DESIGNING A TOOL IN THE FORM OF A MINI CCR AS A FEASIBILITY TESTER FOR SERIES TRANSFORMERS AND ALS LAMPS USING AN ARDUINO-BASED MICROCONTROLLER

Alifian Rayyan Rusdiansyah*, Hartono, Siti Julaihah

Politeknik Penerbangan Surabaya, Jemur Andayani I/73 Wonocolo Surabaya, Jawa Timur, Indonesia, 60236
**Corresponding Author. Email: alifian091200@gmail.com*

ABSTRACT

ALS or commonly called Airfield Lighting System are various types of lights at airports that are used to visually assist pilots in staying and taking off in order to move efficiently and safely. In the power supply of these lights used CCR. The extension of CCR is Constant Current Regulator is a power supply used in the world of aviation for providing electricity to the airport lighting system. Where in the electricity provided to the ALS lights of this airport lighting, it is maintained to provide power supply with a fixed current. It is intended that the ALS lamp has lighting with the desired brightness / light intensity in accordance with the specified taping. The ALS lamp has a very important role in helping pilots make landings and take offs, especially at night or in bad weather. Therefore, fast maintenance is needed when the lamp is in a dead condition. The current condition for testing series transformers and ALS lights is to check continuity using a multmeter. But it was found that when checked using continuity and good results when installed in the field could not work or light up as expected due to the occurrence of shor in ALS lamps and series transformers. This research design refers to the working system of the CCR by making a miniature CCR that serves to test the feasibility of ALS lamps and series transformers. This miniature CCR can supply voltage with a fixed current according to the specified brightness step. The current value and voltage value can be monitored on the LCD display. The research results and conclusions on the design of a mini CCR-shaped tool as a feasibility tester for series transformers and ALS lamps are obtained in the form of a constant current value at each brightness step with an average current value in accordance with the actual CCR. This mini CCR uses a selector switch connected to a microcontroller to adjust the step brightness of the ALS lamp through an AC dimmer from step 1 - 5 according to the needs of the lamp to be tested. It is expected that with the mini CCR, technicians can be helped and more effective in terms of ALS lamp maintenance and so that flight operations can run without interruption. In designing this CCR miniature tool using the 4D method so that the design of this tool can be complex and can be developed later.

Keywords: *Monitoring, Constant Current Regulator, Microcontroller, selector switch, AC Dimmer.*

1. INTRODUCTION

The need for transportation in developing countries is very necessary in this modern era. One of the human needs in the field of transportation is air transportation, because air transportation is more efficient and faster. To be able to meet all the needs of the community by using this means of transportation, adequate infrastructure is needed. One of them is the availability of a continuous and reliable power supply. In addition to continuous power supply, human resources are also needed who have skills and are also experts in the field of providing power supply for airports.

One of the supporting factors in the smooth running of operational activities is to build a safe, comfortable, structured, orderly and organized airport. So to meet the criteria / requirements that have been set, the circuit / installation of visual landing aids is generally made in series with constant / fixed light intensity settings. The supporting tool needed to control the fixed current in Airfield Lighting is Constant Current Regulator or better known as CCR Constant Current Regulator (CCR) is a power supply used in the world of aviation to provide electrical power to the airport lighting system with a

constant current value. The fixed power supply is intended to illuminate the airport to produce the required light intensity in a given cycle. For lighting lamps, the output of the CCR is connected to a series connected current transformer and this output becomes the input of the existing lighting lamps. The CCR is used to meet the power requirements of airport lighting installations such as runway lighting, taxiway lighting, PAPI lighting and approach lighting.

Some airports have been equipped with adequate lighting from ALS lamps, but when damage occurs to ALS lamps and series transformers, repairs need to be done quickly and precisely. In repairing ALS lamps and series transformers, technicians take spare lamps or transformers in the electrical unit warehouse and then check continuity using a multimeter. However, it was found that the lamps and transformers that had been checked for continuity and declared good when they were installed in the field failed to light up. To overcome these problems, it is necessary to modify the actual CCR by making a miniature CCR tool whose working principle is almost the same as the actual CCR, which can be adjusted step brightness of its current output as a tester of ALS lamps and series transformers.

With this background, an idea arises to try to make a tool in the form of a Final Project entitled "DESIGNING A MINI CCR SHAPE TO TEST THE FABILITY OF SERIES TRAFO AND ALS LAMP USING ARDUINOBASED MICROCONTROLLER".

2. METHOD

The design of a tool in the form of a miniature CCR as a feasibility tester for series transformers and ALS lamps is designed with the hope that it can be implemented according to its main function, namely in streamlining technicians in terms of conducting feasibility tests for ALS lamps and series transformers so that testing of lamps and transformers does not need to be done in the field but simply using 220 VAC PLN voltage. So that later this design can be developed to be more complex. The research method used is the 4D method because the system has a clear concept and description of the CCR miniature that will be developed using Arduino Uno

2.1 Hardware components:

1. Step Down Transformer

Step down transformer serves to reduce the voltage from the PLN 220 VAC voltage source to 35VAC in accordance with the specifications of the incandescent lamp load to be tested. This tool uses a 10A step down transformer because the current that will be used on the load is 6.6A.

