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COMPARISON ANALYSIS OF INPUT AND OUTPUT POWER ON INVERTERS OF DIFFERENT TYPES WITH PARARIZED LOADS

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Abstract

The increasing use of electrical energy in homes has resulted in the use of fuel being very depleted, to overcome this problem there must be savings in electrical energy by using an inverter. The inverter is able to convert 12V DC (unidirectional) electricity into 220V 50Hz AC (alternating) electricity. The evaluation of the best inverter and having input and output power efficiency for various types of loads can be seen from the wave output generated. For resistive loads, the average efficiency of the Type A inverter is 38.7%, the Type B inverter has an average of 45.4% and the inductive load on the Type A inverter is 32.8%, for the Type B inverter, it is 81.1 % and the capacitive load on the Type A inverter is 5.3% and the Type B is 62.8%.

Keywords***: Inverter, Efficiency, Power input and output.***

1.INTRODUCTION

Currently around the world the use of inverters as power electronics equipment is quite extensive, because it can convert DC (unidirectional) electricity into AC (alternating) electricity quantities. The inverter output can be in the form of a sine wave, square wave, and modified sine wave, for now it is still using a conventional inverter which has low efficiency and the shape is not close to a sinusoidal wave. Inverters are needed as a backup of electricity when the use of electricity at home goes out. In the use of this inverter, it can be used on electronic devices in the household such as computers/laptops, refrigerators, televisions, fans, and other electronic goods. This tool is widely used in DC energy sources produced by solar panels.

2. LITERATURE REVIEW

2.1. Electrical power

The amount of electrical energy absorbed in a circuit transfers charge per unit time, or the amount of electrical energy used every second. Can also be defined as flow rateenergy. Energy sources such as electric voltage can produce electrical power while the load connected to it will absorb the electrical power.The unit for electrical power is generally the Watt.

2.2. INVERTER

Inverter is an electronic device that functions to convert direct current (DC) into alternating current (AC) with adjustable voltage and frequency. There are several types of inverters that are divided based on their criteria, including:

a. Based on the number of phases: namely single-phase and multi-phase inverters, for example three-phase which so far is the type of inverter used to interconnect the output to the grid of the electric power system.
b. Based on the DC input source: the voltage source inverter (VSI – Voltage Source Inverter), and the current source inverter (CSI – Current Source Inverter).
c. Based on the method of setting the signal shape: namely square wave, pulse amplitude modulation (PAM) and pulse width modulation (PWM).
d. Based on the output waveform: i.e. square wave, stepped square and sinusoidal(Alifia, 2021).

2.3.ONE PHASE INVERTER

1. 1 Phase Half Wave Inverter

The single-phase half-wave inverter will be explained in the figure below. Switch K1 and K2, ON-OFF alternately. When switch K1 is ON, current flows from E/2 (+) to switch K2, to load BA, to E/2 (-), while K2 is open.(Electricity & Renewable Energy, 2020)

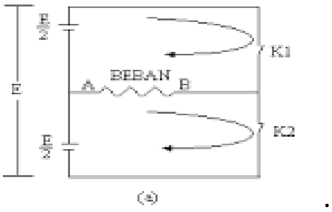

Figure 1. 1 Phase Half-Wave Circuit.

2. 1 Phase Full Wave Inverter

The basic circuit of a full wave inverter and an output waveform with a resistive load is shown in the figure above. When transistors Q1 and Q2 are working (ON), the voltage Vs will flow to the load but Q3 and Q4 are not working (OFF). Furthermore, transistors Q3 and Q4 work (ON) while Q1 and Q2 do not work (OFF), then the load will generate a voltage of –Vs(Battery, 2019).

