return of investment will payback approximately in 4 years and 7 months after. The average life spans of those project components certified by the manufacturer is up to 15 years. Hence after 4 years and 7 months onward the system operates the motor and supply the electricity in a free of charge.

Remaining life span of system = 10 years and 5 months = 125 months

125 months × RM 6.55/ month = RM 818.75

By the calculation of the remaining life span of the system above, it would last about 10 years and 5 months ahead. Which profits the system about RM818.75 of electricity fees. In

a conclusion, the return of investment can be harvested after 4 years, 7 months and the system are proved to worth more than the initial capital.

CHAPTER 5

CONCLUSION

5.1 Conclusion

It can be concluded that a specific PV module can be installed in optimizing a limited space available. Hence, an analysis needs to conduct to measure which type of solar can generate the best production of energy output. It may be stated that no single type of PV panel is applicable to all environments. Each area has its unique meteorological parameters such temperature, sun irradiance, and dust density that make a particular PV panel appropriate for that environment.

A selection of solar charge also needs to be concerned into the account. To utilize the battery charging phase in any condition. An MPPT control is essential towards PV production systems and has an ability to generate maximum output power despite changes in the weather conditions. This is because a proper selection of solar charge controller will regulate the current and voltage of the solar panel to charge the battery ideally and regulate the genuine DC supply for the load as well.

Lastly, an appropriate way in determining the battery capacity and type of battery used need to be concerned to ensure the longevity of expected daily usage. When it comes to stand-alone power supply dependable, a sealed lead-acid has come into an advantage as it is zero-maintenance. Due to it is spill-proof battery type, it is best to use in solar energy storage as it will be left over in somewhere and its endurance is proven to resist and expose in any weather and circumstance.

5.2 Future Works

In my future works, my suggestion for photovoltaic powered water pumping system will be applied in a real application for example in an agriculture sector located in a secluded area. For a better system which has a larger capacity of battery storage, an additional installation of battery is required into the system to store the excessive electricity from being wasted. From this humble concept of photovoltaic powered water pumping system, a larger parameter in sizing to the real application can be accomplished using the calculation studied previously. For the microcontroller section, some improvements can be added into the system such as using ESP 8266 Wi-Fi Module. This microcontroller can be connected to Arduino UNO R3 from this experiment that enable it to communicate control the level monitoring system from afar. With this improvement, the level monitoring system can be monitored just using the Blynk 2.0 to store the data. From here, operation of DC motor pump can be managed via online from the software application.

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APPENDICES

APPENDIX A: GANTT CHART OF PROJECT

PROJECT ACTIVITY	WEEK PROGRESS													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PSM 1 BRIEFING														
TITLE REGISTRATION FORM														
MEETING WITH SUPERVISOR														
JOURNAL AND ARTICLES ANALYSIS														
CHAPTER 1														
CHAPTER 2														
CHAPTER 3														
PRESENTATION FYP PROJECT 1														
FINALISED REPORT WITH SV														
REPORT FYP 1 SUBMISSION														

PROJECT ACTIVITY	WEEK PROGRESS													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
HARDWARE AND SOFTWARE DEVELOPMENT														
TESTING AND EXPERIMENT														
CHAPTER 4 (RESULT)														
PRESENTATION														
BDP 2 REPORT														

APPENDIX B: CHARGING PHASE

Solar to Battery charging phase data (01/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.89	0	0.00	**1325**	12.62	1.97	5.14	**1550**	12.59	0.65	8.24
1105	12.24	2.00	0.16	**1330**	12.62	1.87	5.29	**1555**	12.54	0.34	8.29
1110	12.28	2.00	0.33	**1335**	12.64	1.99	5.45	**1600**	12.52	0.29	8.31
1115	12.31	2.08	0.50	**1340**	12.67	2.12	5.60	**1605**	12.52	0.29	8.34
1120	12.33	2.14	0.69	**1345**	12.65	1.99	5.78	**1610**	12.54	0.40	8.37
1125	12.36	2.35	0.86	**1350**	12.65	1.99	5.78	**1615**	12.58	0.53	8.41
1130	12.38	2.29	1.04	**1355**	12.65	1.56	5.94	**1620**	12.57	0.46	8.45
1135	12.41	2.45	1.24	**1400**	12.64	1.70	6.08	**1625**	12.60	0.57	8.49
1140	12.43	2.51	1.45	**1405**	12.64	1.68	6.19	**1630**	12.69	0.97	8.55
1145	12.47	2.54	1.66	**1410**	12.63	1.60	6.26	**1635**	12.67	0.91	8.63
1150	12.48	2.61	1.88	**1415**	12.64	1.58	6.35	**1640**	12.62	0.55	8.72
1155	12.50	2.57	2.10	**1420**	12.58	1.06	6.46	**1645**	12.60	0.48	8.78
1200	12.51	2.60	2.30	**1425**	12.58	1.08	6.56	**1650**	12.55	0.35	8.81
1205	12.52	2.56	2.52	**1430**	12.60	1.17	6.65	**1655**	12.58	0.41	8.84
1210	12.53	2.56	2.73	**1435**	12.64	1.40	6.77	**1700**	12.52	0.19	8.87
1215	12.55	2.49	2.96	**1440**	12.64	1.39	6.88	**1705**	12.50	0.18	8.88
1220	12.56	2.47	3.17	**1445**	12.67	1.47	6.99	**1710**	12.48	0.13	8.89
1225	12.53	2.13	3.33	**1450**	12.69	1.52	7.11	**1715**	12.48	0.15	8.91

1230	12.58	2.42	3.53	**1455**	12.64	1.19	7.24	**1720**	12.53	0.29	8.92
1235	12.58	2.39	3.74	**1500**	12.64	1.26	7.33	**1725**	12.50	0.13	8.94
1240	12.55	2.04	3.93	**1505**	12.64	1.04	7.43	**1730**	12.50	0.17	8.95
1245	12.48	1.36	4.07	**1510**	12.66	1.22	7.53	**1735**	12.52	0.19	8.97
1250	12.50	1.58	4.19	**1515**	12.67	1.20	7.63	**1740**	12.49	0.13	8.98
1255	12.48	1.30	4.31	**1520**	12.69	1.32	7.72	**1745**	12.50	0.14	8.99
1300	12.52	1.55	4.44	**1525**	12.71	1.47	7.84	**1750`**	12.48	0.12	9.01
1305	12.58	2.00	4.60	**1530**	12.61	0.64	7.93	**1755**	12.48	0.10	9.01
1310	12.57	1.75	4.75	**1535**	12.72	1.37	8.02	**1800**	12.48	0.11	9.02
1315	12.55	1.58	4.88	**1540**	12.60	0.59	8.13	-	∑V	∑A	-
1320	12.52	1.21	5.01	**1545**	12.60	0.72	8.20	-	12.8071	142.56A	-

Solar to Battery charging phase data (02/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.98	0	0.00	**1325**	12.81	2.20	5.26	**1550**	12.86	1.37	8.70
1105	12.30	1.51	0.15	**1330**	12.87	2.59	5.42	**1555**	12.85	1.29	8.81
1110	12.41	1.91	0.29	**1335**	12.91	2.69	5.65	**1600**	12.83	1.10	8.92
1115	12.43	1.96	0.46	**1340**	12.86	2.24	5.85	**1605**	12.82	1.06	8.99
1120	12.46	2.07	0.62	**1345**	12.67	1.09	5.98	**1610**	12.82	1.05	9.08
1125	12.47	2.09	0.80	**1350**	12.82	2.00	6.09	**1615**	12.82	1.01	9.16
1130	12.47	2.01	0.97	**1355**	12.57	1.51	6.21	**1620**	12.84	1.09	9.26
1135	12.50	2.14	1.11	**1400**	12.69	1.10	6.32	**1625**	12.84	1.07	9.34
1140	12.48	1.82	1.27	**1405**	12.67	0.95	6.42	**1630**	12.87	1.20	9.44
1145	12.53	2.24	1.46	**1410**	12.69	0.99	6.50	**1635**	12.86	1.06	9.54
1150	12.50	2.07	1.60	**1415**	12.72	1.11	6.60	**1640**	12.85	1.23	9.63
1155	12.57	2.33	1.73	**1420**	12.77	1.39	6.70	**1645**	12.86	1.01	9.73
1200	12.60	2.47	1.95	**1425**	12.74	1.21	6.80	**1650**	12.77	0.66	9.79
1205	12.57	2.00	2.13	**1430**	12.79	1.48	6.91	**1655**	12.76	0.56	9.84
1210	12.64	2.38	2.31	**1435**	12.75	1.27	7.04	**1700**	12.72	0.42	9.88
1215	12.65	2.35	2.50	**1440**	12.86	1.85	7.18	**1705**	12.74	0.50	9.92
1220	12.67	2.36	2.70	**1445**	12.75	1.17	7.32	**1710**	12.74	0.40	9.96
1225	12.69	2.45	2.90	**1450**	12.75	1.16	7.41	**1715**	12.69	0.27	9.99
1230	12.72	2.33	3.12	**1455**	12.67	0.71	7.49	**1720**	12.71	0.33	10.02
1235	12.70	2.33	3.30	**1500**	12.67	0.65	7.55	**1725**	12.70	0.30	10.04
1240	12.74	2.51	3.51	**1505**	12.77	1.20	7.62	**1730**	12.70	0.31	10.06
1245	12.75	2.50	3.71	**1510**	12.82	1.53	7.73	**1735**	12.72	0.35	10.09
1250	12.75	2.39	3.94	**1515**	12.79	1.20	7.84	**1740**	12.70	0.31	10.12
1255	12.74	2.13	4.12	**1520**	12.74	0.90	7.95	**1745**	12.71	0.32	10.15
1300	12.79	2.50	4.30	**1525**	12.87	1.74	8.06	**1750`**	12.72	0.32	10.17
1305	12.81	2.51	4.53	**1530**	12.86	1.55	8.20	**1755**	12.70	0.29	10.20
1310	12.78	2.26	4.71	**1535**	12.89	1.75	8.34	**1800**	12.70	0.26	10.22
1315	12.75	2.03	4.90	**1540**	12.84	1.38	8.47	-	∑V	∑A	-
1320	12.82	2.42	5.05	**1545**	12.84	1.32	8.59	-	1089.88	123.14	-

Solar to Battery charging phase data (03/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.19	0.40	0.00	**1325**	12.57	1.43	1.54	**1550**	12.57	0.54	3.68
1105	12.21	0.30	0.03	**1330**	12.55	1.26	1.65	**1555**	12.59	0.63	3.72
1110	12.23	0.38	0.06	**1335**	12.58	1.33	1.76	**1600**	12.72	1.29	3.78
1115	12.30	0.51	0.09	**1340**	12.58	1.29	1.87	**1605**	12.70	1.08	3.88
1120	12.30	0.47	0.14	**1345**	12.60	1.42	2.00	**1610**	12.73	1.20	3.99
1125	12.28	0.38	0.17	**1350**	12.74	2.26	2.15	**1615**	12.82	1.77	4.13
1130	12.33	0.43	0.20	**1355**	12.55	0.89	2.28	**1620**	12.82	1.76	4.23
1135	12.13	0.47	0.24	**1400**	12.52	0.72	2.34	**1625**	12.67	0.74	4.39
1140	14.19	0.00	0.29	**1405**	12.53	0.86	2.40	**1630**	12.64	0.60	4.43
1145	12.36	0.62	0.34	**1410**	12.50	0.59	2.47	**1635**	12.64	0.57	4.51
1150	12.35	0.47	0.39	**1415**	12.55	0.85	2.53	**1640**	12.65	0.73	4.54
1155	12.36	0.56	0.43	**1420**	12.58	1.03	2.61	**1645**	12.79	1.42	4.66
1200	12.36	0.56	0.48	**1425**	12.57	0.89	2.68	**1650**	12.74	1.02	4.76
1205	12.36	0.51	0.52	**1430**	12.58	0.89	2.77	**1655**	12.79	1.29	4.87
1210	12.36	0.49	0.56	**1435**	12.58	0.97	2.84	**1700**	12.68	0.68	4.92
1215	12.33	0.39	0.60	**1440**	12.59	0.93	2.91	**1705**	12.60	0.33	4.96
1220	12.31	0.34	0.63	**1445**	12.64	1.14	3.01	**1710**	12.64	0.44	5.00
1225	12.36	0.59	0.67	**1450**	12.64	1.01	3.11	**1715**	12.67	0.49	5.05
1230	12.35	0.43	0.71	**1455**	12.55	0.63	3.18	**1720**	12.60	0.34	5.08
1235	12.40	0.61	0.75	**1500**	12.50	0.37	3.22	**1725**	12.60	0.30	5.11
1240	12.43	0.74	0.82	**1505**	12.48	0.34	3.25	**1730**	12.58	0.26	5.13
1245	12.41	0.73	0.87	**1510**	12.53	0.46	3.30	**1735**	12.57	0.21	5.15
1250	12.47	0.93	0.95	**1515**	12.56	0.65	3.34	**1740**	12.57	0.21	5.17
1255	12.48	1.03	1.03	**1520**	12.57	0.65	3.38	**1745**	12.60	0.24	5.19
1300	12.47	0.96	1.14	**1525**	12.57	0.56	3.43	**1750`**	12.64	0.33	5.21
1305	12.50	1.20	1.23	**1530**	12.57	0.59	3.49	**1755**	12.58	0.27	5.23
1310	12.47	0.86	1.29	**1535**	12.57	0.57	3.53	**1800**	12.58	0.23	5.26
1315	12.45	0.76	1.36	**1540**	12.57	0.57	3.58	-	∑V	∑A	-
1320	12.48	0.93	1.42	**1545**	12.57	0.57	3.63	-	1066.49	61.74	-

Solar to Battery charging phase data (04/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.53	0	0.00	**1325**	12.67	1.80	5.02	**1550**	12.72	1.23	8.15
1105	12.50	1.50	0.13	**1330**	12.82	1.78	5.16	**1555**	12.70	1.02	8.23
1110	12.57	1.55	0.25	**1335**	12.57	2.13	5.34	**1600**	12.73	1.05	8.32
1115	12.60	1.57	0.39	**1340**	12.69	2.50	5.55	**1605**	12.82	0.87	8.39
1120	12.57	1.65	0.52	**1345**	12.67	2.60	5.77	**1610**	12.82	0.67	8.45
1125	12.64	1.83	0.68	**1350**	12.69	2.46	5.97	**1615**	12.67	0.50	8.49
1130	12.65	1.92	0.84	**1355**	12.72	2.10	6.15	**1620**	12.64	0.34	8.52
1135	12.67	1.80	0.99	**1400**	12.77	1.98	6.31	**1625**	12.64	0.29	8.54
1140	12.69	1.98	1.15	**1405**	12.74	1.20	6.41	**1630**	12.72	0.34	8.57
1145	12.72	2.04	1.32	**1410**	12.79	1.10	6.50	**1635**	12.70	0.54	8.61
1150	12.70	2.20	1.50	**1415**	12.75	0.89	6.58	**1640**	12.73	0.65	8.67
1155	12.74	2.23	1.69	**1420**	12.86	0.80	6.64	**1645**	12.82	0.50	8.71
1200	12.75	2.33	1.88	**1425**	12.75	0.76	6.71	**1650**	12.82	0.70	8.77
1205	12.75	2.54	2.10	**1430**	12.75	1.15	6.80	**1655**	12.67	0.64	8.82
1210	12.74	2.35	2.29	**1435**	12.58	1.25	6.91	**1700**	12.64	0.53	8.87
1215	12.33	2.02	2.46	**1440**	12.57	1.40	7.02	**1705**	12.64	0.46	8.90
1220	12.31	1.90	2.62	**1445**	12.58	1.30	7.13	**1710**	12.65	0.40	8.94
1225	12.36	1.89	2.78	**1450**	12.58	1.35	7.25	**1715**	12.79	0.37	8.97
1230	12.35	2.00	2.94	**1455**	12.59	1.40	7.36	**1720**	12.64	0.35	9.00
1235	12.40	2.18	3.12	**1500**	12.64	1.23	7.46	**1725**	12.64	0.24	9.02
1240	12.43	2.20	3.31	**1505**	12.64	1.02	7.55	**1730**	12.72	0.32	9.04
1245	12.41	2.34	3.50	**1510**	12.55	0.78	7.61	**1735**	12.70	0.33	9.07
1250	12.47	2.44	3.71	**1515**	12.50	0.50	7.66	**1740**	12.73	0.21	9.09
1255	12.48	2.60	3.92	**1520**	12.48	0.45	7.69	**1745**	12.82	0.19	9.11
1300	12.47	2.40	4.12	**1525**	12.53	0.60	7.74	**1750`**	12.82	0.15	9.12
1305	12.50	2.57	4.34	**1530**	12.56	0.76	7.81	**1755**	12.67	0.13	9.13
1310	12.47	2.44	4.54	**1535**	12.57	0.89	7.88	**1800**	12.57	0.12	9.14
1315	12.47	2.02	4.71	**1540**	12.57	0.93	7.96	-	∑V	∑A	-
1320	12.50	1.90	4.87	**1545**	12.57	1.02	8.04	-	1073.75	109.66	-

Solar to Battery charging phase data (05/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.72	0	0.00	**1325**	12.77	2.12	4.88	**1550**	12.64	0.86	7.92
1105	12.70	2.11	0.18	**1330**	12.74	1.98	5.05	**1555**	12.72	0.97	7.99
1110	12.74	2.03	0.35	**1335**	12.79	2.14	5.23	**1600**	12.70	1.02	8.07
1115	12.75	2.12	0.52	**1340**	12.75	1.89	5.38	**1605**	12.73	1.04	8.15
1120	12.75	2.22	0.71	**1345**	12.86	1.77	5.53	**1610**	12.82	1.12	8.24
1125	12.74	2.32	0.90	**1350**	12.75	1.75	5.68	**1615**	12.82	1.26	8.33
1130	12.33	2.14	1.08	**1355**	12.75	1.60	5.81	**1620**	12.67	1.28	8.44
1135	12.31	2.20	1.26	**1400**	12.58	1.70	5.95	**1625**	12.64	1.07	8.55
1140	12.36	2.36	1.46	**1405**	12.57	1.56	6.08	**1630**	12.64	0.97	8.63
1145	12.35	2.25	1.65	**1410**	12.58	1.66	6.22	**1635**	12.65	0.94	8.72
1150	12.40	2.31	1.84	**1415**	12.58	1.50	6.35	**1640**	12.79	0.83	8.79
1155	12.43	2.02	2.01	**1420**	12.59	1.55	6.48	**1645**	12.64	0.76	8.86
1200	12.41	2.10	2.18	**1425**	12.64	1.37	6.59	**1650**	12.64	0.79	8.93
1205	12.47	1.98	2.35	**1430**	12.64	1.29	6.70	**1655**	12.64	0.69	8.99
1210	12.53	1.80	2.50	**1435**	12.55	1.20	6.80	**1700**	12.55	0.61	9.05
1215	12.50	1.78	2.65	**1440**	12.59	1.43	6.92	**1705**	12.50	0.54	9.10
1220	12.57	1.98	2.81	**1445**	12.64	1.54	7.04	**1710**	12.48	0.45	9.15
1225	12.60	2.01	2.98	**1450**	12.64	1.57	7.18	**1715**	12.53	0.34	9.18
1230	12.57	2.20	3.16	**1455**	12.55	1.44	7.30	**1720**	12.56	0.36	9.21
1235	12.64	1.70	3.30	**1500**	12.50	1.20	7.40	**1725**	12.57	0.25	9.24
1240	12.65	1.80	3.45	**1505**	12.48	0.98	7.48	**1730**	12.57	0.27	9.26
1245	12.67	1.76	3.60	**1510**	12.53	0.87	7.55	**1735**	12.57	0.21	9.28
1250	12.69	1.69	3.74	**1515**	12.56	0.80	7.62	**1740**	12.57	0.19	9.30
1255	12.72	1.57	3.87	**1520**	12.57	0.56	7.66	**1745**	12.58	0.16	9.32
1300	12.70	1.67	4.01	**1525**	12.57	0.48	7.70	**1750`**	12.58	0.17	9.33
1305	12.43	1.80	4.16	**1530**	12.57	0.50	7.74	**1755**	12.59	0.16	9.35
1310	12.41	2.04	4.33	**1535**	12.50	0.64	7.80	**1800**	12.64	0.13	9.36
1315	12.47	2.30	4.52	**1540**	12.48	0.69	7.86	-	∑V	∑A	-
1320	12.53	2.22	4.71	**1545**	12.53	0.73	7.92	-	1071.02	112.43	-

