Z-Phosphor
LASER LIGHT SOURCE

SONY

SXRD® 4K and BrightEra® 3LCD

Laser Projection

Technical Background

Welcome

The world of video projection changed decisively at InfoComm 2013. That's when Sony introduced the world's first 3LCD laser projector, the VPL-FHZ55. Here was a combination of brightness, resolution, convenience and virtually no maintenance that the world had never seen before. The projector won accolades from independent reviewers, glowing endorsements from delighted owners and several of the industry's top awards.

Sony's Z-Phosphor™ laser light source means there's no lamp that needs to slowly warm up or cool down, no lamp to limit tilt angle and no lamp to burn out. And unlike LED/laser hybrid projectors, Z-Phosphor projectors don't force you to choose between high brightness and high resolution. Sony delivers both. The laser also enables a Constant Brightness mode that delivers remarkably stable picture quality, long operating life and excellent unit-to-unit consistency. As a result, Z-Phosphor projectors are ideal for multi-projector and edge blending applications. In addition, Sony's 3-chip design means high contrast, vivid color and consistently bright images in color or black-and-white.

It's no surprise that these breakthroughs come from Sony. At Sony, projection is not just a product category. It's a passion. It's a quest that we've been pursuing since 1972. Our journey has driven us to innovate at the very heart of the projector: the microdisplay. Where the vast majority of projector brands must buy their microdisplays from third-party suppliers, we make our own. And as you will see, that makes all the difference.

Sony now offers nine Z-Phosphor projectors, models so compelling that they deserve thorough explanation – and reward thorough understanding. That's why we created this document.

Sound & Video Contractor
2015 Innovative Product:
VPL-FHZ65

Sound & Video Contractor
2015 Innovative Product:
VPL-GTZ1

Projector Reviews.com
Hot Product Award:
VPL-FHZ65

Projector Reviews.com
2014-2015 Best in
Classroom, Large Venue,
Solid State:
VPL-FHZ55

Campus Technology
Reader's Choice Awards
2015: Gold Winner:
VPL-FHZ55

InfoComm 2015
Best Projection
Technology: Z-Phosphor

InfoComm 2015
Best New Meeting Room
Projector: VPL-FHZ65

InfoComm 2015
Best New Video Product:
VPL-GTZ1

Sound & Video Contractor
InfoComm 2015 Best of
Show: VPL-FHZ65

CEPro
2015 BEST Award - Most
Promising:
VPL-VW5000ES

Residential Systems
2015 CEDIA Best of Show:
VPL-VW5000ES

Church Production
InfoComm 2014 Top 5
Products: VPL-FHZ700L

AV Technology
InfoComm 2014 Best of
Show: VPL-FHZ700L

Projector Reviews.com
Hot Product Award:
VPL-FHZ55

InfoComm 2013
Best New Projection
Technology: VPL-FHZ55

Commercial Integrator
Most important Products
2013 Integrator's Choice:
VPL-FHZ55

WFX 2013 New Product
Technology
Best New Projection
Technology: VPL-FHZ55

Sony's Z-Phosphor projectors continue to win one award after another.

Laser projection

Sony's Z-Phosphor™ laser light source is a breakthrough among lamp-free projection systems. In order to appreciate Sony's design in context, it helps to recognize the different classes of lamp-free projectors:

1. LED

Generally, this is the most affordable, lowest-output type. An April 2015 survey of 232 models showed nearly 93% with light output of 2000 lumens or less.

2. LED/laser hybrid

A step up in performance and price, these use LEDs for some colors of light and a laser phosphor arrangement for others. As we will see, LEDs continue to impose performance limitations.

3. Laser phosphor

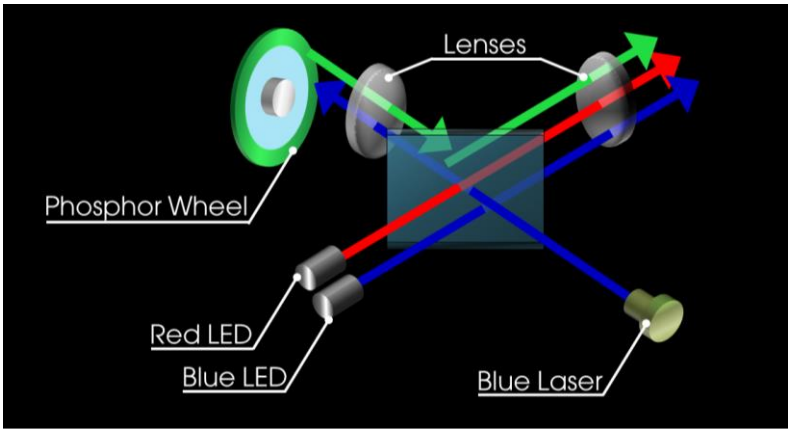
A major step up, these projectors use laser light to excite a phosphor, which provides 100% of the illumination for the screen. Sony's VPL-FHZ55 Z-Phosphor projector was an early member of this group. But even compared to other laser phosphor models, Sony Z-Phosphor projectors stand apart for combining high resolution, high brightness and high color brightness.

4. Direct laser

For the largest venues, some projectors have begun to use a direct laser system: Red, Green and Blue lasers that illuminate the screen without intermediary phosphors. Others use a combination of direct laser and indirect phosphor illumination. In 2005, Sony created a 60,000 lumen RGB direct laser projection system, which we exhibited at the Aichi World Exposition. And we continue to develop direct laser technology. While these projectors have real benefits, important questions remain about price, "speckle" artifacts, physical installation requirements and return on investment.

The limitations of LEDs

The advantages of Sony's Z-Phosphor design become clearer when we take a quick look at LED/laser hybrid technology. While individual models vary, one representative LED/laser hybrid design uses three light sources. A blue laser excites a rotating phosphor wheel to provide only the Green light. Red and Blue are provided via LEDs. While this arrangement does incorporate a laser and does eliminate the projection lamp, reliance on LEDs becomes a major limitation.

