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Power Efficiency Using Bank Capacitor Regulator on Field Service Shoes with Fast Charge Method

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ABSTRACT

Power efficiency is a key factor in military equipment, including field service boots used by personnel in various field situations that often demand durability and reliable electricity availability. This research focused on improving the power efficiency of field service shoes by using capacitor bank regulators and fast charging methods. By designing and implementing this system, this research aims to optimize the use of power sources, extend battery life, and improve personnel comfort in the field. The method used in this research is the fast charge method. The fast charge method enables faster battery charging, which is important in field situations with limited time availability. The findings of this research show that the capacitor bank regulator can keep the DC output stable despite instability in the input. The total power usage in the circuit is 0.20 W, and the power efficiency is about 60.61%. The research shows the potential of this voltage conversion circuit for efficient applications. Although it has not achieved maximum efficiency, the capacitor bank regulator can maintain output stability even in input voltage instability. This circuit can effectively cope with voltage conversion in various applications with further optimization.

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1. INTRODUCTION

In maintaining the territorial unity of the Republic of Indonesia and carrying out its main duties, the Indonesian National Army has military equipment. It requires the supply of electrical energy as one of its main needs. Through the Ministry of Energy and Mineral Resources (ESDM), the Indonesian government has issued a policy to replace fossil fuels with environmentally friendly New Renewable Energy [1]. This environmentally friendly energy resource can be obtained from mechanical energy, such as vibrations produced by human footsteps using piezoelectricity [2]. A mini generator was designed in this study to overcome the problem of charging. This generator can be operated in parallel to increase the power supply from the plant to each generator that multiplies the load [3, 4]. In addition, this research also includes the development of a faster battery charging system with an automatic circuit breaker function [5–15]. Using voltage, current, and temperature sensors connected to the PIC 16F877A microcontroller, the measurement results are displayed on a 16x2 LCD [16]. This study also focused on installing parallel capacitors to compensate for inductive loads in power systems, such as low-voltage main panels [17, 18]. Furthermore, this research includes a battery charging system on solar UAVs using a DC-DC converter type boost converter and a fast charging controller for efficiency in charging batteries [19–27]. Compared to these environmentally friendly energy resources obtained from mechanical energy, such as vibrations produced by human footsteps [2]. This research focused on developing an electrical energy source using Stepper 28-BYJ48, which functions as a generator of electrical energy sources by utilizing footsteps up and down as a power source located in the military field service shoes [28–34, 26, 35]. Research [28] aims to improve the value of the power factor caused by inductive loads, with the results of the research producing a capacitor bank tool that can change the value of the power factor. The research [30] aims to identify unit or element failures in capacitor banks with the results of research into developing voltage differential protection functions for capacitor banks. We utilize a bank capacitor regulator to ensure the output voltage remains stable with fluctuating inputs. However, no previous research has designed a system that accelerates battery charging and automatic disconnection of the electric current, thus providing innovative aspects in safety and efficient energy use. This aims to keep the voltage and current generated consistent and speed up the charging process.

There is previous research related to the bank's capacitor regulator, namely the design of a prototype single-phase Permanent magnet generator axial flux type at low rotation [35]. This study designed a generator system of one phase, axial flux type using a permanent magnet type of neodymium iron boron that rotates at low speed. Design a fast battery charging system and automatic circuit breaker with an LM338K regulator [27]. In this study, we designed a faster battery charging system to cut off the electric current automatically working principle of synchronous generator in this study, synchronous machines are often operated in parallel. The purpose of parallel generators is to increase the power supply from the given generator to each generator delivered to the loadinstallation of capacitor banks for power factor repair [2]. In the study, series and parallel capacitors in the power system generate reactive power to improve power and voltage factors because they increase system capacity and reduce losses of single-phase bank capacitor regulator with power up to 3500V an Arduino [25]. In research, measuring power factor with the zero-crossing detector method works well at inductive linear loads. Analysis of the use of bank capacitors is to improve power factor. This research uses capacitor banks to improve the power factor in reactive, capacitive, and resistive power loads. Design a solar panel charge controller using a fast-charging system. This study needs an efficient charger controller and a battery that can receive large currents to support the fast-charging system. The electric energy harvester floor uses piezoelectric [2]. In this study designing piezoelectricity on the floor, waste energy from footsteps was utilized. Piezoelectricity produces low power due to pressure. Designed a lead acid and li-ion battery charger automatically using a powered PIC 16F877A microcontroller with a pi controller. In this study, the lead acid and li-ion battery fillers were designed automatically using the PIC 16F877A microcontroller, which has a system to stop charging the battery when the battery is full and is equipped with voltage and current temperature sensors to determine the condition of the battery. Design a wireless battery monitoring system based on Esp32 design and construction of wireless battery monitoring [25]. In this research, designing a monitoring system using microcontrollers and sensors was developed into monitoring using the IoT concept. Product planning for a fast-charging charger for USB Type-C involves the application of the Quality Function Deployment method [36]. This study discusses the quality function deployment method, which aims to create fast charging products that shorten the battery charging time and ensure stable power. Fast charging technique for lithium-ion batteries using fuzzy logic [37]. This study uses the fuzzy method in charging PWM (Pulse with Modulation) as a temperature and voltage control when charging the battery. The difference between this research and previous research is the focus on developing a faster and more automatic battery charging system using an LM338K regulator. Previous studies, such as research [25, 36], focused more on the development of generators, the working principle of synchronous generators, and the design of fast battery charging systems. This research aims to design a system that speeds up battery charging and automatically cuts off the electric current, providing innovative aspects of safety and energy use efficiency.

