



Controlling LED Lighting Systems

July 30, 2015

What You Will Learn Today

- Lighting control options for any lighting system
- Basic components of an LED lighting system
- Challenges and technologies for LED lighting control



Lighting Control Options for Any Lighting System

■ Timers and Time Scheduling

- Remotely installed at wall box or control area
- Lights are turned on and off at user-prescribed times or intervals



Wall Timers

Lighting Control Options for Any Lighting System

■ Multi-Level Switching

- Encouraged by many building codes
- Can be done at fixture level or lamp level – lights are manually or automatically switched to half-on or full-on mode



Bi-Level and Multi-Level Switches

Lighting Control Options for Any Lighting System

■ Manual Dimming

- Several different technologies are common
- Most were designed to control incandescent or fluorescent lighting loads
- LED lamps and fixtures may present challenges for some of these technologies

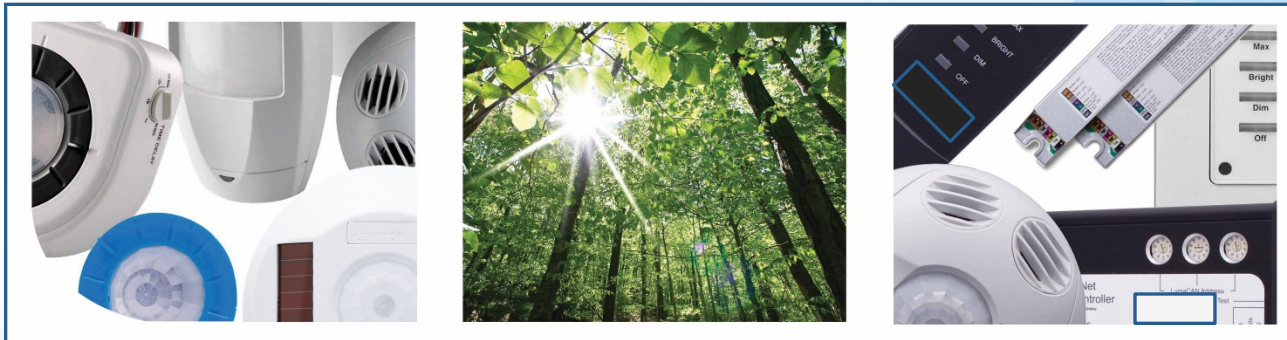


Wallbox Dimmer

Lighting Control Options for Any Lighting System

■ Daylight Harvesting

- Light sensors and switching/dimming controls are matched together and programmed to take advantage of existing sunlight
- Lighting fixtures are switched on/off or dimmed based on the amount of ambient light in the room



Daylight Harvesting Solutions

Lighting Control Options for Any Lighting System

■ Occupancy Sensors

- Use passive infrared and/or ultrasonic sensing technologies to turn lights on and off
- Sensors can be ceiling mounted, wall mounted, or mounted directly to the lighting fixture



Occupancy Sensors

Occupancy Sensors

- 3 main types:
 - Infrared
 - Ultrasonic
 - High Frequency (Microwave)



Occupancy Sensors

- Several different mounting styles
 - Ceiling Mount
 - Wall Mount
 - Fixture Mount (Internal or External)
 - Wall Box Mount



Infrared

- Senses a change in heat signature
- Line of sight only - does not “see” around barriers
- May be fooled by a lack of motion



Ultrasonic

- Sends out a sonic wave
- Can “bounce” around objects and detect motion that is not in line of sight.
- Good for stairwells, rest room stalls



High Frequency

- Same as Ultrasonic, but uses microwave frequencies
- Able to “see” through most materials such as wood, wallboard, plastic and glass
- Good for products where the sensor must be installed behind a cover or barrier
- Not good for many non-industrial applications – specifier must be familiar with product capabilities and limitations



Controlling LED's

■ CONTROLLING LED'S



The Good Part for Best LED Control Performance

■ Repeated Switching

- Unlike incandescent, fluorescent and HID lighting technologies, LEDs love to be turned on and off, and can be switched millions of times without degradation. This makes them ultra-compatible with occupancy sensors, timers and other controls that involve switching systems on and off.



