PROJECT REPORT

SMART CORRIDOR LIGHTING

A SAMPLE OF PRODUCTS AND DESIGN STRATEGIES FOR RETROFIT AND NEW CONSTRUCTION PROJECTS

CLTC
CALIFORNIA LIGHTING TECHNOLOGY CENTER

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ABOUT CLTC

The California Lighting Technology Center's mission is to stimulate the development and application of energy-efficient lighting by conducting technology development and demonstrations, outreach and educational activities, in partnership with lighting manufacturers, lighting professionals, the electric utility community and governmental agencies. CLTC was established as a collaborative effort between the California Energy Commission and UC Davis, with support by the U.S. Department of Energy and the National Electrical Manufacturers Association (NEMA).

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1.0 EXECUTIVE SUMMARY

The PIER Demonstration program partnered with the University of California, Davis (UCD) to demonstrate both new construction and retrofit design strategies that provide dual light levels based on occupancy sensing that is appropriate for the interior corridor application. This demonstration project consists of a one-to-one retrofit of existing fluorescent luminaires with either new fixtures or new components for three corridor areas in Bainer Hall. This project is intended to demonstrate the energy savings that can be achieved by using occupancy-based controls for interior corridor applications. Furthermore, it is the hope of the demonstration program that UCD considers these technologies in future retrofit and new construction projects. In particular, the following recommendations should be considered as viable, visually pleasing alternatives to simple luminaire delamping.

The project team identified three areas for demonstration of the chosen technologies to represent approaches used to achieve bi-level lighting based on occupancy. These areas are the following corridors in Bainer Hall on the UC Davis campus: Rooms 1312-1335, Rooms 1032-1072 and Rooms 1103-1151. Lighting, energy, and economic analyses were completed for this demonstration area.

Three technologies were installed and analyzed for these three demonstration sites. These technologies are 1) LaMar Occu-smart DROS fixture with an integrated ultrasonic occupancy sensor and bi-level dimming ballast 2) Adura's wireless, zonal occupancy sensing solution coupled with bi-level dimming ballasts and 3) a wired fixture-integrated microwave occupancy sensing solution from Wattstopper coupled with bi-level dimming ballasts. During occupied periods, the luminaires provide full light output, and during vacant periods, the luminaires reduce light and power levels to a lower level. The three bi-level lighting strategies in this demonstration are appropriate for new construction and retrofit projects.

Many corridors on campus have undergone systematic delamping or similar lighting reduction strategies designed to cut energy consumption, regardless of reductions to light levels or visual uniformity. In comparison to such a reduced baseline, energy savings for the proposed bi-level lighting strategies is generally 25%; although, project payback calculated under such conditions is exceptionally long. The corridor lighting in Bainer Hall, operating under these deteriorated conditions, does not provide a realistic baseline for reference on future campus lighting projects. Therefore, estimated energy savings and project payback are calculated based on a fully functional baseline design, with existing luminaires fully lamped and operating as originally intended. Comparing the energy savings of the installed systems against the aforementioned "full baseline" shows that the project payback ranges from 4.5 to 8 years based on which solution is installed.

2.0 PRE-RETROFIT CONDITIONS

The bi-level corridor lighting demonstration at Bainer Hall consists of three distinct areas. The two types of luminaires present in these corridors are a suspended direct pendant with acrylic lens and a recessed 1'x4' troffer with either a flat or dropped lens. Each of the three areas received a unique bi-level lighting strategy.

One demonstration area appropriate to display a pendant fixture *replacement* is in the "shop area" of Bainer Hall. The corridor is approximately 100 feet long and was illuminated by 8 – 4 lamp fluorescent luminaires, which were delamped by half. The second demonstration area is for a pendant fixture *retrofit*. The corridor is approximately 193 feet long and is lit by 19 – 4 lamp fluorescent luminaires, which were delamped by half. The final area is two identical corridors, which were chosen to demonstrate two unique *recessed fixture* solutions. Each corridor is approximately 115 feet long and lit by 11 – 4 lamp fluorescent luminaires, where half of the luminaires were fully delamped and the remaining luminaires delamped by half for a total of 75% lighting reduction. Photos of the pre-retrofit luminaires are shown below.

