



Christie Real | Laser

Frequently asked questions (FAQ)



Table of contents

Christie® LiteLOC™	3
1. What does LiteLOC do?	3
2. What's changed with the newest version of LiteLOC?	4
Real Laser and color management	4
1. How is the desired target color and brightness selected?	4
2. What happens if the white light produced by the LOS doesn't match the required target color?	5
3. Does the projector apply color correction to white only? How about all other colors?	5
4. How do we teach (calibrate) the projector's color as perceived in the environment?	6
5. How does color processing/correction work?	6
6. How does TCGD work in conjunction with the MCGD and laser file?	7
7. Do changes to the active channel settings have to be made before the MCGD can be created?	7
8. Why doesn't Christie set the primary colors at the factory?	7
Real Laser and environmental factors	8
1. Why does the temperature of laser devices affect the wavelength?	8
2. How does temperature and/or humidity affect the overall system brightness?	8
3. How does a chiller-cooled system differ from an air-cooled system?	9
4. What is the ideal operating condition for Real Laser models?	9
5. Can white point setting affect max. achievable brightness even if ambient temperature is 25°C (77°F)? ..	9
Miscellaneous	10
1. How should I set up my projector to check the maximum light output?	10
2. General considerations	10



LiteLOC

1. What does LiteLOC do?

LiteLOC is a Christie-developed technology designed to maintain color and brightness produced by the Laser Optics System (LOS) during the projector operation.

- During installation, the red (R), green (G), and blue (B) drive currents are adjusted to achieve a target color (white point) and brightness. The projector saves this information in a laser configuration file on the F-main or the CAVE board. *For detailed information on how to set the laser system please refer to the training material. For any training material that you're missing, please email training@christiedigital.com.*
- The G and B laser devices' operating temperature is directly related to the ambient temperature.
- Light intensity from the G and B laser devices change as the operating temperature changes. These changes affect the color and brightness set during the installation.
- Thermoelectric cooler (TEC) devices control the temperature of the R laser devices to avoid color and brightness changes as the ambient temperature changes. The temperature of the TEC devices is calculated based on the maximum expected room temperature along with the relative humidity detected by a humidity sensor inside the LOS. For this reason, the laser file includes the maximum expected room temperature.
- If the environmental conditions (temperature and/or humidity) change, the projector may change the operating temperature of the TEC devices (for R devices) inside the LOS to ensure reliable operation of the system. For example, the system may increase the TEC operating temperature to protect the R devices from condensation if the original operating temperature had become lower than the dew point.
- As laser devices age, light intensity degrades.
- LiteLOC relies on a device inside the projector called Color Sensor Board (CSBD) to prevent the effects of environmental conditions and the device's age on the color and brightness on the screen. The CSBD measures 3 arbitrary values called Csense X, Csense Y, and Csense Z, which the system software can use to determine a color and brightness level.
- When LiteLOC is enabled in the laser file, the current Csense X, Csense Y, and Csense Z readings are saved. These 3 values become the projector's target for corresponding color and brightness points.
- As the system ages or the environmental conditions change, the system detects color and brightness changes that deviate from the projector's target color and brightness points. If LiteLOC is enabled, the system compensates for this drift by changing the drive current to the R, G, and B laser devices. LiteLOC ensures on-screen color and brightness remain accurate.
- LiteLOC doesn't detect or correct any on-screen color and brightness changes that are affected by external elements, such as the screen and port window.
- If the system **can't** achieve the target Csense X, Y, and Z, the operator receives a warning message.



2. What's changed with the newest version of LiteLOC?

- All LiteLOC upgrades are designed to maintain the on-screen color and brightness as the environmental conditions such as temperature and humidity change and as the laser devices age. The control software uses Csense X, Csense Y, and Csense Z values to change the drive current of the R, G, and B devices.
- In the latest version, we updated the algorithm used to control the R, G, and B drive current to maintain Csense X, Csense Y, and Csense Z reading and maintain the on-screen color and brightness.
- Here's a summary of the differences a system installer will experience:
 - **Ambient temperature:** With older versions of LiteLOC, the installer inputs the predicted highest expected ambient temperature. The system uses this temperature to control the TEC devices. With the latest version, the installer determines the target color and brightness. The system calculates the highest room temperature at which the system can achieve this target. A notification message on the system's user interface informs the installer of the highest ambient temperature at which the system can achieve the target brightness and color.
 - **White point:** With older versions of LiteLOC, the installer adjusts the R, G, and B drive currents independently to achieve the target color and brightness. With the latest version of LiteLOC, the installer defines the target white point and uses one control to increase/decrease the brightness at the defined white point. The system automatically adjusts the R, G, and B drive current to output and maintain the target color and brightness.
- Please refer to the training material for more information about Csense calibration procedure for each version of LiteLOC. For any training material that you're missing, please email training@christiedigital.com.

