OMNI-RAY LIGHTING™

Oconto, Wisconsin USA

Plug-and-Play vs. Ballast-Bypass and External Driver LED Solutions

Thanks to continuing changes in the linear LED solutions available in the market, there are now more options and additional risks to consider when choosing to convert your linear fluorescent lamps to linear LED lamps. And in addition to those technological advances, prices have come down to make upgrading to more energy-efficient linear LED lamps more affordable.

Return on investments (ROIs) in less than a year are becoming more common today, depending on annual burn time, kWh rates, availability of utility rebates for DLC certified products, etc.

Unlike waiting for the next cool technological gadget, or for prices to drop, there is now a cost correlating to your wait to upgrade to more energy efficient lighting - energy and labor savings that you could be enjoying every day.

Today's linear LED solutions

If you're looking to retrofit from linear fluorescent to linear LED, you have a growing number of options.

Today's linear LED solutions include:

Plug-and-Play/Direct Fit Linear LED (UL type A)

A plug-and-play, or direct fit, linear LED is probably what you're imagining — a simple, one-for-one swap out of the original linear fluorescent lamp. This lamp works directly with the existing fluorescent ballast, so there is no rewiring or ballast change required.

Ballast-Bypass/Line Voltage/Direct Wire (UL type B)

Bypass the ballast linear LEDs — also known as line voltage or direct-wire linear LEDs — work straight off the line voltage flowing directly to the sockets, requiring you to remove the original fluorescent ballast.

Hybrid/Dual Technology

(UL type A/B)

Hybrid linear LED lamps are able to work both as a plug and play — with the existing ballast — and, once the ballast peters out, you can remove it and have the lamp run off of line voltage.

External Driver Retrofit (UL type C)

This linear LED solution eliminates any ballast, using the existing fixture and remaining components using an External Driver and LED Lamp, providing a fully grounded system.

Plug-and-Play pros and cons

Plug-and-Play pros:

- **Simplicity for installer**
  The lamp snaps into the existing fixture without any wiring modifications meaning

installation can be done by virtually anyone.

- **Safety**
  Whenever we can shorten the time someone has to spend dangling from a ladder, things are automatically safer.

- **Lowest cost linear LED solution**
  As a simple one-for-one lamp replacement, the cost of the lamps combined with the minimal labor to install them make them the less expensive option in the short run.

- **Ballast protection**
  Fluorescent ballasts are grounded and designed to control the flow of current or voltage to the sockets, by regulating the current spikes that commonly occur throughout the day.

Plug-and-play cons:

- **Ballast Wattage Loss**

Electronic, Instant Start, Rapid Start, Program Start and Magnetic Ballasts limit electrical current in electrical devices such as fluorescent lights. However, they lose energy when they operate because of the way that they are constructed.

Ballasts are basically copper wire in a coil shape that is wrapped around iron. As such, they create heat because they cause electrical resistance to alternating current as it makes its way through the circuit. Not all ballasts will lose the same amount of electrical energy. The amount of energy lost is related to the size of the ballast's key components, the iron core and the coil. The greater the size, the more potential for loss of energy. However, this is often proportional to the type of light being used and is generally expressed as a percentage of loss. No consensus exists regarding a standard percentage loss, but a 36-watt light using a standard ballast will lose about 25 percent of its energy. The amount of energy lost through an electronic ballast is significantly less than that lost through a magnetic ballast. Lights that use 39 to 175 watts of energy will lose between 14.6 and 37.6 watts of energy when used with a Magnetic Ballast, according to the Lawrence Berkeley National Laboratory. By comparison, an Electronic Ballast with the same lights will only lose between 5.2 and 15.2 watts. Reputable contractors will use 7-10 watts of additional energy used when calculating total fluorescent system wattage of ballast and bulbs, so for LED lamps the ballast wattage loss needs to be added to the lamp wattage when calculating the total system wattage for UL Type A (Ballast Compatible).

- **Upfront cost**
  Even with the recent price reductions for linear LEDs, they are still usually 3-7 times the price of the existing fluorescent lamps. The positive news, though, is that it is not too

uncommon to achieve ROIs in under a year based on energy and labor savings.

- **Ballast compatibility**
  While plug-and-play linear LEDs are getting better with ballast compatibility, it's still something you should check.

- **Continued ballast maintenance**
  While LED lamps don't put the same stress on a ballast that linear fluorescents do, on-going ballast maintenance is still required.

