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# The Design of DC 12 V to DC 380 V 1000 Watt Converter with ATmega328 as a 65 KHz Oscillator

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**Abstract.** A DC to DC converter has been built and research has been conducted to examine the effect of load on the output voltage of the DC to DC converter with fixed oscillation frequency. This converter DC to DC circuit uses a 12 V DC battery as an input voltage source connected with a step-up transformer until it is successfully raised to 380 V DC. The load given to the DC to DC circuit converter in the form of lamps, varies from 40 watts to 960 watts with a fixed oscillation frequency of 65 Khz that has been determined by the microcontroller. The test results showed that the output voltage value decreased in accordance with the increase in load so that when the load of 960 watts obtained the output voltage of 220 V DC.

**Keyword:** Transformer, Microcontroller, DC-DC Converter.

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## 1 Introduction

Power with a voltage value of 380V DC is efficient power when compared to electrical power voltage of 220V AC. The 220V AC electrical network began to be abandoned for the purposes of the data network management power grid. The DC 380 V power grid can be easily merged from a variety of different energy sources, from wind, water, solar and fuel oil power plants. In the application of renewable energy sources, wind energy and solar energy produce low and unstable output voltage. The resulting voltage is stored on the battery and a device is needed to raise the voltage [1]. In addition, some renewable energy sources are available very abundantly and free from pollution [2]. Conversion of solar and wind energy into electricity and merging several types of renewable and non-renewable energy using controllers to optimize the utilization of energy sources and use batteries as their energy storage [3]. Current technological developments encourage researchers to develop the utilization of renewable energy sources, in this case solar cells. In its use the electrical energy produced by the solar cell is then stored in accu before being channeled to the load. The problem that then arises is, the power storage in

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accu is at voltages of 12 and 24 Volt DC while some existing loads require a voltage of 220 volts and above [4].

Electricity can be obtained from power plants or energy storage such as batteries. Thomas A. Edison actually started the revolution when he proposed the use of electricity instead of natural gas to light up the house. In the industry we may think of it as a dramatic change in idea or practice. Evolution on the other hand can be considered a gradual development of something into a better form. With the main purpose of data centers as reliability and secondary purposes being to manage costs, one should look at macro trends in terms of power, computing, and reliability [5]. Electrical power is the amount of energy absorbed or produced in a circuit. Energy sources such as electric voltage will produce electrical power while the load connected to it will absorb the electrical power. In other words, electrical power is the level of energy consumption in a circuit or electrical circuit. While based on the concept of business, what is meant by electrical power is the amount of effort in moving the charge per unit of time or shorter is the amount of electrical energy used per second [6]. Electrical power is defined as the rate of electrical energy delivery in the electrical circuit. Si unit of electrical power is a wattage that says the number of electricity flowing unity of time (joule / sekon). Electric currents flowing in circuits with electrical resistances give rise to work. The device converts this work into various useful forms, such as heat (electric heater), light (light bulb), kinetic energy (electric motor), and sound (loudspeaker) [7].

The application of DC–DC converter in its development has enabled an electronic device to function by using a small voltage battery energy source where output voltage can be changed according to usage needs. Electronic converter technology has been widely used in everyday life, for example its application, DC-DC converter is used in renewable energy sources as an energy producer such as in wind and solar power [8]. A DC-DC converter is an electronic circuit and is used to modify the DC electrical circuit from one potential different stage to add a potential level of difference. A DC-DC circuit converter that converts a DC source from one voltage level to another by changing the task cycle of the main switch in the circuit. Dc-DC converters are widely used in power mode switch supply, adjustable speed drives, disconnected power supply (UPS) and many other [9].

Step-up DC-DC konverter yang banyak digunakan untuk meningkatkan tingkat tegangan input rendah dari sistem listrik didistribusikan. Sistem ini didukung oleh sumber energi terbarukan seperti panel surya, baterai, dan sel bahan bakar. Sebuah tren baru dalam sistem generasi fotovoltaik perumahan untuk mengadopsi konfigurasi paralel daripada koneksi seri untuk memenuhi persyaratan keselamatan saat menggambar daya maksimum yang tersedia dari PV panel [10].