2. AC Dimmer

AC dimmers function to increase or decrease the level of light intensity in incandescent lamps. This circuit can adjust the light from dim to dim to maximum brightness depending on the wattage of the lamp.

3. Optocoupler PC817

Optocoupler PC817 serves as a zero crossing detector circuit to Arduino. The zero crossing detector is an electronic circuit that functions to detect zero crossing in the AC voltage sinusoidal wave. 4. Optocoupler MOC3021

Optocoupler MOC3021 functions as the main driver of the triac in the AC dimmer to produce a constant current. This current is then received and utilized to turn on the incandescent lamp.

5. Arduino Uno

Microcontrollers are hardware devices used to receive, process, and transmit data. This Arduino Uno microcontroller has input / output that can be used to send or receive data results by detecting current sensors and voltage sensors. Output or output will be broadcast through the pin used to send data. 6. ACS712 Current Sensor

ACS712 is an active current sensor that uses field effects. This current sensor can be used to measure AC or DC currents in the circuit. This sensor module has been equipped with an active amplifier circuit to increase the sensitivity of current measurements and can read small changes in current.

7. ZMPT101B Voltage Sensor

The ZMPT101B sensor module is a voltage sensor that can measure voltages from 0V to 1000V. The working principle of this sensor is to use a step down transformer to reduce the input voltage. Then enter it into the op-amp and read a stable output value depending on the input value.

8. Selector Switch

Selector Switch or rotary switch is an electrical component located outside the control panel that is used to select a mode or change the direction of current flow by turning the switch to the right or sending a signal. 9. 16x2 LCD

The 16x2 LCD display is one of the most commonly used screens as an interface between the microcontroller and the user. With this 16x2 LCD, users can view/monitor sensor status or program status. To connect to the microcontroller (Arduino), a PCF8574 is needed. The main function of the PCF8574 is to expand the I/O port on the microcontroller through two 2-way I2C bus lines.

2.2 Software components:

1.Arduino IDE

This design uses Arduino as its microcontroller. The Arduino must be given a program so that it can run. So this tool uses the arduino IDE software which is used to program the arduino from the laptop to the microcontroller.

2.3 Tool Design

As a tester system or a feasibility tester for ALS lamps and series transformers, the above tool utilizes a 220 VAC source as the input voltage from a step down transformer with an output voltage of 35VAC. The step down transformer output is connected to an AC dimmer, pc817 optocoupler and ZTMPT101B voltage sensor.

This AC dimmer will provide a constant current to the load according to the program given by the arduino.

To adjust the step brightness of the lamp, a component in the form of a 5-step selector switch is used which is connected to the Arduino. The current output step is based on the CCR work system where step 1 with a constant current output of 2.8 A, step 2 with 3.4 A, step 3 with 4.1 A, step 4 with 5.2 A and step 5 with 6.6 A current. ACS712 current sensor and ZMPT101B voltage sensor work to read the current value and voltage value on the load, which will then be sent to Arduino. and forwarded to be displayed on the 16x2 LCD display.

2.4 How the tool works

The workings of the tool that I have described are as follows. As a system tester or feasibility tester for ALS lamps and series transformers, the above tool is connected to the load to be tested for feasibility, the load can be an ALS lamp or a series transformer. Then the tool is connected to a 220VAC source from PLN. If the tool is already on then we can adjust the brightness of the load using the selector switch step 1 to step 5 according to the desired amount of light intensity. Furthermore, the output current and voltage are connected to the voltage sensor and current sensor which later the voltage value and current value read by the sensor are sent and processed on the Arduino module. Then the arduino module is connected to the 16x2 LCD screen as an indicator of the voltage value and current value reader which also serves to facilitate technicians in knowing the good condition or not of the ALS lamp or series transformer connected to the tool.

3. RESULTS AND DISCUSSION

This chapter discusses testing of the system design made. This test is carried out to determine the performance of the system and to find out whether the system that has been implemented is as planned.

3.1 Overall testing results

a. CT Step Down Transformer Test Results

Figure 3.1 CT Step Down Transformer Test Results

The first hardware test that must be done to measure the performance of a device is testing its power supply. It can be seen that this test aims to adjust the working voltage in the design later. Therefore, the measured voltage must be completely appropriate so as not to have an impact on the performance of the design later. For power supply here using a step down transformer. The voltage from the PLN 220 VAC source is lowered according to the amount of voltage needed by the tool. In this CCR miniature tool, an input voltage of 35 VAC is required, therefore a step down transformer with an output voltage of 35 VAC is needed to turn on the load. The following is table 3.1, which is the data from the CT transformer test results on the mini CCR.

