T-Series Tunable White

Sequence of Operations Guide

LUTRON

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**

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 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.

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.

WARM LEDS
COOL LEDS
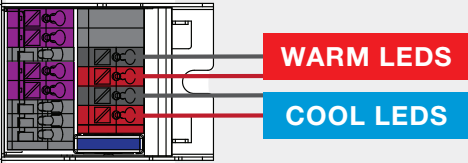
A
Improve color rendering accuracy
Specify your fixtures with smaller CCT ranges to render color that is closer to the black body curve. Lutron recommends 2700 K to 4000 K.

Specify all fixtures with the same CCT range to ensure color consistency from fixture to fixture.
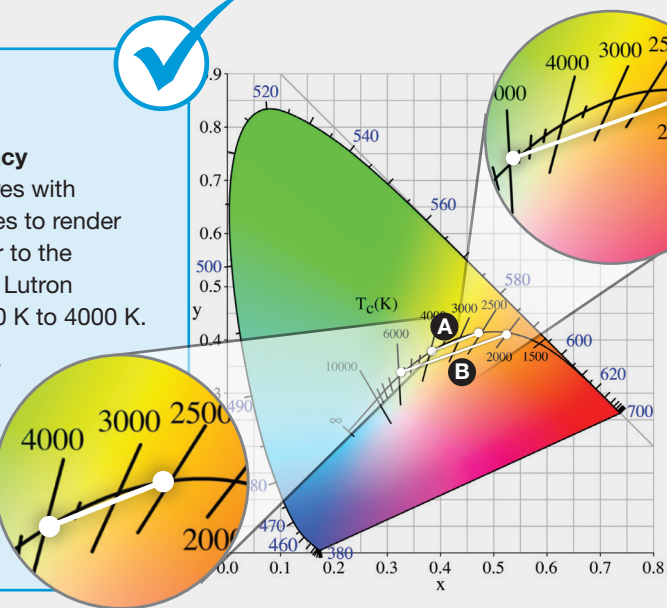
B
Inaccurate color rendering
2-channel solutions render colors that lie on the straight line between a fixture's minimum and maximum CCT values.

Wide CCT ranges deviate from the black body curve, resulting in light that looks redder or bluer than expected.
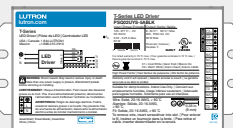
2. T-Series 2-channel tunable white solution

T-Series pairs a digitally controlled 2-channel tunable white driver with a specialized controller to guarantee compatibility and performance, and eliminate risk.
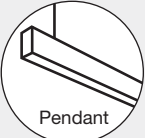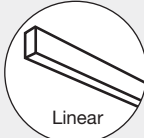
Energi Savr Node T-Series QSN-TW
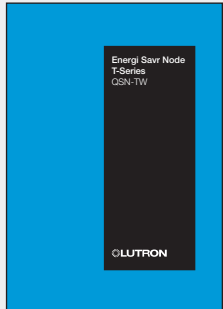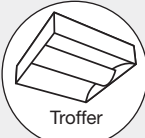
Linear Pendant Driver

Pendant

Linear

Troffer
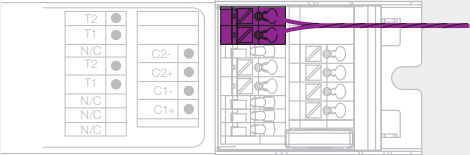
ESN Controller

Downlight Driver

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.
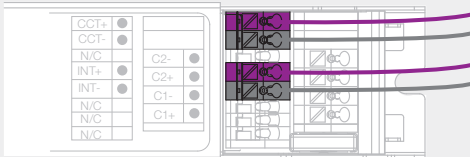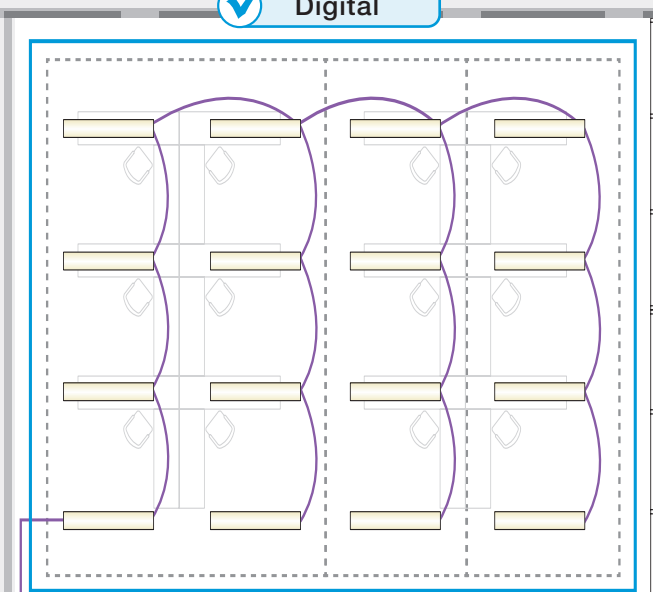
0-10V 2-Channel Tunable White Control Wiring

