



Become an LED Lighting and Controls Expert

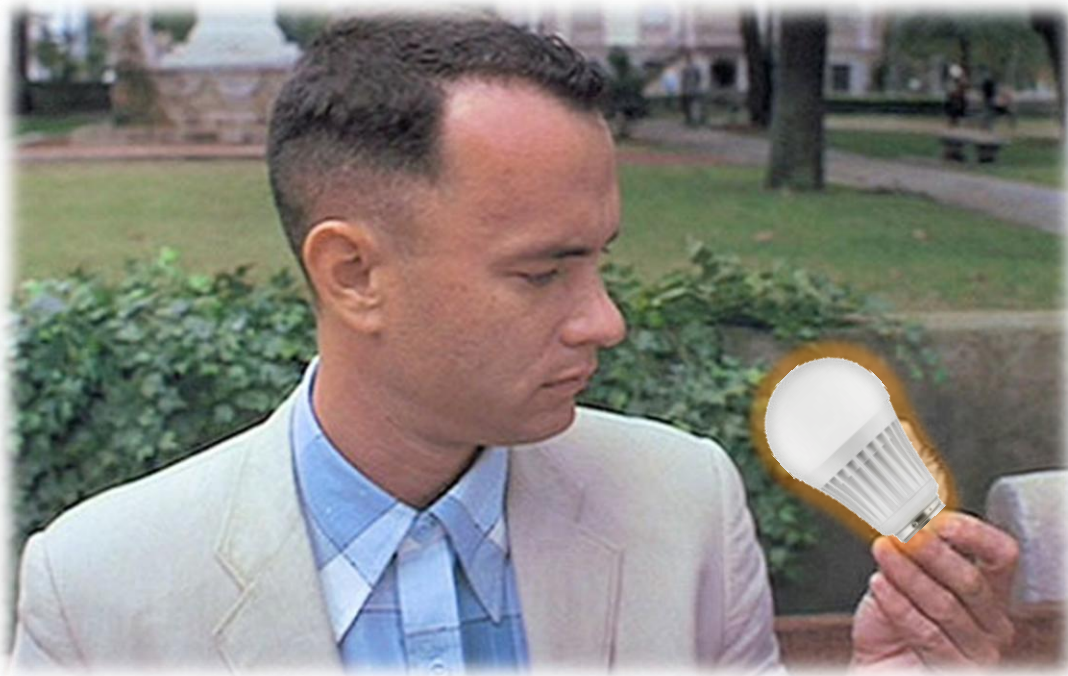
Ethan Biery
Lutron Electronics
September 12, 2014
8:00am – 9:30am

Agenda

- Background
- Challenges of controlling LEDs
- Lutron product solutions
- Tools and resources
- Questions

So what's the problem?

LEDs are like a box of chocolates...



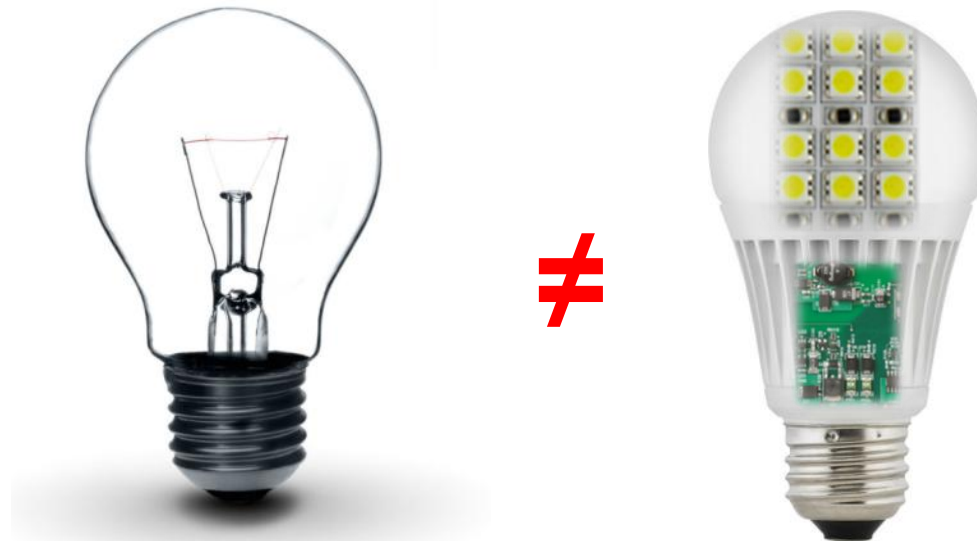
...you never know what you're going to get!

Why do customers want LEDs?

- Saves energy
- Long lasting
- Environmentally friendly
- Elegant form factors
- New functionality (color!)
- “Everybody’s doing it”

Why are LEDs “hard”?

- New market players
- Technology is changing rapidly
- Products are more complicated
- Compatibility is not assured
- LED lamps are different than incandescent lamps!



Terms: Color rendering index (CRI)

- CRI describes how well (accurately) a light source shows color compared to a known reference light source
- Tested against a standardized color swatch set
- Higher is better, 100 is best
 - LEDs:
typically >80 (>95 is available)
 - Sunlight / incandescent lamps:
100 (maximum)

Photo: Javier Ten, RPI Lighting Research Center



CRI=90

CRI=70

CRI=50

Fair

50-60 CRI

Standard Fluorescent

60-70 CRI

Premium HPS

Standard Metal Halide

Better

70-80 CRI

Thin-coat Tri-Phosphor Fluorescent

Best

80-90 CRI

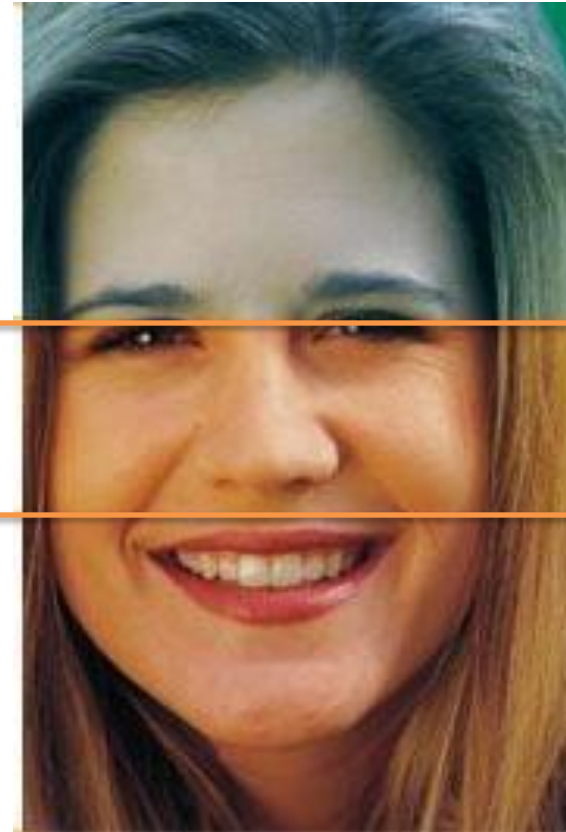
White HPS

Warm Metal Halide

Thick-Coat Tri-Phosphor Fluorescent

90-100 CRI

High CRI Fluorescent
Incandescent and Halogen



Terms: Correlated color temperature (CCT)

- The color emitted from a heated “black body” radiator
- Higher temperature = cooler color (bluer)
- Low temperature = warmer color (redder)
- Measured in degrees Kelvin (K)
 - LEDs: 2200K - 6000K+
 - All tungsten: 2700K*
 - All halogen: 3000K*