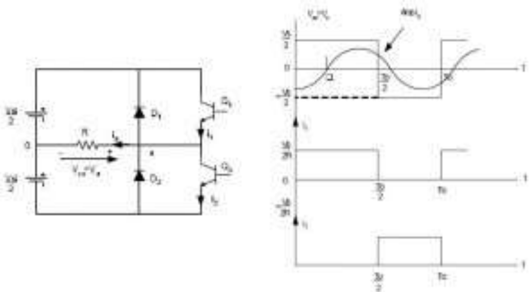

Figure 2. 1 Phase Full Wave Circuit

2.4. FULL-BRIDGE CONVERTER THEORY

S1 and S4 must not close at the same time, as well as S2 and S3, which will cause a short circuit in the DC source. Real switches cannot be on or off instantly. The output voltage of the switch pair condition in the full bridge converter circuit(Fadhli MR, 2010).

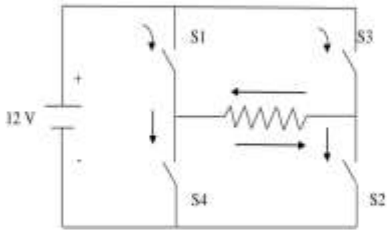

Figure 3. Full Bridge Converter Circuit.

2.5. PULSE WIDTH MODULATION

PuIse Width ModuIation(PWM) is a method used to manipulate the signal width which will later be expressed as a pulse in a period, in order to get a different average voltage value.

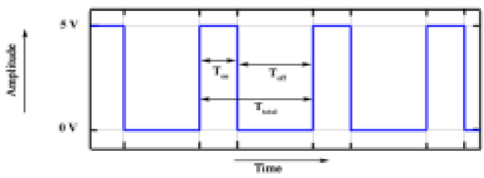

Figure 4. PWM signal.

The known PWM signals generally have a fixed amplitude and fundamental frequency but have varying pulse width values. The value of the PWM pulse width is generally proportional to the amplitude of the unmodulated signal. Where the PWM signal has a constant wave frequency, but the duty cycle varies (between 0% to 100%).

$V_{out} = Duty\ Cycle \times V_{in}$...............(2.4)

3.RESULTS AND DISCUSSION

Inverter testing is carried out to find out whether 2 types of inverters namely Type A and Type B which have good efficiency to convert DC voltage into AC voltage as expected. The test results of Type A and Type B inverters can be seen in the table below.

Table 1. Test Results of Type A. Inverter

Input(V)	Output (V)	Current (I)	Frequency(Hz)
12.50	177	0.58	57

Table 2 Test Results for Type B. Inverter

Input(V)	Output (V)	Current (I)	Frequency(Hz)
12.50	230	0.74	50

Testing 2 Types of inverters with a load is a test carried out to see which one has better efficiency. In testing these 2 types of inverters, it is carried out using variations in the type of load. The results of testing on the inverter using various types of loads can be seen in the table below.

Table 3. Test Results of Type A Inverter with Variation of Load Type

Load Condition	**(V) In**	**(I) In**	**(V) out**	**(I) out**	**Cos Phi**
15-Watt lamp	12.60	1.24	173	0.22	0.9
20-Watt lamp	12.55	1.37	169.5	0.22	0.15
40 Watt lamp	12.50	1.50	170	0.24	0.23
Soldering 60 Watt	12.45	1.88	168	0.12	0.91
50 Watt Fan	12.35	2.58	159.1	0.14	0.94
CT transformer	12.45	2.56	0	0	0
Capacitor 1 F	12.50	1.08	175.5	0.21	0.02
Capacitor 2.5 F	12.38	1.85	172	0.47	0.02
3.5 F . Capacitor	12.25	2.40	167.6	0.64	0.01

Table 4. Test Results of Type B Inverter with Variation of Load Type

Load Condition	**(V) In**	**(I) In**	**(V) out**	**(I) out**	**Cos Phi**
15-Watt lamp	12.27	1.95	227.6	0.28	0.06
20-Watt lamp	12.30	1.80	227.1	0.29	0.10
40 Watt lamp	12.28	1.94	228.1	0.28	0.20
Soldering 60 Watt	12.13	3.05	230	0.14	0.95
50 Watt Fan	12.03	4.07	220	0.21	0.95
CT transformer	4.49	12.21	228.3	0.19	0.92
Capacitor 1 F	12.37	0.96	228.6	1.5	0.02
Capacitor 2.5 F	12.25	2.04	225	2.3	0.03
3.5 F . Capacitor	12.03	4.5	223.2	5.5	0.03