Solar to Battery charging phase data (06/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.41	0	0.00	**1325**	12.65	2.20	5.35	**1550**	12.75	1.02	8.27
1105	12.43	2.45	0.20	**1330**	12.67	2.31	5.54	**1555**	12.86	0.95	8.35
1110	12.46	2.56	0.42	**1335**	12.69	2.29	5.73	**1600**	12.75	0.89	8.42
1115	12.47	2.60	0.63	**1340**	12.72	2.13	5.91	**1605**	12.75	0.98	8.50
1120	12.47	2.56	0.85	**1345**	12.43	2.07	6.08	**1610**	12.58	1.07	8.59
1125	12.50	2.54	1.06	**1350**	12.41	1.93	6.24	**1615**	12.57	0.96	8.67
1130	12.48	2.48	1.27	**1355**	12.47	1.65	6.38	**1620**	12.58	0.83	8.74
1135	12.53	2.37	1.46	**1400**	12.53	1.56	6.51	**1625**	12.58	0.76	8.80
1140	12.50	2.45	1.67	**1405**	12.50	1.45	6.63	**1630**	12.59	0.77	8.87
1145	12.57	2.55	1.88	**1410**	12.57	1.43	6.75	**1635**	12.64	0.94	8.95
1150	12.60	2.38	2.08	**1415**	12.60	1.38	6.86	**1640**	12.74	0.91	9.02
1155	12.57	2.23	2.26	**1420**	12.57	1.23	6.97	**1645**	12.75	0.76	9.09
1200	12.64	2.18	2.45	**1425**	12.58	1.03	7.05	**1650**	12.75	0.84	9.16
1205	12.65	2.09	2.62	**1430**	12.59	0.98	7.13	**1655**	12.74	0.89	9.23
1210	12.67	2.14	2.80	**1435**	12.64	0.86	7.21	**1700**	12.33	0.74	9.29
1215	12.69	2.14	2.98	**1440**	12.64	0.75	7.27	**1705**	12.31	0.65	9.35
1220	12.72	1.98	3.14	**1445**	12.55	0.73	7.33	**1710**	12.36	0.78	9.41
1225	12.43	1.95	3.30	**1450**	12.59	0.89	7.40	**1715**	12.35	0.56	9.46
1230	12.41	1.89	3.46	**1455**	12.64	1.02	7.49	**1720**	12.40	0.64	9.51
1235	12.47	1.87	3.62	**1500**	12.64	1.12	7.58	**1725**	12.43	0.57	9.56
1240	12.53	1.95	3.78	**1505**	12.55	0.98	7.66	**1730**	12.41	0.48	9.60
1245	12.50	1.97	3.94	**1510**	12.50	0.96	7.74	**1735**	12.47	0.47	9.64
1250	12.57	1.94	4.11	**1515**	12.48	0.89	7.82	**1740**	12.53	0.34	9.67
1255	12.60	2.01	4.27	**1520**	12.53	0.60	7.87	**1745**	12.57	0.32	9.69
1300	12.57	2.09	4.45	**1525**	12.56	0.78	7.93	**1750`**	12.50	0.28	9.72
1305	12.64	2.11	4.62	**1530**	12.58	0.57	7.98	**1755**	12.48	0.30	9.74
1310	12.65	2.17	4.80	**1535**	12.58	0.65	8.03	**1800**	12.53	0.27	9.76
1315	12.67	2.18	4.99	**1540**	12.59	0.79	8.10	-	∑V	∑A	-
1320	12.69	2.14	5.16	**1545**	12.64	0.98	8.18	-	1068.08	117.15	-

Solar to Battery charging phase data (07/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.64	0	0.00	**1325**	12.64	2.51	5.58	**1550**	12.55	1.44	9.15
1105	12.74	2.53	0.21	**1330**	12.65	2.54	5.79	**1555**	12.59	1.32	9.26
1110	12.75	2.45	0.42	**1335**	12.67	2.59	6.01	**1600**	12.64	1.27	9.37
1115	12.75	2.57	0.63	**1340**	12.69	2.30	6.20	**1605**	12.64	1.14	9.46
1120	12.74	2.48	0.84	**1345**	12.72	2.27	6.39	**1610**	12.55	1.19	9.56
1125	12.33	2.61	1.05	**1350**	12.43	2.34	6.59	**1615**	12.50	1.07	9.65
1130	12.31	2.54	1.27	**1355**	12.41	2.21	6.77	**1620**	12.48	0.98	9.73
1135	12.36	1.96	1.43	**1400**	12.47	2.01	6.94	**1625**	12.53	0.95	9.81
1140	12.35	1.87	1.58	**1405**	12.53	2.34	7.13	**1630**	12.56	0.83	9.88
1145	12.40	2.20	1.77	**1410**	12.50	2.03	7.30	**1635**	12.57	0.73	9.94
1150	12.43	2.34	1.96	**1415**	12.57	1.63	7.44	**1640**	12.57	0.95	10.02
1155	12.58	2.45	2.17	**1420**	12.60	1.74	7.58	**1645**	12.57	1.00	10.10
1200	12.59	2.60	2.38	**1425**	12.65	1.76	7.73	**1650**	12.50	0.86	10.18
1205	12.64	2.57	2.60	**1430**	12.67	1.30	7.84	**1655**	12.48	0.65	10.23
1210	12.64	2.45	2.80	**1435**	12.69	1.23	7.94	**1700**	12.41	0.54	10.28
1215	12.55	2.47	3.01	**1440**	12.72	1.56	8.07	**1705**	12.43	0.57	10.32
1220	12.59	2.32	3.20	**1445**	12.43	1.67	8.21	**1710**	12.46	0.45	10.36
1225	12.64	2.04	3.37	**1450**	12.41	1.27	8.32	**1715**	12.47	0.60	10.41
1230	12.64	1.96	3.53	**1455**	12.47	1.04	8.40	**1720**	12.47	0.49	10.45
1235	12.55	1.89	3.69	**1500**	12.53	0.98	8.48	**1725**	12.50	0.50	10.49
1240	12.50	1.94	3.85	**1505**	12.50	0.67	8.54	**1730**	12.48	0.48	10.53
1245	12.48	1.98	4.02	**1510**	12.57	0.45	8.58	**1735**	12.53	0.34	10.56
1250	12.53	2.03	4.19	**1515**	12.60	0.48	8.62	**1740**	12.50	0.32	10.59
1255	12.56	2.06	4.36	**1520**	12.57	0.67	8.67	**1745**	12.57	0.25	10.61
1300	12.58	2.30	4.55	**1525**	12.58	0.76	8.74	**1750`**	12.60	0.21	10.63
1305	12.58	2.37	4.75	**1530**	12.59	0.67	8.79	**1755**	12.48	0.17	10.64
1310	12.59	2.47	4.95	**1535**	12.64	0.56	8.84	**1800**	12.53	0.13	10.65
1315	12.64	2.49	5.16	**1540**	12.33	0.98	8.92	-	∑V	∑A	-
1320	12.69	2.54	5.37	**1545**	12.31	1.34	9.03	-	1066.49	61.74	-

Solar to Battery charging phase data (08/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.72	0.00	0.00	**1325**	12.41	1.99	2.03	**1550**	12.67	0.91	4.84
1105	12.43	0.02	0.00	**1330**	12.47	1.76	2.18	**1555**	12.69	0.79	4.90
1110	12.41	0.04	0.01	**1335**	12.53	1.56	2.31	**1600**	12.72	0.38	4.93
1115	12.47	0.02	0.01	**1340**	12.50	1.78	2.46	**1605**	12.43	0.23	4.95
1120	12.53	0.01	0.01	**1345**	12.57	2.01	2.63	**1610**	12.41	0.48	4.99
1125	12.50	0.00	0.01	**1350**	12.60	2.32	2.82	**1615**	12.47	0.37	5.02
1130	12.57	0.00	0.01	**1355**	12.65	2.11	2.99	**1620**	12.53	0.53	5.07
1135	12.60	0.00	0.01	**1400**	12.67	1.98	3.16	**1625**	12.50	0.47	5.11
1140	12.57	0.00	0.01	**1405**	12.69	1.89	3.32	**1630**	12.57	0.31	5.13
1145	12.58	0.00	0.01	**1410**	12.72	1.03	3.40	**1635**	12.60	0.21	5.15
1150	12.59	0.00	0.01	**1415**	12.43	0.89	3.48	**1640**	12.57	0.29	5.17
1155	12.64	0.00	0.01	**1420**	12.41	0.32	3.50	**1645**	12.64	0.39	5.21
1200	12.33	0.01	0.01	**1425**	12.47	0.49	3.54	**1650**	12.65	0.31	5.23
1205	12.31	0.34	0.04	**1430**	12.53	0.65	3.60	**1655**	12.67	0.42	5.27
1210	12.64	0.55	0.08	**1435**	12.50	1.00	3.68	**1700**	12.65	0.31	5.29
1215	12.65	0.65	0.14	**1440**	12.57	1.03	3.77	**1705**	12.67	0.22	5.31
1220	12.67	0.89	0.21	**1445**	12.60	1.21	3.87	**1710**	12.69	0.25	5.33
1225	12.69	1.03	0.30	**1450**	12.57	1.23	3.97	**1715**	12.72	0.19	5.35
1230	12.72	1.19	0.40	**1455**	12.58	0.96	4.05	**1720**	12.43	0.21	5.37
1235	12.43	1.08	0.49	**1500**	12.36	1.06	4.14	**1725**	12.41	0.15	5.38
1240	12.41	0.98	0.57	**1505**	12.35	0.93	4.22	**1730**	12.47	0.17	5.39
1245	12.47	1.39	0.68	**1510**	12.40	0.69	4.27	**1735**	12.53	0.16	5.41
1250	12.56	1.58	0.82	**1515**	12.43	0.68	4.33	**1740**	12.50	0.14	5.42
1255	12.58	1.84	0.97	**1520**	12.58	0.79	4.40	**1745**	12.57	0.29	5.44
1300	12.58	2.01	1.14	**1525**	12.59	0.62	4.45	**1750`**	12.50	0.14	5.45
1305	12.59	2.23	1.32	**1530**	12.64	0.89	4.52	**1755**	12.57	0.09	5.46
1310	12.64	2.32	1.52	**1535**	12.53	0.99	4.61	**1800**	12.60	0.07	5.47
1315	12.69	2.21	1.70	**1540**	12.50	0.98	4.69	-	∑V	∑A	-
1320	12.72	2.01	1.87	**1545**	12.57	0.87	4.76	-	1067.14	65.59	-

Solar to Battery charging phase data (09/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	1.98	0.17	**1325**	12.47	0.00	2.19	**1550**	12.50	0.82	2.87
1105	12.69	1.54	0.29	**1330**	12.53	0.00	2.19	**1555**	12.57	0.50	2.91
1110	12.72	1.67	0.43	**1335**	12.50	0.00	2.19	**1600**	12.60	0.41	2.95
1115	12.43	1.50	0.56	**1340**	12.57	0.00	2.19	**1605**	12.57	0.30	2.97
1120	12.41	1.89	0.72	**1345**	12.60	0.00	2.19	**1610**	12.58	0.56	3.02
1125	12.47	1.87	0.87	**1350**	12.57	0.00	2.19	**1615**	12.59	0.69	3.08
1130	12.53	1.98	1.04	**1355**	12.64	0.00	2.19	**1620**	12.64	0.74	3.14
1135	12.50	1.54	1.16	**1400**	12.65	0.00	2.19	**1625**	12.33	0.58	3.19
1140	12.57	1.67	1.30	**1405**	12.67	0.00	2.19	**1630**	12.57	0.71	3.25
1145	12.60	1.63	1.44	**1410**	12.65	0.00	2.19	**1635**	12.64	0.81	3.31
1150	12.57	1.74	1.58	**1415**	12.67	0.00	2.19	**1640**	12.65	0.42	3.35
1155	12.58	1.76	1.73	**1420**	12.57	0.02	2.19	**1645**	12.67	0.63	3.40
1200	12.58	1.30	1.84	**1425**	12.60	0.09	2.20	**1650**	12.65	0.76	3.46
1205	12.36	1.23	1.94	**1430**	12.65	0.10	2.21	**1655**	12.67	0.32	3.49
1210	12.35	1.01	2.03	**1435**	12.67	0.23	2.23	**1700**	12.69	0.37	3.52
1215	12.40	0.98	2.11	**1440**	12.69	0.33	2.26	**1705**	12.72	0.35	3.55
1220	12.43	0.54	2.15	**1445**	12.72	0.21	2.27	**1710**	12.43	0.41	3.59
1225	12.58	0.32	2.18	**1450**	12.43	0.10	2.28	**1715**	12.36	0.23	3.60
1230	12.59	0.12	2.19	**1455**	12.41	0.45	2.32	**1720**	12.35	0.14	3.62
1235	12.64	0.03	2.19	**1500**	12.47	0.61	2.37	**1725**	12.40	0.23	3.64
1240	12.53	0.01	2.19	**1505**	12.67	0.34	2.40	**1730**	12.43	0.33	3.66
1245	12.50	0.00	2.19	**1510**	12.65	0.20	2.42	**1735**	12.58	0.10	3.67
1250	12.57	0.00	2.19	**1515**	12.67	0.34	2.44	**1740**	12.59	0.19	3.69
1255	12.59	0.00	2.19	**1520**	12.69	0.56	2.49	**1745**	12.64	0.12	3.70
1300	12.64	0.00	2.19	**1525**	12.72	0.55	2.54	**1750`**	12.67	0.10	3.71
1305	12.53	0.00	2.19	**1530**	12.43	0.76	2.60	**1755**	12.65	0.11	3.71
1310	12.50	0.00	2.19	**1535**	12.59	0.81	2.67	**1800**	12.67	0.14	3.73
1315	12.57	0.00	2.19	**1540**	12.64	0.89	2.74	-	∑V	∑A	-
1320	12.60	0.00	2.19	**1545**	12.53	0.74	2.80	-	1068.43	44.71	-

Solar to Battery charging phase data (10/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	0.03	0.00	**1325**	12.60	1.45	2.58	**1550**	12.43	0.83	4.97
1105	12.58	1.56	0.13	**1330**	12.57	1.45	2.71	**1555**	12.58	0.54	5.01
1110	12.58	1.58	0.26	**1335**	12.64	1.67	2.84	**1600**	12.59	0.38	5.04
1115	12.36	1.39	0.38	**1340**	12.65	1.24	2.95	**1605**	12.64	0.23	5.06
1120	12.35	1.32	0.49	**1345**	12.67	1.02	3.03	**1610**	12.64	0.43	5.10
1125	12.40	1.39	0.61	**1350**	12.69	1.04	3.12	**1615**	12.55	0.31	5.13
1130	12.43	1.14	0.70	**1355**	12.72	1.23	3.22	**1620**	12.59	0.48	5.17
1135	12.58	1.35	0.81	**1400**	12.43	1.45	3.34	**1625**	12.64	0.39	5.20
1140	12.59	0.87	0.89	**1405**	12.41	1.23	3.45	**1630**	12.64	0.31	5.22
1145	12.64	0.98	0.97	**1410**	12.47	0.98	3.53	**1635**	12.55	0.27	5.25
1150	12.53	0.87	1.04	**1415**	12.53	0.89	3.60	**1640**	12.50	0.29	5.27
1155	12.50	0.94	1.12	**1420**	12.50	0.51	3.64	**1645**	12.48	0.33	5.30
1200	12.69	0.91	1.19	**1425**	12.57	0.49	3.68	**1650**	12.53	0.41	5.33
1205	12.72	0.69	1.25	**1430**	12.60	0.65	3.74	**1655**	12.57	0.32	5.36
1210	12.43	0.43	1.29	**1435**	12.57	1.00	3.82	**1700**	12.60	0.31	5.38
1215	12.41	0.56	1.33	**1440**	12.57	1.03	3.91	**1705**	12.57	0.32	5.41
1220	12.47	0.56	1.38	**1445**	12.58	1.21	4.01	**1710**	12.64	0.27	5.43
1225	12.53	0.37	1.41	**1450**	12.59	1.23	4.11	**1715**	12.65	0.21	5.45
1230	12.50	0.78	1.48	**1455**	12.64	0.96	4.19	**1720**	12.67	0.19	5.47
1235	12.57	0.98	1.56	**1500**	12.33	1.06	4.28	**1725**	12.65	0.25	5.49
1240	12.60	0.54	1.60	**1505**	12.31	0.97	4.36	**1730**	12.67	0.27	5.51
1245	12.57	0.92	1.68	**1510**	12.64	0.71	4.42	**1735**	12.69	0.16	5.52
1250	12.58	0.93	1.76	**1515**	12.65	0.64	4.47	**1740**	12.72	0.14	5.54
1255	12.72	0.76	1.82	**1520**	12.67	0.79	4.54	**1745**	12.43	0.19	5.55
1300	12.43	1.67	1.96	**1525**	12.69	0.62	4.59	**1750`**	12.41	0.24	5.57
1305	12.36	1.43	2.08	**1530**	12.72	0.88	4.66	**1755**	12.47	0.09	5.58
1310	12.35	1.25	2.18	**1535**	12.43	1.01	4.75	**1800**	12.53	0.07	5.58
1315	12.40	1.58	2.32	**1540**	12.41	0.89	4.82	-	∑V	∑A	-
1320	12.43	1.78	2.46	**1545**	12.47	0.92	4.90	-	1066.82	67.01	-

Solar to Battery charging phase data (11/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.60	0	0.00	**1325**	12.67	2.03	5.02	**1550**	12.59	0.98	9.02
1105	12.57	2.22	0.19	**1330**	12.65	2.05	5.19	**1555**	12.64	1.03	9.11
1110	12.58	2.31	0.38	**1335**	12.67	1.87	5.34	**1600**	12.64	1.11	9.20
1115	12.59	2.18	0.56	**1340**	12.57	1.96	5.51	**1605**	12.55	1.24	9.31
1120	12.64	2.02	0.73	**1345**	12.60	1.80	5.66	**1610**	12.50	1.17	9.40
1125	12.33	1.98	0.89	**1350**	12.65	1.89	5.81	**1615**	12.48	0.89	9.48
1130	12.57	1.54	1.02	**1355**	12.67	1.76	5.96	**1620**	12.53	0.97	9.56
1135	12.64	1.67	1.16	**1400**	12.69	1.67	6.10	**1625**	12.57	0.89	9.63
1140	12.65	1.50	1.29	**1405**	12.72	1.89	6.26	**1630**	12.60	0.77	9.70
1145	12.67	1.89	1.44	**1410**	12.36	1.98	6.42	**1635**	12.60	0.64	9.75
1150	12.65	1.87	1.60	**1415**	12.35	2.03	6.59	**1640**	12.57	0.64	9.80
1155	12.67	1.76	1.75	**1420**	12.40	2.13	6.77	**1645**	12.64	0.54	9.85
1200	12.69	2.01	1.91	**1425**	12.43	2.24	6.96	**1650**	12.65	0.89	9.92
1205	12.72	2.14	2.09	**1430**	12.58	2.11	7.13	**1655**	12.67	0.93	10.00
1210	12.43	2.23	2.28	**1435**	12.59	2.17	7.31	**1700**	12.65	1.07	10.09
1215	12.59	2.31	2.47	**1440**	12.64	2.07	7.48	**1705**	12.67	1.00	10.17
1220	12.64	2.44	2.67	**1445**	12.53	1.78	7.63	**1710**	12.57	0.96	10.25
1225	12.53	2.43	2.88	**1450**	12.50	1.70	7.77	**1715**	12.60	0.90	10.33
1230	12.72	2.17	3.06	**1455**	12.69	1.60	7.91	**1720**	12.65	0.86	10.40
1235	12.43	2.34	3.25	**1500**	12.50	1.55	8.04	**1725**	12.72	0.69	10.46
1240	12.36	2.17	3.43	**1505**	12.57	1.32	8.15	**1730**	12.36	0.56	10.50
1245	12.35	2.34	3.63	**1510**	12.60	1.45	8.27	**1735**	12.35	0.55	10.55
1250	12.40	2.40	3.83	**1515**	12.57	1.57	8.40	**1740**	12.40	0.43	10.58
1255	12.64	2.42	4.03	**1520**	12.64	1.32	8.51	**1745**	12.65	0.45	10.62
1300	12.55	2.01	4.20	**1525**	12.65	1.28	8.62	**1750`**	12.67	0.42	10.66
1305	12.59	1.89	4.35	**1530**	12.67	1.33	8.73	**1755**	12.69	0.34	10.69
1310	12.64	1.93	4.51	**1535**	12.65	0.94	8.80	**1800**	12.72	0.27	10.71
1315	12.64	1.99	4.68	**1540**	12.67	0.87	8.88	-	∑V	∑A	-
1320	12.65	2.00	4.85	**1545**	12.57	0.78	8.94	-	1069.71	128.49	-

Solar to Battery charging phase data (12/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	2.12	0.18	**1325**	12.65	1.43	4.49	**1550**	12.43	0.96	7.14
1105	12.69	2.15	0.36	**1330**	12.67	1.56	4.62	**1555**	12.41	0.85	7.21
1110	12.72	2.13	0.53	**1335**	12.69	1.21	4.72	**1600**	12.47	0.63	7.27
1115	12.43	2.01	0.70	**1340**	12.72	0.98	4.80	**1605**	12.50	0.89	7.34
1120	12.41	1.87	0.86	**1345**	12.43	0.84	4.87	**1610**	12.65	0.87	7.41
1125	12.47	1.97	1.02	**1350**	12.41	0.97	4.95	**1615**	12.67	0.72	7.47
1130	12.53	1.68	1.16	**1355**	12.47	0.86	5.02	**1620**	12.69	0.97	7.55
1135	12.50	1.76	1.31	**1400**	12.50	1.03	5.11	**1625**	12.72	0.64	7.61
1140	12.57	1.90	1.47	**1405**	12.69	1.13	5.20	**1630**	12.67	0.55	7.65
1145	12.64	1.66	1.60	**1410**	12.50	1.25	5.31	**1635**	12.65	0.64	7.71
1150	12.53	1.52	1.73	**1415**	12.57	1.36	5.42	**1640**	12.67	0.58	7.76
1155	12.50	1.90	1.89	**1420**	12.60	1.34	5.53	**1645**	12.57	0.44	7.79
1200	12.57	2.17	2.07	**1425**	12.57	1.08	5.62	**1650**	12.60	0.39	7.82
1205	12.59	2.23	2.26	**1430**	12.64	0.99	5.70	**1655**	12.65	0.39	7.86
1210	12.64	1.95	2.42	**1435**	12.65	1.25	5.81	**1700**	12.65	0.37	7.89
1215	12.53	1.87	2.57	**1440**	12.57	1.29	5.91	**1705**	12.67	0.27	7.91
1220	12.50	1.64	2.71	**1445**	12.60	1.43	6.03	**1710**	12.69	0.41	7.94
1225	12.57	1.56	2.84	**1450**	12.60	1.56	6.16	**1715**	12.72	0.57	7.99
1230	12.60	1.79	2.99	**1455**	12.57	1.04	6.25	**1720**	12.43	0.43	8.03
1235	12.60	2.02	3.16	**1500**	12.64	1.35	6.36	**1725**	12.59	0.39	8.06
1240	12.57	2.11	3.33	**1505**	12.65	1.00	6.45	**1730**	12.64	0.32	8.09
1245	12.64	1.83	3.49	**1510**	12.65	0.97	6.53	**1735**	12.59	0.32	8.11
1250	12.65	1.64	3.62	**1515**	12.72	0.74	6.59	**1740**	12.64	0.24	8.13
1255	12.67	1.44	3.74	**1520**	12.36	0.88	6.66	**1745**	12.64	0.15	8.15
1300	12.65	1.36	3.86	**1525**	12.35	0.99	6.74	**1750`**	12.55	0.11	8.16
1305	12.67	1.30	3.97	**1530**	12.40	1.03	6.83	**1755**	12.50	0.14	8.17
1310	12.57	1.48	4.09	**1535**	12.65	0.95	6.91	**1800**	12.48	0.10	8.18
1315	12.59	1.63	4.22	**1540**	12.67	0.83	6.98	-	∑V	∑A	-
1320	12.64	1.71	4.37	**1545**	12.69	1.02	7.06	-	1069.93	98.1	-