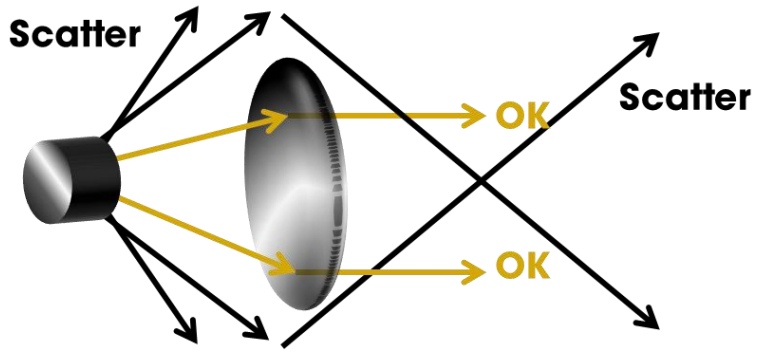


While LED/laser hybrid systems vary, this example is representative. Here the laser is responsible only for Green illumination. Red and Blue are handled by LEDs.

Compared to laser illumination, LEDs just aren't as bright. You might think it a simple matter to increase the brightness by increasing the LED driving power. However this incurs reliability issues

that may someday be resolved by further research and development. Until then, drive power remains limited.

Alternately, you might try increasing brightness by using bigger LEDs or even multiple LEDs. Unfortunately, projection LEDs are already 1,000 times larger than projection lasers of equivalent brightness. The larger the light source, the more diffuse and difficult it is to channel toward the screen. Light tends to be wasted through scatter.

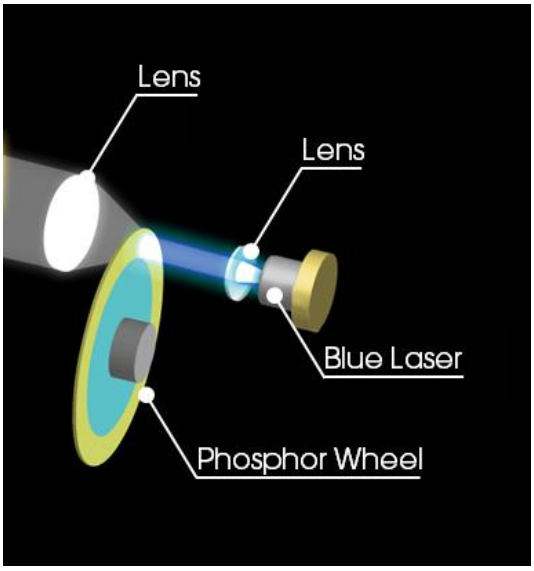


Compared to lasers, LED light sources tend to be relatively large, which incurs light-wasting scatter.

Sony's Z-Phosphor laser light source

Where LED/laser hybrid systems typically provide two out of three colors from LEDs, Sony's Z-Phosphor design is a pure laser phosphor system. So it starts with 100% laser light. And while other projectors can also make this claim, Sony stands alone, delivering a combination of end-user benefits that is unmatched.

In the Z-Phosphor™ laser light source, light from a miniature blue laser array is concentrated even further by an aspheric lens and directed at a spinning phosphor wheel that glows bright white. It is this phosphor that provides all the illumination for the screen. Light from the phosphor wheel is concentrated by a second aspheric lens and directed toward the SXRD® or 3LCD projection chips.



Sony's Z-Phosphor laser light source uses a laser and phosphor wheel to generate the full spectrum of white light. No LEDs are needed.

Both the laser and the phosphor embody Sony's deep understanding of these technologies. For example, Sony Semiconductor began manufacturing lasers in 1986, becoming a leading supplier for the CD, DVD and game console markets. By 2010, we had shipped over 3 billion lasers. Our mastery of blue lasers extends to Blu-ray Disc™ players, PLAYSTATION® consoles and XDCAM® professional optical disc camcorders. We drew on this experience to build multiple blue lasers into an

array roughly 1/1000 the size of an LED of equivalent brightness. Our laser array is highly redundant. So the failure of any single laser has negligible effect on output brightness. Because laser light is coherent, light scattering and waste are less significant. And the miniature size of the laser array reduces light scatter further still.

The phosphor is another unique formulation, based on decades of Sony experience with phosphor coatings in television and projection CRTs. The result is a system that can simultaneously achieve superb resolution and high brightness. Resolution is either WUXGA (1920 x 1200) or 4K (4096 x 2160) depending on the model, while brightness ranges from 2000 to 7000 lumens.

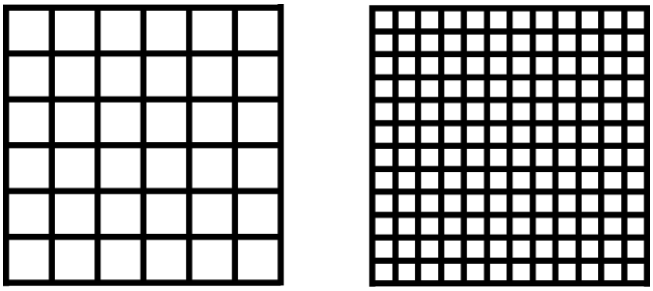
It's no wonder that after our original VPL-FHZ55, Sony has gone on to incorporate the Z-Phosphor system into eight additional models.

Light output versus resolution

Both light output and resolution are critically important. High light output enables a projector to be used in a wider range of commercial applications. High resolution enables a projector to keep pace in a world where mass market tablets and even mobile phones can display full HD. Resolution can make the difference between seeing beautiful images—or pixels. And a higher-resolution projector can display more of a computer window without the need to scroll around.

Unfortunately, there's a tradeoff between resolution and brightness. This happens because of two limitations—technology and cost.

On the technology side, the pixels in modern microdisplays measure only a few millionths of a meter across—a fraction of the thickness of human hair. This means the gaps between pixels are as small as fabrication technology can make them. This leads to a classic engineering tradeoff. Other things being equal, as you increase the pixel count of a projection chip of a given size, you increase the amount of real estate devoted to inter-pixel gaps. This decreases the light output!



All else being equal, increasing the resolution decreases overall brightness (right) because more of the screen is occupied by the gaps between pixels.

One obvious method around this is to pass more light by increasing the size of the chip. But this triggers a cost penalty. Not only do larger chips cost much more, but they also require larger, more expensive optical engines and projection lenses. Achieving both high resolution and high brightness is a challenge.

To achieve high brightness and high resolution in a single projector, Sony engineers pursued a two-pronged approach. First, the Z-Phosphor laser light engine is inherently brighter than LED/laser hybrid systems. So in comparison to that class of projectors, Sony begins with a massive head start. Second, unlike almost every other projector manufacturer, Sony designs and builds our own projection microdisplay chips, in our Kumamoto Technology Center. That's a decisive advantage.

