

Fluorescent Dimming Reference Guide

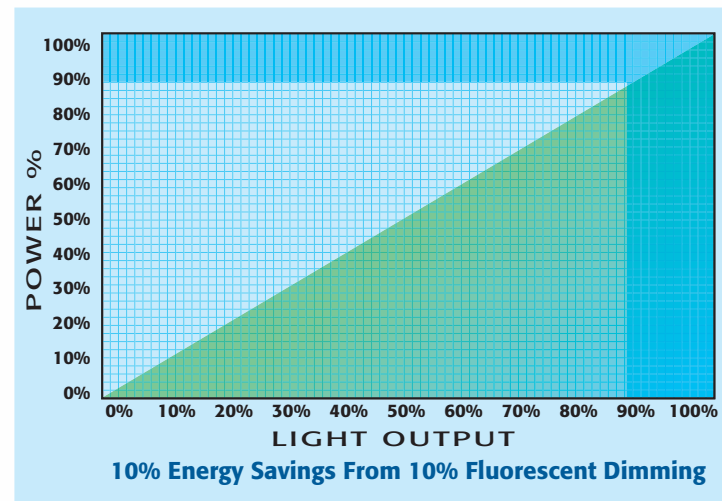


A New Approach
to Lighting With
Superior Energy
Efficiency & Control

New Technologies Put Dimmable Fluorescent Lighting In A Whole New Light

Today, the greatest change in the way we approach lighting projects will involve the increased use of dimmable fluorescent lights including compact fluorescents in a broad range of applications.

Fluorescent lighting provides superior energy efficiency when compared to incandescent lights. Those savings are only increased whenever lights are dimmed. Going one step further, newly available fully automated fluorescent lighting control systems can now factor in available free natural daylight – a technique known as “daylight harvesting” – with the precise control of dimmable fluorescent lighting levels to maintain a pre-selected level of illumination. They build on dimmable fluorescent lighting to offer even greater energy cost reductions than “dimming only” systems.



A modern dimmable fluorescent lighting system can also make a decisive contribution to corporate cost reductions by raising worker productivity. From the high levels of illumination needed to read documents with small text, or engineering drawings, to computer tasks requiring a significantly lower light level, each situation requires an appropriate level of light. What’s more, that level differs for each employee depending not only on the immediate task at hand but also on personal factors such as the ability to focus and the loss of visual acuity with age.

AGE (In Years)	Similar Visual Tasks Require More Illumination With Age*
20	150%
30	200%
40	300%
50	600%
60	1500%

* Baseline =10 year old child

By reducing eye fatigue, dimmable fluorescent lighting can result in a healthier, more comfortable and more productive work force.

