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Simple Automatic Transfer Switch System Using Timer Delay Relay

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Abstract

A control system in the form of an Automatic Transfer Switch (ATS) is needed when a blackout occurs from the PLN that will be transferred to the generator. The research problem was how to save costs for making ATS that can run efficiently. The purpose of this study was to find out how to save costs for making ATS that can run well and efficient. The method used was Research and Development. The Research and Development stages included: collecting data, designing, and testing. To save costs for making ATS, the researchers used the Timer Delay Relay (TDR), as using TDR reduces the cost of making tools because the component prices are relatively affordable. The way the ATS system works is when the PLN electricity is on, the battery will be charged by the battery charger, and when the PLN electricity goes out, the inverter will get a voltage supply from the battery, that was originally 12V will be changed to 220V. The TDR makes it easier to determine the appropriate time when the voltage is stable. Based on the experiment, the time when the voltage is stable is 6 seconds.
Keywords: PLN Electricity, ATS, Inverter

Abstrak

Sistem kontrol berupa Automatic Transfer Switch (ATS) diperlukan saat terjadi pemadaman dari PLN yang akan dipindahkan ke genset. Permasalahan penelitian yaitu bagaimana cara menghemat biaya pembuatan ATS yang dapat berjalan efisien. Tujuan penelitian ini yaitu mengetahui bagaimana cara menghemat biaya pembuatan ATS yang dapat berjalan dengan baik dan efisien. Metode yang digunakan adalah Research and Development. Tahapan Research and Development tersebut meliputi: pengumpulan data, perancangan, dan pengujian. Cara menghemat biaya pembuatan ATS yaitu menggunakan Timer Delay Relay (TDR) karena penggunaan TDR mengurangi biaya pembuatan alat karena harga komponen relatif terjangkau, Cara kerja sistem ATS yaitu pada saat listrik PLN menyala, baterai akan diisi daya oleh charger baterai, dan ketika listrik PLN mati, maka inverter akan mendapat suplai tegangan dari baterai, yang semula 12V akan diubah menjadi 220V. Penggunaan TDR memudahkan kita dalam menentukan waktu yang sesuai ketika tegangan dalam kondisi stabil. Berdasarkan percobaan, waktu saat tegangan stabil adalah 6 detik.
***Kata-kata kunci**: Listrik PLN, ATS, Inverter*

1. Introduction

Electrical energy is the preeminent energy in everyday life. The role of electricity is very dominant in various sectors of life. The availability of electrical energy in quantity and quality of service that is good and affordable is the main driver and greatly encourages the pace of development in various sectors. The main power supply of the State Electricity Company (PLN) is very influential in the supply of electrical energy for public services. Electricity users use both large and small power, but the main power supply originating from PLN is not always continuous in its distribution. One day there will be a total blackout that can be caused by disturbances in the generating system, or disturbances in the transmission system and distribution system. If the PLN goes out, the supply of electrical energy stops, and as a result, all production activities pause. Based on these problems, a generator set (genset) or battery is essential as a back-up for PLN's main supply. The generator and battery controllers take over the supply of electric power to the load or vice versa; a control system is needed that can work automatically to run the generator when the blackout from the PLN occurs. The automatic control is usually called Automatic Transfer Switch (ATS). ATS refers to a switch that works automatically, but its automatic work is based on the possibility that if the power source from PLN is cut off or experiences a blackout, the switch will switch to another power source, for instance, an inverter **[1].** Working devices on ATS must meet the appropriate standards. The standard is being fast respond and having a full-cycle movement **[2].** When ATS works, several errors occur, including a voltage drop, so it is necessary to increase speed, change the operating algorithm, and set the ATS error detector **[3].**

ATS in developing countries often occurs less smooth transfer of power **[4].** The solution to the problem in ATS is to use automatic transfer switches based on programmable logic controllers. The advantages of cable technology in industrial applications can be observed **[5].** ATS development is quite varied. The ATS development carried out by Lanree and Rasheed employed the 555 timers as the primary controller **[6].** This design focuses on the prime power supply source when restarted, starting the generator when the main power fails and shutting down the generator when the main source restores power as well as automatic transfer of load to an available power source, thereby making the whole process easy and reliable.

