Brightness degradation troubleshooting

This document provides brightness degradation troubleshooting for Cinema 4K and 2K projector models. Brightness degradation can be related to failures in optical components. Brightness degradation errors may be reported in the logs.

Affected products

The following products are affected.

- Cinema 2K projectors
- Cinema 4K projectors

Supporting documentation

Use this document in conjunction with the following documentation available on the Christie website (***https://www.christiedigital.com/products/cinema/projection/***):

- *Cinema 2K-RGB (CP2309-RGB, CP2315-RGB, and CP2320-RGB) Service Manual (P/N: 020-102770-XX)*
- *CP2415-RGB and CP2420-RGB Service Manual (P/N: 020-103696-XX)*
- *Cinema 4K-RGB (CP43xx-RGB) Service Manual (P/N: 020-102713-XX)*
- *CineLife+ 4K-RGB (CP4415-RGB, CP4420-RGB, and CP4430-RGB) Service Manual (P/N: 020-103764-XX)*
- *CP4415-RGB and CP4420-RGB Gen2 Service Manual (P/N: 020-103774-XX)*
- *CP4425-RGB and CP4435-RGB Service Manual (P/N: 020-103763-XX)*
- *CP4440-RGB and CP4445-RGB Service Manual (P/N: 020-103076-XX)*
- *CP4445-RGB and CP4455-RGB Service Manual (P/N: 020-103758-XX)*
- *Replacing the Cinema 2K-RGB Diffuser and Depolarizer Instruction Sheet (P/N: 020-103545-XX)*
- *Replacing the Cinema 4K-RGB Diffuser and Depolarizer Instruction Sheet (P/N: 020-103544-XX)*
- *Replacing the CineLife+ RGB PLF Diffuser and Depolarizer Instruction Sheet (P/N: 020-103833-XX)*

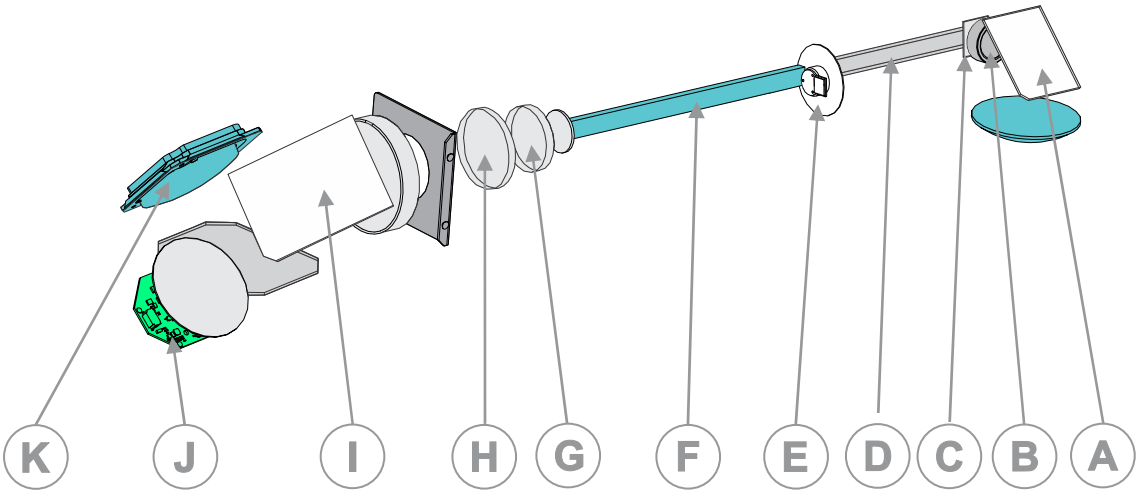
Optical components

The following shows the optical components in the 4K and 2k projector models.