Solar to Battery charging phase data (13/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	1.98	0.17	**1325**	12.59	2.13	4.30	**1550**	12.72	0.86	7.28
1105	12.65	1.54	0.29	**1330**	12.64	2.24	4.49	**1555**	12.67	0.56	7.33
1110	12.67	1.67	0.43	**1335**	12.33	2.11	4.67	**1600**	12.65	0.44	7.37
1115	12.57	1.50	0.56	**1340**	12.31	2.17	4.85	**1605**	12.67	0.38	7.40
1120	12.60	1.89	0.72	**1345**	12.64	2.07	5.02	**1610**	12.57	0.58	7.45
1125	12.65	1.87	0.87	**1350**	12.65	1.78	5.17	**1615**	12.60	0.67	7.50
1130	12.64	1.98	1.04	**1355**	12.67	1.70	5.31	**1620**	12.47	0.78	7.57
1135	12.53	1.54	1.16	**1400**	12.69	1.60	5.44	**1625**	12.50	0.50	7.61
1140	12.50	1.67	1.30	**1405**	12.57	1.55	5.57	**1630**	12.65	0.79	7.68
1145	12.57	1.63	1.44	**1410**	12.64	1.32	5.68	**1635**	12.67	0.87	7.75
1150	12.60	1.74	1.58	**1415**	12.65	1.45	5.80	**1640**	12.69	0.43	7.78
1155	12.60	1.76	1.73	**1420**	12.65	1.53	5.93	**1645**	12.72	0.67	7.84
1200	12.50	1.30	1.84	**1425**	12.72	1.62	6.07	**1650**	12.41	0.89	7.91
1205	12.57	1.23	1.94	**1430**	12.36	1.44	6.19	**1655**	12.47	0.45	7.95
1210	12.64	1.56	2.07	**1435**	12.35	1.37	6.30	**1700**	12.53	0.32	7.98
1215	12.53	1.67	2.21	**1440**	12.40	1.18	6.40	**1705**	12.50	0.35	8.01
1220	12.50	1.27	2.32	**1445**	12.67	1.26	6.50	**1710**	12.57	0.41	8.04
1225	12.57	1.63	2.45	**1450**	12.69	0.98	6.59	**1715**	12.64	0.23	8.06
1230	12.59	1.74	2.60	**1455**	12.72	0.67	6.64	**1720**	12.57	0.14	8.07
1235	12.64	1.76	2.74	**1500**	12.67	0.42	6.68	**1725**	12.64	0.23	8.09
1240	12.53	1.86	2.90	**1505**	12.65	0.39	6.71	**1730**	12.65	0.32	8.12
1245	12.64	1.63	3.04	**1510**	12.67	0.50	6.75	**1735**	12.65	0.14	8.13
1250	12.65	1.93	3.20	**1515**	12.57	0.78	6.82	**1740**	12.72	0.27	8.15
1255	12.65	1.76	3.34	**1520**	12.60	0.89	6.89	**1745**	12.36	0.12	8.16
1300	12.72	1.92	3.50	**1525**	12.60	0.57	6.94	**1750`**	12.35	0.10	8.17
1305	12.36	2.00	3.67	**1530**	12.60	0.88	7.01	**1755**	12.40	0.10	8.18
1310	12.35	2.02	3.84	**1535**	12.57	0.79	7.08	**1800**	12.65	0.11	8.19
1315	12.40	1.83	3.99	**1540**	12.64	0.89	7.15	-	∑V	∑A	-
1320	12.67	1.64	4.13	**1545**	12.65	0.74	7.21	-	1069.61	98.25	-

Solar to Battery charging phase data (14/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	2.14	0.18	**1325**	12.57	1.96	5.33	**1550**	12.64	1.23	8.91
1105	12.57	2.35	0.37	**1330**	12.60	1.80	5.48	**1555**	12.59	1.45	9.03
1110	12.60	2.29	0.57	**1335**	12.60	1.89	5.64	**1600**	12.64	1.32	9.14
1115	12.65	2.45	0.77	**1340**	12.60	1.76	5.78	**1605**	12.64	1.23	9.24
1120	12.72	2.51	0.98	**1345**	12.57	1.67	5.92	**1610**	12.55	1.02	9.32
1125	12.36	2.54	1.19	**1350**	12.64	1.89	6.08	**1615**	12.50	0.66	9.38
1130	12.35	2.61	1.41	**1355**	12.65	1.98	6.24	**1620**	12.69	0.87	9.45
1135	12.40	2.57	1.62	**1400**	12.57	2.03	6.41	**1625**	12.72	0.83	9.52
1140	12.60	2.60	1.84	**1405**	12.60	1.98	6.58	**1630**	12.67	0.75	9.58
1145	12.60	2.56	2.05	**1410**	12.65	1.54	6.71	**1635**	12.65	0.82	9.65
1150	12.60	2.56	2.27	**1415**	12.65	1.77	6.85	**1640**	12.67	0.54	9.70
1155	12.57	2.14	2.44	**1420**	12.67	1.87	7.01	**1645**	12.57	0.43	9.73
1200	12.64	2.35	2.64	**1425**	12.69	1.65	7.15	**1650**	12.65	0.56	9.78
1205	12.65	2.29	2.83	**1430**	12.72	1.32	7.26	**1655**	12.72	0.78	9.84
1210	12.67	1.52	2.96	**1435**	12.43	1.45	7.38	**1700**	12.36	0.54	9.89
1215	12.69	1.90	3.12	**1440**	12.57	1.53	7.51	**1705**	12.35	0.34	9.92
1220	12.57	2.17	3.30	**1445**	12.64	1.62	7.64	**1710**	12.40	0.27	9.94
1225	12.64	2.23	3.48	**1450**	12.53	1.54	7.77	**1715**	12.67	0.26	9.96
1230	12.65	1.95	3.64	**1455**	12.50	1.44	7.89	**1720**	12.57	0.24	9.98
1235	12.65	1.87	3.80	**1500**	12.57	1.23	7.99	**1725**	12.60	0.21	10.00
1240	12.72	1.64	3.94	**1505**	12.59	1.45	8.11	**1730**	12.60	0.31	10.02
1245	12.67	1.56	4.07	**1510**	12.57	1.32	8.22	**1735**	12.50	0.38	10.06
1250	12.69	1.79	4.22	**1515**	12.64	1.29	8.33	**1740**	12.57	0.29	10.08
1255	12.72	2.10	4.39	**1520**	12.65	1.02	8.41	**1745**	12.64	0.12	10.09
1300	12.77	2.34	4.59	**1525**	12.67	1.04	8.50	**1750`**	12.53	0.13	10.10
1305	12.74	1.77	4.73	**1530**	12.69	0.96	8.58	**1755**	12.69	0.10	10.11
1310	12.79	1.69	4.87	**1535**	12.57	0.67	8.64	**1800**	12.72	0.11	10.12
1315	12.75	1.59	5.01	**1540**	12.72	0.97	8.72	-	∑V	∑A	-
1320	12.86	1.89	5.16	**1545**	12.36	1.02	8.80	-	1072.14	121.42	-

Solar to Battery charging phase data (15/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.35	0.02	0.00	**1325**	12.60	1.23	2.48	**1550**	12.57	0.45	4.75
1105	12.40	1.54	0.13	**1330**	12.60	1.45	2.60	**1555**	12.60	0.55	4.80
1110	12.67	1.76	0.28	**1335**	12.60	1.32	2.71	**1600**	12.65	0.38	4.83
1115	12.69	1.32	0.39	**1340**	12.57	1.29	2.82	**1605**	12.64	0.50	4.87
1120	12.72	1.44	0.51	**1345**	12.64	1.02	2.90	**1610**	12.53	0.67	4.93
1125	12.67	1.21	0.61	**1350**	12.65	1.04	2.99	**1615**	12.50	0.58	4.98
1130	12.65	1.11	0.70	**1355**	12.67	1.23	3.09	**1620**	12.57	0.56	5.02
1135	12.64	1.04	0.79	**1400**	12.69	1.45	3.21	**1625**	12.67	0.58	5.07
1140	12.53	0.87	0.86	**1405**	12.57	1.23	3.32	**1630**	12.65	0.67	5.13
1145	12.50	0.98	0.94	**1410**	12.64	0.98	3.40	**1635**	12.67	0.56	5.17
1150	12.57	0.87	1.01	**1415**	12.65	0.78	3.46	**1640**	12.57	0.76	5.24
1155	12.59	0.89	1.09	**1420**	12.57	0.54	3.51	**1645**	12.60	0.54	5.28
1200	12.57	0.98	1.17	**1425**	12.64	0.54	3.55	**1650**	12.60	0.44	5.32
1205	12.64	0.65	1.22	**1430**	12.65	0.87	3.63	**1655**	12.60	0.47	5.36
1210	12.65	0.56	1.27	**1435**	12.57	1.00	3.71	**1700**	12.57	0.32	5.39
1215	12.67	0.78	1.34	**1440**	12.60	1.03	3.80	**1705**	12.57	0.36	5.42
1220	12.57	0.56	1.38	**1445**	12.65	1.21	3.90	**1710**	12.64	0.34	5.44
1225	12.64	0.43	1.42	**1450**	12.65	1.23	4.00	**1715**	12.65	0.45	5.48
1230	12.65	0.78	1.48	**1455**	12.67	0.96	4.08	**1720**	12.67	0.32	5.51
1235	12.57	0.98	1.56	**1500**	12.69	0.76	4.14	**1725**	12.69	0.23	5.53
1240	12.60	0.67	1.62	**1505**	12.72	0.97	4.22	**1730**	12.57	0.29	5.55
1245	12.65	0.92	1.70	**1510**	12.43	0.87	4.30	**1735**	12.64	0.25	5.57
1250	12.65	1.05	1.78	**1515**	12.64	0.65	4.35	**1740**	12.65	0.45	5.61
1255	12.67	0.99	1.87	**1520**	12.59	0.78	4.41	**1745**	12.35	0.23	5.63
1300	12.69	1.19	1.97	**1525**	12.64	0.67	4.47	**1750`**	12.40	0.19	5.64
1305	12.60	1.09	2.06	**1530**	12.64	0.87	4.54	**1755**	12.67	0.14	5.66
1310	12.50	1.13	2.15	**1535**	12.55	0.55	4.59	**1800**	12.57	0.16	5.67
1315	12.57	1.34	2.26	**1540**	12.50	0.70	4.65	-	∑V	∑A	-
1320	12.59	1.39	2.38	**1545**	12.69	0.83	4.72	-	1071.49	68.03	-

Solar to Battery charging phase data (16/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.65	1.76	0.15	**1325**	12.57	1.45	2.77	**1550**	12.60	0.38	4.78
1105	12.57	1.32	0.26	**1330**	12.60	1.23	2.88	**1555**	12.60	0.50	4.82
1110	12.64	1.44	0.38	**1335**	12.65	0.98	2.96	**1600**	12.57	0.67	4.88
1115	12.65	1.21	0.48	**1340**	12.64	0.78	3.02	**1605**	12.64	0.58	4.93
1120	12.57	1.11	0.57	**1345**	12.53	0.54	3.07	**1610**	12.65	0.38	4.96
1125	12.60	1.04	0.66	**1350**	12.60	0.89	3.14	**1615**	12.67	0.50	5.00
1130	12.65	0.87	0.73	**1355**	12.57	0.98	3.22	**1620**	12.69	0.67	5.05
1135	12.65	1.32	0.84	**1400**	12.64	0.65	3.28	**1625**	12.57	0.58	5.10
1140	12.67	1.29	0.95	**1405**	12.65	0.56	3.32	**1630**	12.40	0.56	5.15
1145	12.64	1.02	1.03	**1410**	12.67	0.78	3.39	**1635**	12.67	0.58	5.20
1150	12.65	1.04	1.12	**1415**	12.69	0.56	3.44	**1640**	12.57	0.67	5.25
1155	12.67	1.23	1.22	**1420**	12.57	0.43	3.47	**1645**	12.60	0.56	5.30
1200	12.69	1.45	1.34	**1425**	12.65	0.96	3.55	**1650**	12.60	0.58	5.35
1205	12.57	1.23	1.44	**1430**	12.64	0.76	3.61	**1655**	12.50	0.56	5.40
1210	12.72	1.23	1.55	**1435**	12.53	0.97	3.70	**1700**	12.72	0.32	5.42
1215	12.50	1.45	1.67	**1440**	12.50	0.87	3.77	**1705**	12.67	0.32	5.45
1220	12.72	1.23	1.77	**1445**	12.57	0.65	3.82	**1710**	12.69	0.20	5.47
1225	12.67	0.98	1.85	**1450**	12.59	1.11	3.91	**1715**	12.72	0.28	5.49
1230	12.65	0.78	1.92	**1455**	12.57	1.04	4.00	**1720**	12.77	0.34	5.52
1235	12.64	0.54	1.96	**1500**	12.64	0.87	4.07	**1725**	12.74	0.39	5.55
1240	12.53	0.54	2.01	**1505**	12.65	0.98	4.16	**1730**	12.60	0.28	5.57
1245	12.50	0.87	2.08	**1510**	12.67	0.87	4.23	**1735**	12.65	0.23	5.59
1250	12.57	1.00	2.16	**1515**	12.57	0.89	4.30	**1740**	12.65	0.19	5.61
1255	12.59	1.03	2.25	**1520**	12.60	0.98	4.38	**1745**	12.67	0.13	5.62
1300	12.64	1.21	2.35	**1525**	12.65	0.98	4.47	**1750`**	12.69	0.34	5.65
1305	12.55	0.67	2.41	**1530**	12.64	0.87	4.54	**1755**	12.50	0.28	5.67
1310	12.50	0.92	2.48	**1535**	12.53	0.89	4.61	**1800**	12.69	0.19	5.69
1315	12.69	1.05	2.57	**1540**	12.50	0.98	4.69	-	∑V	∑A	-
1320	12.69	0.99	2.65	**1545**	12.57	0.65	4.75	-	1072.57	68.23	-

Solar to Battery charging phase data (17/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	1.98	0.17	**1325**	12.57	1.09	3.47	**1550**	12.72	0.00	4.28
1105	12.60	1.54	0.29	**1330**	12.60	1.34	3.58	**1555**	12.53	0.00	4.28
1110	12.65	1.67	0.43	**1335**	12.65	1.03	3.67	**1600**	12.50	0.00	4.28
1115	12.65	1.50	0.56	**1340**	12.65	1.20	3.77	**1605**	12.57	0.00	4.28
1120	12.67	1.89	0.72	**1345**	12.67	1.17	3.87	**1610**	12.59	0.00	4.28
1125	12.69	1.87	0.87	**1350**	12.64	0.78	3.93	**1615**	12.57	0.00	4.28
1130	12.60	1.98	1.04	**1355**	12.60	0.67	3.99	**1620**	12.69	0.00	4.28
1135	12.50	1.54	1.16	**1400**	12.60	0.89	4.06	**1625**	12.60	0.09	4.28
1140	12.65	1.67	1.30	**1405**	12.57	0.99	4.14	**1630**	12.50	0.15	4.29
1145	12.67	1.63	1.44	**1410**	12.64	0.56	4.19	**1635**	12.65	0.24	4.30
1150	12.69	1.74	1.58	**1415**	12.65	0.45	4.23	**1640**	12.57	0.22	4.32
1155	12.57	1.76	1.73	**1420**	12.67	0.34	4.26	**1645**	12.64	0.34	4.34
1200	12.72	1.30	1.84	**1425**	12.67	0.22	4.28	**1650**	12.65	0.54	4.37
1205	12.50	1.23	1.94	**1430**	12.69	0.03	4.28	**1655**	12.67	0.43	4.41
1210	12.72	1.01	2.03	**1435**	12.57	0.01	4.28	**1700**	12.57	0.56	4.45
1215	12.53	1.23	2.13	**1440**	12.72	0.00	4.28	**1705**	12.67	0.34	4.49
1220	12.50	1.34	2.24	**1445**	12.50	0.00	4.28	**1710**	12.69	0.32	4.52
1225	12.57	1.55	2.37	**1450**	12.72	0.00	4.28	**1715**	12.57	0.45	4.55
1230	12.59	1.34	2.48	**1455**	12.53	0.00	4.28	**1720**	12.72	0.42	4.59
1235	12.57	0.99	2.56	**1500**	12.50	0.00	4.28	**1725**	12.50	0.17	4.62
1240	12.64	1.35	2.68	**1505**	12.57	0.00	4.28	**1730**	12.72	0.33	4.63
1245	12.64	1.56	2.81	**1510**	12.67	0.00	4.28	**1735**	12.67	0.10	4.66
1250	12.53	0.78	2.87	**1515**	12.65	0.00	4.28	**1740**	12.69	0.19	4.67
1255	12.60	0.97	2.95	**1520**	12.64	0.00	4.28	**1745**	12.57	0.12	4.69
1300	12.57	1.20	3.05	**1525**	12.53	0.00	4.28	**1750`**	12.64	0.12	4.70
1305	12.64	1.34	3.16	**1530**	12.50	0.00	4.28	**1755**	12.57	0.09	4.71
1310	12.65	1.07	3.25	**1535**	12.57	0.00	4.28	**1800**	12.72	0.10	4.71
1315	12.67	0.76	3.32	**1540**	12.59	0.00	4.28	-	∑V	∑A	-
1320	12.57	0.78	3.38	**1545**	12.67	0.00	4.28	-	1072.27	56.66	-

Solar to Battery charging phase data (18/11/2022) Mostly cloud

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	1.63	0.14	**1325**	12.72	1.40	2.57	**1550**	12.50	0.38	4.49
1105	12.64	1.21	0.24	**1330**	12.53	1.30	2.68	**1555**	12.72	0.50	4.53
1110	12.60	1.34	0.35	**1335**	12.50	0.92	2.75	**1600**	12.53	0.67	4.59
1115	12.60	1.02	0.43	**1340**	12.57	0.84	2.82	**1605**	12.50	0.58	4.63
1120	12.57	1.11	0.53	**1345**	12.59	0.67	2.88	**1610**	12.57	0.38	4.67
1125	12.64	1.04	0.61	**1350**	12.65	0.93	2.96	**1615**	12.67	0.43	4.70
1130	12.65	0.87	0.69	**1355**	12.67	0.98	3.04	**1620**	12.69	0.32	4.73
1135	12.67	1.21	0.79	**1400**	12.69	0.65	3.09	**1625**	12.60	0.58	4.78
1140	12.65	1.12	0.88	**1405**	12.57	0.56	3.14	**1630**	12.50	0.56	4.82
1145	12.65	1.00	0.96	**1410**	12.65	0.78	3.20	**1635**	12.65	0.58	4.87
1150	12.67	1.01	1.05	**1415**	12.64	0.59	3.25	**1640**	12.67	0.53	4.92
1155	12.69	0.98	1.13	**1420**	12.57	0.43	3.29	**1645**	12.72	0.45	4.95
1200	12.60	0.87	1.20	**1425**	12.72	0.91	3.36	**1650**	12.53	0.49	4.99
1205	12.57	1.03	1.29	**1430**	12.50	0.64	3.42	**1655**	12.50	0.50	5.04
1210	12.67	1.09	1.38	**1435**	12.72	0.82	3.49	**1700**	12.57	0.37	5.07
1215	12.65	1.32	1.49	**1440**	12.67	0.87	3.56	**1705**	12.59	0.31	5.09
1220	12.64	1.20	1.59	**1445**	12.65	0.65	3.61	**1710**	12.57	0.19	5.11
1225	12.53	1.01	1.67	**1450**	12.64	0.32	3.64	**1715**	12.57	0.23	5.13
1230	12.60	0.98	1.75	**1455**	12.53	1.04	3.73	**1720**	12.64	0.34	5.16
1235	12.50	0.65	1.81	**1500**	12.50	0.87	3.80	**1725**	12.65	0.39	5.19
1240	12.65	0.53	1.85	**1505**	12.50	0.98	3.88	**1730**	12.67	0.28	5.21
1245	12.57	0.67	1.91	**1510**	12.57	0.87	3.95	**1735**	12.65	0.23	5.23
1250	12.64	0.97	1.99	**1515**	12.59	1.05	4.04	**1740**	12.65	0.19	5.25
1255	12.65	0.76	2.05	**1520**	12.57	0.98	4.12	**1745**	12.67	0.16	5.26
1300	12.67	1.21	2.15	**1525**	12.69	0.91	4.20	**1750`**	12.67	0.12	5.27
1305	12.57	0.67	2.21	**1530**	12.60	0.87	4.27	**1755**	12.65	0.09	5.28
1310	12.72	0.92	2.29	**1535**	12.50	0.73	4.33	**1800**	12.64	0.07	5.28
1315	12.50	1.05	2.37	**1540**	12.65	0.98	4.41	-	∑V	∑A	-
1320	12.72	0.93	2.45	**1545**	12.64	0.54	4.46	-	1072.28	63.4	-