The contribution of this research to the development of science and its benefits is to improve our understanding of how to use human physical movement as a reliable source of electrical energy, especially in military contexts where energy resources are often limited. With this approach, we hope to provide innovative solutions to address energy supply issues in emergencies or special missions where rapid and stable energy availability becomes critical to maintaining the readiness of military personnel. Based on the problems described, this paper's writing structure is as follows: the second subsection will explain the applied research method. The third subsection will discuss design results, test results, and analysis. The last subsection will summarize the conclusions of this study and provide suggestions for future research based on the findings obtained in this study.

2. RESEARCH METHOD

The stage in this study is to start. Data collection is the stage of looking for literacy as a theoretical basis in starting research. Data Analysis or sorting data to be used to support research. System design is the process of designing and designing. The design's implementation becomes a tool per the plan made. System testing is used to determine the design results, and system analysis is recording results. The conclusion describes the data obtained compared to planning. The stages of research begin with the analysis and formulation of the problem. Then, proceed with the data collection stage, looking for relevant information. The next stage of system design focuses on designing the structure and features of the system to be developed and implemented in the system implementation stage. After that, the system is tested in the system testing phase to ensure it works as expected. The data analysis phase evaluates system performance using data generated during testing. Finally, the project or system development cycle closes, signifying the completion of the project with the expectation that the system can be used for its original purpose.

2.1. Proposed system

The design of the lamp control system consists of several interconnected devices. The generator used by the 28BYJ-48 stepper motor is used to change the step pressure to rotate the stepper shaft to produce AC voltage. The rectifier converts AC voltage to DC using MB10F diodes arranged in parallel. The input INA219 sensor reads the voltage and inrush current from the rectifier to be transmitted to the microcontroller. The Boost Converter folds the voltage from the rectifier to a 5V output. The battery is used as storage/storage of voltage from the step results and as a supply device and output device. The voltage sensor is used to determine the battery voltage for processing on the microcontroller as a percentage. A Buck-Boost converter is used to increase/decrease the voltage for the supply of output devices. The INA219 sensor (output) reads the voltage and outflow from the Buck-Boost converter to be delivered to the microcontroller. Microcontrollers process data from INA219 input/output and voltage sensors to be sent to OLED. OLED is used to display data from microcontrollers. The output is a voltage connector out of storage to a load or other equipment. The block diagram of the Capacitor Regulator system can be shown in Figure 1.

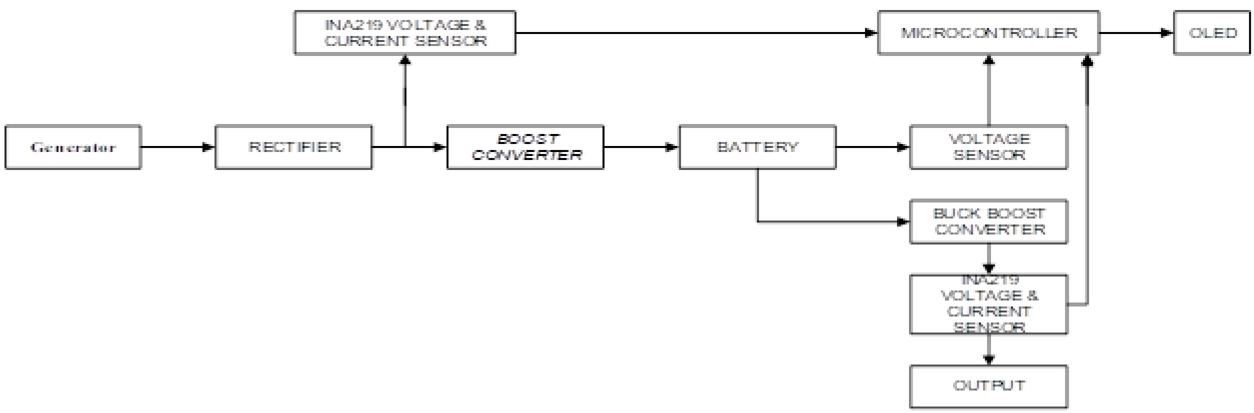


Figure 1. Block Diagram System

The 28BYJ-48 stepper motor generates AC voltage as a step generator. MB10F diodes are arranged parallel in a rectifier to convert AC voltage to DC. The input INA219 sensor reads the voltage and inlet current from the rectifier to be transmitted to the microcontroller. Boost Converter is used to increase the voltage from the rectifier to 5V. The battery serves as a storage voltage and power source for the device. A voltage sensor is used to monitor battery voltage. The buck-boost converter regulates the outgoing voltage from storage for the output device. The INA219 sensor (output) reads the voltage and outflow from the Buck Boost converter. The microcontroller processes data from the INA219 input/output sensor and voltage sensor for display on the OLED. Oled displays data processed by microcontrollers. The output connector directs the voltage from the storage to the load or other equipment.

