

Better Buildings By Design 2010



Applied Lighting Controls

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Learning Objectives



Applied Lighting Controls

- **At the end of this program, participants will be able to:**
 - Operate various lighting controls devices and systems.
 - Distinguish the pros and cons of a range of controls, including occupancy sensors and dimming for various applications.
 - Apply lighting controls strategies to maximize daylight harvesting opportunities.
 - Translate hands-on experience from this session to effectively present to clients lighting control techniques.

Acknowledgements



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Acknowledgements



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Dan Mellinger & Gabe Arnold
Efficiency Vermont

Agenda



1:45-2:30 p.m. – Introduction, general presentation

2:30-3:15 p.m. – Rotation #1

3:15-3:30 p.m. – Break

3:30-4:15 p.m. – Rotation #2

4:15-5:00 p.m. – Rotation #3

Rules



- ✓ Have fun!
- ✓ Ask questions ... there are NO stupid questions!
- ✓ During each “rotation”, help wire this stuff up!
- ✓ Do not plug systems in – Marc, John or I will do that once we are confident that everything is wired correctly.
- ✓ Commission ... commission ... commission!!!
- ✓ Before each “rotation” is over, disassemble equipment we’ve wired up.
- ✓ If you want more advanced or more comprehensive controls workshops in the future, tell Dan & Gabe!



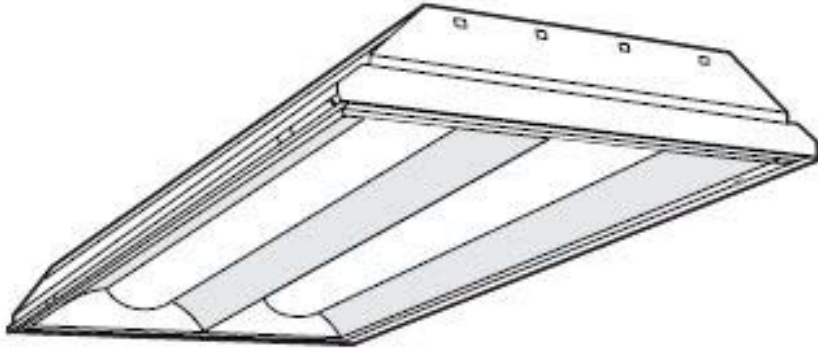
Load reduction







“Volumetric” troffer



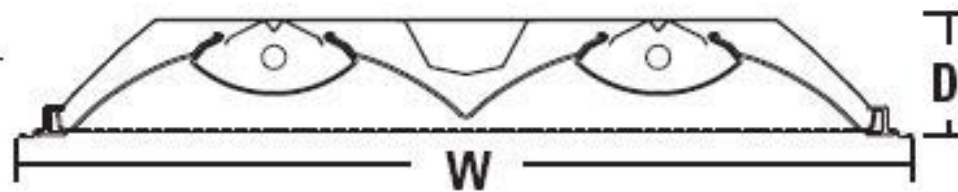
2'x4'
2 Lamps T8

Specifications

Length: 48 (1218)

Width: 24 (610)

Depth: 3-3/16 (81)





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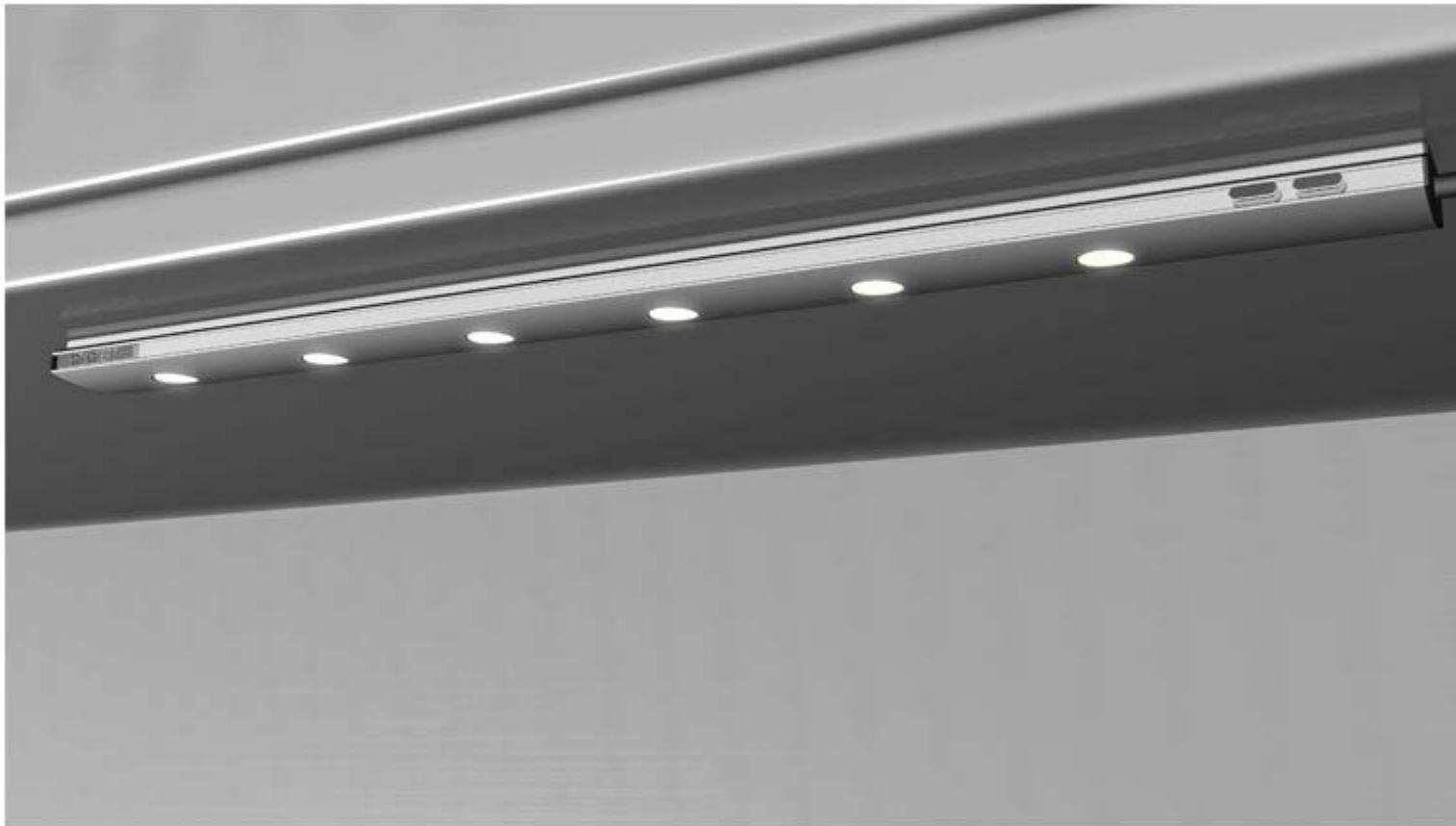
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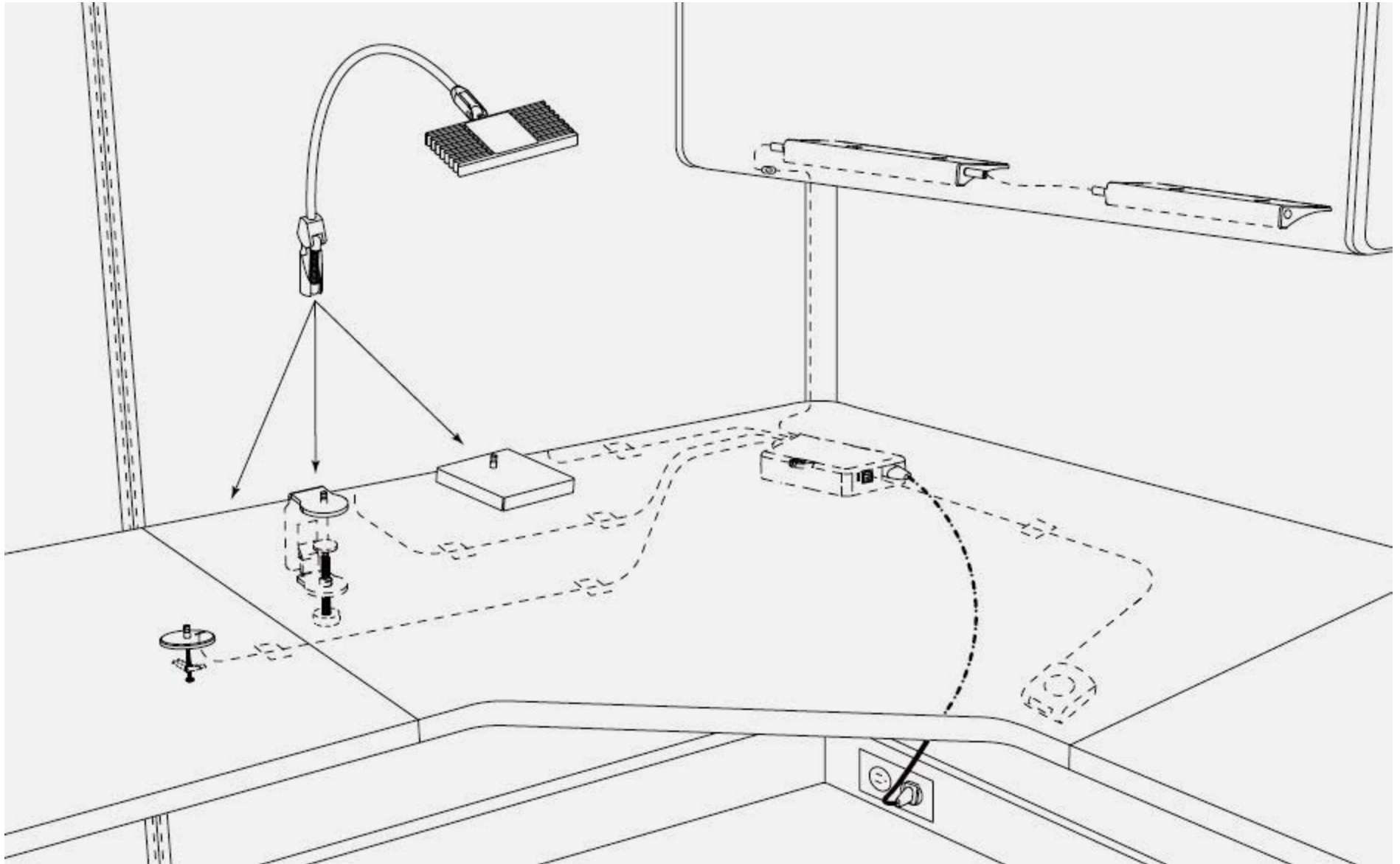
UC 1 LED UNDERCABINET LIGHT

