OCTA LIGHT BULGARIA Plc

BULLSTAR

SERIES

HIGHPOWER LED APPLICATION GUIDE

INTRODUCTION

Octa Light high power white LEDs are optimized to bring high performance and quality of light needed for today's wide range of lighting aplications, such as general, decorative, indoor, outdoor, idustrial or commercial lighting etc. In addition to delivering specified Correlated Color Temperature and Color Rendering combinations, BullStar series emitters deliver good efficacy, lifetime and reliability.

With all the advantages of the LED lighting in regard to the traditional light sources – like reduced energy consumption and greater luminous efficacy, LEDs are becoming an inevitable and very reliable replacement, leading the innovation in lighting industry.

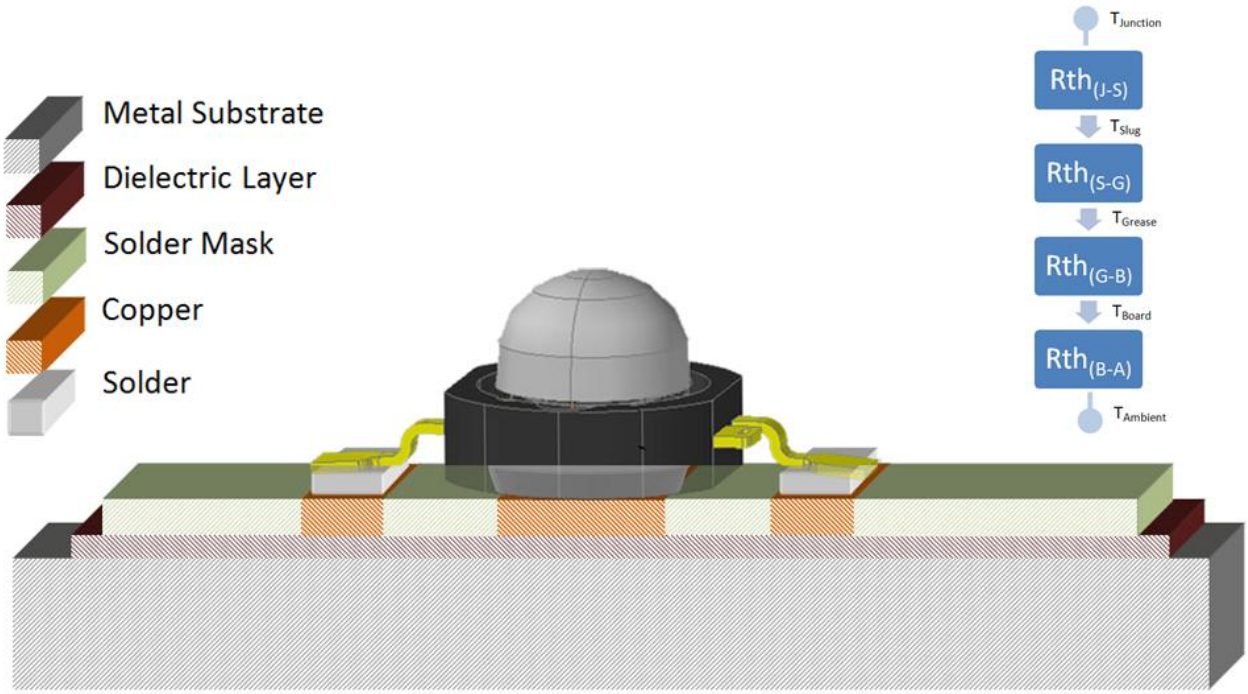
Since its appearance, Octa Light Bulgaria PLC is devoted to promote high brightness LEDs for use in the general lighting applications. This is the way we enable many custom designed and specific applications, which were not possible in the past.

This document contains data needed to design a good thermal application for Octa Light High Power LEDs.