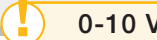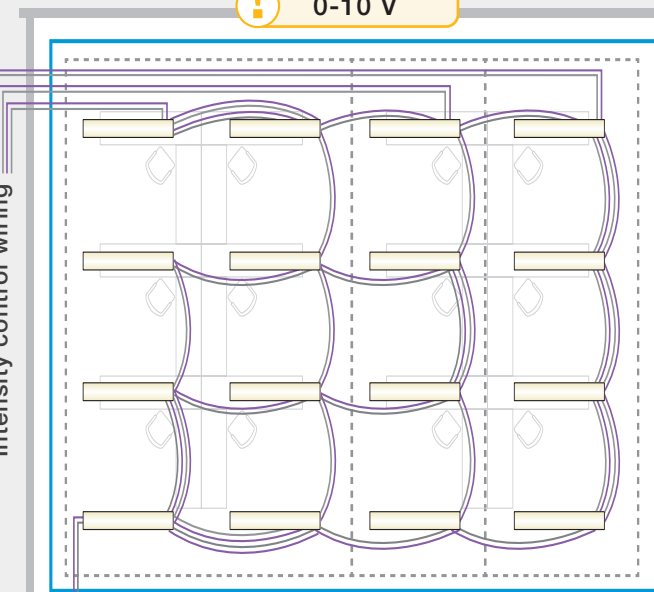## 4. Why T-Series digital? Wire first, determine zone programming later!

Digital

0-10 V

Intensity control wiring

Intensity & CCT control wiring

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.

- 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

Step-by-step guide

This step-by-step guide presents recommended defaults for your tunable white spaces, highlights custom alternatives, and provides guidelines for how to write your desired sequence of operations into your specifications.

Note: If no sequence of operations details are provided to Lutron at the time of quote, the default sequence of operations outlined in this guide will be applied to all tunable white areas.

Recommendations are identified
WITH BLUE TEXT OR BLUE BOXES

Included Areas
This following default sequence of operations is designed 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.

Fixture Selection
Lutron T-Series solution supports independent control of intensity and Correlated Color Temperature (CCT) with one control input for intensity and one control input for CCT.

FIND A FIXTURE

Find T-Series enabled fixtures on the Lutron High Performance Fixture List

lutron.com/TSeriesFixtures

COPY AND PASTE INTO YOUR SPEC

Fixture shall utilize the Lutron T-Series 2-channel tunable white with independent control of intensity and correlated color temperature.

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

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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

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No occupancy/vacancy sensors in the space.

Daylight sensing

DAYLIGHTING

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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
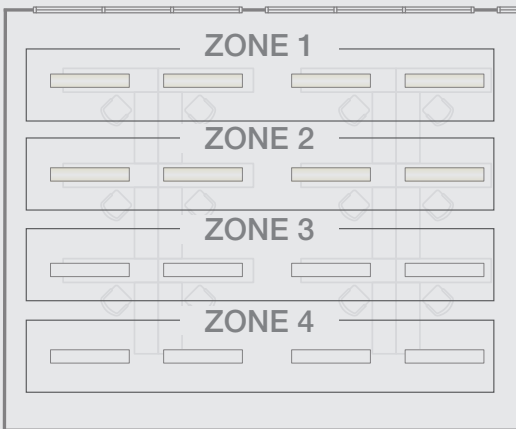
No daylight sensors in the space.

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.
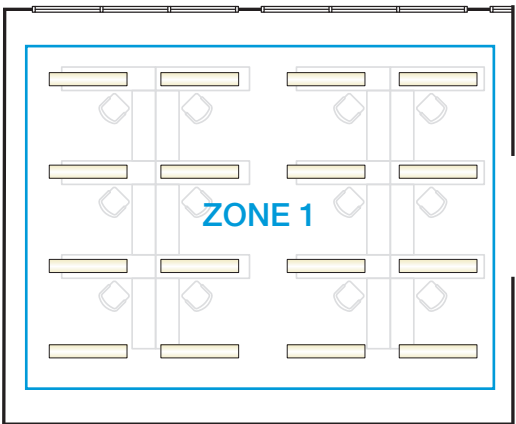
ZONE 1