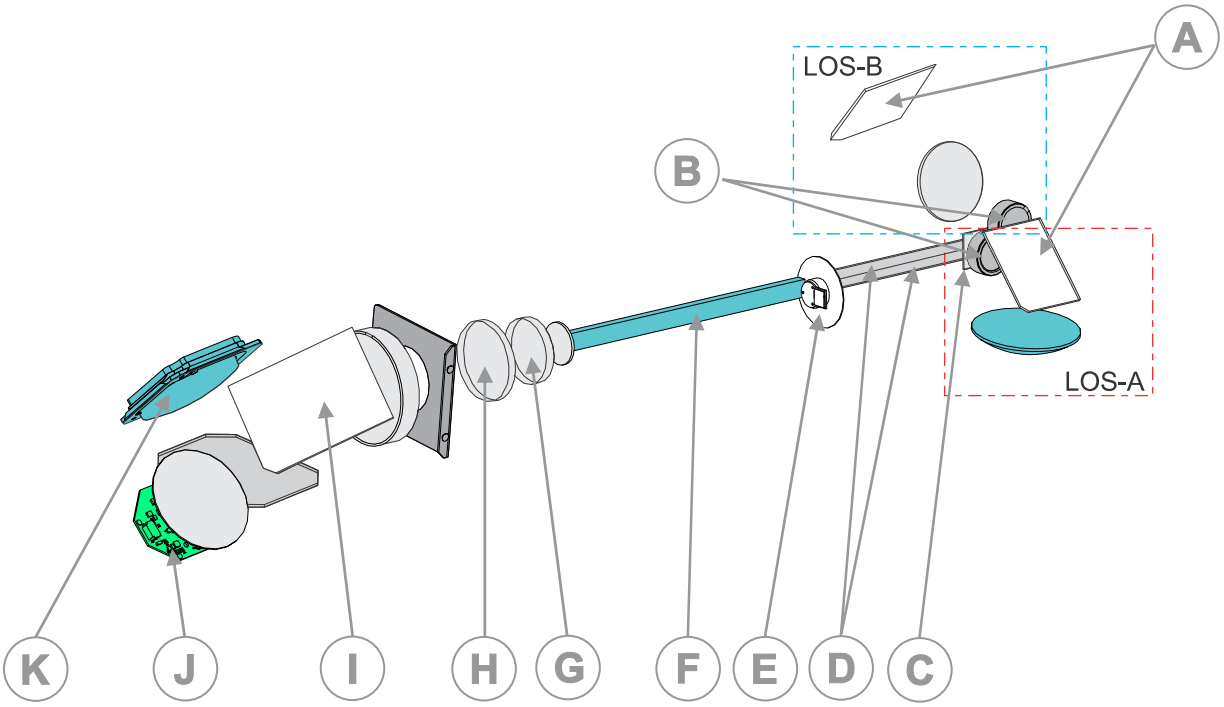
Optical components

A	Coupling mirror(s)	E	Rotating diffuser	I	Fold mirror
B	Depolarizer(s)	F	Second integrator rod	J	Csense board
C	Static diffuser(s)	G	Focus lens	K	Lens #5
D	First integrator rod(s)	H	Zoom lens		