Figure 1: Fluorescent pendants and recessed troffers at Bainer Hall

Retrofitted pendant luminaires are 4 – lamp tandem fixtures from Globe Illumination Company that were delamped by half during a previous energy conservation project. The recessed fixtures are of undetermined brand, initially a 4 – lamp fixture that was half disabled and the remaining side delamped to one lamp during previous retrofits.

Corridor lights stay on all the time; approximately 8760 hours per year. IESNA recommends a minimum maintained horizontal illuminance of 10 foot-candles at grade for basic or typical installations in educational facility corridors.

The original lighting demanded 5.9 kW of electricity. Delamping reduced this baseline to 1.5 kW of electricity. Pre-retrofit annual consumption was approximately 12,952 kWh of electricity. The approximate power density of the corridors, based on the maximum connected load of the luminaires, is approximately 1.13 watts per square foot (W/ft^2). The current version of California Title 24 requires the illumination requirement of no more than 0.6 W/ft^2.

Table 1: Pre-Retrofit Bainer Hall Corridor Lighting

	Original Construction		Delamped System	
	Pendant	Recessed	Pendant	Recessed
Number of Luminaires	27	22	27	22
System Wattage (W)	118	124	29.5	31
Total Connected Load (W)	5,914		1,479	
Site Area (Square Footage)	5,230		5,230	
Power Density (W/Square Foot)	1.13		0.28	
Annual Energy Consumption (kWh)	51,807		12,956	

3.0 DEMONSTRATED TECHNOLOGIES

The pre-existing corridor lighting remained on at full power and light output twenty-four hours a day regardless of occupancy. This practice wastes energy. The following recommended PIER technologies and design practices provide solutions that solve this problem. The lighting strategies consist of bi-level ballasts and occupancy based controls allowing luminaires to maximize energy savings during vacant periods with a limited impact on building occupants. All proposed strategies utilize occupancy sensors to control light output based actual corridor use. The different sensors demonstrated in this project use either passive-infrared (PIR), ultrasonic motion sensing (US) or microwave technologies. Each sensor is used to switch light output from 50% power consumption while unoccupied to 100% while occupied when used in combination with the specific bi-level electronic ballast in this demonstration. Bi-level programmed-start ballasts maximize lamp life, reduce energy use and allow for stepping of light from a low-level to 100% based on corridor occupancy.

The installed technologies include 1) LaMar Occu-smart DROS fixture with an integrated US occupancy sensor and bi-level dimming ballast, 2) Zoned control strategy with a ceiling mounted PIR occupancy sensor equipped with Adura wireless sensor interfaces that communicate with individual luminaires equipped with Adura wireless receivers, and 3) an integrated microwave occupancy sensor by Wattstopper that mounts inside individual luminaires. The approximate power density of the corridors, based on the maximum connected load of the retrofitted systems is 0.55 watts per square foot (W/ft^2).

3.1 PENDANT LUMINAIRE RETROFIT SOLUTIONS

3.1.1 PENDANT LUMINAIRE REPLACEMENT: LAMAR DROS OCCU-SMART

The LaMar DROS luminaire is a fluorescent pendant that provides direct/indirect light distribution, occupancy sensing through an integrated US sensor, and step dimming through the use of a bi-level ballast option. The installed solution is four feet long and contains two 32W T8 lamps. The recommended ballast option has an adjustable low-end light level; the low-end (vacant mode) light level may be set at 5%, 10%, 20%, or 30% of nominal output. This installation was commissioned at 10%. The fixture also includes a patented lamp-conditioning circuit that holds the lamps on for 100 hours to ensure adequate burn-in time, which increases lamp life.

