



# NEMA SSL-7A and SSL-7B: Improving phase-control dimming of LEDS

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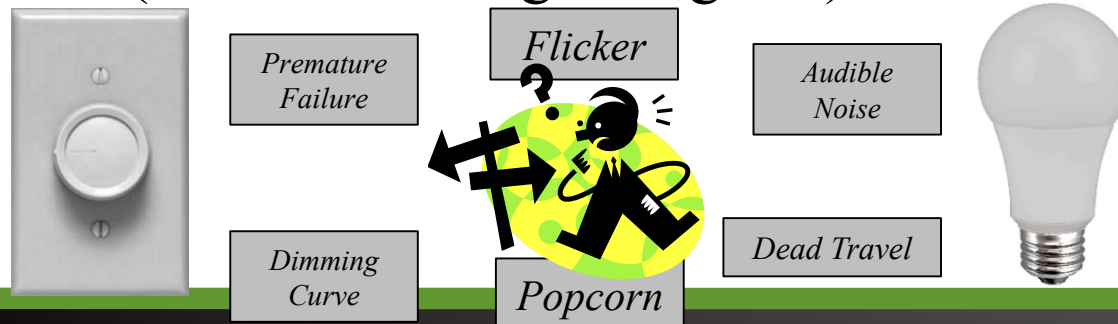
# Agenda

- Background of SSL-7A
  - History
  - Purpose
  - Limitations
- Status of SSL-7B
- Next steps
  - Adoption agents
  - Related efforts



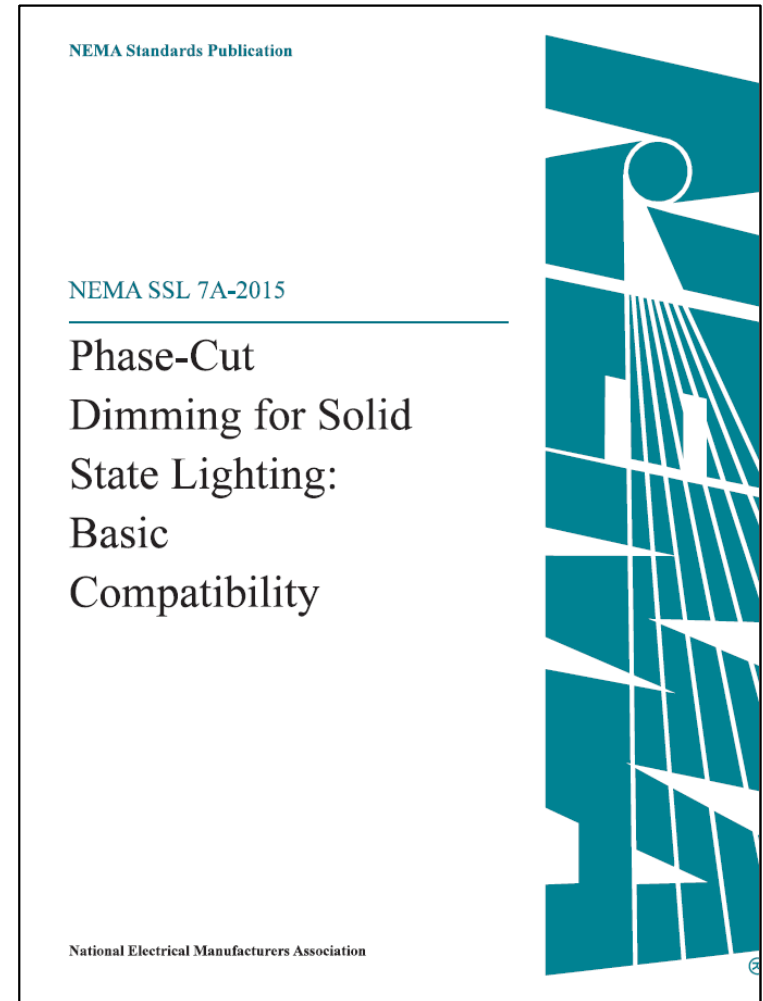
# SSL-7 Inception

- Development started in 2011 to address emerging need for improved dimming compatibility
  - Lamp and control manufacturers participated
- Standards development broken into two phases:
  - Part A: Interoperability and Basic Compatibility
  - Part B: Performance
- Covers forward-phase dimming only (100-277V)
- Targeted at screw-in LED lamps, but could be used on any LED fixture (LLEs: LED Light Engines)