Our Kumamoto engineers are masters at using the latest semiconductor fabrication technologies, materials science and process engineering refinements to reduce the inter-pixel gaps. We dramatically reduced the gap size in 2006 with the launch of our original BrightEra™ 3LCD panels.

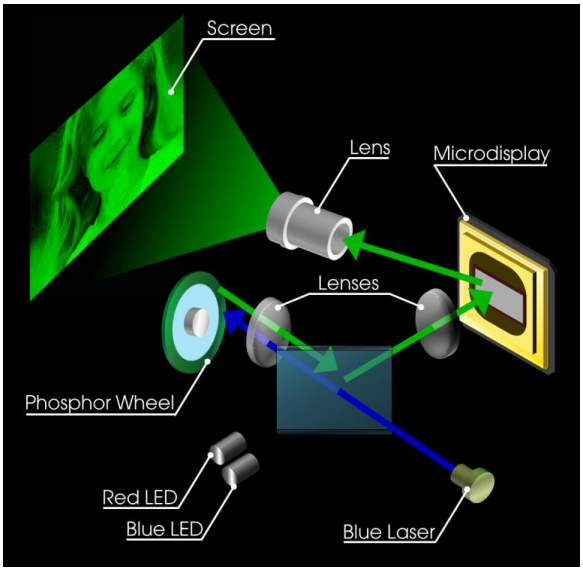
Then in 2010, we incorporated an array of on-chip micro-lenses to pass through an even higher percentage of incoming light. Sony incorporated these advances into the VPL-FHZ Series Z-Phosphor projectors.

By using reflective technology, our SXRD® microdisplays can achieve substantially smaller inter-pixel gaps, enabling substantially higher resolution on chips of comparable size. That's how the VPL-GTZ280, GTZ20, and GTZ1 along with the home theater VPL-VW5000ES and LSPX-W1S projectors can all achieve high brightness and 4K resolution (4096 x 2160).

In addition, every Z-Phosphor projector benefits from Sony's 3-chip design, which delivers superior color brightness and high color accuracy compared to single-chip projection.

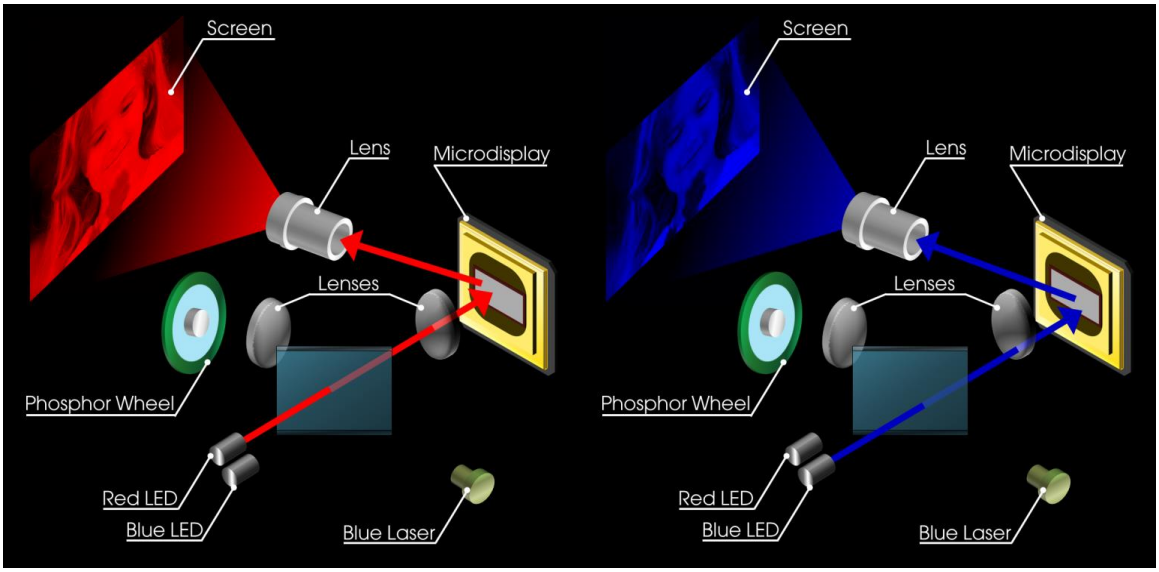
Single-chip issues

A major issue in conventional projector design is the reliance on a single microdisplay chip. Single-chip projection means "sequential color." At any given instant, the system can show either Red, or Green, or Blue, but never all colors at once. Not only does this limit color accuracy, it means that brightness takes a further hit when color images are displayed. Because the single chip can only project one color at a time, color light output is only a fraction of the light output for an all-white screen.



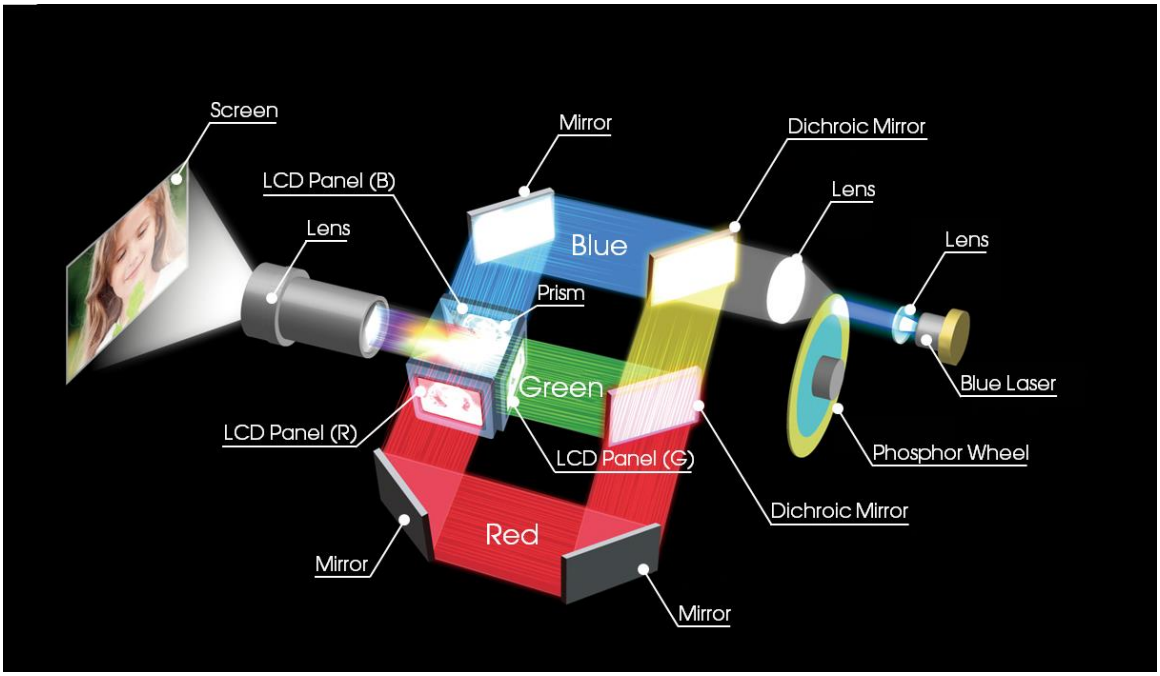
Using a single microdisplay, this LED/laser hybrid system can only present one color at a time—either Red or Green or Blue. In the example shown here, when the laser is active, the projector presents a Green picture.