The AC/DC converter in normal operation has a wide input voltage range to close and provide a high efficiency regulated output voltage. DC/DC converters used in 380 V DC systems usually have a stable input voltage, as the batteries in dc boots the input voltage to the DC/DC converter only changes during the charging cycle and battery emptying. The input voltage can range from 12-50 V and the output voltage is usually 380 V. A conventional boost converter will have a difficult time increasing the input voltage and maintaining high efficiency simultaneously [11]. Data center power topology 380V DC is one of the macro trends. The 380V DC provides the most flexible and cost-effective system to meet fluctuating energy demand that will take advantage of all the engineering benefits of direct current [12].

Small voltage changes in the gate result in voltage changes in resistance resulting in reinforcement. The increase in gate voltage resulted in a decrease in drain voltage, so there was a 180° phase shift between input and FET output [13]. Low working voltage, passive switches (diodes) are often replaced with active switches (MOSFET) so that the power supply on the switch can be reduced. When using 2 active switches, both switches will work alternately, and there is only one switch that closes at any time. The average output voltage value of the converter is proportional to the ratio between the closing time of the switch (conduction switch/ON) to its claiming period. The value of this power factor is not less than 0.2, because if operated at a higher voltage ratio, the switch will work under its reliability and cause the converter's efficiency to drop [14]. If the MOSFET IS OFF then the current flows to the inductor, the energy stored in the inductor will rise. When the MOSFET SWITCH ON the energy in the inductor will drop and the current flows towards the load. In this way, the average value of the output voltage will correspond to the ratio between the opening time and the closing time of the switch. This is what makes this topology can produce an average value of output voltage / load higher or lower than the source voltage [15].

Direct voltage or dc is widely used in the industry, not only as an electric power source dc motor, but also a lot for other applications. Usually dc voltage is obtained from ac voltage that is targeted with semiconductor components such as diodes, thyristor, mosfet etc. This dc voltage must not only be filtered cleanly but also well regulated. If the current source in this direction is charged then the output voltage will change. This change is caused by the fall of voltage in diodes, channels, transformers or in generators if the source is directly from the generator [16]. Buck-boost converters can produce output voltages lower or higher than the source. The power control circuit will signal the MOSFET.

A commonly used tool today is the DC-DC boost converter. This DC-DC converter is widely used for applications that require a higher voltage than its source [17]. DC-DC boost converter is a converter used to provide output voltage higher than low input voltage by controlled by control signal in the form of PWM signal (Pulse Width Modulation) [18].

## 2 Methods

This research was conducted in digital technology laboratory of University of North Sumatra which includes the design of tools and data calculation.

The converter is designed with three main components, namely: Arduino as a data processor of sensors, a series of push pull ups to increase output voltage and FET Logic Driver to set the current and voltage values of the circuit.

The structural design is given in Figure 1 and the flowchart in Figure 2.

