



# Automated Indoor Lighting Controls

Or the  
Lack  
Thereof

?





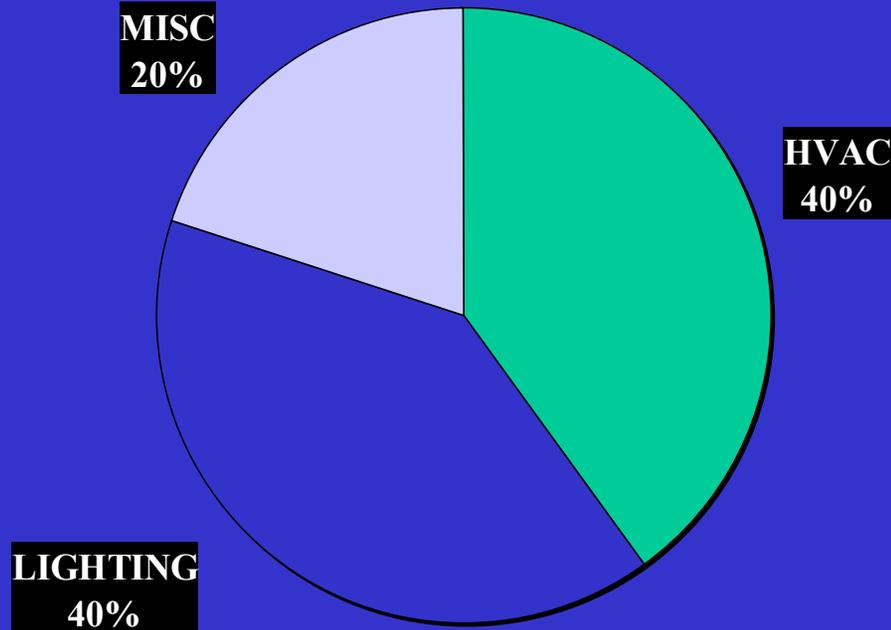
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# What Does it Actually Cost to Operate a Building?



# Typical Building Electrical Costs

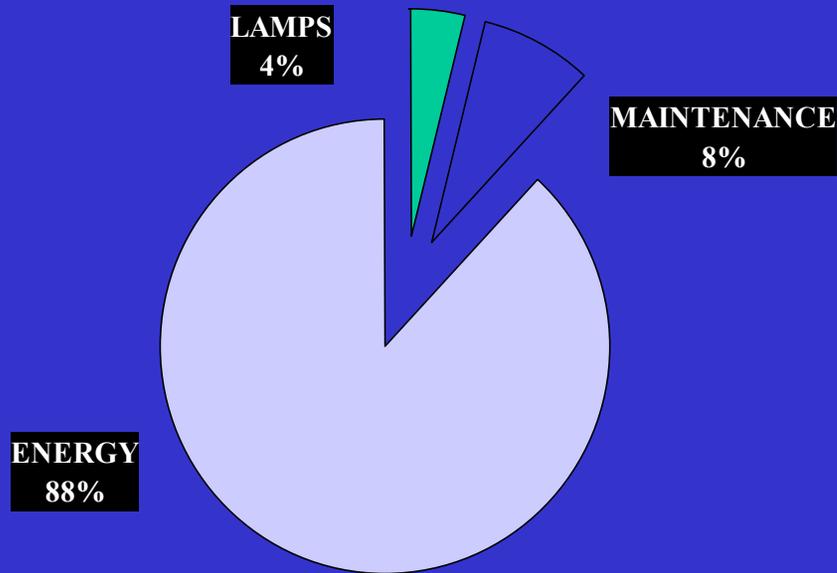
Source: Florida Power & Light Company





# What is the True Cost of Lighting

Source: Sylvania Lightign Services





# Turning Lighting Off Saves Money

**Lighting Energy Is Saved**

**Air Conditioning Energy Is Saved**

**Lamps Are Replaced Less Frequently**



**THE LIGHT SWITCH IS OBSOLETE**

**CONVENTIONAL**



# Control Options

Manuel Control

Mechanical/Wireless Programmable Time Clocks

Occupancy Sensors/Workspace Control

Daylight Harvesting/Photo Control

Building Automation Systems (BAS)

