

T-Series Tunable White

Sequence of Operations Guide



Prioritize Quality Light

Quality Light is more than just illumination.

With the Lutron HXL™ approach to human centric lighting, our quality light solutions like T-Series can do more than just light a space:

- Promote comfort
- Foster engagement
- Enable enhanced well-being



Why tunable white?

Illuminate the human experience

Deliver quality light that enhances occupant comfort and well-being.



Enhance your design with lasting lighting impressions

Independently adjust CCT and intensity to perfectly complement the chosen materials and finishes in the space.

Minimize risk and easily accommodate design changes

When project details — colors, furnishings, and available daylight — unexpectedly change, leverage the flexibility of tunable white to ensure the lighting is perfectly tuned to new project conditions.



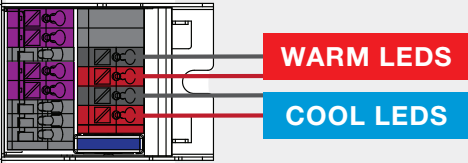
Lutron's T-Series 2-channel tunable white solution delivers high-quality 2-channel tunable white light

T-Series 2-Channel Tunable White LED Driver and T-Series ESN

Why Choose T-Series 2-Channel Tunable White?

1. How does 2-channel tunable white work?

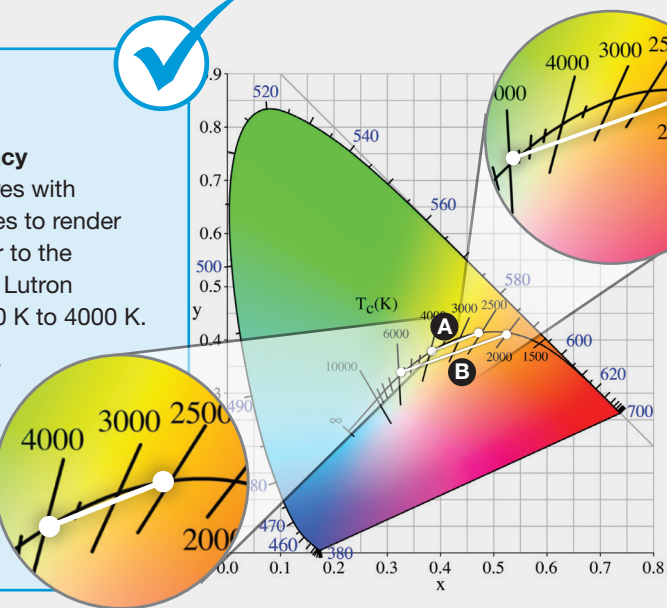
All 2-Channel tunable white solutions render tunable white light by mixing one warm and one cool LED chip set. This easy implementation makes 2-channel tunable white more cost-effective, but also requires careful attention to detail during specification.



A Improve color rendering accuracy

Specify your fixtures with smaller CCT ranges to render color that is closer to the black body curve. Lutron recommends 2700 K to 4000 K.

Specify all fixtures with the same CCT range to ensure color consistency from fixture to fixture.



B Inaccurate color rendering

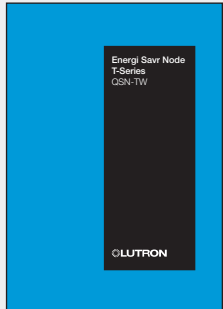
2-channel solutions render colors that lie on the straight line between a fixture's minimum and maximum CCT values.

Wide CCT ranges deviate from the black body curve, resulting in light that looks redder or bluer than expected.

2. T-Series 2-channel tunable white solution



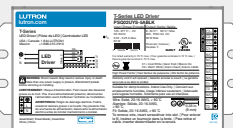
T-Series pairs a digitally controlled 2-channel tunable white driver with a specialized controller to guarantee compatibility and performance, and eliminate risk.



