INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Current Analysis of Automatic Charger and Transformer During Emergency Household Battery Charging

Edo Inaldi Damanik[1], Haris Gunawan[2], Siti Anisah[3]
Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia

Article Info
Keywords:
Automatic charger,
Transformer,
Emergency battery current,
and inverter.

ABSTRACT
Electricity is a very important need, especially in the field of information technology development, educational facilities and households. The application of alternative electrical energy sources as backup energy by utilizing DC (direct current) energy sources from batteries (accu) which are converted through circuit stages so that they can be used as AC (Alternating current) backup energy sources. PLN electricity used to charge the battery (charge) through a step down transformer to 24Vac then rectified through a rectifier circuit in the form of a bridge rectifier aims to rectify the AC voltage to a DC voltage of 24Vdc to charge the 24Vdc battery. This automatic charger test aims to obtain the performance of the circuit that will cut off the charging current at a voltage of 13.5V on a 12V battery with a capacity of 5AH automatically when the battery is fully charged. Where the battery input comes from the rectifier output of 13.5V and the battery output will be used as input from the inverter. Before the automatic Charger circuit is connected to the battery, the battery input voltage is set at 11.5Vdc. Charging the charger produces a voltage of 13.5 volts with a maximum charging current of 1.17Amperes with a charger time of 2.5 hours, the charging process from a voltage of 11.5 Volts increases to 13.5 Volts. The temperature of the battery when charging must also be monitored so that there is no excessive heat that can damage the battery cells which reduces the life of the battery.

Corresponding Author:
Edo Inaldi Damanik
Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia
edodamanik5415@gmail.com

INTRODUCTION

Electricity is used as an energy source to operate various electrical devices for home lighting installations, industry and other electronic equipment. However, in general the supply of electrical energy is produced by PLN (State Electricity Company) and distributed to consumers. A battery is a device that can store electrical energy in the form of chemical energy. In addition to producing electric current, batteries can also be recharged with electric current. Currently, with the rapid development of technology, the use of batteries has become a very necessary need for humans, some electronic devices use batteries as their power source. A battery that is too full or overcharged is very dangerous if it causes a temperature when charging and when it is too full, the temperature will increase resulting in overcharging, where if this condition is left unchecked, the temperature will increase too

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

high and even explode the battery. The tool for charging the battery can use a battery charger, and to change the DC voltage to AC using an inverter so that it can operate devices with a voltage of 220 volts AC, the inverter is the main component that is important in various applications of its use, from households to industry. An inverter in simple terms is a tool that converts DC electric current to AC. This transformation allows various electronic devices to operate efficiently and safely.

Literature Review

Energy System

In designing an emergency electrical energy system, a box is made as a storage place.supporting components. The electrical energy emergency system box is shown in Figure 2.

Figure 2. Component box panel

The cross-sectional box shape is made to suit the needs with the following dimensions:

Length = 30 cm
Width = 20 cm
Height = 40 cm
With an iron plate thickness of 1.2 mm

A battery is an electric cell in which a reversible electrochemical process takes place with high efficiency [1]. What is meant by a reversible electrochemical process is that in the battery a chemical conversion process can take place into electrical energy (discharging process), and vice versa from electrical energy into chemical energy, recharging by means of regeneration of the electrodes used, namely by passing an electric current in the opposite direction (polarity) in the cell [2]. The battery used consists of cells with each cell having a voltage of 2.1 V, meaning that car batteries and motorcycle batteries that have a voltage of 12 V consist of 6 cells installed in series (12.6 V = 6 x 2.1 V) [3].In this study using the Yuasa MF YTZ6V battery type is a MF (Maintenance Free) type battery or dry battery. Yuasa MF YTZ6V specifications: Capacity: 5 Ah (Ampere Hour), Voltage: 12 V, Dimensions: 114 x 71 x 106 mm, Weight: 2.5 kg.