DALI System Control



# Mechanical Time Clocks

## Advantages

Simply to Install

Easy to Manually Change  
Time Settings

Inexpensive

## Disadvantages

Power Outages Affect Time  
of Day

No Daylight Savings  
Adjustment

Frequent Failures

Manual Adjustments Only

Not Reliable

No Contactors

Limited Scheduling



# Digital Time Clocks

## Advantages

- More Programming Options
- Automatic Daylight Savings Adjustment
- Manual Overrides
- Multiple Circuit Control

## Disadvantages

- Expensive
- Difficult to Program and Schedule
- Must Program On-Site
- Battery Backup Needed



# Wireless/Programmable Time Control Systems

Set with

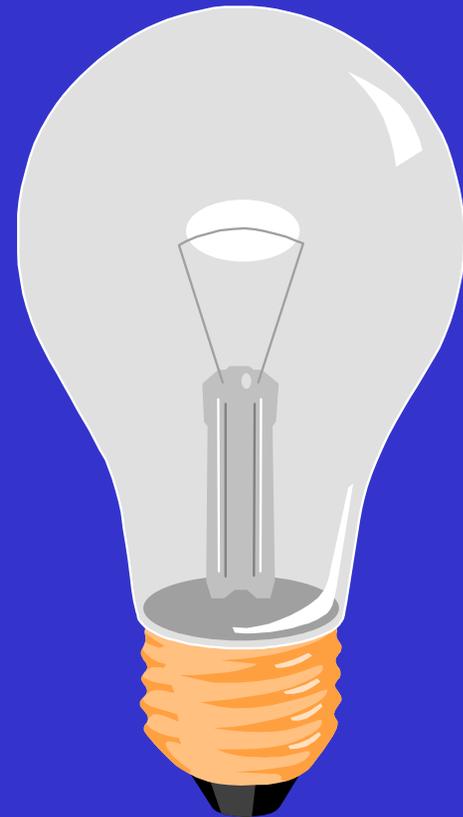
Longitude/Latitude

Adjust to Dusk, Dawn &  
Daylight Savings  
Automatically

Internal Clock Adjusted by  
Wireless Page

Internet Accessible

Lifetime Warranty





