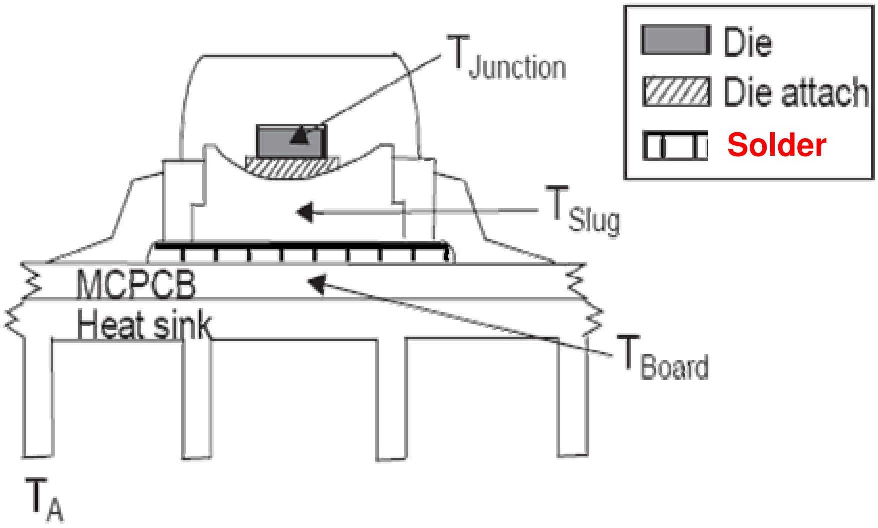
Thermal resistance design.



Thermal Resistance $Rth_{(J\text{-}A)} = Rth_{(J\text{-}S)} + Rth_{(S\text{-}B)} + Rth_{(B\text{-}A)}$

LED Junction Temperature $T_{Junction} = T_{Ambient} + Rth_{(J\text{-}A)} \times P_{Dissipation}$

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

1. $Rth_{(J\text{-}S)}$ = 8 ºC/W for Powerlux 1W LED.
2. $Rth_{(S\text{-}B)} = Rth_{(Slug\text{-}solder)} + Rth_{(solder\text{-}MCPCB)}$

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

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

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

$Rth_{(solder\text{-}MCPCB)}$ = 1.5 ºC/W

$Rth_{(S\text{-}B)}$ = 0.3 ºC/W+1.5 ºC/W=1.8ºC/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 ºC/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.

$$\text{Therefore } Rth_{(B-A)} \fallingdotseq \frac{500}{\text{Area (cm2)}}$$

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. $T_{Junction} = T_{Air} + Rth_{(J-A)} \times P_{Dissipation}$

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!