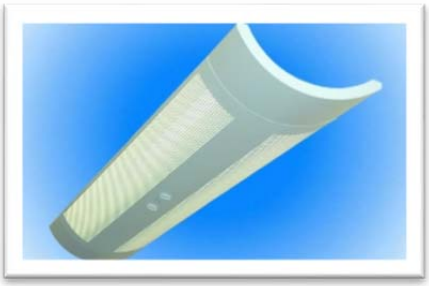


Figure 2: LaMar DROS Fixture with integrated US occupancy sensor and bi-level ballast

3.1.2 PENDANT LUMINAIRE RETROFIT: SENSOR AND BALLAST

The existing pendant luminaire is manufactured by Globe Illumination Company. By replacing the ballast and adding an integrated microwave occupancy sensor, bi-level dimming based on occupancy is achieved without the need to replace the entire luminaire. The occupancy sensor used in this retrofit is the Wattstopper FM-105. The microwave technology used by the sensor

allows for installation inside the fixture, eliminating the need for diffuser modification. The bi-level ballast for this retrofit is the Quicktronic Prostart T8 Quickstep bi-level dimming ballast.

Figure 3: Fixture-integrated solution

3.2 RECESSED LUMINAIRE RETROFIT SOLUTIONS

3.2.1 RECESSED LUMINAIRE RETROFIT: WIRELESS ZONE OCCUPANCY SENSORS

To retrofit existing recessed luminaires with a zoned occupancy solution, wireless interfaces by Adura Technologies, Inc, wireless light controllers by Adura, an Adura Gateway for data gathering, hallway PIR occupancy sensors by Sensor Switch and bi-level ballasts were installed in the corridor. This zonal solution allows for a retrofit that includes minimal wiring. Each luminaire required an upgraded ballast to allow for bi-level dimming controlled by the occupancy sensors. Each of the occupancy sensors is connected to a wireless interface that sends signals to the Adura relays inside each luminaire as well as communicating back to the Gateway to collect energy use and occupancy data.

Figure 4: Installed products for the zoned, wireless retrofit solution

3.2.2 RECESSED LUMINAIRE RETROFIT: INTEGRATED OCCUPANCY SENSORS

The final bi-level strategy for the retrofit of existing recessed luminaires includes the microwave occupancy sensor by Wattstopper (FM-105) that is mounted inside the existing fixture and a bi-level dimming ballast. This solution is identical to that solution for pendent luminaires as described in 3.1.2.

4.0 PROJECT MONITORING AND EVALUATION

Pre- and post-retrofit data was collected to verify corridor occupancy rates, luminaire operating schedules and refine the original energy savings estimates. Data loggers were attached to the demonstration area to collect occupancy data. These results will be used to demonstrate the benefits of the intelligent, bi-level lighting for corridor applications.

5.0 PROJECT SAVINGS

The lighting strategies implemented in this project were expected to achieve 60-70% energy savings over the original lighting design. These savings were based on an estimated corridor occupancy rate of 50%.

Post-retrofit monitoring shows that the specific corridors used in this demonstration were occupied an average of 18% over the monitored period. This resulted in 71-78% energy savings over the original lighting design.

Energy and cost savings, including simple payback, for each retrofit option is shown in the following table and is calculated compared to fully lamped, existing systems. The following calculations assume $0.08 per kWh energy cost, and include actual material and labor costs for this installation. Additional savings can be achieved by applying for local utility incentives for energy efficiency measures.

Table 2: Economic Analysis for Bainer Hall Corridor Lighting Solutions

	Number of Fixtures	Installation Labor	Materials	Total Project Cost	Energy Savings	Project Payback
Shop Corridor						
Pendant Replacement	8	$1,372	$2,680	$4,052	78%	7.9
Pendant Retrofit	19	$3,259	$1,812	$5,071	71%	4.5
Classroom Corridor						
Recessed Retrofit (Wireless)	11	$1,887	$1,049	$2,936	73%	4.2
Recessed Retrofit (Integrated)	11	$1,887	$1,667	$3,554	71%	5.3