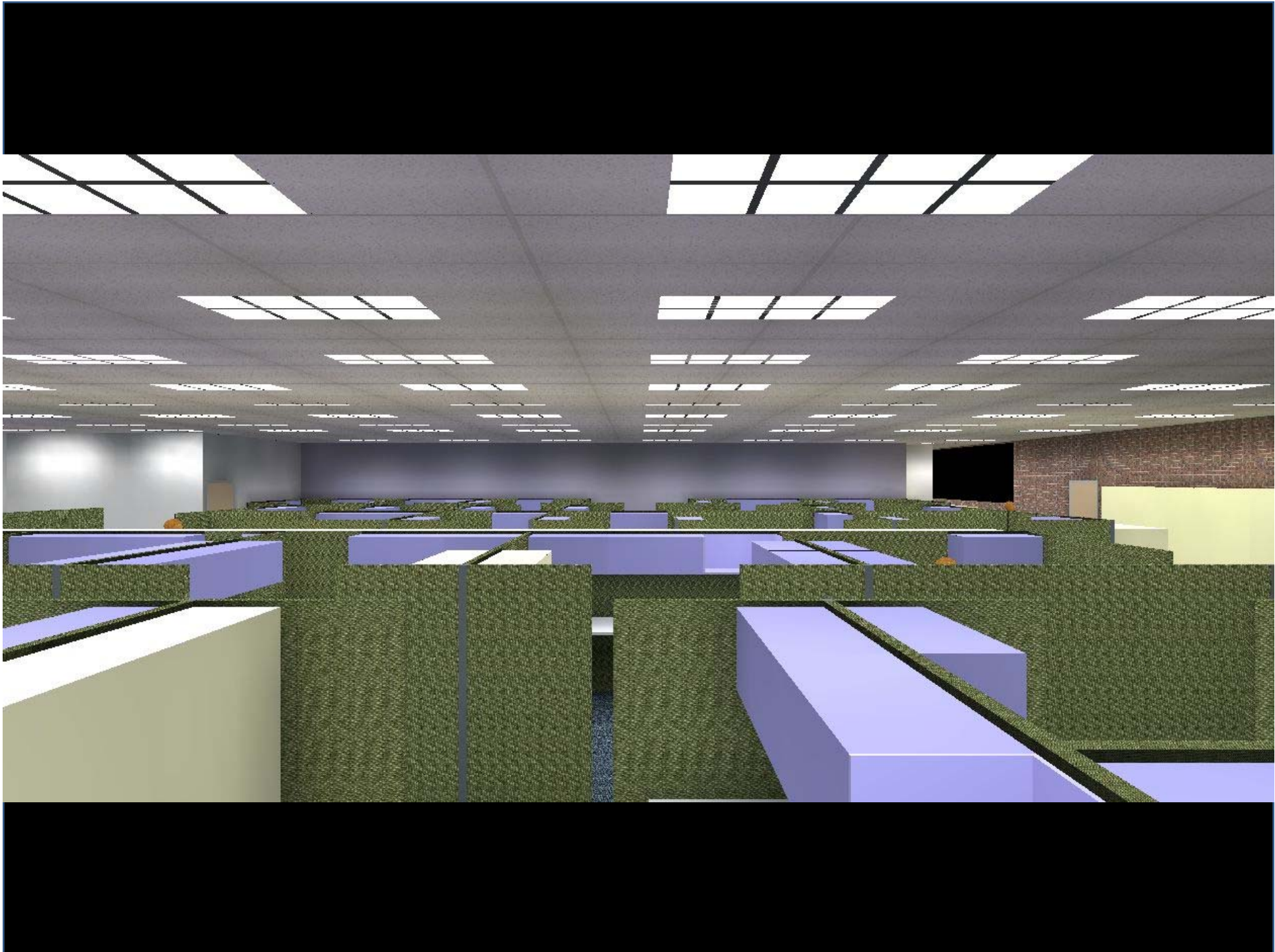


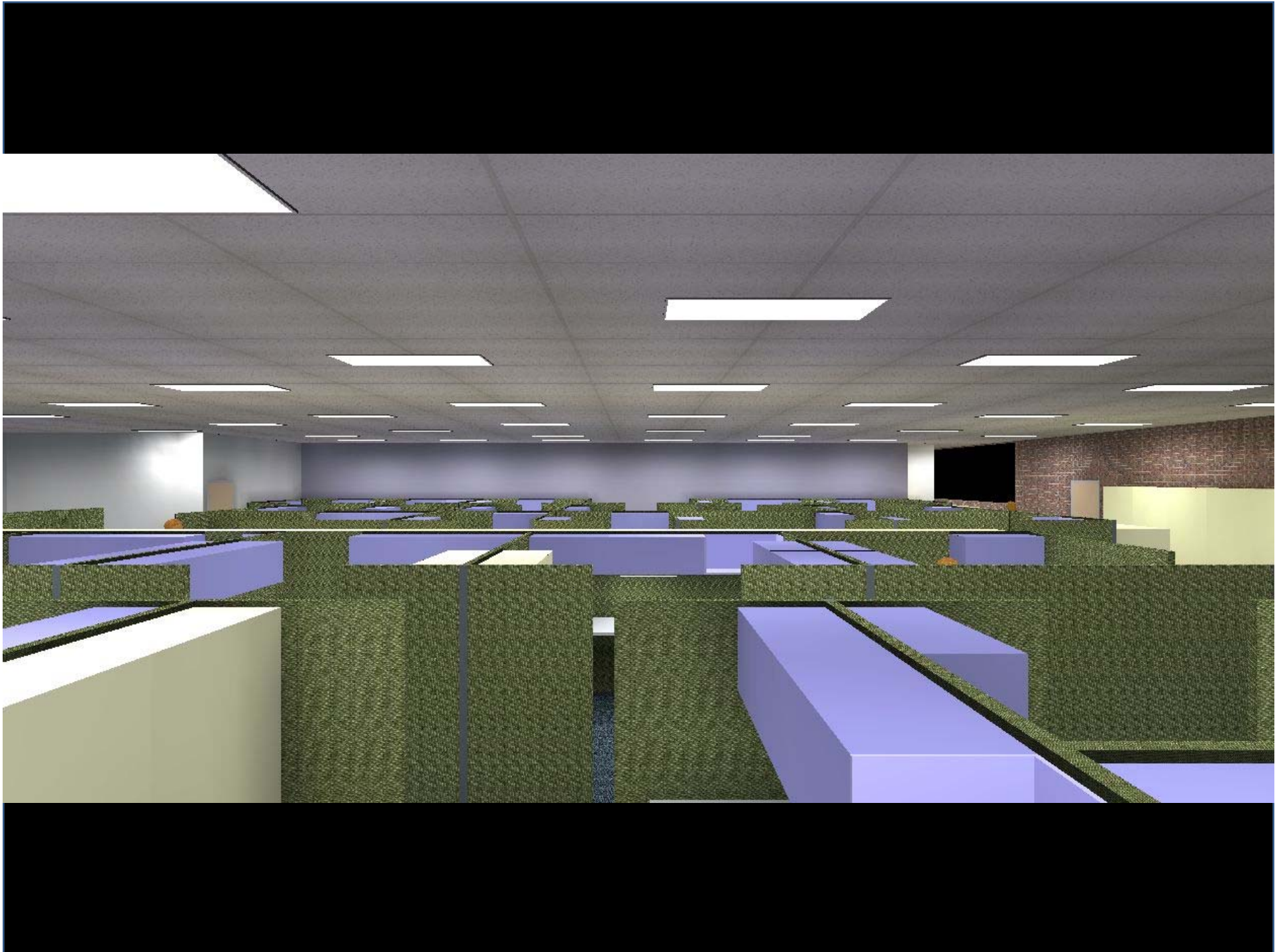
EASY MAGNETIC INSTALLATION











Existing	Without task lights			With task lights				
Fixture type	Watts each	Q	Total watts	Watts each	Q	Total watts	Ave. FC	Max. FC
2-lamp T8 12-cell parabolic troffer	61.6	162	9,979	61.6	162	9,979	55	134
F30T12 undercabinet strip				30	80	2,400		
Total wattage			9,979			12,379		
Area			8,134			8,134		
Watts/square foot			1.23			1.52		