Occupancy Sensors

The Not-So-Good Part

Dimming is not so easy

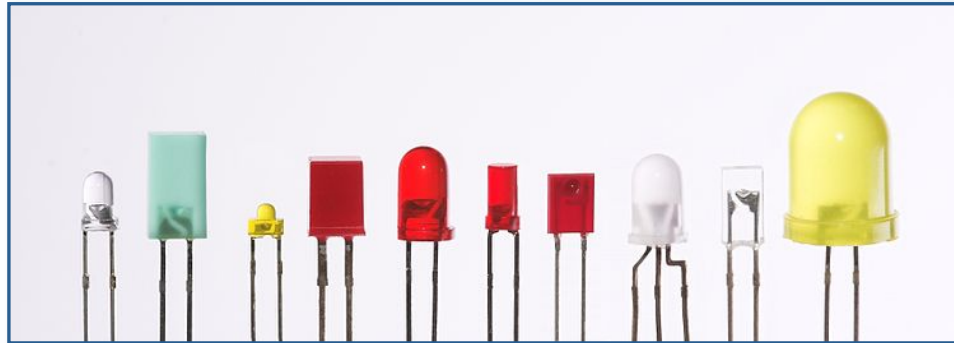
- Nearly all LED lighting systems consist of an LED module or array
- And some form of electronic circuitry for voltage and current control called a driver



LED Dimming Capability and Performance

■ Dimming capability and performance is a function of the driver

- Almost every type of LED can be effectively dimmed...

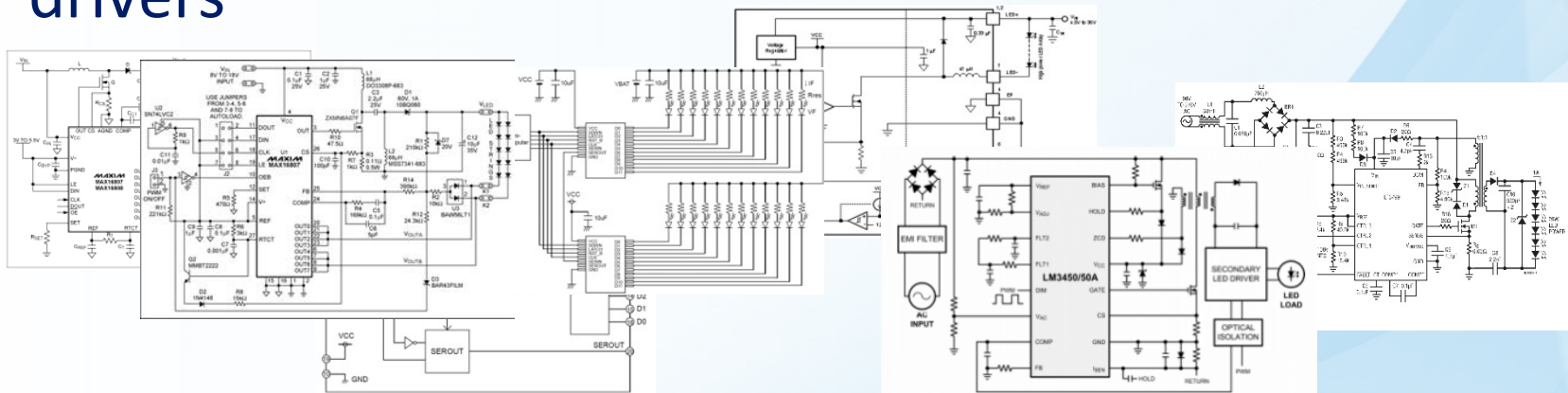


- However, the type of dimming that can be used and the quality of the dimming performance lamp are entirely dependent on the driver and...



LED Dimming Challenge

- There are so many different types of driver design in use today, that it is virtually impossible to create a “universal LED dimmer” that is compatible with all LED drivers



- However, dimming controls can be optimized for use with certain classes of LED drivers

Common LED Dimming Control Methods

■ Several standardized control types used to dim lamps and lighting systems:

- Phase control (Triac Dimming) including forward phase and reverse phase dimming
- 0-10V dimming
- Fluorescent 3-wire
- DMX 512
- DALI
- ELV



0-10V Dimmer

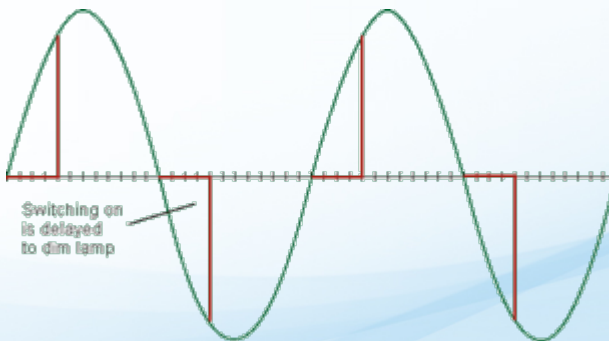


0-10V Driver

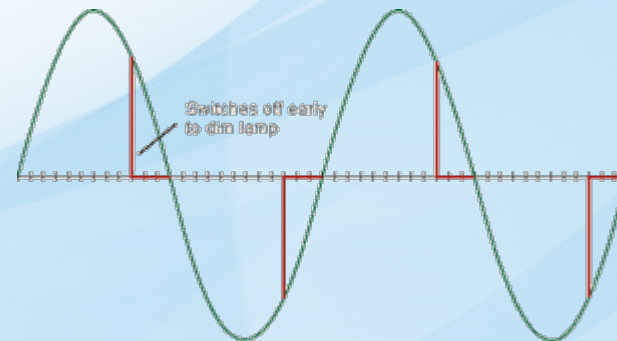
Additional Considerations for LED Dimming Using Phase Control

