Dimming Performance & LED Lighting

Overview

Not all dimmers are created equally. Optimal lighting performance is dependent on selecting the best suited dimmer type for your specific LED lamp or fixture. One very important aspect to be mindful of is dimmer load. Dimmer switches have minimum and maximum load guidelines so that lamp(s) work properly. Failing to meet these guidelines, may result in undesired effects with your lighting such as flickering and flashing. Today there are a number of LED dimmers that can handle much smaller minimum loads, accommodating for the reduced wattage of these lighting solutions.

Why is there a minimum load on my dimmer?

In the LED industry, minimum load is often determined by the number of lamps (fixtures) needed to meet a minimum wattage load and is highly dependent on the lamp type. The biggest reason to have minimum load on a dimmer is to ensure that the dimming circuit is stable. A minimum current is required in order to properly control the load

Not meeting the minimum load can lead to some undesired effects:

- **Flickering** – annoying effect that can be caused anywhere along the dimming curve by variations in the conduction angle of the dimmer. It is usually more prominent at low dim levels.

- **Misbehaved Lights** - When the power supply cannot get sufficient current through the load, the light fixture will behave erratically or not work at all. In some cases, LED fixtures will charge their power supply using the leakage current and then when the unit is off, the LED will flash or glow.

How to prevent these instabilities?

The most obvious solution is to follow the instructions from the lighting manufacturer and load the dimmer with enough fixtures to prevent the issues. (For TROV, the minimum load is 3-4 10W fixtures depending on the dimmer being used.)

An alternative is to add a resistive load at the plug in parallel with the fixture. Resistive loads convert current into energy, reach a steady state with little inrush current and provide consistent supply of quality power. Lutron offers one – Model #LUX-LBX.

What is the Pop-On Effect?

The Pop-on Effect results when the LED fixture does not turn on at its very lowest light level and the dimming level must be increased in order for the light to turn on. The voltage at which the light source begins operation is higher than the voltage of the dimmer's lowest setting, so therefore when the right level is reached the fixture "pops-on". This occurrence happens regardless of the dimmer loading.

It is common practice in the industry to set the trim on the low levels of the dimmer in order to prevent instabilities. Low end trim could be set high enough to guarantee no pop on behavior.

Some dimmers can also be locked to turn on at a preset level. This is a level that is higher than the required pop-on threshold. The dimmer can be programmed to always turn on to the same level (ex: 50%) regardless of the last level it was on, therefore preventing the need to increase the dimmer level, avoiding pop-on.

What is Drop Out?

Drop out occurs where the light turns off (or "drops out") as you move decrease the dimming level, although you have not reached the bottom of the dimmer. This causes some dead travel at the low end of the dimmer. This is common due to the fact that different dimmer models have different values for their lowest, low end voltage. A very common way to control Drop Out is to set the low end trim higher than the drop out point.

Since most lighting fixtures use voltage as a way to determine the requested light level, it is common to set the highest low end voltage possible from the dimmer to match the fixture's absolute low end voltage level.

Summary

LED fixtures are excellent energy-efficient lighting solutions but sometimes that minimum power draw can become problematic for dimming control. The best way to understand fixture dimming performance is to test your fixture(s) directly with the dimmer.

Sources:

Lutron -http://www.lutron.com/TechnicalDocumentLibrary/048487.pdf;
Lutron - http://www.lutron.com/TechnicalDocumentLibrary/367-2035_LED_white_paper.pdf
Legend power - http://legendpower.com/product-info/terms-and-faq/what-are-resistive-loads/
Condor Power Supplies - http://www.slpower.com/reference/An113%20Leakage%20Current.pdf
Lutron - http://www.lutron.com/en-US/Education-Training/Documents/LEDs%20Magazine.pdf
Lutron - http://www.lutron.com/technicaldocumentlibrary/048-123b.pdf