Proposed design	Without task lights			With task lights				
Fixture type	Watts each	Q	Total watts	Watts each	Q	Total watts	Ave. FC	Max. FC
2-lamp T8 "volumetric" retrofit troffer	58	91	5,278	58	91	5,278	35	85
6-LED undercabinet strip				7.6	90	684		
Total wattage			5,278			5,962		
Area			8,134			8,134		
Watts/square foot			0.65			0.73		

Existing watts/square foot	1.23	1.52
Proposed watts/square foot	0.65	0.73
Proposed / Existing	53%	48%
Title 24-2008 limits	1.05	1.05
Proposed / Title 24-2008 limits	62%	70%
Reduction from Title 24-2008 limits	38%	30%

Lighting control strategies

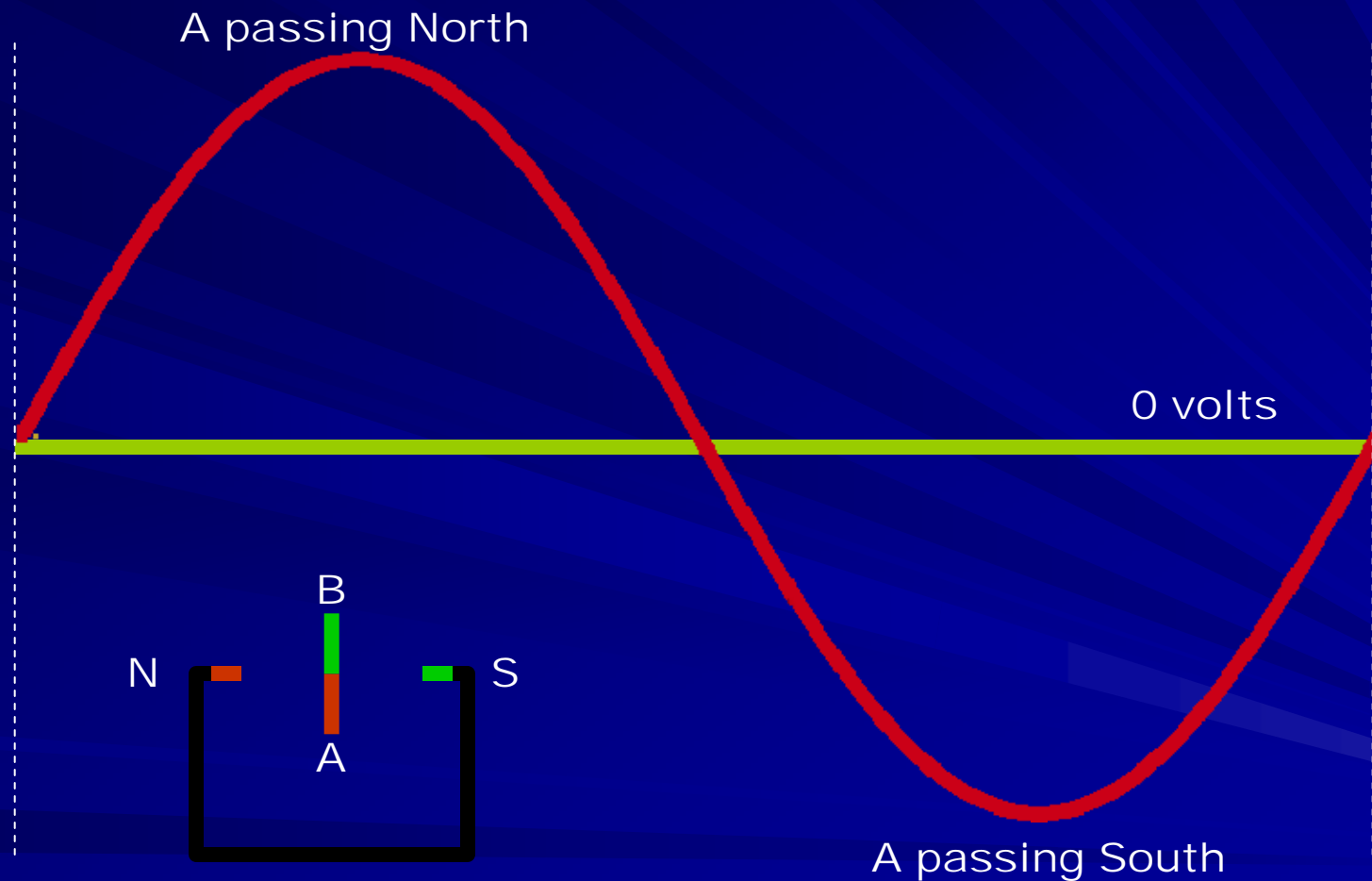
1. DR control from utility company [this is the highest priority].
2. Local manual on/off control for open office.
3. Local manual on/mid/off control for private offices and conf room.
4. Vacancy sensing (OS) in small rooms.
5. Time schedule off with local override for open office.
6. Daylight harvesting.
7. Facility-wide tuning via high end trim (not required if we select 2-step dim ballasts).
8. Personal tuning in private offices and conference rooms (if we decide on dimming ballasts).

Possible control products

- Powerline carrier dimming system:
 - Control signal carried over existing power wires ... no need for rewiring (except for emergency lighting)
 - Ballasts can be dimmed from 100-50% (plus full off)
- Wireless 0-10VDC dimming
 - One receiver/fixture OR one receiver per group of fixtures (10 or less)
 - Transmitters (“switches”) replace existing wall switches
 - How do receivers work with existing emergency lighting circuitry (may need UL924 shunt relays to bypass)
- DALI dimming
- Occupancy sensors (for any control strategy)
- Photosensors (for any control strategy)