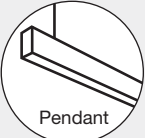
ESN Controller



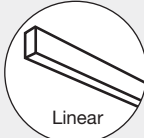
Linear Pendant Driver



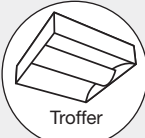
Downlight Driver



Pendant



Linear



Troffer

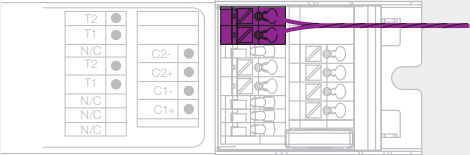


Downlights

3. Why T-Series digital? Minimize wiring mistakes!



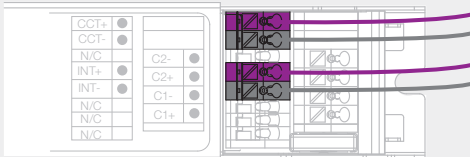
One polarity free control wire means contractors don't have to worry about correctly wiring separate intensity and CCT control wires.



T-Series 2-Channel Tunable White Polarity Free Control Wiring



Two pairs of identical 0-10V control wires means contractors must correctly wire them to achieve the specified intensity and CCT control.

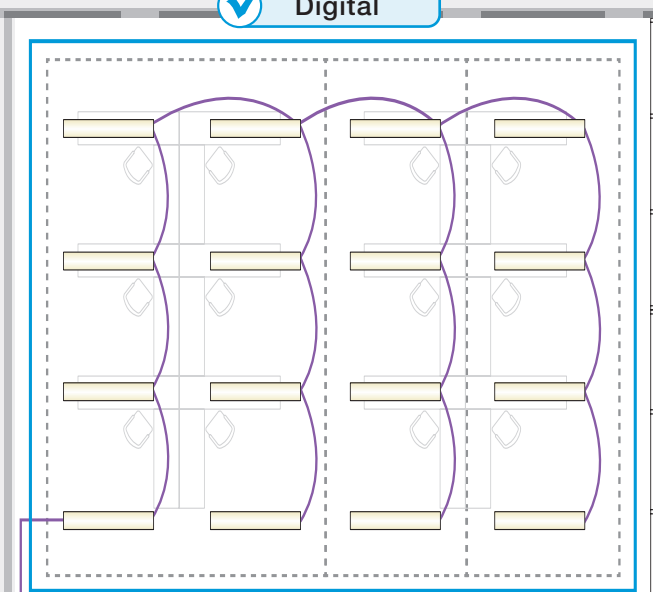


0-10V 2-Channel Tunable White Control Wiring

4. Why T-Series digital? Wire first, determine zone programming later!



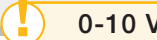
Digital



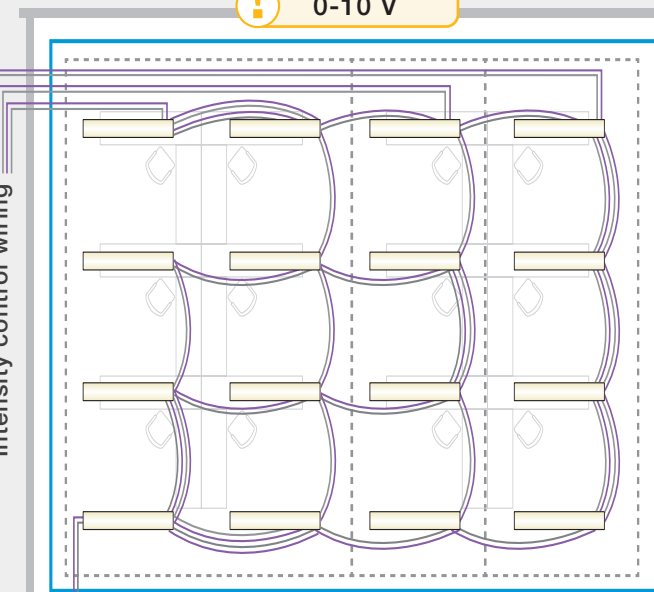
Intensity & CCT control wiring



- Polarity-free daisy chain wiring simplifies control wiring.
- Intensity and CCT zoning are programmed digitally and are not dependent on the way the contractor wires the space.



0-10 V



CCT control wiring



- Zones must be designed up front and hard-wired by the contractor. Any mistakes require rewiring.
- Intensity and CCT are typically zoned differently, complicating the control wiring.