# SSL-7A History

- Built off of NEMA SSL-6
  - Described existing base of lamps and dimmers
- First published in 2013
- Forward-looking
  - Applies only to new products
- Technical revision in 2015
  - Clarified some technical ambiguities
  - Removed the confusing “Type 1” dimmers and lamps



# Phase-cut Dimming User Problems

- ☐ Dimming range
- ☐ Dead travel
- ☐ Pop-on
- ☐ Drop-out
- ☐ Popcorn
- ☐ Ghosting
- ☐ Flashing/Strobing
- ☐ Flicker
- ☐ Audible noise
- ☐ Dimming smoothness
- ☐ Dimming monotonicity
- ☐ Dimming up/down symmetry
- ☐ Dimmer loading
- ☐ LED load - dimmer inoperability
- ☐ Premature failure of dimmer and/or LED load



# NEMA SSL-7 Scope

- Designed as an *interface* standard for compatibility
  - Sets criteria for LLEs (LED Light Engine, a.k.a. lamps) and dimmers
  - Provides a specified *minimum* level of operation when SSL-7 compliant products are used together
- “Compatibility” means:
  - Reliability of the dimmer and LLE are not affected by combining them
  - Dimming behavior meets or exceeds specified functionality



# SSL7 Test Philosophy

- Synthetic Test Circuits are used to produce defined characteristics or waveforms for testing the Device Under Test (DUT: LLE or Dimmer)
- Components in Test Circuits are usually adjusted for:
  - Power rating of Dimmer/LLE being tested
  - Mains voltage of DUT
- If the DUT works with the Synthetic Test Circuit, representing a worst-case scenario, it will work with any device whose characteristics do not exceed that worst-case



# Summary of Tests

## Dimmer Tests

Waveform stability

Inrush

Repetitive Peak Current

Overload

Repetitive Ring-up Voltage

Min. Conduction Angle

Max. Conduction Angle

Off-state Current

On-state Current



## LLE Tests

⇒ Inrush

⇒ Repetitive Peak Current

⇒ Maximum RMS Current

⇒ Repetitive Ring-up Voltage

⇒ Minimum Light Level

⇒ Maximum Light Level

⇒ Off-state Current

⇒ On-state Current





# SSL-7A Limitations

## DOES

- Ensure dimmer power supply can operate properly, without lamp “ghosting”
- Provide defined ranges for allowable max and min dimmer phase angles
- Set limits for inrush current, preventing premature switch failure
- Set limits for repetitive peak current, minimizing dimmer buzzing

## DOES NOT

- Define a “worst-case” level of dimming performance that most would find satisfactory
- Set limits on the level of reliability (it’s determined by the manufacturer)
- Require independent third-party testing
- Eliminate the need for compatibility testing



# How is SSL-7A Useful?

- For lamp manufacturers:
  - Gives guidance on how much dimmer leakage to expect
  - Sets limits on how much inrush and repetitive peak current is allowed
  - Specifies ranges of expected phase angles
- For dimmer manufacturers:
  - Sets limits on how much power supply leakage is allowed
  - Provides design limits for maximum amount of expected inrush and repetitive peak current
  - Defines ranges of phase angles that must be supported
- For end users:
  - Gives a baseline standard they can ask for when requesting dimming capability



# SSL-7A Adoption

- Some manufacturers are beginning to show SSL-7A compliance on their spec sheets
- Many manufacturers are using SSL-7A as an internal design requirement
- No known lamps marked as SSL-7A compliant yet

Ariadni® 250 W C•L® Dimmer Wallbox Controls

369809a 1 04.06.14

**Ariadni® 250 W C•L® Dimmer**  
Dimmer for CFL, LED, Halogen, and Incandescent dimmable bulbs.

**Features**

- On/off toggle switch with a captive linear-slide dimmer for a traditional wallplate opening
- HED™ Technology: Advanced Lutron® dimming circuitry designed for compatibility with most high efficacy light bulbs
- UL® Listed to control:
  - Dimmable compact fluorescent load (CFL) with integrated ballast
  - Dimmable LED with integrated driver
  - Lutron Hi-Lume® A-Series LTE LED Driver
  - Halogen
  - Incandescent

Switch on (to selected preset light level), and off

Select light level with slider

\* Wallplate sold separately

• For a list of compatible DIMMABLE CFLs, visit [www.wallboxcontrols.com](http://www.wallboxcontrols.com)

• Low-end adjustment to accommodate a wide range of bulbs

• 100% factory tested

• [Redacted]

**Application Requirements**

- When dimming CFLs or LEDs, only bulbs marked or rated as DIMMABLE may be used.