Forward and Reverse Phase Dimmers

- Phase control dimmers come in two types:
 - Forward Phase Dimmers
 - Reverse Phase Dimmers
- Most incandescent dimmers in the field are forward phase dimmers
- Forward phase dimmers cause more LED driver performance problems than reverse phase dimmers



Forward Phase



Reverse Phase

Additional Considerations for LED Dimming Using Phase Control

0-10V Dimmer



The dimmer sends a control voltage to the driver.



0-10V Dimmer



0-10V Driver

Common LED Dimming Control Methods

- You don't need to know how these different control types work, but here's what you do need to know:
 - Control type refers to the kind of signal and the type of wiring used by the wall control and the fixture/ lamp
 - The fixture or lamp you are trying to control, and the controller itself **MUST** be the same control type
 - For example, a fixture employing a 0-10V dimmable driver, can only be dimmed using a 0-10V dimming



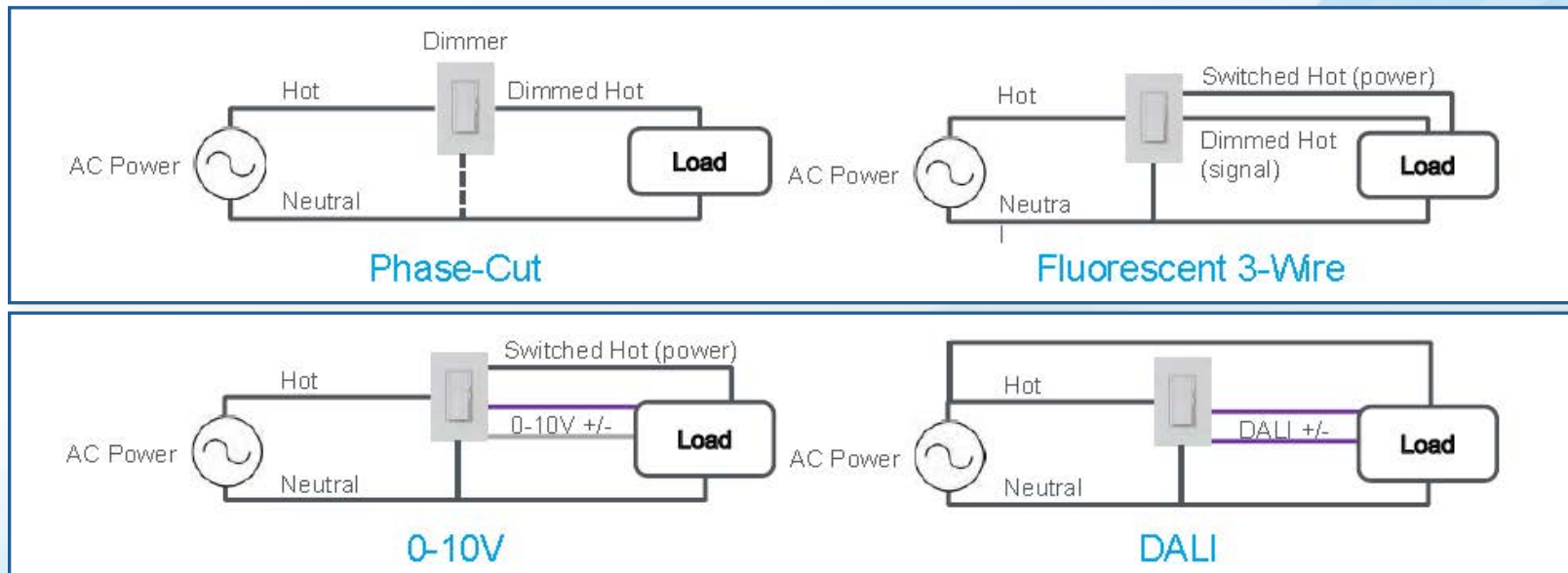
0-10V Dimmer



0-10V Driver

Common LED Dimming Control Methods

- Different control types require different wiring schemes
- The existing wiring configuration may constrain the control choices



What You Also Need to Know – Compatibility is Not Automatic

- With LEDs, using the same control type for the driver and the control does not ensure compatibility



0-10V Dimmer

?