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Rectifier System Design

A rectifier circuit is a circuit that converts alternating voltage (AC) into direct voltage (DC)[5]. The rectifier functions to rectify the AC current from the transformer using a bridge diode[6]. In general, in designing a single-phase DC power supply, it always begins with a wave rectification process so that a unidirectional waveform is obtained. Generally, a fullbridge rectifier or bridge model is used where 4 diodes are installed as switches to regulate the direction.wave flow to the output as shown in figure 3 below:

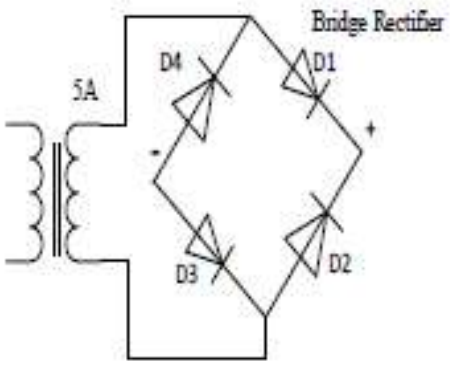

Figure 3. Full Wave Bridge Rectifier

The formation of voltage from a full-wave rectifier using this bridge circuit can be explained by observing the image above that in the positive half cycle, namely 0 to T / 2, diode 1 and diode 3 are in the ON condition and produce half a wave cycle. At the time of the negative half cycle, namely from T / 2 to T, diode 2 and diode 4 will conduct and produce half a wave cycle. The wave that occurs is positive because point A is 0 and point B is positive. In this full-wave rectifier, it has a smaller ripple compared to the output waveform of the half-wave rectifier.

Automatic charger

This charger circuit is used to charge the battery when the PLN grid is working normally. This circuit works automatically, meaning that when the battery needs charging, this circuit will charge the battery and when the battery is in normal condition then the circuit will discharge the battery. This charger is equipped with an LED indicator that indicates the charger is in the charging process or not charging in other words the battery is fully charged.

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

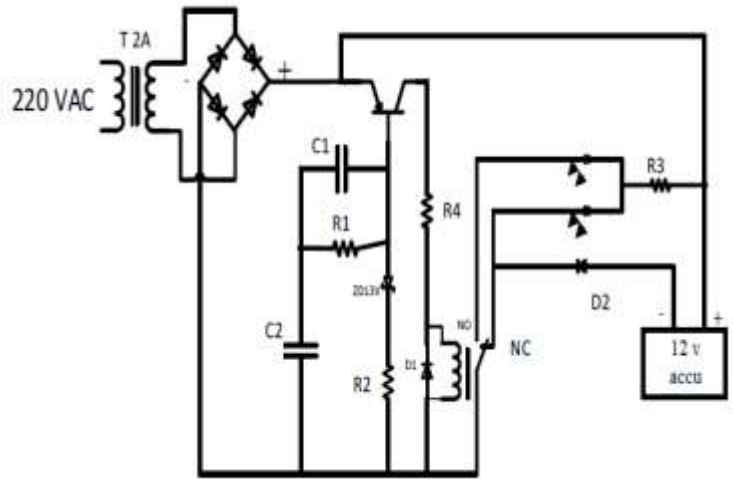

Figure 4. Automatic charger circuit

This battery charger can be used for any type of battery. This circuit is automatic, capable of charging the battery with a current of 6 A until the battery voltage reaches a certain point. At this point the charging current becomes very small. If the battery voltage decreases again, the circuit will charge the battery again until it reaches the previous voltage point. So, the circuit can still be connected to the battery so that the battery is always full without having to worry about damaging the battery. An LED will light up to indicate that the battery is full. After the circuit is ready, the TR1 trimpot is made zero and then the circuit is set as follows.

Before connecting to the battery, make sure both LEDs are lit properly.

TR1 must be set to determine the desired voltage limit. That is, charged with a voltage of 23.5 V, and 27.5 V. To set it, turn the Trimpot TR1 until it reaches the desired voltage. Install the battery to be charged. Observe the charging process with a voltmeter until the battery voltage reaches the desired voltage. Then turn the trimpot TR2 until the LED turns off.

Figure 5. Automatic charger module

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Inverter

A DC to AC converter is called an inverter. The function of an inverter is to change the DC input voltage into an AC output voltage[7]. The output voltage can be specific and can also be changed with a specific frequency[8] or a variable frequency. Variable output voltage is obtained by changing the DC input voltage and so that the inverter gain is constant. On the other hand, if the DC input voltage iscertain and cannot be changed, a variable output voltage can be obtained by changing the gain of the inverter, which is usually done with PWM control inside the inverter. The inverter gain is defined as the ratio of the AC output voltage to the DC input voltage.

