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A New Study Method Protection Safety Equipment Overload Electronic Device

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ABSTRACT
The relay safety device on the prepaid Kwh meter functions as a power limiting protection system to prevent damage to the prepaid Kwh meter relay caused by power consumption exceeding the registered power. Where in this study describes the device to be designed, the code security method automatically cuts off the electric current if the power used exceeds the registered power so that this method can reduce damage to the Kwh relay for customers. The results of testing the designed tool show a difference in the percentage of calculations. For the iron, the percentage of error in the calculation results is 1.99%, while for testing the water heater, the percentage of error is 0.53% due to the lack of sensitivity of the PZEM-004T sensor in reading the load used. The voltage measured at the output of the designed tool reaches 205 V. The test measurement of the tool designed based on SNSU PK.P-02:2020 - National Tolerance Standardization Agency shows an error in measuring digital measuring instruments, namely ±5%. If it exceeds the specified rules, the results cannot be used or referred to because they are not appropriate.

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INTRODUCTION

The KWh meter has the function of calculating electrical power usage by a load within a certain time. This value will be calculated in kWh units (kilo Watt hours) each month and will be multiplied by the unit price of the electric power tariff (TDL) and added to the subscription value plus tax which will produce a monthly electricity bill or in the form of credit.

In the application of prepaid electricity, disturbances or damage to the Prepaid KWh Meter (MPB) are often found, causing disruption or failure in the operation of the Prepaid kWh Meter used by PLN customers. Of course, this will have an impact on losses for PT. PLN (Persero) because the Prepaid Meter used by customers experiences interference or damage to the MPB so that PT. PLN (Persero) has to replace the Kwh with a new Kwh meter. This could be detrimental to PT. PLN (Persero) because many new Kwh replacements are due to Kwh damage. An example of the type of damage that is often experienced by customers so that the Kwh meter is required to be replaced with

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a new one is the Relay Indicator because the power consumption is greater than the Kwh meter used by the customer so that the Relay Indicator is disconnected and the Kwh meter can no longer be used. (SPLN D3.009-1:2010)

Based on this, it is necessary to carry out follow-up research, collecting data to design a relay safety device for the Kwh meter Prepaid as a power limiting protection system to avoid damage to the relay on the prepaid Kwh meter which is caused by power consumption that is greater than the registered power or as well as the occurrence of under or overvoltage. The device that will be designed uses a safety method with a protection system that cuts off the electricity supply automatically if the power used is greater than the registered power, if under voltage or over voltage occurs, so that this method can reduce damage to the kwh relay for customers.

Literature Review

Independent Student Learning Program Independent Campus (MBKM).

The independent learning program of the independent campus (MBKM) is a policy of the Minister of Education and Culture, which aims to encourage students to master various sciences that are useful for entering the world of work. The independent campus provides an opportunity for students to choose the courses they will take. Various forms of learning activities outside of higher education, including internships/work practices in industry or other workplaces, carrying out community service projects in villages, teaching in educational units, participating in student exchanges, conducting research, conducting entrepreneurial activities, making independent studies/projects, and participating in humanitarian programs.

Learning on an independent campus provides challenges and opportunities for the development of innovation, creativity, capacity, personality, and student needs, as well as developing independence in seeking and finding knowledge through reality and field dynamics such as ability requirements, real problems, social interaction, collaboration, self-management, performance demands, targets and their achievements. Experimental learning programs with flexible paths are expected to facilitate students to develop their potential according to their passion and talents, and through a well-designed and implemented independent learning program, students' hard skills and soft skills will be formed strongly. The Electrical Engineering Department, Faculty of Science and Technology, UNPAB, also participated directly in participating in the program from 1 2 the Ministry of Education, Culture, Research and Technology, namely the independent learning independent campus (MBKM) where one of the sub-programs is internship. This internship is offered in the fifth semester where every student who takes part in the program must have sufficient material readiness or knowledge about the topic to be taken. One of the requirements for taking part in this internship program, apart from having to be in the seventh semester, is to take all courses in the seventh semester which is limited to 20 credits which will be converted into an internship program. After completing the internship, students are required to prepare a report which is discussed with the field supervisor.

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History and Development of Aulia Electronics Training Center

Aulia Electronics Training Center is a Course and Training Institution that has received permission from the Medan City Education Office with No.420/15393/.PNF/2019 DATE 08-10-2019 and the Investment and One-Stop Integrated Service Office with no. 0026/0024/3.4/2101/08/2020 Which is a course and training institution and the fields of mechanics, electronics, electricity and computers that have a big goal, namely to equip the next generation of the nation with competencies in the field of technology. Aulia Electronics Training Center also collaborates with the business world or industry to create training graduates who are ready to work and ready to do business.