Color Legend: CCT Zoning Intensity Zoning

A man with a beard and glasses, wearing a light blue shirt, is seated at a desk, looking at a large monitor. The monitor displays a presentation titled "Tunable White Sequence of Operations" with a cityscape image and a timeline diagram. The laptop next to him also displays the same presentation, showing a graph of CCT levels over time. The man is holding a pen in his right hand and has a watch on his left wrist. The desk is white, and there is a red cup on the right side. The background is a bright, out-of-focus office space.

[illegible]

Tunable White Sequence of Operations

Intensity considerations

Occupancy/Vacancy sensing



OCCUPANCY

COPY AND PASTE INTO YOUR SPEC

Occupancy sensors shall only modify intensity and should not modify CCT.

Occupancy sensors shall turn on lighting automatically when the space is occupied and will turn off/reduce lighting automatically 15 minutes after the space is vacated.

OR



VACANCY

COPY AND PASTE INTO YOUR SPEC

Vacancy sensors shall only modify intensity and will not modify CCT.

Vacancy sensors shall turn off or reduce lighting automatically 15 minutes after the space is vacated.

OR



NO OCCUPANCY/ VACANCY

COPY AND PASTE INTO YOUR SPEC

No occupancy/vacancy sensors in the space.

Daylight sensing



DAYLIGHTING

COPY AND PASTE INTO YOUR SPEC

Daylight sensors shall only modify intensity and will not modify CCT.

Daylight sensors shall automatically raise and lower the lighting in the space to maximize the contribution of natural sunlight in the space.

OR



NO DAYLIGHTING

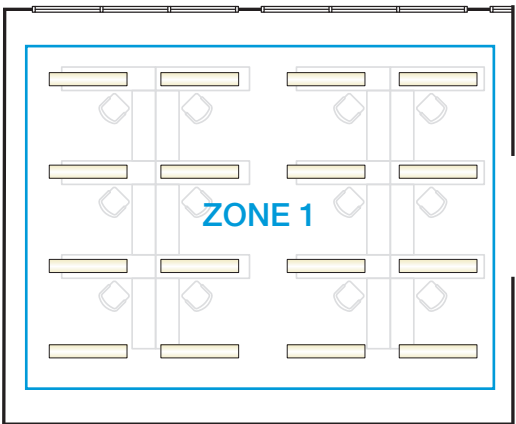
COPY AND PASTE INTO YOUR SPEC

No daylight sensors in the space.

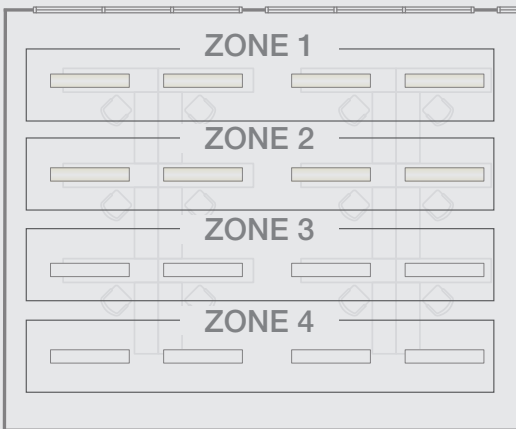
CCT considerations

CCT zoning

Lutron recommends that CCT is defined independently of intensity zones because doing so allows for simple, automatic CCT control throughout the day.



OR



CCT ZONING

COPY AND PASTE INTO YOUR SPEC

The CCT of tunable white fixtures in this space shall be controlled as a single zone.