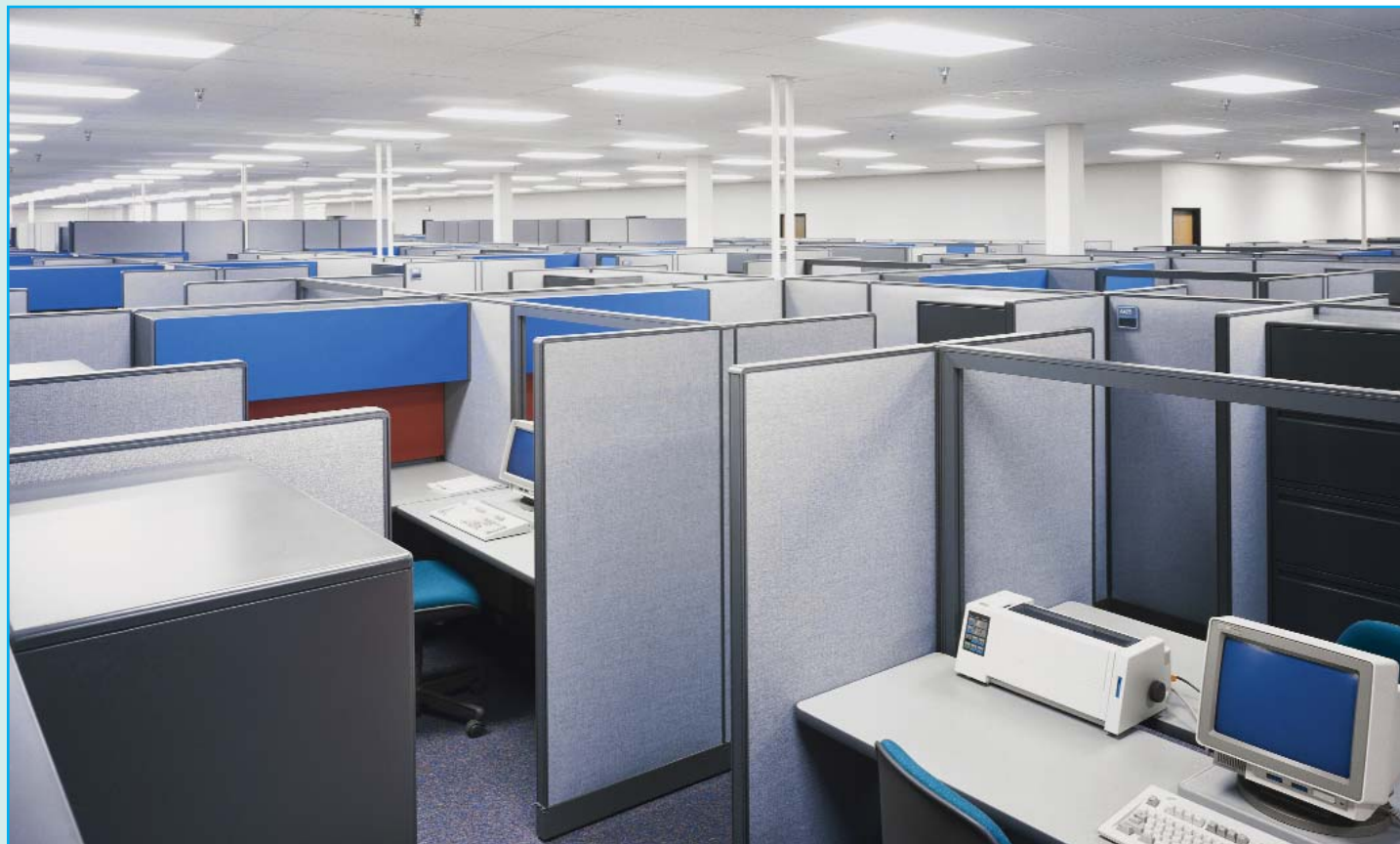
The key to all of this progress has been the development of highly reliable and cost-effective dimmable solid-state ballasts for full range dimming.

Fluorescent Lamps and Ballasts: You Can't Have One Without The Other

Unlike the incandescent lamp that produces light directly by passing electrical current through a filament until it glows, fluorescent lamps convert electrical energy to light more efficiently through a somewhat more indirect process. Their operation relies upon an electrical arc passing between two electrodes, one on each end of a phosphor-coated glass tube. This arc is conducted through a mixture of vaporized mercury and purified gases. The resulting ultra-violet waves react with the phosphor to produce a glow, emitting "fluorescent light."

All fluorescent lamps, no matter what their size or shape, need an additional electrical device called a ballast that:

