Thermal Design of NCSU03xx LEDs

1. Objective
The light output of LEDs is reduced under the influence of heat generation. When LEDs are operated over the absolute maximum junction temperature ($T_{j\text{max}}$), the performance is severely degraded. It is critical to design the heat dissipation not to exceed the $T_{j\text{max}}$ for NCSU03xx to achieve a high reliability and a high performance. This document provides the $T_j$ evaluation results under two conditions by using different heat sinks. Please use the data as reference for NCSU03xx's thermal design at your site.

2. $T_j$ Calculation
$T_j$ can be obtained by the following formula:

$$T_j = T_s + R_{thj-s} \times P_D$$

where,
- $T_j$: Junction Temperature [°C]
- $T_s$: Soldering Temperature [°C]
- $R_{thj-s}$: Thermal resistance between the LED die and the $T_s$ measuring point [°C/W]
- $P_D$: Input Power [W]

* The $R_{thj-s}$ of NCSU03xx is Typ: 4.4 [°C/W] (Max: 7.3 [°C/W])

3. $T_j$ Measurement Result

Ex.1 Aluminum Board

<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>75</td>
<td>3.57</td>
<td>83</td>
</tr>
<tr>
<td>0.7</td>
<td>95</td>
<td>3.63</td>
<td>106</td>
</tr>
</tbody>
</table>

Ex.2 Aluminum Board + Heat Sink

<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>54</td>
<td>3.62</td>
<td>62</td>
</tr>
<tr>
<td>0.7</td>
<td>66</td>
<td>3.70</td>
<td>77</td>
</tr>
</tbody>
</table>

4. Heat Dissipation Materials
- Metal-based board; Aluminum, Dimension; 30mm × 30mm × 1.6mm
- Heat Sink: 30mm × 30mm × h=20mm, Depth: 4mm, Fin; 64 pcs. (Dimension of Fin: 1.4mm × 2mm, Structure: 8 × 8)

Note: Absolute Maximum Ratings
Nichia specifies the absolute maximum ratings for NCSU03xx as $I_F=0.7A$ and $T_{j\text{max}}=130°C$. We cannot assure the performance of the LEDs if they are used above the specified temperature and $I_F$. Thank you very much for your cooperation.

This sheet contains tentative information, we may change contents without notice.

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