MULTIPLE ZONING

COPY AND PASTE INTO YOUR SPEC

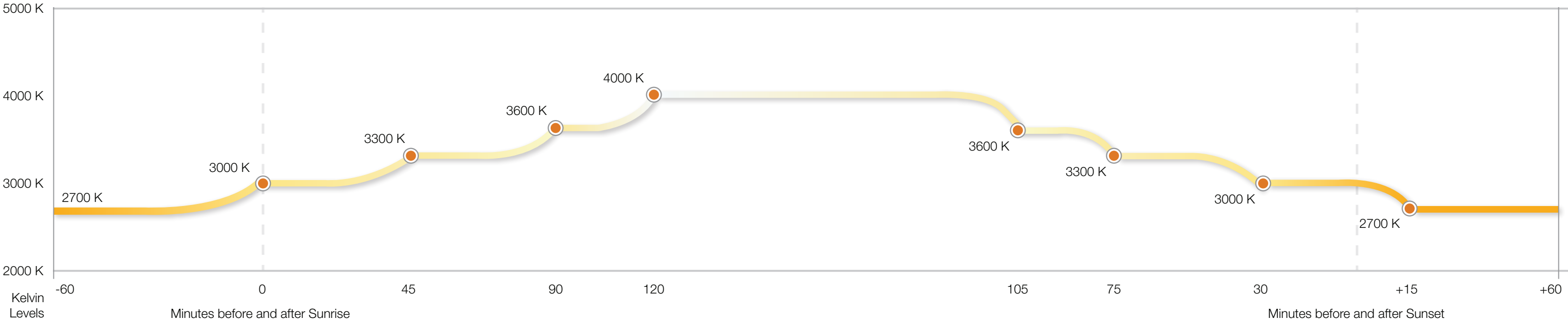
The CCT of tunable white fixtures in this space shall be divided and controlled in multiple zones. [Insert additional language as needed]

Tunable White Sequence of Operations

CCT considerations

Automatic CCT curves

Quantum and T-Series enable the CCT of tunable white fixtures to be automatically adjusted throughout the day to mimic the color temperature of daylight.



CCT CURVES

COPY AND PASTE INTO YOUR SPEC

Tunable white fixture CCT shall be controlled automatically per Lutron's default automatic CCT curve. Fixture CCT shall begin ramping from 2700 K starting 60 minutes before sunrise, completing the ramp up to 4000 K 120 minutes after sunrise. Fixture CCT shall begin ramping down from 4000 K 120 minutes before sunset, completing the ramp down to 2700 K 60 minutes after sunset. The ramp up and ramp down shall each consist of the optimal number of discrete steps needed to achieve the default automatic CCT curve. Each fade duration shall last 15 minutes.

Note:
1. It is possible that the CCT measured from the fixture does not exactly match the CCT values in the above default automatic CCT curve. The CCT produced by an OEM fixture is dependent on each specific OEM's installation of the LEDs used, overall construction of the fixture and its optics, and the configuration of the T-Series LED driver. Coordinate with your OEM and Lutron Sales Rep to understand how to properly program Lutron's system to more accurately render the CCT values listed above.
2. Lutron offers additional services to aid in the design and implementation of tunable white, Speak to your representative agent about Lutron's tunable white service options.

OR

CUSTOM AUTOMATIC CCT CURVES

COPY AND PASTE INTO YOUR SPEC

Tunable white fixture CCT will be controlled automatically per a user-defined automatic CCT curve. **[Insert detailed description of desired CCT fade start times, CCT fade durations, and CCT values throughout the day]**

OR

NO AUTOMATIC CCT CURVES

COPY AND PASTE INTO YOUR SPEC

Tunable white fixture CCT will not be automatically controlled throughout the day.

Tunable White Sequence of Operations

CCT considerations

Return to automatic CCT curve

CCT control via automatic CCT curves introduces new interactions between the lighting control system and the keypads/remotes in the space. When designing a tunable white system, it is important to define how the system will reactivate the automatic CCT curve after it is overridden by the occupant in the space.



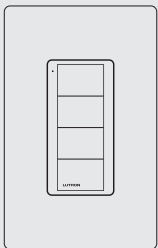
NO AUTOMATIC CCT CURVE OVERRIDE

Lutron's default sequence of operations does not enable the automatic CCT curve to be overridden.

COPY AND PASTE INTO YOUR SPEC

The automatic CCT curve shall not be overridden by the controls in the space.

ADDITIONAL OPTIONS



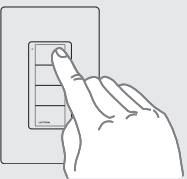
MANUAL
BUTTON
PRESS

COPY AND PASTE INTO YOUR SPEC

Automatic CCT curve is reactivated by manually pressing the **[user-defined]** button on a keypad or remote in the space. **[Insert additional detail regarding button engravings, scene settings, and programming as needed]**

RECOMMENDED

- 2-SECOND FADE TIME
- TOP BUTTON RETURN TO AUTOMATIC CCT



CUSTOM
VACANCY

COPY AND PASTE INTO YOUR SPEC

Occupancy/Vacancy sensors reactivate automatic CCT control **[input user-defined timeout]** minutes after the space is vacated.