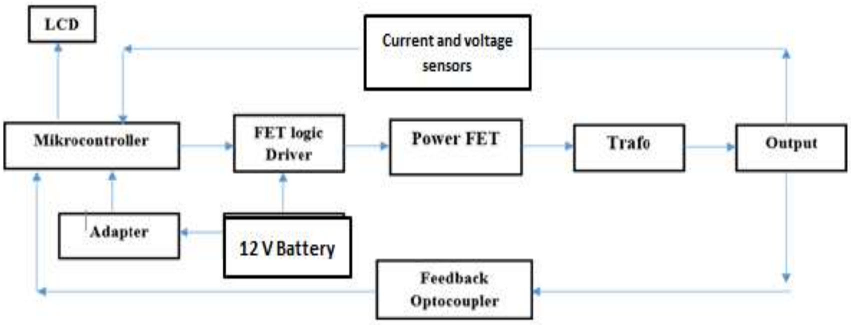


**Figure 1.** The block diagram of the research

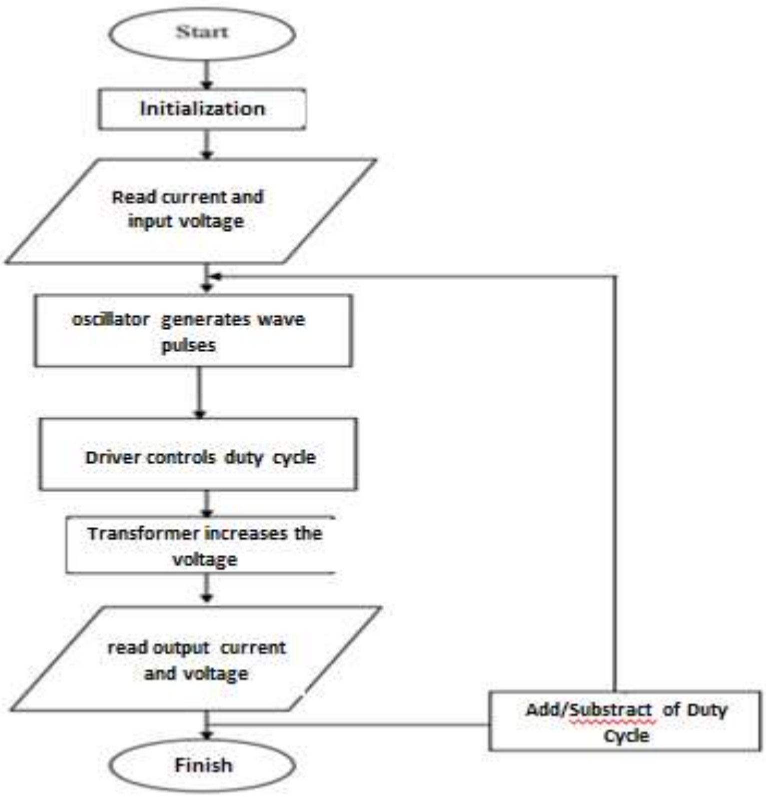


**Figure 1.** Flowchart of the research

# 3 Result and Discussion

## 3.1 Load Testing Vs voltage

This test aims to find out the effect of load on output from DC-DC converter. Testing is done by changing the load and measuring the voltage generated by the DC DC converter.

**Table 1.** Effect of Load on Voltage

| Number | Load (Watt) | $V_{in}$ (V) | $I_{Input}$ (A) | $V_{Out}$ (V) | $I_{Output}$ (A) |
|---|---|---|---|---|---|
| 1 | 40 | 13.65 | 2.92 | 215.2 | 0.15 |
| 2 | 40 | 13.64 | 2.86 | 215.9 | 0.14 |
| 3 | 40 | 13.65 | 2.94 | 215.7 | 0.15 |
| 4 | 40 | 13.63 | 2.83 | 215.9 | 0.14 |
| 5 | 40 | 13.65 | 2.94 | 215.2 | 0.15 |
| 6 | 75 | 13.45 | 5.55 | 211.82 | 0.28 |
| 7 | 75 | 13.48 | 5.52 | 211.38 | 0.27 |
| 8 | 75 | 13.44 | 5.5 | 211.38 | 0.27 |
| 9 | 75 | 13.48 | 5.51 | 211.5 | 0.28 |
| 10 | 75 | 13.4 | 5.49 | 211.51 | 0.28 |
| 11 | 100 | 13.25 | 7.42 | 205.2 | 0.38 |
| 12 | 100 | 13.26 | 7.46 | 205.1 | 0.37 |
| 13 | 100 | 13.18 | 7.4 | 205.3 | 0.37 |
| 14 | 100 | 13.2 | 7.5 | 205.5 | 0.38 |
| 15 | 100 | 13.22 | 7.3 | 205.3 | 0.36 |
| 16 | 150 | 12.88 | 11.2 | 192.3 | 0.6 |
| 17 | 150 | 12.9 | 11.22 | 192.5 | 0.58 |
| 18 | 150 | 12.86 | 11.26 | 192.3 | 0.59 |
| 19 | 150 | 12.84 | 11.2 | 192.7 | 0.57 |
| 20 | 150 | 12.84 | 11.4 | 192.3 | 0.58 |
| 21 | 200 | 12.6 | 15.72 | 186.4 | 0.8 |
| 22 | 200 | 12.64 | 15.7 | 186.1 | 0.82 |
| 23 | 200 | 12.64 | 15.72 | 186.3 | 0.83 |
| 24 | 200 | 12.68 | 15.72 | 186.38 | 0.8 |
| 25 | 200 | 12.63 | 15.7 | 186.6 | 0.8 |
| 26 | 240 | 12.56 | 19.9 | 175.2 | 1.07 |
| 27 | 240 | 12.56 | 19.87 | 175.9 | 1.08 |
| 28 | 240 | 12.55 | 19.8 | 175.7 | 1.06 |
| 29 | 240 | 12.56 | 19.87 | 175.68 | 1.08 |
| 30 | 240 | 12.53 | 19.94 | 175.2 | 1.07 |