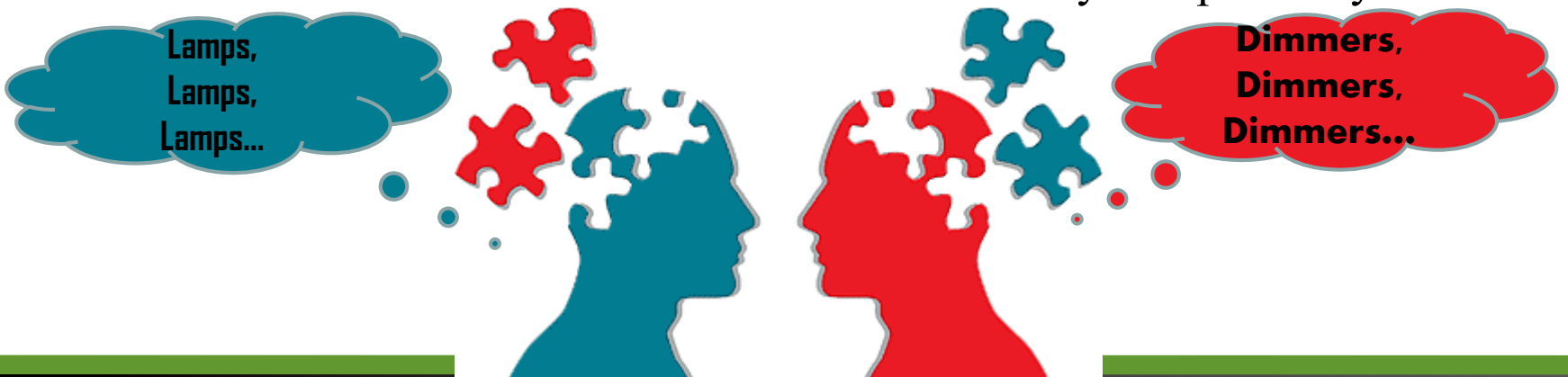
# SSL-7B History

- Work started in 2014; targeted publication date is first half of 2017
- Adds additional tests beyond SSL-7A
- Final scope *MAY* include things such as:
  - Dimming curve definition
  - Flicker limits
  - Acoustic noise limits
  - Turn-on time measurements
  - Max/min light output
- Based significantly off of other standards



# SSL-7B Challenges

- Manufacturers do not want any increased test burden
  - Many proposed tests are based off of existing industry tests (e.g., ENERGY STAR)
- “Performance” can cover many facets of dimming
  - Tests were selected based on known issues customers complain about
- Setting the bar too high on performance minimizes product differentiation
  - Limits are set at levels considered to be currently acceptable by customers



# Current Industry Usage of SSL-7A

- ENERGY STAR
  - Alternate compliance path for dimmer testing
- California Title 24
  - All phase-control dimmers and LED lamps used in new construction must be SSL-7A compliant
- California Title 20 Joint Appendix 8 (JA8)
  - All phase-control LED lamps sold in the state of CA must be SSL-7A compliant (and dim to 10%, and...)
- DLC Networked Lighting Control Systems Spec
  - Phase-cut dimming must be in compliance with NEMA SSL 7A
- Zhaga



# Future Usage of SSL-7B

- Several *potential* uses possible, once standard is complete
  - “Independent” quality metric for manufacturers
  - Regulatory bodies (e.g., CA)
  - Efficiency standards (e.g., ENERGY STAR, DLC)
  - Utility rebate programs



# Related Standards Work

- NEMA TLA working group



- Defining a method of measurement and proposed limits for flicker (visible and stroboscopic)
- Referenced by SSL-7B

- IEC JAHG 17



- Joint effort between Lamps and Controls committees within the IEC
- Similar goal to SSL-7A and -7B, but also includes reverse-phase dimmers
- Likely several years from publication into existing standards