2.2. Tool Planning

In the design process, researchers design or design mechanical designs and detailed schematic designs of tools. The mechanical design is a series of PDL shoes with steppers, springs, and aluminum plates whose design is such that it can rotate the stepper shaft to produce induction voltage. The mechanical design can be shown in Figure 2, which can be seen in Figure **?? ??**.

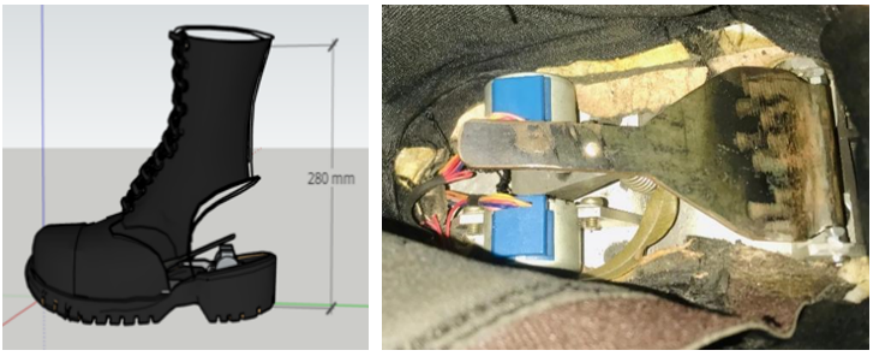
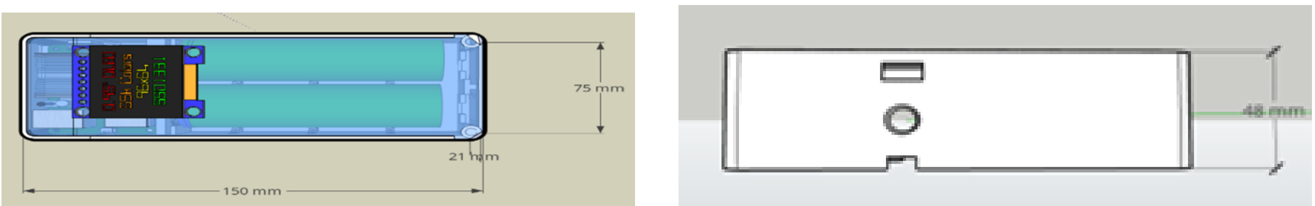


Figure 2. Mechanical Design of Shoes



(a) (b)

Figure 3. (a) The Mechanical Design of Power Storage Top View; (b) Mechanical Design of Power Storage Side View

The schematic design is a wairing from input to output in which electronic components are arranged sequentially (diode bridge, capacitor, boost converter, INA219 sensor, Arduino nano, OLED, Li-ion battery). The schematic design design can be shown in Figure 4.