** Warms (lower CCT) when dimmed*

10,000 K

9,000 K

8,000 K

7,000 K

6,000 K

5,000 K

4,000 K

3,000 K

2,000 K

1,000 K

Blue sky: 10,000-20,000 K

Overcast sky: 6,000 – 7,500 K

Daylight (sun & sky): 5,500 – 6,500 K

Direct sunlight at noon: 5,000 – 5,400 K

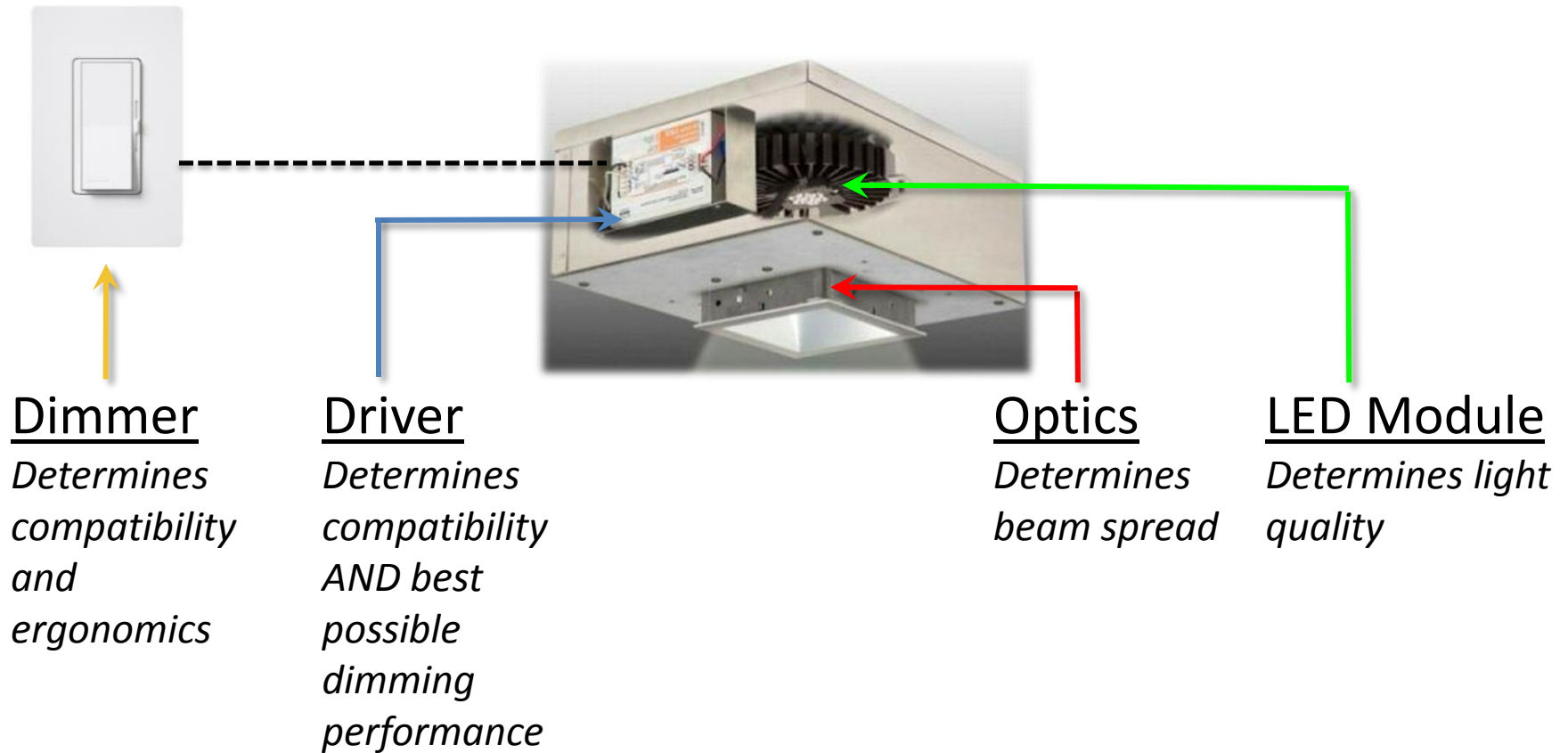
Cool white fluorescent: 4,200 K

Halogen: 3,000 K

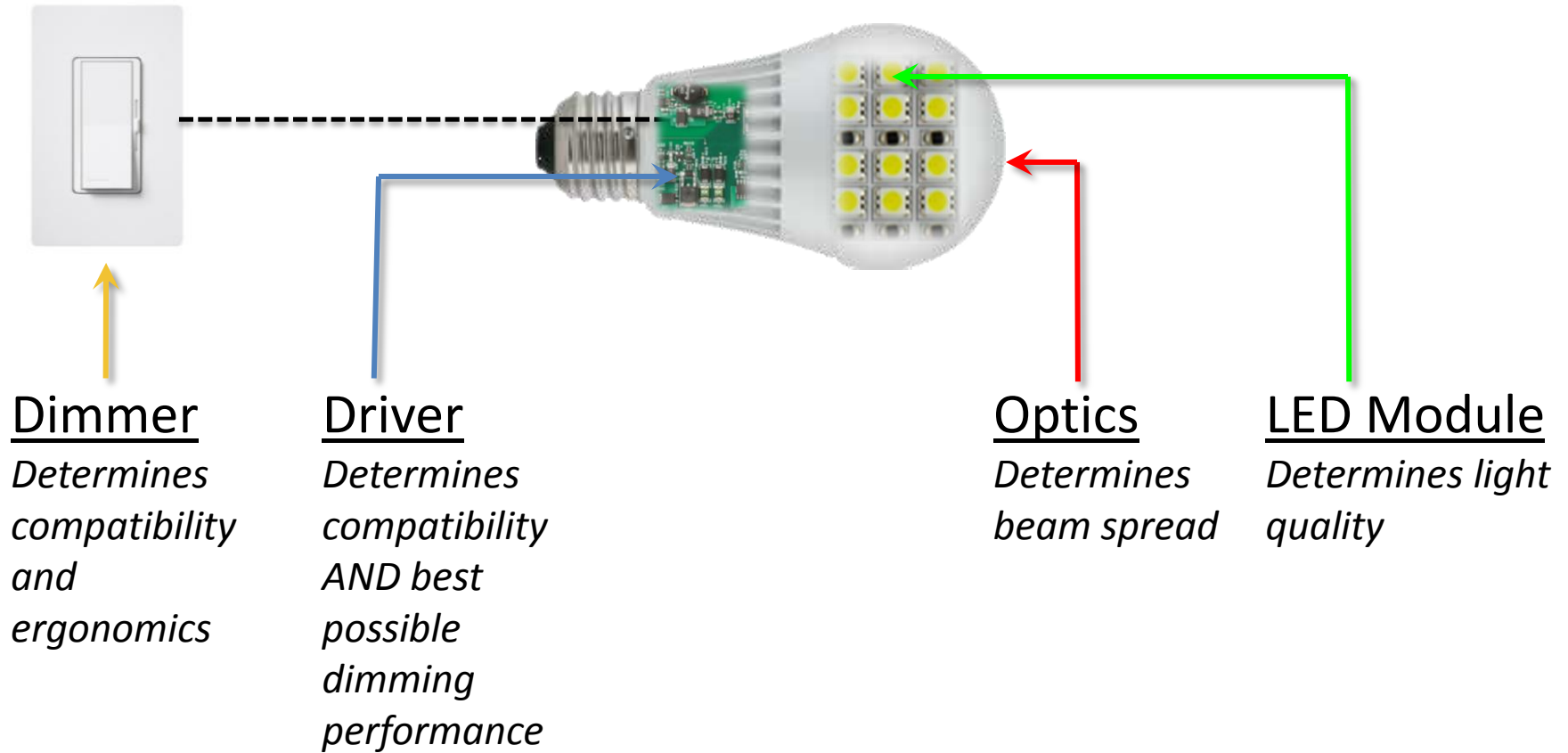
Tungsten Incandescent: 2,700 K

Sunset/Sunrise: 2,000 K

Anatomy of an LED system: Fixture



Anatomy of an LED system: Lamp



Why drivers matter

If you only remember two things...