6.0 APPENDIX: PRODUCT SPECIFICATION SHEETS

DROS SERIES

DURADO

Job Name	
Catalog Number	
Notes	Type

SHOWN WITH OPTIONAL SCOOP END

application

- Attractive and versatile direct/indirect luminaire offers a broad range of configurations, and may accommodate up to (4) T8 lamps to provide maximum uplite with diffused downlight for a balanced appearance
- Suspended mount as individual units or continuous rows
- A unique bi-level luminaire controlled by an integral ultra-sonic motion sensor, designed to provide safe, dependable illumination while conserving energy
- Bi-level fixtures operate at a low standby light level, offering safety and security with full light output instantly upon occupancy with areas fully lit only as needed
- Ideally suited for corridors in office buildings, hotels and apartment complexes where maxium light levels are not required on a constant basis
- The ultra-sonic sensor features enhanced sensitivity and a lamp conditioning circuit (patented) that keeps new lamps on for 100 hours to assure long lamp life and proper operation
- For safety and compliance purposes in areas designated as emergency egress, we recommend choosing a standby light level that will provide minimum code compliant light levels while in the standby mode. In most municipalities, this is 1 FC average (2 FC in NYC.) See back for options

Protected by one or more US Patents Nos. 7,271,543 & 7,081,715

finish

- Prior to painting, all metal parts are treated with a multi-stage phosphate bonding process to ensure adhesion and inhibit rusting
- All exterior parts are finished with white powder coat for durability and a clean finished appearance
- Custom colors and textures are available, consult factory for minimum quantities and lead-time

construction

- The DROS series is a premium grade fluorescent luminaire specifically designed for long-term, dependable service
- Features durable cold rolled steel body, semi- perforated diffuser, quality paint finish and superior electrical components
- Electrical compartment manufactured from code gauge steel for premium strength and rigidity
- Utilizing interlocking ends, continuous runs of any length may be constructed
- 50" Adjustable aircraft cable kit included, may be stem mounted - consult factory
- Individual units are available up to 8' in length
- Choice of flat or scoop style end caps
- All fixtures are U.L. listed and IBEW union made

occu-smart technology

electrical

- All electrical components are U.L. listed
- Ballasts are class P, thermally protected T8 Electronic
- Numerous options are available, including Emergency battery pack see ordering information on back

baffle

- Lateral light distribution through side perforations for soft downlight
- Full indirect is available, consult factory

sensor

- High frequency, extremely sensitive ultra-sonic, internally mounted
- LED status indicator light
- Exclusive lamp conditioning circuit (patented)
- Integral directional cones to optimize detection range in corridors
- New fail-safe feature switches light level to high (100%) if sensor is physically damaged
- New 5 minute walk-test feature, easy-set time and sensitivity controls, compact design

LaMar Lighting

sensorswitch

LOW VOLTAGE PASSIVE INFRARED HALLWAY SENSOR

TECHNICAL DATA

TYPICAL APPLICATIONS

- Hallway Sensing

FEATURES

- PIR Occupancy Detection
- Coverage up to 130 Feet
- Communicates with Other Sensors
- Programmable w/o removing cover
- Time Delay: 30 sec. to 20 minutes, selectable in 2.5 min. increments
- Green LED Activity Indicator
- 100 Hr. Burn-in Timer Mode

AVAILABLE OPTIONS

- Isolated Low Voltage Relay (-R)
- Photocell Daylight Override (-P)
- Low Temp/Hi Humidity (-LT)

SPECIFICATIONS

- Size: Rectangular, 3.0" x 3.6" x 1.75" (7.62 cm x 9.14 cm x 4.45 cm)
- Sensor Weight: 4 Ounces
- Sensor Color: White
- Mounting: 7 to 10 ft in Corner or Ceiling using bracket (WV-BR)
- Relative Humidity: 20 to 90% non-condensing
- Operating Temp: 14° to 160° F (-10° to 29° C)
- Storage Temp: -14° to 160° F (-26° to 71° C)
- Operating Voltage:12 - 24 VAC/VDC
- UL and CUL Listed
- 5 Year Warranty
- Made in U.S.A.

LOW TEMP/HI HUMIDITY(-LT)

- Conformally coated Circuit Board is corrosion resistant from moisture
- Operates down to -40° F(-40° C)

HW-13 SERIES

Programmable Edition!