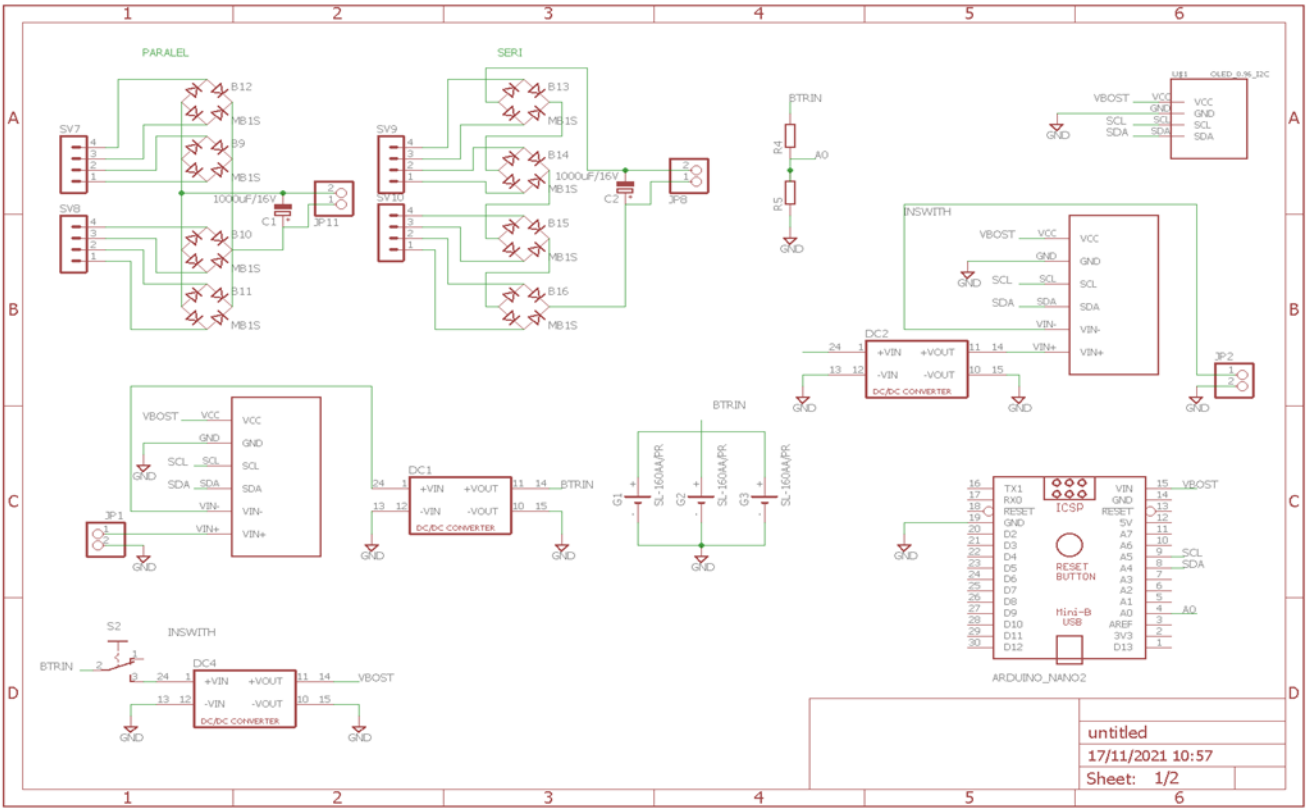


Figure 4. Effects of selecting different switching under dynamic condition

This system uses a 28BYJ-48 stepper motor to generate steps converted into AC voltage. The rectifier with MB10F diode converts AC voltage to DC. The INA219 input sensor reads the incoming voltage and current; the results are sent to the microcontroller. Boost Converter increases the voltage to 5V. The battery functions as a voltage storage and power source. The voltage sensor on the battery provides information in percentages. Buck Boost Converter increases/ decreases the voltage for the output device. The INA219 sensor (output) reads the output voltage and current. The microcontroller processes data and displays information on an OLED screen. The voltage connector directs the voltage to the load or equipment as an output.

2.3. Software Design

A flowchart diagram represents an algorithm or flow of thought that defines the steps and decisions to perform a process. Start on the flowchart when the switch at the voltage ON position turns on the circuit. The INA219 sensor reads the voltage and current from the footsteps; if the voltage is read, it will be forwarded to the microcontroller for data processing. It will return to read on the INA219 sensor if it is not read. The voltage and current reads are processed by a microcontroller (Arduino Nano) to be displayed on an OLED LCD. When the switch as supply position is OFF, the circuit will stop.

3. RESULT AND ANALYSIS

The findings of this research are that the use of a 28BYJ-48 stepper motor as a generator, followed by a rectifier with an MB10F diode, Boost Converter, and Buck-Boost Converter, can produce an efficient voltage to supply the output device. This research's results align with previous findings [37], highlighting stepper motors' potential to produce electrical energy. In this context, previous research has provided a strong foundation for this approach, and our findings further strengthen the sustainability and efficiency of the method.

Analysis of the results of this study also provides insight into potential implications for similar research in the future. By utilizing stepper motors as main generators, rectifiers, boost converters, and buck-boo converters, this research describes an approach that can be adopted to face electrical power challenges. These implications contribute to the practical and applicable understanding of the development of more efficient energy resources, especially in the context of similar research that focuses on increasing the availability of electrical energy in an environmentally friendly manner. Thus, the findings of this research provide a strong basis for further consideration in implementing innovative and sustainable solutions for generating electrical power. The implications of these results can be a valuable guide for further research. They can play an important role in positively contributing to developing alternative energy resource technologies.

3.1. AC Output Test Results With Load

the AC output voltage with a load of 1K Ohms is carried out by connecting the stepper output (1 coil) and then measured using a multimeter. The voltage results obtained can be seen in Table 1. The test results of AC output with a load of 1K Ohms with thirty steps taken get an average of 1.25 volts. The test results are listed in Table 1 and correspond to Figure 5.

Table 1. 1K Ohm load AC voltage output test result

NO	NUMBER OF STEPS	TIME (S)	V
1	10	00.07.69	1.243
2	15	00.11.42	1.24
3	23	00.17.36	1.321
4	31	00.23.77	1.286
5	36	00.26.84	1.29
6	44	00.32.86	1.374
7	54	00.41.09	1.201
8	66	00.50.18	1.349
9	75	00.58.09	1.179
10	87	01.07.90	1.172
11	98	01.15.61	1.174
12	107	01.23.47	1.196
13	112	01.29.42	1.194
14	122	01.37.00	1.209
15	134	01.49.08	1.202
16	136	01.51.32	1.2
17	168	02.23.20	1.18
18	180	02.35.00	1.074
19	185	02.50.63	1.124
20	195	02.50.63	1.129
21	212	03.09.05	1.219
22	222	03.16.96	1.223
23	234	03.29.06	1.248
24	238	03.33.76	1.454
25	244	03.39.78	1.431
26	246	03.42.75	1.4
27	264	04.00.86	1.137
28	268	04.05.34	1.117
29	276	04.13.28	1.13
30	300	04.37.62	1.855

