DECODING THE LED PUZZLE: USER'S PERSPECTIVE

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Abstract

LED lighting has become a necessity due to energy efficiency and long term economy from the considerations of energy bills and thus is beneficial both to the consumer and the society.

The paper discusses the importance of LED lightings from the user's perspectives.

Assurance of Energy Efficiency Promises

There are two main factors promised in the LED lightings, one as life expectancy and other performance. These are to be ensured to the users. Let us examine how these can be ensured.

Life expectancy

Firstly, it should be noted that LEDs, unlike traditional sources, will not turn off suddenly when their working life ends, but will slowly fade their initial luminous flux until they turn off completely. In fact, LEDs do not break (except for manufacturing damages) but decay gradually andconstantly.

The decrease of LED flux, normally after 50,000 hrs, is defined by the working life and is represented by the L70 or L80 mark (ref. fig. 1), which means that the 80% of the initial flux is maintained after 50,000 hrs.

The “B” letter followed by a number ranging between 10 and 50 indicates the quality of the fixture and defines the LED percentage that doesn't retain the declared characteristics when it reaches 50,000 working hours.

Suppose LED life is declared L80/B10 = 50,000 hrs. This means that when the LED reaches 50,000 hours of operation, 90% (B10) of the LEDs will maintain 80% of the initial luminous flux (L80) as shown in Fig. 1.

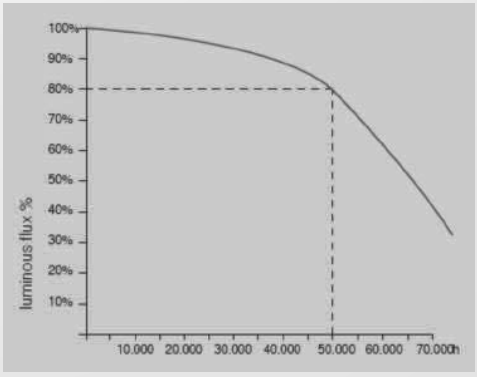

Figure 1: Relation between luminous flux and working hours of LED

Let us take another example. LED life declared L70/B50 = 50,000 hrs. This means that when the LED reaches 50,000 hours of operation, 50% (B50) of the LEDs will maintain70% of the initial luminous flux (L70).

Method to Ensure Working Life and Performance of LEDs as Promised

The following methods can be adopted for the same;

1) Check the LED Type chosen for the application: Unlike conventional light sources (lamps) of the past where fair amount of standardisation was present and there were limited variances in universal ratings, LEDs are continually evolving light sources with numerous types, many also not directly comparable in shape/size/ratings/type of use from manufacturer to manufacturer. However, a basic verification criteria has been illustrated as following;

   - Low / Mid Power Illumination class SMD LEDs (0.2W – 1W) usually individual LED drive current below 50mA – 200mA: These LEDs have High Junction Thermal Resistance (Rth>10^{0}C/W). These are Low cost LEDs meant for use in Indoor or controlled atmospheres, where ambient temperatures (Ta) are maintained around 25^{0}C. : Suited for Indoor Fixtures and advisable life declaration up to 25,000 hrs.

Available in Epoxy Die sizes: 2835 (2.8mm x 3.5mm) / 5630 (5.6mm x 3mm)/ 3030

(3mm x 3mm) etc.These LEDs can be mounted with close spacing of <5mm pitch

These LEDs can be mounted on Aluminium (MCPCB) / FR4 PCB and secured to Heat Sink surface via Thermal Tape/Thermal Paste with Thermal conductivity of 1W/mK or higher.

   - High Power Illumination class SMD LEDs (1W – 10W) usually individual LED drive current ranges between 250mA – 2000mA: These LEDs have LOW Junction Thermal Resistance (Rth< 6^{0}C/W) : The lower the Rth value, better is the heat dissipation from LED Junction to the heat sink. These are rugged professional LEDs meant for use in Outdoor and harsh Industrial atmospheres, where ambient temperatures (Ta) are expected to vary between -30^{0}C to +60^{0}C: Suited for Outdoor & Industrial Fixtures and permissible life declaration 50,000 hrs – 100,000 hrs.

Available in Ceramic Die sizes: 3030 (3mm x 3mm)/ 3535 (3.5mm x 3.5mm) / 7070 (7mm x 7mm)& Epoxy Die Sizes: 5050 (5mm x 5mm) etc.

These LEDs need to be mounted with spacing of minimum 8mm/W pitch in order to ensure adequate heat dissipation from each LED to the heat sink.

surface via Thermal Paste with Thermal conductivity >3W/mK or higher.

- Chip On Board (C.O.B.) LEDs (10W – 255W) Multi Chip Arrays mounted on single die: These LEDs require dedicated heat sink for each COB. Typicaluse of COB LEDs is for Industrial Bay Lights / Wellglass, Retail Spot Lights where dedicated long heat sinks are feasible in luminaire design.
- ENSURE that the LEDs are driven at below 70% of Maximum rated nominal value as specified in LM-80 test report of LED

2) Check the Power Adaptor (Driver) Specifications to Withstand Abnormal Supply Conditions like Prolonged Over Voltage (>270V) / Under Voltage (<130V) / Surge Voltage (>2KV/ 4KV / 10KV / 20KV) / Surge Current (>5KA/10KA) :

- Abnormal Power Supply kills most LED Lights.
- Most common occurrences and related failures are of prolonged High Voltage beyond 270V, which exceed the Driver or Power supply units' standard performance band. – In order to protect from such conditions, either the Driver need to be equipped with High voltage cut-off & auto restore feature inbuilt or luminaire be provided with additional Overvoltage / Under Voltage Protection relay.
- Next common occurrence and related failures are of “Floating Neutral” or improper/ missing Neutral Grounding at Supply Distribution Transformer, which results in high Voltage between Phase and Neutral many times exceeding 360 – 440V. – In order to protect from such conditions too, either the Driver need to be equipped with High voltage cut-off & auto restore feature inbuilt or luminaire be provided with additional Overvoltage / Under Voltage Protection relay.
- Surge Voltages / Surge Currents: These are Transient low time but extremely high magnitude Surges caused by Lightning or Grid Switching. Surges can be between 2KV to 20KV or beyond, and with 5KA to 10KA current occasionally. : Protection against Surges is achieved by – (A) – Internal Surge protector (MOV) provided in Driver / Power Supply Unit or (B) – External Surge Protector (MOV / TMOV based and with / without Overvoltage relay / GDT / Fuse)

3) Check the Mechanical Construction of the Luminaire:

- Check Heat Sink adequacy – This is dependent largely on type of luminaire and it is up to the luminaire manufacturer to ensure the same. While some luminaires have direct exposed heat sink fins, others can depend on large surface area and increased volume

of air around the heat sink surface where LED PCBs are mounted.

- Ingress / Impact protection ratings of Luminaire - Ensure IP & IK ratings for correct application.