# Internet Accessible by Wireless Paging

Password Protected

Scheduling by Location

Serial #

7 Day Period/Up to 320

Settings

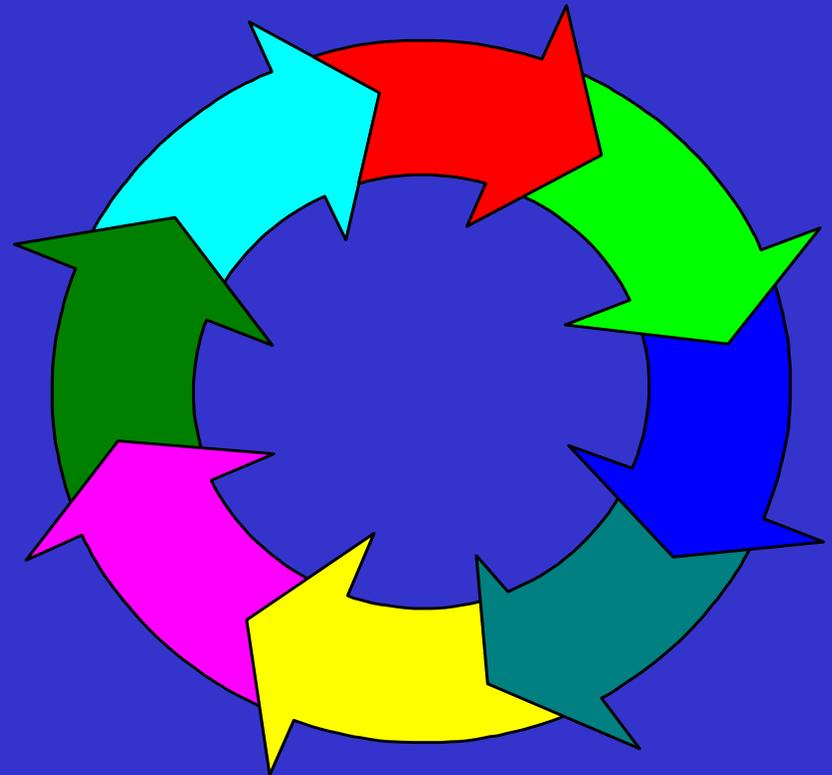
Easily Updateable

Signal Sent to Paging

Company

Paging Signal sent to

Receiver





# Occupancy Sensors Common Technologies

Passive Infrared

Ultrasonic

Microphonics

Dual Technology



# Sensor Considerations

Ability to Detect Minor Motion

Coverage Area Size and Pattern

Required Minimum Time Delay

Appearance and Size

Installation Ease or Difficulty

Return on Investment



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# Methods Comparison



# **Infrared or Ultrasonic**

**Performance More Important than Type**

**Both Are Motion Sensors**

**I/R Suitable for Small Rooms**

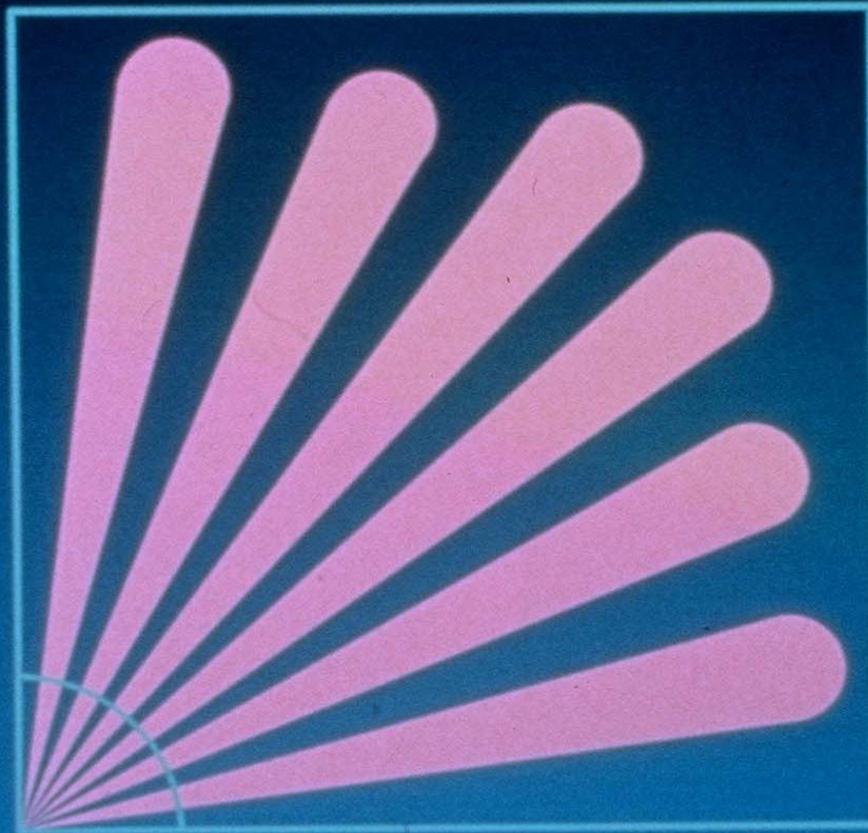
**Use Only U/S in Large Rooms, Classrooms**