Rimbawati, et al. developed Zelio-based ATS **[7]** while Tabil Ahammed, et al. developed ATS using Siemens PLC **[8][9].** The weakness of this design is that it requires a large amount of

money because it uses a PLC. Agbetuyi, et al. developed ATS with the 16F877 PIC microcontroller, of which weakness is that it requires a microcontroller that is rarely used, so the search for these components is quite difficult [10].

Based on the previous research, researchers designed an ATS system that is cheap and easy to use, using magnetic relays and contactors. Similar research has been conducted by Eko Susanto [1] but it needs a lot of relays and timers. Therefore, the author simplified the circuit.

2. Method

a. Materials

The materials used in the manufacture are the components that used in the Automatic Transfer Switch (ATS) System. It includes: MCB 6A, Ewig SN-21 contactor, Schneider contactor, TDR Larkin H3CR, inverter, battery, battery charger, outlet, terminal block, Dinrail, AWG cable or 1.5mm NYAF cable, and 2.5 NYAF cable. The ATS system is expected to provide convenience for users in terms of switching power supply sources as well as security for the user's electronic devices. The tools used include: drill, grinder, min and plus screwdriver, cutting pliers, multitester, and cable stripper.

b. Method

This research method is research and development. This method includes doing needs analysis, planning, testing, and product revision. The design of this ATS is illustrated in Figure 1.

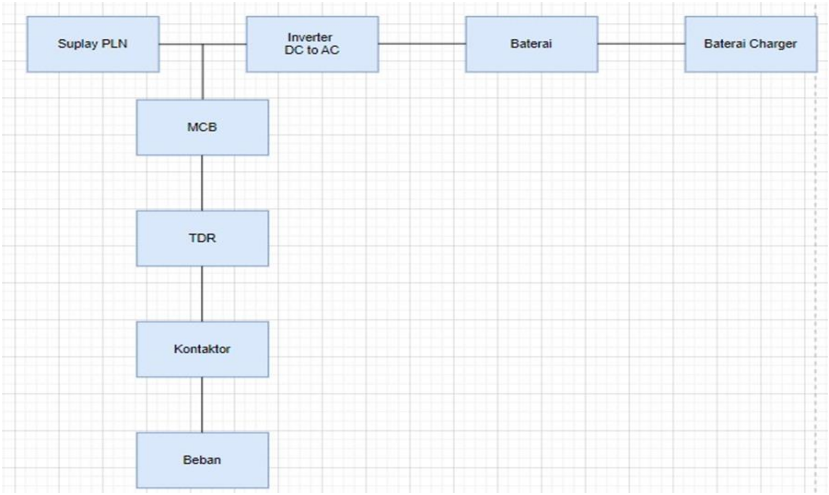

Figure 1. Flowchart of ATS Design

Figure 1 indicates that when the PLN electricity is on, the battery charger will automatically charge the battery, and the device gets a voltage supply from the PLN. Meanwhile, when the

PLN power goes out, the charger will automatically stop, and the inverter will get a voltage supply from the battery that will be converted from 12V to 220V. The Timer Delay Relay (TDR) will then work. This tool can work with a time lag that we can set ourselves for the process of moving the power supply source from the PLN mains to the battery.