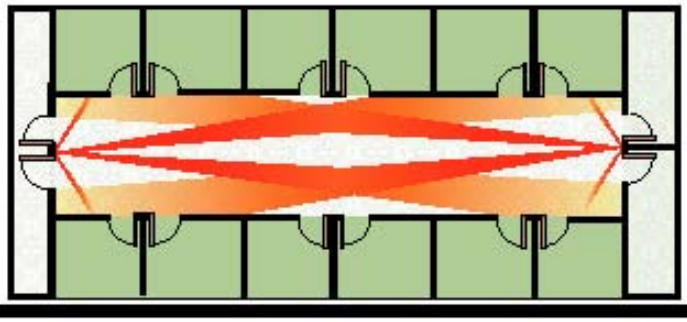
Long narrow Passive Infrared (PIR) detection is provided by the *HW-13* for control of Hallway lighting. Typically mounted at either end of a long corridor, the HW-13 detects occupants entering the hallway up to 130 feet away. Detection at these distances is for entrances at right angles to the beam pattern. Wired in parallel, the *HW-13* may be used with other low voltage sensors. For example, a CM-10 ceiling sensor may be in a vestibule at one end while the *HW-13* is at the other. The *HW-13* is best mounted at 7 feet.

SENSOR OPERATIONS

The sensor detects changes in the infrared energy given off by occupants as they move within the field-of-view. When occupancy is detected, a DC output goes high and can drive up to 200 mA of connected load. The sensor is powered with 12 to 24 VAC/VDC and typically operates with a PP-20 or MP-20 Power Pack; enabling complete 20 Amp circuits to be controlled. An internal timer, factory set at 10 minutes, keeps the lights "On" during brief periods of no activity. This timer is selectable at 2.5 minute increments from 30 seconds to 20 minutes, and is reset every time occupancy is re-detected. This state-of-the-art design requires no manual field adjustments.

PASSIVE INFRARED DETECTION TECHNOLOGY

The *HW-13* has one main PIR collector beam. Motions are detected as occupants cross into or out of this beam. PIR detects motions across the beam much better than motions directly into the beam; therefore care must be taken to make sure the sensor is not viewing out the end of the corridor where crossing traffic provides stronger detection signals than occupants entering directly at the sensor. Positioning sensors at both ends and ensuring that they do not view out of the corridor will provide proper performance.



CATALOG INFORMATION

MODEL #	DESCRIPTION	TEMPERATURE	OP. VOLTAGE	CURRENT
HW-13	Passive Infrared Hallway Sensor	14° to 160° F	12 to 24 VAC/VDC	4 mA
Add suffix				
-R	SPDT Relay, 1 Amp			16 mA
-P	Photocell - Daylight Override			4 mA
-RP	Relay & Photocell			16 mA
-LT	Low Temp/High Humidity	-40° to 160° F		
Accessory				
WV-BR	Ceiling Mount Bracket			

T045-003-P

ADURA™
TECHNOLOGIES

WR10 CONTROLLER

Wireless Relay Controller

The Adura LightPoint System™ combines innovative wireless technology and simple installation to provide an economical digital lighting control solution for existing buildings.

Adura's WR10 family of products are low power wireless relay controllers used for precise control of individual light fixtures or simultaneous control of multiple fixtures, up to the rated load. The on-board relays are independently controlled and can switch any fluorescent electronic or magnetic ballast load. The WR10 controller is offered in a single relay or dual relay configuration to provide bi-level A/B switching control.

The WR10 controller incorporates wireless RF mesh networking technology—using the IEEE 802.15.4 standard—for fail-safe communication. By autonomously forming a self-healing, adaptive mesh network, communication over long distances and maintaining reliable connectivity, even in a difficult environment, is assured.

Once installed, the WR10 controllers can be combined with other Adura control hardware components in the Adura LightPoint System (ALPS) such as occupancy sensors, photo sensors, wall controls, gateways, and web-based software applications, to provide a complete, robust, digital lighting control system. The ALPS innovative design allows for flexible control of individual light fixtures, including automated schedules, central facilities control, and personal or shared occupant override controls. The Adura LightLogic™ Web-based software application provides an intuitive interface for zone setup, light scene creation, and real-time monitoring of energy use.

