CHRISTIE

CHRISTIE Real|laser™

WHITE PAPER

# CHRISTIE REAL|LASER™ ILLUMINATION TECHNOLOGY FOR CINEMA:

## The dynamic relationship between brightness maintenance and environmental operating factors

# Christie Real|Laser™ illumination technology for cinema

The LOS, or laser optical system, is the heart of Christie's Real|Laser projectors. Manufactured by Christie, the LOS integrates many lasers and optical elements such as lenses and mirrors into one package that acts as the illumination engine for the RGB Real|Laser projectors.

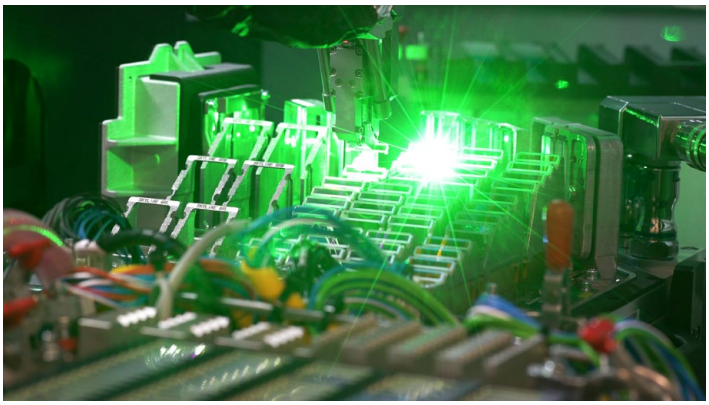
This document is an introduction to the factors affecting the longevity of the LOS. It includes a brief description of the ways that Christie has sought to minimize the effects of brightness degradation and provides insights on predicting how long the LOS can maintain various brightness output settings.

## Making the LOS last

**Optical surface cleanliness**
Inside the LOS, there are many optical surfaces. Any debris or contamination that falls onto these optical surfaces during assembly can diffract light away from the optical path and cause output brightness loss. Christie mitigates this by assembling the LOS in a state-of-the-art target class 1000 cleanroom equivalent to ISO 6 standard, keeping the optical surfaces pristine throughout the assembly process. Christie uses a robust, fully sealed design to prevent dust and other contaminants from getting into the finished optical system, ensuring brightness is maintained over a long lifetime. The LOS itself is maintenance free as a result.

**Laser alignment robustness**
The mirrors and lenses inside the LOS are held in place using spring clips and adhesives. These components must remain in place in order to keep the LOS light output within its specification. Through many years of optomechanical manufacturing experience, Christie has developed very rigorous processes to make the clipped and glued optical elements resistant to extreme shock, vibration and temperature changes. To achieve this, Christie employs advanced robotic automation equipment for assembly so every LOS is manufactured to the same consistent high-quality standards.

**Humidity control**
Laser elements generate heat that must be dissipated for efficient lifetime operation. Overly aggressive cooling can result in condensation on the optical elements in the LOS that can in turn cause output brightness loss. Christie solves this with a control circuit that can detect moisture levels using a humidity sensor, automatically adjusting system settings to prevent condensation and potential damage.



Robotic assembly of Christie Laser Optical System

## Laser longevity

All illumination sources, whether xenon or laser, degrade over time. Laser degradation is mostly attributed to two factors: temperature and power.

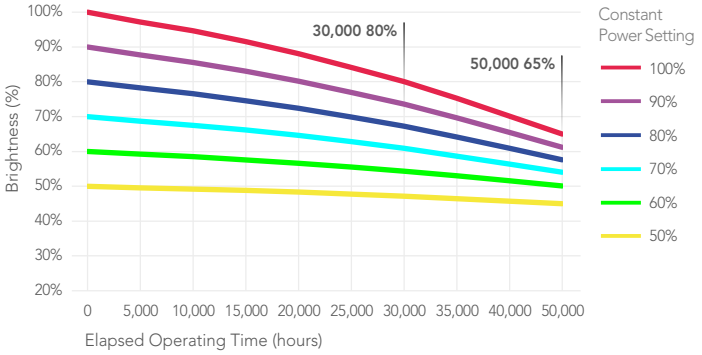
Laser diodes can achieve extremely high brightness. Their function is simple, and they can have a very long operational life. Christie has worked diligently with laser suppliers to understand and optimize the design parameters providing the best value for cinema use. A careful balance between laser temperature and drive level can reduce laser degradation and ensure long life.

**Temperature**
Lasers operate more efficiently at lower temperatures. This means lasers can achieve greater brightness (lumens per watt) when they are adequately cooled. Maintaining a low ambient temperature in the projection booth is important for long laser lifetime. For the best results, Christie recommends a maximum booth temperature of 25°C (77°F).

The Christie LOS employs advanced cooling plates and heat exchangers to efficiently remove heat from the laser diodes. The temperature for all three laser colors are controlled, but red lasers are the most sensitive to temperature fluctuations. Christie uses specific thermal management techniques to keep red laser diodes at optimal operational temperature.