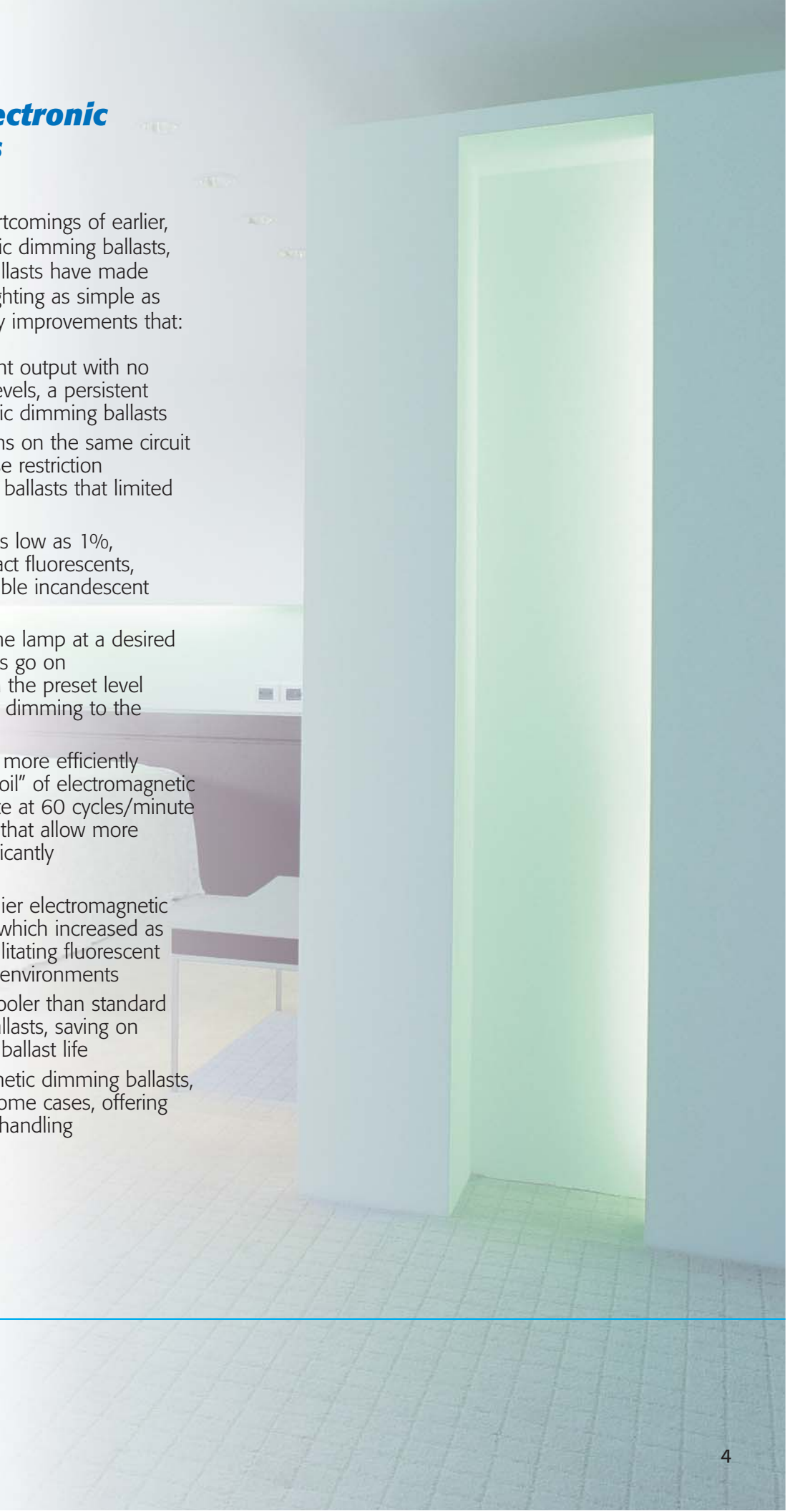
- Provides the proper starting voltage for a particular fluorescent lamp to establish its arc
- Regulates the electric current flowing through that lamp to stabilize light output
- Supplies the correct voltage required for that lamp's proper operation and compensates for voltage variations in the electrical current



Energy Saving Electronic Dimming Ballasts Come Of Age

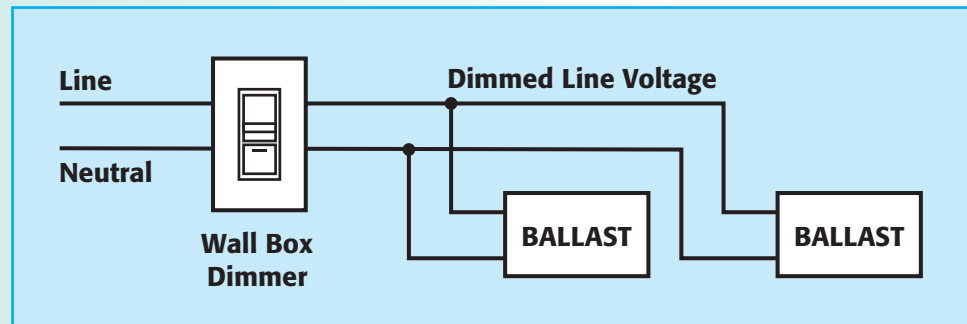
By overcoming the many shortcomings of earlier, first-generation electromagnetic dimming ballasts, today's electronic dimming ballasts have made the dimming of fluorescent lighting as simple as non-dimming control, with key improvements that:

- Provide stable flicker-free light output with no color shift at very low light levels, a persistent problem with electromagnetic dimming ballasts
- Permit mixing of lamp lengths on the same circuit vs. the single bulb/ballast use restriction of electromagnetic dimming ballasts that limited their flexibility
- Deliver full-range dimming as low as 1%, including dimming of compact fluorescents, as a replacement for dimmable incandescent down-lights
- Offer the ability to turn on the lamp at a desired light level (Note: Some bulbs go on at a slightly higher level than the preset level desired before automatically dimming to the desired level)
- Convert power to light 10% more efficiently by replacing the "core and coil" of electromagnetic dimming ballasts that operate at 60 cycles/minute with electronic components that allow more efficient operation at a significantly higher frequency
- Minimize ballast hum of earlier electromagnetic "core and coil" laminations, which increased as the lights were dimmed, facilitating fluorescent dimming in extremely quiet environments
- Operate as much as 30% cooler than standard electromagnetic dimming ballasts, saving on cooling costs and extending ballast life
- Weigh less than electromagnetic dimming ballasts, as little as half as much in some cases, offering lower shipping costs, easier handling and lower structural stress