3.1. Calculation of Resistive Load

- Load Capacity 15 Watt on Inverter Type A

Vin = 12.60 Volts
Iin = 1.24 Ampere
Vout = 173 Volts
Iout = 0.22 Ampere
cos = 0.09

In the Type A inverter, first find the input power. The results of the calculations are below.

$$Pin = Vin \times Iin$$
$$= 12{,}60\,V \times 1{,}24\,A$$
$$= 15{,}6\,Watt$$

Then calculate the output power on the Type A inverter. The calculation results are below.

$$Pout = V \times I \times \text{Cos}\,\varphi$$
$$= 173 \times 0{,}22 \times 0{,}09$$
$$= 3{,}4\,Watt$$

After getting the results on the input and output power, it will calculate the efficiency of the Type A inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$
$$\eta = \frac{3{,}4}{15{,}6} \times 100 = 21{,}7\%$$

- Load Capacity 15 Watt on Inverter Type B

Vin = 12.27 Volts
Iin = 1.95 Ampere
Vout = 227.6 Volts
Iout = 0.28 Ampere
cos = 0.06

In the Type B inverter, first find the input power. The results of the calculations are below.

$$Pin = Vin \times Iin$$
$$= 12{,}27\,V \times 1{,}95\,A$$
$$= 23{,}9\,Watt$$

Then calculate the output power on the Type B inverter. The calculation results are below.

$$Pout = V \times I \times \text{Cos}\,\varphi$$
$$= 227{,}6 \times 0{,}28 \times 0{,}06$$
$$= 3{,}8\,Watt$$

After getting the results on the input and output power, it will calculate the efficiency of the Type B inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$
$$\eta = \frac{3{,}8}{23{,}9} \times 100 = 15{,}8\%$$

Table1Analysis of the calculation results of the Efficiency value of the Resistive load on the Type A and B. Inverters

Burden	Efficiency Value Type	Efficiency Value Type

	A	B
15 Watt	21%	15.8%
20 Watt	32.16%	29.8%
40 Watt	50%	53.6%
60 Watt	51.9%	82.6%

Based on the calculation results, the average value of efficiency in resistive loads with Type A inverters is 38.7% and with Type B inverters is 45.4%, this can be seen in Figure 4.1 below.

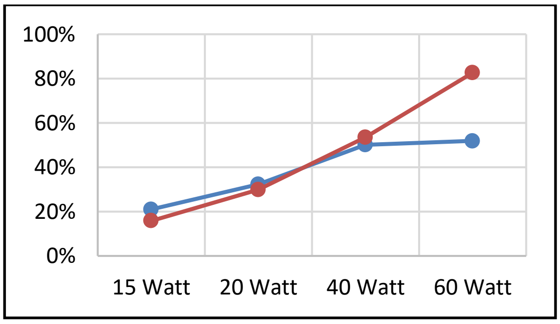

Figure 4.1Resistive Load Efficiency Graph

3.2. Calculation of Inductive Load

- Load Capacity 50 Watt on Inverter Type A

Vin = 12.35 Volts
Iin = 2.58 Ampere
Vout = 159.1 Volts
Iout = 0.14 Ampere
Cos φ = 0.94 Watt

In the Type A inverter, first find the input power. The results of the calculations are below.

$$Pin = Vin \times Iin$$
$$= 12{,}35\,V \times 2{,}58\,A$$
$$= 31{,}86\,Watt$$

Then calculate the output power on the Type A inverter. The calculation results are below.

$$Pout = V \times I \times \text{Cos } \varphi$$
$$= 159{,}1 \times 0{,}14 \times 0{,}94$$
$$= 20{,}9\,Watt$$

After getting the results on the input and output power, it will calculate the efficiency of the Type A inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$
$$\eta = \frac{20{,}9}{31{,}86} \times 100 = 65{,}7\%$$

- 50 Watt Capacity Load On Type B . Inverter

Vin = 12.03 Volts
Iin = 4.07 Ampere
Vout = 220 Volts
Iout = 0.21 Ampere
Cos φ = 0.95

In the Type B inverter, first find the input power. The results of the calculations are below.

$$Pin = Vin \times Iin$$

$= 12{,}03\ V \times 4{,}07\ A$
$= 48{,}96\ Watt$

Then calculate the output power on the Type B inverter. The calculation results are below.

