

## Thermal Design of NVSU333A (U405) LEDs with Water Cooling System

### 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 ( $T_j$ ).

It is critical to design the heat dissipation performance not to exceed the  $T_{jmax}$  for NVSU333A, to deliver high reliability/performance.

This document shows the  $T_j$  evaluation results by demonstrating two heat dissipation conditions with a water cooling system. Please use the data for reference to your thermal design.

### 2. $T_j$ Calculation

$T_j$  can be calculated by the following formula:

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

$T_j$ : Junction Temperature

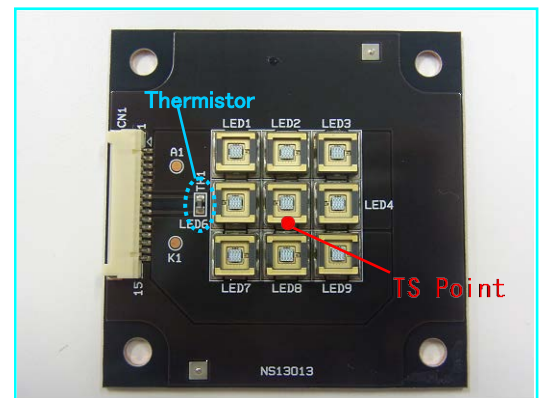
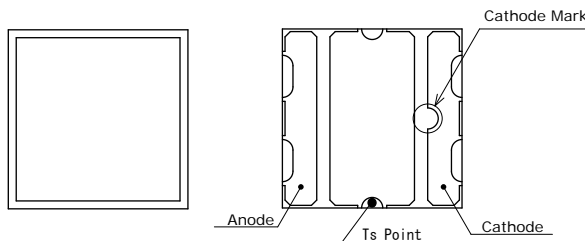
$T_s$ : Soldering Temperature ( $^{\circ}C$ )

$R_{thj-s}$ : Thermal resistance ( $^{\circ}C/W$ ) from the die to the  $T_s$  measuring point

\*  $R_{thj-s}$  (NVSU333A):  $2.08^{\circ}C/W$

$P_D$ : Input Power (W)

### 3. $T_s$ Measuring Point



Picture 1  $T_s$  Measuring Point

The thermocouple was solder-attached to the  $T_s$  measuring point for the evaluation. (Board Size:  $60\text{mm} \times 60\text{mm} \times 1\text{mm}$ )

### 4. $T_j$ Evaluation Result

Type of Board	$I_F$ (A)	Thermistor ( $^{\circ}C$ )	$T_s$ ( $^{\circ}C$ )	$V_F$ (V)	$T_j$ ( $^{\circ}C$ )
Cu	3.5	25	34	3.85	62

### 5. PCB Specifications

Type of Board	Land Pattern ( $\mu\text{m}$ )	Insulating Layer ( $\mu\text{m}$ )	Heat Conductivity ( $W/(m \cdot K)$ )	Board Thickness (mm)	Notes
Cu	35	120	10	1	The thermal pad is not in contact with the copper base.

## 6. Heat Dissipating Conditions

Input Current [A]	Temperature [°C]	Water Flow [L/min.]	Cooling Heat Sink	LED Pitch [mm]	Internal Circuit	Interface between Heat Sink and Board	
						Thermal Conductivity [W/(m·K)]	Material
3.5	18	2.5	Oxygen-free copper 60mm×60mm×10mm	8.2	9 LEDs connected in series	0.9	Grease

### Note

We specified the absolute maximum ratings for NVSU333A;  $I_F=4.5A$  and  $T_{jmax} = 100^{\circ}C$ .

We cannot guarantee the usage over these ratings.

We appreciate your understanding and cooperation.