Solar to Battery charging phase data (19/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.50	0.01	0.00	**1325**	12.67	0.00	1.00	**1550**	12.67	0.91	2.37
1105	12.65	1.98	0.17	**1330**	12.69	0.00	1.00	**1555**	12.69	0.79	2.44
1110	12.67	1.78	0.31	**1335**	12.60	0.00	1.00	**1600**	12.60	0.38	2.47
1115	12.72	1.55	0.44	**1340**	12.57	0.00	1.00	**1605**	12.50	0.23	2.49
1120	12.53	1.67	0.58	**1345**	12.67	0.00	1.00	**1610**	12.65	0.48	2.53
1125	12.50	1.23	0.69	**1350**	12.65	0.00	1.00	**1615**	12.67	0.37	2.56
1130	12.57	1.03	0.77	**1355**	12.64	0.00	1.00	**1620**	12.53	0.53	2.61
1135	12.59	0.76	0.83	**1400**	12.53	0.00	1.00	**1625**	12.50	0.47	2.64
1140	12.65	0.65	0.89	**1405**	12.64	0.00	1.00	**1630**	12.57	0.31	2.67
1145	12.64	0.43	0.92	**1410**	12.57	0.09	1.01	**1635**	12.67	0.21	2.69
1150	12.53	0.32	0.95	**1415**	12.72	0.35	1.04	**1640**	12.69	0.24	2.71
1155	12.50	0.28	0.97	**1420**	12.50	0.39	1.07	**1645**	12.60	0.35	2.74
1200	12.57	0.18	0.99	**1425**	12.72	0.58	1.12	**1650**	12.57	0.31	2.76
1205	12.59	0.10	1.00	**1430**	12.67	0.65	1.17	**1655**	12.59	0.42	2.80
1210	12.57	0.02	1.00	**1435**	12.53	1.05	1.26	**1700**	12.65	0.31	2.82
1215	12.64	0.02	1.00	**1440**	12.50	1.23	1.36	**1705**	12.67	0.22	2.84
1220	12.65	0.01	1.00	**1445**	12.57	1.29	1.47	**1710**	12.69	0.25	2.86
1225	12.67	0.00	1.00	**1450**	12.59	1.31	1.58	**1715**	12.57	0.19	2.88
1230	12.65	0.00	1.00	**1455**	12.65	0.99	1.66	**1720**	12.60	0.21	2.90
1235	12.65	0.00	1.00	**1500**	12.64	1.06	1.75	**1725**	12.57	0.15	2.91
1240	12.67	0.00	1.00	**1505**	12.60	0.93	1.83	**1730**	12.64	0.17	2.92
1245	12.69	0.00	1.00	**1510**	12.60	0.69	1.89	**1735**	12.65	0.16	2.94
1250	12.69	0.00	1.00	**1515**	12.57	0.68	1.94	**1740**	12.67	0.14	2.95
1255	12.57	0.00	1.00	**1520**	12.64	0.54	1.99	**1745**	12.65	0.29	2.97
1300	12.72	0.00	1.00	**1525**	12.65	0.52	2.03	**1750`**	12.50	0.14	2.98
1305	12.50	0.00	1.00	**1530**	12.67	0.79	2.10	**1755**	12.72	0.09	2.99
1310	12.72	0.00	1.00	**1535**	12.65	0.79	2.16	**1800**	12.67	0.07	3.00
1315	12.53	0.00	1.00	**1540**	12.57	0.88	2.24	-	∑V	∑A	-
1320	12.50	0.00	1.00	**1545**	12.72	0.74	2.30	-	1072.37	35.96	-

Solar to Battery charging phase data (20/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.67	2.45	0.20	**1325**	12.50	1.23	4.08	**1550**	12.65	0.76	6.47
1105	12.69	2.51	0.41	**1330**	12.57	0.97	4.16	**1555**	12.67	0.78	6.53
1110	12.57	2.54	0.63	**1335**	12.59	0.67	4.21	**1600**	12.69	0.88	6.61
1115	12.65	2.61	0.84	**1340**	12.65	1.02	4.30	**1605**	12.60	0.89	6.68
1120	12.64	2.57	1.06	**1345**	12.64	1.09	4.39	**1610**	12.57	0.56	6.73
1125	12.57	2.60	1.27	**1350**	12.60	1.13	4.48	**1615**	12.67	0.92	6.80
1130	12.72	2.56	1.49	**1355**	12.60	1.34	4.60	**1620**	12.65	0.67	6.86
1135	12.50	2.56	1.70	**1400**	12.65	1.32	4.71	**1625**	12.64	0.56	6.91
1140	12.60	2.14	1.88	**1405**	12.64	1.28	4.81	**1630**	12.65	0.67	6.96
1145	12.60	2.35	2.07	**1410**	12.53	1.17	4.91	**1635**	12.67	0.45	7.00
1150	12.57	1.98	2.24	**1415**	12.64	1.06	5.00	**1640**	12.59	0.56	7.05
1155	12.64	1.95	2.40	**1420**	12.57	1.08	5.09	**1645**	12.57	0.65	7.10
1200	12.65	1.05	2.49	**1425**	12.72	1.00	5.17	**1650**	12.72	0.53	7.14
1205	12.67	1.23	2.59	**1430**	12.50	0.95	5.25	**1655**	12.50	0.49	7.18
1210	12.65	0.98	2.67	**1435**	12.59	0.87	5.32	**1700**	12.60	0.67	7.24
1215	12.64	1.32	2.78	**1440**	12.57	0.64	5.38	**1705**	12.60	0.72	7.30
1220	12.53	0.97	2.86	**1445**	12.57	0.87	5.45	**1710**	12.57	0.53	7.34
1225	12.50	1.23	2.97	**1450**	12.64	0.77	5.51	**1715**	12.59	0.31	7.37
1230	12.57	1.23	3.07	**1455**	12.65	0.72	5.57	**1720**	12.65	0.23	7.39
1235	12.59	1.24	3.17	**1500**	12.67	1.00	5.66	**1725**	12.64	0.14	7.40
1240	12.57	1.38	3.29	**1505**	12.59	1.04	5.74	**1730**	12.60	0.27	7.42
1245	12.64	0.94	3.37	**1510**	12.65	0.78	5.81	**1735**	12.60	0.30	7.45
1250	12.57	0.78	3.43	**1515**	12.64	0.99	5.89	**1740**	12.53	0.32	7.48
1255	12.59	0.76	3.49	**1520**	12.53	1.09	5.98	**1745**	12.50	0.21	7.49
1300	12.65	0.94	3.57	**1525**	12.50	1.03	6.07	**1750`**	12.57	0.18	7.51
1305	12.64	1.03	3.66	**1530**	12.57	1.11	6.16	**1755**	12.59	0.12	7.52
1310	12.53	1.21	3.76	**1535**	12.59	1.03	6.25	**1800**	12.65	0.09	7.53
1315	12.50	1.25	3.86	**1540**	12.57	1.02	6.33	-	∑V	∑A	-
1320	12.57	1.34	3.98	**1545**	12.64	0.87	6.40	-	1071.38	90.3	-

Solar to Battery charging phase data (21/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.65	0.07	0.01	**1325**	12.60	1.87	5.12	**1550**	12.64	0.65	8.42
1105	12.67	2.00	0.17	**1330**	12.60	1.85	5.28	**1555**	12.57	0.34	8.45
1110	12.69	2.00	0.34	**1335**	12.57	1.95	5.44	**1600**	12.72	0.29	8.48
1115	12.72	2.08	0.51	**1340**	12.64	2.10	5.61	**1605**	12.50	0.29	8.50
1120	12.43	2.14	0.69	**1345**	12.65	1.93	5.78	**1610**	12.69	0.43	8.54
1125	12.59	2.35	0.89	**1350**	12.67	1.94	5.94	**1615**	12.60	0.55	8.58
1130	12.65	2.29	1.08	**1355**	12.65	1.57	6.07	**1620**	12.50	0.41	8.62
1135	12.64	2.45	1.28	**1400**	12.72	1.73	6.21	**1625**	12.65	0.53	8.66
1140	12.53	2.51	1.49	**1405**	12.50	1.67	6.35	**1630**	12.67	0.94	8.74
1145	12.50	2.54	1.70	**1410**	12.60	1.68	6.49	**1635**	12.57	0.95	8.82
1150	12.57	2.61	1.92	**1415**	12.60	1.53	6.62	**1640**	12.67	0.53	8.86
1155	12.59	2.57	2.13	**1420**	12.57	1.03	6.70	**1645**	12.65	0.49	8.90
1200	12.57	2.60	2.35	**1425**	12.64	1.09	6.80	**1650**	12.64	0.32	8.93
1205	12.59	2.56	2.56	**1430**	12.65	1.09	6.89	**1655**	12.65	0.44	8.97
1210	12.57	2.56	2.78	**1435**	12.50	1.40	7.00	**1700**	12.64	0.20	8.98
1215	12.57	2.49	2.99	**1440**	12.57	1.39	7.12	**1705**	12.65	0.21	9.00
1220	12.64	2.47	3.19	**1445**	12.59	1.47	7.24	**1710**	12.67	0.20	9.02
1225	12.65	2.13	3.37	**1450**	12.57	1.52	7.37	**1715**	12.65	0.17	9.03
1230	12.67	2.42	3.57	**1455**	12.59	1.19	7.47	**1720**	12.72	0.29	9.06
1235	12.59	2.39	3.77	**1500**	12.59	1.26	7.57	**1725**	12.57	0.13	9.07
1240	12.65	2.04	3.94	**1505**	12.57	1.04	7.66	**1730**	12.59	0.17	9.08
1245	12.64	1.36	4.05	**1510**	12.59	1.22	7.76	**1735**	12.57	0.19	9.10
1250	12.53	1.58	4.18	**1515**	12.57	1.20	7.86	**1740**	12.64	0.13	9.11
1255	12.50	1.30	4.29	**1520**	12.57	1.32	7.97	**1745**	12.72	0.14	9.12
1300	12.50	1.55	4.42	**1525**	12.64	1.47	8.09	**1750`**	12.53	0.14	9.13
1305	12.57	2.00	4.59	**1530**	12.65	0.64	8.15	**1755**	12.50	0.13	9.14
1310	12.59	1.75	4.73	**1535**	12.67	1.37	8.26	**1800**	12.57	0.10	9.15
1315	12.65	1.58	4.87	**1540**	12.65	0.59	8.31	-	∑V	∑A	-
1320	12.64	1.21	4.97	**1545**	12.64	0.72	8.37	-	1071.71	109.79	-

Solar to Battery charging phase data (22/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.50	0.01	0.00	**1325**	12.57	2.12	5.34	**1550**	12.59	0.78	8.65
1105	12.57	2.01	0.17	**1330**	12.50	2.14	5.51	**1555**	12.65	1.32	8.76
1110	12.59	2.24	0.36	**1335**	12.50	2.43	5.72	**1600**	12.64	0.88	8.84
1115	12.65	2.34	0.55	**1340**	12.57	2.24	5.90	**1605**	12.53	1.12	8.93
1120	12.64	2.43	0.75	**1345**	12.60	1.04	5.99	**1610**	12.67	0.52	8.97
1125	12.53	2.10	0.93	**1350**	12.60	2.04	6.16	**1615**	12.69	0.98	9.06
1130	12.50	2.23	1.11	**1355**	12.53	1.56	6.29	**1620**	12.57	0.67	9.11
1135	12.57	2.11	1.29	**1400**	12.50	1.10	6.38	**1625**	12.65	1.00	9.19
1140	12.59	2.32	1.48	**1405**	12.57	0.95	6.46	**1630**	12.64	0.76	9.26
1145	12.57	2.43	1.69	**1410**	12.59	0.99	6.54	**1635**	12.57	0.86	9.33
1150	12.50	2.54	1.90	**1415**	12.65	1.11	6.64	**1640**	12.72	0.54	9.37
1155	12.50	2.60	2.11	**1420**	12.64	1.39	6.75	**1645**	12.50	0.65	9.43
1200	12.57	2.17	2.29	**1425**	12.53	1.21	6.85	**1650**	12.64	0.53	9.47
1205	12.59	2.26	2.48	**1430**	12.50	1.48	6.98	**1655**	12.53	0.49	9.51
1210	12.65	2.45	2.69	**1435**	12.64	1.27	7.08	**1700**	12.67	0.67	9.57
1215	12.64	2.58	2.90	**1440**	12.65	1.85	7.24	**1705**	12.69	0.72	9.63
1220	12.53	2.12	3.08	**1445**	12.67	1.19	7.33	**1710**	12.65	0.53	9.67
1225	12.50	2.09	3.25	**1450**	12.59	1.13	7.43	**1715**	12.64	0.31	9.70
1230	12.50	1.98	3.42	**1455**	12.65	0.78	7.49	**1720**	12.57	0.23	9.72
1235	12.57	1.97	3.58	**1500**	12.64	0.45	7.53	**1725**	12.72	0.14	9.73
1240	12.50	1.87	3.74	**1505**	12.59	1.20	7.63	**1730**	12.50	0.22	9.75
1245	12.57	1.67	3.88	**1510**	12.57	1.59	7.76	**1735**	12.67	0.21	9.77
1250	12.59	1.98	4.04	**1515**	12.59	1.35	7.88	**1740**	12.65	0.17	9.78
1255	12.65	2.21	4.23	**1520**	12.59	0.98	7.96	**1745**	12.65	0.21	9.80
1300	12.64	2.23	4.41	**1525**	12.57	1.34	8.07	**1750`**	12.67	0.18	9.81
1305	12.64	2.43	4.61	**1530**	12.59	1.55	8.20	**1755**	12.69	0.12	9.82
1310	12.60	2.38	4.81	**1535**	12.57	1.75	8.34	**1800**	12.69	0.08	9.83
1315	12.60	2.02	4.98	**1540**	12.57	1.47	8.47	-	∑V	∑A	-
1320	12.57	2.13	5.16	**1545**	12.64	1.46	8.59	-	1070.64	117.95	-

Solar to Battery charging phase data (23/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.65	0	0.00	**1325**	12.57	2.24	5.43	**1550**	12.59	1.37	8.85
1105	12.67	1.55	0.13	**1330**	12.64	2.61	5.64	**1555**	12.57	1.29	8.96
1110	12.69	1.99	0.30	**1335**	12.65	2.69	5.87	**1600**	12.60	1.10	9.05
1115	12.72	1.93	0.46	**1340**	12.67	2.2	6.05	**1605**	12.60	1.06	9.14
1120	12.43	2.19	0.64	**1345**	12.65	1.09	6.14	**1610**	12.53	1.05	9.22
1125	12.59	2.20	0.82	**1350**	12.64	2.00	6.31	**1615**	12.50	1.01	9.31
1130	12.64	2.09	1.00	**1355**	12.59	1.51	6.43	**1620**	12.64	1.09	9.40
1135	12.65	2.14	1.17	**1400**	12.57	1.10	6.53	**1625**	12.65	1.07	9.49
1140	12.67	1.82	1.33	**1405**	12.50	0.95	6.60	**1630**	12.50	1.20	9.59
1145	12.59	2.24	1.51	**1410**	12.50	0.99	6.69	**1635**	12.57	1.06	9.68
1150	12.65	2.07	1.69	**1415**	12.57	1.11	6.78	**1640**	12.59	1.23	9.78
1155	12.53	2.33	1.88	**1420**	12.65	1.39	6.90	**1645**	12.57	1.01	9.86
1200	12.50	2.47	2.09	**1425**	12.67	1.21	7.00	**1650**	12.59	0.66	9.92
1205	12.50	2.00	2.25	**1430**	12.69	1.48	7.12	**1655**	12.59	0.56	9.96
1210	12.57	2.34	2.45	**1435**	12.60	1.27	7.23	**1700**	12.57	0.42	10.00
1215	12.50	2.35	2.64	**1440**	12.57	1.85	7.38	**1705**	12.59	0.50	10.04
1220	12.57	2.37	2.84	**1445**	12.69	1.17	7.48	**1710**	12.57	0.40	10.07
1225	12.59	2.44	3.04	**1450**	12.72	1.16	7.57	**1715**	12.57	0.27	10.10
1230	12.57	2.32	3.24	**1455**	12.43	0.71	7.63	**1720**	12.59	0.33	10.12
1235	12.60	2.31	3.43	**1500**	12.59	0.65	7.69	**1725**	12.65	0.30	10.15
1240	12.60	2.57	3.64	**1505**	12.64	1.20	7.79	**1730**	12.64	0.31	10.18
1245	12.53	2.54	3.86	**1510**	12.50	1.53	7.91	**1735**	12.53	0.35	10.20
1250	12.50	2.41	4.06	**1515**	12.57	1.20	8.01	**1740**	12.67	0.31	10.23
1255	12.57	2.13	4.23	**1520**	12.59	0.90	8.09	**1745**	12.69	0.32	10.26
1300	12.65	2.50	4.44	**1525**	12.57	1.74	8.23	**1750`**	12.57	0.32	10.28
1305	12.64	2.51	4.65	**1530**	12.60	1.55	8.36	**1755**	12.65	0.29	10.31
1310	12.57	2.26	4.84	**1535**	12.60	1.75	8.51	**1800**	12.72	0.13	10.32
1315	12.72	2.34	5.03	**1540**	12.53	1.38	8.62	-	∑V	∑A	-
1320	12.65	2.45	5.24	**1545**	12.50	1.32	8.73	-	1070.67	123.82	-

Solar to Battery charging phase data (24/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	0	0.00	**1325**	12.65	2.12	5.21	**1550**	12.72	0.00	6.57
1105	12.50	1.43	0.12	**1330**	12.50	2.14	5.39	**1555**	12.43	0.00	6.57
1110	12.50	1.09	0.21	**1335**	12.57	1.09	5.48	**1600**	12.59	0.00	6.57
1115	12.57	0.99	0.29	**1340**	12.59	0.87	5.55	**1605**	12.64	0.00	6.57
1120	12.65	2.21	0.48	**1345**	12.57	0.99	5.64	**1610**	12.65	0.00	6.57
1125	12.67	2.29	0.67	**1350**	12.59	1.02	5.72	**1615**	12.67	0.00	6.57
1130	12.69	2.45	0.87	**1355**	12.59	1.31	5.83	**1620**	12.59	0.00	6.57
1135	12.60	2.67	1.09	**1400**	12.57	1.12	5.92	**1625**	12.64	0.04	6.57
1140	12.57	1.89	1.25	**1405**	12.59	0.94	6.00	**1630**	12.53	0.09	6.58
1145	12.64	2.25	1.44	**1410**	12.57	0.91	6.08	**1635**	12.50	0.16	6.59
1150	12.65	2.78	1.67	**1415**	12.57	1.14	6.17	**1640**	12.50	0.24	6.61
1155	12.67	2.38	1.87	**1420**	12.64	1.43	6.29	**1645**	12.57	0.22	6.63
1200	12.65	2.39	2.07	**1425**	12.53	0.94	6.37	**1650**	12.59	0.18	6.65
1205	12.64	2.37	2.27	**1430**	12.50	0.54	6.42	**1655**	12.65	0.18	6.66
1210	12.59	2.39	2.47	**1435**	12.64	0.55	6.46	**1700**	12.57	0.09	6.67
1215	12.57	2.45	2.67	**1440**	12.65	0.67	6.52	**1705**	12.65	0.12	6.68
1220	12.50	2.56	2.88	**1445**	12.50	0.30	6.54	**1710**	12.67	0.07	6.68
1225	12.50	2.24	3.07	**1450**	12.57	0.29	6.57	**1715**	12.57	0.17	6.70
1230	12.57	2.42	3.27	**1455**	12.59	0.02	6.57	**1720**	12.50	0.23	6.72
1235	12.65	2.03	3.44	**1500**	12.57	0.01	6.57	**1725**	12.50	0.11	6.73
1240	12.67	2.09	3.61	**1505**	12.59	0.00	6.57	**1730**	12.64	0.06	6.73
1245	12.69	2.15	3.79	**1510**	12.57	0.00	6.57	**1735**	12.72	0.12	6.74
1250	12.60	2.32	3.99	**1515**	12.60	0.00	6.57	**1740**	12.53	0.12	6.75
1255	12.57	2.12	4.16	**1520**	12.60	0.00	6.57	**1745**	12.50	0.10	6.76
1300	12.50	2.11	4.34	**1525**	12.53	0.00	6.57	**1750`**	12.57	0.07	6.77
1305	12.57	2.07	4.51	**1530**	12.50	0.00	6.57	**1755**	12.78	0.09	6.77
1310	12.50	2.00	4.68	**1535**	12.64	0.00	6.57	**1800**	12.80	0.09	6.78
1315	12.57	2.07	4.85	**1540**	12.65	0.00	6.57	-	∑V	∑A	-
1320	12.59	2.21	5.04	**1545**	12.50	0.00	6.57	-	1070.21	81.37	-

Solar to Battery charging phase data (25/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	2.32	0.19	**1325**	12.50	1.20	3.40	**1550**	12.57	0.76	5.68
1105	12.59	2.12	0.37	**1330**	12.57	1.04	3.49	**1555**	12.50	0.78	5.74
1110	12.65	2.00	0.54	**1335**	12.59	0.67	3.55	**1600**	12.50	0.88	5.82
1115	12.64	2.13	0.71	**1340**	12.65	0.76	3.61	**1605**	12.57	0.89	5.89
1120	12.53	1.97	0.88	**1345**	12.64	1.09	3.70	**1610**	12.65	0.56	5.94
1125	12.67	1.97	1.04	**1350**	12.53	1.13	3.79	**1615**	12.57	0.92	6.01
1130	12.69	1.84	1.20	**1355**	12.50	1.34	3.91	**1620**	12.57	0.67	6.07
1135	12.57	0.96	1.28	**1400**	12.50	1.32	4.02	**1625**	12.64	0.56	6.12
1140	12.57	1.03	1.36	**1405**	12.57	1.28	4.12	**1630**	12.65	0.67	6.17
1145	12.64	1.45	1.48	**1410**	12.50	1.10	4.21	**1635**	12.67	0.45	6.21
1150	12.65	2.01	1.65	**1415**	12.57	1.06	4.30	**1640**	12.65	0.56	6.26
1155	12.67	1.95	1.81	**1420**	12.59	1.08	4.39	**1645**	12.64	0.65	6.31
1200	12.65	1.05	1.90	**1425**	12.50	1.00	4.48	**1650**	12.59	0.53	6.35
1205	12.64	1.23	2.00	**1430**	12.57	0.95	4.56	**1655**	12.53	0.49	6.40
1210	12.59	0.87	2.08	**1435**	12.59	0.84	4.63	**1700**	12.67	0.69	6.45
1215	12.57	1.12	2.17	**1440**	12.57	0.63	4.68	**1705**	12.69	0.67	6.51
1220	12.50	0.99	2.25	**1445**	12.59	0.89	4.75	**1710**	12.57	0.53	6.55
1225	12.50	1.24	2.35	**1450**	12.59	0.79	4.82	**1715**	12.57	0.31	6.58
1230	12.57	1.27	2.46	**1455**	12.57	0.73	4.88	**1720**	12.64	0.25	6.60
1235	12.50	1.29	2.57	**1500**	12.59	1.03	4.96	**1725**	12.65	0.19	6.62
1240	12.50	1.33	2.68	**1505**	12.57	0.95	5.04	**1730**	12.50	0.23	6.63
1245	12.57	0.93	2.76	**1510**	12.57	0.78	5.11	**1735**	12.50	0.29	6.66
1250	12.65	0.74	2.82	**1515**	12.57	0.85	5.18	**1740**	12.57	0.30	6.68
1255	12.67	0.64	2.87	**1520**	12.57	1.02	5.26	**1745**	12.65	0.21	6.70
1300	12.69	0.64	2.92	**1525**	12.64	1.01	5.35	**1750`**	12.67	0.18	6.72
1305	12.69	1.02	3.01	**1530**	12.65	1.09	5.44	**1755**	12.69	0.12	6.73
1310	12.60	1.20	3.11	**1535**	12.67	0.87	5.51	**1800**	12.69	0.07	6.73
1315	12.57	1.19	3.21	**1540**	12.69	0.56	5.56	-	∑V	∑A	-
1320	12.64	1.14	3.30	**1545**	12.69	0.67	5.61	-	1070.8	80.78	-