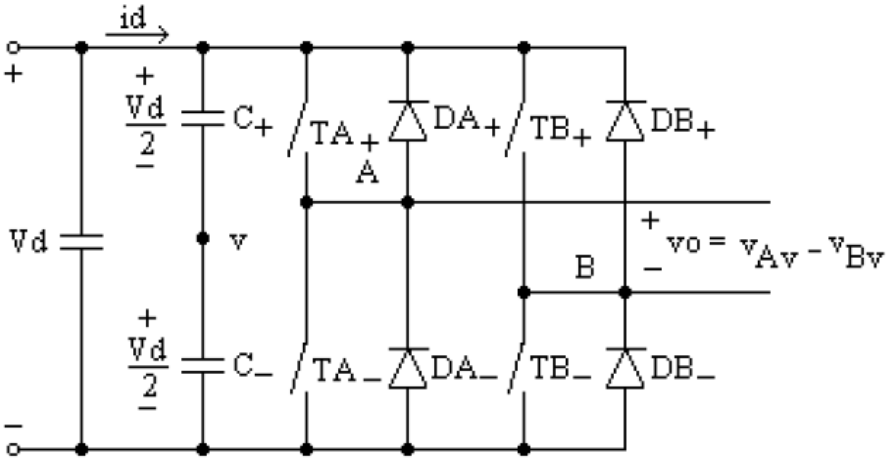

Figure 6. Single phase inverter

Figure 7. PhysiqueSingle phase inverter

In this study, an inverter with a type of Pure Sine Wave Inverter 1000watt (Pure Sine Wave Inverter) is used. This type of inverter can produce electrical waves that are very similar to electrical waves from the PLN network, making it suitable for sensitive electronic devices, such as televisions, computers, and medical devices. This type of inverter can provide the best performance and is much more efficient compared to other types of inverters.

Transformer

Transformer is a tool that functions to change a certain voltage into another voltage of

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

a different magnitude[9] based on the principle of electromagnetic induction. Transformers are widely used, both in the fields of electrical power and electronics. The use of transformers in power systems allows the selection of appropriate and economical voltages for each need, for example the need for high voltage in sending electrical power over long distances. In the field of electronics, transformers are used, among others, as impedance coupling between source and load; to separate one circuit from another circuit; and to inhibit direct current while still conducting or flowing alternating current between circuits. Basically, a transformer consists of two coils, namely the primary coil and the secondary coil. Where the voltage on the primary coil will be transformed (changed) on the secondary coil, the amount of which depends on the number of turns on each of the two coils. If on the primary coil there are N1 turns given a voltage source V1 and on the secondary coil there are N2 turns, then on the secondary coil there is a voltage of:

$$V_1 = \frac{N_2}{N_1} V_2 \ldots\ldots\ldots\ldots\ldots\ldots$$

With:
V2: secondary voltage (V)
V1: primary voltage (V)
N2: number of secondary turns
N1: number of primary turns

In a transformer, two principles occur, namely Oersted's law occurs in the primary coil and Faraday's law occurs in the secondary coil, where the two laws are as follows:

1. Faraday's law states that a static magnetic field that moves according to a function of time will produce an induced voltage which then produces an induced electric current[10].
2. Oersted's Law states that when an electric current flows through a conductor wire, a magnetic field is created around the conductor wire.