Direct Wire pros and cons

Direct wire pros:

- **No ballast maintenance**
  Removing the ballast simplifies the number of fixture components that need to be maintained.

- **Lamp wattage equals actual fixture wattage**
  Since you're removing the ballast from the equation, the lamp wattage is the same as what's listed on the box. Simple.

Direct wire cons:

- **Safety risk**
  The most significant negative to a ballast-bypass linear LED is the risk of electric shock since the sockets carry line voltage. It's a common practice to place a finger on the lamp pins while you are trying to install it, and this becomes a risky endeavor with ballast-bypass wiring.

- **Fixtures must be rewired**
  It can be argued that this is a simple process. Disconnect the ballast from the circuit and wire the sockets to line voltage. There are several video tutorials available to demonstrate this task. Interestingly enough, most of these demos are performed with the fixture being rewired laying on a table. If you've done this before, you understand that doing this over your head while balancing on a ladder (and maybe before your morning coffee) can make things more complicated.

- **Exact wiring uncertainty**
  Unfortunately, there's no industry-standard wiring schematic for ballast-bypass linear LEDs. Different manufacturers have a variety of approaches that the installer must consider. Among the 31 linear lamps tested in a recent DOE Caliper report, seven different wiring configurations were used. Of the options, single or double-ended wiring to the lamp — and shunted or non-shunted sockets — are possible scenarios a retrofit installer might face. In two lamps, additional wiring was required between the two end connectors. This type of variation among commercial products introduces a new layer of complexity.

- **Fluorescent lamp compatibility/ snap-back**
  I hope that once you retrofit to LED you don't decide to go back to fluorescent, but it's possible that someone could inadvertently install a linear fluorescent lamp in a ballast-bypass fixture. When the LED lamp does need replacing, if you mistakenly try to replace it with a fluorescent, the lamp will not be compatible and not function properly with direct line voltage.

- **Title 24 requirements**
  In California, there are new Title 24 requirements that need to be meet when you retrofit existing fixtures by replacing the ballast. Please refer to the current Title 24 requirements for more details.

- **Higher initial labor costs**
  The need to remove the original fluorescent ballast and rewire the line voltage to the sockets requires more labor than plug and play solutions that work with the existing fluorescent ballast.

- **Socket compatibility**
  When bypassing the ballast, you may need to change your sockets from the most common shunted sockets to non-shunted sockets, depending on the LED Lamp configuration. This will require a small amount of additional material cost and more labor to replace them all. In addition, Leviton — one of the top fluorescent socket manufacturers that are installed in many fixtures — will no longer honor the socket warranty if line voltage is direct-wired to their sockets.

Hybrid UL A/B pros and cons

Hybrid Linear LED pros:

- **Greater flexibility**
  The hybrid lamps were designed to work both with the existing fluorescent ballast and by bypassing it. You can start by using it like a plug-and-play lamp and then, when the ballast fails, you can direct wire it to line voltage.

- **Initial simplicity for installer**
  The lamp snaps into the existing fixture without any wiring modifications meaning installation can be done by virtually anyone.

Hybrid linear LED cons:

- **Eventual safety risk**
  The most significant negative to bypassing the ballast with a linear LED — once the ballast burns out — is the risk of electric shock since the sockets carry line voltage. It's a common practice to place a finger on the lamp pins while you are trying to install it, and this becomes a risky endeavor with ballast-bypass wiring.

- **Fixtures must be eventually be rewired**
  It can be argued that this is a simple process. Disconnect the ballast from the circuit and wire the sockets to line voltage. There are several video tutorials available to demonstrate this task. Interestingly enough, most of these demos are performed with the fixture being rewired laying on a table. If you've done this before, you understand that doing this over your head while balancing on a ladder (and maybe before your morning coffee) can make things more complicated.

- **DLC listing issues**
  To be eligible for potential utility rebates, linear LED lamps usually need to be listed on the Design Lights Consortium (DLC) list of certified products. Hybrid lamps are often listed as DLC certified when used with the fluorescent ballast, but are not DLC approved when bypassing the ballast, as it is considered a fixture modification.

- **Eventual extra labor**
  Once the original fluorescent ballast dies, the need to remove it and rewire the line voltage to the sockets requires additional advanced labor. As well as during the initial installation where several types of ballasts are in the system, due to many years of

replacements, and those ballasts may not be compatible, so you need to open up the fixture and direct wire anyway.