Solar to Battery charging phase data (26/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.65	0	0.00	**1325**	12.50	2.03	5.20	**1550**	12.50	0.45	8.53
1105	12.64	2.25	0.19	**1330**	12.57	2.15	5.38	**1555**	12.64	0.78	8.60
1110	12.53	2.37	0.39	**1335**	12.59	1.98	5.55	**1600**	12.65	0.89	8.67
1115	12.67	2.23	0.57	**1340**	12.50	1.78	5.69	**1605**	12.50	1.02	8.76
1120	12.69	2.13	0.75	**1345**	12.57	2.01	5.86	**1610**	12.57	1.03	8.84
1125	12.57	2.00	0.92	**1350**	12.59	1.94	6.02	**1615**	12.59	0.89	8.92
1130	12.57	1.53	1.04	**1355**	12.57	1.92	6.18	**1620**	12.57	0.79	8.98
1135	12.64	1.97	1.21	**1400**	12.59	1.85	6.34	**1625**	12.59	0.89	9.06
1140	12.65	1.54	1.34	**1405**	12.59	1.89	6.50	**1630**	12.57	1.02	9.14
1145	12.67	1.93	1.50	**1410**	12.65	1.76	6.64	**1635**	12.67	1.07	9.23
1150	12.65	1.89	1.65	**1415**	12.57	1.65	6.78	**1640**	12.57	0.78	9.30
1155	12.57	1.97	1.82	**1420**	12.65	1.56	6.91	**1645**	12.50	0.89	9.37
1200	12.59	2.76	2.05	**1425**	12.67	1.87	7.07	**1650**	12.50	0.87	9.44
1205	12.65	2.34	2.24	**1430**	12.57	1.64	7.20	**1655**	12.64	0.75	9.51
1210	12.64	2.23	2.43	**1435**	12.57	1.34	7.31	**1700**	12.72	0.70	9.56
1215	12.53	2.31	2.62	**1440**	12.57	1.37	7.43	**1705**	12.53	0.65	9.62
1220	12.67	2.44	2.82	**1445**	12.64	1.45	7.55	**1710**	12.65	0.68	9.68
1225	12.57	2.43	3.03	**1450**	12.65	1.25	7.65	**1715**	12.67	0.54	9.72
1230	12.50	2.17	3.21	**1455**	12.67	1.36	7.77	**1720**	12.69	0.47	9.76
1235	12.50	2.34	3.40	**1500**	12.65	1.30	7.87	**1725**	12.60	0.56	9.81
1240	12.57	2.19	3.59	**1505**	12.57	0.98	7.96	**1730**	12.57	0.60	9.86
1245	12.65	2.38	3.78	**1510**	12.59	0.76	8.02	**1735**	12.50	0.42	9.89
1250	12.57	2.48	3.99	**1515**	12.65	0.64	8.07	**1740**	12.57	0.49	9.93
1255	12.57	2.04	4.16	**1520**	12.59	0.89	8.15	**1745**	12.50	0.33	9.96
1300	12.57	2.15	4.34	**1525**	12.65	0.77	8.21	**1750`**	12.65	0.31	9.99
1305	12.59	1.97	4.50	**1530**	12.57	1.01	8.30	**1755**	12.64	0.31	10.01
1310	12.65	2.04	4.67	**1535**	12.65	0.87	8.37	**1800**	12.53	0.20	10.03
1315	12.64	2.23	4.86	**1540**	12.57	0.87	8.44	-	∑V	∑A	-
1320	12.53	2.08	5.03	**1545**	12.64	0.67	8.50	-	1070.78	120.33	-

Solar to Battery charging phase data (27/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	2.00	0.17	**1325**	12.57	1.98	5.76	**1550**	12.59	0.76	10.04
1105	12.64	2.00	0.33	**1330**	12.65	1.78	5.91	**1555**	12.50	0.45	10.08
1110	12.65	2.08	0.51	**1335**	12.57	2.01	6.07	**1600**	12.57	0.56	10.13
1115	12.67	2.14	0.69	**1340**	12.57	1.94	6.23	**1605**	12.59	0.98	10.21
1120	12.65	2.35	0.88	**1345**	12.64	1.92	6.39	**1610**	12.57	0.78	10.28
1125	12.65	2.29	1.07	**1350**	12.65	1.85	6.55	**1615**	12.59	0.88	10.35
1130	12.67	2.45	1.28	**1355**	12.67	1.89	6.71	**1620**	12.59	0.89	10.42
1135	12.69	2.51	1.49	**1400**	12.65	1.76	6.85	**1625**	12.65	0.56	10.47
1140	12.60	2.54	1.70	**1405**	12.64	1.65	6.99	**1630**	12.57	0.97	10.55
1145	12.57	2.61	1.91	**1410**	12.59	1.56	7.12	**1635**	12.65	0.67	10.61
1150	12.67	2.57	2.13	**1415**	12.53	1.87	7.28	**1640**	12.67	0.56	10.65
1155	12.65	2.60	2.35	**1420**	12.67	1.80	7.43	**1645**	12.67	0.67	10.71
1200	12.64	2.61	2.56	**1425**	12.69	1.89	7.58	**1650**	12.65	0.45	10.75
1205	12.53	2.57	2.78	**1430**	12.57	1.76	7.73	**1655**	12.64	0.57	10.79
1210	12.60	2.60	2.99	**1435**	12.59	1.67	7.87	**1700**	12.59	0.56	10.84
1215	12.50	2.56	3.21	**1440**	12.57	1.89	8.03	**1705**	12.57	0.67	10.90
1220	12.65	2.56	3.42	**1445**	12.67	1.98	8.19	**1710**	12.50	0.63	10.95
1225	12.57	2.14	3.60	**1450**	12.57	2.03	8.36	**1715**	12.50	0.73	11.01
1230	12.67	2.35	3.79	**1455**	12.50	2.13	8.54	**1720**	12.57	0.67	11.07
1235	12.69	2.29	3.99	**1500**	12.50	2.24	8.73	**1725**	12.59	0.54	11.11
1240	12.57	1.52	4.11	**1505**	12.64	2.11	8.90	**1730**	12.57	0.43	11.15
1245	12.57	1.90	4.27	**1510**	12.72	2.17	9.08	**1735**	12.59	0.43	11.18
1250	12.64	2.56	4.48	**1515**	12.57	2.07	9.25	**1740**	12.57	0.56	11.23
1255	12.65	2.56	4.70	**1520**	12.50	1.89	9.41	**1745**	12.67	0.63	11.28
1300	12.50	2.14	4.88	**1525**	12.50	1.65	9.55	**1750`**	12.57	0.31	11.31
1305	12.65	2.35	5.07	**1530**	12.59	1.89	9.71	**1755**	12.72	0.24	11.33
1310	12.64	2.03	5.24	**1535**	12.57	1.34	9.82	**1800**	12.83	0.14	11.34
1315	12.53	2.12	5.42	**1540**	12.67	0.98	9.90	-	∑V	∑A	-
1320	12.67	2.10	5.59	**1545**	12.64	0.97	9.98	-	1071.75	136.06	-

Solar to Battery charging phase data (28/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.41	0.02	0.00	**1325**	12.62	2.02	5.36	**1550**	12.50	0.00	6.56
1105	12.43	1.67	0.14	**1330**	12.62	2.01	5.53	**1555**	12.57	0.00	6.56
1110	12.46	1.89	0.30	**1335**	12.64	2.32	5.72	**1600**	12.59	0.00	6.56
1115	12.47	1.45	0.42	**1340**	12.67	2.09	5.89	**1605**	12.57	0.00	6.56
1120	12.47	2.34	0.61	**1345**	12.65	1.12	5.99	**1610**	12.59	0.00	6.56
1125	12.50	2.23	0.80	**1350**	12.65	2.02	6.16	**1615**	12.57	0.00	6.56
1130	12.48	2.56	1.01	**1355**	12.65	1.51	6.28	**1620**	12.67	0.12	6.57
1135	12.53	2.44	1.22	**1400**	12.64	1.09	6.37	**1625**	12.57	0.32	6.60
1140	12.50	1.98	1.38	**1405**	12.64	1.01	6.46	**1630**	12.50	0.43	6.63
1145	12.57	1.24	1.49	**1410**	12.63	0.55	6.50	**1635**	12.50	0.54	6.68
1150	12.60	2.45	1.69	**1415**	12.64	0.34	6.53	**1640**	12.64	0.54	6.72
1155	12.57	2.56	1.90	**1420**	12.58	0.23	6.55	**1645**	12.72	0.34	6.75
1200	12.64	2.47	2.11	**1425**	12.58	0.12	6.56	**1650**	12.57	0.66	6.81
1205	12.65	2.00	2.28	**1430**	12.60	0.01	6.56	**1655**	12.59	0.56	6.85
1210	12.67	2.34	2.47	**1435**	12.64	0.00	6.56	**1700**	12.57	0.42	6.89
1215	12.69	2.35	2.67	**1440**	12.64	0.00	6.56	**1705**	12.59	0.52	6.93
1220	12.72	2.37	2.86	**1445**	12.67	0.00	6.56	**1710**	12.57	0.46	6.97
1225	12.70	2.44	3.07	**1450**	12.69	0.00	6.56	**1715**	12.67	0.23	6.99
1230	12.74	2.35	3.26	**1455**	12.64	0.00	6.56	**1720**	12.57	0.31	7.01
1235	12.75	2.38	3.46	**1500**	12.64	0.00	6.56	**1725**	12.50	0.25	7.04
1240	12.75	2.57	3.68	**1505**	12.64	0.00	6.56	**1730**	12.50	0.29	7.06
1245	12.74	2.54	3.89	**1510**	12.66	0.00	6.56	**1735**	12.64	0.13	7.07
1250	12.41	2.81	4.12	**1515**	12.67	0.00	6.56	**1740**	12.67	0.24	7.09
1255	12.43	2.23	4.31	**1520**	12.69	0.00	6.56	**1745**	12.69	0.12	7.10
1300	12.46	2.10	4.48	**1525**	12.71	0.00	6.56	**1750`**	12.64	0.19	7.12
1305	12.47	2.09	4.66	**1530**	12.61	0.00	6.56	**1755**	12.64	0.10	7.12
1310	12.47	2.03	4.83	**1535**	12.72	0.00	6.56	**1800**	12.64	0.09	7.13
1315	12.50	2.14	5.00	**1540**	12.60	0.00	6.56	-	∑V	∑A	-
1320	12.48	2.24	5.19	**1545**	12.60	0.00	6.56	-	1070.93	85.58	-

Solar to Battery charging phase data (29/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.65	1.03	0.09	**1325**	12.81	1.34	2.39	**1550**	12.50	0.29	4.24
1105	12.67	1.11	0.18	**1330**	12.87	1.45	2.51	**1555**	12.57	0.43	4.28
1110	12.69	1.32	0.29	**1335**	12.91	0.97	2.59	**1600**	12.59	0.39	4.31
1115	12.60	1.10	0.38	**1340**	12.86	0.83	2.66	**1605**	12.57	0.49	4.35
1120	12.57	1.09	0.47	**1345**	12.67	0.79	2.73	**1610**	12.59	0.38	4.38
1125	12.67	0.79	0.54	**1350**	12.82	0.86	2.80	**1615**	12.59	0.43	4.42
1130	12.65	0.87	0.61	**1355**	12.57	0.83	2.87	**1620**	12.65	0.32	4.44
1135	12.64	0.76	0.67	**1400**	12.69	0.63	2.92	**1625**	12.57	0.54	4.49
1140	12.53	1.03	0.76	**1405**	12.67	0.50	2.96	**1630**	12.65	0.47	4.53
1145	12.60	1.00	0.84	**1410**	12.69	0.64	3.02	**1635**	12.67	0.58	4.58
1150	12.67	1.01	0.93	**1415**	12.72	0.52	3.06	**1640**	12.57	0.43	4.61
1155	12.67	0.86	1.00	**1420**	12.77	0.40	3.09	**1645**	12.57	0.45	4.65
1200	12.65	0.87	1.07	**1425**	12.74	0.73	3.15	**1650**	12.57	0.32	4.68
1205	12.64	1.03	1.16	**1430**	12.79	0.60	3.20	**1655**	12.64	0.50	4.72
1210	12.59	1.03	1.24	**1435**	12.75	0.82	3.27	**1700**	12.65	0.37	4.75
1215	12.57	1.25	1.35	**1440**	12.86	0.87	3.34	**1705**	12.67	0.29	4.77
1220	12.50	1.21	1.45	**1445**	12.75	0.65	3.40	**1710**	12.69	0.19	4.79
1225	12.50	1.01	1.53	**1450**	12.75	0.32	3.42	**1715**	12.60	0.23	4.81
1230	12.57	0.98	1.61	**1455**	12.67	0.98	3.51	**1720**	12.57	0.29	4.83
1235	12.59	0.65	1.67	**1500**	12.67	0.87	3.58	**1725**	12.67	0.25	4.85
1240	12.57	0.45	1.70	**1505**	12.77	0.98	3.66	**1730**	12.53	0.27	4.87
1245	12.59	0.69	1.76	**1510**	12.82	0.87	3.73	**1735**	12.67	0.12	4.88
1250	12.57	0.76	1.83	**1515**	12.79	1.05	3.82	**1740**	12.69	0.19	4.90
1255	12.67	0.79	1.89	**1520**	12.74	0.98	3.90	**1745**	12.57	0.16	4.91
1300	12.75	0.98	1.97	**1525**	12.87	0.91	3.98	**1750`**	12.59	0.12	4.92
1305	12.75	0.69	2.03	**1530**	12.86	0.83	4.05	**1755**	12.57	0.09	4.93
1310	12.74	0.87	2.10	**1535**	12.89	0.73	4.11	**1800**	12.50	0.03	4.93
1315	12.41	1.05	2.19	**1540**	12.84	0.75	4.17	-	∑V	∑A	-
1320	12.59	1.06	2.28	**1545**	12.84	0.54	4.22	-	1076.58	59.2	-

Solar to Battery charging phase data (30/11/2022)

Time	Voltage	Current	Ah	Time	Voltage	Current	Ah	Time	Voltage	Current	Ah
1100	12.57	0	0.00	**1325**	12.87	2.06	5.72	**1550**	12.64	0.45	9.02
1105	12.64	2.57	0.21	**1330**	12.91	2.15	5.90	**1555**	12.64	0.78	9.08
1110	12.65	2.50	0.42	**1335**	12.86	1.98	6.07	**1600**	12.65	0.89	9.16
1115	12.67	2.60	0.64	**1340**	12.67	1.78	6.21	**1605**	12.79	1.02	9.24
1120	12.65	2.63	0.86	**1345**	12.82	2.01	6.38	**1610**	12.74	1.03	9.33
1125	12.65	2.54	1.07	**1350**	12.57	1.94	6.54	**1615**	12.79	0.89	9.40
1130	12.67	2.32	1.26	**1355**	12.69	1.92	6.70	**1620**	12.68	0.79	9.47
1135	12.69	1.97	1.43	**1400**	12.67	1.85	6.86	**1625**	12.60	0.89	9.54
1140	12.60	1.78	1.58	**1405**	12.69	1.89	7.01	**1630**	12.64	1.02	9.63
1145	12.57	2.20	1.76	**1410**	12.72	1.76	7.16	**1635**	12.67	1.07	9.71
1150	12.67	2.40	1.96	**1415**	12.77	1.65	7.30	**1640**	12.60	0.78	9.78
1155	12.65	2.58	2.17	**1420**	12.65	1.56	7.43	**1645**	12.60	0.89	9.85
1200	12.64	2.55	2.39	**1425**	12.65	1.87	7.58	**1650**	12.58	0.87	9.93
1205	12.53	2.48	2.59	**1430**	12.67	1.64	7.72	**1655**	12.57	0.75	9.99
1210	12.60	2.39	2.79	**1435**	12.69	1.34	7.83	**1700**	12.57	0.70	10.05
1215	12.50	2.61	3.01	**1440**	12.60	1.37	7.95	**1705**	12.60	0.65	10.10
1220	12.65	2.60	3.23	**1445**	12.57	1.45	8.07	**1710**	12.64	0.68	10.16
1225	12.57	2.55	3.44	**1450**	12.67	1.25	8.17	**1715**	12.58	0.65	10.21
1230	12.65	2.47	3.65	**1455**	12.65	1.36	8.29	**1720**	12.58	0.45	10.25
1235	12.67	2.43	3.85	**1500**	12.64	1.30	8.39	**1725**	12.72	0.56	10.30
1240	12.69	2.32	4.04	**1505**	12.59	0.98	8.48	**1730**	12.57	0.59	10.35
1245	12.60	2.15	4.22	**1510**	12.59	0.78	8.54	**1735**	12.50	0.40	10.38
1250	12.57	2.38	4.42	**1515**	12.65	0.66	8.60	**1740**	12.50	0.46	10.42
1255	12.67	2.28	4.61	**1520**	12.57	0.79	8.66	**1745**	12.59	0.37	10.45
1300	12.65	2.40	4.81	**1525**	12.65	0.75	8.72	**1750`**	12.57	0.34	10.48
1305	12.64	2.28	5.00	**1530**	12.67	0.98	8.81	**1755**	12.67	0.28	10.50
1310	12.53	2.16	5.18	**1535**	12.60	0.65	8.86	**1800**	12.64	0.24	10.52
1315	12.60	2.13	5.36	**1540**	12.57	0.87	8.93	-	∑V	∑A	-
1320	12.67	2.32	5.55	**1545**	12.67	0.56	8.98	-	1074.62	126.23	-

APPENDIX C: DISCHARGING PHASE

Battery to water pump discharging phase data (01/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	11.86	2.39	0.20	28.3	2.4	**0135**	11.65	2.08	3.57	24.2	41.9
0010	11.84	2.45	0.41	29.0	4.8	**0140**	11.63	2.08	3.74	24.2	43.9
0015	11.83	2.44	0.62	28.5	7.3	**0145**	11.61	2.08	3.92	24.1	45.9
0020	11.82	2.42	0.81	28.5	9.6	**0150**	11.61	2.08	4.09	24.1	47.9
0025	11.80	2.40	1.01	28.3	12.0	**0155**	11.60	2.08	4.27	24.1	50.0
0030	11.79	2.35	1.20	27.7	14.2	**0200**	11.58	2.06	4.45	23.8	52.1
0035	11.79	2.26	1.39	26.6	16.5	**0205**	11.57	2.05	4.61	23.7	54.0
0040	11.77	2.26	1.58	26.6	18.7	**0210**	11.56	2.07	4.78	23.9	55.9
0045	11.76	2.23	1.78	26.3	21.0	**0215**	11.55	2.06	4.95	23.7	57.9
0050	11.75	2.19	1.96	25.7	23.1	**0220**	11.54	2.06	5.12	23.7	59.9
0055	11.73	2.17	2.15	25.6	25.4	**0225**	11.52	2.06	5.30	23.7	61.9
0100	11.73	2.17	2.32	25.4	27.3	**0230**	11.50	2.05	5.47	23.5	63.9
0105	11.72	2.16	2.51	25.3	29.6	**0235**	11.50	2.05	5.64	23.5	65.9
0110	11.70	2.14	2.68	25.0	31.6	**0240**	11.48	2.07	5.81	23.7	67.8
0115	11.69	2.11	2.87	24.6	33.8	**0245**	11.47	2.07	5.99	23.7	69.8
0120	11.68	2.11	3.03	24.6	35.7	**0250**	11.45	2.06	6.16	23.5	71.8
0125	11.67	2.11	3.22	24.6	37.8	**0255**	11.44	2.04	6.34	23.3	73.8
0130	11.66	2.10	3.39	24.4	39.9	**0300**	11.43	2.06	6.50	23.5	75.7