$Pout = V \times I \times \text{Cos}\ \varphi$
$= 220 \times 0{,}21 \times 0{,}95$
$= 43{,}89\ Watt$

After getting the results on the input and output power, it will calculate the efficiency of the Type B inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$

$$\eta = \frac{43{,}89}{48{,}96} \times 100 = 89{,}6\%$$

$$\eta = \frac{39{,}90}{54{,}84} \times 100 = 72{,}7\%$$

Table2Analysis of the calculation results of the Efficiency value of the Inductive load on the Type A and B. Inverters

Burden	Efficiency Value Type A	Efficiency Value Type B
50 Watt	65.7%	89.6%
CT transformer	0%	72.7%

Based on the results of the calculation, the average efficiency value for the inductive load with the Type A inverter is 32.8% and the Type B inverter is 81.15%, this can be seen in Figure 4.2 below.

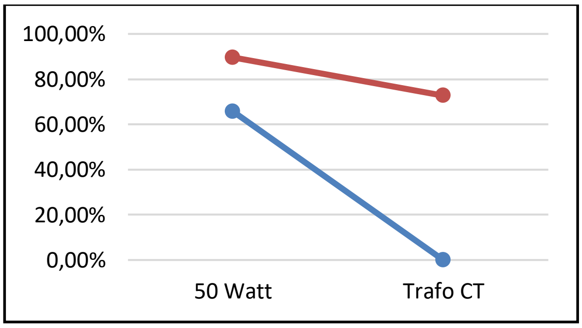

Figure 4.2Inductive Load Efficiency Graph

3.3. Calculation of Capacitive Load

- Load Capacity 1 F On Inverter Type A

Vin = 12.50 Volts
Iin = 1.08 Ampere
Vout = 175.5 Volts
Iout = 0.21 Ampere
Cos φ = 0.02

In the Type A inverter, first find the input power. The results of the calculations are below.

$Pin = Vin \times Iin$
$= 12{,}50\ V \times 1{,}08\ A$
$= 13{,}5\ Watt$

Then calculate the output power on the Type A inverter. The calculation results are below.

$$Pout = V \times I \times \text{Cos}\ \varphi$$
$$= 175{,}5 \times 0{,}21 \times 0{,}02$$
$$= 0{,}73\ Watt$$

After getting the results on the input and output power, it will calculate the efficiency of the Type A inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$
$$\eta = \frac{0{,}73}{13{,}5} \times 100 = 5{,}4\%$$

- Load Capacity 1 F On Type B . Inverter

Vin = 12.37 Volts
Iin = 0.96 Ampere
Vout = 228.6 Volts
Iout = 1.5 Ampere
Cos φ = 0.02

In the Type B inverter, first find the input power. The results of the calculations are below.

$$Pin = Vin \times Iin$$
$$= 12{,}37\ V \times 0{,}96\ A$$
$$= 11{,}8\ Watt$$

Then calculate the output power on the Type B inverter. The calculation results are below.

$$Pout = V \times I \times \text{Cos}\ \varphi$$
$$= 228{,}6 \times 1{,}5 \times 0{,}02$$
$$= 6{,}8\ Watt$$

After getting the results on the input power, it will calculate the efficiency of the Type B inverter.

$$\eta = \frac{Pout}{Pin} \times 100$$
$$\eta = \frac{6{,}8}{11{,}8} \times 100 = 58{,}11\%$$

Table3Analysis of the calculation results of the Efficiency value of the Capacitive load on the Type A and Type B inverter inverters

Burden	Efficiency Value Type A	Efficiency Value Type B
1 F	5.4%	58.4%
2.5 F	7%	62.1%
3.5 F	3.6%	68%

Based on the calculation results obtained the average value of efficiency on a capacitive load with a Type A inverter is 5.3% and a Type B inverter is 62.83%, this can be seen in Figure 4.3 below.