THE LANGUAGE OF ELECTRICITY

Voltage – Alternating Current sine wave

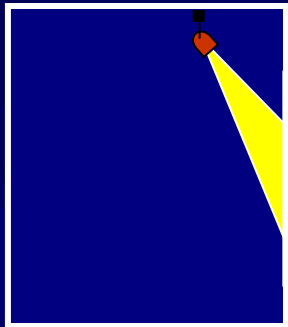




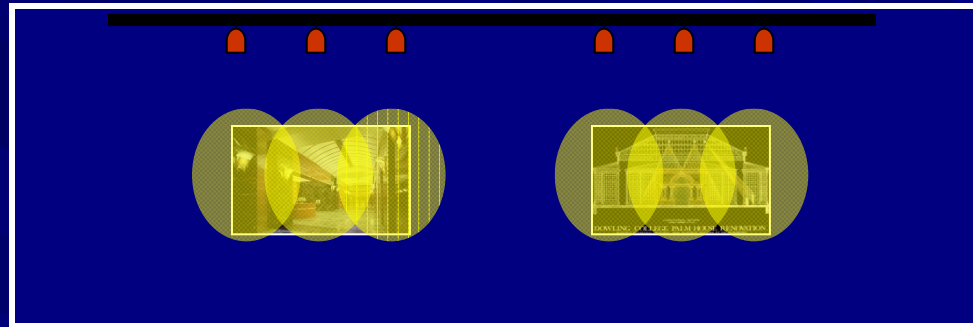
Dimming

TRACK

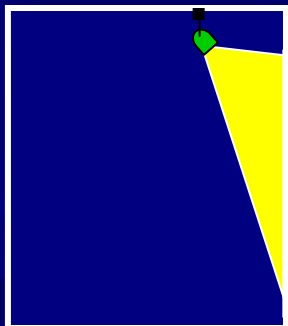
Track lighting



Accent lighting



Elevation of wall with artwork



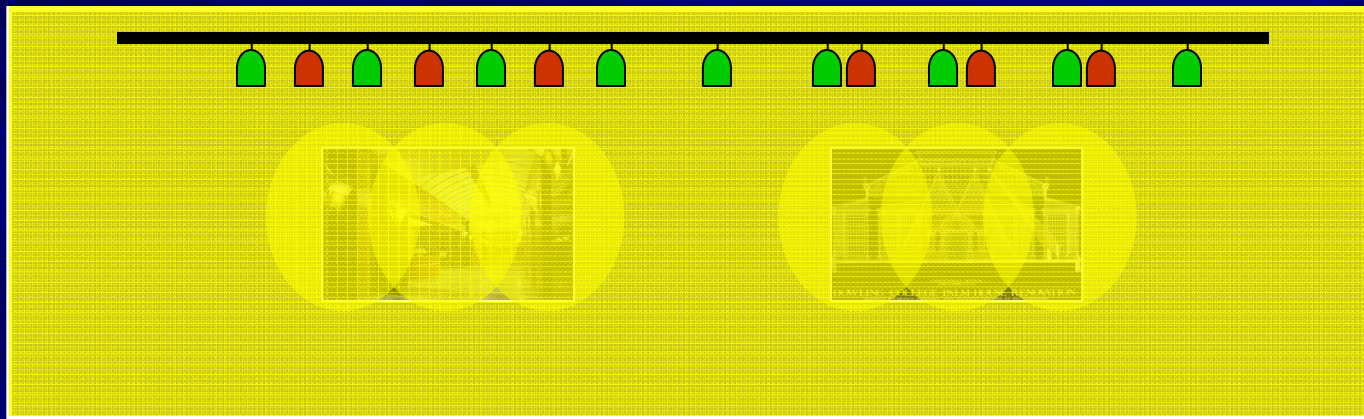
Wall washing



Elevation of wall with artwork

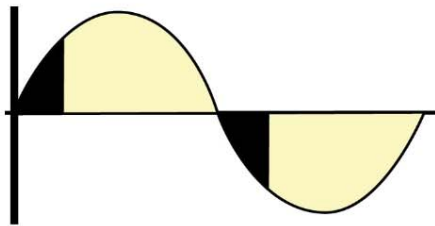
TRACK

2-circuit track lighting

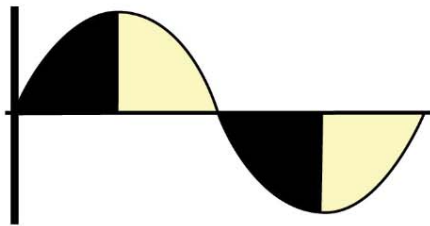


Elevation of wall with artwork

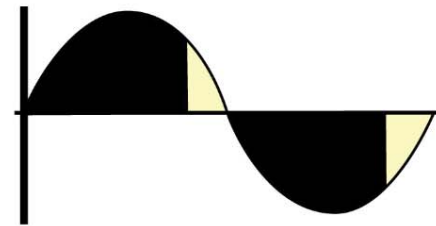
Phase Control Dimming



Lights on @ 75%
(Dimmed 25%)

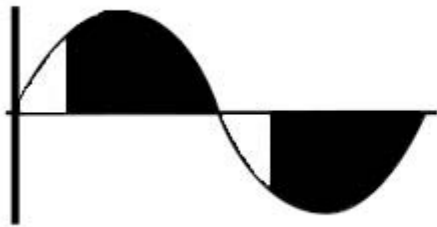


Lights on @ 50%,
(Dimmed 50%)

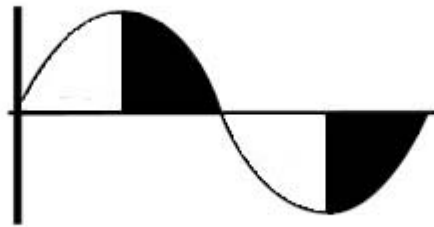


Lights on @ 25%
(Dimmed 75%)

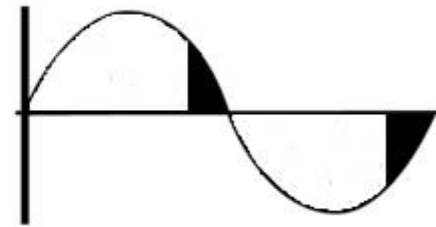
Reverse Phase Control Dimming



Lights on @ 25%
(Dimmed 75%)



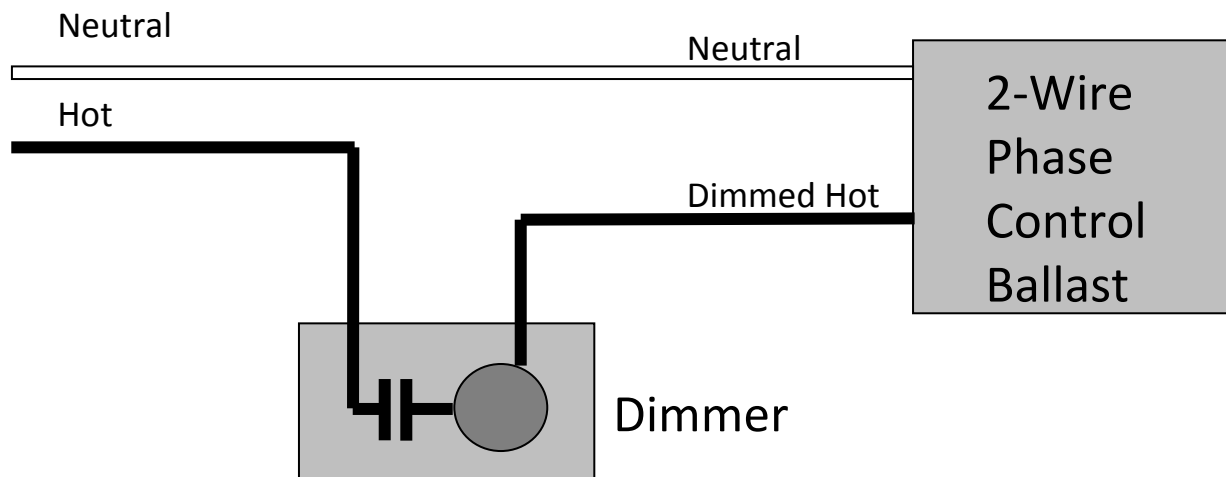
Lights on @ 50%,
(Dimmed 50%)



Lights on @ 75%
(Dimmed 25%)

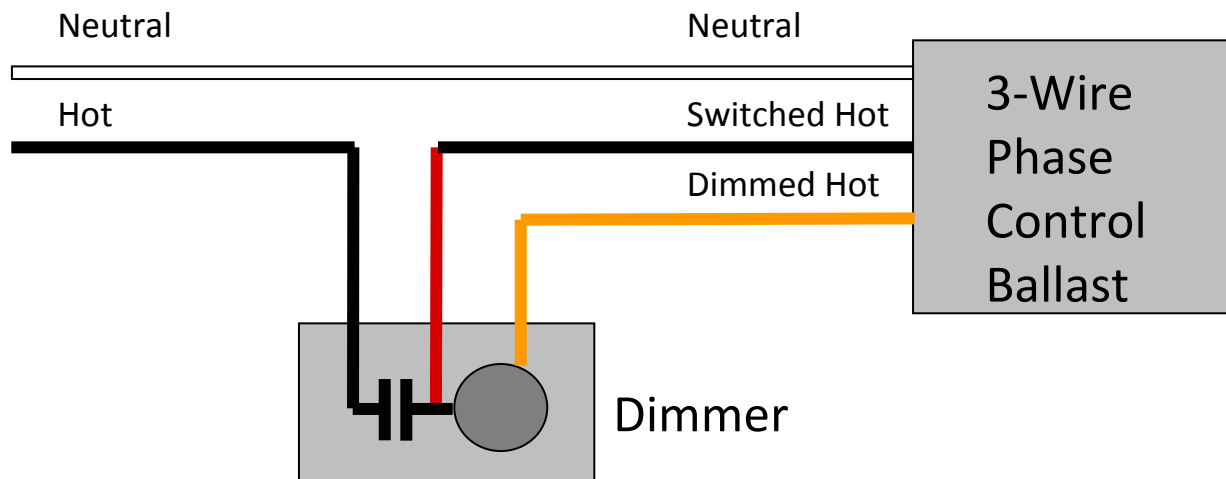
Analog 2-Wire Phase Control

- Phase-control dimmers control the amount of voltage and current to the dimming ballast.
- The dimmer turns off part of the AC sine wave for a preset amount of time, resulting in lamp dimming.



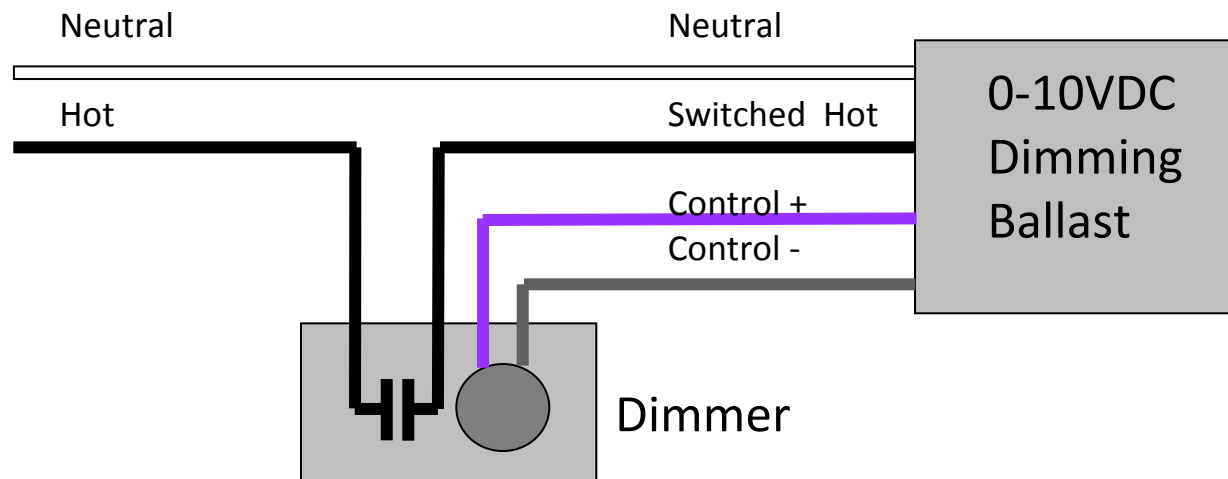
Analog 3-Wire Phase Control

- Have a third line-voltage wire for control.
- Forward-phase-cut dimming across dimmed hot and neutral.
- Switched hot insures constant voltage to ballast for correction heater operation.