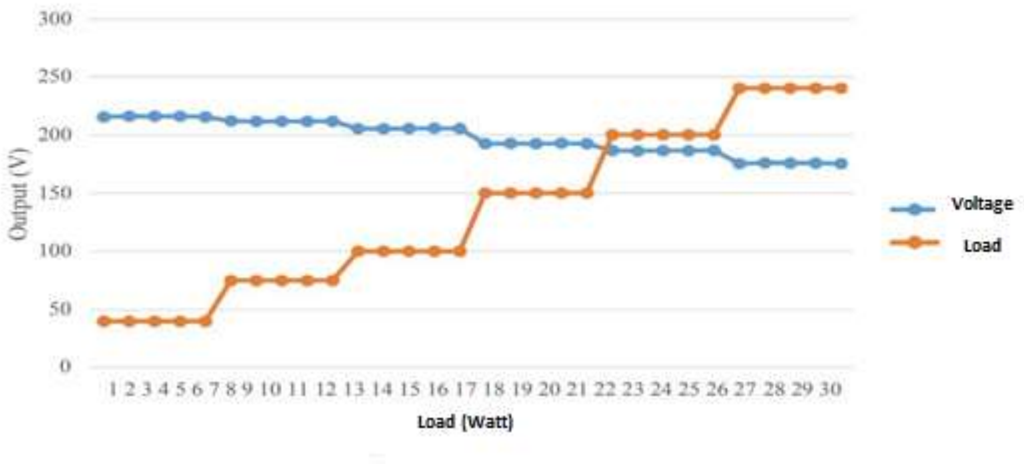


**Figure 3.** Load graph to voltage

Figure 3 shows the greater the load given to the circuit, the lower the output voltage obtained on the system. The output voltage value is inversely proportional to the given load.

## 3.2 Testing of Efficiency of DC-DC converter

The efficiency of the DC to DC Converter can be found by calculating the ratio of the input power (Pin) and Output power (POut) on the DC to DC Converter in each experiment using the equation (1), and the results are given in Table 2 to Table 7.

$$\text{Efficiency} = \frac{P_{out}}{P_{in}} x100\% \quad (1)$$

**Table 2.** Efficiency Testing Data with a load of 40 Watts

| Experiment | $V_{in}$ (V) | $I_{in}$ (A) | $V_{out}$ (V) | $I_{out}$ (A) | $P_{In}$ (W) | $P_{Out}$ (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 13.65 | 2.92 | 215.2 | 0.15 | 39.858 | 32.28 | 80.98751 |
| 2 | 13.64 | 2.86 | 215.9 | 0.14 | 39.0104 | 30.226 | 77.4819 |
| 3 | 13.65 | 2.94 | 215.7 | 0.15 | 40.131 | 32.355 | 80.62346 |
| 4 | 13.63 | 2.83 | 215.9 | 0.14 | 38.5729 | 30.226 | 78.36071 |
| 5 | 13.65 | 2.94 | 215.2 | 0.15 | 40.131 | 32.28 | 80.43657 |
| 6 | 13.65 | 2.96 | 215.2 | 0.15 | 40.404 | 32.28 | 79.89308 |
| 7 | 13.63 | 2.93 | 215.9 | 0.14 | 39.9359 | 30.226 | 75.68629 |
| 8 | 13.65 | 2.83 | 215.8 | 0.15 | 38.6295 | 32.37 | 83.79606 |
| 9 | 13.65 | 2.92 | 215.7 | 0.14 | 39.858 | 30.198 | 75.76396 |
| 10 | 13.63 | 2.91 | 215.1 | 0.14 | 39.6633 | 30.114 | 75.92409 |
| 11 | 13.65 | 2.94 | 215.5 | 0.15 | 40.131 | 32.325 | 80.5487 |
| 12 | 13.65 | 2.94 | 215.5 | 0.15 | 40.131 | 32.325 | 80.5487 |
| 13 | 13.66 | 2.91 | 215.7 | 0.14 | 39.7506 | 30.198 | 75.96866 |
| 14 | 13.65 | 2.94 | 215.6 | 0.15 | 40.131 | 32.34 | 80.58608 |
| 15 | 13.65 | 2.93 | 215.8 | 0.14 | 39.9945 | 30.212 | 75.54039 |
| 16 | 13.67 | 2.87 | 215.9 | 0.15 | 39.2329 | 32.385 | 82.54552 |
| **Average efficiency** | | | | | | | 79.04323 |