Applications:

- Commercial Office
- Education (K-12)
- Campus (University)
- Retail Big Box
- Warehouse

Features:

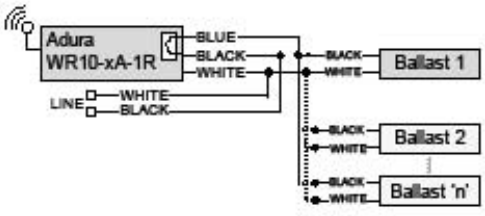
- Available in single-relay model (WR10-4.9A-1R) or dual-relay model (WR10-4.9A-2R) for independent bi-level switching and up to 9.8 Amps rated load (4.9 Amps per relay)
- Universally compatible with all non-dimming fluorescent ballasts (electronic or magnetic)—no ballast retrofit required
- Web-based control, configuration, and monitoring of facilities lighting using Adura LightLogic™ software
- Maintains lighting schedules, including weekend, holiday and other special exceptions
- Astronomical time clock for scheduled day-lighting control
- RF mesh networking technology using IEEE 802.15.4
- Integrated internal antenna

This device is compliant with FCC Part 15 and UL 508 specifications

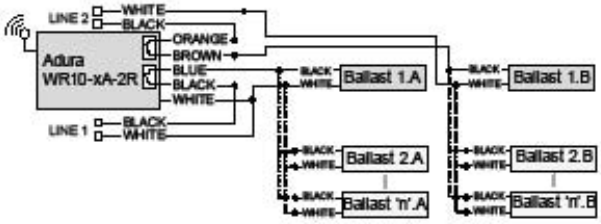
FC c UL us 3119435

Wiring Diagram:

Single Relay (WR10-xA-1R)



Dual Relay Bi-Level (A/B) Switching (WR10-xA-2R)



FIXTURE SENSORS

FM-105 Super High Frequency Occupancy Sensor

Product Overview

Description

The FM-105 Super High Frequency Occupancy Sensor is a line voltage sensor that turns lighting on and off based on occupancy, and can hold lights off when sufficient daylight is available. It detects motion via super high frequency (SHF) electromagnetic waves and the Doppler principle. Because it can detect motion through many dense materials other than metal, the FM-105 can be installed behind fixture lenses and hidden from view.

Operation

The FM-105 operates at 120 or 277 VAC and utilizes SHF technology to control lighting based on occupancy. It sends out electromagnetic waves that bounce off nearby surfaces, and uses the Doppler principle to analyze changes in the return waves to detect motion in the area (similar to the way that ultrasonic sensor technology performs). When motion is detected, the FM-105 turns on the load, unless the ambient light level is greater than the daylighting setpoint (if enabled), or turns off the load when no motion is detected for the preset time delay.

Flexible Functionality

The FM-105 Sensor coverage pattern is omnidirectional. Depending on its installation, it can be adjusted to detect occupancy up to 20 feet away. The FM-105 can be placed inside a lighting fixture or behind an object so that it is completely hidden from direct view. Its integrated daylight sensitivity adjusts from 2 to 200 footcandles, and its time delay may be set from 10 seconds to 30 minutes.

Applications

The FM-105 operates best when installed behind low-density fixture materials, such as polycarbonate, acrylic and glass diffusers. FM-105 technology also provides superior detection in hard surfaced areas such as stairwells and hallways. This sensor is also suited for installation behind lenses in outdoor wall sconces, wall packs and pedestrian-scale luminaires.

Features

- Detects movement when installed behind low-density fixture materials, such as polycarbonate, acrylic and glass diffusers
- Provides hold-off daylighting control when ambient light is greater than daylighting setpoint
- Can be mounted hidden from view
- Easy adjustment via trimpots
- Mounting bracket facilitates installation in various mounting positions
- Simple line voltage wiring does not require a power pack
- Time delay adjustable from 10 seconds to 30 minutes
- Adjustable sensitivity range up to 20 feet

www.wattstopper.com
866.588.5473

www.sylvania.com

QUICKTRONIC® PROStart® T8 QUICKSTEP® Bi-Level Dimming

NEMA Premium

Normal Ballast Factor

High Efficiency Series

QHES T8 BI-LEVEL

Lamp / Ballast Guide

Primary Systems
32W T8 - OCTRON®
2-lamp QHES2x32T8/UNV PSN-SC

Also operates:
FB032, FB031, F025, FB024, F017 & FBO16

NOTE: NOT FOR USE WITH ENERGY SAVING T8 LAMPS, (operation in bi-level mode will cause lamp instability and lamps may not start)