Battery to water pump discharging phase data (02/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.04	2.49	0.21	30.02	2.50	**0135**	11.83	2.37	3.85	28.00	45.92
0010	12.03	2.48	0.41	29.89	4.99	**0140**	11.81	2.36	4.04	27.89	48.24
0015	12.02	2.48	0.62	29.78	7.47	**0145**	11.80	2.35	4.24	27.78	50.55
0020	12.00	2.47	0.83	29.66	9.95	**0150**	11.79	2.35	4.44	27.66	52.86
0025	11.99	2.46	1.03	29.55	12.41	**0155**	11.78	2.34	4.63	27.55	55.16
0030	11.98	2.46	1.24	29.44	14.86	**0200**	11.77	2.33	4.83	27.44	57.44
0035	11.97	2.45	1.44	29.33	17.31	**0205**	11.75	2.33	5.02	27.33	59.72
0040	11.96	2.44	1.65	29.22	19.74	**0210**	11.74	2.32	5.21	27.22	61.99
0045	11.94	2.44	1.85	29.11	22.17	**0215**	11.73	2.31	5.40	27.11	64.25
0050	11.93	2.43	2.05	29.00	24.58	**0220**	11.72	2.30	5.60	27.00	66.50
0055	11.92	2.42	2.25	28.89	26.99	**0225**	11.71	2.30	5.79	26.89	68.74
0100	11.91	2.42	2.45	28.78	29.39	**0230**	11.69	2.29	5.98	26.78	70.97
0105	11.90	2.41	2.66	28.66	31.78	**0235**	11.68	2.28	6.17	26.66	73.19
0110	11.88	2.40	2.86	28.55	34.16	**0240**	11.67	2.28	6.36	26.55	75.40
0115	11.87	2.40	3.05	28.44	36.53	**0245**	11.66	2.27	6.55	26.44	77.61
0120	11.86	2.39	3.25	28.33	38.89	**0250**	11.65	2.26	6.74	26.33	79.80
0125	11.85	2.38	3.45	28.22	41.24	**0255**	11.63	2.25	6.92	26.22	81.99
0130	11.84	2.37	3.65	28.11	43.58	**0300**	11.62	2.25	7.11	26.11	84.16

Battery to water pump discharging phase data (03/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	11.98	2.39	0.20	28.59	2.38	**0135**	11.77	2.26	3.68	26.57	43.65
0010	11.97	2.38	0.40	28.46	4.75	**0140**	11.75	2.25	3.86	26.46	45.86
0015	11.96	2.37	0.59	28.35	7.12	**0145**	11.74	2.24	4.05	26.35	48.05
0020	11.94	2.36	0.79	28.23	9.47	**0150**	11.73	2.24	4.24	26.23	50.24
0025	11.93	2.36	0.99	28.12	11.81	**0155**	11.72	2.23	4.42	26.12	52.41
0030	11.92	2.35	1.18	28.01	14.15	**0200**	11.71	2.22	4.61	26.01	54.58
0035	11.91	2.34	1.38	27.90	16.47	**0205**	11.69	2.22	4.79	25.90	56.74
0040	11.90	2.34	1.57	27.79	18.79	**0210**	11.68	2.21	4.98	25.79	58.89
0045	11.88	2.33	1.77	27.68	21.09	**0215**	11.67	2.20	5.16	25.68	61.03
0050	11.87	2.32	1.96	27.57	23.39	**0220**	11.66	2.19	5.34	25.57	63.16
0055	11.86	2.31	2.15	27.46	25.68	**0225**	11.65	2.19	5.53	25.46	65.28
0100	11.85	2.31	2.35	27.35	27.96	**0230**	11.63	2.18	5.71	25.35	67.39
0105	11.84	2.30	2.54	27.23	30.23	**0235**	11.62	2.17	5.89	25.23	69.50
0110	11.82	2.29	2.73	27.12	32.49	**0240**	11.61	2.16	6.07	25.12	71.59
0115	11.81	2.29	2.92	27.01	34.74	**0245**	11.60	2.16	6.25	25.01	73.67
0120	11.80	2.28	3.11	26.90	36.98	**0250**	11.59	2.15	6.43	24.90	75.75
0125	11.79	2.27	3.30	26.79	39.21	**0255**	11.57	2.14	6.61	24.79	77.82
0130	11.78	2.27	3.49	26.68	41.44	**0300**	11.56	2.13	6.78	24.68	79.87

Battery to water pump discharging phase data (04/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.13	2.39	0.20	28.95	2.41	**0135**	11.92	2.26	3.68	26.93	44.22
0010	12.12	2.38	0.40	28.82	4.81	**0140**	11.90	2.25	3.87	26.82	46.46
0015	12.11	2.37	0.59	28.71	7.21	**0145**	11.89	2.25	4.05	26.71	48.68
0020	12.09	2.36	0.79	28.59	9.59	**0150**	11.88	2.24	4.24	26.59	50.90
0025	12.08	2.36	0.99	28.48	11.96	**0155**	11.87	2.23	4.43	26.48	53.10
0030	12.07	2.35	1.18	28.37	14.33	**0200**	11.86	2.22	4.61	26.37	55.30
0035	12.06	2.34	1.38	28.26	16.68	**0205**	11.84	2.22	4.80	26.26	57.49
0040	12.05	2.34	1.57	28.15	19.03	**0210**	11.83	2.21	4.98	26.15	59.67
0045	12.03	2.33	1.77	28.04	21.36	**0215**	11.82	2.20	5.16	26.04	61.84
0050	12.02	2.32	1.96	27.93	23.69	**0220**	11.81	2.20	5.35	25.93	64.00
0055	12.01	2.32	2.15	27.82	26.01	**0225**	11.80	2.19	5.53	25.82	66.15
0100	12.00	2.31	2.35	27.71	28.32	**0230**	11.78	2.18	5.71	25.71	68.29
0105	11.99	2.30	2.54	27.59	30.62	**0235**	11.77	2.17	5.89	25.59	70.43
0110	11.97	2.30	2.73	27.48	32.91	**0240**	11.76	2.17	6.07	25.48	72.55
0115	11.96	2.29	2.92	27.37	35.19	**0245**	11.75	2.16	6.25	25.37	74.66
0120	11.95	2.28	3.11	27.26	37.46	**0250**	11.74	2.15	6.43	25.26	76.77
0125	11.94	2.27	3.30	27.15	39.72	**0255**	11.72	2.15	6.61	25.15	78.87
0130	11.93	2.27	3.49	27.04	41.98	**0300**	11.71	2.14	6.79	25.04	80.95

Battery to water pump discharging phase data (05/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.30	2.39	0.20	29.34	2.44	**0135**	12.09	2.26	3.68	27.32	44.84
0010	12.29	2.38	0.40	29.21	4.88	**0140**	12.07	2.25	3.87	27.21	47.11
0015	12.28	2.37	0.59	29.10	7.30	**0145**	12.06	2.25	4.05	27.10	49.36
0020	12.26	2.36	0.79	28.98	9.72	**0150**	12.05	2.24	4.24	26.98	51.61
0025	12.25	2.36	0.99	28.87	12.13	**0155**	12.04	2.23	4.42	26.87	53.85
0030	12.24	2.35	1.18	28.76	14.52	**0200**	12.03	2.23	4.61	26.76	56.08
0035	12.23	2.34	1.38	28.65	16.91	**0205**	12.01	2.22	4.80	26.65	58.30
0040	12.22	2.34	1.57	28.54	19.29	**0210**	12.00	2.21	4.98	26.54	60.51
0045	12.20	2.33	1.77	28.43	21.66	**0215**	11.99	2.20	5.16	26.43	62.72
0050	12.19	2.32	1.96	28.32	24.02	**0220**	11.98	2.20	5.35	26.32	64.91
0055	12.18	2.32	2.15	28.21	26.37	**0225**	11.97	2.19	5.53	26.21	67.09
0100	12.17	2.31	2.35	28.10	28.71	**0230**	11.95	2.18	5.71	26.10	69.27
0105	12.16	2.30	2.54	27.98	31.04	**0235**	11.94	2.18	5.89	25.98	71.43
0110	12.14	2.30	2.73	27.87	33.36	**0240**	11.93	2.17	6.07	25.87	73.59
0115	12.13	2.29	2.92	27.76	35.68	**0245**	11.92	2.16	6.25	25.76	75.74
0120	12.12	2.28	3.11	27.65	37.98	**0250**	11.91	2.15	6.43	25.65	77.87
0125	12.11	2.27	3.30	27.54	40.28	**0255**	11.89	2.15	6.61	25.54	80.00
0130	12.10	2.27	3.49	27.43	42.56	**0300**	11.88	2.14	6.80	25.43	82.12

Battery to water pump discharging phase data (06/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.48	2.39	0.20	29.78	2.48	**0135**	12.27	2.26	3.68	27.76	45.54
0010	12.47	2.38	0.40	29.65	4.95	**0140**	12.25	2.26	3.87	27.65	47.84
0015	12.46	2.37	0.59	29.54	7.41	**0145**	12.24	2.25	4.06	27.54	50.13
0020	12.44	2.36	0.79	29.42	9.87	**0150**	12.23	2.24	4.24	27.42	52.42
0025	12.43	2.36	0.99	29.31	12.31	**0155**	12.22	2.24	4.43	27.31	54.70
0030	12.42	2.35	1.18	29.20	14.74	**0200**	12.21	2.23	4.61	27.20	56.96
0035	12.41	2.34	1.38	29.09	17.17	**0205**	12.19	2.22	4.80	27.09	59.22
0040	12.40	2.34	1.57	28.98	19.58	**0210**	12.18	2.21	4.98	26.98	61.47
0045	12.38	2.33	1.77	28.87	21.99	**0215**	12.17	2.21	5.17	26.87	63.71
0050	12.37	2.32	1.96	28.76	24.38	**0220**	12.16	2.20	5.35	26.76	65.94
0055	12.36	2.32	2.16	28.65	26.77	**0225**	12.15	2.19	5.53	26.65	68.16
0100	12.35	2.31	2.35	28.54	29.15	**0230**	12.13	2.19	5.72	26.54	70.37
0105	12.34	2.30	2.54	28.42	31.52	**0235**	12.12	2.18	5.90	26.42	72.57
0110	12.32	2.30	2.73	28.31	33.88	**0240**	12.11	2.17	6.08	26.31	74.76
0115	12.31	2.29	2.92	28.20	36.23	**0245**	12.10	2.17	6.26	26.20	76.95
0120	12.30	2.28	3.11	28.09	38.57	**0250**	12.09	2.16	6.44	26.09	79.12
0125	12.29	2.28	3.30	27.98	40.90	**0255**	12.07	2.15	6.62	25.98	81.29
0130	12.28	2.27	3.49	27.87	43.22	**0300**	12.06	2.14	6.80	25.87	83.44

Battery to water pump discharging phase data (07/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.72	2.39	0.20	30.37	2.53	**0135**	12.51	2.27	3.68	28.35	46.47
0010	12.71	2.38	0.40	30.24	5.05	**0140**	12.49	2.26	3.87	28.24	48.82
0015	12.70	2.37	0.59	30.13	7.56	**0145**	12.48	2.25	4.06	28.13	51.17
0020	12.68	2.37	0.79	30.01	10.06	**0150**	12.47	2.25	4.25	28.01	53.50
0025	12.67	2.36	0.99	29.90	12.55	**0155**	12.46	2.24	4.43	27.90	55.83
0030	12.66	2.35	1.18	29.79	15.04	**0200**	12.45	2.23	4.62	27.79	58.14
0035	12.65	2.35	1.38	29.68	17.51	**0205**	12.43	2.23	4.81	27.68	60.45
0040	12.64	2.34	1.58	29.57	19.97	**0210**	12.42	2.22	4.99	27.57	62.75
0045	12.62	2.33	1.77	29.46	22.43	**0215**	12.41	2.21	5.18	27.46	65.03
0050	12.61	2.33	1.96	29.35	24.88	**0220**	12.40	2.21	5.36	27.35	67.31
0055	12.60	2.32	2.16	29.24	27.31	**0225**	12.39	2.20	5.54	27.24	69.58
0100	12.59	2.31	2.35	29.13	29.74	**0230**	12.37	2.19	5.72	27.13	71.84
0105	12.58	2.31	2.54	29.01	32.16	**0235**	12.36	2.19	5.91	27.01	74.10
0110	12.56	2.30	2.73	28.90	34.57	**0240**	12.35	2.18	6.09	26.90	76.34
0115	12.55	2.29	2.93	28.79	36.96	**0245**	12.34	2.17	6.27	26.79	78.57
0120	12.54	2.29	3.12	28.68	39.35	**0250**	12.33	2.16	6.45	26.68	80.79
0125	12.53	2.28	3.31	28.57	41.74	**0255**	12.31	2.16	6.63	26.57	83.01
0130	12.52	2.27	3.50	28.46	44.11	**0300**	12.30	2.15	6.81	26.46	85.21

Battery to water pump discharging phase data (08/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.64	2.39	0.20	30.16	2.51	**0135**	12.43	2.26	3.68	28.14	46.14
0010	12.63	2.38	0.40	30.03	5.02	**0140**	12.41	2.26	3.87	28.03	48.47
0015	12.62	2.37	0.59	29.92	7.51	**0145**	12.40	2.25	4.06	27.92	50.80
0020	12.60	2.36	0.79	29.80	9.99	**0150**	12.39	2.24	4.24	27.80	53.12
0025	12.59	2.36	0.99	29.69	12.47	**0155**	12.38	2.24	4.43	27.69	55.42
0030	12.58	2.35	1.18	29.58	14.93	**0200**	12.37	2.23	4.62	27.58	57.72
0035	12.57	2.34	1.38	29.47	17.39	**0205**	12.35	2.22	4.80	27.47	60.01
0040	12.56	2.34	1.57	29.36	19.83	**0210**	12.34	2.22	4.99	27.36	62.29
0045	12.54	2.33	1.77	29.25	22.27	**0215**	12.33	2.21	5.17	27.25	64.56
0050	12.53	2.32	1.96	29.14	24.70	**0220**	12.32	2.20	5.35	27.14	66.82
0055	12.52	2.32	2.16	29.03	27.12	**0225**	12.31	2.20	5.54	27.03	69.08
0100	12.51	2.31	2.35	28.92	29.53	**0230**	12.29	2.19	5.72	26.92	71.32
0105	12.50	2.30	2.54	28.80	31.93	**0235**	12.28	2.18	5.90	26.80	73.55
0110	12.48	2.30	2.73	28.69	34.32	**0240**	12.27	2.18	6.08	26.69	75.78
0115	12.47	2.29	2.92	28.58	36.70	**0245**	12.26	2.17	6.26	26.58	77.99
0120	12.46	2.28	3.11	28.47	39.07	**0250**	12.25	2.16	6.44	26.47	80.20
0125	12.45	2.28	3.30	28.36	41.44	**0255**	12.23	2.15	6.62	26.36	82.39
0130	12.44	2.27	3.49	28.25	43.79	**0300**	12.22	2.15	6.80	26.25	84.58

Battery to water pump discharging phase data (09/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.43	2.39	0.20	29.68	2.47	**0135**	12.22	2.26	3.68	27.66	45.38
0010	12.42	2.38	0.40	29.55	4.94	**0140**	12.20	2.26	3.87	27.55	47.67
0015	12.41	2.37	0.59	29.44	7.39	**0145**	12.19	2.25	4.06	27.44	49.96
0020	12.39	2.37	0.79	29.32	9.83	**0150**	12.18	2.24	4.24	27.32	52.24
0025	12.38	2.36	0.99	29.21	12.27	**0155**	12.17	2.24	4.43	27.21	54.50
0030	12.37	2.35	1.18	29.10	14.69	**0200**	12.16	2.23	4.62	27.10	56.76
0035	12.36	2.35	1.38	28.99	17.11	**0205**	12.14	2.22	4.80	26.99	59.01
0040	12.35	2.34	1.58	28.88	19.51	**0210**	12.13	2.22	4.99	26.88	61.25
0045	12.33	2.33	1.77	28.77	21.91	**0215**	12.12	2.21	5.17	26.77	63.48
0050	12.32	2.33	1.96	28.66	24.30	**0220**	12.11	2.20	5.35	26.66	65.70
0055	12.31	2.32	2.16	28.55	26.68	**0225**	12.10	2.19	5.54	26.55	67.92
0100	12.30	2.31	2.35	28.44	29.05	**0230**	12.08	2.19	5.72	26.44	70.12
0105	12.29	2.31	2.54	28.32	31.41	**0235**	12.07	2.18	5.90	26.32	72.31
0110	12.27	2.30	2.73	28.21	33.76	**0240**	12.06	2.17	6.08	26.21	74.50
0115	12.26	2.29	2.92	28.10	36.10	**0245**	12.05	2.17	6.26	26.10	76.67
0120	12.25	2.28	3.11	27.99	38.43	**0250**	12.04	2.16	6.44	25.99	78.84
0125	12.24	2.28	3.30	27.88	40.76	**0255**	12.02	2.15	6.62	25.88	80.99
0130	12.23	2.27	3.49	27.77	43.07	**0300**	12.01	2.15	6.80	25.77	83.14

Battery to water pump discharging phase data (10/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.36	2.39	0.20	29.49	2.46	**0135**	12.15	2.26	3.68	27.47	45.08
0010	12.35	2.38	0.40	29.36	4.90	**0140**	12.13	2.25	3.87	27.36	47.36
0015	12.34	2.37	0.59	29.25	7.34	**0145**	12.12	2.25	4.05	27.25	49.63
0020	12.32	2.36	0.79	29.13	9.77	**0150**	12.11	2.24	4.24	27.13	51.89
0025	12.31	2.36	0.99	29.02	12.19	**0155**	12.10	2.23	4.43	27.02	54.14
0030	12.30	2.35	1.18	28.91	14.60	**0200**	12.09	2.23	4.61	26.91	56.38
0035	12.29	2.34	1.38	28.80	17.00	**0205**	12.07	2.22	4.80	26.80	58.62
0040	12.28	2.34	1.57	28.69	19.39	**0210**	12.06	2.21	4.98	26.69	60.84
0045	12.26	2.33	1.77	28.58	21.77	**0215**	12.05	2.21	5.17	26.58	63.05
0050	12.25	2.32	1.96	28.47	24.14	**0220**	12.04	2.20	5.35	26.47	65.26
0055	12.24	2.32	2.15	28.36	26.50	**0225**	12.03	2.19	5.53	26.36	67.46
0100	12.23	2.31	2.35	28.25	28.86	**0230**	12.01	2.18	5.71	26.25	69.64
0105	12.22	2.30	2.54	28.13	31.20	**0235**	12.00	2.18	5.89	26.13	71.82
0110	12.20	2.30	2.73	28.02	33.54	**0240**	11.99	2.17	6.08	26.02	73.99
0115	12.19	2.29	2.92	27.91	35.86	**0245**	11.98	2.16	6.26	25.91	76.15
0120	12.18	2.28	3.11	27.80	38.18	**0250**	11.97	2.16	6.44	25.80	78.30
0125	12.17	2.28	3.30	27.69	40.49	**0255**	11.95	2.15	6.61	25.69	80.44
0130	12.16	2.27	3.49	27.58	42.79	**0300**	11.94	2.14	6.79	25.58	82.57

Battery to water pump discharging phase data (11/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.61	2.39	0.20	30.09	2.51	**0135**	12.40	2.26	3.68	28.07	46.03
0010	12.60	2.38	0.40	29.96	5.00	**0140**	12.38	2.26	3.87	27.96	48.36
0015	12.59	2.37	0.59	29.85	7.49	**0145**	12.37	2.25	4.06	27.85	50.68
0020	12.57	2.36	0.79	29.73	9.97	**0150**	12.36	2.24	4.24	27.73	52.99
0025	12.56	2.36	0.99	29.62	12.44	**0155**	12.35	2.24	4.43	27.62	55.29
0030	12.55	2.35	1.18	29.51	14.90	**0200**	12.34	2.23	4.62	27.51	57.58
0035	12.54	2.34	1.38	29.40	17.35	**0205**	12.32	2.22	4.80	27.40	59.87
0040	12.53	2.34	1.57	29.29	19.79	**0210**	12.31	2.22	4.99	27.29	62.14
0045	12.51	2.33	1.77	29.18	22.22	**0215**	12.30	2.21	5.17	27.18	64.40
0050	12.50	2.32	1.96	29.07	24.64	**0220**	12.29	2.20	5.35	27.07	66.66
0055	12.49	2.32	2.16	28.96	27.05	**0225**	12.28	2.20	5.54	26.96	68.91
0100	12.48	2.31	2.35	28.85	29.46	**0230**	12.26	2.19	5.72	26.85	71.14
0105	12.47	2.30	2.54	28.73	31.85	**0235**	12.25	2.18	5.90	26.73	73.37
0110	12.45	2.30	2.73	28.62	34.24	**0240**	12.24	2.18	6.08	26.62	75.59
0115	12.44	2.29	2.92	28.51	36.61	**0245**	12.23	2.17	6.26	26.51	77.80
0120	12.43	2.28	3.11	28.40	38.98	**0250**	12.22	2.16	6.44	26.40	80.00
0125	12.42	2.28	3.30	28.29	41.34	**0255**	12.20	2.15	6.62	26.29	82.19
0130	12.41	2.27	3.49	28.18	43.69	**0300**	12.19	2.15	6.80	26.18	84.37

Battery to water pump discharging phase data (12/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.45	2.39	0.20	29.70	2.47	**0135**	12.24	2.26	3.68	27.68	45.41
0010	12.44	2.38	0.40	29.57	4.94	**0140**	12.22	2.26	3.87	27.57	47.71
0015	12.43	2.37	0.59	29.46	7.39	**0145**	12.21	2.25	4.05	27.46	49.99
0020	12.41	2.36	0.79	29.34	9.84	**0150**	12.20	2.24	4.24	27.34	52.27
0025	12.40	2.36	0.99	29.23	12.28	**0155**	12.19	2.23	4.43	27.23	54.54
0030	12.39	2.35	1.18	29.12	14.70	**0200**	12.18	2.23	4.61	27.12	56.80
0035	12.38	2.34	1.38	29.01	17.12	**0205**	12.16	2.22	4.80	27.01	59.05
0040	12.37	2.34	1.57	28.90	19.53	**0210**	12.15	2.21	4.98	26.90	61.29
0045	12.35	2.33	1.77	28.79	21.93	**0215**	12.14	2.21	5.17	26.79	63.53
0050	12.34	2.32	1.96	28.68	24.32	**0220**	12.13	2.20	5.35	26.68	65.75
0055	12.33	2.32	2.15	28.57	26.70	**0225**	12.12	2.19	5.53	26.57	67.96
0100	12.32	2.31	2.35	28.46	29.07	**0230**	12.10	2.19	5.71	26.46	70.17
0105	12.31	2.30	2.54	28.34	31.43	**0235**	12.09	2.18	5.90	26.34	72.36
0110	12.29	2.30	2.73	28.23	33.78	**0240**	12.08	2.17	6.08	26.23	74.55
0115	12.28	2.29	2.92	28.12	36.13	**0245**	12.07	2.16	6.26	26.12	76.73
0120	12.27	2.28	3.11	28.01	38.46	**0250**	12.06	2.16	6.44	26.01	78.89
0125	12.26	2.28	3.30	27.90	40.79	**0255**	12.04	2.15	6.62	25.90	81.05
0130	12.25	2.27	3.49	27.79	43.10	**0300**	12.03	2.14	6.79	25.79	83.20