The Red and Blue pictures are illuminated, in turn, by dedicated LEDs.



The 3-chip advantage

After Sony's laser and phosphor wheel, the remaining optical engine reaps all the benefits of Sony's 3-chip system. In this design, a pair of dichroic mirrors separates white light into Red, Green and Blue beams. These pass through the LCD layers of the three microdisplays, which reproduce the Red, Green and Blue components of the video picture. These Red, Green and Blue components immediately pass into an optical prism, which fuses them into a unified, full-color image. In the 3-chip system, the projector displays all the colors, all the time.



In the 3-chip design, there's one chip each for Red, Green and Blue, enabling our laser projectors to show all the colors all the time—a powerful advantage.

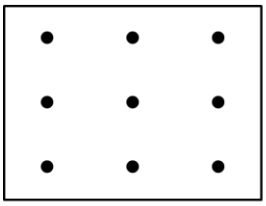
The benefits are many:

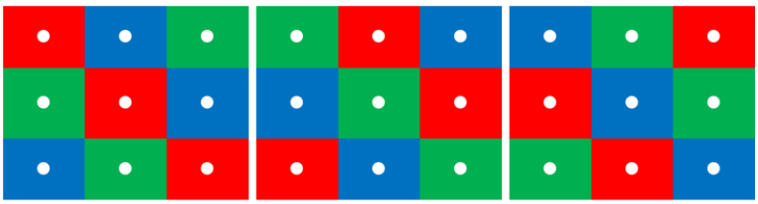
Up to 7000 lumens of light output

The 3-chip design is instrumental in delivering the benchmark performance of 7000 lumens.

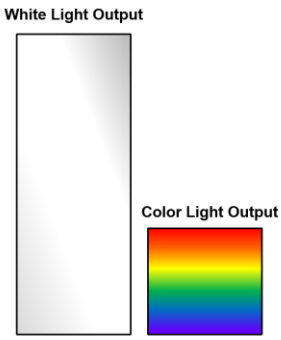
Up to 7000 lumens of color light output

Projector light output is conventionally measured on an all-white screen—not exactly an accurate representation of actual viewing conditions. A more realistic (and more demanding) test is color light output, as standardized by the Society for Information Display (SID) in 2012. The color light output of single-chip projectors is just a fraction of the white light output claimed in typical brochures. But Sony 3-chip projectors shine. For every one of Sony's Z-Phosphor projectors, color light output is exactly equal to the white light output specification.

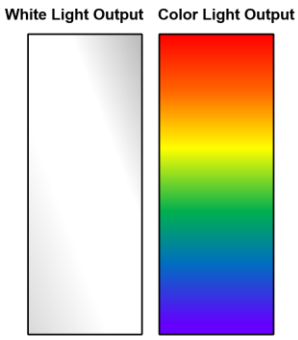




White light output measures nine test points on an all-white screen (left). It's a holdover from the days when computer screens were mostly text on a white background. Color light output measures 27 test points on a sequence of three color screens (right). It's far more representative of today's projector usage.



Single-Chip Projectors



3-Chip Projectors

Single-chip projection color light output is just a fraction of the white light output claimed in brochures and ads. For the 3-chip system of Sony laser projectors, the two measures are identical.

Color accuracy

Projecting all the colors, all the time, 3-chip projectors are known for high color accuracy.

Color stability

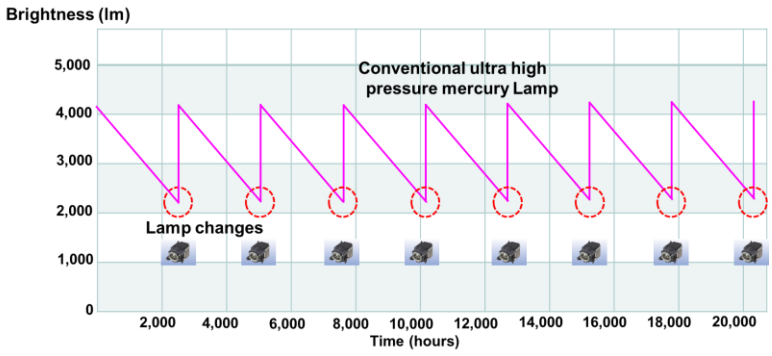
Depending on viewing conditions and individual viewer sensitivity, single-chip projectors can reveal "color breaking" and "rainbow" artifacts. These tend to be especially notable on scenes with high contrast and high motion. Because 3-chip projectors display all the colors all the time, they are immune to these artifacts.

Operational advantages

We've seen that the Z-Phosphor™ laser light source enables Sony's laser projectors to combine impressive brightness and resolution. But that's only part of the story. By replacing the typical ultra-high-pressure mercury lamp, the laser revolutionizes the ownership experience. You'll notice the advantages as soon as you power up one of our projectors. And you'll continue to experience advantages for years to come.