RECOMMENDED

- RETURN TO AUTOMATIC CCT VIA VACANCY SENSOR
- VACANCY TIMEOUT OF 15 MINUTES



CUSTOM
END OF DAY

COPY AND PASTE INTO YOUR SPEC

Automatic CCT curve is reactivated at **[insert user-defined time]**

RECOMMENDED

- END OF DAY REACTIVATION AT 2:00 AM



ADDITIONAL OPTIONS

Tunable White Sequence of Operations

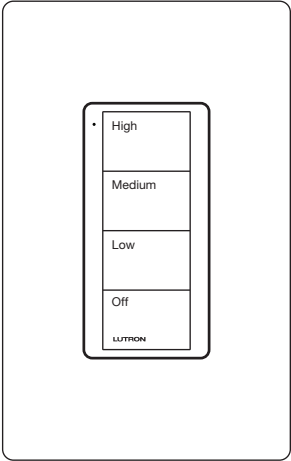
Manual controls

Intensity and CCT keypads and remotes

Lutron recommends that manual controls only adjust intensity. This prevents users from interrupting any automatic CCT curves that are used in the space.

If manual control of CCT is desired, the recommendations for user-defined keypad/remote engraving and programming can serve as a guide when defining the keypads/remotes in the space.

SCENE CONTROL OF INTENSITY ONLY



Lutron’s default keypad programming does not enable users to manually control CCT

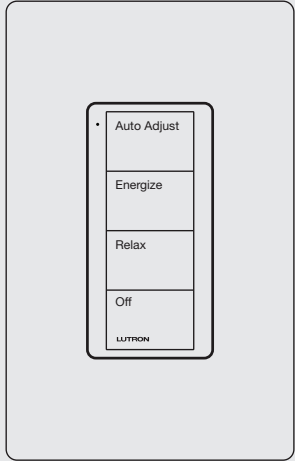
Engraving	Intensity Programming	CCT Programming
High	100%	N/A
Medium	50%	N/A
Low	25%	N/A
Off	0%	N/A

COPY AND PASTE INTO YOUR SPEC

Single gang [Insert keypad/remote brand name/model number] for control of intensity. Button engraving and programming, from top to bottom, shall be “High” (set intensity to 100%), “Medium” (set intensity to 50%), “Low” (set intensity to 25%), Off (set intensity to 0%).

ADDITIONAL OPTIONS

SCENE CONTROL OF BOTH INTENSITY AND CCT



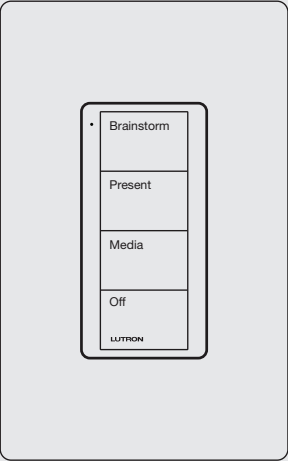
Recommended for

- Open Office
- Private Office
- Classroom
- Training room

Engraving	Intensity Programming	CCT Programming
Auto Adjust	Defined by User	Return to Automatic CCT Curve
Energize	100%	4000 K
Relax	25%	2700 K
Off	0%	N/A

COPY AND PASTE INTO YOUR SPEC

Single gang [Insert keypad/remote brand name/model number] for scene control of both intensity and CCT. [Insert engraving and programming details]



Recommended for

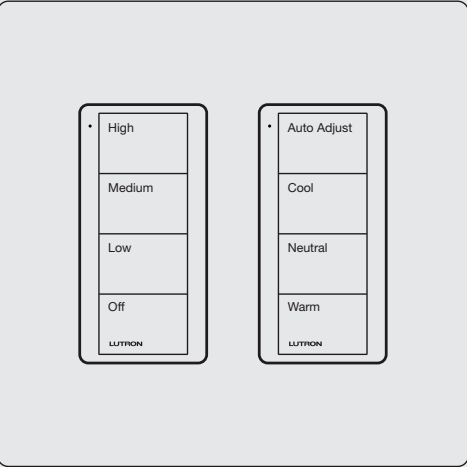
- Conference Room
- Classroom
- Training Room