Battery to water pump discharging phase data (13/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.70	2.39	0.20	30.31	2.53	**0135**	12.49	2.27	3.68	28.29	46.37
0010	12.69	2.38	0.40	30.18	5.04	**0140**	12.47	2.26	3.87	28.18	48.72
0015	12.68	2.37	0.59	30.07	7.55	**0145**	12.46	2.25	4.06	28.07	51.06
0020	12.66	2.37	0.79	29.95	10.04	**0150**	12.45	2.25	4.25	27.95	53.39
0025	12.65	2.36	0.99	29.84	12.53	**0155**	12.44	2.24	4.43	27.84	55.71
0030	12.64	2.35	1.18	29.73	15.01	**0200**	12.43	2.23	4.62	27.73	58.02
0035	12.63	2.35	1.38	29.62	17.48	**0205**	12.41	2.23	4.80	27.62	60.32
0040	12.62	2.34	1.57	29.51	19.93	**0210**	12.40	2.22	4.99	27.51	62.62
0045	12.60	2.33	1.77	29.40	22.38	**0215**	12.39	2.21	5.17	27.40	64.90
0050	12.59	2.33	1.96	29.29	24.83	**0220**	12.38	2.20	5.36	27.29	67.17
0055	12.58	2.32	2.16	29.18	27.26	**0225**	12.37	2.20	5.54	27.18	69.44
0100	12.57	2.31	2.35	29.07	29.68	**0230**	12.35	2.19	5.72	27.07	71.69
0105	12.56	2.31	2.54	28.95	32.09	**0235**	12.34	2.18	5.90	26.95	73.94
0110	12.54	2.30	2.73	28.84	34.50	**0240**	12.33	2.18	6.09	26.84	76.18
0115	12.53	2.29	2.92	28.73	36.89	**0245**	12.32	2.17	6.27	26.73	78.40
0120	12.52	2.29	3.11	28.62	39.27	**0250**	12.31	2.16	6.45	26.62	80.62
0125	12.51	2.28	3.30	28.51	41.65	**0255**	12.29	2.16	6.63	26.51	82.83
0130	12.50	2.27	3.49	28.40	44.02	**0300**	12.28	2.15	6.81	26.40	85.03

Battery to water pump discharging phase data (14/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.91	2.39	0.20	30.82	2.57	**0135**	12.70	2.27	3.68	28.80	47.18
0010	12.90	2.38	0.40	30.69	5.13	**0140**	12.68	2.26	3.87	28.69	49.57
0015	12.89	2.37	0.59	30.57	7.67	**0145**	12.67	2.26	4.06	28.57	51.95
0020	12.87	2.37	0.79	30.46	10.21	**0150**	12.66	2.25	4.25	28.46	54.32
0025	12.86	2.36	0.99	30.35	12.74	**0155**	12.65	2.24	4.44	28.35	56.69
0030	12.85	2.35	1.18	30.24	15.26	**0200**	12.64	2.24	4.62	28.24	59.04
0035	12.84	2.35	1.38	30.13	17.77	**0205**	12.62	2.23	4.81	28.13	61.38
0040	12.83	2.34	1.58	30.02	20.27	**0210**	12.61	2.22	4.99	28.02	63.72
0045	12.81	2.33	1.77	29.91	22.77	**0215**	12.60	2.22	5.18	27.91	66.04
0050	12.80	2.33	1.96	29.80	25.25	**0220**	12.59	2.21	5.36	27.80	68.36
0055	12.79	2.32	2.16	29.69	27.72	**0225**	12.58	2.20	5.54	27.69	70.67
0100	12.78	2.31	2.35	29.57	30.19	**0230**	12.56	2.19	5.73	27.57	72.97
0105	12.77	2.31	2.54	29.46	32.64	**0235**	12.55	2.19	5.91	27.46	75.26
0110	12.75	2.30	2.73	29.35	35.09	**0240**	12.54	2.18	6.09	27.35	77.53
0115	12.74	2.29	2.93	29.24	37.53	**0245**	12.53	2.17	6.27	27.24	79.80
0120	12.73	2.29	3.12	29.13	39.95	**0250**	12.52	2.17	6.45	27.13	82.07
0125	12.72	2.28	3.31	29.02	42.37	**0255**	12.50	2.16	6.63	27.02	84.32
0130	12.71	2.27	3.50	28.91	44.78	**0300**	12.49	2.15	6.81	26.91	86.56

Battery to water pump discharging phase data (15/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.84	2.39	0.20	30.64	2.55	**0135**	12.63	2.27	3.68	28.62	46.90
0010	12.83	2.38	0.40	30.51	5.10	**0140**	12.61	2.26	3.87	28.51	49.28
0015	12.82	2.37	0.59	30.40	7.63	**0145**	12.60	2.25	4.06	28.40	51.65
0020	12.80	2.37	0.79	30.29	10.15	**0150**	12.59	2.25	4.25	28.29	54.00
0025	12.79	2.36	0.99	30.18	12.67	**0155**	12.58	2.24	4.43	28.18	56.35
0030	12.78	2.35	1.18	30.07	15.17	**0200**	12.57	2.23	4.62	28.07	58.69
0035	12.77	2.35	1.38	29.96	17.67	**0205**	12.55	2.23	4.81	27.96	61.02
0040	12.76	2.34	1.57	29.84	20.16	**0210**	12.54	2.22	4.99	27.84	63.34
0045	12.74	2.33	1.77	29.73	22.63	**0215**	12.53	2.21	5.17	27.73	65.65
0050	12.73	2.33	1.96	29.62	25.10	**0220**	12.52	2.21	5.36	27.62	67.95
0055	12.72	2.32	2.16	29.51	27.56	**0225**	12.51	2.20	5.54	27.51	70.25
0100	12.71	2.31	2.35	29.40	30.01	**0230**	12.49	2.19	5.72	27.40	72.53
0105	12.70	2.31	2.54	29.29	32.45	**0235**	12.48	2.19	5.91	27.29	74.80
0110	12.68	2.30	2.73	29.18	34.88	**0240**	12.47	2.18	6.09	27.18	77.07
0115	12.67	2.29	2.92	29.07	37.31	**0245**	12.46	2.17	6.27	27.07	79.32
0120	12.66	2.29	3.12	28.96	39.72	**0250**	12.45	2.17	6.45	26.96	81.57
0125	12.65	2.28	3.31	28.84	42.12	**0255**	12.43	2.16	6.63	26.84	83.81
0130	12.64	2.27	3.49	28.73	44.52	**0300**	12.42	2.15	6.81	26.73	86.03

Battery to water pump discharging phase data (16/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.77	2.39	0.20	30.46	2.54	**0135**	12.56	2.27	3.68	28.44	46.61
0010	12.76	2.38	0.40	30.33	5.07	**0140**	12.54	2.26	3.87	28.33	48.97
0015	12.75	2.37	0.59	30.22	7.58	**0145**	12.53	2.25	4.06	28.22	51.32
0020	12.73	2.36	0.79	30.10	10.09	**0150**	12.52	2.24	4.24	28.10	53.67
0025	12.72	2.36	0.99	29.99	12.59	**0155**	12.51	2.24	4.43	27.99	56.00
0030	12.71	2.35	1.18	29.88	15.08	**0200**	12.50	2.23	4.62	27.88	58.32
0035	12.70	2.34	1.38	29.77	17.56	**0205**	12.48	2.22	4.80	27.77	60.64
0040	12.69	2.34	1.57	29.66	20.03	**0210**	12.47	2.22	4.99	27.66	62.94
0045	12.67	2.33	1.77	29.55	22.50	**0215**	12.46	2.21	5.17	27.55	65.24
0050	12.66	2.32	1.96	29.44	24.95	**0220**	12.45	2.20	5.35	27.44	67.52
0055	12.65	2.32	2.16	29.33	27.39	**0225**	12.44	2.20	5.54	27.33	69.80
0100	12.64	2.31	2.35	29.22	29.83	**0230**	12.42	2.19	5.72	27.22	72.07
0105	12.63	2.31	2.54	29.10	32.25	**0235**	12.41	2.18	5.90	27.10	74.33
0110	12.61	2.30	2.73	28.99	34.67	**0240**	12.40	2.18	6.08	26.99	76.58
0115	12.60	2.29	2.92	28.88	37.08	**0245**	12.39	2.17	6.26	26.88	78.82
0120	12.59	2.29	3.11	28.77	39.47	**0250**	12.38	2.16	6.44	26.77	81.05
0125	12.58	2.28	3.30	28.66	41.86	**0255**	12.36	2.16	6.62	26.66	83.27
0130	12.57	2.27	3.49	28.55	44.24	**0300**	12.35	2.15	6.80	26.55	85.48

Battery to water pump discharging phase data (17/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.63	2.39	0.20	30.13	2.51	**0135**	12.42	2.26	3.68	28.11	46.09
0010	12.62	2.38	0.40	30.00	5.01	**0140**	12.40	2.26	3.87	28.00	48.42
0015	12.61	2.37	0.59	29.89	7.50	**0145**	12.39	2.25	4.06	27.89	50.75
0020	12.59	2.36	0.79	29.77	9.98	**0150**	12.38	2.24	4.24	27.77	53.06
0025	12.58	2.36	0.99	29.66	12.45	**0155**	12.37	2.24	4.43	27.66	55.37
0030	12.57	2.35	1.18	29.55	14.92	**0200**	12.36	2.23	4.62	27.55	57.66
0035	12.56	2.34	1.38	29.44	17.37	**0205**	12.34	2.22	4.80	27.44	59.95
0040	12.55	2.34	1.57	29.33	19.81	**0210**	12.33	2.22	4.99	27.33	62.23
0045	12.53	2.33	1.77	29.22	22.25	**0215**	12.32	2.21	5.17	27.22	64.49
0050	12.52	2.32	1.96	29.11	24.68	**0220**	12.31	2.20	5.35	27.11	66.75
0055	12.51	2.32	2.16	29.00	27.09	**0225**	12.30	2.20	5.54	27.00	69.00
0100	12.50	2.31	2.35	28.89	29.50	**0230**	12.28	2.19	5.72	26.89	71.24
0105	12.49	2.30	2.54	28.77	31.90	**0235**	12.27	2.18	5.90	26.77	73.48
0110	12.47	2.30	2.73	28.66	34.29	**0240**	12.26	2.17	6.08	26.66	75.70
0115	12.46	2.29	2.92	28.55	36.66	**0245**	12.25	2.17	6.26	26.55	77.91
0120	12.45	2.28	3.11	28.44	39.03	**0250**	12.24	2.16	6.44	26.44	80.11
0125	12.44	2.28	3.30	28.33	41.40	**0255**	12.22	2.15	6.62	26.33	82.31
0130	12.43	2.27	3.49	28.22	43.75	**0300**	12.21	2.15	6.80	26.22	84.49

Battery to water pump discharging phase data (18/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.67	2.36	0.20	29.89	2.49	**0135**	12.46	2.24	3.64	27.87	45.71
0010	12.66	2.35	0.39	29.76	4.97	**0140**	12.44	2.23	3.82	27.76	48.02
0015	12.65	2.34	0.59	29.65	7.44	**0145**	12.43	2.22	4.01	27.65	50.33
0020	12.63	2.34	0.78	29.53	9.90	**0150**	12.42	2.22	4.19	27.53	52.62
0025	12.62	2.33	0.98	29.42	12.35	**0155**	12.41	2.21	4.38	27.42	54.91
0030	12.61	2.32	1.17	29.31	14.80	**0200**	12.40	2.20	4.56	27.31	57.18
0035	12.60	2.32	1.36	29.20	17.23	**0205**	12.38	2.20	4.75	27.20	59.45
0040	12.59	2.31	1.56	29.09	19.65	**0210**	12.37	2.19	4.93	27.09	61.71
0045	12.57	2.30	1.75	28.98	22.07	**0215**	12.36	2.18	5.11	26.98	63.95
0050	12.56	2.30	1.94	28.87	24.48	**0220**	12.35	2.18	5.29	26.87	66.19
0055	12.55	2.29	2.13	28.76	26.87	**0225**	12.34	2.17	5.47	26.76	68.42
0100	12.54	2.28	2.32	28.65	29.26	**0230**	12.32	2.16	5.65	26.65	70.64
0105	12.53	2.28	2.51	28.53	31.64	**0235**	12.31	2.16	5.83	26.53	72.86
0110	12.51	2.27	2.70	28.42	34.01	**0240**	12.30	2.15	6.01	26.42	75.06
0115	12.50	2.26	2.89	28.31	36.36	**0245**	12.29	2.14	6.19	26.31	77.25
0120	12.49	2.26	3.08	28.20	38.71	**0250**	12.28	2.13	6.37	26.20	79.43
0125	12.48	2.25	3.26	28.09	41.06	**0255**	12.26	2.13	6.54	26.09	81.61
0130	12.47	2.24	3.45	27.98	43.39	**0300**	12.25	2.12	6.72	25.98	83.77

Battery to water pump discharging phase data (19/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.29	2.39	0.20	29.33	2.44	**0135**	12.08	2.26	3.68	27.31	44.82
0010	12.28	2.38	0.40	29.20	4.88	**0140**	12.06	2.25	3.87	27.20	47.09
0015	12.27	2.37	0.59	29.09	7.30	**0145**	12.05	2.25	4.05	27.09	49.35
0020	12.25	2.36	0.79	28.97	9.72	**0150**	12.04	2.24	4.24	26.97	51.59
0025	12.24	2.36	0.99	28.86	12.12	**0155**	12.03	2.23	4.43	26.86	53.83
0030	12.23	2.35	1.18	28.75	14.52	**0200**	12.02	2.23	4.61	26.75	56.06
0035	12.22	2.34	1.38	28.64	16.90	**0205**	12.00	2.22	4.80	26.64	58.28
0040	12.21	2.34	1.57	28.53	19.28	**0210**	11.99	2.21	4.98	26.53	60.49
0045	12.19	2.33	1.77	28.42	21.65	**0215**	11.98	2.21	5.17	26.42	62.69
0050	12.18	2.32	1.96	28.31	24.01	**0220**	11.97	2.20	5.35	26.31	64.89
0055	12.17	2.32	2.16	28.20	26.36	**0225**	11.96	2.19	5.53	26.20	67.07
0100	12.16	2.31	2.35	28.09	28.70	**0230**	11.94	2.18	5.71	26.09	69.24
0105	12.15	2.30	2.54	27.97	31.03	**0235**	11.93	2.18	5.89	25.97	71.41
0110	12.13	2.30	2.73	27.86	33.35	**0240**	11.92	2.17	6.08	25.86	73.56
0115	12.12	2.29	2.92	27.75	35.66	**0245**	11.91	2.16	6.26	25.75	75.71
0120	12.11	2.28	3.11	27.64	37.97	**0250**	11.90	2.16	6.44	25.64	77.85
0125	12.10	2.28	3.30	27.53	40.26	**0255**	11.88	2.15	6.61	25.53	79.97
0130	12.09	2.27	3.49	27.42	42.55	**0300**	11.87	2.14	6.79	25.42	82.09

Battery to water pump discharging phase data (20/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.34	2.39	0.20	29.44	2.45	**0135**	12.13	2.26	3.68	27.42	45.00
0010	12.33	2.38	0.40	29.31	4.90	**0140**	12.11	2.25	3.87	27.31	47.27
0015	12.32	2.37	0.59	29.20	7.33	**0145**	12.10	2.25	4.05	27.20	49.54
0020	12.30	2.36	0.79	29.08	9.75	**0150**	12.09	2.24	4.24	27.08	51.80
0025	12.29	2.36	0.99	28.97	12.17	**0155**	12.08	2.23	4.43	26.97	54.04
0030	12.28	2.35	1.18	28.86	14.57	**0200**	12.07	2.23	4.61	26.86	56.28
0035	12.27	2.34	1.38	28.75	16.97	**0205**	12.05	2.22	4.80	26.75	58.51
0040	12.26	2.34	1.57	28.64	19.35	**0210**	12.04	2.21	4.98	26.64	60.73
0045	12.24	2.33	1.77	28.53	21.73	**0215**	12.03	2.21	5.16	26.53	62.94
0050	12.23	2.32	1.96	28.42	24.10	**0220**	12.02	2.20	5.35	26.42	65.14
0055	12.22	2.32	2.15	28.31	26.46	**0225**	12.01	2.19	5.53	26.31	67.34
0100	12.21	2.31	2.35	28.20	28.81	**0230**	11.99	2.18	5.71	26.20	69.52
0105	12.20	2.30	2.54	28.08	31.15	**0235**	11.98	2.18	5.89	26.08	71.69
0110	12.18	2.30	2.73	27.97	33.48	**0240**	11.97	2.17	6.07	25.97	73.86
0115	12.17	2.29	2.92	27.86	35.80	**0245**	11.96	2.16	6.26	25.86	76.01
0120	12.16	2.28	3.11	27.75	38.11	**0250**	11.95	2.16	6.43	25.75	78.16
0125	12.15	2.28	3.30	27.64	40.42	**0255**	11.93	2.15	6.61	25.64	80.29
0130	12.14	2.27	3.49	27.53	42.71	**0300**	11.92	2.14	6.79	25.53	82.42

Battery to water pump discharging phase data (21/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.48	2.39	0.20	29.79	2.48	**0135**	12.27	2.26	3.68	27.77	45.55
0010	12.47	2.38	0.40	29.66	4.95	**0140**	12.25	2.26	3.87	27.66	47.86
0015	12.46	2.37	0.59	29.55	7.42	**0145**	12.24	2.25	4.06	27.55	50.15
0020	12.44	2.37	0.79	29.43	9.87	**0150**	12.23	2.24	4.24	27.43	52.44
0025	12.43	2.36	0.99	29.32	12.31	**0155**	12.22	2.24	4.43	27.32	54.71
0030	12.42	2.35	1.18	29.21	14.75	**0200**	12.21	2.23	4.62	27.21	56.98
0035	12.41	2.35	1.38	29.10	17.17	**0205**	12.19	2.22	4.80	27.10	59.24
0040	12.40	2.34	1.57	28.99	19.59	**0210**	12.18	2.22	4.99	26.99	61.49
0045	12.38	2.33	1.77	28.88	21.99	**0215**	12.17	2.21	5.17	26.88	63.73
0050	12.37	2.33	1.96	28.77	24.39	**0220**	12.16	2.20	5.35	26.77	65.96
0055	12.36	2.32	2.16	28.66	26.78	**0225**	12.15	2.19	5.54	26.66	68.18
0100	12.35	2.31	2.35	28.55	29.16	**0230**	12.13	2.19	5.72	26.55	70.39
0105	12.34	2.30	2.54	28.43	31.53	**0235**	12.12	2.18	5.90	26.43	72.60
0110	12.32	2.30	2.73	28.32	33.89	**0240**	12.11	2.17	6.08	26.32	74.79
0115	12.31	2.29	2.92	28.21	36.24	**0245**	12.10	2.17	6.26	26.21	76.97
0120	12.30	2.28	3.11	28.10	38.58	**0250**	12.09	2.16	6.44	26.10	79.15
0125	12.29	2.28	3.30	27.99	40.91	**0255**	12.07	2.15	6.62	25.99	81.32
0130	12.28	2.27	3.49	27.88	43.24	**0300**	12.06	2.15	6.80	25.88	83.47

Battery to water pump discharging phase data (22/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.67	2.39	0.20	30.24	2.52	**0135**	12.46	2.27	3.68	28.22	46.26
0010	12.66	2.38	0.40	30.11	5.03	**0140**	12.44	2.26	3.87	28.11	48.61
0015	12.65	2.37	0.59	30.00	7.53	**0145**	12.43	2.25	4.06	28.00	50.94
0020	12.63	2.37	0.79	29.88	10.02	**0150**	12.42	2.25	4.25	27.88	53.26
0025	12.62	2.36	0.99	29.77	12.50	**0155**	12.41	2.24	4.43	27.77	55.58
0030	12.61	2.35	1.18	29.66	14.97	**0200**	12.40	2.23	4.62	27.66	57.88
0035	12.60	2.35	1.38	29.55	17.43	**0205**	12.38	2.22	4.80	27.55	60.18
0040	12.59	2.34	1.57	29.44	19.89	**0210**	12.37	2.22	4.99	27.44	62.46
0045	12.57	2.33	1.77	29.33	22.33	**0215**	12.36	2.21	5.17	27.33	64.74
0050	12.56	2.33	1.96	29.22	24.77	**0220**	12.35	2.20	5.36	27.22	67.01
0055	12.55	2.32	2.16	29.11	27.19	**0225**	12.34	2.20	5.54	27.11	69.27
0100	12.54	2.31	2.35	29.00	29.61	**0230**	12.32	2.19	5.72	27.00	71.52
0105	12.53	2.31	2.54	28.88	32.02	**0235**	12.31	2.18	5.90	26.88	73.76
0110	12.51	2.30	2.73	28.77	34.41	**0240**	12.30	2.18	6.09	26.77	75.99
0115	12.50	2.29	2.92	28.66	36.80	**0245**	12.29	2.17	6.27	26.66	78.21
0120	12.49	2.29	3.11	28.55	39.18	**0250**	12.28	2.16	6.45	26.55	80.42
0125	12.48	2.28	3.30	28.44	41.55	**0255**	12.26	2.16	6.63	26.44	82.63
0130	12.47	2.27	3.49	28.33	43.91	**0300**	12.25	2.15	6.80	26.33	84.82