4K models

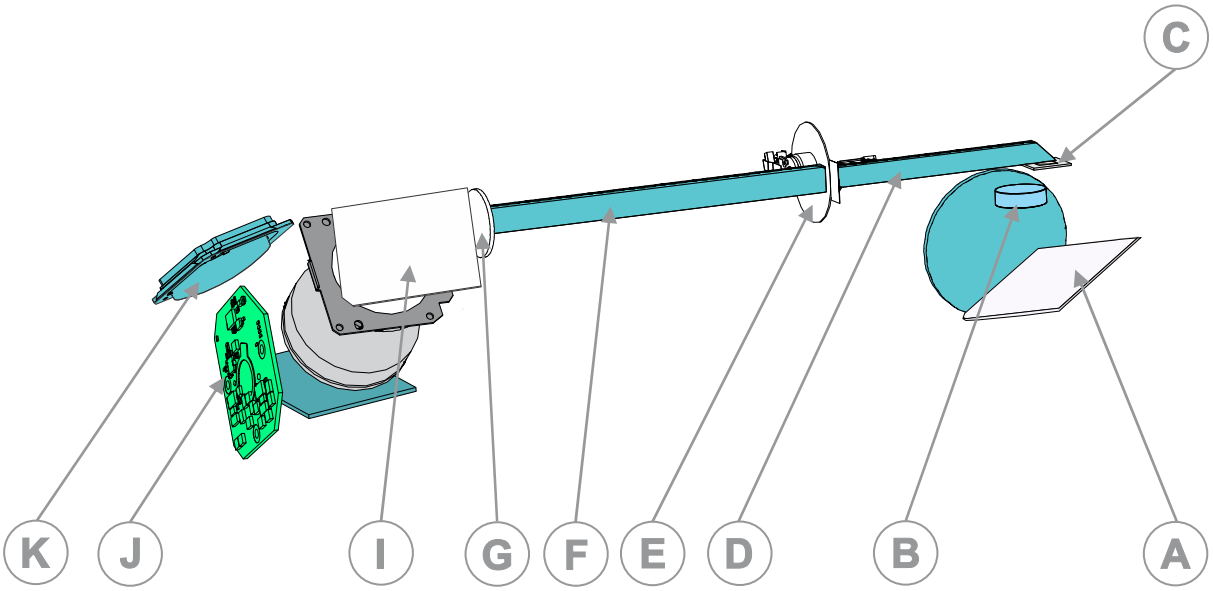


PLF (CP4440-RGB and CP4450-RGB) models



Common optical components listed as A-D in the PLF Projectors (CP4440-RGB and CP4450-RGB) are doubled due to two laser optical subsystems (LOS). When working with these projectors, make sure to inspect both. For more information, see *Failures on PLF systems* (on page 5).

2K models



Illumination optical system (IOS) Zoom is fixed on 2K-RGB models.

Failures related to optical components

The following provides information on failures related to the optical components.

ID	Component	Symptoms	Failure mode	Corrective actions
A	Coupling mirror	• Poor color uniformity • Excessive red deficiency causing lower overall system brightness	Out of alignment after laser optical subsystem (LOS) or illumination optical system (IOS) replacement	Refer to the Service manual and training documentation for the alignment procedure. The new LOS assembly ships with a replacement mirror.
		Significant brightness drop (not seen in the field)	Cracked, burnt, or both	Replace and adjust the coupling mirror.
B	Depolarizer	Hazy, spotted/dashed blemishes on the glass	Minor brightness loss	Replace the depolarizer.
C	Static Diffuser	Significant brightness degradation	Cracked, burnt, or both	Replace the static diffuser.
D	First integrator rod*	Gradual and potentially significant brightness drop	Integrator rod moves closer to the rotating diffuser	Replace the integrator rod assembly.
E	Rotating diffuser	Cannot turn on the laser	Speed (RPM) is outside of specs.	Replace the rotating diffuser.
		Significant brightness drops	Motor spins but the diffuser is cracked, burnt, or both.	Replace the rotating diffuser.
G	Focus lens	Shadow around the edge of the screen	Light is not focused on the surface of the digital micromirror device (DMD)	Refer to the Service manual and training documentation for the adjustment procedure.
H	Zoom lens	Significant brightness degradation	Light is overfilling the surface of the DMD. Running the projector for extended period at high laser power while overfilling the DMD can damage it.	Refer to the Service manual and training documentation for the adjustment procedure.
		Shadows around the edge of the screen	Light is underfilling the surface of the DMD.	Refer to the Service manual and training documentation for the adjustment procedure.
I	Fold mirror	Dark section around the edge of the screen or missing parts of the image	If the light is not aligned to the DMD, sections of the DMD may not be illuminated.	Refer to the Service manual and training documentation for the adjustment procedure.
J	Csense board	LiteLOC™ is not achievable	Hardware failure	Replace the Csense board.
		• DAC calibration is missing	Calibration is missing	Perform the DAC and color calibration.

