Thermal Design of NCSU275 (U405) LEDs

1. Objective
   The LEDs’ light output can be affected by the heat generated from the LEDs/LED-assembled products. Also, the reliability performance can be seriously degraded, if the LEDs are operated over the absolute maximum rated junction temperature (Tj).

   It is critical to design the heat dissipation performance not to exceed the Tjmax for NCSU275, to deliver high reliability/performance.

   This document shows the Tj evaluation results by demonstrating two heat dissipation conditions. Please use the data for reference to your thermal design.

2. Tj Calculation
   Tj can be calculated by the following formula:

   \[ Tj = Ts + R_{thj-s} \times PD \]

   Tj: Junction Temperature
   Ts: Soldering Temperature (°C)
   R_{thj-s}: Thermal resistance (°C/W) from the die to the Ts measuring point
   * R_{thj-s} (NCSU275): 10.5°C/W
   PD: Input Power (W)

3. Ts Measuring Point

4. Tj Evaluation Result

   Example 1. Copper Board + Heat Sink B

<table>
<thead>
<tr>
<th>I_{F} (A)</th>
<th>T_{S} (°C)</th>
<th>V_{F} (V)</th>
<th>T_{j} (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>40.3</td>
<td>3.6</td>
<td>59</td>
</tr>
<tr>
<td>0.7</td>
<td>46.2</td>
<td>3.8</td>
<td>74</td>
</tr>
<tr>
<td>1.0</td>
<td>58.0</td>
<td>4.1</td>
<td>101</td>
</tr>
</tbody>
</table>

   Example 2. Copper Board + Heat Sink C

<table>
<thead>
<tr>
<th>I_{F} (A)</th>
<th>T_{S} (°C)</th>
<th>V_{F} (V)</th>
<th>T_{j} (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>37.6</td>
<td>3.6</td>
<td>57</td>
</tr>
<tr>
<td>0.7</td>
<td>43.1</td>
<td>3.8</td>
<td>71</td>
</tr>
<tr>
<td>1.0</td>
<td>52.3</td>
<td>4.1</td>
<td>95</td>
</tr>
</tbody>
</table>
5. Heat Dissipating Materials

Metal-based Board: Copper, 30mm × 30mm × 1.7mm
Heat Sink B: 50mm × 38mm × 25mm (H), Base Thickness: 5 mm, Fin: 8 pcs.(1mm × 38mm, Array: 1 × 8)
Heat Sink C: 54mm × 54mm × 35mm (H), Base Thickness: 4mm, Fin=64 pcs.(0.8mm × 9mm, Array: 5 × 13)

Note
We specified the absolute maximum ratings for NCSU275; \( I_F = 0.7 \text{A} \) and \( T_{\text{max}} = 130^\circ \text{C} \).
We cannot guarantee the usage over these ratings.
We appreciate your understanding and cooperation.