Typical Control Types for Electronic Dimming Ballasts

2-Wire Dimming Ballast Control Dimming Technology



The 2-wire method of control requires no additional wiring between the fixture and the switch. The popular Advance Mark X® Powerline ballast operates in this fashion and makes it as fast and easy to install as fixed output ballast. Simply replace an incandescent fixture with a new fluorescent dimming fixture, change the wall switch to a compatible dimmer or other control – widely available with many choices from Leviton – and connect to existing leads.

It's also the most cost-effective fluorescent dimming choice for enhancing lighting and energy performance in fluorescent retrofit applications. Simply replace magnetic dimming or non-dimming T12 or fixed output T8 ballasts with Mark X® Powerline ballasts and T8 lamps, change the wall switch to a Leviton compatible dimmer or other control and connect the existing leads. (Note: Use ONLY Rapid Start Sockets as outlined in the "Design Considerations For A Successful Installation" section of this brochure.) This approach is used most often in areas where local control of single circuits will be employed



Compatible Leviton Controls:

Wallbox Dimmers			Power Extender
Cat. No.	Rating	Description	PE200-1 for 120V applications PE200-7 for 277V applications
MNX10-1L	1000VA, 120V	Monet™	
MNX15-1L	1500VA, 120V	Monet™	
MNX20-7L	2000VA, 277V	Monet™	
MNX30-7L	3000VA, 277V	Monet™	
26666-31	1200VA, 120V	Renoir™	
26666-37	1200VA, 277V	Renoir™	
MCX10-1L	1000VA, 120V	Mural™ Scene	
MLX06-1L	600VA, 120V	Mural™ L/S	
TPX06-1L	600VA, 120V	TouchPoint™	
TPX10-1L	1000VA, 120V	TouchPoint™	
IPX06-1L	600VA, 120V	IllumaTech™	
IPX10-1L	1000VA, 120V	IllumaTech™	
IPX12-7L	1200VA, 277V	IllumaTech™	
IPX06-7	600VA, 277V	IllumaTech™	

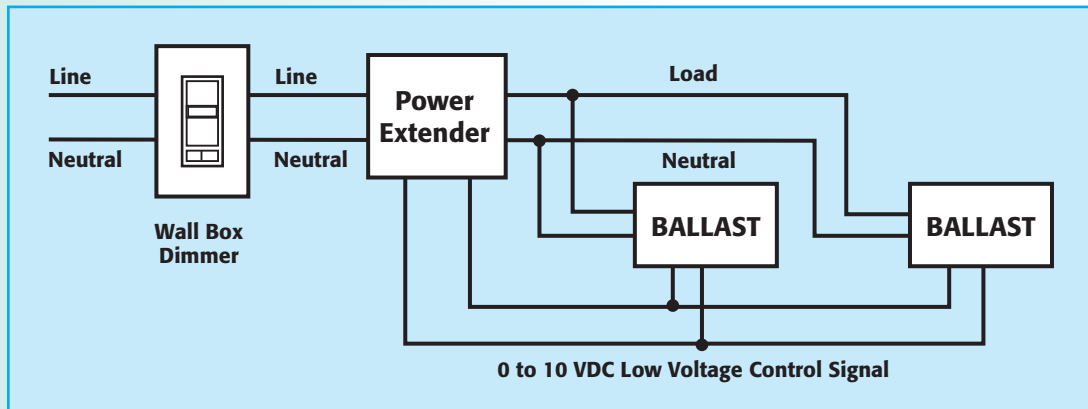
Architectural Controls			Power Unit Extender
Cat. No.	Rating	Description	PE200-1 for 120V applications PE200-7 for 277V applications
MNX10-1L	1000VA, 120V	Monet™	
MNX15-1L	1500VA, 120V	Monet™	
MNX20-7L	2000VA, 277V	Monet™	
MNX30-7L	3000VA, 277V	Monet™	
26666-31	1200VA, 120V	Renoir™	
26666-37	1200VA, 277V	Renoir™	
Any Dimensions Series Multizone Dimmer/Controller			
a-2000 Dimmer System			
MDS System			
I series e Dimmer System			

Total Building Lighting Control System
a-2000 Dimmer System
MDS System
I series e Dimmer System