Real | Laser and color management

1. How is the desired target color and brightness selected?

Target brightness is application-specific:

- Typically, content is mastered to a specific brightness level, which should be the target projector brightness.
- Most 2D cinema content is mastered for 14 fL. Exceptions will be special PLF cinema such as Dolby Cinema or Cinity.

Target color is also dictated by the content and ultimately matched by the DLP® light engine.

- Each type of content is created to meet a specific color gamut. The 3 primary colors, R, G, and B, the 3 secondary colors, C, M, and Y, plus white define the target color gamut.
- The target white for the content determines the ideal white point that should be produced by the Laser Optics System (LOS).



- The projector video processing includes the most common color correction modes called Target Color Gamut Data (TCGD), such as DCI-P3 and DCI XYZ.
- Each TCGD defines the color gamut the projector will use when processing the video to display the content.
- The TCGD should be selected based on the content and how it is mastered. For example, mainstream cinema typically uses only the DCI XYZ target.
- Ideally, the white produced by the laser light source matches the white defined by the color gamut in color correction mode. In other words, each required color gamut, format and brightness would have a unique matching laser file and corresponding MCGD to ensure maximum efficiency.

2. What happens if the white light produced by the LOS doesn't match the required target color?

- The projector video processing electronics are designed to control the intensity of the R, G, and B laser devices using the DLP (light engine) to create the color of each pixel in the frame. The same processing is used to control the overall intensity of the 3 primary colors projected on the screen, perfectly correcting the white on the screen to match the white defined by the content.
- The closer the white produced by the LOS is to the white in the TCGD, the less correction the projector applies.
- Color correction is done by reducing the intensity of one or more colors to achieve the desired white. The more correction applied by the system, the more overall brightness output drops, resulting in lower overall system efficiency.
- Color correction reduces the maximum brightness level (white) but it **doesn't** affect the minimum brightness level (black). If the system contrast ratio is defined as (white maximum center brightness) / (black minimum center brightness), then color correction also negatively impacts the system contrast.
- To maximize system efficiency and contrast, set the projector to output white as defined by the content and the TCGD.

3. Does the projector apply color correction to white only? How about all other colors?

The projector corrects all colors, not just white. To accomplish this, the installer should calibrate the projector to produce all colors correctly.

- Any single color is a combination of three primary colors (R, G, and B)
- The projector's raw primary colors are determined by the RGB laser devices within the LOS and can't be changed during installation. Laser devices vary slightly in color if the operating temperature changes. LiteLOC ensures that on-screen color and brightness remain accurate.
- Many environmental factors such as the type of the screen, seat location, and auditorium lighting affect perceived color.
- For the above reasons, the projector needs to 'learn' its own primary colors as perceived in the



environment as well as the combined 3 primary colors (plus white). This process is called color calibration, and is saved in a Measured Color Gamut Data (MCGD) file. The system uses this information to correct colors for each pixel in the projected frame.

4. How do we teach (calibrate) the projector's color as perceived in the environment?

Every time a MCGD file is created, a new set of primary colors is created. The projector can store multiple MCGD files to be used in conjunction with the corresponding laser configuration file and TCGD file in a channel. For the complete procedure, please refer to the technical training material.

Follow these steps to calibrate the projector's color:

1. Create a laser configuration file that meets the application color (white point) and brightness requirements.
2. Set the active channel to use the laser configuration file created in step 1.
3. Go to the MCGD page. The projector automatically disables all color correction while the MCGD page is active. In other words, when a color is displayed from this page, the raw light generated by the laser devices projects on the screen without any correction.
4. Select a color to measure. For each of the required colors (R, G, B, and W) measure the x and y coordinates then type this information into the corresponding boxes in the user interface (UI).
5. Save the file.
6. Change the active channel settings to use the MCGD file created for this channel.