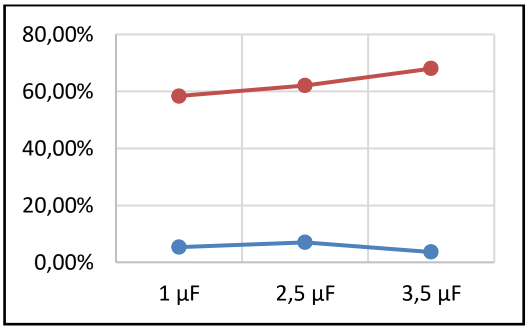

Figure 4.3Capacitive Load Efficiency Graph

4.CONCLUSION

Based on the results of measurements and calculations as well as data collection from research conducted on 2 types of inverters, namely Type A and Type B inverters with variations in the type of load, it can be concluded as follows:

1. Inverter is a series of electronic devices that can convert direct current (DC) voltage into alternating current (AC) voltage. To determine the input and output of 2 types of inverters, namely Type A and Type B inverters, measurements of voltage, current, and power were carried out in order to determine the efficiency of the inverter by using variations in the type of load so that the inverter selection parameters get the energy obtained can be channeled to the load, because the energy used less than the maximum affects the components in the inverter circuit when given a load.
2. Based on the results of measurements and calculations of 2 types of inverters, namely Type A and Type B inverters, it can be concluded that Type B inverters have high efficiency with an average resistive load of 45.4%, and Type A inverters have an average efficiency. 38.7%, then on the inductive load the Type B inverter has an average of 81.1% and the Type A inverter has an average efficiency of 32.8%, and at the capacitive load it is very clear that the efficiency of the Type A inverter is much lower by 5.3% compared to Type B inverter which far has a very high efficiency with an average of 62.8%.

REFERENCES

Balisranislam, IN Sutantra, B. Sampurno, and H. Sufyan Hadi, "Numerical Study of Glass Cleaning Robot Simulation in High-rise Buildings," J. Electron. List. telecommunication. Computers, Information. Sister. Control, vol. 1, no. 1, p. 25–31, 2019, doi:10.30649/je.v1i1.20.

Bustani, B., Gaddafi, M., & Nur Ilham, R. (2022). REGIONAL FINANCIAL MANAGEMENT SYSTEM OF REGENCY/CITY REGIONAL ORIGINAL INCOME IN ACEH PROVINCE PERIOD YEAR 2016-2020. International Journal of Educational Review, Law and Social Sciences (IJERLAS), 2(3), 459–468.https://doi.org/10.54443/ijerlas.v2i3.277

D. Cookson and PMR Stirk, “Simulation of Alternator Voltage Control on A Battery Charging System Using Fuzzy Sliding Mode Control (Fsmc) Method,” p. 1-10, 2019.

Evalina, N., & Arfis, A. (2019). The Use of 3G3MX2 Inverter To Change The Rotation Speed Of A 3-Phase Induction Motor. 4(2), 93–96.

Fadli MR. (2010). Design and Build Inverter 12V DC to 220V AC With 50Hz Frequency and Sinusoidal Output Waveform. Design and Build Inverter 12V Dc To 220V Ac With 50Hz Frequency And Sinusoidal Output Waveform, 85(UI), 1–40.

Falahuddin, F., Fuadi, F., Munandar, M., Juanda, R.., & Nur Ilham, R. (2022). INCREASING BUSINESS SUPPORTING CAPACITY IN MSMES BUSINESS GROUP TEMPE BUNGONG NANGGROE KERUPUK IN SYAMTALIRA ARON DISTRICT, UTARA

ACEH REGENCY. IRPITAGE JOURNAL, 2(2), 65–68.https://doi.org/10.54443/irpitage.v2i2.313