Remote Control Via Computer
a-2000 Dimmer System
MDS System
I series e Dimmer System

Theatrical Controls
I series e Dimmer System

4-Wire 0-10V Dimming Ballast Control Wiring Scheme



Designed to operate with linear fluorescent and 4-pin compact fluorescent lamps, the Advance Mark VII® 0-10V, OSRAM Sylvania Quicktronic® Helios™ and other similar 4-wire electronic 0-10V family of dimming ballasts, provide 100-5% full-range dimming for T8 and Compact Fluorescent bulbs and 100-1% full-range dimming for T5/HO bulbs for flexibility and energy efficiency. In the 4-wire control scheme, two wires are used to provide the line voltage to the ballast and two wires are used to control the low voltage dimming signals to the ballast. It requires that the line voltage wired to the ballasts be switched ON for operation, and OFF to achieve zero light level and to de-energize the ballast for service. The 0 to 10 volt DC low voltage control signal sent to the ballast determines the light level. If the positive and negative control wires are left open, the light level is FULL BRIGHT and when connected (shorted), the light level is OFF (or minimum). Depending on the manufacturer of the wall box dimmer used, usually a device such as a power extender/interface is used to provide and connect the additional 2 wires required. Some versions of the 4-wire scheme employ a digital signal rather than a 0-10 volt DC signal on the low voltage wires. These "digital" dimming ballasts are discussed in the DALI section on page 10.

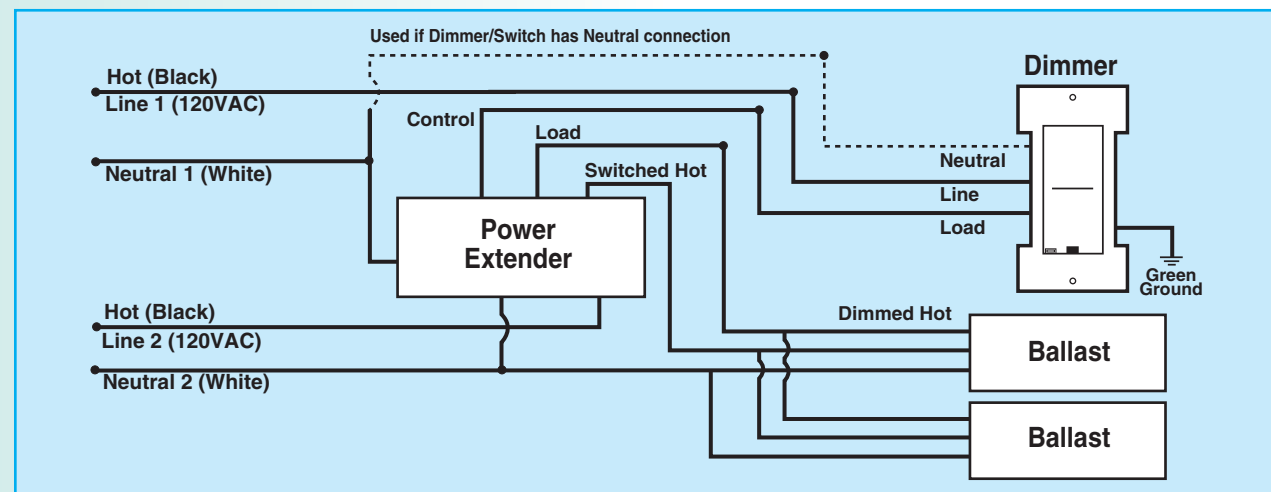
These ballasts allow you to dim a variety of lamp types from a single control. Reflecting open standards, they also afford a choice of compatible controls with a broad selection available from Leviton. Units like the Mark VII® 0-10V work well with Building Management Systems and other centralized controls or sensors. New energy conservation technologies like daylight harvesting systems require low voltage control and thus necessitate this type of dimming ballast. These ballasts are often used to control multiple circuits within a single zone unlike the Mark X® Powerline ballast mentioned above which is better suited for single circuit control. Also, when attempting to control fluorescent lamps of varying voltage on different circuits from the same control point, Mark VII® 0-10V type ballasts are the choice as one control signal can be utilized to control both 120V and 277V ballasts. While Mark VII® 0-10V type ballasts may be utilized for a retrofit, they require pulling control wiring from the ballast to the control. Unless required for a specific application, they would be more applicable to new construction.