Please note, multiple laser configuration files and MCGD files may be required in a typical cinema application. For example, a laser file for 2D and another for 3D require separate MCGD files. The installer should create the 3D MCGD file with the 3D glasses or filters mounted in front of the color meter.

5. How does color processing/correction work?

- At installation, set the LOS to output the desired white and brightness level. This process controls the LOS **only**. Ideally, the output white will match the white in the content to be displayed.
- Set the primary colors (MCGD), which teaches the projector how its primary colors and white are perceived in the environment where the projector is installed.
- Set the color correct mode (TCGD). The projector uses the primary color information to accurately calculate the color of each pixel in the content. TCGD **must** match the type of content played.
- If the white produced by the LOS drifts from its initial settings, the projector automatically corrects using LiteLOC technology.
- If the selected color correction mode **doesn't** match the color in the content, the displayed color/brightness will be inaccurate.



- If the selected color correction mode is different from the white point produced by the LOS, the projector video processing will correct all colors to match the content. However, this processing reduces both brightness and contrast.

6. How does TCGD work in conjunction with the MCGD and laser file?

- At installation, create a laser configuration file. Ideally, the laser file is configured to output the target white point at the target brightness + 10% margin for color correction.
- Create a MCGD for the laser configuration file. The MCGD provides the primary color and white point information to the projector.
- Set a channel to use the laser configuration file and its corresponding MCGD. The channel setup also includes the TCGD, which is selected based on the color space used to create the content.
- When XYZ color space is used, the white point in the TCGD is not used. Instead, the projector uses the video information and the MCGD information to output all colors including white. In other words, the color information in the video is absolute and the MCGD is only used to calculate raw primary colors.
- When another color space is required, the white point and RGB colors are defined in the TCGD. All displayed colors are calculated based on the MCGD and the TCGD information.
- The projector determines the color space based on the color coordinate information within the TCGD. Video is processed in the XYZ color space when the TCGD in the active channel contains the following information: R (1,0), G (0,1), and B (0,0).
- If the TCGD has other coordinates in it, the projector processes the video in P3 color space according to the color coordinates defined in the TCGD.

7. Do changes to the active channel settings have to be made before the MCGD can be created?

Yes. Make sure the laser file in the active channel is the laser file you intend to create the MCGD file for.

8. Why doesn't Christie set primary colors at the factory?

We don't set primary colors at the factory because your operating temperature onsite may be different than the Christie factory. To ensure the primary colors are set correctly for color-critical applications such as Cinema, we recommend setting the primary colors (create MCGD file) onsite.

The operating temperature of the laser devices is affected by:

- The ambient temperature
- The drive current of each laser device
- The maximum expected ambient temperature setting in the UI (affects R only)



- The laser device's operating temperature may affect its wavelength (native color).
- In addition, the environment affects primary colors. For example, port glass, ambient lighting, and screen surfaces can all impact perceived color.

Real|Laser and environmental factors

1. Why does the temperature of laser devices affect the wavelength?

- The laser devices we use in our Christie® Real|Laser™ optical systems are subject to environmental temperatures and can be affected in either extreme. We recommend maintaining and operating the lasers below 25°C (or 70°F). Outside of this normal range, the lasers can shift in color or degrade prematurely.