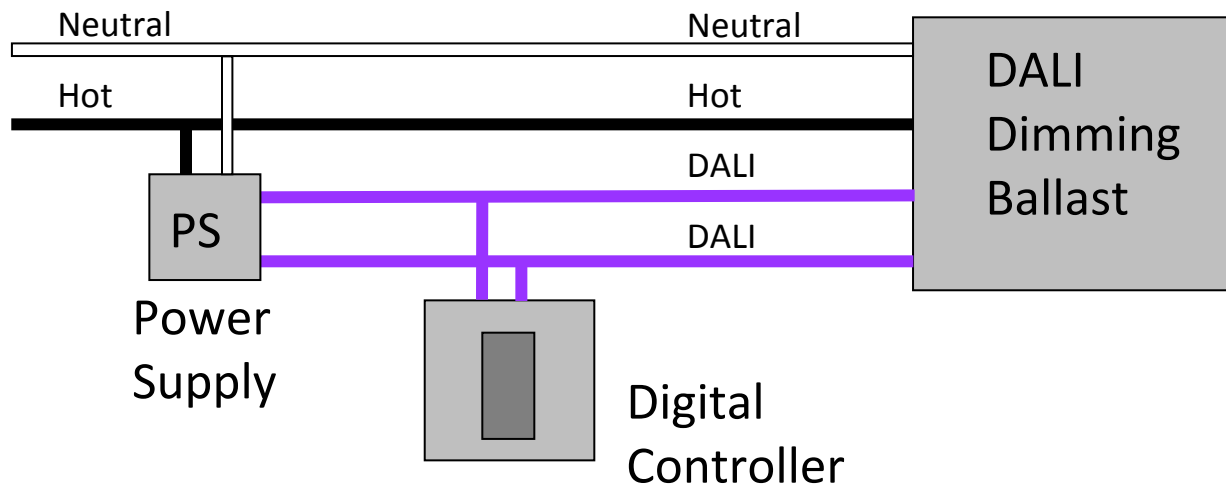
Analog 0–10VDC Control

- 4-Wire:
 - 2 line-voltage wires: hot & neutral (for power) ... plus
 - 2 low-voltage wires: for control (violet & gray wires)
- Class 1 or Class 2
- Control wires are polarity sensitive



Digital DALI

- 4-Wire:
 - 2 line-voltage wires: hot & neutral (for power) ... plus
 - 2 low-voltage digital wires: for control (purple wires)
- Class 1 or Class 2
- Control wires are **not** polarity sensitive



Why you need a preset dimmer system



Dimming products

1. Wallbox devices – generally dims one switch leg
2. Wallbox (multi-gang) preset systems – generally dims a handful of switch legs
3. Panel preset systems – dims (and/or switches) multiple “zones”
4. Fluorescent dimming:
 1. Full-range
 2. Step dim
 1. Two level ... 100%-50%-0%
 2. Seven level