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

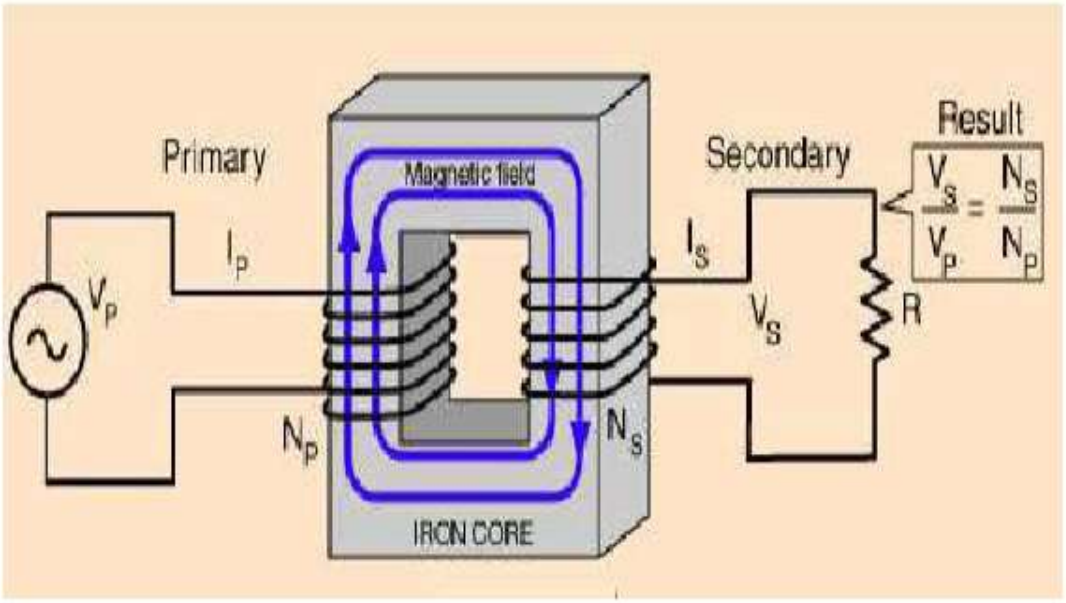

Figure 8. Transformer

Volt ampere meter

A digital volt amper meter (also known as a digital multimeter or DMM) is an electrical measuring instrument that can be used to measure voltage (volts), current (amperes) digitally which has a numeric display, which provides more accurate and easy-to-read measurements compared to analog multimeters that use pointers.

Figure 9. Volt Ampere meter

RESEARCH METHODS

The research method explains the steps taken in the research in a structural manner expected to achieve the research objectives. The research went through several stages, namely literature study, preparation of tools and materials, tool making and tool testing, data collection.

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

1. Literature study
2. Preparation of tools and materials
3. Tool making
4. Tool testing
5. Data retrieval

*Flow chart*This design stage explains the process of making an electrical energy emergency system tool, from the beginning of manufacture to completion. Flowchart Flowchart of the electrical energy emergency system design process, as shown below.

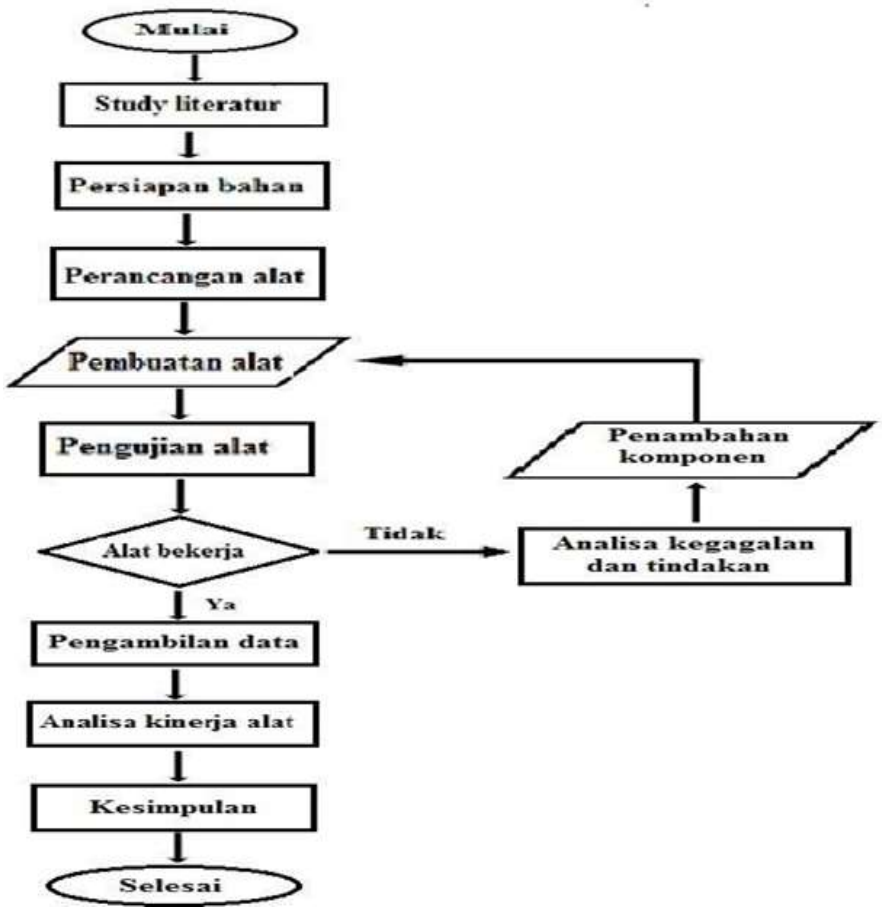

Figure 10. Flowchart of the tool system design process

RESULTS AND DISCUSSION

Design Results of Automatic Charger and Transformer Design for Emergency Battery Charging

In the design of the research system this time, it was made using a panel box as a support for the components needed to support the performance of the equipment and an indicator light was installed on the front as a performance that indicates that the tool is operating.