2. How does temperature and/or humidity affect overall system brightness?

- All Real|Laser RGB systems except CP4440/CP4450-RGB are air-cooled. As room temperature increases, operating temperature of the laser devices also increases.
- R laser devices have an additional temperature control measure using TEC devices. The purpose of these TECs is to increase the operating temperature of the R devices to the maximum expected ambient temperature. The higher the maximum expected ambient temperature is, the higher the TEC devices' temperature will be set during operation.
- As the temperature of a laser device increases, the wavelength of the light produced also changes. As wavelength changes, the perceived brightness from the device (if driven at same power level) degrades as well. You can compensate for the perceived brightness drop by increasing the drive current (driving the laser device at a higher power level).
- As the temperature of the laser devices increases, the system automatically lowers the maximum allowed current driving the laser devices.
 - If the lower "system-defined maximum" drive current is higher than the current required to compensate for the perceived brightness drop described above, the overall system brightness **won't** be reduced.
 - If the lower "system-defined maximum" drive current is lower than the drive current required to compensate, the system light output is reduced.
- The system **doesn't** include a dehumidifier, but it does include a Humidity Sensor inside the LOS. If the humidity inside the LOS increases, the system may increase the TEC temperature to avoid condensation on the R laser devices. This temperature increase forces the system to lower the maximum-allowed current for the R devices, which may lead to an overall drop in brightness.
- If the operating temperature is lower than 25°C (77°F), the system automatically lowers the maximum drive current. Lowering the power level ensures the perceived brightness remains



constant.

- To maintain the hazard distance calculation, the system lowers the maximum drive current, to keep the maximum brightness output within specifications.

3. How does a chiller-cooled system differ from an air-cooled system?

- The CP4440-RGB and CP4450-RGB use an external chiller to control the temperature of the laser devices.
- The chiller set point is configured according to the ambient air condition (temperature and relative humidity). The lower the chiller temperature, the more efficient the laser system will be. With a chiller installed, lower system operating temperatures are possible if ambient humidity is also controlled. You need to consider relative humidity and ensure that the chiller's operating temperature is at least 3°C above the dew point. *Please refer to the technical training material for additional details.*
- The temperature of the G and B devices directly relates to the chiller temperature.
- The R device temperatures are controlled by TEC devices. Under normal operating condition, the TEC devices are set to operate at the same temperature as the chiller.
- The projector head has a humidity and temperature sensor module (HTSM) that monitors the relative humidity in the light engine compartment. If ambient conditions (humidity and/or temperature) change and cause a risk of condensation on the light engine, the system automatically increases the chiller set point to a level higher than the dew point.
- The LOS also has a humidity sensor. If the humidity level inside the LOS increases, the system increases the chiller operating temperature and the TEC temperature to avoid condensation.
- If the chiller and/or the TEC set temperatures increase, the LiteLOC system compensates for any color or brightness drift.

4. What are the ideal operating conditions for Real|Laser models?

All Real|Laser projectors are specified to operate between 10 and 35°C (50-95°F) and relative humidity (RH) 10% – 80% non-condensing. Note that the maximum light output can be achieved at 25°C (77°F) over the range of the specified RH.

5. Can the white point setting affect the maximum achievable brightness even if the ambient temperature is 25°C (77°F)?

Yes, because:

- Each white point requires a unique balance of R, G, and B intensity levels.
- Since the system has a limited quantity of each of the 3 colors, the maximum brightness at each white point is determined by 1 or more of the 3 primary colors. The color that reaches its maximum power defines the maximum light output and is usually called the “limiting color.”



- All Real|Laser cinema projector brightness is specified at DCI white ($x=0.314, y=0.351$).

Miscellaneous

1. How should I set up my projector to check the maximum light output?

- Enter the laser configuration setup page and display the white test pattern.
- Make sure the ambient temperature is 25°C or less and the room relative humidity is lower than 80%.
- Set the maximum-expected room temperature to 25°C.
- **With LiteLOC disabled:** Adjust the R, G, and B drive current to achieve the DCI white point ($x = 0.314, y = 0.351 \pm 0.002$) and set at least one of the 3 colors to 100%.

2. General consideration:

- Not all spectroradiometers are designed to work with laser light sources. Please check with your meter manufacturer before using the device to measurement color and/or brightness.
- The angle between the meter and the screen affects the measurements. For the most accurate result, set the meter to be perpendicular to the center of the screen. If the projection angle is steep (more than 15 degrees), matching the projection angle helps ensure more accurate measurements.
- Follow the manufacturer's recommendation for calibration intervals of the measuring device.
- Measuring devices provide brightness density value. When calculating system brightness, first accurately calculate screen size. Please note, even minor keystone correction can result in large errors while calculating the screen area.
- Screen gain can degrade and will affect measurement. Please check the actual screen gain at the time of measurement not just the manufacturer's specification of a new screen.
- For more details, please refer to the [Christie Real|Laser Cinema Projectors Best Practice guide](#).