**Power**
The power level that lasers are driven at have a big effect on the lifetime of the laser diode. The result of excessive drive current will initially appear as optical damage on the microscopic reflective surfaces that exist at the ends of the laser diodes. Performance of the laser cavity gradually decays, resulting in a negative impact to the laser's efficiency. Lasers require additional power to maintain initial brightness levels as they age.

**Estimated Brightness Drop-off**
Different Constant Power Settings (without the benefits of LiteLOC)




The graph above shows the laser output degradation for six different constant power settings. If the projector is set to 100% constant power, then its initial 100% brightness will degrade to 80% of its original brightness at 30,000 hours of operation. If the same lasers are used at a lower initial power setting, the brightness output decreases at a slower rate. Christie RGB Real|Laser projectors feature our renowned LiteLOC™ technology, which has innovative algorithms that can control power settings maximizing brightness output over a longer lifetime.

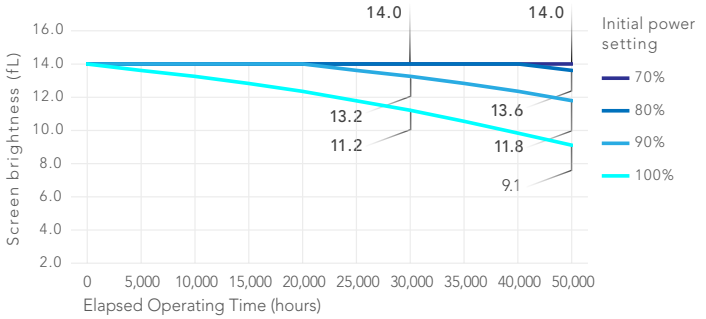
## LiteLOC™

Christie's LiteLOC technology senses light output and adjusts laser drive power for constant light output while always maintaining white-point accuracy.

Brightness headroom is very important to consider when selecting a projector that can accommodate light level requirements for a specific screen. LiteLOC uses this headroom to compensate over time for aging lamps or lasers. In the graphs below, starting the laser at less than its maximum power will improve its ability to maintain brightness longer. A typical cinema application with about 20% headroom where you start at about 80% power setting, should maintain that initial brightness level for at least 50,000 hours with proper environmental controls. Environmental controls include maintaining the recommended booth ambient temperature and humidity along with a clean, dust-free environment.

The following graph shows a few different initial power settings and how LiteLOC can maintain brightness before reaching the lifetime limit condition.

**Maintaining brightness**
Starting at different power levels, using LiteLOC to maintain brightness




## Conclusion

Christie cinema projectors have always been designed with stringent industry performance requirements in mind. The RGB Real|Laser cinema projectors featuring innovative LOS and LiteLOC technologies are no different. These new Christie innovations optimize and protect the entire system from manufacturing to operation. Brightness output, power levels and white-point accuracy are maintained against variations in operating environment for a long and trouble-free life.

Peak efficiency is the perfect balance of performance and economy.

## Pioneering RGB laser projection:

- ✓ Cinema industry's first deployment of RGB laser projectors (CP42LH) in 2014
- ✓ Cinema industry's first integrated RGB laser projector without an external chiller (CP4325-RGB) incorporating Christie's RealLaser technology
- ✓ Cinema industry's only 2K RGB laser projectors (CP2315-RGB and CP2320-RGB)
- ✓ First and only true HDR capable RGB laser cinema projection system (used in all Dolby Cinema installations)
- ✓ First "maintenance free" laser illumination technology


### Corporate offices

Christie Digital Systems USA, Inc.
Cypress
ph: 714 236 8610

Christie Digital Systems Canada Inc.
Kitchener
ph: 519 744 8005

### Worldwide offices

Australia
ph: +61 (0) 7 3624 4888

Brazil
ph: +55 (11) 2548 4753

China (Beijing)
ph: +86 10 6561 0240

China (Shanghai)
ph: +86 21 6030 0500

Colombia
ph: +57 (318) 477-3179

France
ph: +33 (0) 1 41 21 44 04

Germany
ph: +49 221 99 512-0

India
ph: +91 (080) 6708 9999

Mexico
ph: +52 55 4744 1790

Singapore
ph: +65 6877 8790

South Korea
ph: +82 2 702 1601 Spain
ph: +34 91 633 9990

United Arab Emirates
ph: +971 (0) 4 503 6800

United Kingdom
ph: +44 (0) 118 977 8000

United States (Arizona)
ph: 602 943 5700

### Independent sales consultant offices

Italy
ph: +39 (0) 2 9902 1161

Russia
ph: +7 (495) 136 62 43


For the most current specification information, please visit christiedigital.com



CINE0141-LOS-Lifetime-White-Paper-Jun-20-EN-US


DLP CINEMA TEXAS INSTRUMENTS

CERTIFIED ISO 9001 QUALITY SYSTEM

CHRISTIE®