Wallbox preset systems

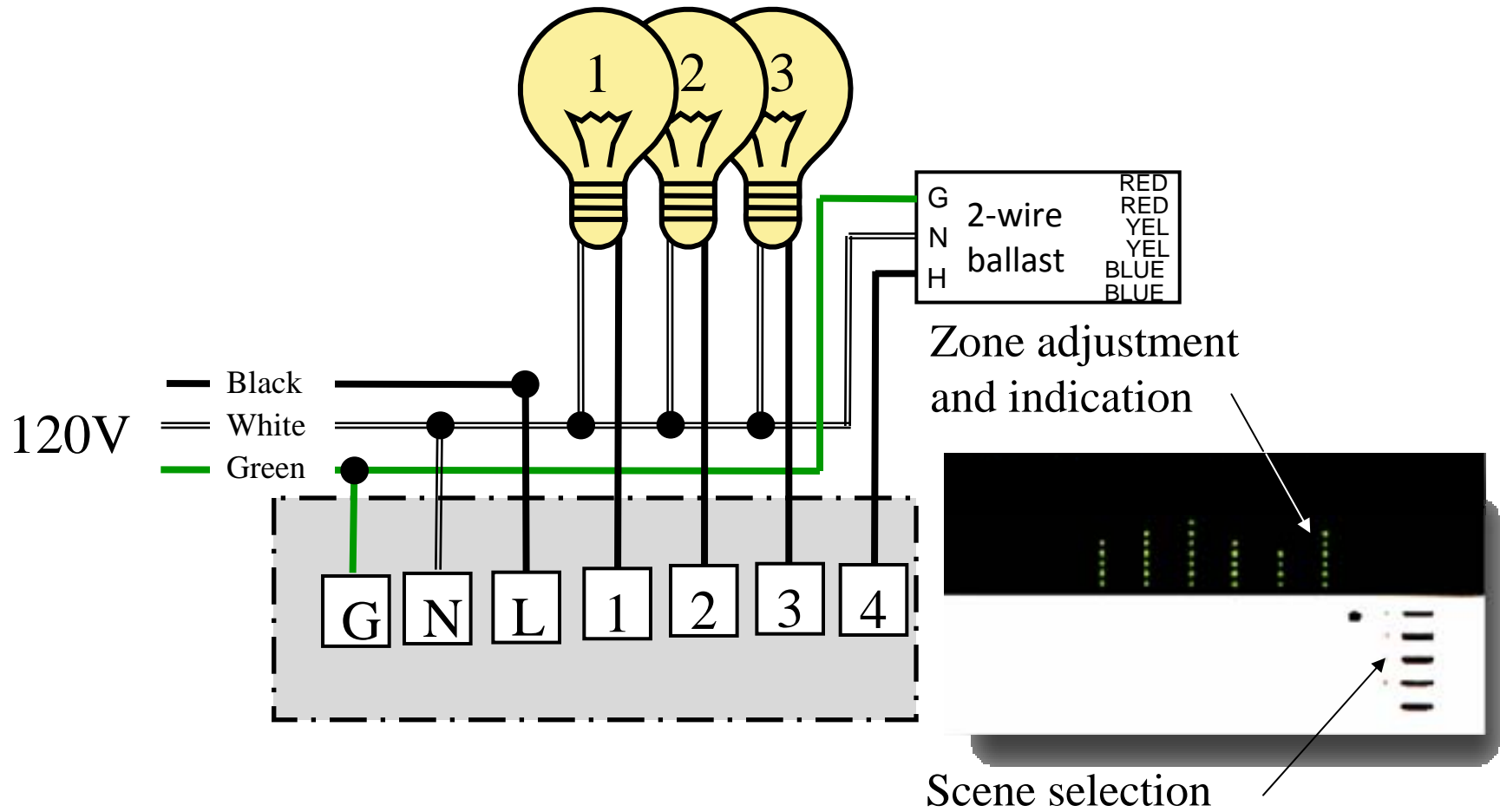


Image courtesy of LUTRON

Dimming panels

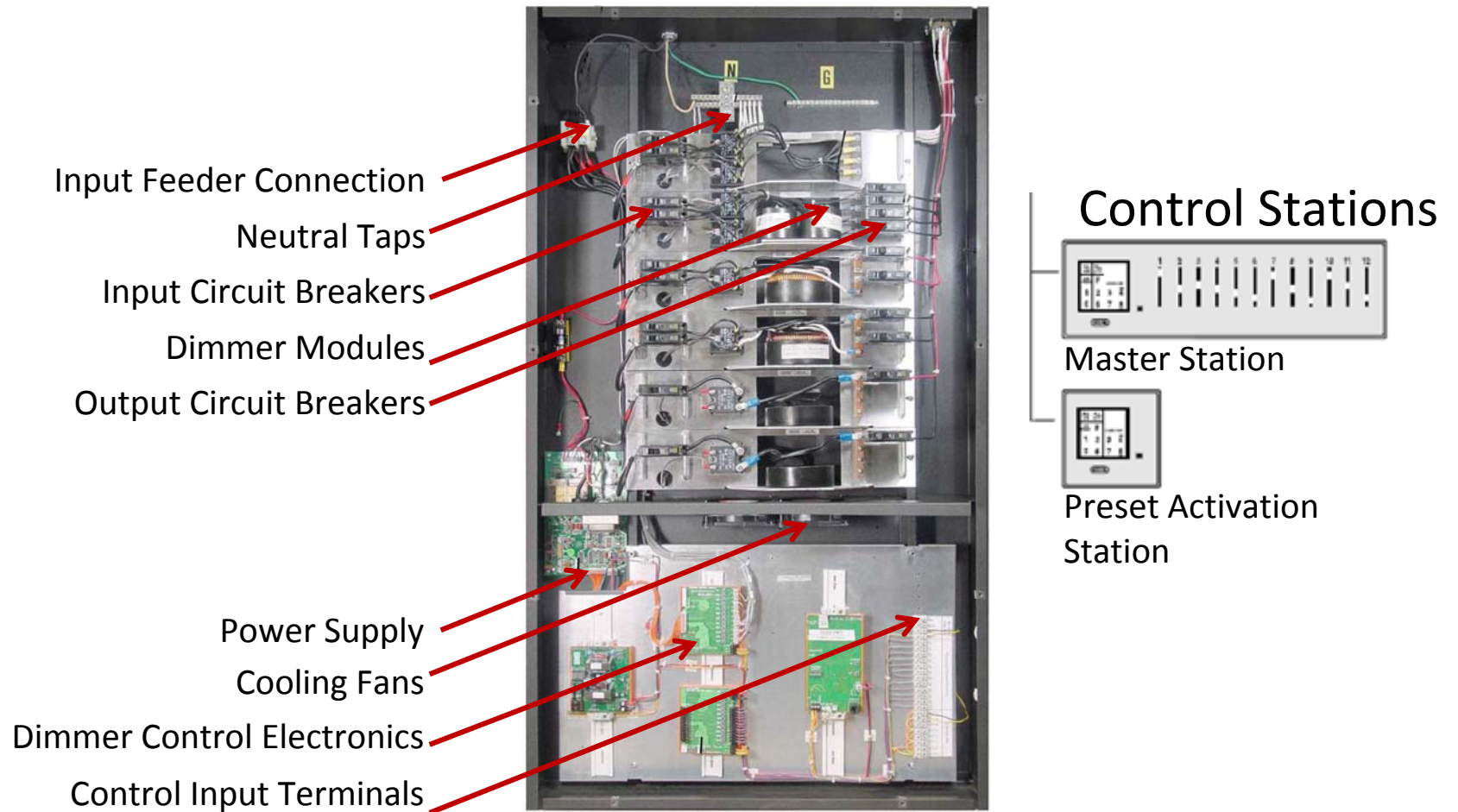


Image courtesy of Douglas Lighting Controls



Occupancy sensors

Occupancy Sensor Mounting



Wall
switch



Ceiling mounted
sensor



High corner
mounted sensor

Images Courtesy of LUTRON

False Triggering

- False triggering can be resolved by properly adjusting the sensitivity and time delay.
- Commonly used definitions of false triggering:
 - “False positive”: lights remain on when a room is unoccupied.
 - “False negative” or “miss”: lights are switched off when the room is occupied.

Auxiliary Equipment – Power Pack

- A combination of a transformer and relay in a single package.
- Uses a low voltage signal to control a line voltage load. (Line voltage occupancy sensors do not require a power pack.)
- Power packs have a single pole line voltage contact and 24VDC low voltage signal wires.



Image Courtesy of The Watt Stopper

Power pack schematic

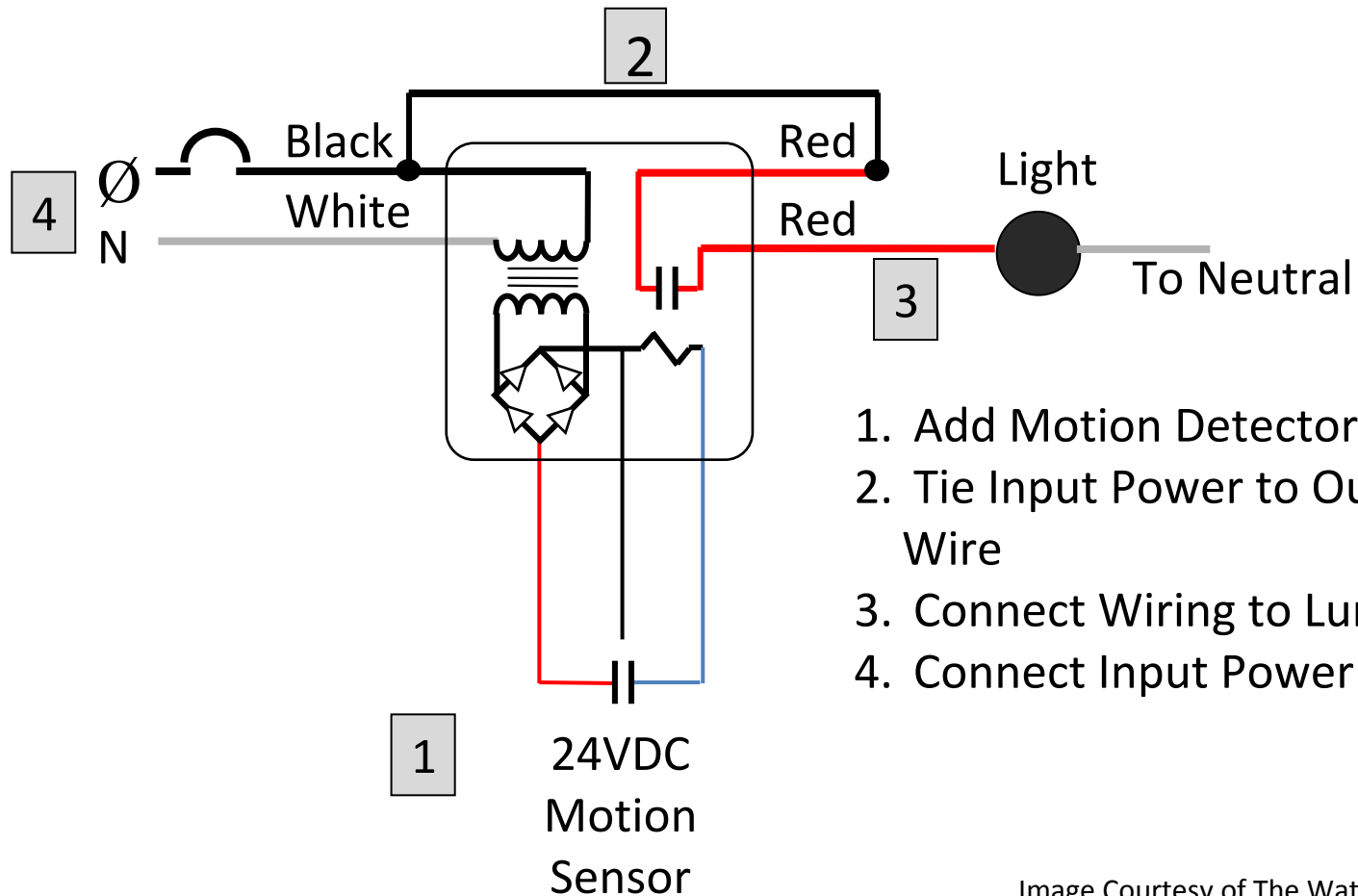
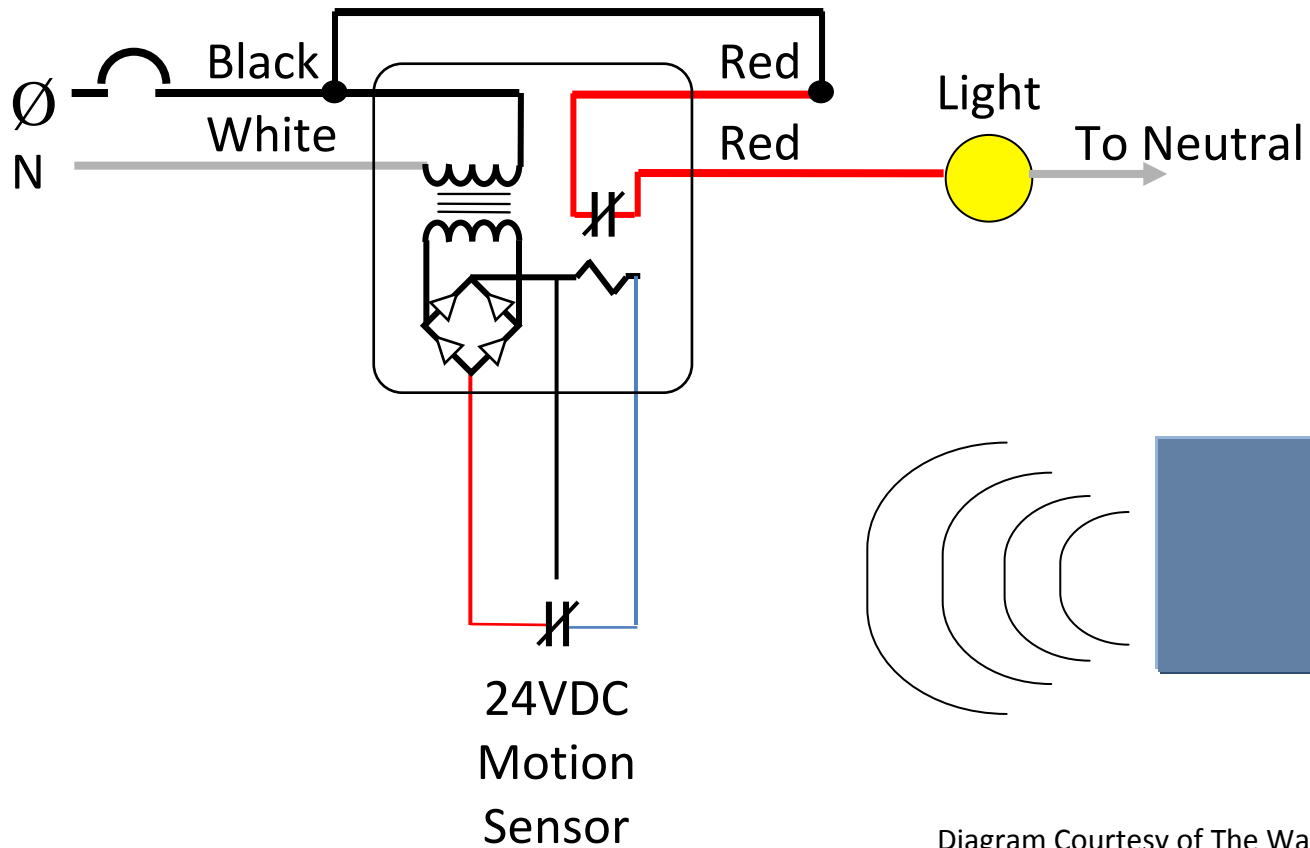


Image Courtesy of The Watt Stopper

Power pack application



Occupancy sensor technologies



Passive Infrared (PIR) - Relies on “line-of-sight” to detect a movement of heat.