Aulia electronics training center is an institution that holds courses or training for the community, both from education and the general public. The training carried out is either direct or virtual. Some of the training provided at the Aulia Electronics Training Center are basic aurduino, automation, robotics, advanced automation, plc, scada, hmi, electrical installation, electric welding, autocad, car air conditioning, building air conditioning, electric water pump motors, electronic repair, advertising design, digital marketing, etc. Then in 2021 AETC built a company named CV. Aulia Berkah Utama. In the AC buying and selling and service business, Aulia Electronics Training Center is located at Jl. Bunga Pariama I Puri Adam Malik Complex Block D No.2 Ladang Bambu Kec. Medan Tuntungan, Medan City, North Sumatra. Aulia Electronics Training Center started opening an AC buying and selling and service business in 2021, starting with the founder of Aulia Electronics Training Center, Rahman Aulia, S.T., M.Kom who works as an ATKP Lecturer. CV. Aulia Berkah Utama serves AC repair or maintenance and other service services.

Prepaid Kwh Meter

Prepaid kwh meter, namely, a tool designed by pln using the new electric kwh, a charging system using credit. To start subscribing to electricity from pln, customers must first know the system implemented by pln for electricity customers. (spln d3.009-1:2010 no.719.k/dir/201). The general way a digital kwh meter works is by digitally calculating the amount of a customer's electrical energy usage. To detect or measure voltage and electric current, a current sensor is used. The output from the sensor will be converted into digital data which will then be processed in the microcontroller to produce the price or amount of customer electricity usage which will then be displayed on the lcd. Apart from being displayed on the lcd, data is also stored in memory. The data stored in memory is not only data from the kwh meter, but also the value of the pulse amount. The credit amount is defined by certain numbers as a voucher code. If the voucher code entered is correct, the amount of kwh credit will increase and decrease along with pln power usage. Voucher codes are entered via the keypad and codes that have been entered cannot be used again. These data must not be lost at any time there is no supply, therefore a microcontroller is needed that has an internal eeprom. The relay is used to cut

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off pln power when the prepaid credit runs out. (spln d3.009-1:2010 no.719.k/dir/201), the prepaid meter section can be seen in the picture:

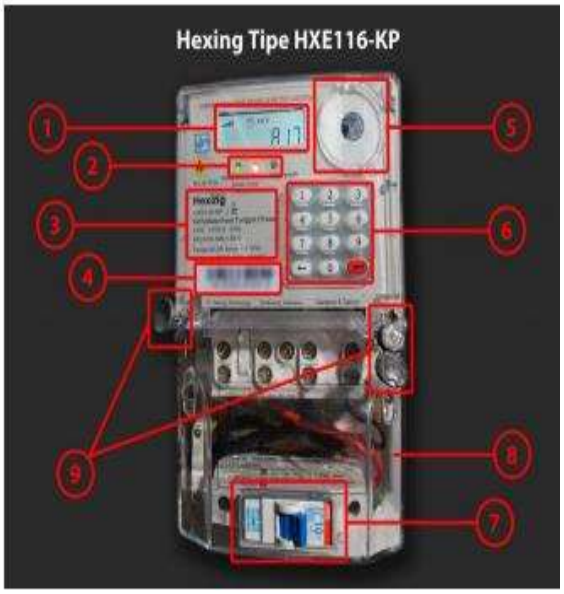

Figure 1. Prepaid KWH meter section.

The power factor consists of two characteristics, namely the "leading" power factor and the "lagging Leading Power Factor If the current is ahead of the voltage, then this power factor is said to be "leading". This leading power factor occurs if the load is capacitive, such as capacitors, synchronocus generators, synchronocus motors and synchronocus condensers.