CCT ZONING

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

OR

ZONE 1
ZONE 2
ZONE 3
ZONE 4

MULTIPLE ZONING

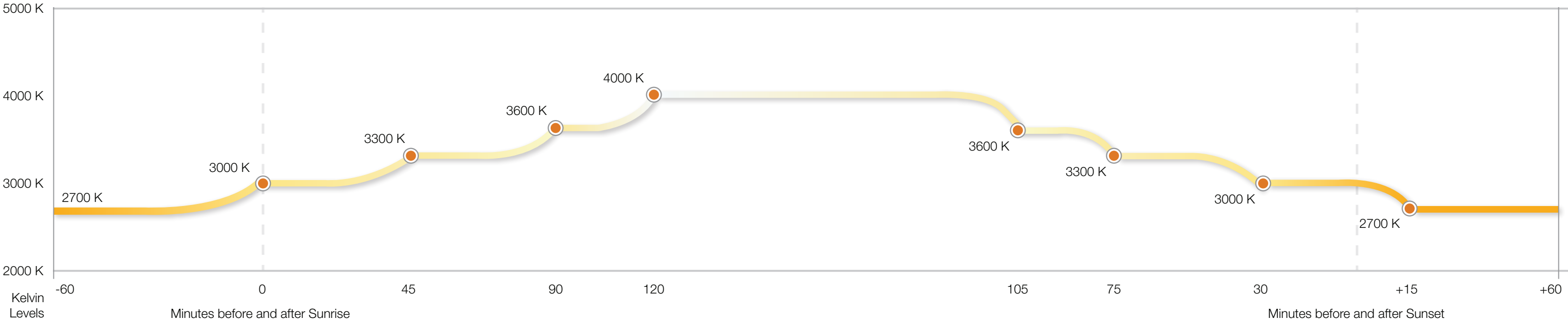**COPY AND PASTE INTO YOUR SPEC**

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.

Kelvin Levels		

Minutes before and after Sunrise ... **Minutes before and after Sunset**

Graph values: 5000 K, 4000 K, 3000 K, 2000 K (vertical axis). Horizontal axis: -60, 0, 45, 90, 120 ... 105, 75, 30, +15, +60

Data points (sunrise side): 2700 K, 3000 K, 3300 K, 3600 K, 4000 K
Data points (sunset side): 3600 K, 3300 K, 3000 K, 2700 K

CCT CURVES

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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

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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.
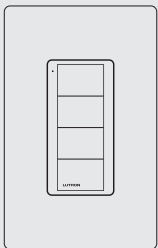

RECOMMENDED

NO AUTOMATIC CCT CURVE OVERRIDE

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

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

ADDITIONAL OPTIONS

MANUAL BUTTON PRESS

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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

AND

OR

1 TO 60 MIN
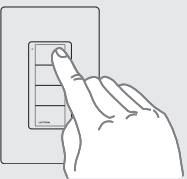
CUSTOM VACANCY

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

15 MIN

OR

User Defined

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

2:00am

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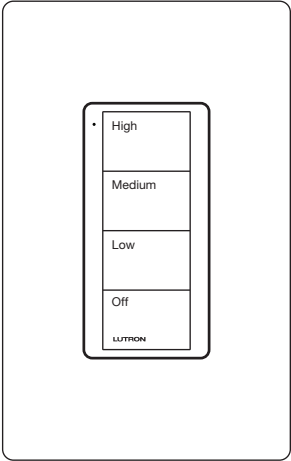
Lutron's default keypad programming does not enable users to manually control CCT

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

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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%).

SCENE CONTROL OF BOTH INTENSITY AND CCT
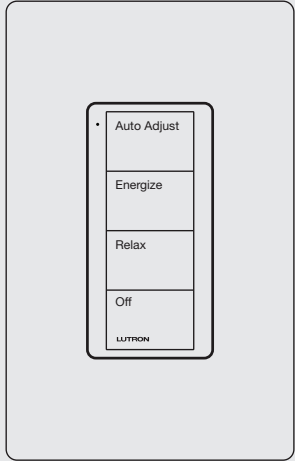
Recommended for
· Open Office
· Private Office
· Classroom
· Training room

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]**

SCENE CONTROL OF BOTH INTENSITY AND CCT
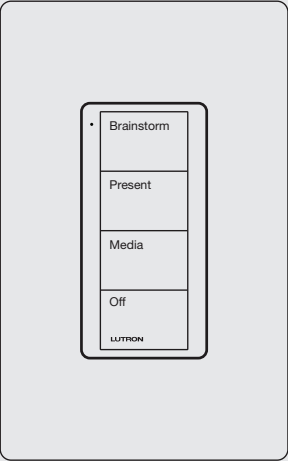
Recommended for
· Conference Room
· Classroom
· Training Room

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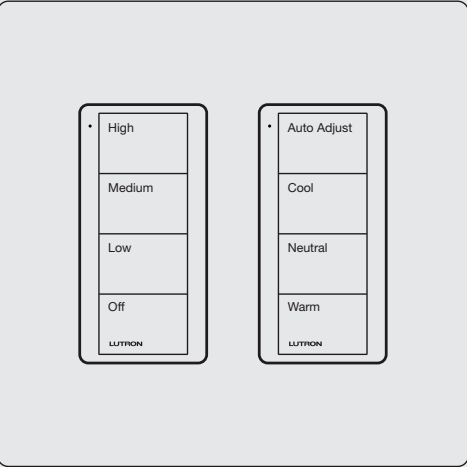
Engraving	Intensity Programming	CCT Engraving	CCT Programming
High	100%	Auto Adjust	Return to Automatic CCT Curve
Medium	50%	Cool	4000 K
Low	25%	Neutral	3200 K
Off	Off	Warm	2700 K

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

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

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

OR

CUSTOM INTENSITY TIMECLOCK EVENTS

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

Emergency/Egress

E

EMERGENCY/ EGRESS

Intensity value: 100%
CCT value: 50%

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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

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

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