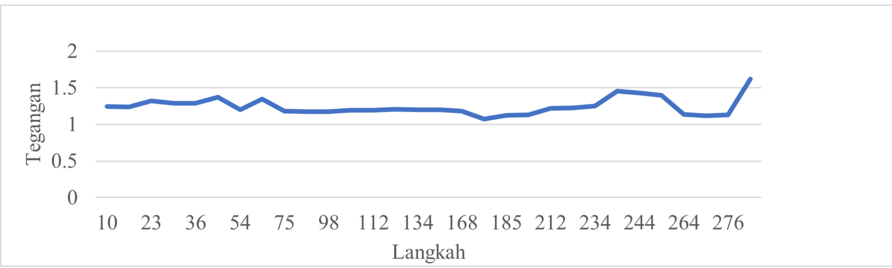


Figure 5. 1K Ohm load AC voltage output test chart

3.2. Test Results of Series Series DC Output Rectifier

Series circuit DC output testing is performed by measuring the output voltage at the rectifier. A circuit of 4 coils is connected to the rectifier using an MB10F diode with the outputs connected in series. The following is the data obtained according to Table 2. The test results of the MB10F diode output are assembled in series to have a greater voltage value with a smaller current value. The test result data shows that the average current produced is 28.5 mA.

Table 2. Series Circuit DC Output

No	Step	Time	Voltage (V)	Current (mA)
1	6	00.03.94	4.3	26.875
2	9	00.05.38	4.44	27.75
3	17	00.12.57	4.75	29.6875
4	20	00.14.41	4.56	28.5
5	32	00.20.95	4.26	26.625
6	34	00.23.77	4.19	26.1875
7	46	00.32.06	4.27	26.6875
8	53	00.36.10	5.06	31.625
9	64	00.43.94	4.83	30.1875
10	68	00.48.44	4.94	30.875

3.3. Test results of parallel circuit DC output rectifier

Parallel circuit DC output testing is performed by measuring the output voltage at the rectifier. A circuit of 4 coils is connected to the rectifier using an MB10F diode with the outputs connected in parallel. The following is the data obtained according to Table 3. In testing the assembled MB10F diode circuit, parallel gets an average of 66.5 mA.

Table 3. Parallel Circuit

No	Step	Time	Voltage (V)	Current (mA)
1	5	00.03.94	1.3	65
2	7	00.05.38	1.44	72
3	10	00.07.66	1.14	57
4	13	00.09.17	1.43	71.5
5	18	00.12.57	1.75	87.5
6	21	00.14.41	1.56	78
7	24	00.16.89	1.02	51
8	27	00.18.86	1.22	61
9	30	00.20.95	1.26	63
10	34	00.23.77	1.19	59.5

3.4. Test Results of DC Output with Step Speed

The DC output test with step speed is carried out by changing the step speed within a specified time. Voltage measurement is carried out using a multimeter at the output of the capacitor as a stabilizer of the output of the rectifier. The results obtained are according to Table 4. In the DC output test with a slow stroke, the maximum voltage value is 5.65 volts in the fifty-seventh step; for the normal step, it obtains a maximum voltage of 5.26 volts in the sixty-fourth step; for the last step, the maximum voltage is 7.14 volts in the eighty-second step. The test was carried out with three variables of step speed, namely slow, normal, and fast, by walking for one minute.

Table 4. DC Output Testing with Step Speed

NO	Step	Time	V
1	4	00.04.05	2.92
2	8	00.06.07	3.67
3	13	00.10.20	4.28
4	18	00.13.74	4.23
5	23	00.17.21	4.32
6	29	00.21.40	4.58
7	33	00.24.53	4.94
8	37	00.27.50	4.93
9	45	00.32.96	4.92
10	50	00.36.82	4.97
11	54	00.39.70	5.17
12	59	00.43.36	5.19
13	64	00.47.22	5.26
14	69	00.50.94	5.23
15	80	00.59.24	5.22

3.5. Output Boost Converter Test Results

The output boost converter is tested by measuring the output voltage before entering storage. The test results are according to Table 5. In the boost converter test, the Vin voltage gets the result = 3.05 V, so it is not stable, but for the Vbost voltage, it gets a value = 5 V, so it is stable.

Table 5. Boost Converter Testing

NO	STEP	TIME	Wine	Vbost
1	4	00.03.20	3.65	5.02
2	8	00.06.21	3.66	5.02
3	11	00.08.62	2.95	5.02
4	16	00.12.55	3.07	5.01
5	20	00.15.55	3.43	5.02
6	23	00.17.78	2.99	5.01
7	27	00.21.30	3.04	5.02
8	31	00.24.57	2.86	5.01
9	35	00.28.10	2.87	5.01
10	39	00.31.30	3.24	5.01
11	42	00.33.78	2.66	5.02
12	46	00.37.44	3.42	5.01
13	50	00.40.46	2.76	4.91
14	54	00.43.90	2.45	4.96
15	69	00.56.30	2.65	4.94

3.6. Storage Load Calculation Results

Calculating load on storage to determine power usage as an operational tool consisting of Oled, buck-boost converter, and Arduino.

