

## Minimum and Maximum loads for LED and CFL lamps/fixtures

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### Overview

Many Lutron® products provide minimum and maximum load ratings in Watts (W) and/or Volt Amps (VA). These ratings are based on traditional light sources (incandescent and halogen lamps) and **do not** apply to LED and CFL loads.

### Minimum Load for LED and CFL Lamps

In place of a minimum W or VA rating, the minimum load for LEDs and CFLs are described with a minimum number of lamps. This value is determined on an individual load basis, and may be different for each specific lamp model number.

For example, a user may wish to control an 8 W LED lamp with a Grafik Eye® QS control unit. A single lamp does not meet the published minimum load rating of the Grafik Eye® QS control unit at 120 V~, which is 25 W. However, the 25 W requirement applies only to incandescent or halogen lamps, and does not apply to CFL or LED lamps. To determine the proper minimum load, testing is necessary to show how many of the desired loads are needed for the desired control to function properly.

Testing done by the Lutron® LED Center of Excellence has shown that with certain 8 W LED lamps, the minimum number of lamps required on the Grafik Eye® QS control unit is only one. Other 8 W LED lamps may require more than one lamp to meet the minimum load requirement of the Grafik Eye® QS control unit, and this value may vary if other dimmers are used. Therefore, the required minimum load for LED and CFL lamps depends on the specific lamp model number and the dimming control being used.

### Why is there a minimum load?

There are two main reasons for minimum load requirements:

- **To limit the effect of leakage current through the dimmer:** This is the current through the filtering and sensing circuits of the dimmer, as well as the small amount of current needed to power the internal circuitry of the dimmer.
- **To ensure dimming circuit stability (sometimes referred to as Triac holding current):** This is the minimum current needed for the dimmer to properly control the load.

#### Operating dimmers with insufficient minimum load may cause one or more of the following problems:

- A. Glow when OFF (sometimes referred to as ghosting):** Even when the dimmer is turned OFF, an incandescent filament may still visibly glow or an LED or CFL may stay ON at a low level.
- B. Flashing when OFF:** Some LED or CFLs will slowly charge their power supply with the leakage current. After a certain amount of time, they may turn ON briefly, run out of charge, shut off, and then slowly charge up again. In the case of CFLs, this can damage the lamp.
- C. Reduced dimming range:** Leakage current can affect the dimming range for some loads, and may prevent them from reaching low light levels.
- D. Intermittent dimmer operation:** When the power supply in the dimmer cannot get sufficient current through the load, the dimmer may behave erratically or not work at all.
- E. Flickering:** Insufficient load may cause undesired variations in the conduction angle of the dimmer, which can cause the light output to vary slightly. This may be seen as flicker at different points in the dimming range.

**Note:** Some LEDs and CFLs have built in circuitry that may eliminate these issues. Therefore, satisfactory performance may be seen with LED or CFL loads that are less than the minimum load rating of the dimmer or switch.

## Maximum Load for LED and CFL Lamps

In place of a maximum W or VA rating, the maximum load for LED and CFL lamps are described with a maximum number of lamps. This value is determined on an individual lamp basis, and may be different for each specific lamp model number. **Note:** Lutron® C•L® products have been designed specifically for CFL and LED loads. The design for these products and the testing performed by Lutron allows a lamps rated wattage to be used in combination with the CFL/LED load rating of the dimmer to determine the maximum number of lamps.

For example, a user may wish to control a 10 W, Par 30 LED lamp on a typical non C•L® dimmer. The dimmer has an incandescent rating of 600 W. At first pass it appears that you could use 60 of these LED lamps. However, the 600 W requirement applies only to incandescent or halogen lamps, and does not apply to LED lamps. To determine the proper maximum load, testing is necessary to show how many of the desired loads are within the capability of the dimmer.

Testing done by the Lutron® LED Center of Excellence has shown that with a particular 10 W LED lamp, the maximum number of lamps allowed on a specific non C•L® dimmer is 32 or 320 W. Other 10 W LED lamps may allow more or less lamps on the module, and this value may vary if other dimmers are used. Therefore, the maximum load for LED and CFL lamps depends on the specific lamp model number and the dimming product required.

## Why is there a maximum load?

There are 2 main reasons for maximum load limits:

- **To limit inrush Current:** The current spike created by the load when first turning ON the load.
- **To limit repetitive Peak Current:** Continuous spikes of current caused by the power supply of the LED or CFL.

### Operating dimmers beyond the maximum load may cause one or more of the following problems:

- Early dimmer failure:** Excessive current may damage the dimmer.
- Buzzing noise:** Current spikes may make filter components buzz.  
**Note:** These large current spikes may cause a humming noise even if the dimmer is not overloaded.
- Breaker tripping:** Larger than expected current spikes could cause nuisance tripping of circuit breakers.
- Intermittent dimmer operation:** Electrical noise from current spikes may interfere with the dimmer's circuits, it may behave erratically or not work at all.
- Flickering:** Current spikes may cause line noise and result in load flickering, even on dimmers wired to separate loads.

## What is the minimum and maximum load of my dimmer or switch with LEDs and CFLs?

Minimum and maximum loads for LEDs and CFLs are given in number of lamps instead of W or VA. Since LED and CFL loads can vary widely, only testing can determine the minimum and maximum loads for a particular control. The Lutron® LED Center of Excellence tests hundreds of LED and CFL lamps for compatibility and determines:

- If the lamp is compatible with Lutron® controls.
- The minimum and maximum number of lamps required for reliable operation of the control.

For a complete list of compatible lamps for most Lutron® controls, including maximum and minimum loads, visit [www.lutron.com/dimcflled](http://www.lutron.com/dimcflled) and [www.lutron.com/ledtool](http://www.lutron.com/ledtool).

## Summary

Minimum and maximum load specifications for Lutron® dimming controls apply to traditional loads (i.e. incandescent and halogen) and do not apply to LED and CFL loads. Minimum and maximum loads for LEDs and CFLs are given in number of lamps and may vary, depending on the lamp being used. Only testing can determine the actual minimum and maximum load needed for a particular lamp and control. Even when minimum and maximum loading requirements for dimmers are met, the dimming performance may not meet all applications. Information on the Lutron® test results can be found by visiting [www.lutron.com/dimcflled](http://www.lutron.com/dimcflled) or [www.lutron.com/ledtool](http://www.lutron.com/ledtool).

For more information on dimming LEDs refer to the Controlling LEDs white paper, 367-2035 or contact the Lutron® LED Control Center of Excellence at (+1) 877-DIM-LED8 (+1.877.346.5338) or [leds@lutron.com](mailto:leds@lutron.com).

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