ID	Component	Symptoms	Failure mode	Corrective actions
		• Color calibration is missing		

* Two parallel rods on PLF projectors

Fold mirror, zoom lens, and focus lens adjustment interact with one another. All three adjustments are usually done over a few iterations by rotating between the three adjustments.

Failures on PLF systems

PLF systems (CP4440-RGB and CP4450-RGB) employ two laser optical subsystems (LOS). For this reason, the optical system includes an additional coupling mirror, static diffuser, and depolarizer to capture the light emitted from the LOS-2.

The two main classes of errors are `LiteLOC not reachable` and errors related to the laser system.

- If the overall system brightness drops with an error indicating `LiteLOC not reachable` because one of the three colors had reached its maximum drive level (see *Using logs to determine if optical losses are present* (on page 7)). However, additional steps are required to determine if the failure is caused by the second LOS coupling mirror, depolarizer, and/or static diffuser. This troubleshooting step requires disabling LOS-2 and compares the on-screen brightness when both LOSs are enabled to when LOS-2 is disabled.

  To disable LOS-2, turn off breaker B. An error indicating a LOS-2 failure occurs. The error is expected as the LOS-2 power supply does not receive AC while breaker B is off.

  - If brightness drops by about 50% after disabling LOS-2, it means the error is not limited to the optical components specific to LOS-2. Instead, it could be the integrator rod, rotating diffuser, and so on (the common optical path).
  - If the brightness drops less than 40 to 50% after disabling LOS-2, check the LOS-2 coupling mirror and/or static diffuser.
  - If the brightness drops much more than 50% after disabling LOS-2, check the LOS-1 coupling mirror and/or static diffuser.
- If the overall system brightness drops with other laser-system-related errors such as high voltage current source (HVCS) or low voltage current source (LVCS) board failures, troubleshoot the failing LOS card cage and harnesses.

Determining if the system is compensating for a brightness drop

The system may significantly increase the drive level to compensate for a brightness drop caused by a laser device failure or the degradation or failure of an optical component before the Csense board in the optical path.

To determine if this is occurring, complete the following steps:

1. Connect to the projector using NetTerminal or Kore Librarian.
   - Projector IP address
   - Port 5000

2. Log into the projector using service level access.
   - User ID = service
   - Password = <service level password>
3. Send the `(CAL + pass 1)` command to open port 5103.
4. Connect to the projector using NetTerminal or Kore Librarian.
   - Projector IP address
   - Port 5103
5. Send the `(RGB + meas?)` command.

   The system reports the current drive levels for all three colors.
6. Compare the values read in the previous step to the values in the laser file to determine the amount of increase of the drive current.

   A small percentage increase (less than 5% after 2000 hours of the laser being on) is normal and compensates for the aging of the laser devices. However, a large increase (more than 5% after 2000 hours of the laser being on) may be a result of a failure of an optical component.

   Laser device failures and driver board failures are reported in the projector logs.

Failures reported in the logs

Use the logs to determine if optical losses are present.

Using logs to determine LiteLOC™ status

Use the logs to determine whether LiteLOC™ is enabled. If it is, determine the initial drive current of the red, green, and blue devices.

1. Open the logs in the interrogator viewer.
2. In the files section, select `Controller Config File`.
3. Select **Photon**.
4. Select a `Laser Configuration File`.

   The file opens.
5. Check the value of the `<mode>`.