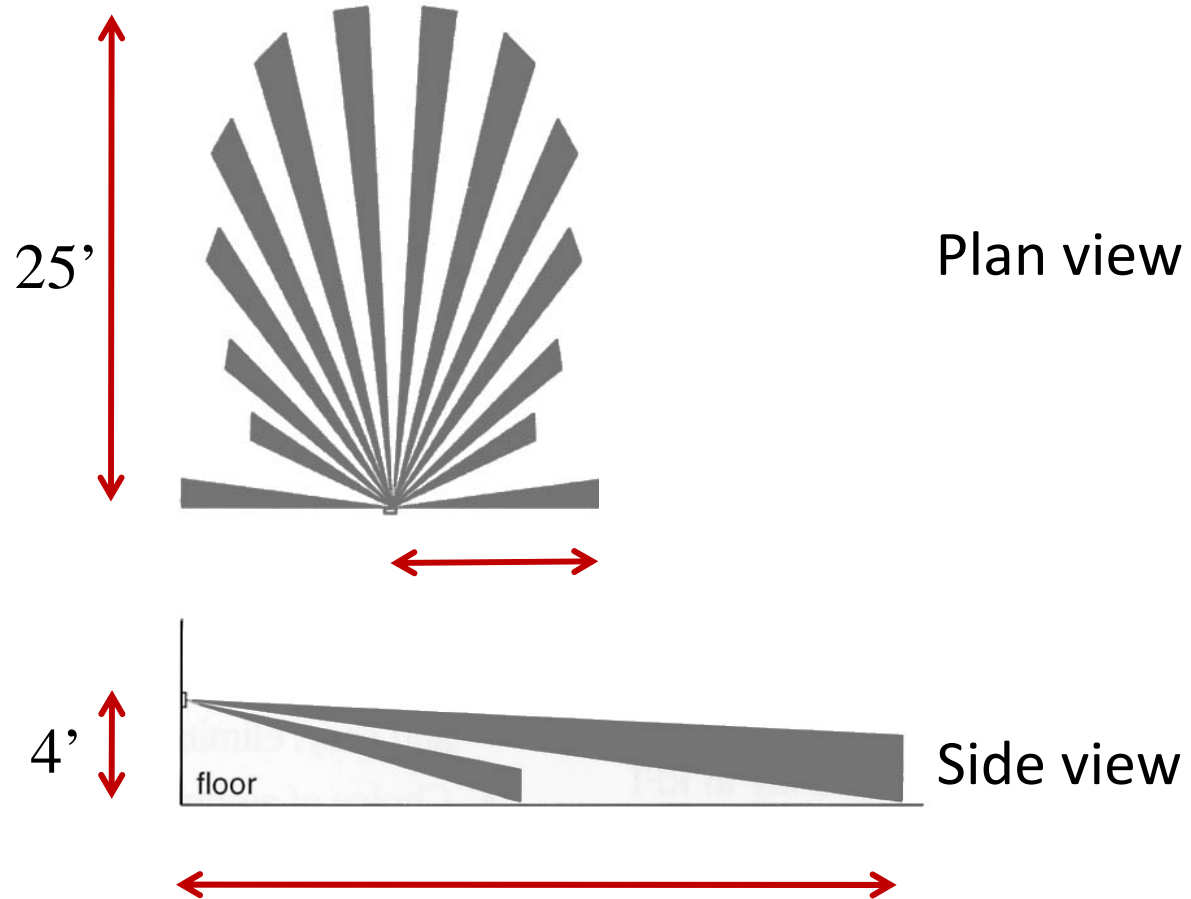
Ultrasonic (US) - Utilizes the Doppler principle to detect changes in ultrasonic sound waves caused by motions.



Dual Technology (DT) - Employs both PIR and US technologies in one device.