Table 3.1 Bar chart of 100W Lamp Testing

Uji ke-	Tegangan *Input* (VAC)	Tegangan *Output* (VAC)
1.	226,0	36,81
2.	226,5	36,83

Based on the transformer test results above, it can be concluded that the 10A step down transformer is capable of reducing the AC voltage from an average of 226 VAC to 36 VAC as a voltage supply to the load.

b. 100W Incandescent Lamp Testing Results

Figure 3.2 100W Incandescent Lamp Testing Results

The next test is testing the brightness step of current and light intensity in incandescent lamps with 100w power specifications. In this test, the current value and the light intensity value will be obtained using avometer and luxmeter measuring instruments. In this test, a selector switch is also needed to adjust the output step brightness. The following below is table 3.2, which is the data from the Step brightness test on incandescent lamps conducted by the author:

Table 3.2 Bar chart of 100W Lamp Testing

Uji ke-	Brightness Step	Lampu 100W	
		Nilai Arus (A)	Intensitas Cahaya (Candela)
1.	1	2,75	68,3
2.	2	3,34	358
3.	3	4,16	3.430
4.	4	5,46	7.040
5.	5	6,36	13.030

Based on the test results on the 100w lamp above, it can be concluded that the current output value from the mini CCR to the load in the form of a 100w halogen lamp affects the amount of light intensity from the lamp. This proves that the greater the current flowing into the 100W lamp load, the value of the light intensity also increases or gets brighter.

Figure 3.3 Bar chart of 100W Lamp Testing

In Figure 3.3 above is a comparison bar chart of the test results of the current value and the intensity of light on a 100W lamp, it can be concluded that the step level on the mini CCR is in accordance with the main CCR, which is between 2.8A - 6.6A current. the value of the current flowing towards the load greatly affects the amount of light intensity value produced by the lamp. This proves that the mini CCR can be used for feasibility testing or lamp tester on ALS lamps with 100W lamp specifications. In the test, the lamp used is a halogen motor H4 lamp with 12V/100W specifications.

c. 200W Incandescent Lamp Testing Results

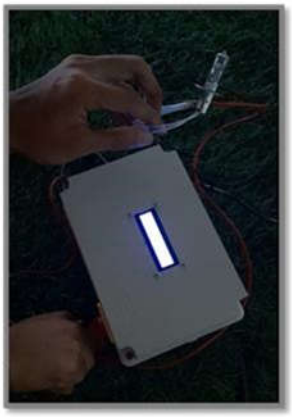

Figure 3.4 200W Incandescent Lamp Testing Results

Next is the brightness step testing of current and light intensity in incandescent lamps with 200W power specifications. Just like the previous test, in this test the current value and light intensity value will be obtained using avometer and luxmeter measuring instruments. In this test, a selector switch is also needed to adjust the output step brightness. The following below is table 4.3, which is the data on the results of step brightness testing on incandescent lamps conducted by the author:

Table 3.3 Bar chart of 100W Lamp Testing

Uji ke-	Brightness Step	Lampu 200W	
		Nilai Arus (A)	Intensitas Cahaya (Lux)
1.	1	2,89	68,3
2.	2	3,45	358
3.	3	5,25	3.430
4.	4	6,54	7.040
5.	5	6,36	13.030

Based on the test results on the 200w lamp above, it can be concluded that the value of the current output from the mini CCR to the load in the form of a 200w halogen lamp affects the amount of light intensity from the lamp. This proves that the greater the current flowing into the 200W lamp load, the greater the value of light intensity or the brighter the lighting. The 200W lamp that I used in this test is a PAPI lamp located in the AFL Lab of Surabaya Aviation Polytechnic.

Figure 3.5 Bar chart of 200W Lamp Testing

In Figure 4.10 above is a comparison bar chart of the test results of current value and light intensity in 200W lamps, it can be concluded that the step level on the mini CCR is in accordance with the main CCR, which is between 2.8A - 6.6A current. The value of the current flowing towards the load greatly affects the value of the light intensity produced by the lamp. This proves that the mini CCR can be used for feasibility testing or lamp tester on ALS lamps with 200W PAPI lamp specifications.

4. CONCLUSION

From the overall test of the author's research entitled "Designing a Mini CCR-shaped Tool as a Series Transformer and ALS Lamp Feasibility Tester Using an Arduino-Based Microcontroller" and based on the discussion in the previous chapter, the following conclusions can be drawn:

1. This Mini CCR system can provide a constant output current from 2.8A to 6.6A by changing the selector switch on the mini CCR. The more it is rotated clockwise, the selector switch will provide a current value to the load that is getting bigger according to the current setting on the mini CCR.

2. This ALS lamp feasibility test monitoring system can facilitate and streamline airport electricians in terms of checking the condition of ALS lamps that will be installed in the field. This is because this Mini CCR can test lamps with a current load of 2.8A to 6.6A so that if the lamp is dead or unable to fulfill up to 6.6A, the technician can immediately replace the lamp with

another lamp without having to check the condition of the lamp in the field.

3. This monitoring system can determine how well or not the ALS lamp uses Mini CCR with step brightnes control according to the main CCR installed. In this Mini CCR there is an ACS712 current sensor and a ZTMPT101B Voltage sensor so that the results of the voltage and current values on the lamp can be monitored on the 16x2 LCD display..

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