

DLC SOLID-STATE LIGHTING RESOURCES:

Testing Tightly Packed Arrays of LED Packages

For projections of lumen maintenance via TM-21 testing, the DLC generally requires thermal testing of the hottest LED package/module/array in a product (luminaire, lamp, or retrofit kit) in the *In-Situ Temperature Measurement Test (ISTMT)*. Manufacturers and test labs are expected to understand the thermal dynamics of the products they design and test, to identify and measure the hottest LED at the LM-80 designated temperature measurement point (TMP) of that LED, and, if necessary, to provide rationale and documentation of how the hottest LED was determined.

The DLC understands that in some circumstances and with certain product designs, it may not be possible to directly measure the temperature of the hottest LED at the appropriate TMP. In such cases, the general Testing Constraints policy (available on p. 28 of the V5.1 Technical Requirements Tables) applies, and DLC is willing to consider proposals from submitters for how to accurately assess the relevant temperature for lumen maintenance calculations.

A common circumstance that prevents temperature measurement at the appropriate LED is when a relatively large number of LEDs are placed on module or board such that they are adjacent, creating a tightly packed array, as shown in **Figure 1** below.

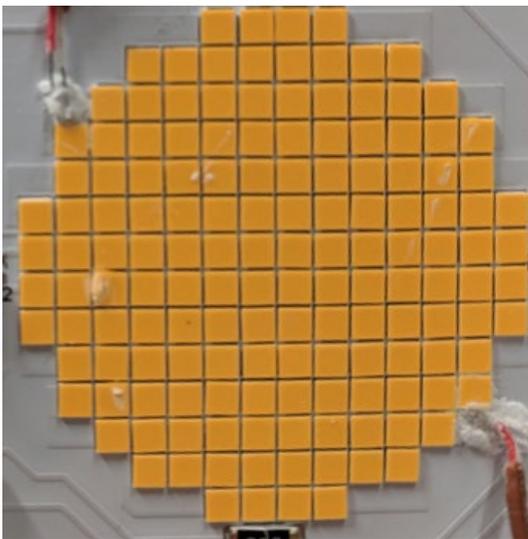


Figure 1: Example of tightly packed array of LEDs

HIGHLIGHTS

- ▼ Outlines an alternative approach for thermal testing of products with tightly packed LED arrays.
- ▼ Defines circumstances in which it is appropriate to test products using the alternative approach.

In such circumstances, it is expected that the hottest LEDs will be the ones in the center of the array; however, the presence and proximity of the other LED packages may make it impossible to place a thermocouple at the correct TMP location of the hottest LED.

The DLC recognizes that in these circumstances, while it is impossible to measure the hottest LED at the LM-80 designated TMP as described in the Technical Requirements, this design feature should not preclude a product from being listing on the QPL.

Alternative testing method for tightly packed LED arrays

For product designs with tightly packed LED arrays, the DLC will accept a calculation of the estimated hottest temperature LED using the following method:

1. The temperature of an accessible LED package (in the outer ring of the array) must be measured at the relevant TMP location, in accordance with typical DLC *ISTMT* procedures.
2. A thermal image of the array must be taken and used to calculate the temperature difference between the accessible LED (on the edge of the array), and the hottest LED (expected to be in the center of the array), as shown in **Figure 2**. The TMP for the accessible LED and the hottest LED must be in the same location relative to the LED.
3. The temperature difference must be added to the measured temperature of the accessible LED to estimate the temperature of the hottest LED. This calculated temperature will be used for lumen maintenance projections via TM-21.

When using this method, test reports or supplemental materials must clearly document the actual measured LED temperature, show the thermal image and calculated temperature difference, and display the estimated temperature of the hottest (center) LED.

Please note that DLC will not accept absolute temperature measurements via thermal imaging. Only temperature differences are derived from the above approach, which are then applied to the accessible LED temperature as measured in typical DLC *ISTMT* procedures.

The DLC reserves the right to ask for additional details or seek additional clarification for applications that use this alternative method. The DLC reserves the right to modify this alternative path at any time and plans to align with new Technical Requirements and industry standards that address this testing limitation as they are published. Questions on this approach should be sent to applications@designlights.org.

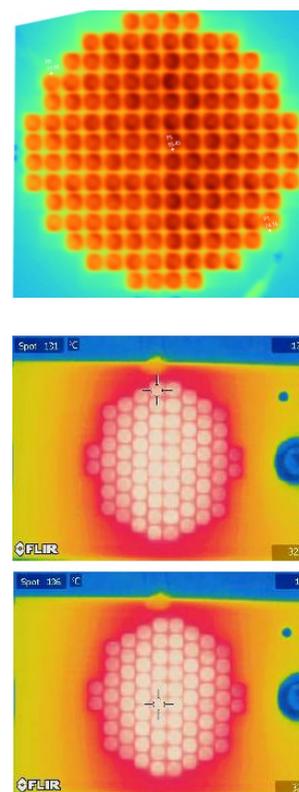


Figure 2: Examples of acceptable thermal images for tightly packed arrays