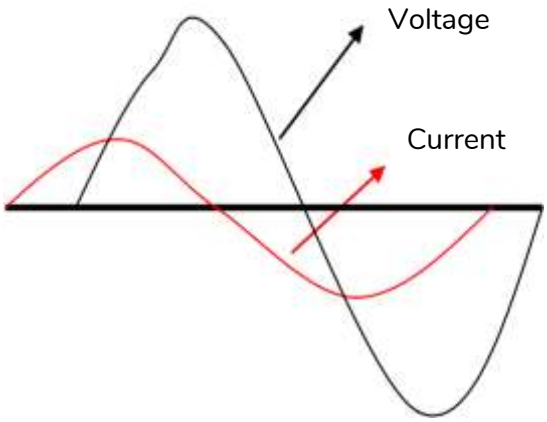

Figure 2. Leading power factor

Power Factor “lagging” If the voltage is ahead of the current, then this power factor is said to be “lagging”. This lagging power factor occurs if the load is inductive, such as induction motors, ACs and transformers

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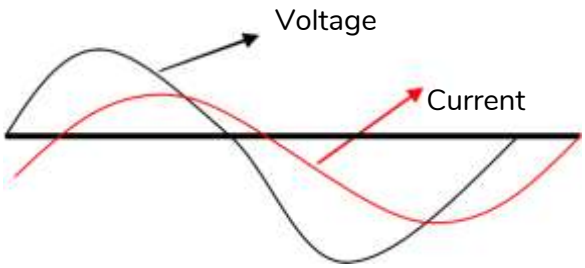

Figure 3."Lagging" Power Factor

Properties of Electrical Loads

In an alternating current source, if the applied load is purely resistive, then the voltage and current waves are in phase as shown in the figure below.

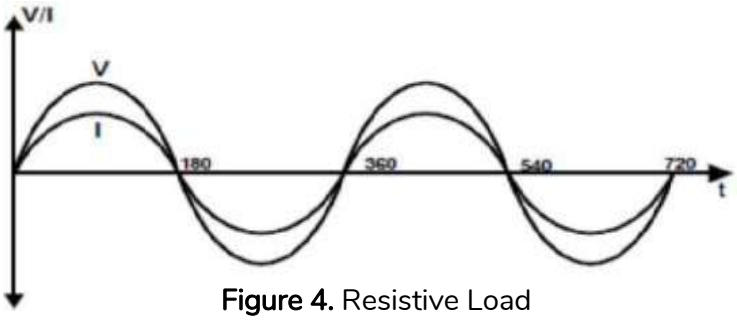

Figure 4. Resistive Load

Loads that are inductive or capacitive can shift the zero crossing point between voltage and current. If the load is an inductive load, the zero crossing of the current wave appears some time after the zero crossing of the voltage wave appears. This is usually said to be a lagging current, as shown in the figure below:

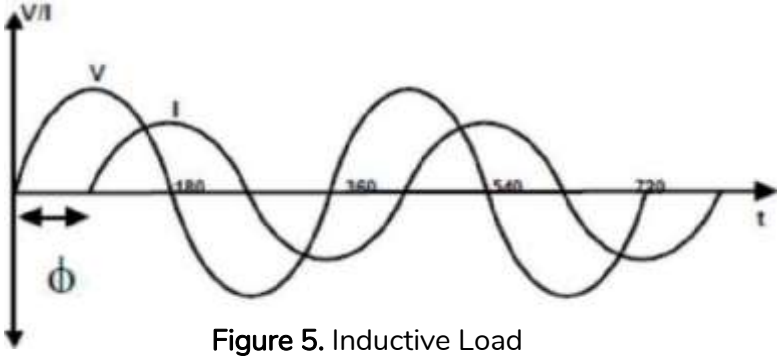

Figure 5. Inductive Load

On the other hand, for capacitive load currents, the zero crossing of the current wave will appear some time before the zero crossing of the voltage wave. This is usually said to be a leading current as shown in the figure below:

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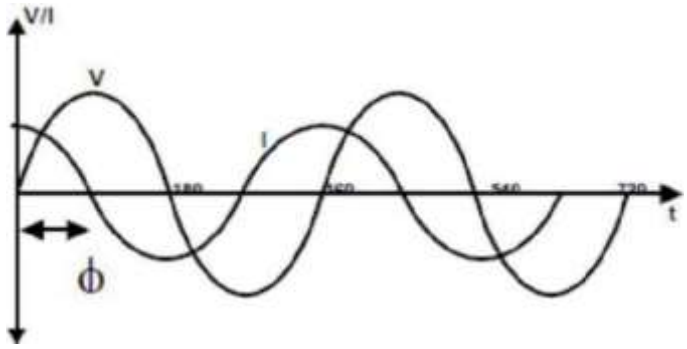