- **Fluorescent lamp compatibility/ snap-back**
  We hope that once you retrofit to LED you don't decide to go back to fluorescent, but it's possible that someone could inadvertently install a linear flourescent lamp in the fixture after you rewire it directly to line voltage. When the LED lamp does need replacing, if you mistakenly try to replace it with a fluorescent, the lamp will not be compatible and not function properly with direct line voltage.

External Driver Retrofit (UL type C) pros and cons

External Driver Retrofit (UL type C) pros:

- **Better energy savings**
  LED drivers are far more energy efficient than today's ballasts. The wattage of the LED lamp is all that is consumed, whereas when used with a fluorescent ballast, the energy consumed increases by about 3-4 watts per lamp on average or more depending on the age of the ballast.

- **Reduced maintenance**
  LED drivers are designed to last longer than traditional fluorescent ballasts, thus greatly reducing maintenance costs. This system is serviceable: The Linear LED can be replaced or the Driver, unlike Integrated Driver A, B, or A/B Systems that are a throw away item when in or out of warranty.

- **No ballast compatibility issues**
  LED drivers are properly paired with the right linear LED lamps and eliminate any ballast compatibility issues that are often common with plug-and-play LED lamps.

- **No snap-back**
  The term snap-back refers to replacing the energy efficient lamp with the older, less energy efficient technologies (in this case, linear fluorescents). When the LED lamp needs replacing, if you try to replace with a fluorescent, the lamp will not be compatible and not function properly with the LED driver.

External Driver Retrofit (UL type C) cons:

- **Higher initial material costs**

  Replacing both ballast with an LED driver and new LED linear lamps come with higher material costs when compared to the plug & play solutions. However, this is offset by the great energy savings and reduced future labor costs, as well as better warranties and serviceability.

- **Higher initial labor costs**
  The need to replace the original fluorescent ballast with a new LED driver requires more labor than plug-and-play solutions, which work with the existing fluorescent ballast. However, this does not apply to UL B Direct Wire or A/B Hybrid, as once you open up the fixture, it is most cost effective to use the UL C system.

- **Title 24 requirements**
  In California, there are new Title 24 requirements that need to be meet when you retrofit existing fixtures by replacing the ballast. Please refer to the current Title 24 requirements for more details.

Other important things to consider when comparing linear LED solutions

1. Proper socket seating

Though the traditional fluorescent sockets have a plastic exterior, they have metal contacts on each side of the interior of the socket. For a lamp to properly be “seated” in a socket, it needs to snap securely into place to avoid coming loose or movement, and with both of the pins on the LED lamp coming into contact with the metal contacts inside the sockets.

2. Emergency ballast compatibility

Many of the traditional emergency ballasts used with fluorescent lamps are not compatible with most of the LED linear solutions on the market today. The most common emergency ballast that are compatible with LED’s are often much more expensive that the fluorescent versions. This will add to the material cost and labor to the retrofit project.

3. Limited dimming options

Though there are currently some good dimmable LED linear options available, the choices are limited and often cost more. However, UL C Dimmable External Drivers are compatible with most systems and are usually standard.

Choosing the right linear LED

The first part of your linear LED decision should involve choosing a quality manufacturer. You want to work with someone that has extensive knowledge in LED Electronics, fully understand the principals of these complex electronic systems, have put their product through proper testing, and will ultimately stand by it by offering warranties that fit the application for where the products are used.

The second part of your decision is which linear LED solution is best for your application. The most common decision is ballast-bypass vs. plug-and-play. For some, the ease of installation on plug-and-play products is attractive, but for others, the simpler long-term maintenance of a direct-wire LED is most valuable. Both are viable options that will save your property time and money, but we strongly recommend External Driver UL Type C installations first and foremost.

Here's why:

Your safety is extremely important.

While there are benefits to the ballast-bypass products, we don't feel comfortable recommending a product that poses a risk to you or your team. While a hybrid solution would also provide the initial ease of installation with the flexibility to switch to direct-wire in the future, we still feel that there is a potential safety risk and that External Driver UL Type C is the best first consideration.

As you consider the variables that go into a lighting retrofit decision, remember to evaluate your priorities for the project and keep safety first.

As always, feel free to reach out if you have questions or if we can help.