ID: 2016-ISFT-385

A Review on Long Term Performance of Led Lightning by an Efficient Electronic Control Unit

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Abstract: *The aim of Electronic Control Unit in LED driving systems is to prevent the decay in light output as a function of time and life of LED as a function of temperature. For a general common application like offices and homes the majority of occupants will accept light level drop up to 30% with little notice where the drop is gradual, but lower than 70% i.e. a standard by the Alliance for Solid State Illumination Systems and Technologies (ASSIST), a group led by the Lighting Research Centre (LRC), recommends defining useful life as the point at which light output has declined to 70% of initial lumens (abbreviated as L70) for general lighting .In this paper I had proposed a manner to prevent exponential decay of LED light and even giving it a longer life. This research associates a technique of monitoring the temperature of LED and as well as current input so, providing a better life to LED by monitored electronic control unit which will decrease the level of drop and will provide LED based systems longer life and less lumen decay with time.*

Keywords: *Led, Led Driving System, Life ofLed, Decay of led life, monitored electronic control.*

1. INTRODUCTION

Led's better known as Light Emitting Diodes are elctronic components they are designed to convert eletrical energy into light . They are first manufactured in 1960's as in form of Infra red diodes, but they steped into light sector 40 years later.[1]

The lightining sector was previously limited to :-

- Incadescent Light Bulbs (ie traditional bulbs) and,
- Florecent Lights ie CFL and LFL mai nly used in homes ie housing sector
- Until today Led found their own space in market and applied in enormous applications .Led's were mainly used in LCD Screen for cell phones, tablets, computers and televisions else used in vehicle head lamps.

With the span of time and technological advancements and ease of production LED has stepped into lightning sector and due to smaller size less power consumption and better life hours as compared to historical lightning solution's led lightning has proven his marks .[2]

In fig1 we have shown the different percent division in which the different consumer sector usage of electricity in lightning purpose.

This shows a comparison that the energy conservation can be achieved by focusing on the particular sector and providing energy efficient schemes like LED lightening.

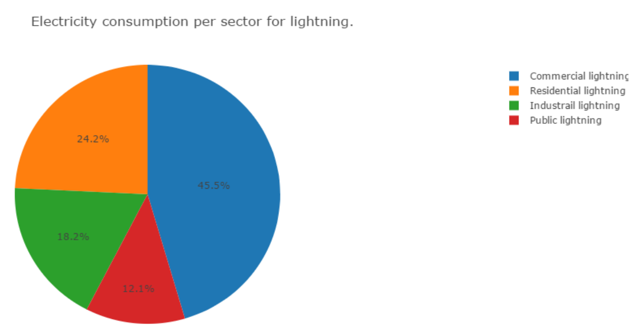

Fig. 1.

1.1 Power Usage

Led light in comparison to other light sources like CFl's and Incandescent bulb have proven to be of greater efficiency Fig-2 shows the graphical representation of the same.

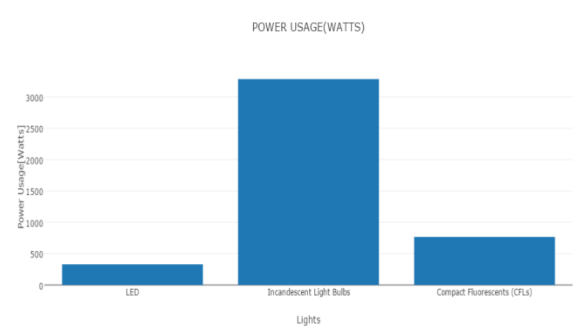

Fig. 2.

Third and the most important comparisons is of the life span Led lights having a good life span which nearly about 50000 hours which in comparison to other lights i.e. CFL's an incandescent bulb which shown in Fig-3.

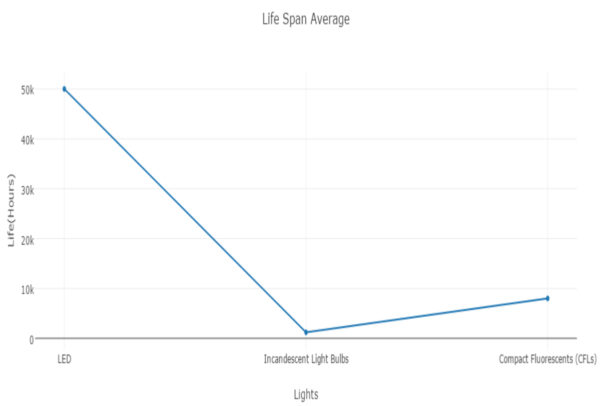

Fig. 3.