Engraving	Intensity Programming	CCT Programming
Brainstorm	100%	4000 K
Present	25%	Return to Automatic CCT Curve
Media	10%	Return to Automatic CCT Curve
Off	0%	N/A

COPY AND PASTE INTO YOUR SPEC

Single gang [Insert keypad/remote brand name/model number] for scene control of both intensity and CCT. [Insert engraving and programming details]

SEPARATE CONTROL OF INTENSITY AND CCT



Engraving	Intensity Programming	CCT Engraving	CCT Programming
High	100%	Auto Adjust	Return to Automatic CCT Curve
Medium	50%	Cool	4000 K
Low	25%	Neutral	3200 K
Off	Off	Warm	2700 K

COPY AND PASTE INTO YOUR SPEC

2-gang [Insert keypad/remote brand name/model number] for separate control of intensity and CCT. [Insert engraving and programming details]

ADDITIONAL OPTIONS

Tunable White Sequence of Operations

Additional considerations

Intensity Timeclock Events

Intensity timeclocks can be used to adjust intensity to accommodate the unique needs of a space



INTENSITY TIMECLOCK EVENTS

COPY AND PASTE INTO YOUR SPEC

User defined timeclock events shall not be used in the space.

Emergency/Egress



EMERGENCY/ EGRESS

Intensity value: 100%
CCT value: 50%

COPY AND PASTE INTO YOUR SPEC

In the event of an emergency/egress situation, tunable white fixtures designated as Emergency/Egress will have their intensity automatically set to 100% and their CCT automatically set to 50% of the fixture's CCT range.

* 50% CCT denotes the value between the maximum and minimum CCT rendered by the fixture. The exact CCT rendered is fixture dependent.

OR



CUSTOM INTENSITY TIMECLOCK EVENTS

COPY AND PASTE INTO YOUR SPEC

Timeclock events shall be used to adjust [Intensity-only timeclock event times and desired intensity levels] in the space.

OR



EMERGENCY/ EGRESS

COPY AND PASTE INTO YOUR SPEC

Tunable white fixtures shall not be designated for Emergency/Egress functionality.

Default sequence of operations

Overview

This default tunable white sequence of operations is Lutron's recommendation for a sequence of operations that meets the needs of a typical tunable white application. Should these defaults not meet the needs of the space, Lutron recommends that you refer to the T-Series Tunable White Sequence of Operations Guide (367-2835) for a detailed overview of all recommended customization options.

Lutron T-Series 2-Channel Tunable White Default Sequence of Operations

This following default sequence of operations is structured for a single space within a building being controlled by Lutron's Quantum system. In order to ease system programming and to help facilitate communication, it is recommended that a sequence of operations be provided for each individual space that requires tunable white.

1. [Input area/space name or type] Tunable White Sequence of Operations
 - a. Intensity considerations
 - i. Occupancy/Vacancy sensing
 1. Occupancy sensors shall only modify intensity and should not modify CCT.
 2. Occupancy sensors shall turn on lighting automatically when the space is occupied and shall turn off/reduce lighting automatically 15 minutes after the space is vacated.
 - ii. Daylighting
 1. Daylight sensors shall only modify intensity and should not modify CCT.
 2. Daylight sensors shall automatically raise and lower the lighting in the space to maximize the lighting contribution of natural sunlight in the space.
 - b. CCT considerations
 - i. CCT zoning
 1. The CCT of tunable white fixtures in this space shall be controlled as a single zone.
 - ii. Automatic CCT curve
 1. Tunable white fixture CCT shall be controlled automatically per Lutron's default automatic CCT curve. Fixture CCT shall begin ramping from 2700 K starting 60 minutes before sunrise, completing the ramp up to 4000 K 120 minutes after sunrise. Fixture CCT shall begin ramping down from 4000 K 120 minutes before sunset, completing the ramp down to 2700 K 60 minutes after sunset. The ramp up and ramp down shall each consist of 13 discrete 15-minute fades.
 - iii. Return to automatic CCT curve
 1. The automatic CCT curve shall not be overridden by the controls in the space.
 - c. Manual controls
 - i. Intensity and CCT keypads and remotes
 1. Single gang [Insert keypad/remote brand name/model number] for control of intensity only. Button engraving and programming, from top to bottom, shall be "High" (set intensity to 100%), "Medium" (set intensity to 50%), "Low" (set intensity to 25%), Off (set intensity to 0%).
 - d. Intensity timeclock events
 - i. User-defined timeclock events shall not be used in the space.
 - e. Emergency/Egress
 - i. In the event of an emergency/egress situation, tunable white fixtures designated as Emergency/Egress will have their intensity automatically set to 100% and their CCT automatically set to 50% of the fixture's CCT range.