3. Results and Discussion

a. Results of the Research

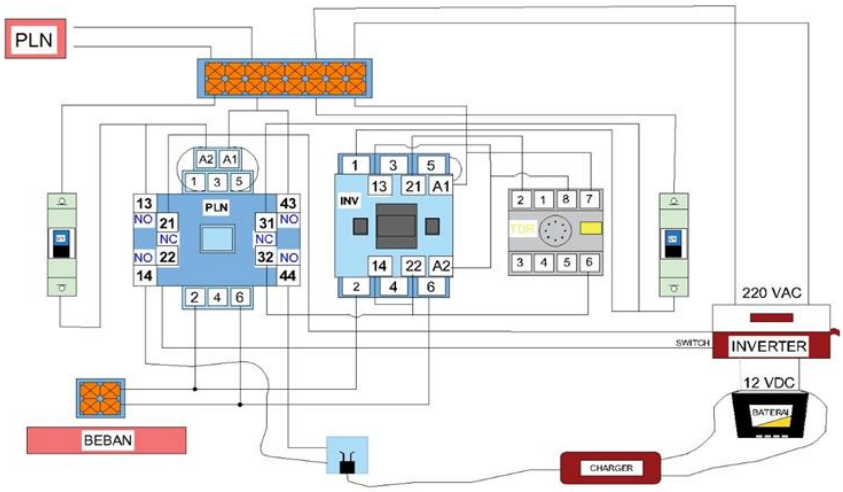

Figure 2. Wiring Diagram of ATS Circuit

Based on the **Figure 2**, the ATS works as follows.

1) PLN Normal Condition

When the PLN is on, and there is voltage flowing from terminals A2 and A1, the PLN contactor goes to terminals 2 and 6, then to the load (lamp) so that the lamp lights up. Besides, the voltage also flows from terminals 13 and 43 of the PLN contactor to terminals 14 and 44. Then, the voltage flows into the socket, where the socket is used to insert the battery charger plug. Therefore, when PLN is normal, the battery will be automatically charged.

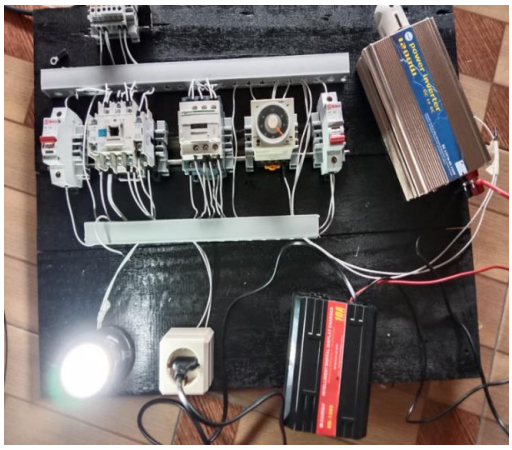

Figure 3. PLN in Normal conditions

2) PLN Off Condition

When the PLN goes out, the outlet does not get a voltage supply from terminals 14 and 44 of the PLN contactor, so the battery charger will automatically stop, and the inverter will turn on. Then, when our Inverter MCB is ON, the voltage from the inverter will flow to the Timer Delay Relay (TDR), and the TDR will calculate the time we have set. After that, the voltage flows to the inverter contactor, then to terminals 2 and 6, where the terminal is connected to the lamp, so the lamp lights up with the voltage source from the inverter.

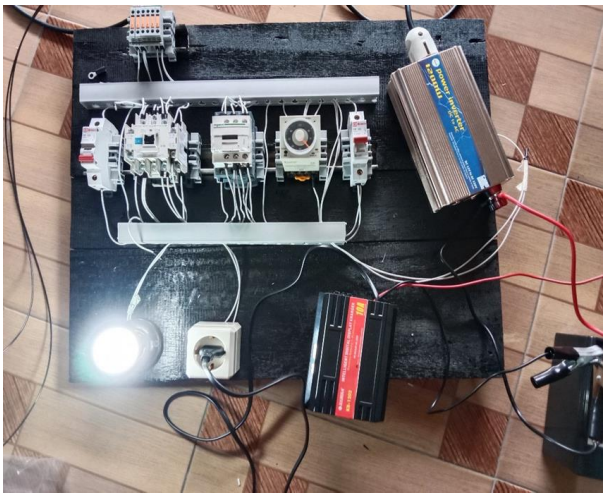

Figure 4. PLN in OFF Conditions

The results of the ATS test can be seen in **Table 1**.