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Figure 11. Physical Form of Design

Charger Control Circuit

The making of this Charger control circuit starts from several components, namely: 5A step down transformer which functions as a voltage reducer from 220Volt (AC) PLN, to 12Volt (AC) then the output from the transformer is forwarded to the rectifier system which uses a diode which functions as a rectifier from 12Volt (AC) to 12Volt (DC) which functions as charging electrical energy (charge) on the battery. Because the battery is a source of unidirectional electrical energy. The physical form of the charger control is as shown in Figure.

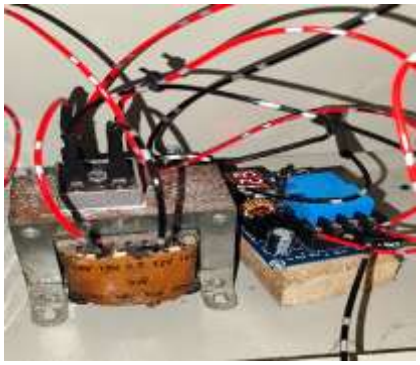

Figure 12. Physical Form of Charger Control Circuit

Figure 13. Inverter Physics

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

Charger Control Function Testing

In this automatic charger test, the aim is to obtain the performance of the circuit that will cut off the charging current at a voltage of 13.5V on a 12V battery with a capacity of 5AH automatically when the battery is fully charged. Where the battery input comes from the rectifier output of 13.5V and the battery output will be used as input from the inverter. Before the automatic charger circuit is connected to the battery, the battery input voltage is set at 11.5Vdc. The conditions when charging are shown in Figure 14.

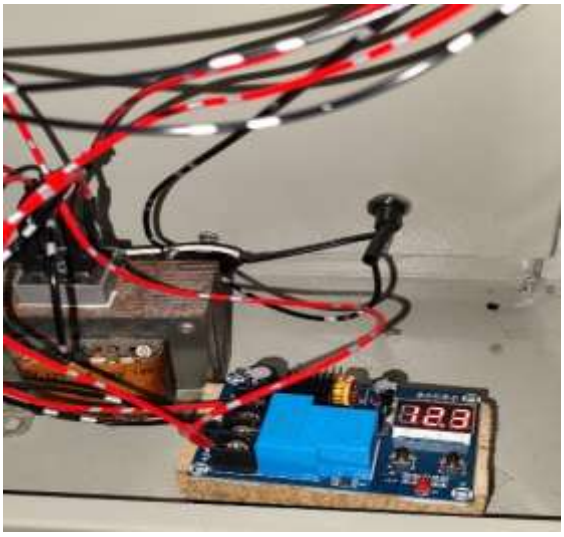

Figure 14. When Charging

The picture shows the condition of the device when charging the battery, marked by the red LED indicator light. After the charger circuit is set and connected to the battery, there will be a charging current. And if the battery is fully charged, there is no charging current.

Table 1. test results for automatic chargers and transformers during emergency battery charging.

No	Time	Voltage (V)	Current (A)	Transformer Temperature
1.	15.00	11.5V	1.17	31.8
2.	15.10	12.3V	1.03	35.6
3.	15.20	12.6V	0.98	38.6
4.	15.30	12.6V	0.89	39.2
5.	15.40	12.7V	0.89	40.4
6.	15.50	12.8V	0.88	42.8
7.	16.00	12.9V	0.89	42.4
8.	16.10	13.00V	0.92	44.5
9.	16.20	13.00V	0.83	43.6
10.	16.30	13.1V	0.82	44.9
11.	16.40	13.33V	0.82	41.5
12.	16.50	13.33V	0.70	44.7
13.	17.00	13.38V	0.67	44.8
14.	17.10	13.39V	0.65	44.1

