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Energy Savings with Fluorescent and LED Dimming

National Electrical Manufacturers Association

A NEMA Lighting Systems Division Document
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Prepared by:

NEMA Ballast and Lighting Controls section
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

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The opinions expressed in this statement represent the consensus views of the member companies of the Lighting Systems Division of the National Electrical Manufacturers Association. The members of the Lighting Systems Division manufacture traditional technology lamps and ballasts, light-emitting diodes (LEDs and OLEDs), LED lamps and modules, LED drivers and power supplies, luminaires, lighting controls, and management systems.

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1 Scope

The scope of this paper includes dimmable fluorescent ballast and Light Emitting Diode (LED) drivers that are controlled by 0-10 V (1-10 V) control input. This paper explains the relationship between the control input voltage and overall energy consumed by these ballasts and drivers.

2 Purpose

Dimmable fluorescent ballasts and LED drivers consume less power when dimming. However, determining the energy savings at different output levels can be challenging because several components comprise lighting systems: control, control wiring, power source, and light source. This paper describes the signal path from the user control input through the control wiring, ballast or driver, and lamp or LED module. It also explains factors that affect energy consumption and savings, efficacy, and user experience at each stage. This paper is written for stakeholders interested in energy-efficient lighting, including manufacturers, specifiers, facility managers, and consultants.

3 References

ANSI C82.11-2011, *American National Standard for Lamp Ballast: High Frequency Fluorescent Lamp Ballast*

ANSI C82.13-2002, *American National Standard for Lamp Ballasts—Definitions for Fluorescent Lamps and Ballasts*

IEC 60929, Edition 4.0, *AC- and/or DC-supplied electronic control gear for tubular fluorescent lamps—Performance requirements*

NEMA LL 9-2011, *Dimming of T8 Fluorescent Lighting Systems*

4 Definitions

All definitions in this white paper are consistent with the definitions provided in ANSI standards. Refer to ANSI C82.13.

5 0-10 V Dimming

5.1 BACKGROUND

For close to 30 years, general lighting control by DC voltage has been used throughout the US to control brightness of fluorescent lighting. Called 0-10 V dimming in the US, in other parts of the world it is referred to as 1-10 V dimming. It is used today to control light sources such as LEDs. Throughout this paper, references to ballasts also include drivers for LEDs or other sources.

The ANSI standard is C82.11-2011, *American National Standard for Lamp Ballast: High Frequency Fluorescent Lamp Ballast,* Annex A, and the IEC standard is IEC 60929, *AC- and/or DC-supplied electronic control gear for tubular fluorescent lamps—Performance requirements,* Appendix E2. Both standards are similar and define a minimal set of requirements:

Current is always sourced at the ballast (10µA to 2mA). This allows very simple devices, such as potentiometers, to control dimming. Note that most modern control devices are capable of sourcing current; in general lighting, however, the ballast is always the source. (0-10 V is different for theatrical lighting and generally not compatible).

The only requirement for control signal voltage in ANSI C82.11 is value of lamp power:

1 V = minimum value of lamp power