**Table 3**. Efficiency Testing Data with a load of 75 Watt

| Experiment | $V_{in}$ (V) | Iin (A) | Vout(V) | Iout(A) | P In (W) | P Out (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 13.45 | 5.55 | 211.82 | 0.28 | 74.6475 | 59.3096 | 79.4529 |
| 2 | 13.48 | 5.52 | 211.38 | 0.27 | 74.4096 | 57.0726 | 76.70059 |
| 3 | 13.44 | 5.5 | 211.38 | 0.27 | 73.92 | 57.0726 | 77.2086 |
| 4 | 13.48 | 5.51 | 211.5 | 0.28 | 74.2748 | 59.22 | 79.73095 |
| 5 | 13.4 | 5.49 | 211.51 | 0.28 | 73.566 | 59.2228 | 80.50295 |
| 6 | 13.42 | 5.47 | 211.5 | 0.27 | 73.4074 | 57.105 | 77.79188 |
| 7 | 13.46 | 5.48 | 211.48 | 0.28 | 73.7608 | 59.2144 | 80.27896 |
| 8 | 13.44 | 5.54 | 211.6 | 0.28 | 74.4576 | 59.248 | 79.5728 |
| 9 | 13.49 | 5.48 | 211.7 | 0.26 | 73.9252 | 55.042 | 74.45634 |
| 10 | 13.42 | 5.46 | 211.5 | 0.29 | 73.2732 | 61.335 | 83.70728 |
| 11 | 13.44 | 5.48 | 211.5 | 0.28 | 73.6512 | 59.22 | 80.40602 |
| 12 | 13.4 | 5.38 | 211.2 | 0.29 | 72.092 | 61.248 | 84.95811 |
| 13 | 13.48 | 5.5 | 211.7 | 0.26 | 74.14 | 55.042 | 74.24063 |
| 14 | 13.41 | 5.4 | 211.2 | 0.27 | 72.414 | 57.024 | 78.7472 |
| 15 | 13.4 | 5.56 | 211.5 | 0.28 | 74.504 | 59.22 | 79.48567 |
| 16 | 13.46 | 5.54 | 211.65 | 0.28 | 74.5684 | 59.262 | 79.47334 |
| **Average efficiency** | | | | | | | 79.16964 |

**Table 4**. Efficiency Testing Data with a load of 100 Watt

| Experiment | Vin (V) | Iin (A) | Vout(V) | Iout(A) | P In (W) | P Out (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 13.25 | 7.42 | 205.2 | 0.38 | 98.315 | 77.976 | 79.31241 |
| 2 | 13.26 | 7.46 | 205.1 | 0.37 | 98.9196 | 75.887 | 76.71584 |
| 3 | 13.18 | 7.4 | 205.3 | 0.37 | 97.532 | 75.961 | 77.88316 |
| 4 | 13.2 | 7.5 | 205.5 | 0.38 | 99 | 78.09 | 78.87879 |
| 5 | 13.22 | 7.3 | 205.3 | 0.36 | 96.506 | 73.908 | 76.58384 |
| 6 | 13.24 | 7.4 | 205.4 | 0.35 | 97.976 | 71.89 | 73.37511 |
| 7 | 13.2 | 7.2 | 205.2 | 0.34 | 95.04 | 69.768 | 73.40909 |
| 8 | 13.18 | 7.4 | 205.3 | 0.33 | 97.532 | 67.749 | 69.46336 |
| 9 | 13.26 | 7.4 | 205.5 | 0.38 | 98.124 | 78.09 | 79.58298 |
| 10 | 13.16 | 7.44 | 205.6 | 0.39 | 97.9104 | 80.184 | 81.89528 |
| 11 | 13.18 | 7.46 | 205.6 | 0.38 | 98.3228 | 78.128 | 79.46072 |
| 12 | 13.22 | 7.39 | 205.7 | 0.38 | 97.6958 | 78.166 | 80.00958 |
| 13 | 13.26 | 7.45 | 205.3 | 0.37 | 98.787 | 75.961 | 76.89372 |
| 14 | 13.28 | 7.43 | 205.6 | 0.38 | 98.6704 | 78.128 | 79.18079 |
| 15 | 13.2 | 7.2 | 205.2 | 0.4 | 95.04 | 82.08 | 86.36364 |
| 16 | 13.21 | 7.42 | 205.1 | 0.39 | 98.0182 | 79.989 | 81.60627 |
| **Average efficiency** | | | | | | | 78.16341 |