   The following values identify the LiteLOC version and state:
   - 0 = LiteLOC V1 enabled
   - 1 = LiteLOC disabled
   - 2 = LiteLOC V2 enabled
   - 3 = LiteLOC V3 enabled

   For example, if LiteLOC V1 is enabled, the file looks like the following:

```
<?xml version="1.0"?>
<CPhotoLaserConfig>
    <version>1</version>
    <maxExpectedAmbient>30</maxExpectedAmbient>
    <chillerSetpoint>24</chillerSetpoint>
```

```
    <brightness>100</brightness>
    <mode>0</mode>
    <drivePercentages.red>67.4</drivePercentages.red>
    <drivePercentages.green>48.3</drivePercentages.green>
    <drivePercentages.blue>51</drivePercentages.blue>
    <sensorValues.SX>1434880</sensorValues.SX>
    <sensorValues.SY>1909760</sensorValues.SY>
    <sensorValues.SZ>1014016</sensorValues.SZ>
    <sensorValues.gains.SX>3</sensorValues.gains.SX>
    <sensorValues.gains.SY>3</sensorValues.gains.SY>
    <sensorValues.gains.SZ>3</sensorValues.gains.SZ>
    <liteLocMetaData>1, 02862,02566.02513,02820,
        02862,02566,02513,02820</liteLocMetaData>
</CPhotoLaserConfig>
```

In the above example:

- Red drive level = 67.4%
- Green drive level = 48.3%
- Blue drive level = 51%
- LiteLOC is enabled with SX = 1434880, SY = 1909760, and SZ = 1014016.

If LiteLOC is disabled, the file looks like the following:

```
<?xml version="1.0"?>
<CPhotoLaserConfig>
    <version>1</version>
    <maxExpectedAmbient>25</maxExpectedAmbient>
    <brightness>100</brightness>
    <mode>1</mode>
    <drivePercentages.red>90</drivePercentages.red>
    <drivePercentages.green>61.3</drivePercentages.green>
    <drivePercentages.blue>60</drivePercentages.blue>
    <sensorValues.SX>0</sensorValues.SX>
    <sensorValues.SY>0</sensorValues.SY>
    <sensorValues.SZ>0</sensorValues.SZ>
    <sensorValues.gains.SX>3</sensorValues.gains.SX>
    <sensorValues.gains.SY>3</sensorValues.gains.SY>
    <sensorValues.gains.SZ>3</sensorValues.gains.SZ>
    <liteLocMetaData></liteLocMetaData>
</CPhotoLaserConfig>
```

Notice the SX, SY, and SZ sensor values are not reported and the LiteLOC metadata field is not populated.

Using logs to determine if optical losses are present

Brightness degradation due to optical component failures are detected by the Csense board.

- If LiteLOC™ is enabled, the system increases the laser devices' drive current to compensate for the drop.

  If the system reaches the maximum drive current for any of the three colors, a warning message is displayed on the user interface indicating LiteLOC is not achievable.
- If LiteLOC is not enabled at the time of failure, the system continues to drive the laser devices at the drive levels recorded in the laser configuration file. In such cases, the system does not display any errors but the on-screen brightness is lower than expected.

Errors reported	Conditions	Potential points of failure and resolutions
Red, green, blue, and TEC should report values of 0x00000000. A value such as Red 0x00000003 indicates an error. To determine the cause of the faulty string, see the decoding document or see *Decoding errors reported in the user interface* (on page 9).	• Unless the system has reasonable headroom, these errors are usually accompanied by `LiteLOC not achievable` errors. • If one or more TEC devices fail, the red devices in the affected strings are also disabled. • If the cooling system fails, the temperature of the laser devices rises. At a certain threshold, the system reports temperature warnings followed by error messages. When a device reaches the error threshold, the system automatically disables the string where this device is connected. Typically, TEC and red devices reach the error threshold first, followed by the green, then blue.	• Harness—Identify and replace. • Laser device inside the LOS—Replace the laser optical subsystem (LOS). • High voltage current source board (HVCS)—Identify and replace. All HVCS boards are identical—Try swapping boards to check whether the failure follows the board. • Low voltage current source board (LVCS)—Identify and replace. • If all colors are failing, inspect the cooling system.
Warning and error messages related to the ambient temperature.	System operates near or above the Max ambient temperature specified in the Laser configuration file.	Address the environmental issues.
LiteLOC not achievable error with no other errors.	Temperature-related settings are too high or one of the colors has reached its maximum drive.	• Current Max ambient setting or Chiller set point is too high, which limits the red output. To address this issue, lower the Max ambient temperature settings. • One or more of the colors has reached its maximum drive. Adjust the Laser configuration file to a lower brightness level at the required white point. This action provides some headroom for the system to use LiteLOC technology to maintain the on-screen color and brightness.
No errors reported but the on-screen brightness is lower than expected.	Possible causes include the following: • Software misconfiguration • External contamination • Contamination or cracks along the optical path in the projector.	1. For all series 4 models, upgrade the projector software to version 1.3.x or higher.