Compatible Leviton Controls:

Wallbox Dimmers			Power Extender
Cat. No.	Rating	Description	
IP710	1200VA-120VAC/ 1500VA-277VAC	IllumaTech™ Preset, Single Pole & 3-Way	N/A
The PE300 Power Extender makes any Leviton box mount dimmer compatible with the Advance Mark VII® 0-10V ballast* [*Compatibility: Must use a 120V, 600W incandescent version from the following families: IllumaTech™ (except Cat. No. IP710), Mural™, True Touch™, Toggle Touch™ and TouchPoint™. For Monet™ installations use a 120V 600VA Monet Magnetic Low-Voltage dimmer (requires a neutral wire). For dimmers that include a Neutral wire (such as scene capable dimmers), the dimmer neutral wire must be connected.]			PE300 Required
Total Building Lighting Control System			
a-2000 Dimmer System MDS System Centura Fluorescent Control System			
Architectural Controls			
a-2000 Dimmer System MDS System			
Any Dimensions Controller/Dimmer Series			PE300 Required for D3200 Series
Fluorescent Energy Management/Daylight Harvesting Systems			
Centura Fluorescent Control System			
Remote Control Via Computer			
a-2000 Dimmer System MDS System Centura Fluorescent Control System			



Proprietary 3-Wire Dimming Ballast Control Dimming Technology

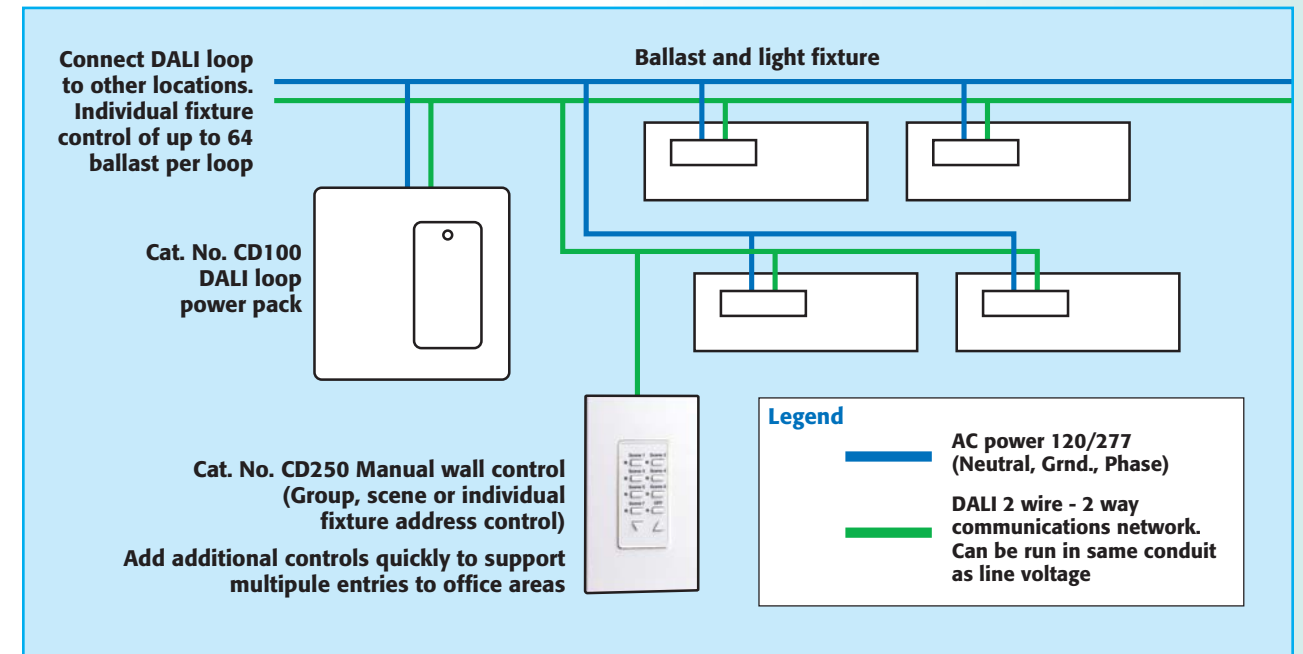


This method of control is used with Lutron Hi Lume™ and Lutron Eco 10™ ballasts (and older core and coil type magnetic dimming ballasts). It uses 3 wires to the dimming ballast. One is a fixed unvarying “line” voltage which switches power ON/OFF, another a dimming variable phase controlled “line” voltage wire and a neutral wire. Because of the 3-wire configuration of the power wiring, this type of ballast requires a special fluorescent wall box dimmer with limited availability from wall box dimmer manufacturers other than the ballast manufacturer. Wall box dimmers designed to control this type of fluorescent dimming ballast have some form of low end trimpot (electrical or mechanical) to set the minimum light level or RMS voltage as specified by the ballast manufacturer. Please note that Leviton dimming systems can readily and successfully control these loads.