1. Oled = 0.02 W
2. Buck boost converter = 0.10 W
3. Arduino nano = 0.05 W
4. INA219 = 0.03 W

3.7. The result of the calculation of efficiency

Efficiency calculation is the calculation of input power compared to the power used in the circuit. This calculation aims to determine the tool's efficiency to work optimally. The results obtained are as follows:

Boost voltage = 5 volts
Current I Max = 0.066 A
Input force (P input) V $\times$ I = 5 V $times$ 0.066 A = 0.3 W
Output power (output P) = 0.20 W (assumed you have this data)
The correct calculation of efficiency is:

Efficiency (n) = (Output power / Input power) $\times$ 100%
Efficiency (n) = (0.20 W / 0.33 W) $\times$ 100%
Efficiency (n) $\approx$ 60.61%

So, the power efficiency of the capacitor bank regulator is about 60.61% at each step performed. This means that of the input power of 0.33 W, about 60.61% is effectively used in the circuit.

3.8. Analysis

This circuit can produce a stable AC voltage at a load of 1K Ohms. MB10F diodes can convert AC voltage to DC voltage, and series and parallel diode configurations provide the option to adjust voltage and current as needed. DC output has a maximum voltage variation depending on stroke speed, which indicates that the stroke speed level affects circuit performance. The capacitor bank's regulator can keep the DC output stable despite the instability in the input. The total power usage in the circuit is 0.20 W, and the power efficiency is about 60.61%. In the overall analysis, this circuit can be used in various applications that require good voltage conversion and power efficiency. However, improvements may be required to optimize efficiency or performance under various steps and load conditions.

4. CONCLUSION

This research details the tested circuits' broad applicative potential, especially in applications requiring optimal voltage conversion and power efficiency. Although current efficiency has not yet peaked, the findings show that capacitor bank regulators successfully maintain stable output, even under conditions of input voltage instability. This illustrates the circuit's ability to maintain consistent output power. However, these findings also highlight the potential for further improvement and optimization, especially in the face of changes in stride and variations in load levels. The limitations of this research can be seen from the level of efficiency, which still needs to be optimal. Therefore, future work could focus on improving circuit performance in terms of efficiency and robustness to input and load variations. Future research could explore solutions to improve efficiency and implement more adaptive automatic adjustments under varying operational conditions. Thus, this research provides a solid foundation for further development, emphasizing improving and optimizing the circuit to meet specific challenges and needs in various applications.

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All authors contributed to the writing of this article.

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REFERENCES

[1] R. E. Prasetiyo, A. N. Coutsar, S. Aprilya, M. Tobing, A. Endy, and Ansori, "Potensi Penggunaan Energi Ramah Lingkungan Pada Sistem Daya Gerak Alpalhankam dalam Mendukung Strategi Pertahanan Indonesia," *G-Tech: Jurnal Teknologi Terapan*, vol. 7, no. 3, pp. 923–938, 2023, https://doi.org/10.33379/gtech.v7i3.2622.

[2] M. I. Mowaviq, A. Junaidi, and S. Purwanto, "Lantai Pemanen Energi Listrik Menggunakan Piezoelektrik," *Energi & Kelistrikan*, vol. 10, no. 2, pp. 112–118, 2019.

[3] C.-T. Tsai, T. M. Beza, E. M. Molla, and C.-C. Kuo, "Analysis and Sizing of Mini-Grid Hybrid Renewable Energy System for Islands," *IEEE Access*, vol. 8, no. March, pp. 70 013–70 029, 2020, https://doi.org/10.1109/ACCESS.2020.2983172.

[4] M. E. M. Ali, A. M. Kassem, and H. F. A. Hamed, "Modeling and Control of a Mini Hybrid Hydro Matrix / Wind in Micro Grid Applications," *IEEE Access*, vol. 8, no. September, pp. 170 843–170 852, 2020, https://doi.org/10.1109/ACCESS.2020.3022753.

[5] A. Singh, A. Lodge, Y. Li, W. D. Widanage, and A. Barai, "A new method to perform lithium-ion battery pack fault diagnostics Part 3: Adaptation for fast charging," *Journal of Energy Storage*, vol. 66, no. August, pp. 1–19, 2023, https://doi.org/10.1016/j.est.2023.107424.

[6] F. Xia, H. Chen, L. Chen, and X. Qin, "A Hierarchical Navigation Strategy of EV Fast Charging Based on Dynamic Scene," *IEEE Access*, vol. 7, no. February, pp. 29 173–29 184, 2019, https://doi.org/10.1109/ACCESS.2019.2899265.

[7] Q. Cheng, L. Chen, Q. Sun, R. Wang, D. Ma, and D. Qin, "A smart charging algorithm based on a fast charging station without energy storage system," *CSEE Journal of Power and Energy Systems*, vol. 7, no. 4, pp. 850–861, 2020, https://doi.org/10.17775/CSEEJPES.2020.00350.

[8] N. Poursafar, S. Taghizadeh, M. J. Hossain, and M. Karimi-Ghartemani, "A Voltage-supportive Controller for Ultra-fast Electric Vehicle Chargers in Islanded DC Microgrids," *Journal of Modern Power Systems and Clean Energy*, vol. 11, no. 3, pp. 896–906, 2023, https://doi.org/10.35833/MPCE.2022.000304.

