

Solid state illumination may be the future of projection...but the technology is not yet ready for prime time.



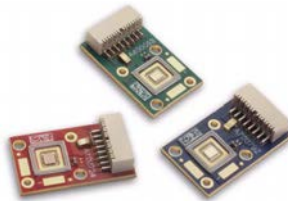
- Hybrid solid state lighting techniques are unproven in the market.
- The hybrid's phosphor disk will degrade over time. Replacement will result in a high cost and the downtime associated with repairs
- The average customer uses their projector far less than they originally assume, so their factory lamp will last longer than they think.
- Traditional lamp technology is reliable. Although lamp lifespan is limited, it's predictable and it's easy and relatively inexpensive to replace.

A special note about LED and 3LCD.

A couple years ago the market was tested with a 3LCD based LED projector that reached 1000 lumens. Using the same exact LEDs, the brightest 1-chip system achieved far less brightness. While not a commercial success, this showed that 3LCD based systems still enjoy a significant efficiency advantage over 1-chip systems. As newer illumination systems become more mature, 3LCD technology will still hold an efficiency advantage over the sequential color technology in 1-chip DLP.

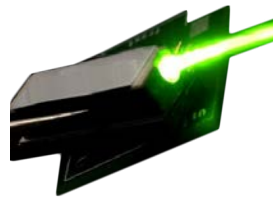
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Types of Solid State Lighting



LED

Light Emitting Diodes (LED) have been used for some time now in projection. Most pico projectors use LEDs. The problem with LEDs is limited brightness. LED based projectors top out today at about 500 lumens.



Laser

Laser projectors are starting to appear in the digital cinema market. By using three separate lasers—red, green and blue—outstanding color is possible. However, the cost of the green laser will limit the availability of pure laser projectors for several years.



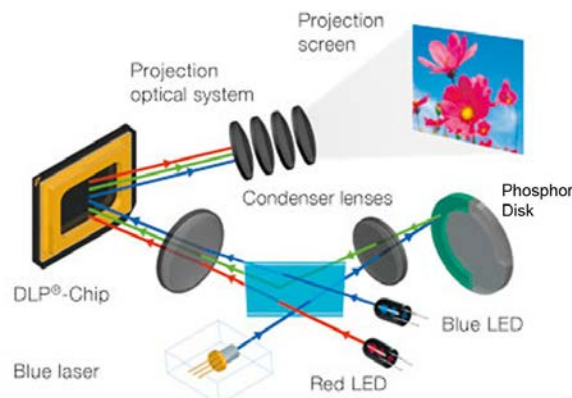
Hybrid

Hybrid light engines use a combination of LEDs and lasers for the red and blue light channels. Green lasers are still too expensive and green LEDs are not bright enough, so to create green these hybrids use a phosphor disk. That process is detailed below.

Hybrid Light Engines

Hybrid light engines use either a red LED or a red laser combined with a blue laser to create these two primary colors. For green, they aim the blue laser into a phosphor disk. This disk is similar to the color wheels in every other 1-chip DLP... but instead of color filters, this disk uses a phosphor to emit green light.

What is a phosphor? A phosphor is any material that, when exposed to radiation, emits visible light. Think of your old CRT television. In a CRT, phosphor coats the inside of the screen. When the electron beam strikes the phosphor, it makes the screen glow.



It's key to point out that the phosphor disk will degrade over time. This technology is new to projection... so the industry is still learning about the long-term life span of the phosphor.



Lamp Life of 20,000+ Hours

Solid state illumination, like LED or laser, has the advantage of long life. However, we don't really know how long the hours are. The professional buyer uses their projector an average of **33 hours per month** (PMA 2011 End User Survey). 20,000 hours is over **50 years** of service for the average professional. What about high hour use customers like educators? According to the Department of Education, the average school year is 180 days and the average school day is 6.7 hours. Assuming the projector is on, all but a couple hours for lunch and recess, from the time the children arrive to the ending bell that's just about 850 hours per school year. Meaning 20,000 hours equals over **23 years**. Ask yourself, as fast as technology changes, am I going to want this projector in 20+ years?

Competitive Landscape

In general, Hitachi projectors are **much smaller and lighter** than competing hybrid projectors. Although the white brightness metric may be comparable, the hybrid models use 1-chip DLP sequential color technology, so once the data is available we will likely see a Hitachi advantage in color brightness. Hitachi also enjoys a **power efficiency advantage** on many models. Finally, Hitachi has a sizeable **price advantage** even with factoring in the cost of a replacement lamp. Below is a quick comparison of a couple competitors against Hitachi's model CP-D31N short throw projector.



	Hitachi CP-D31N	Competitive Laser Model	Competitive Hybrid Model
Street Price	\$895	\$1,899	\$1,849
White Brightness	3000 lumens	2000 lumens	2500 lumens
Color Brightness	3000 lumens	TBD	TBD
Max. Power	290 W	270 W	430 W
Lumens / Watt	10.34	7.4	5.8
Weight	3.8 kg	5.1 kg	7.1 kg
Size / Volume (cc)	10393	17550	14380

When compared to the competition, Hitachi is less than half the price, has a higher efficiency, and is much lighter and smaller.

Lamp Technology Summary

- LED technology is not bright enough for mainstream projection. Buyers overwhelmingly choose projectors with more than 2,000 lumens for business and education applications.
- Pure laser projectors show great promise. But, the cost and availability of quality green lasers will limit the availability of these systems for the next several years.
- Hybrid lighting systems from the competition deliver the lumens, but are unproven in the market and introduce their own shortcomings. These create green light by aiming blue laser light into a spinning phosphor disk. This phosphor disk will degrade over time.
- Traditional lamps do have limitations but still offer several key advantages including the following:
 - Lamp technology is tried and true with a 20+ year history.
 - Although limited...lamp life is well understood and predictable.
 - The industry is still learning how long the phosphors inside the hybrid systems will truly last.
 - The price of a new lamp is still more cost effective than repairing a phosphor disk.