Battery to water pump discharging phase data (23/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.90	2.39	0.20	30.78	2.56	**0135**	12.69	2.27	3.68	28.76	47.12
0010	12.89	2.38	0.40	30.65	5.12	**0140**	12.67	2.26	3.87	28.65	49.51
0015	12.88	2.37	0.59	30.54	7.66	**0145**	12.66	2.25	4.06	28.54	51.88
0020	12.86	2.37	0.79	30.42	10.20	**0150**	12.65	2.25	4.25	28.42	54.25
0025	12.85	2.36	0.99	30.31	12.73	**0155**	12.64	2.24	4.43	28.31	56.61
0030	12.84	2.35	1.18	30.20	15.24	**0200**	12.63	2.23	4.62	28.20	58.96
0035	12.83	2.35	1.38	30.09	17.75	**0205**	12.61	2.23	4.80	28.09	61.30
0040	12.82	2.34	1.57	29.98	20.25	**0210**	12.60	2.22	4.99	27.98	63.63
0045	12.80	2.33	1.77	29.87	22.74	**0215**	12.59	2.21	5.17	27.87	65.96
0050	12.79	2.33	1.96	29.76	25.22	**0220**	12.58	2.21	5.36	27.76	68.27
0055	12.78	2.32	2.16	29.65	27.69	**0225**	12.57	2.20	5.54	27.65	70.57
0100	12.77	2.31	2.35	29.54	30.15	**0230**	12.55	2.19	5.72	27.54	72.87
0105	12.76	2.31	2.54	29.42	32.60	**0235**	12.54	2.19	5.91	27.42	75.15
0110	12.74	2.30	2.73	29.31	35.04	**0240**	12.53	2.18	6.09	27.31	77.43
0115	12.73	2.29	2.92	29.20	37.48	**0245**	12.52	2.17	6.27	27.20	79.70
0120	12.72	2.29	3.11	29.09	39.90	**0250**	12.51	2.17	6.45	27.09	81.95
0125	12.71	2.28	3.30	28.98	42.32	**0255**	12.49	2.16	6.63	26.98	84.20
0130	12.70	2.27	3.49	28.87	44.72	**0300**	12.48	2.15	6.81	26.87	86.44

Battery to water pump discharging phase data (24/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.90	2.38	0.20	30.76	2.56	**0135**	12.69	2.27	3.68	28.74	47.09
0010	12.89	2.38	0.40	30.63	5.12	**0140**	12.67	2.26	3.87	28.63	49.47
0015	12.88	2.37	0.59	30.52	7.66	**0145**	12.66	2.25	4.06	28.52	51.85
0020	12.86	2.36	0.79	30.40	10.19	**0150**	12.65	2.25	4.24	28.40	54.22
0025	12.85	2.36	0.99	30.29	12.72	**0155**	12.64	2.24	4.43	28.29	56.57
0030	12.84	2.35	1.18	30.18	15.23	**0200**	12.63	2.23	4.62	28.18	58.92
0035	12.83	2.34	1.38	30.07	17.74	**0205**	12.61	2.23	4.80	28.07	61.26
0040	12.82	2.34	1.57	29.96	20.23	**0210**	12.60	2.22	4.99	27.96	63.59
0045	12.80	2.33	1.77	29.85	22.72	**0215**	12.59	2.21	5.17	27.85	65.91
0050	12.79	2.32	1.96	29.74	25.20	**0220**	12.58	2.21	5.35	27.74	68.22
0055	12.78	2.32	2.15	29.63	27.67	**0225**	12.57	2.20	5.54	27.63	70.53
0100	12.77	2.31	2.35	29.52	30.13	**0230**	12.55	2.19	5.72	27.52	72.82
0105	12.76	2.31	2.54	29.40	32.58	**0235**	12.54	2.19	5.90	27.40	75.10
0110	12.74	2.30	2.73	29.29	35.02	**0240**	12.53	2.18	6.08	27.29	77.38
0115	12.73	2.29	2.92	29.18	37.45	**0245**	12.52	2.17	6.27	27.18	79.64
0120	12.72	2.29	3.11	29.07	39.87	**0250**	12.51	2.16	6.45	27.07	81.90
0125	12.71	2.28	3.30	28.96	42.29	**0255**	12.49	2.16	6.63	26.96	84.14
0130	12.70	2.27	3.49	28.85	44.69	**0300**	12.48	2.15	6.80	26.85	86.38

Battery to water pump discharging phase data (25/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	12.89	2.39	0.20	30.78	2.56	**0135**	12.68	2.27	3.69	28.76	47.12
0010	12.88	2.38	0.40	30.65	5.12	**0140**	12.66	2.26	3.87	28.65	49.51
0015	12.87	2.37	0.60	30.54	7.66	**0145**	12.65	2.26	4.06	28.54	51.88
0020	12.85	2.37	0.79	30.42	10.20	**0150**	12.64	2.25	4.25	28.42	54.25
0025	12.84	2.36	0.99	30.31	12.73	**0155**	12.63	2.24	4.44	28.31	56.61
0030	12.83	2.35	1.19	30.20	15.24	**0200**	12.62	2.24	4.62	28.20	58.96
0035	12.82	2.35	1.38	30.09	17.75	**0205**	12.60	2.23	4.81	28.09	61.30
0040	12.81	2.34	1.58	29.98	20.25	**0210**	12.59	2.22	4.99	27.98	63.63
0045	12.79	2.33	1.77	29.87	22.74	**0215**	12.58	2.22	5.18	27.87	65.96
0050	12.78	2.33	1.96	29.76	25.22	**0220**	12.57	2.21	5.36	27.76	68.27
0055	12.77	2.32	2.16	29.65	27.69	**0225**	12.56	2.20	5.55	27.65	70.57
0100	12.76	2.31	2.35	29.54	30.15	**0230**	12.54	2.20	5.73	27.54	72.87
0105	12.75	2.31	2.54	29.42	32.60	**0235**	12.53	2.19	5.91	27.42	75.15
0110	12.73	2.30	2.74	29.31	35.04	**0240**	12.52	2.18	6.09	27.31	77.43
0115	12.72	2.30	2.93	29.20	37.48	**0245**	12.51	2.17	6.27	27.20	79.70
0120	12.71	2.29	3.12	29.09	39.90	**0250**	12.50	2.17	6.46	27.09	81.95
0125	12.70	2.28	3.31	28.98	42.32	**0255**	12.48	2.16	6.64	26.98	84.20
0130	12.69	2.28	3.50	28.87	44.72	**0300**	12.47	2.15	6.81	26.87	86.44

Battery to water pump discharging phase data (26/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	13.10	2.39	0.20	31.27	2.61	**0135**	12.89	2.27	3.69	29.25	47.89
0010	13.09	2.38	0.40	31.14	5.20	**0140**	12.87	2.26	3.87	29.14	50.32
0015	13.08	2.37	0.59	31.03	7.79	**0145**	12.86	2.26	4.06	29.03	52.74
0020	13.06	2.37	0.79	30.91	10.36	**0150**	12.85	2.25	4.25	28.91	55.15
0025	13.05	2.36	0.99	30.80	12.93	**0155**	12.84	2.24	4.44	28.80	57.55
0030	13.04	2.35	1.18	30.69	15.49	**0200**	12.83	2.24	4.62	28.69	59.94
0035	13.03	2.35	1.38	30.58	18.04	**0205**	12.81	2.23	4.81	28.58	62.32
0040	13.02	2.34	1.58	30.47	20.57	**0210**	12.80	2.22	4.99	28.47	64.70
0045	13.00	2.33	1.77	30.36	23.10	**0215**	12.79	2.22	5.18	28.36	67.06
0050	12.99	2.33	1.96	30.25	25.63	**0220**	12.78	2.21	5.36	28.25	69.41
0055	12.98	2.32	2.16	30.14	28.14	**0225**	12.77	2.20	5.55	28.14	71.76
0100	12.97	2.32	2.35	30.03	30.64	**0230**	12.75	2.20	5.73	28.03	74.09
0105	12.96	2.31	2.54	29.91	33.13	**0235**	12.74	2.19	5.91	27.91	76.42
0110	12.94	2.30	2.73	29.80	35.62	**0240**	12.73	2.18	6.10	27.80	78.74
0115	12.93	2.30	2.93	29.69	38.09	**0245**	12.72	2.18	6.28	27.69	81.04
0120	12.92	2.29	3.12	29.58	40.55	**0250**	12.71	2.17	6.46	27.58	83.34
0125	12.91	2.28	3.31	29.47	43.01	**0255**	12.69	2.16	6.64	27.47	85.63
0130	12.90	2.28	3.50	29.36	45.46	**0300**	12.68	2.16	6.82	27.36	87.91

Battery to water pump discharging phase data (27/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	13.39	2.39	0.20	31.96	2.66	**0135**	13.18	2.27	3.69	29.94	48.99
0010	13.38	2.38	0.40	31.83	5.32	**0140**	13.16	2.27	3.88	29.83	51.47
0015	13.37	2.37	0.59	31.72	7.96	**0145**	13.15	2.26	4.06	29.72	53.95
0020	13.35	2.37	0.79	31.60	10.59	**0150**	13.14	2.25	4.25	29.60	56.42
0025	13.34	2.36	0.99	31.49	13.22	**0155**	13.13	2.25	4.44	29.49	58.87
0030	13.33	2.35	1.18	31.38	15.83	**0200**	13.12	2.24	4.63	29.38	61.32
0035	13.32	2.35	1.38	31.27	18.44	**0205**	13.10	2.23	4.81	29.27	63.76
0040	13.31	2.34	1.58	31.16	21.03	**0210**	13.09	2.23	5.00	29.16	66.19
0045	13.29	2.34	1.77	31.05	23.62	**0215**	13.08	2.22	5.18	29.05	68.61
0050	13.28	2.33	1.96	30.94	26.20	**0220**	13.07	2.21	5.37	28.94	71.02
0055	13.27	2.32	2.16	30.83	28.77	**0225**	13.06	2.21	5.55	28.83	73.43
0100	13.26	2.32	2.35	30.72	31.33	**0230**	13.04	2.20	5.74	28.72	75.82
0105	13.25	2.31	2.54	30.60	33.88	**0235**	13.03	2.20	5.92	28.60	78.20
0110	13.23	2.30	2.74	30.49	36.42	**0240**	13.02	2.19	6.10	28.49	80.58
0115	13.22	2.30	2.93	30.38	38.95	**0245**	13.01	2.18	6.28	28.38	82.94
0120	13.21	2.29	3.12	30.27	41.47	**0250**	13.00	2.18	6.46	28.27	85.30
0125	13.20	2.29	3.31	30.16	43.99	**0255**	12.98	2.17	6.64	28.16	87.64
0130	13.19	2.28	3.50	30.05	46.49	**0300**	12.97	2.16	6.82	28.05	89.98

Battery to water pump discharging phase data (28/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	13.39	2.39	0.20	31.96	2.66	**0135**	13.18	2.27	3.69	29.94	48.99
0010	13.38	2.38	0.40	31.83	5.32	**0140**	13.16	2.27	3.88	29.83	51.47
0015	13.37	2.37	0.59	31.72	7.96	**0145**	13.15	2.26	4.06	29.72	53.95
0020	13.35	2.37	0.79	31.60	10.59	**0150**	13.14	2.25	4.25	29.60	56.42
0025	13.34	2.36	0.99	31.49	13.22	**0155**	13.13	2.25	4.44	29.49	58.87
0030	13.33	2.35	1.18	31.38	15.83	**0200**	13.12	2.24	4.63	29.38	61.32
0035	13.32	2.35	1.38	31.27	18.44	**0205**	13.10	2.23	4.81	29.27	63.76
0040	13.31	2.34	1.58	31.16	21.03	**0210**	13.09	2.23	5.00	29.16	66.19
0045	13.29	2.34	1.77	31.05	23.62	**0215**	13.08	2.22	5.18	29.05	68.61
0050	13.28	2.33	1.96	30.94	26.20	**0220**	13.07	2.21	5.37	28.94	71.02
0055	13.27	2.32	2.16	30.83	28.77	**0225**	13.06	2.21	5.55	28.83	73.43
0100	13.26	2.32	2.35	30.72	31.33	**0230**	13.04	2.20	5.74	28.72	75.82
0105	13.25	2.31	2.54	30.60	33.88	**0235**	13.03	2.20	5.92	28.60	78.20
0110	13.23	2.30	2.74	30.49	36.42	**0240**	13.02	2.19	6.10	28.49	80.58
0115	13.22	2.30	2.93	30.38	38.95	**0245**	13.01	2.18	6.28	28.38	82.94
0120	13.21	2.29	3.12	30.27	41.47	**0250**	13.00	2.18	6.46	28.27	85.30
0125	13.20	2.29	3.31	30.16	43.99	**0255**	12.98	2.17	6.64	28.16	87.64
0130	13.19	2.28	3.50	30.05	46.49	**0300**	12.97	2.16	6.82	28.05	89.98

Battery to water pump discharging phase data (29/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	13.29	2.39	0.20	31.71	2.64	**0135**	13.08	2.27	3.69	29.69	48.59
0010	13.28	2.38	0.40	31.58	5.27	**0140**	13.06	2.26	3.87	29.58	51.06
0015	13.27	2.37	0.59	31.47	7.90	**0145**	13.05	2.26	4.06	29.47	53.51
0020	13.25	2.37	0.79	31.35	10.51	**0150**	13.04	2.25	4.25	29.35	55.96
0025	13.24	2.36	0.99	31.24	13.11	**0155**	13.03	2.24	4.44	29.24	58.39
0030	13.23	2.35	1.18	31.13	15.71	**0200**	13.02	2.24	4.62	29.13	60.82
0035	13.22	2.35	1.38	31.02	18.29	**0205**	13.00	2.23	4.81	29.02	63.24
0040	13.21	2.34	1.58	30.91	20.87	**0210**	12.99	2.23	5.00	28.91	65.65
0045	13.19	2.33	1.77	30.80	23.43	**0215**	12.98	2.22	5.18	28.80	68.05
0050	13.18	2.33	1.96	30.69	25.99	**0220**	12.97	2.21	5.36	28.69	70.44
0055	13.17	2.32	2.16	30.58	28.54	**0225**	12.96	2.21	5.55	28.58	72.82
0100	13.16	2.32	2.35	30.47	31.08	**0230**	12.94	2.20	5.73	28.47	75.19
0105	13.15	2.31	2.54	30.35	33.61	**0235**	12.93	2.19	5.91	28.35	77.56
0110	13.13	2.30	2.73	30.24	36.13	**0240**	12.92	2.19	6.10	28.24	79.91
0115	13.12	2.30	2.93	30.13	38.64	**0245**	12.91	2.18	6.28	28.13	82.25
0120	13.11	2.29	3.12	30.02	41.14	**0250**	12.90	2.17	6.46	28.02	84.59
0125	13.10	2.28	3.31	29.91	43.63	**0255**	12.88	2.17	6.64	27.91	86.92
0130	13.09	2.28	3.50	29.80	46.12	**0300**	12.87	2.16	6.82	27.80	89.23

Battery to water pump discharging phase data (30/11/2022)

Time	Voltage	Current	Ah	Power	Wh	Time	Voltage	Current	Ah	Power	Wh
0005	13.52	2.39	0.20	32.27	2.69	**0135**	13.31	2.27	3.69	30.25	49.48
0010	13.51	2.38	0.40	32.14	5.37	**0140**	13.29	2.27	3.88	30.14	51.99
0015	13.50	2.37	0.59	32.03	8.04	**0145**	13.28	2.26	4.07	30.03	54.49
0020	13.48	2.37	0.79	31.91	10.70	**0150**	13.27	2.25	4.25	29.91	56.98
0025	13.47	2.36	0.99	31.80	13.35	**0155**	13.26	2.25	4.44	29.80	59.47
0030	13.46	2.35	1.19	31.69	15.99	**0200**	13.25	2.24	4.63	29.69	61.94
0035	13.45	2.35	1.38	31.58	18.62	**0205**	13.23	2.24	4.81	29.58	64.41
0040	13.44	2.34	1.58	31.47	21.24	**0210**	13.22	2.23	5.00	29.47	66.86
0045	13.42	2.34	1.77	31.36	23.85	**0215**	13.21	2.22	5.19	29.36	69.31
0050	13.41	2.33	1.96	31.25	26.46	**0220**	13.20	2.22	5.37	29.25	71.75
0055	13.40	2.32	2.16	31.14	29.05	**0225**	13.19	2.21	5.55	29.14	74.18
0100	13.39	2.32	2.35	31.03	31.64	**0230**	13.17	2.20	5.74	29.03	76.59
0105	13.38	2.31	2.54	30.91	34.21	**0235**	13.16	2.20	5.92	28.91	79.00
0110	13.36	2.30	2.74	30.80	36.78	**0240**	13.15	2.19	6.10	28.80	81.40
0115	13.35	2.30	2.93	30.69	39.34	**0245**	13.14	2.18	6.29	28.69	83.79
0120	13.34	2.29	3.12	30.58	41.89	**0250**	13.13	2.18	6.47	28.58	86.18
0125	13.33	2.29	3.31	30.47	44.43	**0255**	13.11	2.17	6.65	28.47	88.55
0130	13.32	2.28	3.50	30.36	46.96	**0300**	13.10	2.16	6.83	28.36	90.91

APPENDIX D: CHARGING PHASE STATISTICAL ANALYSIS DATA

Day	Mean(V)	Mean(A)	StdDev(V)	StdDev(A)	Day	Mean(V)	Mean(A)	StdDev(V)	StdDev(A)
1	12.81	1.68	0.927	0.821	**16**	12.62	0.80	0.067	0.357
2	12.82	1.45	0.927	0.740	**17**	12.61	0.66	0.066	0.640
3	12.55	0.73	0.231	0.403	**18**	12.62	0.75	0.066	0.342
4	12.63	1.29	0.127	0.783	**19**	12.62	0.42	0.067	0.470
5	12.60	1.32	0.118	0.683	**20**	12.60	1.06	0.055	0.633
6	12.57	1.38	0.110	0.734	**21**	12.61	1.29	0.061	0.815
7	12.55	1.50	0.104	0.811	**22**	12.60	1.39	0.060	0.768
8	12.55	0.77	0.104	0.690	**23**	12.60	1.46	0.064	0.752
9	12.57	0.53	0.101	0.580	**24**	12.59	0.96	0.069	0.973
10	12.55	0.79	0.106	0.455	**25**	12.60	0.95	0.060	0.489
11	12.58	1.51	0.102	0.638	**26**	12.60	1.42	0.056	0.702
12	12.59	1.15	0.093	0.586	**27**	12.61	1.60	0.062	0.757
13	12.58	1.16	0.107	0.644	**28**	12.60	1.01	0.085	1.009
14	12.61	1.43	0.101	0.732	**29**	12.67	0.696	0.106	0.329
15	12.61	0.80	0.075	0.375	**30**	12.64	1.49	0.076	0.780

APPENDIX E: DISCHARGING PHASE STATISTICAL ANALYSIS

Day	Mean(V)	Mean(A)	StdDev(V)	StdDev(A)	∑Wh	Day	Mean(V)	Mean(A)	StdDev(V)	StdDev(A)	∑Wh
1	11.65	2.16	0.125	0.127	75.7	**16**	12.56	2.27	0.124	0.070	85.48
2	11.83	2.37	0.124	0.072	84.16	**17**	12.42	2.27	0.124	0.070	84.49
3	11.77	2.26	0.124	0.075	79.87	**18**	12.46	2.24	0.124	0.070	83.77
4	11.92	2.26	0.124	0.073	80.95	**19**	12.08	2.26	0.124	0.072	82.09
5	12.09	2.26	0.124	0.073	80.12	**20**	12.13	2.26	0.124	0.072	82.44
6	12.27	2.27	0.124	0.071	83.44	**21**	12.27	2.27	0.124	0.072	83.47
7	12.51	2.27	0.124	0.070	85.21	**22**	12.46	2.27	0.124	0.071	84.82
8	12.43	2.27	0.124	0.070	84.58	**23**	12.69	2.27	0.124	0.070	86.44
9	12.22	2.27	0.124	0.072	83.14	**24**	12.69	2.27	0.124	0.069	86.38
10	12.15	2.26	0.124	0.072	82.57	**25**	12.68	2.27	0.124	0.069	86.44
11	12.40	2.27	0.124	0.070	84.37	**26**	12.89	2.27	0.124	0.068	87.91
12	12.24	2.27	0.124	0.072	83.2	**27**	13.18	2.28	0.124	0.066	89.98
13	12.49	2.27	0.124	0.071	85.03	**28**	13.18	2.28	0.124	0.066	89.98
14	12.70	2.27	0.124	0.069	86.56	**29**	13.08	2.27	0.124	0.067	89.23
15	12.63	2.27	0.124	0.070	86.03	**30**	13.31	2.28	0.124	0.066	90.91
										Total Wh	2538.76

APPENDIX F: WATER LEVEL MONITORING CODING

```
#define POWER_PIN  7
#define SIGNAL_PIN A5
#define THRESHOLD 260 //need calibration

int value = 0; // variable to store the sensor value
const int RELAY_PIN = 2;
void setup() {
  Serial.begin(9600);
  pinMode(POWER_PIN, OUTPUT);   // configure D7 pin as an OUTPUT
  digitalWrite(POWER_PIN, LOW); // turn the sensor OFF
  pinMode(RELAY_PIN, OUTPUT);
}

void loop() {
  digitalWrite(POWER_PIN, HIGH);  // turn the sensor ON
  delay(10);                      // wait 10 milliseconds
  value = analogRead(SIGNAL_PIN); // read the analog value from sensor
  digitalWrite(POWER_PIN, LOW);   // turn the sensor OFF

  // relay on off depend NC/NO type
  if(value > THRESHOLD){
    digitalWrite(RELAY_PIN, LOW); // on relay
  }
```

```
  else{
    digitalWrite(RELAY_PIN, HIGH); //off relay,
  }

  // Check value untuk water calibration
  Serial.print("Sensor value: ");
  Serial.println(value);

  delay(1000);
}
```