Powerlux Technology Co., Ltd.

Thermal resistance design.
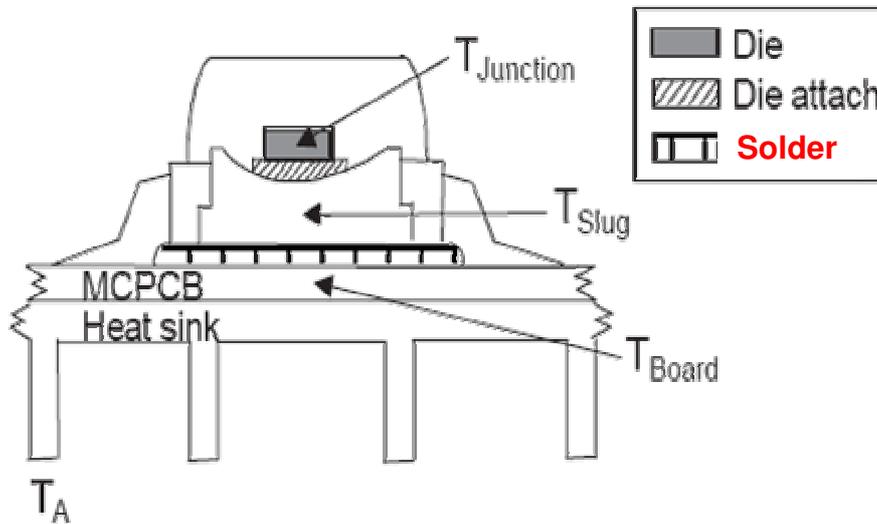
Thermal Resistance $Rth_{(J-A)} = Rth_{(J-S)} + Rth_{(S-B)} + Rth_{(B-A)}$
LED Junction Temperature $T_{Junction} = T_{Ambient} + Rth_{(J-A)} \times P_{Dissipation}$

A. Calculation of $Rth_{(J-A)}$

1. $Rth_{(J-S)} = 8\,°C/W$ for Powerlux 1W LED.
2. $Rth_{(S-B)} = Rth_{(Slug-solder)} + Rth_{(solder-MCPCB)}$
   If the thickness of solder is 200um and area is $(6.4/2)^2\pi$ mm^2.
   Thermal conductivity of solder is 20 W/mK.

   The Formula of Rth is

   $$\frac{Thickness(um)}{Thermal\ Conductivity\ (W/mK) \times Area(mm^2)}$$

   Therefore Rth(slug-solder) $= \dfrac{200}{20 \times (6.4/2)^2\pi} = 0.3\,°C/W$

$Rth_{(solder-MCPCB)} = 1.5\,°C/W$

$Rth_{(S-B)} = 0.3\,°C/W + 1.5\,°C/W = 1.8°C/W$

Please note Powerlux suggest to use solder instead of thermal grease. For thermal grease the thermal conductivity is around 2W/mK, which caused $Rth_{(slug-solder)} = 3\,°C/W$, and in some case there is bubble inside it which make Rth even higher.

3. Rth$_{(B-A)}$

The Rth between board and air is mainly dependent on the total surface area.

Therefore Rth$_{(B-A)}$ ≒ $\dfrac{500}{\text{Area (cm2)}}$

If Area is 30cm^2 Rth=16.7   Rth$_{(J-A)}$ =8+1.8+16.7 =26.5 ºC/W

If Area is 60cm^2 Rth=8.3   Rth$_{(J-A)}$ =8+1.8+8.3 =18.1 ºC/W

If Area is 90cm^2 Rth=5.5   Rth$_{(J-A)}$ =8+1.8+5.5 =15.3 ºC/W

Therefore, to increase heat sink surface will reduce Rth.

B. Calculation of Junction Temperature.

The total power dissipated by the LED is the product of the forward voltage (V_F) and

the forward current (I_F) of the LED.

The temperature of the LED junction is the sum of the ambient temperature and

the product of the thermal resistance from junction to ambient and the power

dissipated. $T_{Junction}$ =T_{Air} + Rth$_{(J-A)}$ x P$_{Dissipation}$

If one white Powerlux LED in room temperature (25ºC) operated 350mA and
V_F=3.3V,

the P$_{Dissipation}$=0.35 x 3.3=1.155W

And junction temperature is

$T_{Junction}$ = 25ºC+ 15.3 x 1.155 = 42.67ºC (total surface area =90cm^2)

$T_{Junction}$ = 25ºC+ 18.1 x 1.155 = 45.90 ºC (total surface area=60cm^2)

$T_{Junction}$ = 25ºC+ 26.5 x 1.155 = 55.61 ºC (total surface area =30cm^2)

Please note Junction temperature will impact LED life, we strongly recommend to
keep the junction temperature as low as possible!