[9] V. M. Iyer, S. Gulur, G. Gohil, and S. Bhattacharya, "An approach towards extreme fast charging station power delivery for electric vehicles with partial power processing," *IEEE Transactions on Industrial Electronics*, vol. 67, no. 10, pp. 8076–8087, 2020, https://doi.org/10.1109/TIE.2019.2945264.

[10] X. Liu, "Dynamic Response Characteristics of Fast Charging Station-EVs on Interaction of Multiple Vehicles," *IEEE Access*, vol. 8, no. March, pp. 42 404–42 421, 2020, https://doi.org/10.1109/ACCESS.2020.2977460.

[11] C. Zoerr, J. J. Sturm, S. Solchenbach, S. V. Erhard, and A. Latz, "Electrochemical polarization-based fast charging of lithium-ion batteries in embedded systems," *Journal of Energy Storage*, vol. 72, no. November, pp. 1–15, 2023, https://doi.org/10.1016/j.est.2023.108234.

[12] Y. Li, J. Guo, K. Pedersen, L. Gurevich, and D.-I. Stroe, "Investigation of multi-step fast charging protocol and aging mechanism for commercial NMC/graphite lithium-ion batteries," *Journal of Energy Chemistry*, vol. 80, no. May, pp. 237–246, 2023, https://doi.org/10.1016/j.jechem.2023.01.016.

[13] L. Argiolas, M. Stecca, L. M. Ramirez-Elizondo, T. B. Soeiro, and P. Bauer, "Optimal Battery Energy Storage Dispatch in Energy and Frequency Regulation Markets While Peak Shaving an EV Fast Charging Station," *IEEE Open Access Journal of Power and Energy*, vol. 9, no. February, pp. 374–385, 2022, https://doi.org/10.1109/OAJPE.2022.3198553.

[14] K. Wen, X. Fu, and F. Pei, "Research on the thermal management safety of the fast charging power battery management system," *Energy Reports*, vol. 10, no. August, pp. 3289–3296, 2023, https://doi.org/10.1016/j.egyr.2023.09.130.

[15] R. Venugopal, B. Chandrasekar, A. D. Savio, R. Narayanamoorthi, K. M. Aboras, H. Kotb, Y. Y. Ghadi, M. Shouran, and E. Elgamli, "Review on Unidirectional Non-Isolated High Gain DC-DC Converters for EV Sustainable DC Fast Charging Applications," *IEEE Access*, vol. 11, no. April, pp. 78 299–78 338, 2023, https://doi.org/10.1109/ACCESS.2023.3276860.

[16] S. S and D. S. G, “Optimal power control in Renewable Energy sources using Intelligence algorithm,” *Heliyon*, vol. 9, no. 9, pp. 1–21, 2023, https://doi.org/10.1016/j.heliyon.2023.e19724.

[17] J. Chen, K. Ding, Y. Zhong, F. Deng, and S. Abulanwar, “A double input-parallel-output-series hybrid switched-capacitor boost converter,” *Chinese Journal of Electrical Engineering*, vol. 6, no. 4, pp. 15–27, 2020, https://doi.org/10.23919/CJEE.2020.000027.

[18] Z. Xu, X. Zheng, T. Lin, J. Yao, and A. Ioinovici, “Switched-capacitor multi-level inverter with equal distribution of the capacitors discharging phases,” *Chinese Journal of Electrical Engineering*, vol. 6, no. 4, pp. 42–52, 2020, https://doi.org/10.23919/CJEE.2020.000029.

[19] S. Abdelhady, A. Osama, A. Shaban, and M. Elbayoumi, “A Real-Time Optimization of Reactive Power for An Intelligent System Using Genetic Algorithm,” *IEEE Access*, vol. 8, no. January, pp. 11 991–12 000, 2020, https://doi.org/10.1109/ACCESS.2020.2965321.

[20] M. Ali, M. I. Hossain, F. S. Al-Ismail, M. A. Abido, and M. Khalid, “Capacitor ripple reduction in T-type multilevel inverter operation for solar PV-application,” *Alexandria Engineering Journal*, vol. 77, no. July, pp. 613–624, 2023, https://doi.org/10.1016/j.aej.2023.06.088.

[21] P. C. Sahu, S. Jena, S. Mohapatra, and S. Debdas, “Impact of energy storage devices on microgrid frequency performance: A robust DQN based grade-2 fuzzy cascaded controller,” *e-Prime - Advances in Electrical Engineering, Electronics and Energy*, vol. 6, no. December, pp. 1–16, 2023, https://doi.org/10.1016/j.prime.2023.100288.

[22] J. D. Barros, J. F. A. Silva, and L. Rocha, “New backstepping controllers with enhanced stability for neutral point clamped converters interfacing photovoltaics and AC microgrids,” *International Journal of Electrical Power & Energy Systems*, vol. 153, no. November, pp. 1–9, 2023, https://doi.org/10.1016/j.ijepes.2023.109332.

