1 目的：應用熱阻方式，計算風扇驅動 IC 之設計安全性。
Purpose: Using in thermal resistance, to confirm the safety of driver IC in fan application.

2 方法：應用熱阻計算公式，反推晶圓溫度是否使用到極限。
Method：Using the thermal resistance formula, to calculate the junction temperature of die, to check this application is safe or not.

參數說明：
Parameter illustrate

晶圓接面溫度: 晶圓接面的溫度，套用熱阻公式計算得出。
T_j: the junction temperature of die, be calculated by thermal formula.

最大晶圓接面溫度: 晶圓可承受最高溫度，此參數記錄在規格書上。
$T_{j(max)}$: the maximum junction temperature of die, the value indicate in data sheet.

IC 封裝熱阻: 晶圓接面到膠體表面的熱阻係數，此參數記錄在規格書上。(不同的封裝有不同的熱阻)
θ_{jc}: the thermal resistance of junction-case by assembly, the value indicate in data sheet. (various packages have various thermal resistance)

IC 消耗功率: IC 的消耗功率，量測運轉相關的電壓、電流和週期，計算得出 IC 的消耗功率。需在此應用的最大操作電壓及最高操作溫度下進行波形量測。
P_d: the power dissipation of IC, via measure voltage, current and period, to calculated the power consumption of IC when it is working. To obtain these waveform , need at the maximum operating voltage and ambient temperature,.

IC 消耗功率計算如下：實際量測相關的電壓、電流、週期等數據，帶入下列算式。
Calculated P_d method: to measure related to voltage, current and period etc. bring the below formula.

$$P_d = P_1 + P_2 + P_3$$

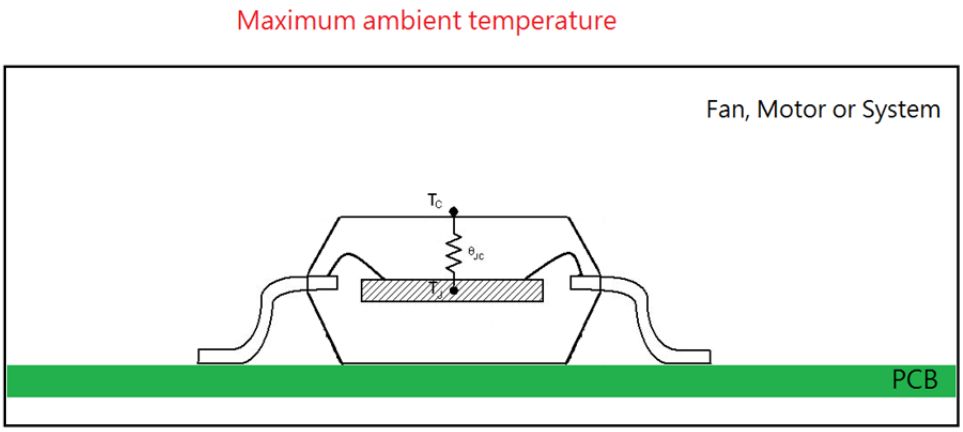
$$P_1 = V_{supply\ IC} \times I_{supply\ IC}$$

$$P_2 = V_{output\ ON} \times I_{coil}$$

$$P_3 = V_{peak} \times I_{peak} \times \frac{T_{peak}}{T_{1pole}}$$

IC 表面溫度: IC 的表面溫度。IC 因工作使得表面溫度昇高，使用工具測量其值。需在此應用最大操作電壓及最高操作溫度下進行溫度量測。
T_C: Case temperature of IC. While the IC is working, its temperature will increase. We use tool to catch case temperature of IC, and need at the maximum operating voltage and ambient temperature,.

圖示：
Figure:



3 判定：由計算結果確認此設計是否安全。
Judgment: Confirmed by the calculation results if the design is safe.

由θ_{jc}、P_d和T_C計算實際的T_j，如下公式，比較是否有超出最大T_j值。
To calculate T_j by θ_{jc}、P_d and T_C, as below formula, confirmed whether the value exceed the maximum T_j.

$$T_j = P_d \times \theta_{jc} + T_C$$

若$T_j > T_{j(max)}$，表示設計不安全。
若$T_j < T_{j(max)}$，表示設計安全。
If $T_j > T_{j(max)}$, then this design isn't safe.
If $T_j < T_{j(max)}$, then this design is safe.

註：有些公司考量到產品壽命和降低失效率等原因，會使用減額定的方式管制。減額定的參數每間公司定義不同，依公司品質政策決定。
PS: Some company consider the reason of product life and reduce the failure rate etc., using derating method to control. Any company determine various derating parameter, its determined in accordance with the company's quality policy.