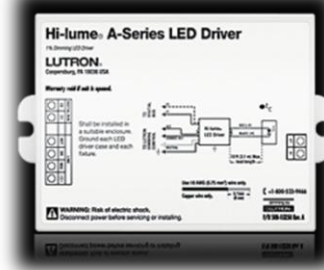
1. The LED driver design determines the best possible dimming performance

- Dimming range (non-dim, 20%, 10%, 1%...)
- Dimming curve (linear, logarithmic, monotonic...)
- Dimming smoothness

2. The compatibility between the LED driver and the control determines to what degree the driver can deliver upon its designed performance

- The wrong dimmer will make a great driver dim poorly
- Even a perfect dimmer can't make up for a bad driver

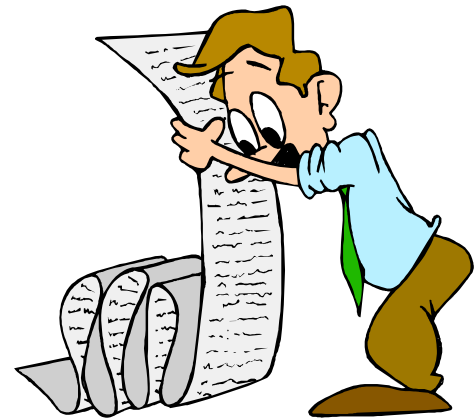
Having a reliable driver will eliminate the common concerns of LED lighting (flicker, loading, dimming performance...)



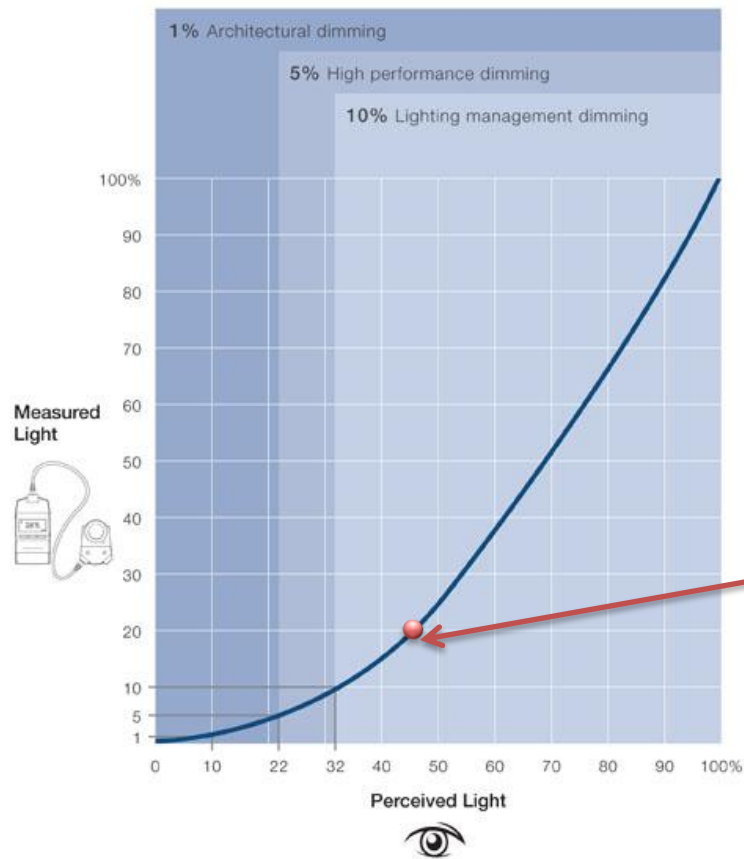
Steps to a successful LED dimming installation

Ideally:

1. Determine the dimming range needed by the application
2. Select whether an LED lamp or LED fixture is appropriate
3. Choose the appropriate control type
4. Confirm maximum/minimum number of loads on the control
5. Adjust trims and load types as necessary



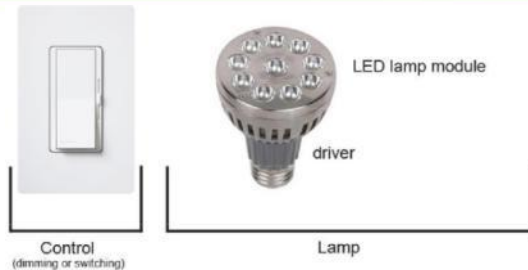
1. Determine the dimming range needed



Measured vs. Perceived

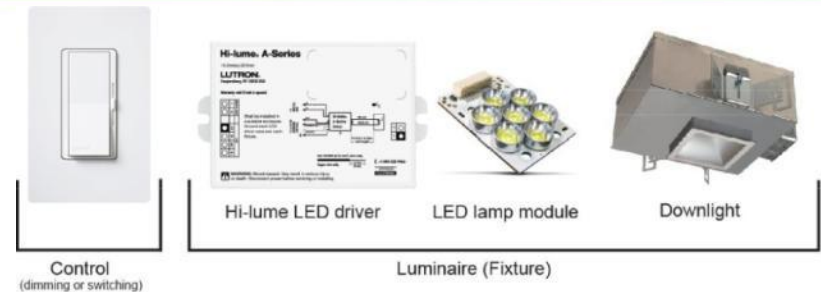
- **Measured light:** the amount of light as shown on a light meter
- **Perceived light:** the amount of light that your eye interprets due to dilation
- **Example:** 20% measured = 45% perceived
- Different applications have different low-end needs
- Different LEDs have different low end light levels

2. Select an LED lamp or LED fixture



LED Lamps (LEDIs)

- Designed to replace/retrofit standard incandescent or screw-in CFL bulbs
- Standard Edison (E26) base sockets, as well as candelabra & MR16
- Integral drivers determine dimming performance (if dimmable)
- Easy to install, generally lowest cost

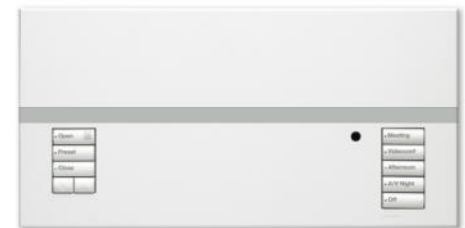


LED Fixtures

- Variable in purpose (cove lights, down lights, 2x2, etc.)
- Usually have an external driver, selected by the OEM and mounted as part of the fixture housing
- OEMs may offer different control technologies (dim vs. non-dim, 0-10V vs. DALI)
- Sleek and elegant, precise optical control

