An analysis of intelligent LED emergency lamp with voltage and resistance activated sensor

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Abstract. LED as illumination lamps has become popular because of its efficiency to save energy, especially electricity. This lamp can be operated as normal lamp connected to AC power line but if the failure of power line electricity occurs, the lamp is still on for hours depends on battery capacity. This lamp circuits have voltage and resistance sensor in the end of circuit connected to threaded (screw) electrode of the lamp. This paper analyzes the principle and performance of the circuit, especially to voltage and resistance threshold activation, and the other factor that can cause success or failure operation. The analysis concludes that the voltage from power line installation can activate the lamp to bright up and to charge its battery at once. When the supply of power source is failure, it triggers the circuit to keep the lamp on with battery operated, by term and condition applied that the connection to line power installation established. It is caused of resistance sensor that detected no resistance value in loop circuit connection. This lamp will be able to operate correctly in single line load circuit, and only one lamp as line load, no other resistive or inductive load.

1. Introduction

LED as illumination lamps has become popular because of its efficiency to save energy, especially electricity. The LED consumes less voltage and current to produce more bright light, which means using minimal watt can produce optimal bright light. Finally, the LED lamps production becomes massive in the market. One of them is used for emergency lamps with DC or battery power supply and can be recharged with AC power line.

There are so much variations of design, with small or big size depends on consumer needs. The sample of product design is like threaded lamp but there is a LED circuit with small battery inside. This lamp can be operated as normal lamp connected to AC power line, but if the failure of power line electricity occurs, the lamp is still on for hours depends on battery capacity. Uniquely, this lamp can be switched off by disconnecting its contact to power line installation. It is not like conventional emergency lamps, when the electricity failure, the lamp is switched on, but if the electricity establishes, the lamp would be switched off and the battery is being charged [1, 2].

It is important to analyze the unique system inside these lamps and to know how the system works. So, this article would like to explain the analysis done by exploring main circuit of the lamp with its operational steps and characteristics.

2. System design

The diagram in figure 1 shows that LEDs circuit is driven by main circuit with two sub circuits inside, they are voltage activated sensor circuit and resistance activated sensor circuit. Due it has two sub circuits, so it also has two inputs, voltage and resistance. As the emergency lamp, this system must have the energy source from battery unit to supply voltage to the circuits [3, 4].

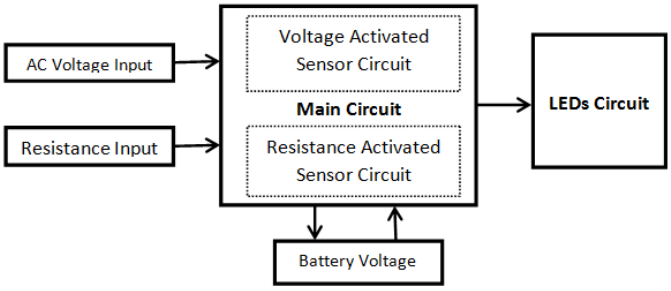

Figure 1. LEDs circuit system design.

3. Research method

The research is conducted by observing physical shape, functional characteristic and operational performance of the lamp. Physical shape contains it design and operation manual procedures, including power dissipation in watt and voltage optimal range in volt listed on its body name plate. Functional characteristic and operational performance is done by implementing the lamp on actual line installation and testing it in dummy circuit load, as behalf of voltage or resistance. This research is different from previous research that conducted to analyze its characteristic only without its operational performance and implementation test.

4. Data and analysis

There are about five components in LED intelligent emergency lamp unit. The 3,7V battery as emergency power supply, main board with sub circuits included that also called smart boards, the wick as LEDs circuit board, light body as the cover of lamp unit, and screw/threaded electrode connector as voltage and resistance input line are shown in figure 2.

Figure 3 shows the circuit with AC voltage input rectified by rectifier circuit block which supplies LED circuit to be on. There is two kind of LED circuits, serial one and parallel one. The serial one is functioned to be light and to be line rectified voltage to charge the battery at once when the voltage power supply is established. And the parallel one is just being light, and to be indicator that the voltage is enough to supply battery. The important one to note here is the battery circuit; it has a control system connected to resistance input circuit showed in figure 4 [4, 5].

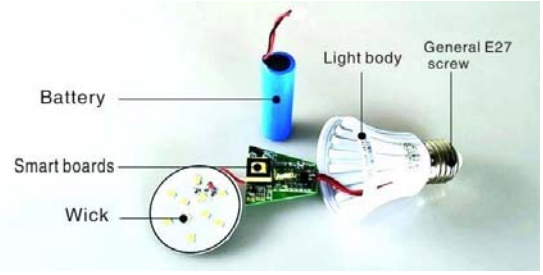

Figure 2. LED emergency lamp components.