This paper will investigate the main reasons behind Led light failures and develop a Self-monitoring electronic control unit to examine and save the light from reaching failure. Traditional light life testing areknown as measuring and reporting rate lamp life. These methods are published by the IES, e.g. LM-49-01 for incandescent lamp [3].

2. METHODOLOGY

2.1 FAILURES IN LED LIGHTING

Lumen Depreciation is known to be the main fatal failure mode in LED's. We should first understand the structural and build quality model of Led lamps[4]

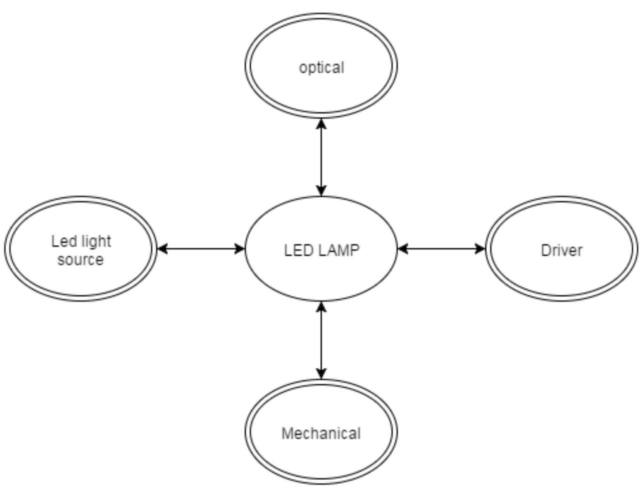

Fig. 4.

The Fig-4 shows the four sub systems the led lamps include i.e.

Led lamp as source of light.

The driver circuit which operates the led Drive load.

Mechanical housing i.e. the outer casing which provides Electronic isolation, thermal runaway, physical protection.

Optical bulb, it's a lens to meet the optical requirement.

$$\beta_{led\ system} = \alpha_{led} \times \alpha_{driver} \times \alpha_{optical} \times \alpha_{mechanical}$$

Therefore to evaluate the system reliability we need to make an understanding of both Lifetime and failure mode of each system. Here, we will discuss about the protection of junction temperature to reach the threshold and degrade junction lumen. It is the heat produced with in the device which is hazardous to the device performance itself. The wall plug efficiency i.e. the optical power output divided by the electrical power in is a calculating measure in LED lighting it is noted that 60% -95% of electrical energy is lost as heat, it is required to remove or control the heat produced as it can change the property of LED, without good heat sinking mechanism the internal junction temperature of LED rises and causes Led Properties to change. As a result both the forward voltage and the lumen output decreases Shown in Fig-5[5].

2.2 ANOTHER FAILURE IS WEAR-OUT FAILURE

The passive dissipation of heat from bulb housing. It occurs due to very less or small form factor of LED lamp, it is more difficult for heat dissipation, and causes the temperature of components, Solder joint temperature raises more than the adjoining components, This results in shorter life time as the components and joints looses lifetime and performance reliability rate.

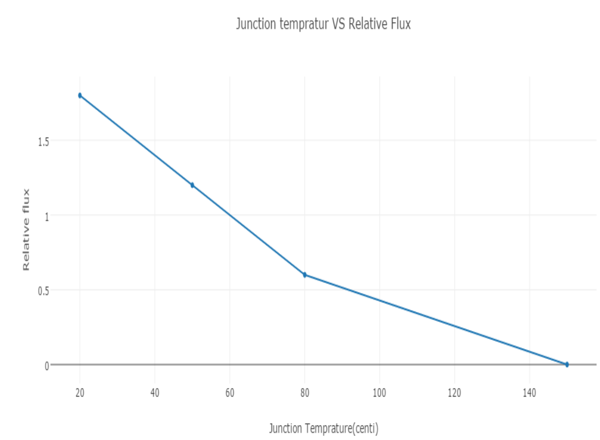

Fig. 5.

This shows that cooler the environment around and higher will be the LED light output and higher temperature regions generally reduces the LED light output, as the light output of a led at constant current Is variable as the function of the junction temperature.

Now the junction temperature depends on:-

Ambient Temperature.

The current flowing through the junction of Led.

The exact heat sinking material provided around Led.

Prolonged heat can majorly shorten the useful life of LED Lamps. Higher ambient temperature results into higher junction temperatures, which in turn increase the degradation rate of the LED junction element, possibly it results in the light output of an LED to irreversibly decrease over the long term at a faster rate than as compared on lower temperatures.

Controlling the temperature of an LED system is, therefore one of the most important task for optimum performance of LED systems.

With this we come to a notation that the heat generated degrades the led junction and needed to be monitored so we rise with an idea of relation between current and junction temperature i.e.

$$P = I^2R$$

Where:-
P=Power (watt).
I=Current (Amp).
R=Resistance (ohm).