0-10V Driver

Compatibility

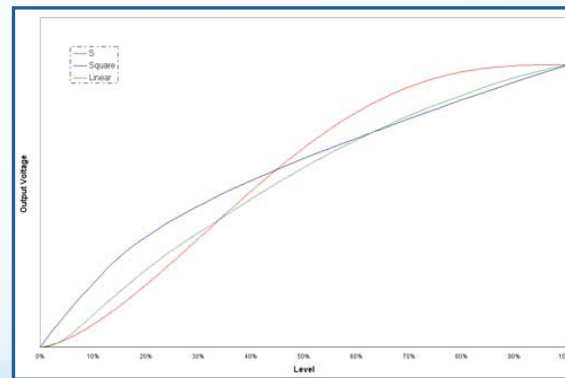
LED Dimming Compatibility Issues

- **Limited Dimming Range** – lights dim down only to a percentage of full light with dimming control on lowest level; non-compatible dimmer/driver combinations can result in only 20-30% (or less) dimming at full downward dimmer position
- **Flicker** – perceptible light level modulation – usually occurs at the low end of the dimming range; possible safety issue
- **Dead-Travel** – partial movement of dimming control produces little or no dimming effect
- **Non-Linear Dimming** – small movement of dimming control results in sudden drop or increase in light output
- **Drop-out** – light turns completely off before full downward dimmer travel
- **Ghosting** – light stays on with dimmer at full travel off, or with switch off
- **Audible Noise** – buzzing or hum from fixtures under dimming conditions

Compatibility

What Does Compatible Mean?

- Many fixture and light source manufacturers claim compatibility with certain controls in their literature. But what does the term compatibility imply?
 - If the lamps or fixtures dim to 50% of their initial output, is that compatible? What about 30%?
 - Is a small amount of barely perceptible flicker under worst case settings good enough to call it compatible?
 - How linear must the dimming curve be before it is considered compatible?



- Currently there are no standards in place for any of these considerations, so the decision rests ultimately with the end-user.

Additional Considerations for LED Dimming Using Phase Control

- Traditional incandescent dimmers are generally phase control type dimmers; this control type was not designed for LED, and may exhibit additional issues that need to be taken into account

Minimum Number of Lamps

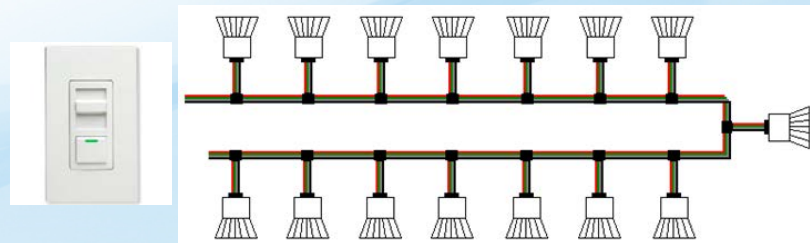
- Some lamp/driver combinations may work fine with several lamps connected, but exhibit problems with just one or two lamps
- Many incandescent dimmers require a 25-40 watt minimum load to operate
- If you are attempting to control a series of 10W LED fixtures, you may experience poor performance with fewer than 4 fixtures connected to the dimmer
- Currently there are no standards in place for any of these considerations, so the decision rests ultimately with the end-user



Additional Considerations for LED Dimming Using Phase Control

Maximum Number of Lamps

- In the past, a simple wattage calculation was all it took to determine the maximum number of lamps that could be controlled by a single dimmer
 - It was safe to assume that a 600W dimmer could control up to ten 60-watt fixtures
- With LED lighting, this is no longer the case
 - LED lamps and driver circuits exhibit inrush currents and current draw fluctuations that cause them to draw more than expected current given their wattage rating
 - A better rule of thumb is to limit LED loads to 10% or 15% of the maximum dimmer wattage rating.



Tips for Best LED Control Performance

■ Dimming

- Dimmers and daylight harvesting systems intended to control LEDs will require additional steps to ensure safety, quality and performance:
 1. Make sure the types of control technologies match
 2. Obtain information about the dimming range and dimming performance of the lamps or fixtures
 3. Choose compatibility requirements based on application – 20% dimming may be acceptable for office spaces and lobbies, 1% may be needed for residential or hospitality applications
 4. Determine the minimum and maximum load requirements for the dimmer/fixture combination



Dali Reverse Phase Forward Phase 0-10V DMX512

Better Safe Than Sorry

- Best practice is to mock up the system BEFORE you install it
- Make sure you test with the maximum and minimum loads you will experience in the installation



QUESTIONS/ANSWERS

Thank you for your attention! Please feel free to use this opportunity to ask any questions you may have about today's employee training presentation.

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