Figure 6. Capacitive Load

METHOD

This parts ncludes research time and place, tools and materials, tool design, research methods, and research procedures. In the research procedure, several testing steps will be carried out to find out how the tool worksPrepaid Kwh Meter Protection Relay Safety Based on Microcontrol-Based Overloadr. In designing the tools in this research the author used several tools and materials for design:

Table1 Tools and Materials

TOOL	MATERIAL
Laptops	Arduino Uno microcontroller
Cutting pliers	16 x 2 LCDs
Negative and Positive Screwdrivers	PZEM-004T sensor
Soldering	5 volt relay
Cellphone	12 volt power supply
	LM9526 Voltage Regulator
	450 Watt Prepaid Kwh Meter
	220V Dimmers

What is meant by a system is a set of interrelated elements that process one input with another input so that it is able to produce an output in the form of information that can be used in making a decision. Block Diagrams are a form of process diagram for systems specialized in engineering activities. The diagram is arranged from a high level point of view or does not highlight too detailed parts of the system. The purpose of making it is to show the main parts when creating a new system or improving an existing system.

The kWh meter supplies the electrical load and is connected to the power supply to reduce the voltage from 220 VAC to 12VDC, the output of the power supply is connected to the voltage regulator to reduce the voltage from 12V to 5 V to supply the Arduino Uno, and other components. Meanwhile, the dimmer module works to regulate the voltage rise and fall. The Pzem004t sensor works to detect the amount of voltage from the dimmer output and at the same time detects the amount of power in the load. If

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the voltage detected by the pzem004t sensor is greater than 231V or smaller than 198V and the detected power is greater than 450 watts, the pzem004t sends data to the Arduino so that the Arduino orders the protection relay to cut off the electricity supply to the load. Meanwhile, if the Pzem004t sensor detects a voltage smaller than 231V or greater than 198V and the power detected is smaller than 450 watts, then the Pzem004t sends data to the Arduino so that the Arduino orders the protection relay to connect the electricity to the load.

The minimum system circuit is the minimum circuit in which the microcontroller chip can work (run). The Atmega AVR chip is equipped with an internal oscillator so, to save costs, there is no need to use an external crystal/resonator to source the CPU clock:

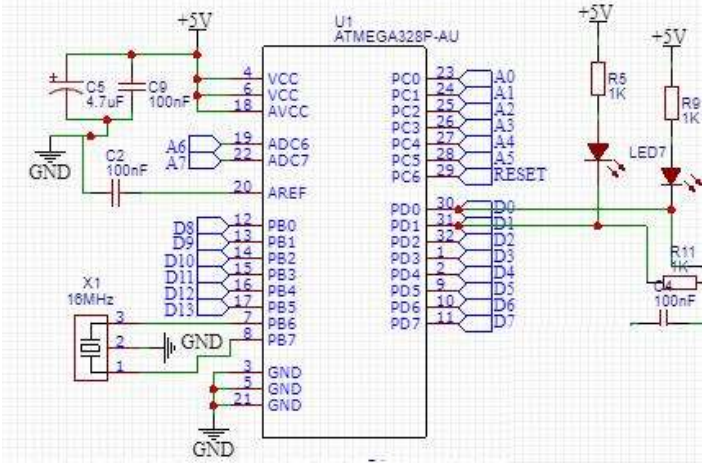

Figure 7. Arduino Uno schematic

The Arduino schematic circuit has several components, namely:

1. ATMega 328 microcontroller IC
2. 2 capacitors, namely 22 pF (C1 and C2) and 10 uF (C3)
3. 1 resistor whose value is 4k7 ohm
4. 1 reset pushbutton (PB1)

Program memory is Flash PEROM memory which is responsible for storing programs (software) that we create in the form of program codes (containing addresses along with program codes in the address memory space) which we compile in the form of hexa or binary numbers. In simple terms, it works as a switch in an electrical circuit. For a 5 leg relay, each relay leg will have a code which is usually marked with a number to differentiate the function of the relay leg. Each leg of the relay will have different functions from one to another. So if the legs are installed with a different configuration, the relay function will also be different.