**Table 5**. Efficiency Testing Data with a load of 150 watt

| Experiment | Vin (V) | Iin (A) | Vout(V) | Iout(A) | P In (W) | P Out (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 12.88 | 11.2 | 192.3 | 0.6 | 144.256 | 115.38 | 79.98281 |
| 2 | 12.9 | 11.22 | 192.5 | 0.58 | 144.738 | 111.65 | 77.13938 |
| 3 | 12.86 | 11.26 | 192.3 | 0.59 | 144.8036 | 113.457 | 78.35233 |
| 4 | 12.84 | 11.2 | 192.7 | 0.57 | 143.808 | 109.839 | 76.37892 |
| 5 | 12.84 | 11.4 | 192.3 | 0.58 | 146.376 | 111.534 | 76.19692 |
| 6 | 12.88 | 11.25 | 192.4 | 0.59 | 144.9 | 113.516 | 78.34092 |
| 7 | 12.9 | 11.26 | 192.6 | 0.6 | 145.254 | 115.56 | 79.55719 |
| 8 | 12.84 | 11.2 | 192.3 | 0.6 | 143.808 | 115.38 | 80.23198 |
| 9 | 12.83 | 11.2 | 192.6 | 0.58 | 143.696 | 111.708 | 77.73912 |
| 10 | 12.88 | 11.28 | 192.8 | 0.6 | 145.2864 | 115.68 | 79.62204 |
| 11 | 12.9 | 11.2 | 192.6 | 0.58 | 144.48 | 111.708 | 77.31728 |
| 12 | 12.92 | 11.25 | 192.7 | 0.6 | 145.35 | 115.62 | 79.54592 |
| 13 | 12.9 | 11.18 | 192.4 | 0.58 | 144.222 | 111.592 | 77.37516 |
| 14 | 12.8 | 11.16 | 192.6 | 0.56 | 142.848 | 107.856 | 75.50403 |
| 15 | 12.84 | 11.22 | 192.3 | 0.54 | 144.0648 | 103.842 | 72.08006 |
| 16 | 12.81 | 11.16 | 192.5 | 0.58 | 142.9596 | 111.65 | 78.09899 |
| **Average efficiency** | | | | | | | 77.71644 |

**Table 6**. Efficiency Testing Data with a load of 200 Watt

| Experiment | Vin (V) | Iin (A) | Vout (V) | Iout (A) | P In (W) | P Out (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 12.6 | 15.72 | 186.4 | 0.8 | 198.072 | 149.12 | 75.28575 |
| 2 | 12.64 | 15.7 | 186.1 | 0.82 | 198.448 | 152.602 | 76.89773 |
| 3 | 12.64 | 15.72 | 186.3 | 0.83 | 198.7008 | 154.629 | 77.82002 |
| 4 | 12.68 | 15.72 | 186.38 | 0.8 | 199.3296 | 149.104 | 74.80274 |
| 5 | 12.63 | 15.7 | 186.6 | 0.8 | 198.291 | 149.28 | 75.2833 |
| 6 | 12.65 | 15.78 | 186.48 | 0.84 | 199.617 | 156.6432 | 78.47187 |
| 7 | 12.66 | 15.75 | 186.2 | 0.82 | 199.395 | 152.684 | 76.57364 |
| 8 | 12.64 | 15.7 | 186.5 | 0.84 | 198.448 | 156.66 | 78.94259 |
| 9 | 12.6 | 15.74 | 186.52 | 0.85 | 198.324 | 158.542 | 79.9409 |
| 10 | 12.68 | 15.77 | 186.48 | 0.81 | 199.9636 | 151.0488 | 75.53815 |
| 11 | 12.7 | 15.74 | 186.7 | 0.82 | 199.898 | 153.094 | 76.58606 |
| 12 | 12.68 | 15.75 | 186.3 | 0.82 | 199.71 | 152.766 | 76.49392 |
| 13 | 12.71 | 15.78 | 186.5 | 0.81 | 200.5638 | 151.065 | 75.32017 |
| 14 | 12.68 | 15.76 | 186.6 | 0.84 | 199.8368 | 156.744 | 78.436 |
| 15 | 12.65 | 15.68 | 186.5 | 0.82 | 198.352 | 152.93 | 77.10031 |
| 16 | 12.68 | 15.76 | 186.4 | 0.81 | 199.8368 | 150.984 | 75.55365 |
| **Average efficiency** | | | | | | | 76.81543 |