3. Choose the appropriate control type

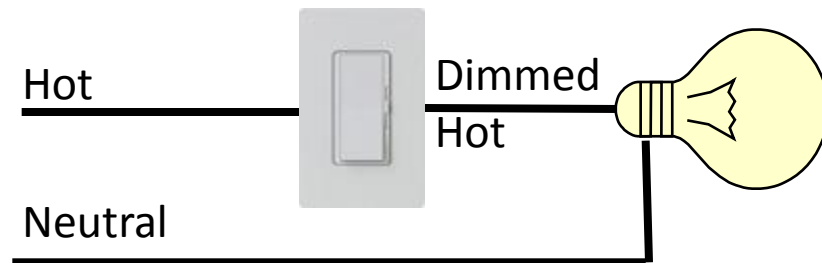
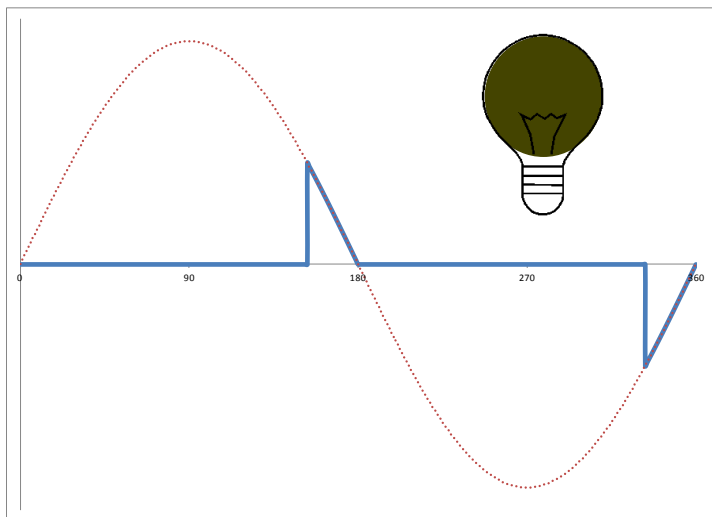
- Control type refers to the signal and wiring between the wall control and fixture / lamp
 - Lamps generally use only forward/reverse phase control
 - Fixtures can use any method
 - The LED and control MUST be of the same control type!
- Control options
 - Forward Phase
 - Reverse Phase
 - 3 Wire
 - DMX 512
 - 0-10V
 - EcoSystem



Control type summary

- Forward Phase

- Most common dimming method (150 million dimmers in use)
- Designed for resistive (incandescent, halogen) or magnetic low-voltage (MLV) loads; not originally intended for LEDs
- Performance issues possible on existing dimmers



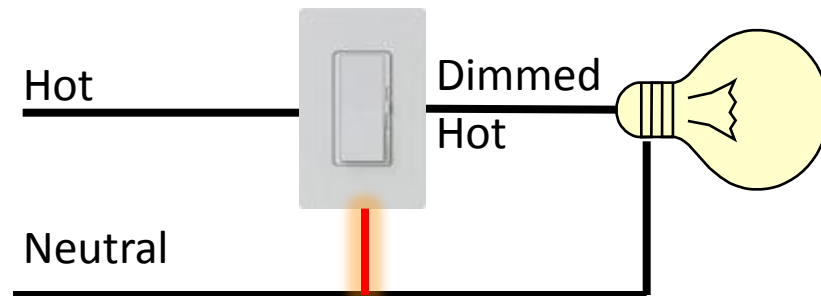
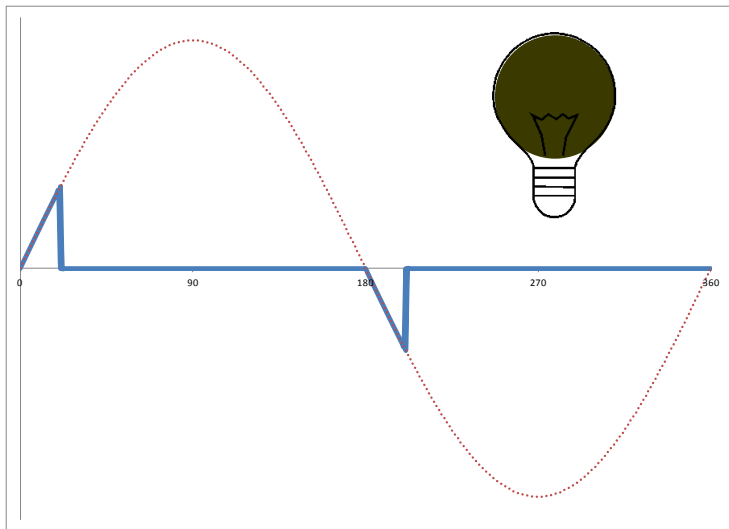
Applicable LED-rated Controls

Caseta	PD-6WCL, PD-3PCL
RadioRA 2	RRT-G25LW, RRD-6NA, RRD-6CL, RRD-10ND
HomeWorks QS	HWQS-6NA, HWQS-6CL, HWQS-10ND

Control type summary

- Reverse Phase

- Typically used for ELV loads, sometimes perform better with LEDs (or select LEDs may require reverse-phase)
- Smaller installed base, always require a neutral wire



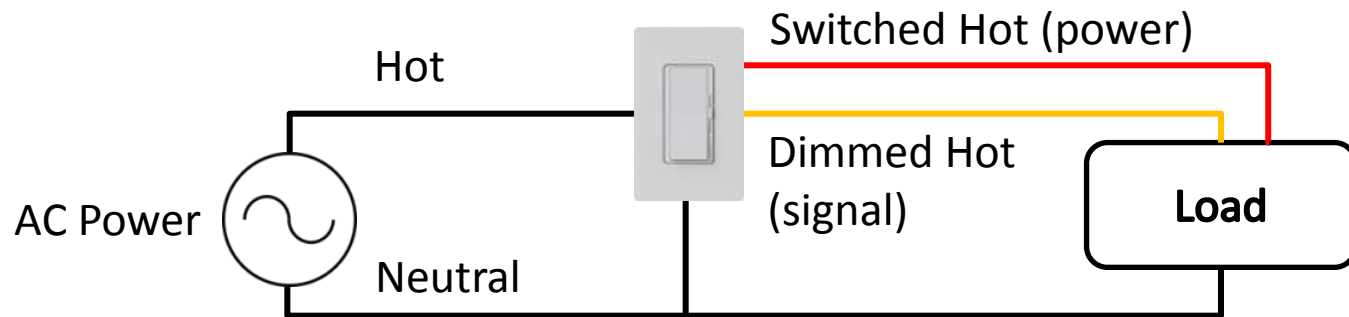
Applicable LED-rated Controls

Caseta	N/A
RadioRA 2	RRD-6NA
HomeWorks QS	HWQS-6NA, 4A Panel Module

Control type summary

- 3 Wire

- Fluorescent standard, control signal carried separate from power
- Precise, less prone to noise, but requires a third line voltage wire

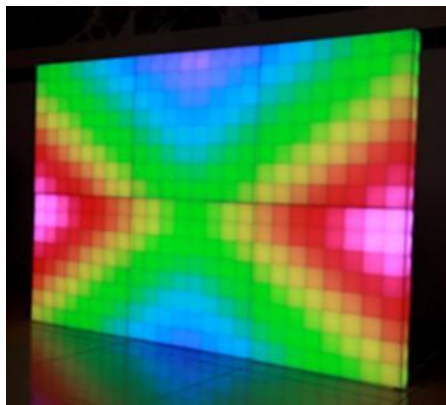


Applicable LED-rated Controls

Caseta	N/A
RadioRA 2	RRD-F6AN
HomeWorks QS	HWV-FDB-8A

Control type summary

- DMX-512
 - Popular in theater applications & RGB LED control
 - Multiple channels for individual color control
 - Possible to use for single color general applications
 - Complicated wiring for general illumination
 - Often requires an interface and more complex programming and installation

