Advanced test equipment enables LED lighting manufacturers to ensure compliance with standards

This article provides an overview of the relevant industry standards for LED lighting products. It also describes how advanced test equipment helps ensure that LED lighting products meet all necessary parameters for performance, energy efficiency, consumption verification, and safety certification

Standard and specification for solid-state lighting

Updated in 2019 (the first time since 2008), ANSI/IES LM-79-19 is the standard and specification for solid-state lighting. In addition to specifying optical measurements (lumens, chromaticity, luminous flux, etc.), LM-79-19 includes stringent system efficacy specifications. For LED lighting, the relevant parameters fall under "AC Power Supply Standards" (sections 5.1-5.3).

The LED driver can be integrated into the LED lighting fixture itself. In this case, the input power coming into the luminaire's LED driver (power supply), as well as its output power, must be measured using test equipment to compute system efficiency.

Standard and specification for LED drivers

Updated in 2015, ANSI C 82.16-15 is a mandatory standard and specification for the methods and measurement of LED driver input and output parameters.

Voluntary energy initiatives

In addition to mandatory EIS and ANSI standards/specifications, LED lighting is often tested to meet voluntary national and state certification programs and initiatives that enable energy savings. These national and state programs/initiatives have different objectives and requirements, each with precise measurement and unique submission requirements to assure compliance. Those that deal with LED lighting include:

- Energy Star: EPA/DOE programs. Minimum luminous efficacy (LED power <10W, 50 Lm/W; >= 10W; 55 Lm/W).
- LED Lighting Facts: A DOE program that is mandatory for Energy Star.
- Design Lights Consortium (DLC): Utility-based programs. SSL Technical Requirements V5.1 (80-120 Lm/W, minimum efficacy), decided by product type (LED lamp, outdoor lighting, etc.).
- California Energy Commission (CEC): Mainly energy efficiency. Standby power 200mW or less; PF 0.7 or greater.
- MSSL (Municipal Solid State Street Lighting): DOE program focusing on outdoor lighting (streetlights, parking lots and garages, etc.).

When an LED lighting product completes qualification for one of these programs/initiatives, a label appears on the product packaging to show that the specification has been met (e.g., light output per watt, etc.).

International standards

The International Electric Commission (IEC) provides international standards that bring together the agreed-upon set of rules, specifications, and terminology that allow manufacturers to have their devices tested for conformity. The following specifications are relevant for testing LED lighting systems:

- **Power consumption testing**
  - The EN50564:2011, which replaces the IEC62301 specification, specifies test procedures for low-power consumption equipment and offers guidance for specifying the measurement equipment, such as power analyzers, used for such tests. It describes how to test products with a supply voltage between 100V

and 250V AC. It may also apply to 3-phase equipment. It may be used in conjunction with other standards for measuring energy efficiency, such as Energy Star and EU standby Power directives.

- **Harmonics testing**
  - EN 61000-3-2 test standard specifies the limits of harmonic components of the input current that may be produced by equipment tested under specified conditions (Class C of the specification is for lighting devices).
  - IEC 61000-3-12 deals with the limitation of harmonic currents injected into a system, such as a lighting system or electronic ballast.
  - IEC 61000-4-7 is applicable to instrumentation intended for measuring spectral components in the frequency range up to 9kHz, which are superimposed on the fundamental of the power supply systems at 50Hz and 60Hz.

Using test equipment during product development

There are four key parameters for LED products: performance, energy efficiency, consumption verification, and safety. To ensure a LED product will pass UL, TUV, Intertek, and SA testing, engineers and technicians need to analyze these parameters during each phase of product development, from design to final test.

As shown in the table, power analyzers, electronic DC loads, high potential (hipot) testers, and high voltage switches can be used to check compliance.

- **Power Analyzers:** Advanced test equipment, such as Vitrek's PA900 power analyzer, can be used to measure LED lighting parameters during the design, production, and verification phases of the product's development. The compact, small-footprint, lightweight PA900 device is easy to handle. It also meets the updated LM-79-19 specification for the higher K=2 accuracy requirements. Examples of the PA900's capabilities are as follows:
  - **LED Driver Efficiency Testing:** The PA900 works as a virtual power analyzer, providing the ability to integrate separate power analyzer functionality into a single instrument. In this way, the power analyzer calculates the output/input power of the LED driver by showing output, loss, and driver efficiency on its display screen.
  - **Standby Power Testing:** The smart lighting fixture itself can be turned off while its electronics are being constantly energized to communicate over the internet or to an app. To simplify LED lighting compliance testing, the PA900 has the portion of Energy Star's EN50564:2011 5.3.2a specification for standby power built into the unit.
  - **Harmonics Emissions Testing:** The PA900 also has the EN61000-3-2, 3-12 and 4-7 specifications for harmonics built into the unit.
- **Electronic DC Load:** LED drivers (basically, the power supplies) for LED lighting products need to maintain a constant current even if the load increases. An electronic DC load can be used to check performance and energy efficiency parameters for LED lighting during the product's design and production phases of development. Where an LED lighting product is installed, test equipment, such as the DL Series DC load, can be used to detect if the current is stable and luminous intensity (luminous flux) stays within reason even if the load changes.
- **Hipot Testers and High Voltage Switch:** In addition to pre-certification compliance testing, electrical safety (hipot) testers can be used during the final product testing phase to confirm the devices meet safety standards. High-performance testers, such as V7X series and 95X series hipot testers, can perform various tests, including AC hipot, DC hipot, along with insulation resistance, continuity, and ground bond. Additionally, a high voltage switch can be used along with hipot testers during the final test phase of product production, thereby enabling rapid testing of multiple units.

Summary

As discussed in this article, highly functional, user-friendly test equipment is ideally suited for testing LED products for energy efficiency, performance, and safety compliance. Using advanced test equipment during product development enables manufacturers and engineers to ensure that their LED lighting products will comply with all necessary lighting standards, specifications and initiatives prior to reaching the certifying agency.

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Parameters		Test Phase	Test Equipment
Performance	Photometry (lighting measurements): lumens, chromaticity, luminous flux	Design	Power analyzer, electronic DC load
	Electrical (voltage, current, power)		
Energy Efficiency	Luminous efficacy: the amount of electrical input power vs. the amount of light power coming out on the other end of the fixture	Design / Production	Power analyzer, electronic DC load
	Energy efficiency of LED drivers		
Verification (Consumption)	Consumption: e.g., hooking up LED lighting device to a power analyzer to monitor power over a certain time period	Production	Power analyzer
Safety Certification	Shock hazards, fire, and health concerns	Final Test	Hipot tester, high voltage switch