



**Federal Communications Commission
Office of Engineering and Technology
Laboratory Division**

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RADIO FREQUENCY LED LIGHTING PRODUCTS

INTRODUCTION

This document provides guidance on FCC Equipment Authorization and Compliance testing for LED Lighting Products, including fixtures and assemblies, etc. In this context, the term RF LED (Radio frequency light-emitting diode) lighting is used for a device that has the primary function of generating light by electrically powering LEDs with a switching power supply using RF frequencies (in the range defined as RF by FCC rules). Such light generation is commonly intended for illumination, and includes a variety of other signaling applications.

This KDB publication discusses the radiated emission limits from 30 MHz to 1000 MHz for RF LED lighting devices subject to Section 15.109, and provides details on how to ensure overall compliance with radiated emissions requirements.

BACKGROUND

RF LED lighting products are subject to FCC rules to ensure that devices do not cause harmful interference¹ to radiocommunications services. This KDB publication clarifies how the FCC rules apply to LED lighting devices, and outlines manufacturers' responsibilities for controlling interference. This publication does not address older legacy lighting technologies such as incandescent, fluorescent, and high intensity discharge (HID) lighting products.²

RF LED lighting devices intentionally generate RF energy for *ac/dc* electronic power conversion, sometimes including digital circuitry, but are not intended to emit RF energy by radiation or induction, and thus they are classified as unintentional radiators according to the FCC rules.³

RF LED lighting products typically employ single or multiple LED chip arrays, LED light modules, or LED "light engines", but can also include organic LEDs (OLEDs), polymer OLEDs, and quantum dots.

¹ See 47 CFR. § 15.3(m).

² Other lighting devices, such as fluorescent lighting devices, and LED double capped retrofit tubes (TLEDs) intended to replace linear fluorescent tubes operated by RF ballasts, are subject to compliance requirements under Part 18 and are not addressed in this guidance document. Incandescent lamps are not considered RF devices. Also, LED lamps powered by internal direct current (DC) power sources, without RF circuitry (operating at greater than 9 kHz), with a passive LED array load and delivering only DC current to LEDs, are not considered RF devices. Large LED digital displays are considered digital-device peripheral equipment subjected to FCC Part 15B.

³ For definitions of LED lighting products, see, e.g., Energy Star® Program Requirements, Product Specification for Luminaires, https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pd and ANSI/IES RP-16-10.

In most cases, RF LED lighting devices are configured using an independent or an integrated electronic LED driver, operating at RF frequencies similar to those used in digital electronic products. As such, electronic LED drivers independently marketed and sold are required to be evaluated for compliance under “four-corner” load conditions. This entails using a synthetic load for changing the electronic LED driver under output to ensure that the maximum emissions are identified and reported. Accordingly, there are four industry-established, test load conditions for LED drivers: maximum output voltage with minimum operating output current, maximum output current with minimum operating voltage, maximum operating output power (maximum voltage and current), minimum operating output power (minimum voltage and current).

For other LED lighting products, such as dimmable self-ballasted LED bulbs, LED rope lights, LED light strip luminaires, decorative LED entertainment, still LED advertising lighting signs, LED pole mount streetlamps, or ceiling fan LED light luminaires, it is recommended to explore the specific light output settings that produce maximum emissions for the device under test. In some cases, LED devices produce highest emissions under either maximum or minimum (dimmed) light output configurations or settings. For this reason, the aforementioned “four corners” LED test configurations are required to identify the configuration that produces maximum emissions, and also needs to be tested within a representative test fixture.

LED devices are subject to Part 15 Subpart B Section 15.107 (line-conducted) and 15.109 (radiated) emission limits, for which the Supplier’s Declaration of Conformity (SDoC, Section 2.906) equipment authorization procedures apply, that include optional certification, per § 2.906(c).

GENERAL CONDITIONS OF OPERATION

Part 15 requires that unintentional radiators operate without causing harmful interference⁴, and that manufacturers and users should therefore ensure that lighting devices cease operation if harmful interference occurs.⁵

To help mitigate interference from lighting devices to authorized radio services, all responsible parties in the production and installation process (from manufacturers, to third-party product assemblers, to installer) are shall tailor their process operations by including the following:

- use best EMC engineering practices for design, construction, and installation
- meet or exceed Part 15 required attenuation of unwanted emissions
- when applicable, consider extending compliance testing beyond the 10th harmonic, in a similar fashion to 15.33 (see discussion in the following “Measurement Guidance” section
- describe interference mitigation techniques applicable to the specific device at hand in user’s manual⁶.

MEASUREMENT GUIDANCE

Frequency Range of Radiated Emissions Measurements. In many interference cases involving RF LED lighting devices, the specified operating frequency of the lighting device was found in a frequency range even past the 10th harmonic of the highest fundamental frequency used in the device. This is typically due

⁴ See 47 CFR § 15.5.

⁵ For devices subject to the verification procedure, the manufacturer, or in the case of imported equipment, the importer, is responsible for ensuring compliance. See 47 CFR § 2.909(b).

⁶ See 47 CFR § 15.15.

to the waveform of the electric current in the device, leading to “broadband” radiated and conducted emissions.

For this reason, this KDB guidance requires that all RF LED lighting devices, even those that have been considered to operate on frequencies below 1.705 MHz⁷, are required to have radiated emissions measurements performed at a minimum from 30 MHz to 1000 MHz, to adequately demonstrate compliance with the Section 15.109 radiated emission limits.

Change Notice:

04/26/2022: 640677 D01 RF LED Lighting v01 is being replaced by 640677 D01 RF LED Lighting v02. The revision clarifies using LED drivers into "four-corner" output load conditions, varying the output setting using representative test fixtures for luminaires.

⁷ Section 15.33(b) of the FCC Rules specifies when radiated emissions measurements are needed based on the highest frequency generated or used in the device. When the device’s internal frequency is less than 1.705 MHz, the Part 15.33 requires to perform radiated emissions measurements only up to 30 MHz. However, there have been demonstrated cases where broadband emissions originating from RF LED lighting devices well above 30 MHz.