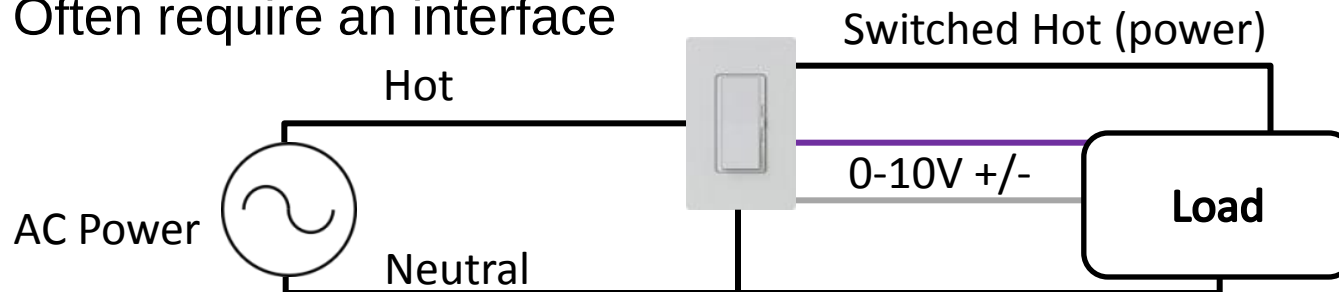


Applicable LED-rated Controls

Caseta	N/A
RadioRA 2	N/A
HomeWorks QS	LUT-DMX

Control type summary

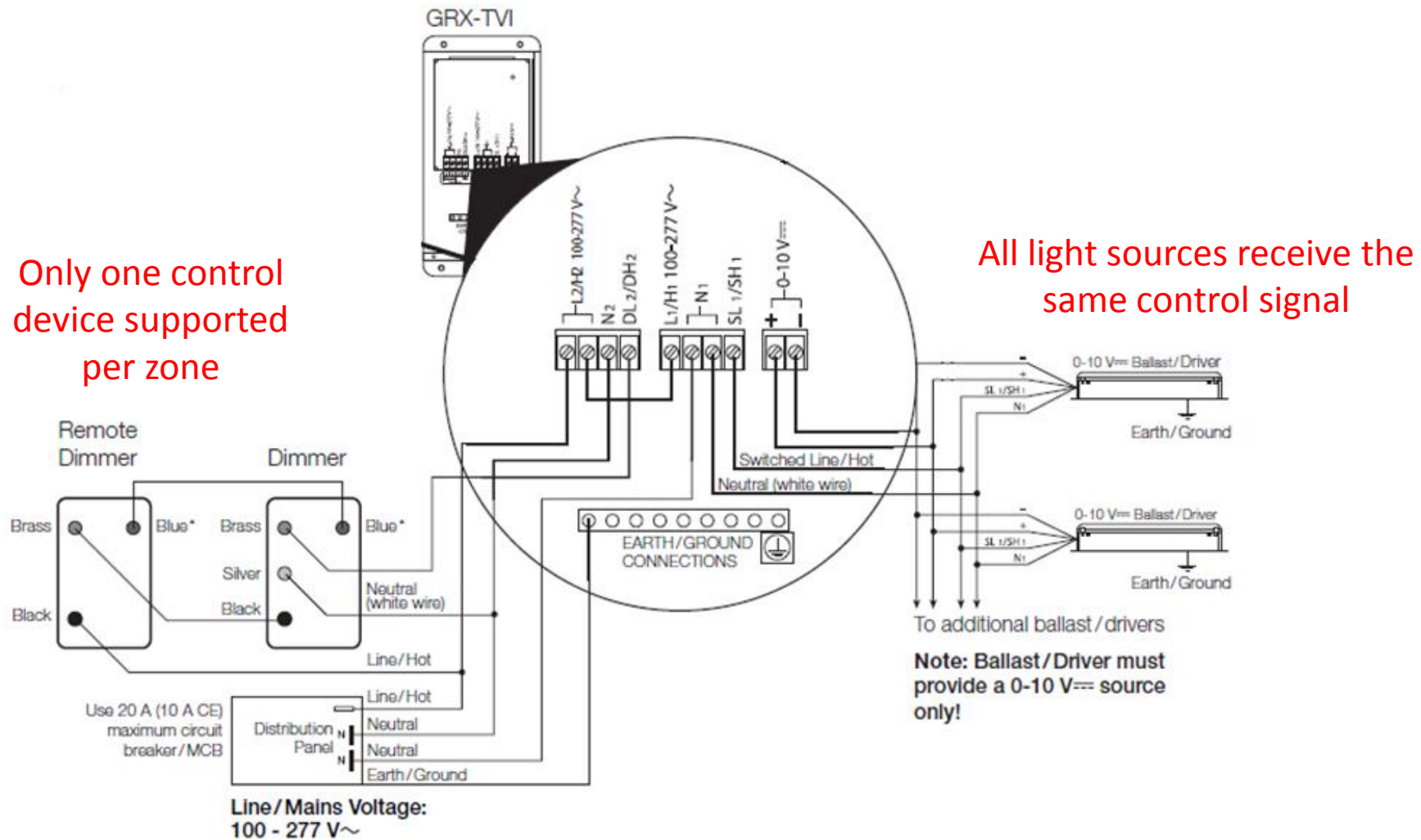
- 0-10V
 - Analog control standard, low voltage (simplified wiring)
 - IEC standard exists for general illumination, not always followed (alternate incompatible standard also exists)
 - Requires low voltage output AND line voltage switching
 - Often require an interface



Applicable LED-rated Controls

Caseta	GRX-TVI Interface
RadioRA 2	GRX-TVI Interface, 0-10V PowPak
HomeWorks QS	GRX-TVI Interface, 0-10V PowPak, TVM2 Panel Module

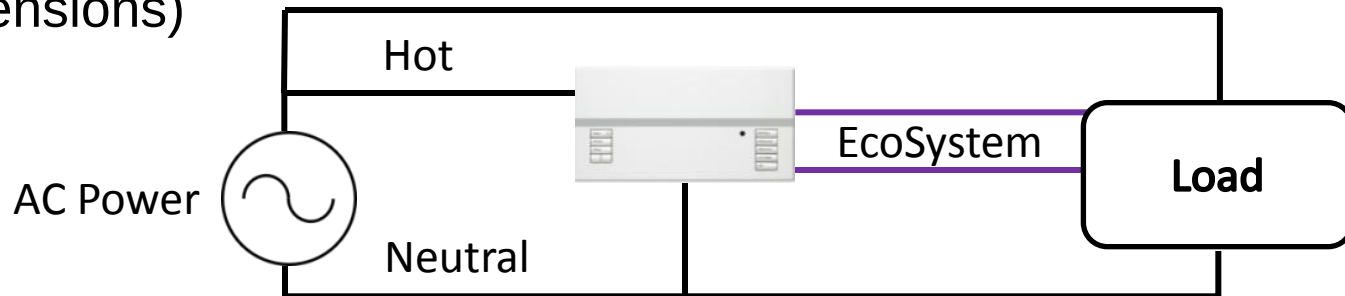
Typical 0-10V system architecture



Control type summary

- EcoSystem

- Allows digital addressing of individual fixtures and status feedback
- Allows assignment to occupancy sensors, timeclocks and controls to one or many fixtures without added wiring
- Based off of DALI IEC standard (with some manufacturer-specific extensions)



Applicable LED-rated Controls

Caseta	N/A
RadioRA 2	N/A
HomeWorks QS	Grafik Eye QS, DIN Rail Power Module

0-10V vs. EcoSystem

	Lutron EcoSystem	0-10V
Re-zoning ability	Simple reprogramming	Re-circuiting and re-wiring
Polarity and topology free wiring	Yes	No
Lights track together	Yes	May not over long wire runs
Automatic ballast replacement	Yes	N/A
Guaranteed compatibility controls + drivers	Yes	No
Load feedback	Extensive	No
BMS integration	Fixture by fixture information	Generally circuit level information (depends on amount of control interfaces)

Special case: MR16 lamps

- Huge issue for very popular MR16 lamps
- Two compatibility requirements
 - LED lamp and step-down transformer
 - Step-down transformer and dimmer
- Step-down transformer characteristics are often not known (and not locatable) for retrofits
- Both magnetic and electronic transformers designed for LV systems were typically designed for halogen (not LED) loads
 - Simply pairing an MLV dimmer with a magnetic transformer *or* ELV dimmer with an electronic transformer does not guarantee success with LED loads



Special case: MR16 lamps

- Both dimmer and step-down transformer (ELV or MLV) may have minimum loading requirements

Minimum load and
compatibility requirements
both here and here



The right dimmer type (MLV/ELV) must be used AND compatibility confirmed!