SYLVANIA QUICKTRONIC High Efficiency PROStart QUICKSTEP is a programmed rapid start electronic T8 ballasts that will easily switch from 100% to 50% power with standard wall switches. The QUICKSTEP ballast will operate the family of linear and U-bend equivalent T8 lamps at high efficiency. QUICKSTEP bi-level step dim ballasts are specifically designed to meet California's Energy Efficiency Standards (Title 24) for multi-level lighting controls, (Section 131). The combined lamp and ballast system offers a high efficiency system for T8 luminaires along with high performance features that are standard on SYLVANIA HIGH EFFICIENCY Series ballasts.

QUICKTRONIC QHE PROStart delivers an optimized programmed rapid start technology which extends T8 lamp life and allows over 100,000 switching cycles for occupancy sensor and building control systems applications.

The QUICKTRONIC PROStart QUICKSTEP ballasts also meets the requirements for the NEMA Premium Ballast, (NPB) program. The NPB program promotes the use of high efficiency T8 electronic ballasts by meeting or exceeding the Ballast Efficiency Factors, (BEF) established by the CEE, (Consortium for Energy Efficiency). For additional information on this program go to: *www.ceef.org or www.nema.org*

Key System Features

- QUICKSTEP Stepped Switching bi-level dimming (0.87 BF to 0.348F)
- High Efficiency Systems – over 90% efficient
- NEMA Premium Ballast compliant
- California Title 24 compliant
- PROStart Programmed Rapid Start
  - Extends lamp life
- Universal input voltage (120-277V)

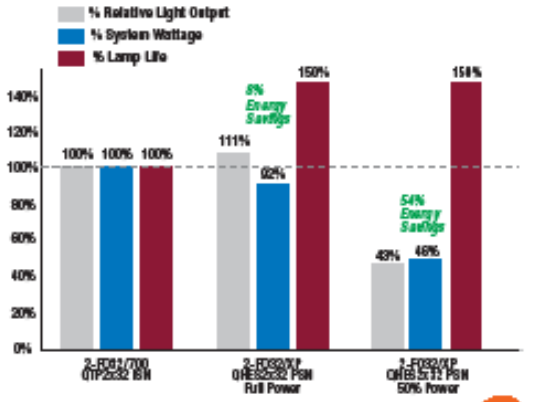
System Information

SYLVANIA QUICKTRONIC PROStart QUICKSTEP High Efficiency (QHES) ballasts operate from 120V through 277V, eliminating "wrong voltage" wiring errors and reducing the number of models in inventory by 50%.

QUICKSTEP QHES PROStart system has two AC line inputs in addition to the neutral wire. These AC line inputs must be connected to the same phase of the line voltage. The two line inputs can be configured to provide a bi-level light output system by wiring with two switches. When both switches are on, the lamps operate at full light output. When either switch is off, the lamps operate in a dimmed mode and the ballast wattage is reduced by 50%.

Alternatively, QUICKSTEP ballasts can be controlled by occupancy sensors allowing for customized zone controls and various energy saving configurations.

Lamp & Ballast Type	BF	Input Power (W)	Initial LPW	Mean System Lumens	Relative Mean Light Output	% System Power	% Energy Savings	% Lamp Life @3hrs/ Start
2-F032/700 QTP2x32 ISN	0.88	59	84	4435	100%	100%	0%	100%
2-F032/XP QHES2x32 PSN Full Power	0.87	54	97	4905	111%	92%	8%	150%
2-F032/XP QHES2x32 PSN 50% Power	0.34	27	76	1920	43%	46%	54%	150%



Application Information

SYLVANIA QUICKTRONIC PROStart T8 QUICKSTEP is ideally suited for:

- Office
- Schools
- Commercial
- Retail
- Occupancy sensor usage
- Building control systems
- Institutional

SEE THE WORLD IN A NEW LIGHT SYLVANIA

80