TABLE OF CONTENTS

PRODUCT THERMAL APPLICATION INFORMATION

A good thermal application is a crucial feature in LED lifetime. An effective thermal design relies on heat conduction and dissipation. The conduction path depends on material properties while dissipation depends mainly on the contact area between heat-sink (metal substrate) and ambient . Therefore, it is important to provide a good heat extraction for the LEDs by reducing the contact resistance between the interfaces. So it's recommended that thermal grease with thickness of about 100 µm should be evenly applied to the termal pad, when assembling a LED on Printed Circuit Board (PCB) or heatsink carrier. Due to electrical connection present between anode and heat-sink, metal substrate (PCB thermal pad) should be electrically separated from the slug (heat-sink).



Thermal Resistance Calculations

$R_{thJ\text{-}A} = R_{thJ\text{-}S} + R_{thS\text{-}G} + Rth_{G\text{-}B} + R_{thB\text{-}A}$

$T_{Junction} = T_{Ambient} + R_{thJ\text{-}A} \times P_{diss}$

$(T_J = T_A + R_{thJ\text{-}A} \times P_{diss})$

$$R_{thx-y} = \frac{T_x - T_y}{P_{diss}}, [°C/W]$$

The thermal resistance between two points ***x*** and ***y*** is defined as the ratio of the difference in temperature to the power dissipated (P_{diss}). In LEDs thermal resistance

junction to ambient should be considered in order to be achieved a good thermal application.

R_{th} from LED junction to the thermal pad (Slug) is defined by the package parameters (R_{thJ-S}). For BullStar series this value is 9 ºC/W.

Thermal resistance between slug and ambient represents the thermal path from slug through thermal grease, board to ambient. It is defined as the sum of series resistances R_{thS-G}, R_{thG-B} and R_{thB-A}.

The following calculations refer to computing R_{th} for each part of LED assembled module:

1. **$R_{th\ J-S}$= 9 °C/W;**
2. **R_{thS-G}**

If the thickness of thermal grease is x=100um and area is A=$(3.04)^2\pi$ mm^2.
Thermal conductivity of thermal grease is k=2.4 W/mK.
The Formula is $\boldsymbol{R_{th} = \frac{x}{kA} = 1.4}$**°C/W;**

3. **R_{thG-B}**

The Rth of standard PCB is **1.5 °C/W;**

4. **R_{thB-A}**

The Rth between board and air is mainly dependent on the total contact area.
If Area is **30cm²** R_{thB-A} =16.7 °C/W;
R_{thJ-A} =9+1.4+1.5+16.7 =**28.6 °C/W;**
If Area is **60cm²** R_{thB-A} =8.3 °C/W;
R_{thJ-A} =9+1.4+1.5+8.3 =**20.2°C/W;**
If Area is **90cm²** R_{thB-A} =5.5 °C/W;
R_{thJ-A} =9+1.4+1.5+5.5 =**17.4°C/W.**

JUNCTION TEMPERATURE CALCULATION

The total power dissipated by the LED is :

$P_{diss} = If \times U_f\ [W];$

The Junction Temperature is calculated by:

$$T_j = R_{thJ-A} \times P_{diss} + T_A\ [°C];$$

For example, if BullStar LEDs are operated at room temperature (25 °C) under drive currents of If=350mA, with forward voltage U_f=3.2V, the temperature at the junction is:
T_J = 25 °C+ 17.4 x 1.12 = **44.5°C** (total contact area air-board =90cm2);
T_J = 25 °C+ 20.2 x 1.12 = **47.6°C** (total contact area air-board =60cm2);
T_J = 25 °C+ 28.6 x 1.12 = **57°C** (total contact area air-board =30cm2).