Geovani, I.., Nurkhotijah, S.., Kurniawan, H. ., Milanie, F., & Nur Ilham, R. . (2021). JURIDICAL ANALYSIS OF VICTIMS OF THE ECONOMIC EXPLOITATION OF CHILDREN UNDER THE AGE TO REALIZE LEGAL PROTECTION FROM HUMAN RIGHTS ASPECTS: RESEARCH STUDY AT THE OFFICE OF SOCIAL AND COMMUNITY EMPOWERMENT IN BATAM CITY. International Journal of Educational Review, Law and Social Sciences (IJERLAS), 1(1), 45–52.https://doi.org/10.54443/ijerlas.v1i1.10

Hidayat, I., Mahdali, A., & Afandy, M. (2022). Comparative Analysis of PWM and SPWM Single Phase Inverters with Transformers. Jambura Journal of Electrical and Electronics Engineering, 4(1), 27–32. https://doi.org/10.37905/jjeee.v4i1.11900

Hidayat, R. (2020). We have. 1–12.https://www.kitapunya.net/definisi-public-relation/

Ilham, Rico Nur. et all (2019). Investigation of the Bitcoin Effects on the Country Revenues via Virtual Tax Transactions for Purchasing Management. International Journal of Supply Management.Volume 8 No.6 December 2019.

Ilham, Rico Nur. et all (2019).. Comparative of the Supply Chain and Block Chains to Increase the Country Revenues via Virtual Tax Transactions and Replacing Future of Money. International Journal of Supply Management.Volume 8 No.5 August 2019.

Lasta Irawan, A. ., Briggs, D. ., Muhammad Azami, T. ., & Nurfaliza, N. (2021). THE EFFECT OF POSITION PROMOTION ON EMPLOYEE SATISFACTION WITH COMPENSATION AS INTERVENING VARIABLES: (Case Study on Harvesting Employees of PT. Karya Hevea Indonesia). International Journal of Social Science, Educational, Economics, Agriculture Research, and Technology (IJSET), 1(1), 11–20.https://doi.org/10.54443/ijset.v1i1.2

likdanawati, likdanawati, Yanita, Y., Hamdiah, H., Nur Ilham, R., & Sinta, I. (2022). EFFECT OF ORGANIZATIONAL COMMITMENT, WORK MOTIVATION AND LEADERSHIP STYLE ON EMPLOYEE PERFORMANCE OF PT. ACEH DISTRIBUS INDO RAYA. International Journal of Social Science, Educational, Economics, Agriculture Research, and Technology (IJSET), 1(8), 377–382. https://doi.org/10.54443/ijset.v1i8.41

Majied Sumatrani Saragih, M.., Hikmah Saragih, U.., & Nur Ilham, R.. (2021). RELATIONSHIP BETWEEN MOTIVATION AND EXTRINSIC MOTIVATION TO ICREASING ENTREPRENEURSHIP IMPLEMENTATION FROM SPP AL-FALAH GROUP AT BLOK 10 VILLAGE DOLOK MASIHUL. MORFAI JOURNAL, 1(1), 1–12.https://doi.org/10.54443/morfai.v1i1.11

Nur Ilham, R.., Arliansyah, A., Juanda, R., Multazam, M.., & Saifanur, A. (2021). RELATHIONSIP BETWEEN MONEY VELOCITY AND INFLATION TO INCREASING STOCK INVESTMENT RETURN: EFFECTIVE STRATEGIC BY JAKARTA AUTOMATED TRADING SYSTEM NEXT GENERATION (JATS-NG) PLATFORM. International Journal of Economic, Business, Accounting, Agriculture Management and Sharia Administration (IJEBAS), 1(1), 87–92.https://doi.org/10.54443/ijebas.v1i1.27

Nur ilham, R., Likdanawati, L., Hamdiah, H., Adnan, A., & Sinta, I. (2022). COMMUNITY SERVICE ACTIVITIES "SOCIALIZATION AVOID STUDY INVESTMENT" TO THE STUDENT BOND OF SERDANG BEDAGAI. IRPITAGE JOURNAL, 2(2), 61–64.https://doi.org/10.54443/irpitage.v2i2.312

P. Harahap, FI Pasaribu, CAP Siregar, and B. Oktrialdi, "Performance of Grid-connected Rooftop PLTS System for Households During the Covid-19 Pandemic," J. Electr. technology. UMY, vol. 5, no. 1, p. 26–31, 2021, doi:10.18196/jet. v5i1.12089.