Images Courtesy of The Watt Stopper

PIR coverage zone

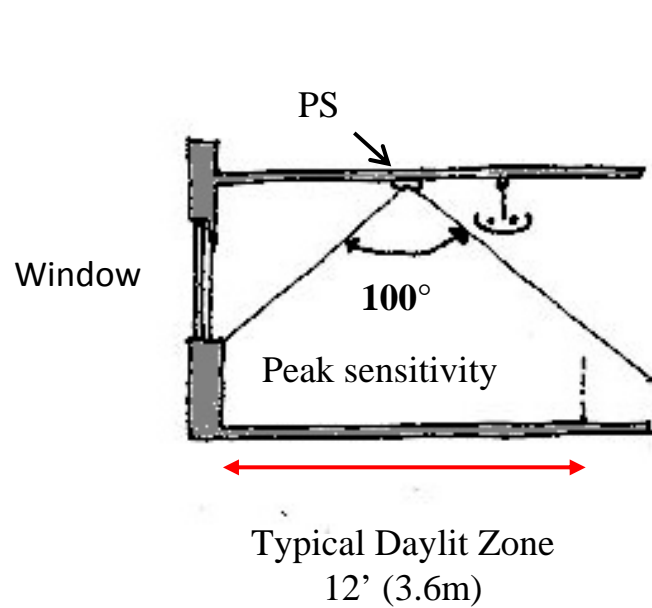


Images Courtesy of The Watt Stopper

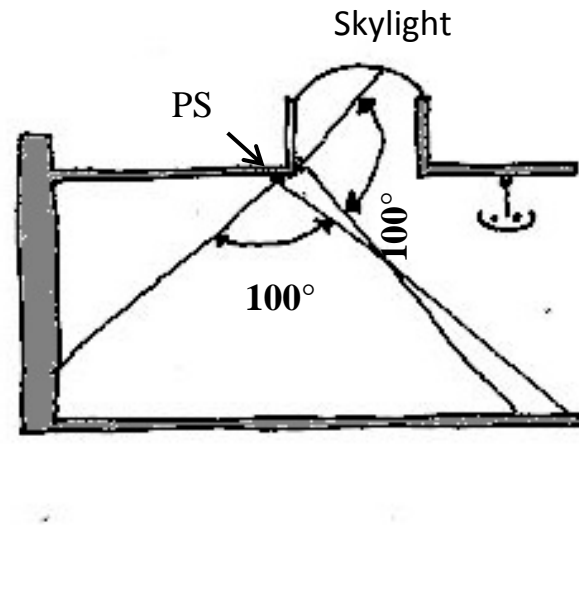


Photosensors

Sensor mounting location

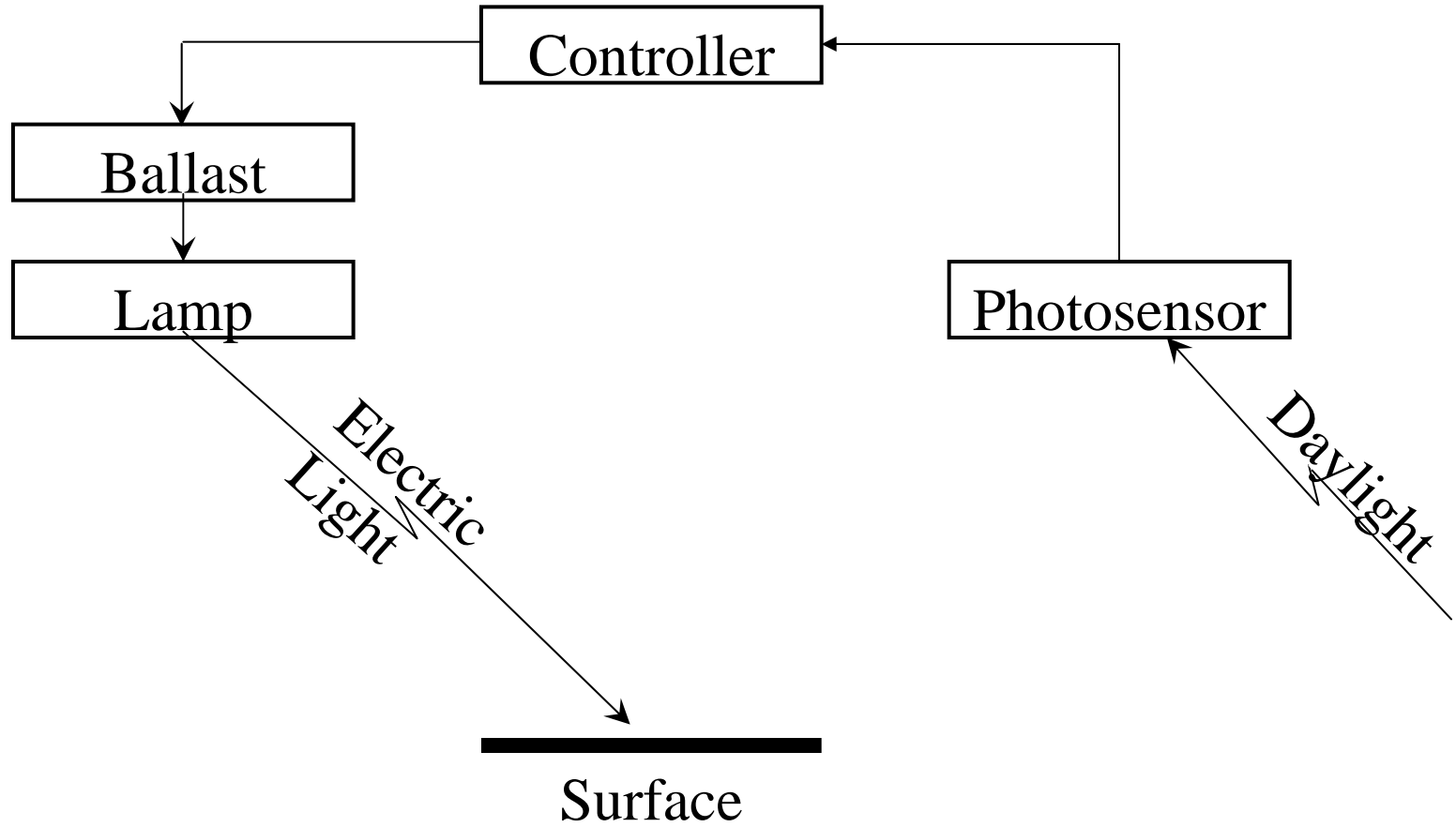


Side Lighting Application

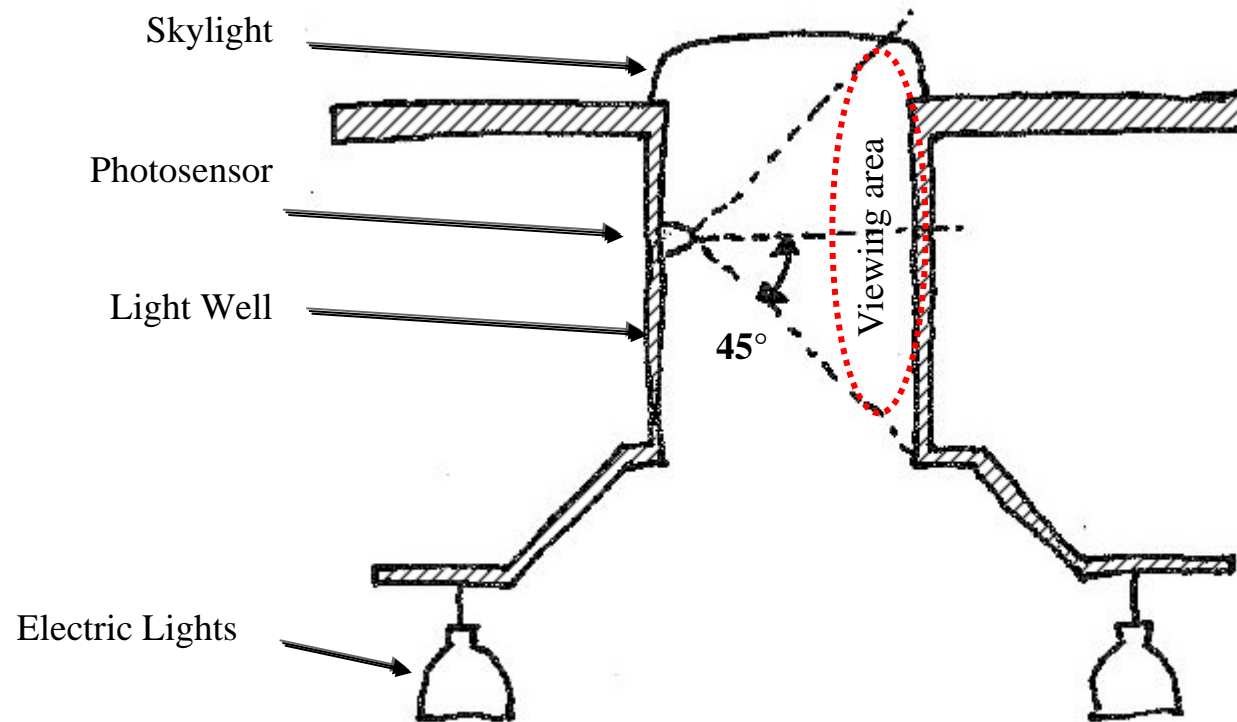


Top Lighting Application

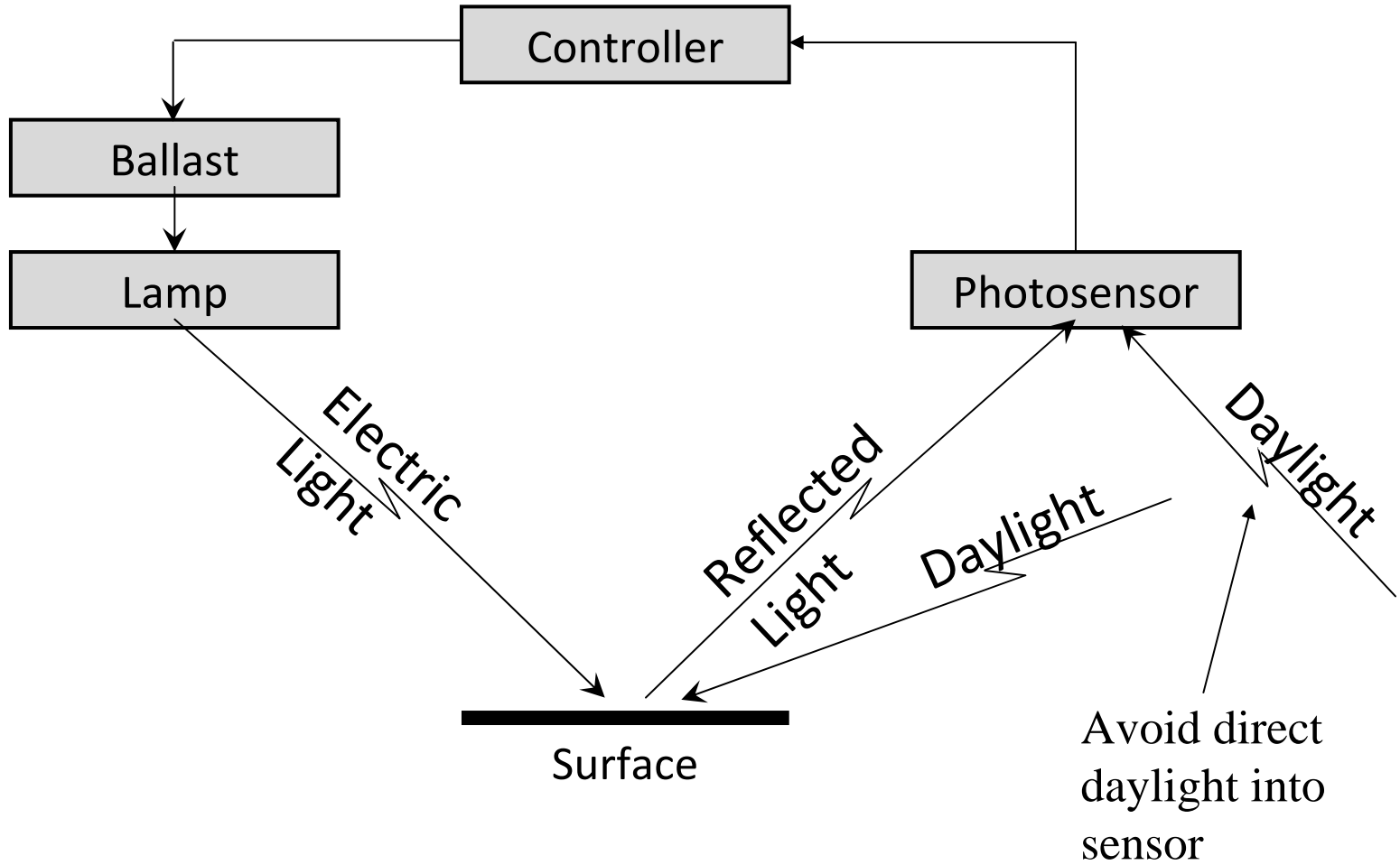
Open loop



Open loop



Closed loop



Closed loop