Now,
Rise in temperature = power (p) ×Thermal Resistance (Tr)

As we can conclude that all current carrying conductors used in electrical equipment have some resistance. So it states that power will be generated in any conductor carrying a load. Properly operating electrical equipment will have a thermal signature that depends on the type of equipment, surrounding temperatures, Amps (I) load, and for how much time it has been under load. In general, conductors and semiconductors that have been carrying a reasonable current load continuously, over an extended period of time, will look hotter than their surroundings. It is normal for conductors and semiconductors to heat up. Most guidelines, as indicated, suggest that thermographic surveys should be conducted at maximum load, or at some reasonable percentage when maximum is reached. I propose a ECU (electronic control unit) that can be used as an temperature compensation circuit which in turns monitors current input level to the ratio of temperature and sensing temperature by placing temperature sensors very near to LED .As the temperature increases to a threshold according to the pre-defined conditions the ECU will limit the input current as it has a direct relation with the junction temprature so in turn limiting the junction-temprature, it will do so by following the input current readings and the temprature variation with in the system as shown in Fig-7 and Fig-8.

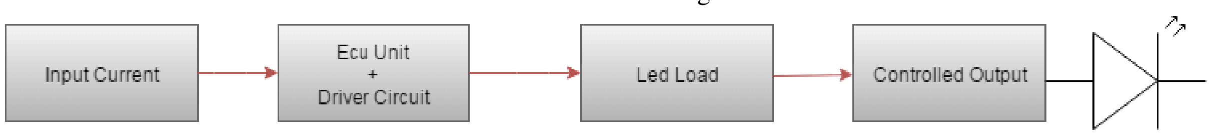

Fig. 7.

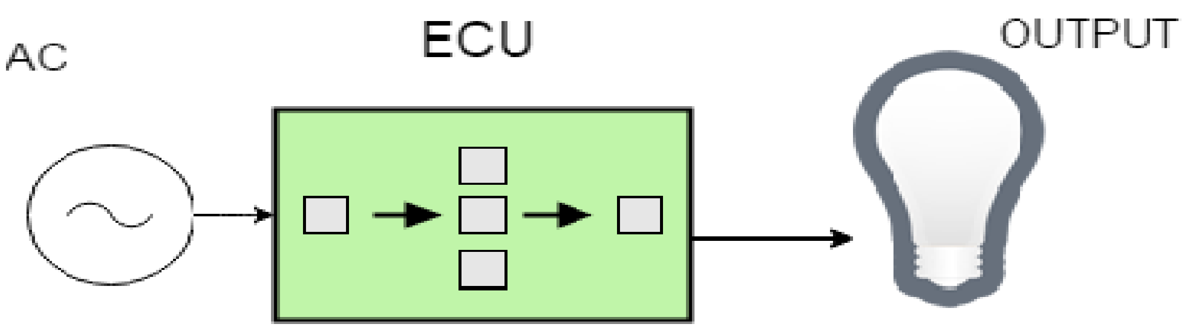

Fig. 8.

3. RESULTS

The result of this implementation will be that the junction temprature will never be reached which would destroy the p-n junction in turn reduces lumen output, so it will be really efficient way to use the led lightning source with longer and efficient life and with less maintenance . and these measures can be made that accurate that the light will approximately never loses the standard output and can be a very good implementation in high load LED's and place with higher natural temprature.

4. CONCLUSION

This paper has touched a major issue of led light and proposed a measure to prevent it in a more efficient way and now its concluded that the life of led lamp i.e. the life period of it is more complex than any other electric light solutions like CFL's and bulbs, so it is needed to take primitive measures to reach the maximum efficiency of LED light systems so now the reliability can be more efficiently achieved by following the above methodology.

ACKNOWLEGMENT

Authors will like to give thanks to my industry mentors Mr S.P Sharma and Mr. Praveen Sharma for their guidance and lab associates.

REFERENCES

[1] Validation of The Methodology of Lumen Depreciation Acceleration of LED Lighting Lamar University, Beaumont, TX 77710, USA.

[2] Blish, R.C. Thermal Cycling and Thermal Shock Failure Rate modelling. IEEE, IRPS, 1997.

[3] Pan, N. et al. An Acceleration Model for Sn-ag-cu Solder Joint Reliability under Various Thermal Cycle Conditions. HP2005.

[4] LM-49-01 IESNA Approved Method for Life Testing of Filament Lamps, Illuminating Engineering Society, 2001.

[5] Li, P.; Chen, L.; Chen, M. An Approach of LED Lamp System Lifetime Prediction. Philips Lighting, Shanghai, China.