Prasetijo and B. Dharmawan, "Permanent Magnet Generators as Low Rotation Power Generators," Din. Techniques, vol. 8, no. 2, p. 70–77, 2012.

Rahmaniar, R., Subhan, S., Saharuddin, S., Nur Ilham, R. ., & Anwar, K. . (2022). THE INFLUENCE OF ENTREPRENEURSHIP ASPECTS ON THE SUCCESS OF THE CHIPS INDUSTRY IN MATANG GLUMPANG DUA AND PANTON PUMP.

International Journal of Social Science, Educational, Economics, Agriculture Research, and Technology (IJSET), 1(7), 337–348.https://doi.org/10.54443/ijset.v1i7.36

R. Rimbawati, P. Harahap, and KU Putra, "Analysis of the Effect of Changes in Excitation Current on Generator Characteristics (Electrical Machine Application Laboratory, Faculty of Engineering-Umsu)," RELE (Electrical and Energy Engineering) J.Tek. Electro, vol. 2, no. 1, p. 37–44, 2019, doi:10.30596/rele. v2i1.3647.

Sandi, H.., Afni Yunita, N.., Heikal, M.., Nur Ilham, R.., & Sinta, I. (2021). RELATIONSHIP BETWEEN BUDGET PARTICIPATION, JOB CHARACTERISTICS, EMOTIONAL INTELLIGENCE AND WORK MOTIVATION AS MEDIATOR VARIABLES TO STRENGTHENING USER POWER PERFORMANCE: AN EMPERICAL EVIDENCE FROM INDONESIA GOVERNMENT. MORFAI JOURNAL, 1(1), 36–48.https://doi.org/10.54443/morfai.v1i1.14

Sinta, I., Nur Ilham, R., Kumala Sari, D.., M, M., Khaidir, K., & Ekamaida, E. (2021). Training The Processing Of Tomato Sauce For A Home-Based Business The Scale Of SMES. IRPITAGE JOURNAL, 1(1), 26–28.https://doi.org/10.54443/irpitage.v1i1.24

Sinurat, M.., Heikal, M.., Simanjuntak, A. ., Siahaan, R. ., & Nur Ilham, R. . (2021). PRODUCT QUALITY ON CONSUMER PURCHASE INTEREST WITH CUSTOMER SATISFACTION AS A VARIABLE INTERVENING IN BLACK ONLINE STORE HIGH CLICK MARKET: Case Study on Customers of the Tebing Tinggi Black Market Online Store. MORFAI JOURNAL, 1(1), 13–21.https://doi.org/10.54443/morfai.v1i1.12

S. Lubis, F. Lubis, and P. Harahap, “PLTB as an Alternative to New Renewable Energy”, Semin. Notes. Technology. …, 2019, [Online]. Available:https://repository.unimal.ac.id/4991/1/37-Paper-SNTI-2019.pdf.

SEE Profile, "Analysis of Alternator Power on Electricity Consumption Loads on 4K Kijang Engines Alternator Power Analysis on Electricity Consumption Loads on 4K Kijang Engines Alternator Power Analysis on Electricity Consumption Loads on 4K Alte Kijang Engines" no. October 2020.

Yusuf Iis, E., Wahyuddin, W., Thoyib, A., Nur Ilham, R., & Sinta, I. (2022). THE EFFECT OF CAREER DEVELOPMENT AND WORK ENVIRONMENT ON EMPLOYEE PERFORMANCE WITH WORK MOTIVATION AS INTERVENING VARIABLE AT THE OFFICE OF AGRICULTURE AND LIVESTOCK IN ACEH. International Journal of Economic, Business, Accounting, Agriculture Management and Sharia Administration (IJEBAS), 2(2), 227–236.https://doi.org/10.54443/ijebas.v2i2.191

Y. Yunus, Sihana, and Subekti Lukman, "Modification of Car Alternator Into 3 Phase Generator 220 V 600 RPM," p. 1-4, 2012.