Table 1. ATS Device Test Results

Component	PLN ON			PLN OFF			Description
	Work	Standby	Don't Work	Work	Standby	Don't Work	
MCB PLN	v					v	Function
MCB Inverter		v		v			Function
Contractor PLN	v				v		Function
Contractor Inverter		v		v			Function
TDR		v		v			Function
Inverter		v		v			Function
Battery Charger	v					v	Function
Battery		v		v			Function
Lamp	v						Function

Based on **Table 1**, ATS was running according to what the researcher expected. The weakness of ATS is the voltage instability when switching energy sources. Based on these

problems, it is necessary to test the voltage in a stable condition. The results of the voltage test are displayed in **Figure 5.**

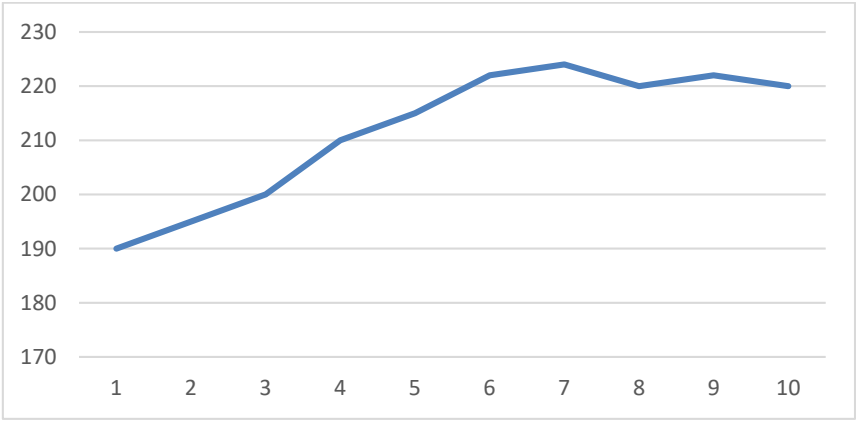

Figure 5. Graph of Time against Voltage

b. Discussion

Making ATS that saves manufacturing costs is using a Timer Delay Relay (TDR). With this, it can reduce the cost of making the equipment because the prices of the components used are relatively affordable, easy to obtain, and of good enough quality so that it is more economical for households. Based on the results of the component functioning test, the ATS components functioned properly. The way the ATS system works is that when the PLN electricity is on, the battery charger will charge the battery automatically, and our device gets a voltage supply from the PLN, and when the PLN electricity goes out, the battery charger will automatically stop, and the inverter will get a voltage supply from which battery 12V will be changed to 220V. Furthermore, the Timer Delay Relay (TDR) can work with a time lag that we can set ourselves for the process of moving the power supply source from the PLN mains to the battery. It is not unsafe to claim that our electronic equipment is more durable, because there is no excess current and voltage to the device. The appropriate time delay is 4 seconds because the voltage starts to stabilize at the 6th second. Some previous research created ATS using PLC. Using a PLC is not complicated because it only requires a programming language and a ladder diagram, but the price of a PLC is quite costly. Previous studies have also used microcontrollers. The weakness of a microcontroller is that it has a programming language and a DC voltage source, but the cost is inexpensive.

4. Conclusion

How to save costs for making ATS is by using the Timer Delay Relay (TDR), since it reduces the cost of making tools because of the relatively affordable component prices. The way

the ATS system works is when the PLN electricity is on, the battery will be charged by the battery charger, and when the PLN electricity goes out, the inverter will get a voltage supply from the battery that was originally 12V will be changed to 220V. The TDR makes it easier for us to determine the appropriate time when the voltage is stable. Based on the experiment, the time when the voltage is stable is 6 seconds.

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