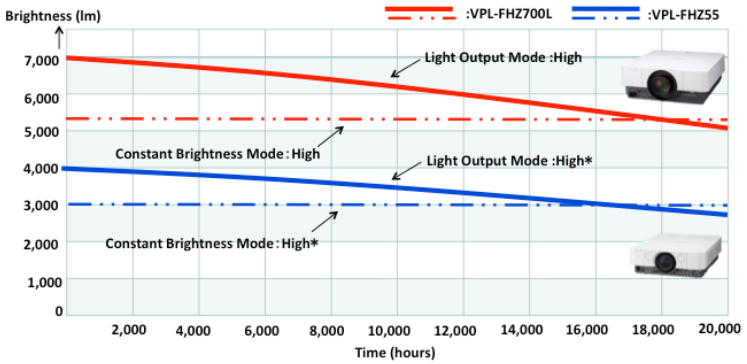
20,000 hours with virtually no maintenance*

The ultra-high-pressure (UHP) mercury lamp inside conventional projectors is essentially a high-tech light bulb. And like more familiar light bulbs, it burns out, typically needing replacement every 1,500 to 3,000 hours. (Some of the latest lamps need replacement every 6000 hours.) In dramatic contrast, Sony's Z-Phosphor™ laser light source is rated at 20,000 hours of life. That's equal to 10 hours a day, 5 days a week, 50 weeks a year for *eight years*. Projection with virtually no maintenance is a major advance for simplicity, convenience and peace of mind.



Conventional projectors incur the expense (and inconvenience) of fluctuating light levels and regular lamp replacement.

Of course, some conditions apply. The 20,000 hour figure assumes an Auto Dimming duty cycle of 5% of projection time at 100% brightness, 85% of time at 85% brightness and 10% of time at 5% brightness. Actual hours may vary depending on usage environment.



Sony's Z-Phosphor projectors can go 20,000 hours with virtually no maintenance (conditions apply).

For digital signage, museums and other applications where a consistent visual experience is crucial, Sony has incorporated Constant Brightness mode. This maintains uniform brightness (at reduced light output) throughout the life of the projector.

The long operating life of these projectors speaks volumes not only for the stamina of the Z-Phosphor™ laser light source, but also for the durability of Sony's latest BrightEra™ and SXRD® microdisplay panels.

*Auto Dimming duty cycle of 5% of projection time at 100% brightness, 85% of time at 85% brightness and 10% of time at 5% brightness. Actual hours may vary depending on usage environment.

Up to 87,000 hours Extended Mode*

For applications where long operating life is paramount, the VPL-FHZ700L, FHZ65 and FHZ60 offer Extended Mode operation at reduced output. You get up to 87,000 hours* of operating life at approximately 40% brightness. In extended mode, air filters must be replaced at 20,000 hour intervals.

* Requires filter replacement at 20,000 hour intervals. 87,000 hour endurance is achieved at approximately 40% brightness operation in Auto Dimming mode. Actual hours may vary depending on usage environment.

Multi-projector consistency

In multi-projector and edge-blending applications, variations in projector ageing can ruin the intended effect. What should appear to be a single, seamless picture can become of a mosaic of obviously different colors and brightness levels. Sony's Z-Phosphor™ projectors are a dramatic step forward. The combination of the highly stable laser light source and the Constant Brightness mode delivers remarkably consistent picture quality from one unit to the next. As a result, the Z-Phosphor projectors are ideal for multi-projector and edge blending applications in fields as diverse as simulation, scientific visualization and product design.

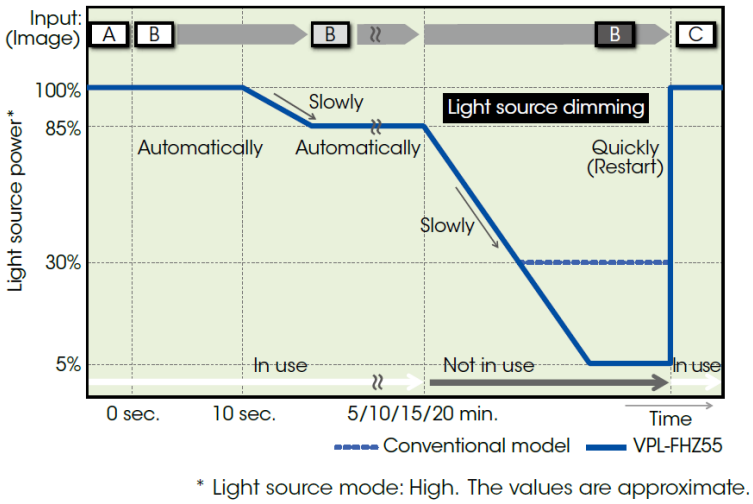
Lower cost of ownership

The Z-Phosphor laser light source makes for major savings, compared to conventional lamp projectors. Consider the cost of lamp replacement. You can save $1,876 over the life of the projector (compared to Sony LMP-F272 replacement lamp at suggested retail price and recommended replacement intervals).

You also save money on the labor cost of sending someone up the ladder to perform the lamp replacement.

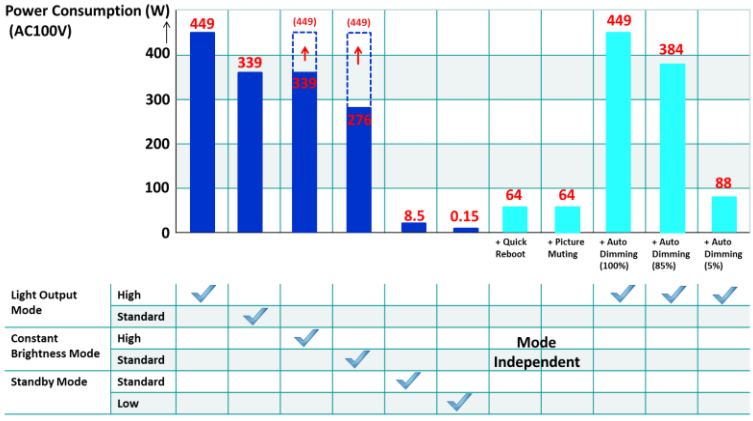
In addition to savings on both maintenance parts and labor, Sony's 3LCD laser projectors provide another measure of economy: higher energy efficiency than typical competitors. And compared to a

lamp projector, the Z-Phosphor™ design reduces power consumption in Auto Dimming and Picture Muting modes. In fact, Z-Phosphor projectors offer a full range of power-saving operating modes.



* Light source mode: High. The values are approximate.