**Always Test For Minor Motion Coverage**



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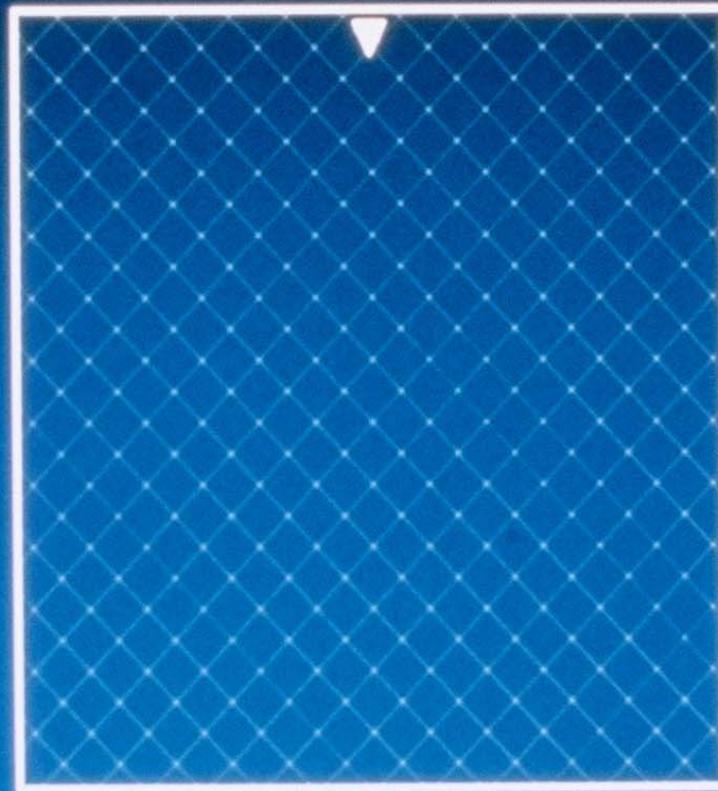
# PASSIVE INFRARED COVERAGE





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# ULTRASONIC COVERAGE





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# Application Guidelines

**Cover Entire Use Area**

**Select Correct Sensor Model**

**Design Coverage by Type of Motion**

**Avoid Air Vents**

**Don't Point Out Doors**

**Avoid Blocking Line of Site**



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# Selection of Good Applications

**Non - Predictable Occupancy  
Fluorescent/Incandescent/Multi-Level  
HID**

**150 Watts Minimum**

**Night Time Cleaning**

**Indoor Only**

**32 Degrees or More**



# Typical Savings by Area

## Percent Savings

Individual Offices.....	45%
Open/Partitioned Space.....	30%
Conference Rooms.....	50%
Classrooms.....	40%
Restrooms.....	60%
Corridors.....	35%



# Wasted Lighting In Offices

Period	Lighting Hours	Wasted Hours
8 AM - 12 Noon	4.0	1.0
12 Noon - 2 PM	2.0	1.0
2 PM - 6 PM	4.0	1.0
6 PM - 12 Midnight	3.0	2.8
Daily Hours	<u>13.0</u>	<u>5.8</u>
% of Daily Hours	100%	45%

Source: Novitas, Inc.