[23] N.-A. Masood, A. Jawad, K. T. Ahmed, S. R. Islam, and M. A. Islam, “Optimal capacitor placement in northern region of Bangladesh transmission network for voltage profile improvement,” *Energy Reports*, vol. 9, no. December, pp. 1896–1909, 2023, https://doi.org/10.1016/j.egyr.2023.01.020.

[24] S. D. Patil, R. A. Kachare, A. M. Mulla, and D. R. Patil, “Performance enhancement of modified SVC as a thyristor binary switched capacitor and reactor banks by using different adaptive controllers,” *Journal of King Saud*, vol. 35, no. 5, pp. 342–357, 2023, https://doi.org/10.1016/j.jksues.2021.06.006.

[25] D. I. Nugroho, H. Khoswanto, H. H. Tumbelaka, P. Studi, T. Elektro, U. K. Petra, and J. Siwalankerto, “Regulator Capacitor Bank Satu Fasa dengan Daya hingga 3500VA Berbasis Arduino,” *Jurnal Teknik Elektro*, vol. 11, no. 1, pp. 12–16, 2018, https://doi.org/10.9744/jte.11.1.12-16.

[26] Q.-r. Hu, X.-y. Shen, X.-m. Qian, G.-y. Huang, and M.-q. Yuan, “The personal protective equipment (PPE) based on individual combat: A systematic review and trend analysis,” *Defence Technology*, vol. 28, no. October, pp. 195–221, 2023, https://doi.org/10.1016/j.dt.2022.12.007.

[27] S. Krishnamurthy, R. Jones, and M. A. Mquqwana, “System-based testing of a voltage differential protection scheme for shunt capacitor bank,” *Energy Reports*, vol. 6, no. December, pp. 243–259, 2020, https://doi.org/10.1016/j.egyr.2020.11.254.

[28] J. K. W. Lee, B. Tan, B. R. M. Kingma, F. Haman, and Y. Epstein, “Biomarkers for warfighter safety and performance in hot and cold environments,” *Journal of Science and Medicine in Sport*, vol. 26, no. December, pp. S71–S78, 2023, https://doi.org/10.1016/j.jsams.2022.12.006.

[29] C. A. G. Chávez, D. Romero, M. Rossi, R. Luglietti, and B. Johansson, “Circular lean product-service systems design: A literature review, framework proposal and case studies,” *Procedia CIRP*, vol. 83, no. March, pp. 419–424, 2019, https://doi.org/10.1016/j.procir.2019.03.109.

[30] E. T. Pring, G. Malietzis, S. W. H. Kendall, J. T. Jenkins, and T. Athanasiou, “Crisis management for surgical teams and their leaders, lessons from the COVID-19 pandemic; A structured approach to developing resilience or natural organisational responses,” *International Journal of Surgery*, vol. 91, no. July, pp. 1–12, 2021, https://doi.org/10.1016/j.ijsu.2021.105987.

[31] E. D. Luise and P. A. Magni, “Interim recommendations for the management of forensic investigation during the COVID-19 pandemic: An Italian perspective,” *Science and Justice*, vol. 61, no. 6, pp. 735–742, 2021, https://doi.org/10.1016/j.scijus.2021.08.002.

[32] D. Janson, S. T. Newman, and V. Dhokia, “Next Generation Safety Footwear,” *Procedia Manufacturing*, vol. 38, no. 2019, pp. 1668–1677, 2019, https://doi.org/10.1016/j.promfg.2020.01.117.

[33] A. Bomba, P. Favaro, R. Haus, L. Aigle, F. X. Jean, I. Dauphin, P. Guigon, B. Fontaine, M. Puidupin, J. P. Demoncheaux, and S. Larréché, “Review of Scorpion Stings and Snakebites Treated by the French Military Health Service During Overseas Operations Between 2015 and 2017,” *Wilderness and Environmental Medicine*, vol. 31, no. 2, pp. 174–180, 2020, https://doi.org/10.1016/j.wem.2020.01.006.

[34] B. M. Jennings, J. C. Ransom, and S. G. Hopkinson, “The Influence of Time and Place on the Experiences of US Military Nurses in Vietnam,” *Nursing Outlook*, vol. 70, no. 6, pp. S104–S114, 2022, https://doi.org/10.1016/j.outlook.2022.08.003.

[35] L. Noprizal, M. Syukri, and S. Syahrizal, “Perancangan Prototype Generator Magnet Permanen 1 Fasa Jenis Fluks Aksial Pada Putaran Rendah,” *Kitektro*, vol. 1, no. 1, pp. 40–44, 2019.

[36] Hilmansyah, R. M. Utomo, A. W. Saputra, and R. F. Alif, “Rancang Bangun Wireless Battery Monitoring System Berbasis ESP32,” in *Prosiding SNITT Poltekba*, 2020, pp. 194–199.

[37] B. N. Va and D. Ernawati, “Perancangan Produk Charger Fast Charging Untuk USB Type C Menggunakan Metode Quality Function Deployment,” *Jurnal Juminten*, vol. 1, no. 5, pp. 49–60, 2020, https://doi.org/10.33005/juminten.v1i5.160.