Compatible Leviton Controls:

Wallbox Dimmers	Power Extender
When used with the PE200 power extender, The following Leviton Mark X 120V 600VA dimmers are capable of controlling Hi-Lume and Eco-10 Ballasts: Monet, Illumatech, Mural and TouchPoint	PE200 Required
Total Building Lighting Control System	
a-2000 Dimmer System MDS System	
Architectural Controls	
a-2000 Dimmer System MDS System Any Dimensions Controller Seires	PE200 Required for D3200Series
Remote Control Via Computer	
a-2000 Dimmer System MDS System	

DALI 4-Wire Digital Addressable Ballast Control Dimming Technology



Key to the DALI (Digital Addressable Lighting Interface) system is the combination of ballast switching and dimming via a control wire with digital signal ballast addressing. This enables different luminaires on the same circuit to be controlled independently and installations to be reconfigured without the need for costly wiring changes. In the DALI 4-wire control scheme, two wires are used to control the line voltage between the DALI loop power pack and the DALI ballasts and two low voltage wires transmit digital signals around the DALI loop for group, scene or individual fixture address control. DALI-compatible ballasts and controls have become available from all major U.S. manufacturers.

When tied to a building management system, the DALI system enables the building maintenance department to pinpoint the performance of each individual luminaire. The DALI system works with dimmer switches, multi-button scene controllers, occupancy sensors, daylight sensors and other DALI compatible devices as well as offering individual lighting control using desktop computers. The DALI protocol makes selective switching or dimming for the purposes of peak load shedding very simple.

Compatible Leviton Controls:

Wallbox Dimmers	Power Unit Available
Cat. No.	Description
CD250	DALI Controller
	CD100 DALI Loop Power Pack

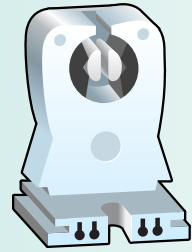
Design Considerations For A Successful Installation

Following are a few simple design considerations that can help to assure a successful installation:

- **Employ Rapid Start Knife Edge Sockets Only**

Dimming Ballasts need to make good contact with both lamp pins to heat the lamp filaments correctly. Poor contact can lead to premature failure in a matter of weeks. For good filament contact and correct wiring to produce flicker-free dimming and ensure long lamp life, use only Rapid Start Knife Edge Sockets. A knife-edge socket makes superior contact with the lamp pin by contacting with a sharp edge rather than a flat surface.

Knife-edge socket

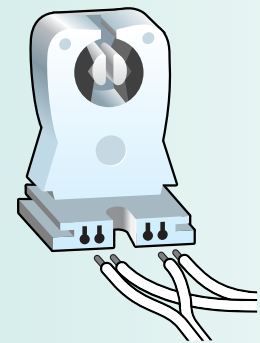


Flat-edge socket

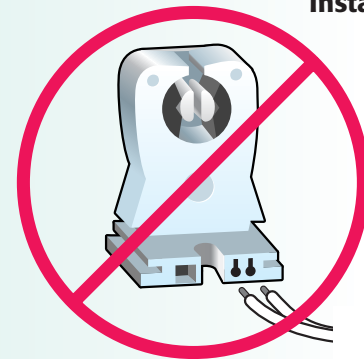


Also, Instant Start Sockets can only accept 2 wires (1 wire from the ballast and 1 wire to another lamp) and need to be replaced with Rapid Start Sockets. Rapid Start Sockets can accept 4 wires (2 for wires from the ballast and 2 for wires to another lamp).

Rapid Start Socket



Instant Start Socket



- **Stay Within Maximum Lead Lengths**
(Ballast to Lamp)

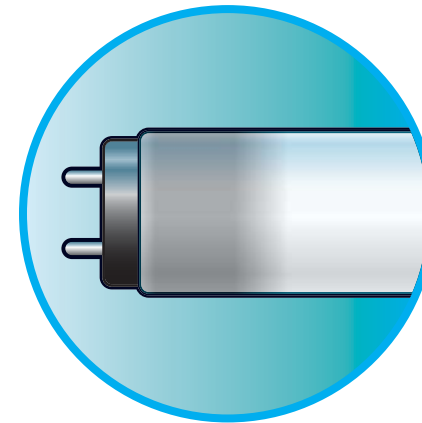
Capacitance on the ballast leads reduces the voltages supplied by the ballast to the lamp as the lead lengths are increased. At low light levels, this is a critical issue with dimming ballasts. Exceeding these maximum lengths can lead to lamp flicker, improper lamp starting and reduced lamp life. Check with ballast manufacturer regarding the maximum lead length for your lamp type and ballast before commencing any retrofit.