# Wasted Classroom Building Lighting

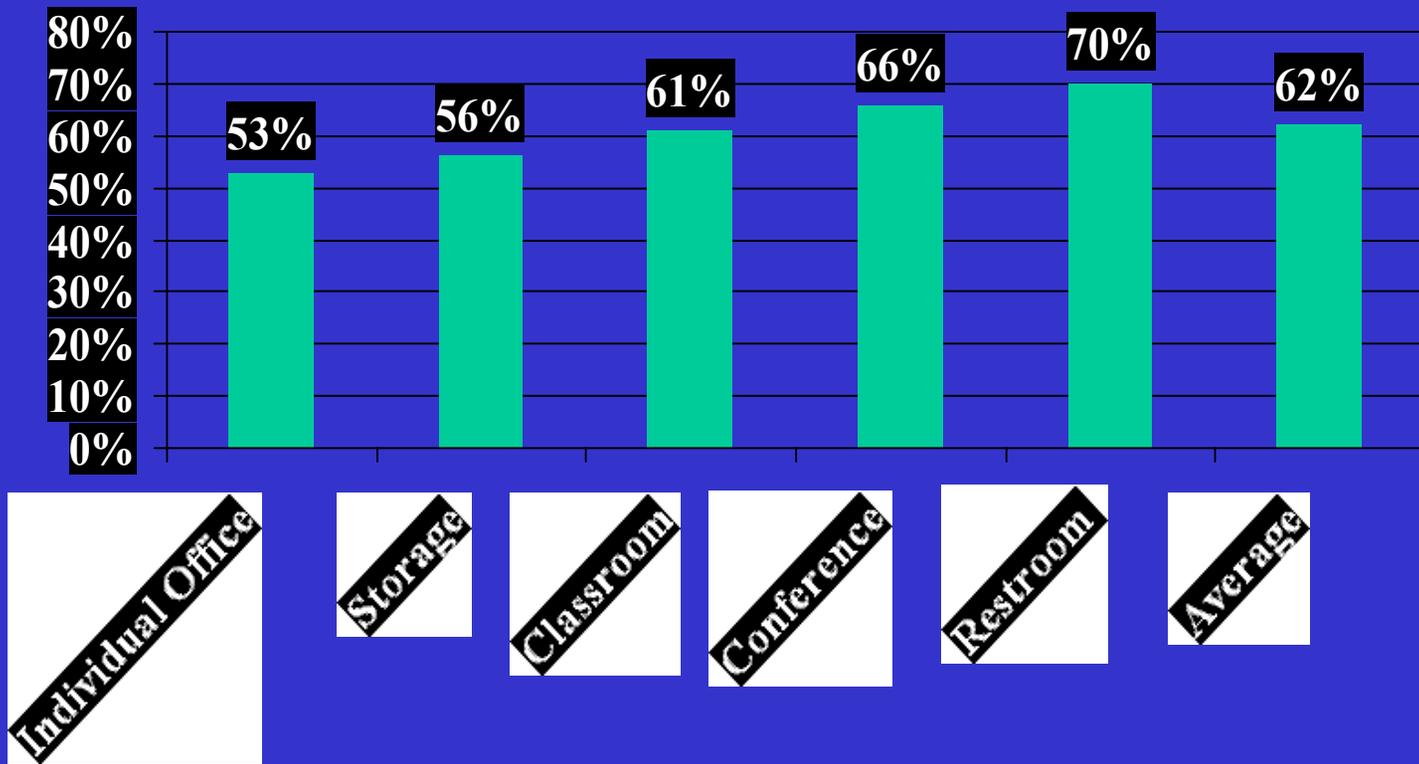
Source: California State Univ Study

	Hours Used	Hours Needed	Hours Wasted
Ground Floor	286	140	146
First Floor	165	98	67
Second Floor	181	98	83
Third Floor	<u>153</u>	<u>93</u>	<u>60</u>
Total Hours	785	429	356
<b>Percent Wasted</b>			<b>45.3%</b>