Control quick comparison

Control Technology	Type	Wiring	Notes
Forward Phase	Analog line voltage	2: Hot / Dimmed Hot	Most common type of dimmer installed
Reverse Phase	Analog line voltage	2: Hot / Dimmed Hot	Typically requires a neutral wire
3-wire	Analog line voltage	3: Hot / Switched Hot / Dimmed Hot	Originally developed for high-performance fluorescent dimming
EcoSystem	Digital low voltage	2: E1 / E2	Allows easy programming and zoning changes after installation
DALI	Digital low voltage	2: D+ / D-	Open standard, not always compatible
0-10V	Analog low voltage	2: +/-	Open standard, performance difficult to predict
DMX	Digital low voltage	2: D1 / D2	Often used with theatrical or color-changing fixtures
ClearConnect	Wireless	N/A	Available in limited products so far

4. Determine maximum & minimum loads

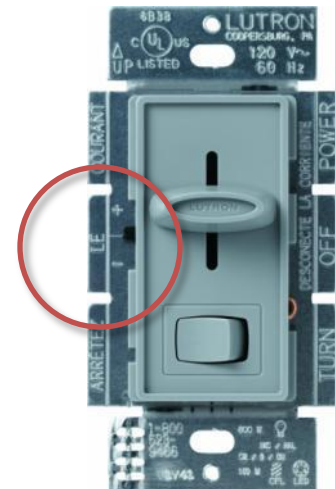
- Most new Lutron dimmers have LED-specific load ratings and ratings for mixed loads
- LED load power ratings are LOWER than incandescent ratings
- LED dimmers have low minimum loads (e.g., 10W or one lamp)

Total CFL/LED Wattage Installed (Watts per bulb x # of bulbs)	 	Maximum Allowable Incandescent/Halogen Wattage*	
		No sides removed	1 side removed
0 W	+	600 W	500 W
1 W – 25 W	+	500 W	400 W
26 W – 50 W	+	400 W	300 W
51 W – 75 W	+	300 W	200 W
76 W – 100 W	+	200 W	100 W
101 W – 125 W	+	100 W	50 W
126 W – 150 W	+	0 W	0 W



5. Set load type and trim settings

- Default (incandescent) settings may not provide smooth dimming performance on LED loads
 - Low end too low: dead travel, flicker, drop-out
 - High end too high: dead travel
- Incorrect load type (for adaptive dimmers) may provide unreliable operation
 - Loads may operate differently on forward vs. reverse phase
- See individual control instructions for setting trim and load type
- See LED load specifications or compatibility tables for recommended settings



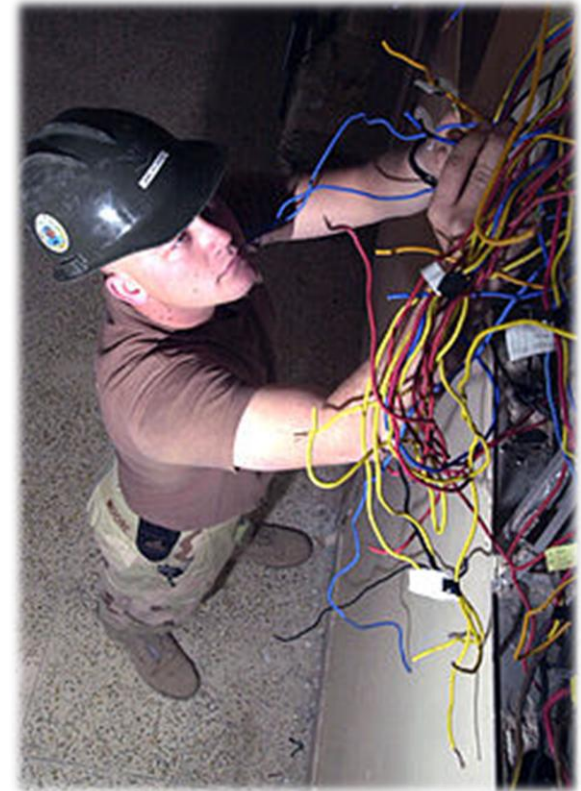
Risk mitigation and best practices

- Understand product dimming performance in advance
 - “Dims from 100%-0%” (what’s just before 0%?)
- Follow recommendations from fixture and/or control manufacturer
 - Beware: they may vary!
- Do mock-ups
 - Use real amounts of load in real applications
- Develop trusted sources
 - Who will support you if things don’t go as expected?
- Understand that installed legacy dimmers weren’t designed for new LED loads – always use dimmers rated for LEDs
- System “tuning” may be needed
 - Load type setting
 - Low end / high end trim adjustment



Fixing dimming problems

- Often there are no good solutions once products are installed
- Common “fixes”
 - Change the LED load
 - Use a different driver (if possible)
 - Use a different control (with neutral?)
 - Add incandescent or dummy load
 - Add additional wires and/or interface devices and/or minimum load box
- Who is responsible? Who pays?
- **Compatibility must be determined BEFORE products are ordered and installed!**





Product Solutions

Summary of different LED Product Solutions

Solution	Product	Caseta	RA 2	HW QS
Fixtures	Finiré 	✓	✓	✓
	Lumaris 	✓	✓	✓
	Aliante, L'ale, Rotare 	✓	✓	✓
Drivers	Hi-lume A-Series 	✓	✓	✓
	EcoSystem 5-Series 			✓
Phase Control Dimmers	C.L Dimmer 	✓	✓	✓
	Phase Adaptive Dimmer 		✓	✓
	Grafik T 		✓	✓
	Panel Dimming Modules			✓

Finiré by Ivalo LED Recessed Lighting

- 4" downlight, wall wash, and adjustable luminaires
- Flicker-free dimming down to 1% with Lutron Hi-lume A-Series LED Driver
- Guaranteed performance and compatibility of fixture, driver, & control
- Options include 2700K, 3000K, or 3500K CCT; trim or trim-less; IC rated or standard
- Industry best color consistency and available 98 CRI
 - Standard offering is 83 CRI
- Industry best 5 year warranty on fixture, driver, and LED color consistency



www.lutron.com/finire

Lumaris by Ivalo LED Linear Lighting

- Sleek LED system that provides high-quality, uninterrupted lines of LED illumination
- Flicker-free dimming down to % via UL-listed Hi-lume A-Series LED driver
 - Driver can be remote mounted up to 180' away
- Now available in brown, silver or black with clear or frosted lens
- 30° and 60° bracket options available
- 95 CRI; 2700K or 3500K options
- Industry best 5 year warranty on fixture, driver, and LED color consistency



www.lutron.com/lumaris

LED pendant and sconces by Ivalo

- High-end pendant and sconce fixtures now available in LEDs
- Flicker-free dimming down to 1% with Lutron Hi-lume A-Series LED Driver
- Guaranteed performance and compatibility of fixture, driver, & control
- 95 CRI; 2700K or 3500K options
- Industry best 5 year warranty on fixture, driver, and LED color consistency