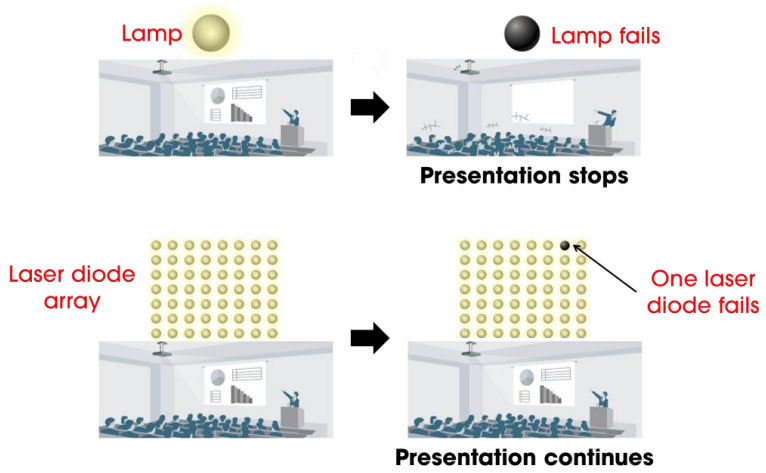
The ability of the laser to restart faster enables Sony to save more power in Auto Dimming mode.



A wide range of operating modes gives you tremendous opportunities to save power.

Worry free

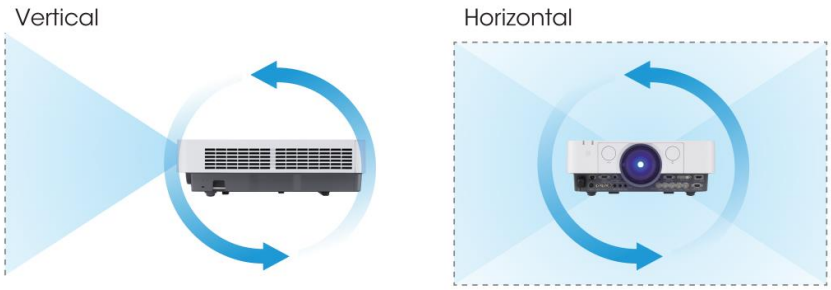
Conventional projector lamps can fail, undermining your productivity and embarrassing you at high-profile events. Sony's Z-Phosphor™ laser light source sustains high productivity and drastically minimizes downtime. Sony's blue laser light source is actually an array of multiple redundant lasers. This means that the failure of any individual laser is not a show-stopper.



You can present with greater confidence because Sony uses an array of minuscule lasers.

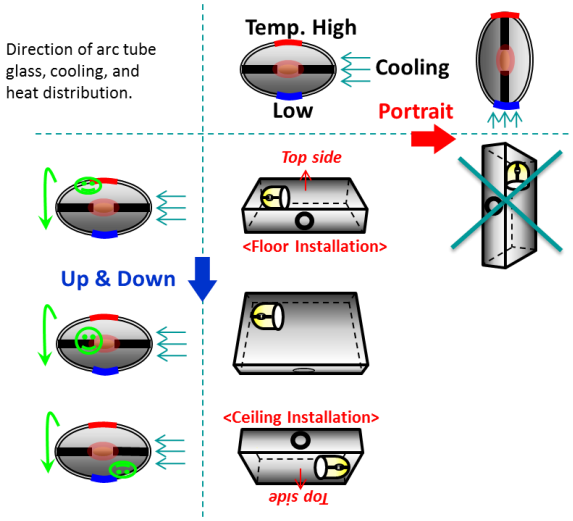
Tilt angle freedom*

Sony's Z-Phosphor™ projectors liberate you from the mounting angle limitations of conventional mercury lamp projectors. These projectors offer complete freedom* of installation angle: whether landscape mode or portrait mode. You get 360° of tilt about the vertical axis or horizontal axis.*



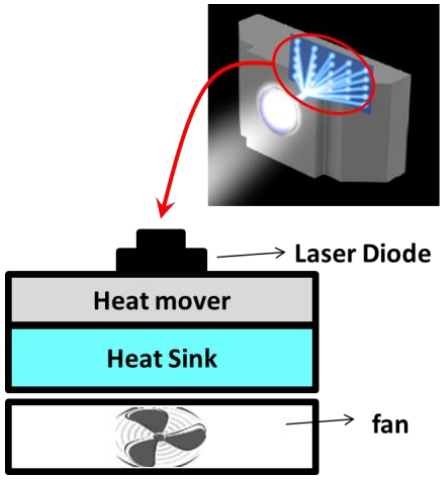
Sony projectors achieve 360° tilt angle freedom* about the vertical or horizontal axis.

The mounting angle limitations of conventional projectors are caused by cooling issues. Ultra-high pressure mercury lamps generate significant heat—and require carefully designed ventilation and cooling systems. But because heat rises, the cooling system performs better at some installation angles than others. Typical lamp-equipped projectors are designed to function right-side up (when sitting on a table) or upside down (when hanging from a ceiling). These projectors tend to continue operating properly when tilted up or down at intermediate angles. But when they're rotated from landscape to portrait mode, there's trouble. Suddenly the hottest part of the lamp becomes inaccessible to cooling air. Premature lamp failure ensues.



Many lamp-equipped projectors can be tilted vertically (i.e. for floor projection) but cannot be rotated into portrait mode due to limitations in the way lamps can be oriented. Lamps are subject to overheating and failing prematurely when the projector is not installed properly.