High-Performance LED Fixture List

The High-Performance LED Fixture List tool is designed to help select Lutron enabled fixtures, eliminating the need to search the internet and review individual specification sheets. We work hard to promote our partners to make specification of fixtures with guaranteed performance easy. Customers can use this simple tool to select the fixtures they want and quickly get specifications to add to their job.

Step 1

Visit lutron.com/HPFL

Easily search all fixtures available or quickly narrow your search

Step 2

Adjust search parameters to meet the needs of your specification

Select from fixture options from dimensions to lumen output ranges with simple filters

Step 3


Find the right tunable white fixture

Search through hundreds of T-Series enabled fixture families to find the right fixture for your application

Step 4

Finalize your fixture selections

Evaluate the results provided and get direct access to the fixture specification documents. Direct links to fixture spec sheets allow you to finalize fixture selection without needing to dig through each manufacturer’s website



High Performance LED Fixture List

What fixture are you looking for?

Communication Method

☒ Wired ☐ Wireless

Manufacturer

All Manufacturers


Show only Lutron OEM Advantage Program Partner Accounts


Fixture Type

Troffer (368)

Get my results

High Performance LED Fixture List



Filters [\[Start Over\]](#) 

Communication Method: Wired

Manufacturer

All Manufacturers

Show only Lutron OEM Advantage Program Partner Accounts

Fixture Type

Troffer (105)

Fixture Style

All Fixture Styles

Driver Family, Control Protocol and Dimming Level

T-Series 1% PSQ (105)

All Driver Families

T-Series 1% PSQ (105)

Lumenetix (2-Address EcoSystem) (57)

Hi-lume Premier 0.1% PEQ0 (19)

Hi-lume 1% LDE1 (341)

5-Series 5% LDE5 (335)


10-Series 10% LDE10 (400)

High Performance LED Fixture List

Results 1-25 of 278

Lutron Driver Family, Control Protocol and

Fixture Type	Fixture Style	Manufacturer	Manufacturer Fixture Family	Tunable White Digital	
				T-Series 1% PSQ	Lumenetix (2-Address EcoSystem)
Linear Slot	Recessed	Day-O-Lite	Profile Series PRFL-24-D-G	Yes*	Yes*
Linear Slot	Recessed	Day-O-Lite	Profile Series PRFL-44-D-G	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Downlight	Recessed	Elite Lighting	Maxilum	Yes*	Yes*
Linear Wall Wash	Wall Mount	Finelite	HP-2 Indirect Direct Wall Mount Tunable White	Yes*	No
Linear Wall Wash	Wall Mount	Finelite	HP-2 Direct Wall Mount Tunable White	Yes*	No
Pendant	Linear Suspended	Finelite	HP-2 Indirect Direct Pendant Tunable White	Yes*	No
Pendant	Linear Suspended	Finelite	HP-2 Direct Pendant Tunable White	Yes*	No
Pendant	Linear Suspended	Finelite	HP-2 Indirect Pendant Tunable White	Yes*	No
Linear Wall Wash	Wall Mount	Finelite	HP-2 Indirect Wallwash Tunable White	Yes*	No
Linear Wall Wash	Wall Mount	Finelite	HP-2 Direct Wallwash Pendant Tunable White	Yes*	No
Linear Wall Wash	Recessed	Finelite	HP-2 Wallwash Recessed Tunable White	Yes*	No
Linear Wall Wash	Surface Mount	Finelite	HP-2 Wallwash Surface Mount Tunable White	Yes*	No
Linear Wall Wash	Surface Mount	Finelite	HP-2 Wallwash Arm Mount Tunable White	Yes*	No
Linear Slot	Surface Mount	Finelite	HP-2 Surface Mount Tunable White	Yes*	No
Linear Slot	Recessed	Finelite	HP-2 Recessed Tunable White	Yes*	No
Linear Wall Wash	Wall Mount	Finelite	HP-4 Indirect Direct Wall Mount Tunable White	Yes*	No
Linear Wall Wash	Wall Mount	Finelite	HP-4 Direct Wall Mount Tunable White	Yes*	No