Errors reported	Conditions	Potential points of failure and resolutions
		2. Readjust the Laser configuration file and then re-shoot the MCGD. 3. Check the external equipment (such as the port window and the screen) for degradation or contamination. 4. Check the projection lens for cracks or contamination. Clean or replace as necessary. 5. If brightness is significantly lower than expected and at least one of the three colors has reached its maximum drive level, follow the instructions in *Failures related to optical components* (on page 4). 6. Clean lens #5. This requires removing the engine from the projector. Lens #5 contamination may indicate that the rest of the projector optics are contaminated as well. Also clean the integrator rod and the fold mirror. 7. Contact Technical Support.

Decoding errors reported in the user interface

The status of the red, green, blue, and TEC devices is reported in a hex string. To decode the hex value, you must convert it to binary. The ones in the binary version indicate the failed strings.

To see the binary representation of a hex value, complete the following steps.

1. Open the Microsoft® calculator.
2. Select **Open Navigation** in the upper-left corner and select **Programmer**.
3. To set the calculator to accept hex values, select **HEX**.
4. Enter the hex value reported in the user interface.
   For example, enter 1A.
5. Read the BIN string.
   For a hex value of 1A, the binary value is 0001 1010.

6. Decode the binary value by mapping ones to string numbers.

   For example, 1A maps to strings 5, 4, and 2.

Hex value	Binary equivalent					
1A	0	1	1	0	1	0
Out of service strings	—	String 5	String 4	—	String 2	—

Troubleshooting summary

The following provides a troubleshooting summary.

- Failures and degradation of components located before the Csense board in the optical path are detected by the Csense board.
  - If LiteLOC™ is enabled, the system increases the red, green, and blue drive current to compensate for the degradation. To determine the change in the drive current, see *Using logs to determine if optical losses are present* (on page 7).

    If the system increases the drive current until one or more colors reaches its maximum drive levels, an error indicating LiteLOC is not reachable is reported.
  - If LiteLOC is not enabled, the on-screen brightness drops despite the same current being applied by the values set in the laser files. Interrogation of the log files by Technical Support can help determine if the losses in the system are greater than expected based on the age of the system .
  - Electrical failures (laser devices, driver boards, controls, and so on) are reported in the logs.

- Failures and degradation of components after the Csense board in the optical path cannot be detected or compensated for by the system. Therefore, the drive levels do not increase.
  - Only on-screen brightness measurements can determine the degradation.
  - The degradation may be explained by factors outside of the projector such as:
    - Port window contamination or degradation—If possible, remove the port window and measure again.
    - Screen gain degradation—If possible, use an external surface with a known gain and measure again.
    - Measuring device failure—If possible, use a calibrated laser-compatible chromaticity meter such as CR-250.
    - Measuring device position—Make sure the meter is perpendicular to the screen on both horizontal and vertical axes. If the projector tilt angle is more than 5 degrees, set up the color meter to match the projection angle.
- For information on other factors that can affect the on-screen brightness, see the *RGB Laser FAQ*.
- For information on reading the logs, see *Using logs to determine LiteLOC status* (on page 6).

Technical support

Technical support for Christie Cinema products is available at:

- *Support.cinema@christiedigital.com*
- +1-877-334-4267
- Christie Professional Services: +1-800-550-3061 or *NOC@christiedigital.com*