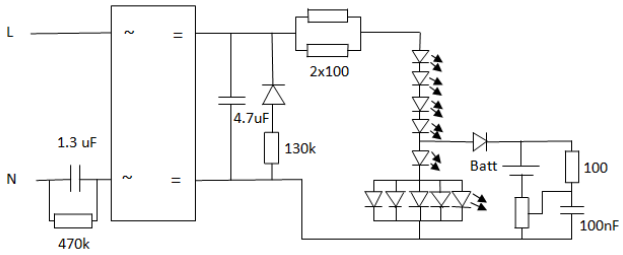

Figure 3. Voltage input circuit.

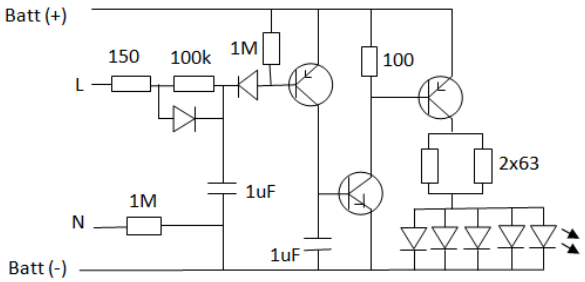

Figure 4. Resistance input circuit.

The resistance input circuit will work when energy failed and no voltage detected in L and N inputs. Then the circuit will check the inputs, if there is detected value resistance threshold or short circuited, the battery discharged to supply LEDs lamp circuit, otherwise the LEDs circuit will be shut down and the battery is in standby mode.

Three tests are conducted to know operational characteristic and performance of the LED lamp unit. Every test is using 3 lamps with difference watt. Figure 5 is scenario diagram to test lamp using a transformer unit as behalf of electricity network in real installation line. By estimating that the battery in the lamp unit is fully charged, S1 and S2 switched to open and close. First step, all switches S1-S2 are closed, the current flows and the lamp lights on. When S1 is opened that denotes failed energy, the lamp is still on, because inductor coil in the transformer is still connected to the lamp and gives the impedance input as resistance to the lamp. But, if S2 is opened the lamp will be switched off, because there is no voltage and no resistance input.

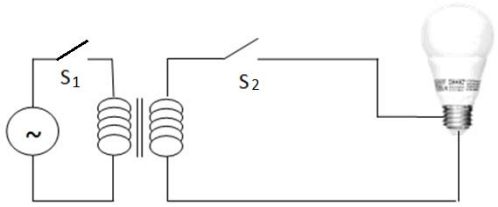

Figure 5. Voltage activation input test diagram.

In figure 6, there is no external energy operated. When S2 is closed, it means that the lamp electrode is short-circuited, the lamp will on. And when S2 is opened and S1 is closed, the electrode will meet variable resistor VR unit that able to change the value of its resistance. It is about 10 Mega Ohm (MΩ) variable resistors, considering of dry skin resistance in about 1 MΩ. When the VR is set to skin resistance range (about 0 – 1M), the lamp stays to keep light on. Otherwise, the lamp will be off [6, 7].

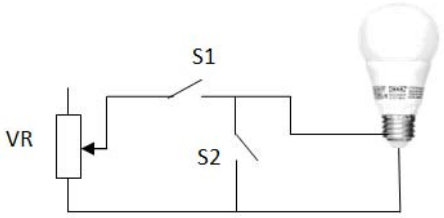

Figure 6. Resistance input test diagram.

If resistive or inductive load added on the diagram of figure 5 become to diagram in figure 7, the lamp will always on although the switch S is opened. It is because off the resistance value detected by resistance sensor in the lamp unit. Resistive or inductive load can be other lamp, electric fan, wash machine, radio or television, computer unit, charger, or the other electric/electronics devices. Capacitive load takes no effect to this system, because if switch S2 is opened, there is only DC power supply of lamp internal battery unit operated.

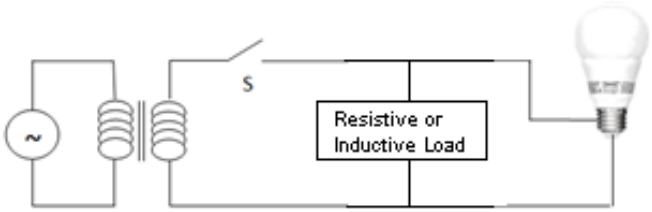

Figure 7. Inductive or resistive parallel load diagram.

5. Conclusion and suggestion

An intelligent LED emergency lamp has main circuit with two sub circuits, voltage activated circuit and resistance activated circuit, to control the light on and the battery charging time. The lamp can operate correctly when it becomes a single load in a single line, no other resistive or inductive load. Range of

resistance to activate the lamp is about 0 Ω (short circuit) to 1 MΩ (dry skin resistance). To operate this lamp well, it is strongly recommended not to use it in parallel connection with other electric device unit although with the same lamp.

References

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