# EPA Monitored Occupancy Sensor Energy Savings

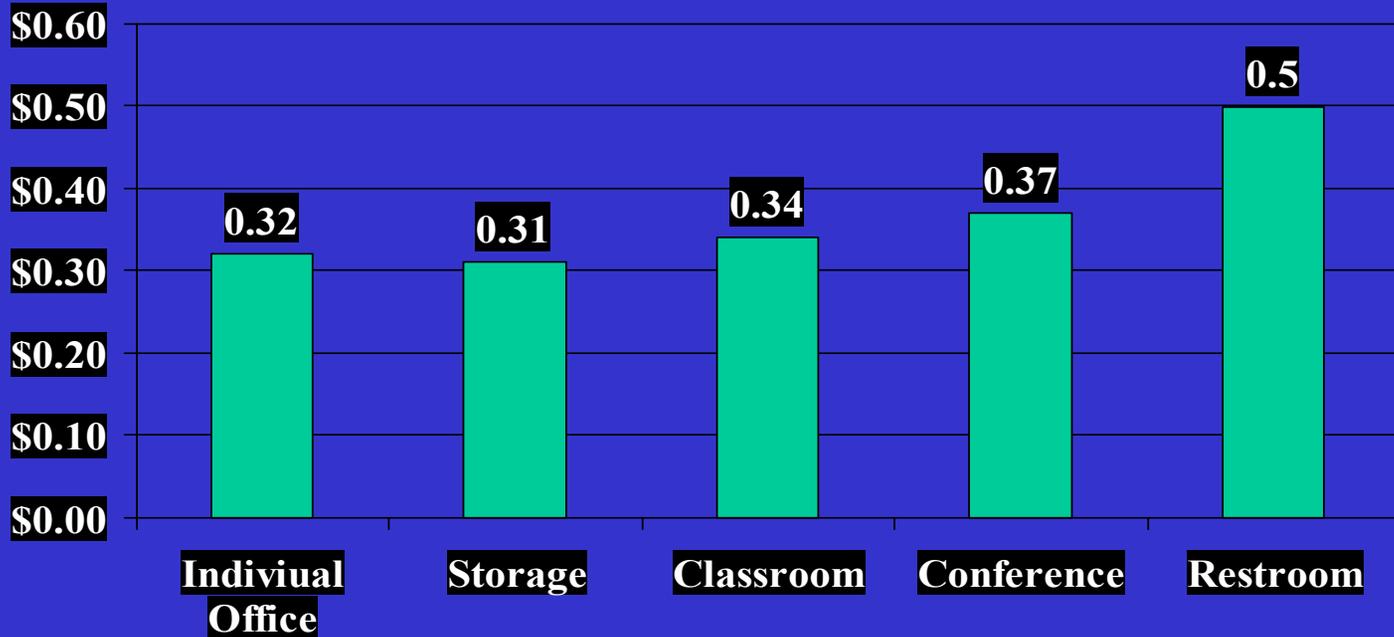
Source: EPA Greenlights Metered Test in 171 Sites - 1997





# EPA Monitored Occupancy Sensor Annual \$/Ft Savings

Source: EPPA Greenlights Metered Tests in 171 Sites 1997





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# Improved Security

Lights Are On Only When People Are Present

Security People Will Recognize Occupancy

Sudden Light Is A Deterrent

Central Control Panel Capability



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# Beware!

**Inability to Detect Minor Motion  
Coverage Gaps  
Exaggerated Coverage Claims  
Partial Room Coverage Advice  
Short Warranties**



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# Daylight Harvesting Product Summary

Photo - Sensors

Energy Management Sensors

Photo - Sensor Response Curves

Electronic Dimming Ballast Sensors

Control Panel Systems



# Indoor Photo - Sensors

## Characteristics

Mounted to Ceiling

Looking Down

Coverage in 60 Degree  
Cone

Typically Used with  
Dual- Set Point Controller

## Applications

Office Space

Classrooms

Typical Low Ceiling Type  
Application



# Outdoor Photo - Sensor

## Characteristics

Mount Horizontally facing  
North

Cone of Response is wider

Hooded to Provide Partial  
Shielding

Used with Single or Dual  
Setpoint Controllers

## Applications

Parking Lots

Garages

Greenhouses

Tunnels

Gas Stations

Convenience Markets



# Atrium Photo - Sensors

## Characteristics

Mounted Inside an Atrium

Mounted Facing Upward

Located Near the Upper  
Portion of Atrium

Used with Single or Dual  
Set-Point Controller

## Applications

Enclosed Atrium Areas



# Skylight Photo - Sensors

## Characteristics

Mounted Inside a Skylight

Located Near the Center of  
Skylight

Avoid Shading from  
Skylight Sides

Used with single or Dual  
Set-Point Controller

## Applications

Skylight Areas Only



# Energy Management Photo - Sensors

Photo-Diode Technology

Connection to Building Automation Systems  
(BAS)