CURRENT DERATING CURVE FOR 350 MA DRIVE CURRENT

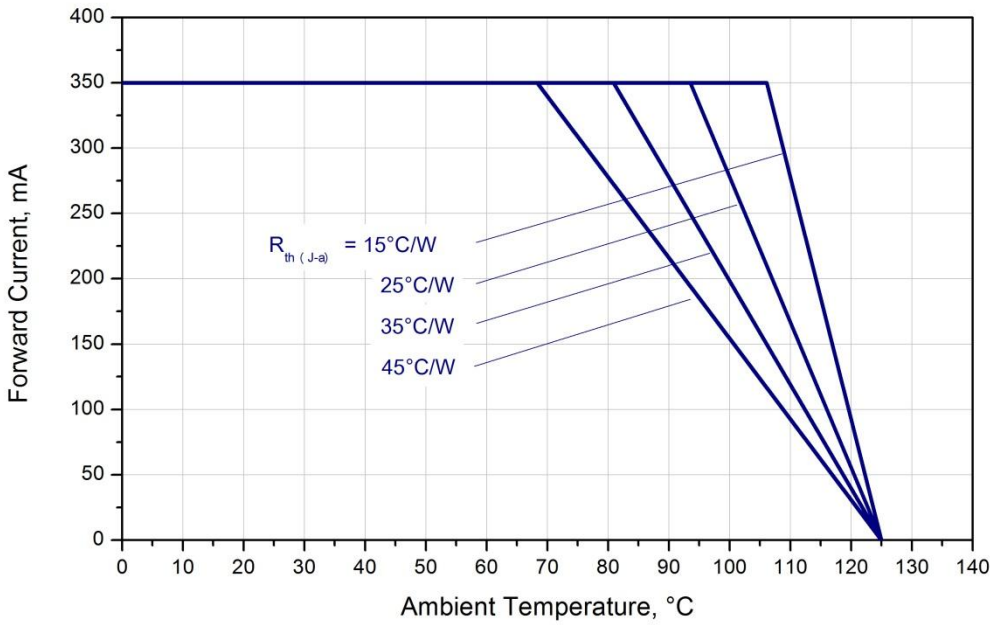


Figure 1. Maximum Forward current Vs. Ambient temperature based on T_{jMAX} = 125°C

CURRENT DERATING CURVE FOR 700 MA DRIVE CURRENT

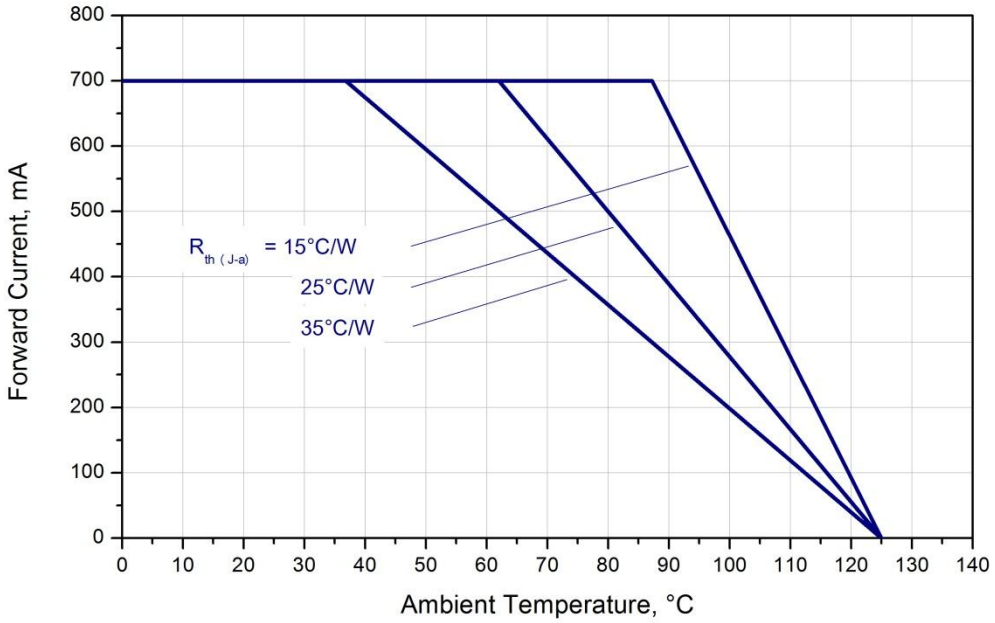


Figure 2. Maximum Forward current Vs. Ambient temperature based on T_{jMAX} = 125°C

Suggested Adhesive for Selection (such as thermal grease)

For the selection of a proper adhesive you can follow a few important rules:

- The adhesive should be non-solvent, one component is preferred
- The thermal grease should have low volatility and be fast tack free
- Adhesion should be very good to most materials without use of a primer
- The grease should have excellent thermal stability and cold resistance
- The adhesive should have good dielectric properties