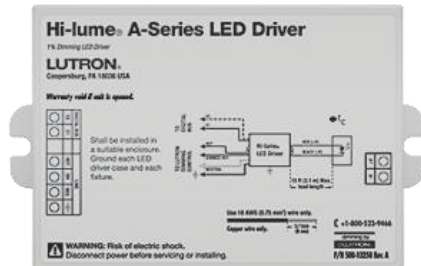
C•L Controls

- Available in standalone, Caseta, RadioRA 2, and HomeWorks QS varieties
- 2-wire (non-neutral) high-efficacy load dimmer
- Controls dimmable CFL, LED, and INC/HAL/MLV loads designed for forward phase control
- Controls up to 150W of dimmable CFL/LED loads or 600W of INC/HAL/MLV
- 10W minimum load or 1 LED bulb
- Adjustable low end trim



Hi-lume A-Series LED driver family

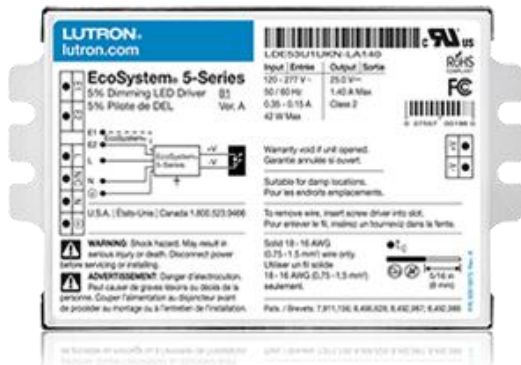
- Flexible platform with many options offering smooth, continuous, addressable, 100%-1% dimming
- Versions available up to 53W maximum load
- Multiple dimmer control types
 - Phase control (Caseta, RA2, HWQS) or digital EcoSystem (HWQS) control options
- Various enclosure sizes, including UL Listed remote mountable (ideal for tape light)



www.lutron.com/hilumeled

EcoSystem 5-Series LED driver family

- Built on the EcoSystem platform (HomeWorks QS only)
- Provides smooth, flicker-free dimming from 100%-5%
- A low price solution for high quality LED dimming
- 50,000 hour lifetime at worst-case conditions
- Various current and power configurations for 5-75W fixtures
- Can be remote mounted up to 50ft away from fixture



www.lutron.com/ecosystem5series

Phase adaptive controls

- Available in RadioRA 2 and HomeWorks QS varieties
- Controls incandescent, halogen, MLV, ELV & LED lighting designed for forward or reverse phase control
- Up to 600W maximum load, requires a neutral wire
- Adjustable minimum load and default load type
- Minimum load: 5W or 1 LED bulb



Grafik T C•L dimmer

- Neutral-optional, high-efficacy load dimmer
- UL Listed to control:
 - Up to 250W of compatible CFL/LED loads
 - 600W of INC/HAL
 - 300 VA MLV
 - Up to 8 Lutron A-Series LED drivers
- Minimum load varies based on application (as low as 5W or 1 LED lamp)
- Adjustable low-end trim



www.lutron.com/GrafikT



Tools and Resources

Summary of tools and resources

Tool	Description	Link
High Performance Fixture List	List of fixtures available with Lutron drivers	www.lutron.com/findafixture
Compatibility Lists	List of loads compatible with a variety of controls	www.lutron.com/dimcflled
LED Product Selection Tool	Report Cards on select LED loads with detailed compatibility information	www.lutron.com/ledtool
Whitepapers and resources	Background information and related links	www.lutron.com/leds
LED Center of Excellence	Specially trained tech support resources	leds@lutron.com 877-DIM-LED8

RadioRA 2 and HomeWorks compatible controls

Dimmable CFL & LED bulbs

Compatible with RadioRA₂ and HomeWorks_{QS} dimmers



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Dimmable CFL & LED bulbs

Compatible with RadioRA₂ and HomeWorks_{QS} dimmers

List updated August 1, 2014
For the most up-to-date list, visit www.lutron.com/dimcflled.

600W Two-wire CFL and LED RF Dimmer

Models: RRD-6CL HQRD-6CL HGRA-6CL



LED bulbs

Brand	Wattage	Model	Description
Cree	9.5W	BR30-06527FLF-12DE26-1U100	BR30, 650 Lumen, Soft White, 2700K
	9.5W	BR30-06550FLF-12DE26-1U100	BR30, Daylight, 5000K 650 Lumen, 9.5W
	18.0W	BA21-180500MF-12DE26-1U100	A21, 2700K, 1800 Lumen, E26, 18.0W
Eco	17.0W	BR40/DIM/LED ¹	BR40, 2700K, 1065 Lumen
	20.0W	20PAR38/LEDG5	PAR38
	20.0W	BPCEPAR38/LEDG5	PAR38
	20.0W	PAR38/5K/LEDG5	PAR38, 5000K
	20.0W	PAR38/5K/LEDG5/CAN	PAR38, 5000K
	20.0W	PAR38/LEDG5	PAR38
	20.0W	PAR38/LEDG5/CAN	PAR38
Litetronics	20.5W	LED156/827	5" or 6" Downlight, 2700K, 1245 Lumen
	14.0W	LP14560FL2D ¹	BR30, 2700K, 925 Lumen
	14.0W	LP14560FL4D ¹	BR30, 3000K, 925 Lumen
Philips	14.0W	LP14560FL8D ¹	BR30, 4000K, 925 Lumen
	11.0W	9290002268	A19, 2700K, 830 Lumen
	11.0W	9290002296	A19, 5000K, 830 Lumen
	13.0W	9290002523 13PAR38/F25 3000 DIM AF RD	PAR38, 3000K, 950 Lumen
	15.0W	9290002426	A21, 2700K, 1180 Lumen
	18.0W	9290002202	PAR38, 3000K, 951 Lumen, Medium Base
	18.0W	9290002236	PAR38
	18.0W	9290002237	PAR38
	18.0W	9290002245	PAR38, 2700K, 938 Lumen
	18.0W	9290002246	PAR38
	18.0W	9290002307	PAR38
	18.0W	9290002308	PAR38
	18.0W	9290002309	PAR38
	18.0W	9290002310	PAR38
	18.0W	9290002311	PAR38
	18.0W	18E26PAR38-3	PAR38
	18.0W	18E26PAR38-4	PAR38
	19.0W	9290002473	PAR38, 3000K, 1250 Lumen

¹ Requires a minimum of 2 lamps

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4

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www.lutron.com/dimcflled

LED Product Selection Tool

LED Product Selection Tool

While LEDs have shown great potential within the lighting industry, they – like all lights – benefit from the proper control. Use the dropdown choices to search for tested LED solutions that will ensure compatibility between controls and drivers with other LED products.

[View the LED Product Selection Overview Video](#)

Fixture/Lamp Type

A Lamp

Control Technology

Forward Phase

Lutron Control

Select All
Ariadni Dimmer
C.L Dimmers
Caseta Dimmer

Manufacturer

Select All
Advance
Aurora Lighting
British Electrical Lamps
Bulbrite Industries
Color Kinetics/Philips
Cooper/Halo

Input Voltage

☒ 120 V
☒ 120/277 V
☒ 240 V CE
☒ Low Voltage (12-24 volt)

* Hold Ctrl key for selecting multiple items

☐ Show only Lutron drivers (removes any non-Lutron driver options)

Search

Clear Form

[View Lutron Qualified Partners](#) | [Learn more](#) about all available control technologies.