Inputs Used for Day-Lighting Control

Inputs Used for Load Shedding Opportunities



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# Photo Sensor Response Curves

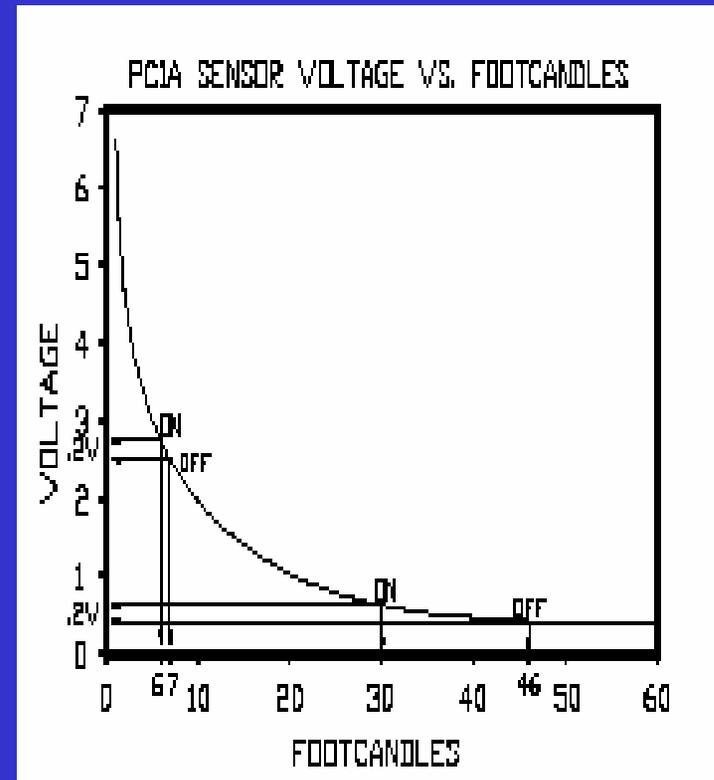
Photoconductive Response Curve  
Sensor

Photodiode Response Curve Sensor



# Photoconductive Light Sensor Characteristics

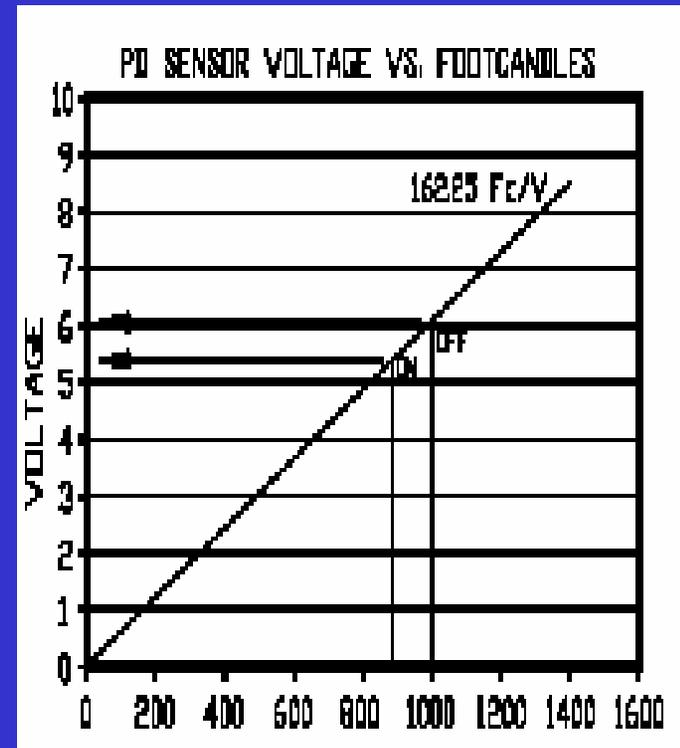
- Logarithmic Output
- Responds inversely proportional to light levels
- Have a fixed range
- Simple Installation