Adhesive Specification	Suggested Properties
Specific gravity	< 3.2 g/cm^2
Thermal conductivity	> 2.4 W/mK
Take-free time	5÷10 minutes
R_{th} in using	< 1.4 °C/W
Volume resistance	> 1x10^{14}
Tensile strength	> 4 Mpa
Lap shear adhesion strength	> 200 N/cm^2

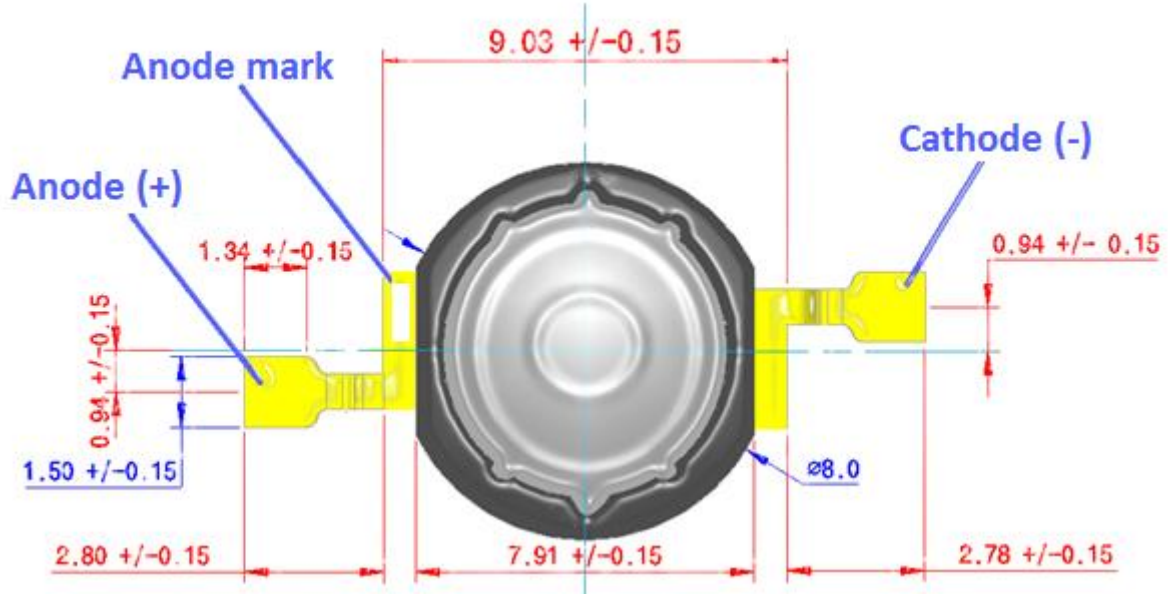
Table 1. Recomended adhesive properties

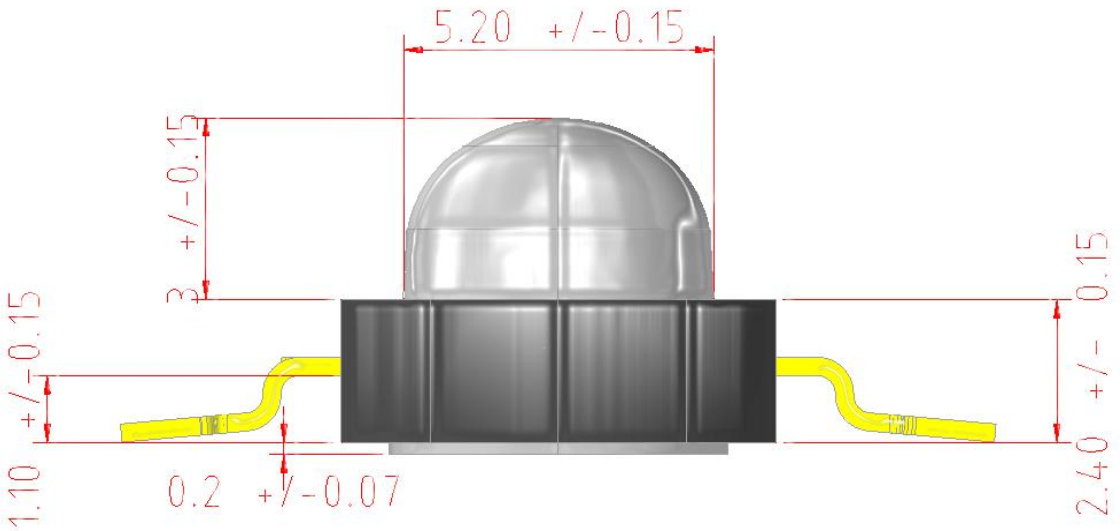
CORRECT PRODUCT APPLICATION

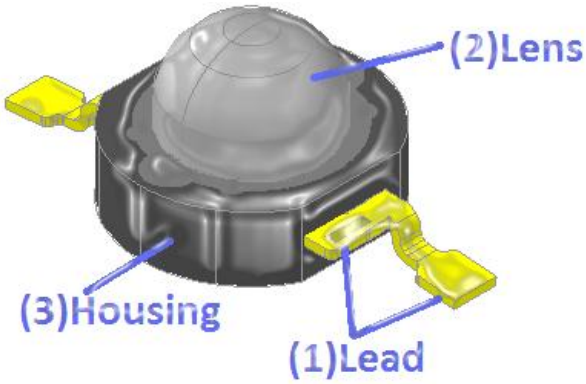
Here are some simple rules on how to protect the LED from overheating or physical damage to ensure their long term life.

- No external forces or pressure should be exerted on LED emitters
- When you are mounting the LED to a heat sink or PCB, pick up the LED by gripping the plastic body using tweezers. Avoid pressing or puncturing the silicone lens. When stress is applied on the silicone lens, it may damage optical properties and the internal electrical connections
- Thermal grease is applied evenly between the surface of heatsink and the slug (or Aluminum PCB)
- LED is well fixed on the heat sink. Use adequate screws if you are fixing an aluminum star PCB to the heat sink
- The surface temperature on aluminum PCB is kept under 70°C at thermal equilibrium
- The suppling source should be a constant current LED driver
- The input current should not exceed the absolute maximum ratings (per emitter) as specified in the datasheet
- The input voltage should not exceed the absolute maximum ratings (per emitter) as specified in the datasheet

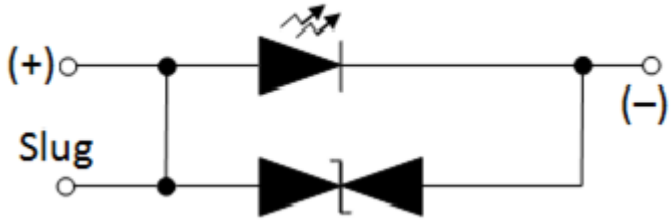
LED Package Dimensions and Polarity







Octa Light LED circuits



Notes:

1. All dimensions are in mm
2. Drawings are not to scale
3. It is strongly recommended to apply on electrically isolated heat conducting film between the slug and contact surfaces.

COMPANY INFORMATION

Octa Light Bulgaria Plc is the first Bulgarian Manufacturer of High Power Light Emitting Diodes for general lighting applications. The long year company experience in artificial lighting on LED basis has made possible the creation of the first European LED specially designed for reaching best performance in light output, optical efficacy and thermal management.

Octa Light Products help reduce CO_2 emissions and reduce the need for power plant expansion.

Thanks to its advances optical properties, the BullStar series enabe never before possible applications in outdoor, indoor, industrial, architectural and general lighting when pure white light is necessary. The sophisticated optical properties allow strong package light concentration suitable for most general lighting applications without the need of any secondary optics.

Octa Light is a fully integrated supplier, offering core Light emitting devices in all three base colors - red, green, blue and white, as well as exotic colors as pink, cyan, yellow, purple and other on basis of client requirements. Octa Light Bulgaria Plc is entirely based within Europe, with R&D and manufacturing centers in Bulgaria. Founded in 2010, Octa Light commits to continuously rise the lumen efficiency of its products and to bring its light emitting diodes closer to mass usage within next years.

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