INFOKUM
Volume 13, Number 04, 2025, DOI 10.58471/infokum.v13i04
ESSN 2722-4635 (Online)
https://infor.seaninstitute.org/index.php/infokum

No	Time	Voltage (V)	Current (A)	Transformer Temperature
15.	17.20	13.42V	0.65	44.1
16.	17.30	13.5V	0.64	44.5

Looking at the results of the table above, the analysis of the research tool in the battery charging process is taken, the current will slowly decrease from the initial charging of 1.17 Ampere and decrease to 0.64 Ampere. However, the battery voltage increases from 11.5 Volts to 13.5 Volts and a significant increase at the beginning of charging until 1 hour of charging to 1.4 Volts increase. After reaching a voltage of 13.5 charging, the charger will automatically cut off the current flow rate and voltage to the battery at a voltage of 13.5 Volts because the charger control settings are at that voltage.

CONCLUSION

Based on the results of the research method and discussion obtained from the testing and data collection in this study, several conclusions can be drawn, namely, it can be seen that the charger produces a voltage of 13.5 volts with a maximum charging current of 1.17 Ampere with a charger time of 2.5 hours, the charging process from a voltage of 11.5 Volts increases to 13.5 Volts. The temperature of the battery when charging must also be monitored so that there is no excessive heat that can damage the battery cells which reduces the life of the battery. While this series of tools can charge batteries with voltage variations from 11.5 volts to 13.5 volts

REFERENCES

NHS Wildan Budiman, "Design and Realization of 12 Volt 45 Ah Battery Charging System in Pico Hydro Power Plant at UPI Bandung," Jurnal Reka Elkomika, vol. Vol.2 |, p. 5, 2014.

ITSM I Nugroho, "Battery as DC Voltage Supply at 150 KV Kalisari Substation," p. 2, October 2012.

EWLY Joke Pratilastiarso, "UPS Design for Load (900VA) Based on Microcontroller," p. 9.

MH Rashid, Power Electronics Indonesian Edition Volume 1, Jakarta: PT Prenhallindo, 1999.

F. MR, "Design and Construction of 12V DC to 220V AC Inverter with 50HZ Frequency and Sinusoidal Output Waveform," University of Indonesia, December 2010.

MP Siti Nurhabibah Hutagalung, "Protype of 900 Watt DC to AC Inverter Circuit," ISSN 2301-9425 Pelita Informatika Journal, vol. Volume 16, July 2017.

Arismunandar Rober Wahyu, Deni Hendarto, Design and Construction of a Solar Panel-Based Gadget Charging System as an Alternative Electricity Source in Public Facilities, JuTEkS, October 2017, 4(2):46-53

Fadhli MR. 2010. Design and Construction of 12v DC to 220v AC Inverter with 50hz Frequency and Sinusoidal Output Waveform, Thesis, University of Indonesia, Depok.

Zainal Abidin.2014. Backup power supply using inverter.thesis. Electrical Engineering, Banjarmasin State Polytechnic.

Suharijanto, 2012, Utilization and creation of automatic electrical power supply devices using a 12V DC to 220 VAC inverter, Lamongan Islamic University

Hamdani, ST, MT, Siti Anisah, ST, MT, Hj. Zuraidah Tharo, ST, MT, Dr. Solly Aryza,, ST.,M.Eng. ISBN:978-623-7297-16-1156 SEMNASTEK UISU 2020 "Design and Construction of Modified Sine Wave Inverter in Solar Power Plant for Residential Homes".

Pristisal Wibowo, Beni Satria, M. Erpandi Dalimunte, Alim Muflih, Electrical Engineering Study Program, Development of Charging System for Electric Vehicles Panca Budi Development University 2024

Mhd Hasbi Ramadhan, Haris Gunawan, Dicky Lesmana, INFOKUM Journal, Volume 13/04 - 918-920 "Analysis of Solar Power System Planning for Street Lighting SUPPLY at Campus I Panca Budi Development University Medan" 2025

MustafidAmna Designs and Builds Automatic Battery Charger Tool 12 V 35 AH 2018

Fauzan Firdaus, M. Hariansyah, Suratun Design and Construction of Emergency Electrical Energy System for Household Consumers in the Ri Group,JuTEkS, Vol. 5, no. 1, April 2018