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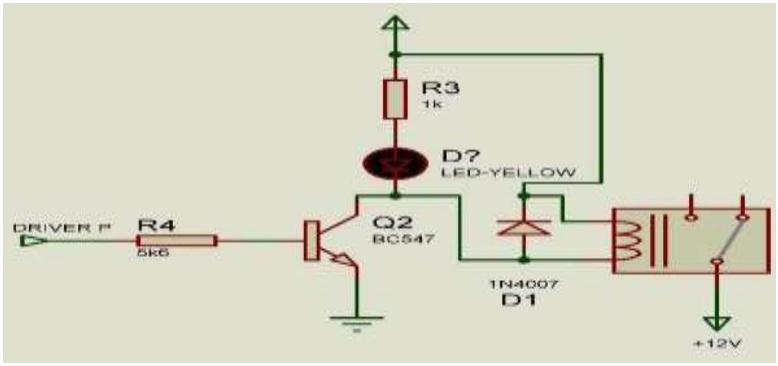

Figure 8. Relay Driver Circuit

RESULTS AND ANALYSIS

In accordance with the outline of the aim of this research is to create toolsPrepaid Kwh Meter Protection Relay Safety Based on Microcontrol-Based Overloadr. There are several steps used in making the tool before carrying out testing.

Power Supply Testing

The voltage source used as the working voltage in the Prepaid Kwh Meter Security Device Circuit Based on Overload to Avoid Damage to Microcontroller Based Relays has a source originating from DC12 V. In this research, testing will be carried out on the power supply circuit, namely by measuring the output voltage produced by each -each source of voltage applied to the circuit.

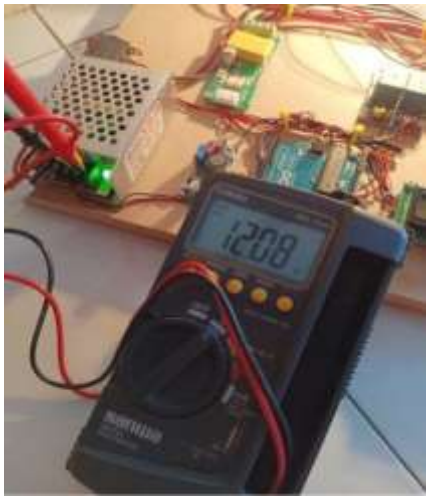

Figure 9. Power Supply Output Testing

The power supply test was carried out twice to get good results based on the data sheet of the power supply, however the measurements carried out directly using a multitester can be seen in the table below:

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Table 2. Power supply stability test measure

Test	Expected based on data sheets	Measurement results
	Vcc	Vcc
Number 1	12 V	12.08 V
2nd	12 V	12.08 V
The 3rd	12 V	12.08 V
To 4	12 V	12.08 V
5th	12 V	12.08 V
Average value	12 V	12.08 V

Figure 10. Testing and Apllied

Voltage Regulator Output Testing

Use of regulators on Prepaid Kwh Meter Security Devices Based on Overload to Avoid Damage. Relays function to provide constant voltage to the device's minimum system circuit. Based on the datasheet, there are several types of regulator ICs which indicate the output voltage produced. This series of tools uses the LM2596 regulator IC, according to the data sheet on the LM2596 regulator IC, it produces a voltage of 5 volts DC which is stated in the two digit numbers from the back on the regulator body The testing system on the LM2596 regulator IC is carried out to determine the output voltage produced by the regulator IC. Reasons for choosing to use The LM2596 regulator IC is because each component in the device on average works based on a voltage of 5V DC.

Figure 11. Voltage Regulator Output Testing

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To achieve more accurate test results, the voltage regulator output test was carried out up to 3 times. The following is the test table

Table 3. IC Regulator Test Results

Test	Expected	Measurement results
Number 1	5 V	5.05V
2nd	5 V	5.05V
The 3rd	5 V	5.05V
Average value	5 V	5.05V

The picture above shows a voltage test carried out using a 220v dimmer, to regulate the size of the voltage in the circuit. From the test results above, if the sensor detects a voltage <198V, the LCD will display information that Under Voltage has occurred in the circuit and the relay works to cut off the electricity flow. on the load, likewise if the voltage is >231V, the LCD will display information that Over Voltage has occurred in the circuit and the relay works to cut off the electricity flow to the load.

CONCLUSION

From the results of the discussion in the previous chapter, the writer will draw conclusions in writing this thesis as follows: To help people save electricity usage at home, use electricity correctly and appropriately to turn it on and turn it off. Test results for tools designed with calculation results have different calculation percentages. Irons have percentages error 1.99% of the calculation results for heating testing Water has an error percentage of 0.53% due to the lack of sensitivity of the PZEM-004T sensor in reading the used load. The protection relay will work to cut off electricity if the voltage is <198V or >231V, and if the power is >450 Watts. The measured voltage at the output of the designed tool reaches 205 V and is still within the SPLN standard.

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