ANSI/IES/IUVA LM-92-22

Illuminating
ENGINEERING SOCIETY

APPROVED METHOD:
OPTICAL AND ELECTRICAL MEASUREMENT OF ULTRAVIOLET LEDS

AN AMERICAN NATIONAL STANDARD

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Publication of this document has been approved by IES. Suggestions for revisions should be directed to IES.

Prepared for IES
IES Testing Procedures Committee

Approved by the IES Standards Committee, February 28, 2022, as a Transaction of the Illuminating Engineering Society.

Approved March 10, 2022, as an American National Standard.

Published by the Illuminating Engineering Society, 120 Wall Street, New York, New York 10005.

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Printed in the United States of America.

ISBN# 978-0-87995-419-2

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1.0 Introduction and Scope

1.1 Introduction

This document is a guide developed for the measurement of ultraviolet (UV) light emitting diodes (LEDs), normally in the form of an LED package, array, or module. This document provides uniform methods for operation of UV LEDs and test methods for optical and electrical measurements of UV LED output at a given junction temperature in a continuous-pulse mode, and provides the grounds for specification of UV LEDs at high temperature conditions. The continuous-pulse mode of measurement provides a radiant efficiency (optical power [watts] divided by electrical power [watts]) at a given peak current for a given junction temperature, which allows the calculation of optical power output for a given electrical power input at a specific junction temperature.

The UV optical output of an LED depends on its thermal conditions, in particular, the junction temperature, T_J. Manufacturers of visible-range emitting LEDs normally use single-pulse operation for quality control and binning, whereby LEDs are measured with no heat sink and with the underlying assumption that the junction temperature under these conditions is equal to the room temperature, typically 25 °C. Therefore, published LED specifications are normally for a junction temperature of 25 °C. Furthermore, under a single-pulse mode of operation (often lasting tens of milliseconds) the junction temperature may increase significantly; therefore, the resulting efficiency may correspond to a much hotter junction temperature than the reported 25 °C.

UV LEDs in actual products, however, are typically operating in direct current (DC) and at much higher temperatures (the junction temperature typically ranges from 60 °C to over 100 °C). At these temperatures their emitted flux tends to deviate significantly from what it is under the room temperature condition of 25 °C. Thus, UV product manufacturers often need to know the performance of UV LEDs operating at full rated DC current, and at a thermal equilibrium temperature much higher than 25 °C. To set or measure thermal conditions of the UV LED, case temperature, pin temperature, board temperature, solder-point temperature, or heat sink temperature is commonly used, depending on the type of UV LED. While these methods are useful to reproduce the same condition for the particular LED, the results using these different methods cannot easily be compared with each other and cannot be reconciled into a universal standard method. Due to the optical characteristics of UV LEDs and their dependence on junction temperature, the only way to obtain reproducible results universally for all types of UV LEDs is by setting them to a specified junction temperature. The test method described in this document sets the UV LED under test to a pre-determined junction temperature for measurement under a continuous-pulse mode of operation. Such a method can establish equivalence of results between the pulse mode operation (normally performed by UV LED manufacturers) and the DC mode operation in products.

The radiometric information typically required for UV LEDs to be used in products includes total radiant flux (watts, or joules per second), centroid wavelength, peak wavelength, and bandwidth. For the purpose of this document, the determination of these values is referred to as *optical measurement*.

The electrical characteristics typically required for UV LEDs to be used in products are peak input current, forward voltage, and input power. For the purpose of this document, the determination of these values is referred to as *electrical measurement*.

1.2 Scope

This document describes the procedures to be followed and precautions to be observed in performing measurements of total radiant flux (total radiant power), electrical power, and wavelength characteristics of ultraviolet (UV) light emitting diodes (LEDs). This document covers measurement of UV LEDs in the wavelength range of 200 nm to 400 nm* under continuous-pulse operation. Where the term "thermal condition" is used with respect to a UV LED, this refers to the junction temperature.

* LEDs with wavelengths longer than 360 nm are covered in ANSI/IES-LM-85-20.[1]