Thanks to an innovative laser cooling system, Sony laser projectors free you from installation angle limitations.*



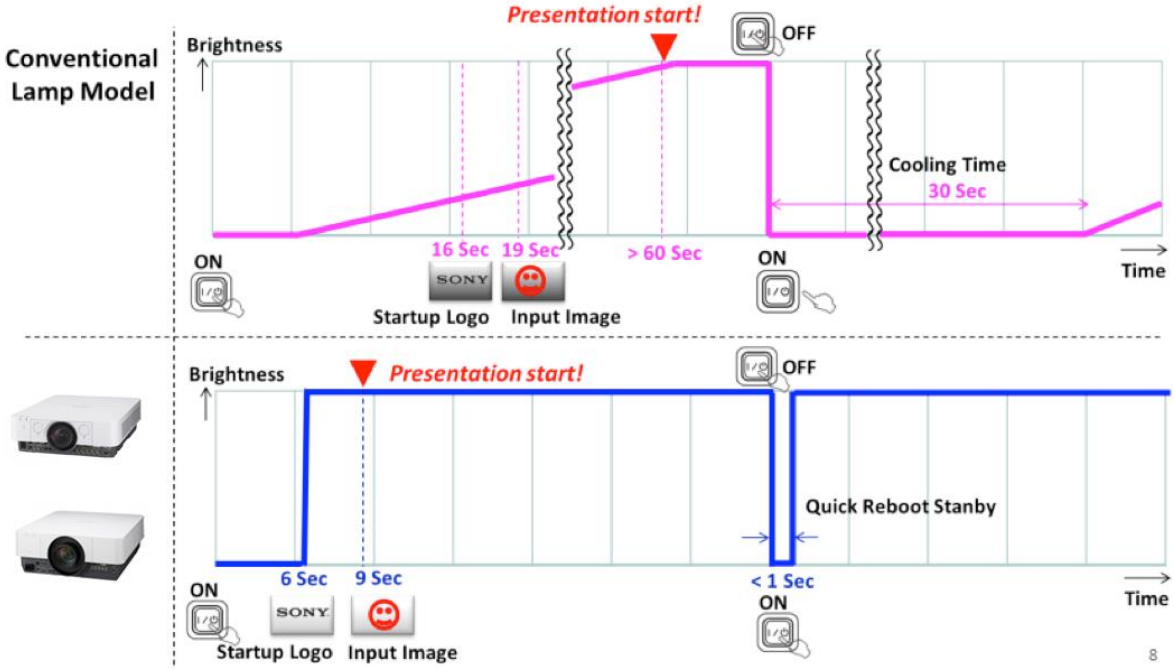
The cooling systems of Sony's laser projectors accommodates all installation angles.*

* The VPL-VW5000ES home theater projector is designed for 30 degrees maximum tilt angle. The LSPX-W1S 4K Ultra Short Throw Projector is designed for horizontal mounting.

Rapid on/off

Conventional projection lamps are at odds with today's impatient culture. When you power up, it typically takes more than 60 seconds to achieve full brightness. When you power down, it typically requires 30 seconds of cooling time. When you want to reboot from standby, the 30 second cool-down becomes a minimum waiting interval. For a society accustomed to instant everything, 30 seconds can feel like an eternity.

Sony's Z-Phosphor™ laser light source changes the rules. It takes just 9 seconds to full brightness and presentation start. It reboots from standby in less than 1 second. When you turn it off, there's no need to wait until the unit cools. And there's no limitation in reboot cycles or durations.



Compared to lamp projectors, the difference in operating convenience is night and day.

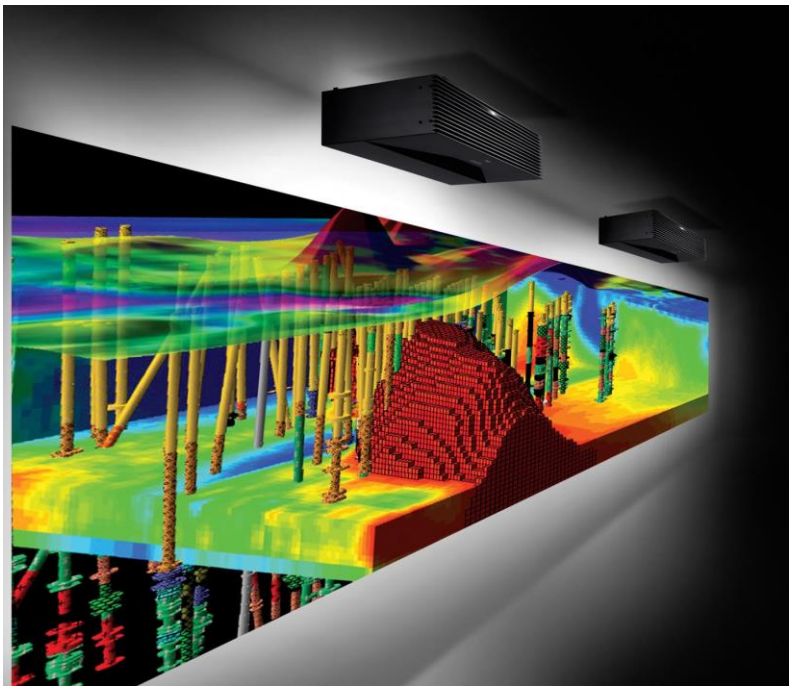
Mercury free

Our projectors even have better chemistry. As the name implies, the ultra-high-pressure mercury lamp contains mercury, a poison. The Sony laser system is mercury free, a far better choice for the environment.

Other features

Ultra-short throw

VPL-GTZ1, LSPX-W1S

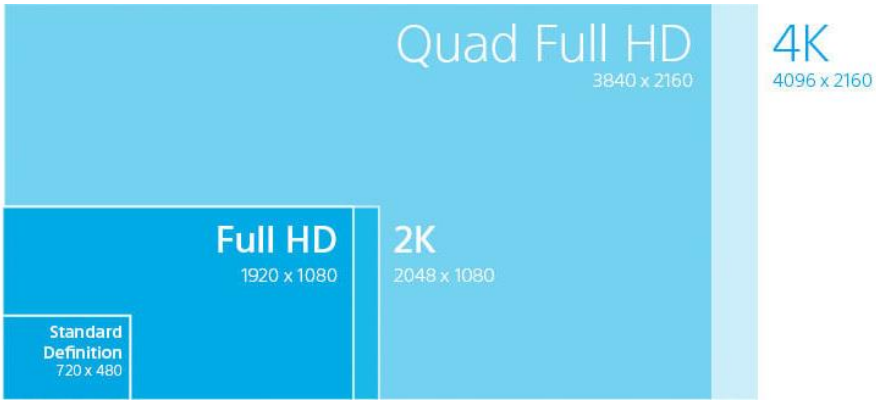


Conceptual view of a pair of edge-blended, ceiling-mounted VPL-GTZ1 ultra-short-throw projectors. The maximum distance between the projector and the wall is just 7 inches. Pictures simulated.