Tunable White High Performance Recessed (HPR LED) 2x4 Surface Mount

Date

Project

Type

Comments



Tunable White High Performance 2" (HP-2) - Indirect/Direct

Date

Project

Type

Comments

DESCRIPTION

High Performance 2" aperture Indirect/Direct (HP-2 ID) is a patented, linear LED luminaire that offers many aesthetic options including Top Glow™ or Flush for uplight and Bottom Glow™, 1" Drop Down Lens, Flush, White Cross Blade Baffle, Hollowed Ellipse Louver, Hat Louver, or Recessed diffuser for downlight. HP-2 ID delivers excellent performance using an advanced optical design and mid-power LEDs to achieve 90% of initial light output at 100,000+ hours.

ORDERING GUIDE: Sample Number: HP-2 ID - 32 - B - V - BTW - TG - F - 90LG - 120V - FA - FE - SC - C1

Finelite HP-2 ID (See pg 2 for cross sections)

HP-2 ID H2 (See pg 2 for cross sections)

Length / FineTune Only (Minimum 2", increments accurate to 1/16" (a 1/2", standard)

Uplight Output (B - Boosted Standard, V - Very High)

Downlight Output (B - Boosted Standard, V - Very High)

LED CR/CCT (BTW - 80 CRI min, Tunable White; BTW - 90 CRI min, Tunable White. See below for Tunable White controls options).

Uplight Option (TG - Top Glow (standard), F - Flush, WSD - Widespread Optic, WSDTS - Widespread Optic with Top Glow; ASY-L - Asymmetric Left Optic; ASY-R - Asymmetric Right Optic; ASYTB-L - Asymmetric Left Optic with Top Glow; ASYTB-R - Asymmetric Right Optic with Top Glow)

Downlight Option (FE - Flush (standard), BG 1" - Bottom Glow, BG 1" - 1" Drop Down Lens, BG-D 1" - Flat Diffuser with 1" Recessed, BG-WCB 1" - White Cross Blade Baffle, BG-LNE 1" - Hollowed Ellipse Louver, BG-HLC 1" - Hat Louver)

Reflector System (90LG - Line Glow)

Voltage (120V, 277V)

Mounting (FA - Fully Adjustable)

Endcap (FE - Flat Endcap, DE 1" - 1" Drop Down Lens Illuminated Endcap, DE 1" - Open Endcap)

Circuiting (1BC - Single Circuit, BC 1 - Dual Circuit)

Ceiling Type (C1 - 1" T-Bar, C2 - 9/16" T-Bar, C3 - screw slot, C4 - hard ceiling)

* Available for HP-2 Indirect/Direct (HP-2 ID) only

* Available for HP-2 Indirect/Direct Recessed (HP-2 ID R2) only

* Available in 1" increments

* Connect factory for switching options

* DC only available for fixtures 2' or longer

* Available for 1" Drop Down Lens (DL) overnight order only

When selecting FineTune or pre-qualified DMX drivers made by others choose one of the following feed lengths below:

DMX Pendant Feed Length (5', 12', 30')

TUNABLE WHITE CONTROLS OPTIONS: SELECT ONE

☐ FineTune controller with FineTune DMX Driver

OR

☐ Controls by others with pre-qualified DMX driver

☐ Controls by others with pre-qualified DALI driver

☐ Controls by others with pre-qualified PoE setup

☐ Controls by Lutron with pre-qualified Lutron driver

Protected by one or more US Patents: 8,918,113; 9,760,391; 9,760,390; 9,760,722; 9,727,854; 9,727,858; 9,727,861; 9,727,862

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Customer Assistance

Online: lutron.com/help | Email: support@lutron.com | Phone: 1.844.LUTRON1 (588.7661) — includes 24/7 technical support

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