**Table 7**. Efficiency Testing Data with a load of 240 Watt

| Experiment | Vin (V) | Iin (A) | Vout (V) | Iout (A) | P In (W) | P Out (W) | Eficiency (%) |
|---|---|---|---|---|---|---|---|
| 1 | 12.56 | 19.9 | 175.2 | 1.07 | 249.944 | 187.464 | 75.0024 |
| 2 | 12.56 | 19.87 | 175.9 | 1.08 | 249.5672 | 189.972 | 76.12058 |
| 3 | 12.55 | 19.8 | 175.7 | 1.06 | 248.49 | 186.242 | 74.94949 |
| 4 | 12.56 | 19.87 | 175.68 | 1.08 | 249.5672 | 189.7344 | 76.02538 |
| 5 | 12.53 | 19.94 | 175.2 | 1.07 | 249.8482 | 187.464 | 75.03116 |
| 6 | 12.54 | 19.7 | 175.2 | 1.1 | 247.038 | 192.72 | 78.01229 |
| 7 | 12.58 | 19.86 | 175.9 | 1.09 | 249.8388 | 191.731 | 76.74188 |
| 8 | 12.57 | 19.84 | 175.6 | 1.08 | 249.3888 | 189.648 | 76.04512 |
| 9 | 12.54 | 19.8 | 175.7 | 1.08 | 248.292 | 189.756 | 76.42453 |
| 10 | 12.55 | 19.9 | 175.1 | 1.08 | 249.745 | 189.108 | 75.72043 |
| 11 | 12.54 | 19.68 | 175.5 | 1.05 | 246.7872 | 184.275 | 74.66959 |
| 12 | 12.53 | 19.7 | 175.48 | 1.09 | 246.841 | 191.2732 | 77.48842 |
| 13 | 12.56 | 19.88 | 175 | 1.05 | 249.6928 | 183.75 | 73.59043 |
| 14 | 12.57 | 19.87 | 175.7 | 1.08 | 249.7659 | 189.756 | 75.97354 |
| 15 | 12.54 | 19.89 | 175.6 | 1.05 | 249.4206 | 184.38 | 73.92332 |
| 16 | 12.56 | 19.7 | 175.8 | 1.09 | 247.432 | 191.622 | 77.44431 |
| **Average efficiency** | | | | | | | 75.82268 |

**Table 8.** Efficiency Value of DC to DC Converter

| Number | Load (Watt) | Eficiency (%) |
|---|---|---|
| 1 | 40 | 79.04323 |
| 2 | 75 | 79.16964 |
| 3 | 100 | 78.16341 |
| 4 | 150 | 77.71644 |
| 5 | 200 | 76.81543 |
| 6 | 240 | 75.82268 |
| **Average Eficiency** | | 77.7884 |

Based on Table 8, the greater the load used, the efficiency of DC to DC Converter decreases, this is due to the step-up transformer working above its working rating, the higher the primary current then most of its power is converted into heat. From the data above, the average efficiency of DC to DC Converter is 77.78%. This efficiency value is influenced by step-up transformers and on the reasoning where each switch component is given a large load so that some of it becomes a loss in the form of heat.

## 4 Conclusion

From the results of the design of the tool to the testing and discussion of the system, the author can draw conclusions:

1. DC to DC Converter converts 12V DC to 380 V DC, the voltage obtained is about 220 V to 380 V using a frequency value of 65 Khz.
2. Power produced by 240 Watts by using a lamp module as a load, using four lamp modules, the power generated is 960 Watts (~1000 Watts).
3. The results of this research can be used directly on inverter DC to DC pure sine.

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