# Photodiode Light Sensor Characteristics

- Foot-candle/volts  
produced linear output
- Precise adjustment
- Simple adjustment
- Simple installation





# Electronic Dimming Ballast Sensors

**Proportional Dimming Capabilities**

**Adjustable to Available Daylight**

**Maximum Light Level is Set at Sensor Head**

**Control up to 80 Electronic Dimming Ballast with  
Single Sensor**



# Daylighting Design Considerations

**Closed Loop System:**

**Photo-Sensor Looks at Area to be Controlled**

**Open Loop System:**

**Photo-Sensor Looks at Conditions outside of Area Controlled**

**Consider Whether sensors will react to Lighting Level Changes due to Switching/Dimming**

**Where Above is Impractical, Use a Dual Setpoint Controller with Adjustable Dead-Band**



# Types of Daylighting Controllers

## Single Set-Point

Minimum Built in

Dead-band

No Adjustment of

Dead-band

Can be Cascaded from One  
to Another

Exterior Type Applications

## Dual Set-Point

Adjustable Dead-band

Multiple Outputs

Can be Daisy Chained  
Together

Interior Type Applications



# Building Automation Systems

**Expensive**

**May or May Not Include  
Lighting Circuits**

**BAS Solves Your Problems  
- Sometimes?**





# DALI Systems

Digital Addressable Lighting Interface

What is DALI?

How Does it Work?

Why You Should Care?



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# DAI Systems Energy Features

Ashrae 90.1 & CA 2005 Title 24 Compliant  
Energy Monitoring  
Tenant Billing  
Open & Closed Loop Daylight Dimming  
Motion Sensor Interface  
Sweep with Manual Override  
Load Shed/Peak Shaving Capabilities



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# DALI Systems Operating Features

Developed by & for the Lighting Industry

Peer-to-Peer, Client Server, Bi-Directional Comm.

Non-Proprietary Published Standards

2 Wire Not Polarized Power & Network Bus

Suitable for Class 1 & Class 2 Wiring

Interoperable Equipment

Local & Global Control

Embedded Energy Management & Control



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# DALI Systems Stakeholder Benefits

**Designer: Simplicity, modular, generic rough-in**

**Installer: Simplicity (2 wire non-polarized), standard materials & methods, in or outside of conduit**

**Owner: Quick Turn-Time, tenant Billing**

**User: Individual Workstation control through computers**

**Maintenance: Lamp & Ballast Failure monitoring, energy monitoring, open system**



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# What Ever you Decide

# Make Sure It Works



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# Best Way To Save Lighting Electricity

To Automate Control of the Lighting to take advantage of Empty Rooms, Extra Daylight Entering the Space, or simply by Dimming or Turning the Lighting Out When Unoccupied for more than Five Minutes.



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# Main Question ? What Is Main Benefit Of Using Lighting Controls ?



# Controlling Lights Save Money Three Ways:

Lighting Energy is  
reduced.

Air Conditioning energy is  
reduced.

Lamps are replaced less  
frequently.







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# Questions and Comments



# **Presentation Prepared by**

**Robert Muntun**

**Western Region Manager**

**PLC Multipoint, Inc.**

**2476 Crocker Way**

**Antioch, CA 94531**

**Office: 925-706-2202 Fax: 925-706-2669**

**Rmuntun@prodigy.net**