If you would like your product added to this list or you would like more information about our testing program, please e-mail LEDs@lutron.com.

www.lutron.com/ledtool

LED Report Cards

Residential Systems

RadioRA 2	RRD-10ND	FP	1 - 18	7%	92%	26%	
HomeWorks QS	HQRD-10ND	FP	1 - 18	7%	92%	26%	
RadioRA 2	RRD-6NA	RP	1 - 18	7%	98%	27%	
HomeWorks QS	HQRD-6NA	RP	1 - 18	7%	98%	27%	
HomeWorks	HxD-6ND	FP	1 - 13	7% (15)	89% (99)	27%	
Panel Module	HW/LP-RPM-4A-120	RP	1 - 89	7% (11)	98% (99)	26%	Rating is per channel; total per module is 142.
Panel Module	HW/LP-RPM-4U-120	FP	1 - 125	7% (16)	98% (99)	26%	Rating is per channel; total per module is 125.
Grafik QS/ Wallbox Power Module	Grafik Eye QS Main Unit Family/ LQRJ-WPM-6P	FP	1 - 62	7% (16)	98% (99)	26%	Rating is per output; total quantity per Main Unit is 155.
Panel Module	GP (Harrier) Card	FP	1 - 44	8% (14)	97% (99)	27%	Rating is per output. Use load type 2-1.
Grafik Eye 3000/ HomeWorks	Grafik Eye 3000 Family/ HWI-WPM-6D-120	FP	1 - 62	7% (16)	98% (99)	26%	Rating is per output; total quantity per Main Unit is 93/116/155/155 for 2/3/4/6-Zone units, respectively.
RadioRA 2	RRD-6CL (R3)*	FP	1 - 18	20%	86%	44%	Low end trim required.
HomeWorks QS	HQRD-6CL (H2)*/ HQRD-6CL (H2)*	FP	1 - 18	20%	86%	44%	Low end trim required.

Interfaces ⁽⁵⁾

	PHPM-PA with Grafik Eye QS Main Unit	RP	1 - 89	7% (15)	98% (96)	26%	
	PHPM-WBX with 3-wire fluorescent control	RP	1 - 89	7%	98%	26%	

Notes:

* Identical model numbers with different compatibility codes may have different performance; () means there is no compatibility code assigned; contact technical support for additional information.

(1) Control types of FP and RP represent Forward Phase and Reverse Phase, respectively. See product literature for details.

(2) Maximum Fixtures per Dimmer value represents the maximum safe loading of the control.

(3) Values are based on light output using the specified dimming control, and may not be an indication of the fixture's full rated capability.

Values are set to optimize performance, such as reducing dead travel, ensuring that fixtures turn on at low end, reducing turn-on time at low end, and trimming out instability. Software trim values are indicated in parentheses when applicable.

(4) Perceived light level percentage is the square root of the measured light level percentage, per IESNA Lighting Handbook.

(5) Interfaces have been tested with the listed control; any compatible dimmer may be used instead, but high end/low end light levels may vary slightly.

Test Comments:

Performance verified with up to 18 fixtures per control.

Limitations to recommendations

- Lutron recommendations are tested with up to 150W of load
- Only loads which perform well enough in most applications on multiple dimmers have Report Cards
 - For example, LEDs must dim to at least 20% measured light
- Only listed dimmers are approved; “similar” dimmers may have different performance
 - Check with the LED Center of Excellence with questions
- Lutron can only list solutions for products which are UL-approved for LED loads

High Performance LED Fixture Tool

- Lists fixtures from OEMs that contain Lutron drivers or EcoSystem technology
 - Updated regularly
- Guaranteed dimming performance and control compatibility
- Hundreds of fixtures listed:
 - Accent Lights
 - Coves
 - Downlights
 - Grazers
 - Pendants
 - Slots
 - Strips
 - Track
 - Linears
 - Sconces...

High-Performance LED Fixture List

Lutron's Hi-Lume A-Series 1% LED driver and 5-Series 5% LED driver with EcoSystem® work with many high-performance LED fixtures, for use in many applications. This newly revised tool is designed to help specifiers and lighting designers select fixtures available with Lutron dimming performance, reliability and guaranteed compatibility for 2-wire forward phase, 3-wire, EcoSystem® and Eco-embedded control options. If you have any feedback or would like to see your fixture listed, contact your Lutron OEM Sales Representative.

The following controls are engineered and tested to be compatible with the Lutron LED drivers used in the fixtures on this list:

2W: 2-wire forward phase control (compatibility list)

3W: 3-wire control (compatibility list)

Eco: EcoSystem control (compatibility list)

EE: Eco-Embedded fixtures (contact your OEM account manager for details)

Updated: 06/01/14.

Fixture Type	Aperture	Manufacturer	Dimming & Control Type					
Select All	Select All	Select All	Select All	Select All	Select All	Select All	Select All	Search

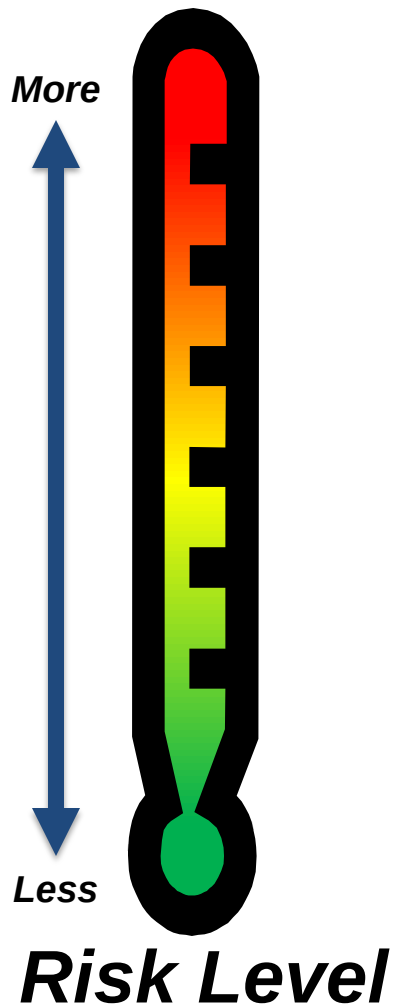
Print | Show All

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Fixture Type	Aperture	Manufacturer	Lumens	Dimming & Control				Family/Model Number
				1%	5%	EE		
Accent Light	NA	Acolyte	1360 - 2160	Y	Y			HD24...
Accent Light	2"	Edison Price	700 - 1000	Y	Y			TWO*LS-AA...-DLU
Accent Light	3"	Edison Price	700 - 1000	Y	Y			Three LS AATHREE-LS-AA...-DLU
Accent Light	4"	Edison Price	700 - 1000	Y	Y			Minimax LED

www.lutron.com/findafixture

Summary of solutions



Untested products with drivers by others	Untested; dimming performance unknown or uncertain
Loads on Compatibility Lists <i>or</i> LED Product Report Cards	Lutron-tested compatibility and confirmed dimming performance
Fixtures with Lutron drivers	Lutron-guaranteed compatibility and dimming performance
Ivalo fixtures	Lutron-guaranteed light quality, compatibility, and dimming performance

LED Control Center of Excellence

- A resource for you and your customers to get answers on any LED control question, including:
 - Compatibility lists
 - Tested/non-tested products
 - Whitepapers and presentations
 - Educational information to share with customers
- Ways to reach us:
 - 1-877-DIM-LED8
 - LEDs@lutron.com
 - www.lutron.com/LED

Summary

- Using LED loads is not the same (not as easy!) as using previous technologies
- Successful projects depend on selecting the proper load and control early in the design process
- Understand that changing the load or the control may impact performance
- Fixing dimming compatibility “in the field” is costly and time consuming; LED-compatible controls should be selected for all designs today, regardless of the load type initially needed

Summary

- Lutron is the leader of controlling ANY light source, including LEDs:
 - Product innovation and performance
 - Customer education and support
 - Industry involvement and leadership
- Using Lutron products and resources simplifies the selection of LED lighting fixtures and controls
 - Use Lutron C•L products and drivers
 - Follow recommendations from the LED Center of Excellence
- Lutron's LED fixture, driver, and control solutions are available to control hundreds of fixtures globally with known performance and compatibility



Further questions...?