- **Double Check Wiring**

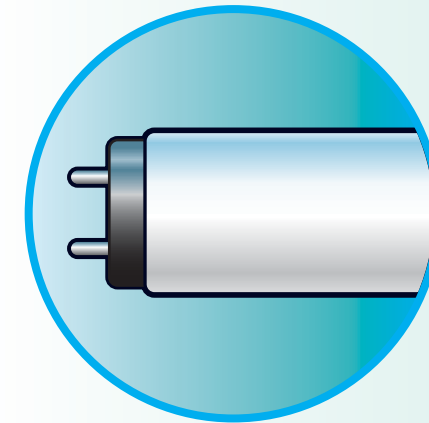
One of the major sources of ballast failure is from incorrect wiring. Double check wiring diagrams before and after jobs are completed to avoid easily avoidable mistakes.

- **Season New Fluorescent Lamps**

Some fluorescent lamps contain impurities that cannot be completely purged by lamp manufacturers. Leaving the lamps on at full intensity for 100 hours before dimming can neutralize the detrimental effects of these impurities. Not doing so may cause premature lamp failure within weeks or several months. According to many lamp manufacturers, this is no longer true for most of their linear bulbs but is still needed for compact fluorescents. Contact your lamp manufacturer for their latest recommendation.



Unseasoned Lamp
(Darkens from impurities)



Seasoned Lamp





Centura Fluorescent Energy Management System

The new Centura modular Fluorescent Energy Management System for dimming fluorescent ballasts makes a decisive new contribution to corporate cost reductions by raising worker productivity through greater individual control over lighting and by lowering the energy cost of energy-saving fluorescent lighting even further by offering a fully automated lighting control system that factors in available free natural daylight with the precise control of fluorescent lighting levels to maintain a pre-selected level of illumination.



a-2000 Dimmer Cabinets

Providing theatrical grade performance and reliability at commercial grade pricing, compact, easy-to-install digital a-2000 modular dimmer cabinets work with virtually any type of lighting, including 120 and 277V AC dimmable fluorescent lamps, and can be integrated seamlessly with preset control systems, manual controls, building automation systems, time clocks, hand-held remotes, photocell energy conservation systems or any other type of required control system.



Fluorescent Box-Mount Dimmers

Leviton's box-mount dimmer controls for fluorescent lighting are offered in Architectural Specification, Mural™, Touch and Traditional groupings. They provide full-range dimming in single-pole, three-way, four-way and multi-location switching schemes and feature digital microprocessor state-of-the-art circuitry and styling for use with Decora wallplates.



Dimensions D4200 Architectural Lighting Control System

Designed for larger commercial and residential applications, Leviton's Dimensions D4200 Architectural Lighting Control System is a system-based multi-zone dimming system that works with dimming/switching panels to allow for the creation and selection of preset lighting scenes throughout a room or group of rooms. The system can control 32 zones and includes such useful features as remote control, an attractive wall-mount scene controller, a PC interface, On/Off scheduling using a built-in astronomical clock and additional customization. It can control virtually any type of lighting, including 120 and 277V AC fluorescent lamps.



Dimensions D3200 Architectural Lighting Control System

The Dimensions D3200 system takes self-contained preset scene-dimming systems for smaller installations to the next level, with features and power never before available in a stand-alone controller. The system features 6 internal zones. Programming and setup functions are built in with easy-to-use wizards with on-screen information to guide you every step of the way. A built-in astronomical clock enables time-driven event control, and even room combination functions are incorporated into the D3208, all with no external hardware. It can handle virtually any type of lighting including 120V AC Mark X fluorescent as well as Mark VII and 277V AC Mark X when used in conjunction with an optional Power Extender unit.



Dimensions D8000 Scalable Control System

The Dimensions D8000 is the most flexible and scalable control system available on the market today. It's distributed processing design and network topology bring the power of networked computing to the lighting realm. D8000 easily integrates architectural, theatrical and conservation lighting control requirements into one cohesive system. Advanced programming software enables any button to execute any system command, enabling the system to precisely meet the user's requirements. Whether controlling two or two thousand dimming channels, D8000 provides the ultimate in control and flexibility.



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