Presenting the world's first 4K laser ultra-short-throw projectors. The professional VPL-GTZ1 and the home theater LSPX-W1S are designed to install flush up against the wall. In fact, the maximum space between the rear of the projector cabinet and the screen is just seven inches. In front projection, you can walk up close without blocking the light cone and casting unwanted shadows. Which means it's perfect for meeting rooms, classrooms, living rooms and public spaces. In rear projection, you can minimize the depth required behind the screen. Which saves space in exhibits and staged events. In both modes, the projector tends to disappear, whether mounted on the floor or ceiling. (Ceiling mount and rear projection for VPL-GTZ1 only.) Picture size varies from 66 to 147 inches diagonal (in 17:9 format, achieved at 0 and 7 inches throw, respectively).

4K resolution (4096 x 2160)

VPL-GTZ280, GTZ270, GTZ1, VW5000ES, LSPX-W1S



4K offers more than four times the detail of Full HD.

Eyebrows shot up when Sony introduced the world's first commercial 4K (4096 x 2160) projectors back in 2005. We had to tell people what a "K" was (1024 horizontal pixels). We had to explain how to connect a 4K signal. And we had to issue tutorials on how 4K provided a more immersive, more compelling visual experience, enabling viewers to sit closer to the screen (or install a larger screen) without being disturbed by visible pixels or "jaggies."

Sony's expertise in professional 4K extends from glass to glass: from our F55 digital motion picture camera to our SRX-R510P digital cinema projector.

Fast forward ten years and 4K is now a part of everyday life. Over 17,000 movie theaters use Sony 4K projectors. In fact, if you've been to a movie theater recently, the chances are good that you saw Sony's 4K projection. Thanks in part to Sony's professional cameras, 4K has also become a widespread production format for movies, commercials and episodic television. Consumer camcorders (and even cellphone videos) boast 4K resolution. Ultra HD televisions with Quad Full HD resolution (nearly the equivalent of 4K) now dominate the high end at electronics retailers. Amazon® Prime and Netflix are streaming 4K content to the home.

4K is not just about beauty. It's a strategic advantage for anyone trying to pinpoint a needle in a haystack of data. Pictures simulated.

It's no surprise that the people who kicked off the 4K revolution in commercial projection now offer the largest 4K line and the biggest installed base of commercial 4K projectors. And it's no surprise that we brought our award-winning Z-Phosphor® laser light source into the 4K category. While many readers already know the benefits of 4K projection, permit us to provide a brief refresher.

Greater immersion

For motion pictures, 4K enables the audience to sit closer to the screen – or if the seating distance is fixed, watch a larger screen – without enduring screen-door effect, visible pixels or "jaggies" on picture diagonals. You can think of 4K as delivering four times the pixels per square inch. For example, if you held a credit card up to a screen 27 feet (8.2 m) wide, the card would be covered by over 1,000 pixels. The net effect is heightened viewer involvement and a more compelling emotional experience.

More information

For scientific visualization, simulation, medical education, command & control or even everyday computer graphics, 4K enables more information to be displayed on a single screen. 4K has slightly more than four times the pixels of Full HD. That's a huge canvas on which to display data.

Four simultaneous HD pictures

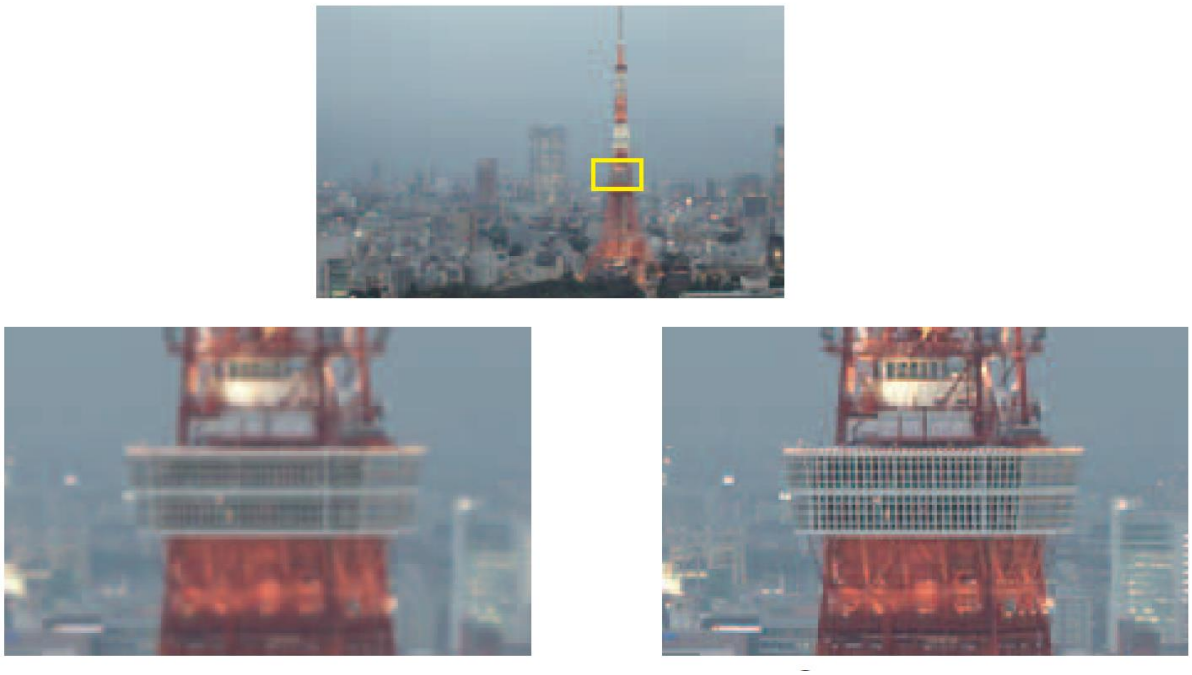
You can perform a quad split on the 4K image to show four pictures at a time, each in Full HD (1920 x 1080) resolution. That's ideal for casino sports book, command & control, digital surveillance and other multi-image applications. Of course, you can also display two HD images side-by-side.

Better presentation of HD

Intelligent 2:1 upscaling of the HD signal creates a visibly smoother picture, suppressing visible pixels and jaggies. And Sony's Digital Reality Creation™ system is among the most intelligent out there. The system compares details in the video picture to a vast database of recorded images to identify picture edges and dynamically apply the most appropriate processing. While it's not quite the same as watching 4K native content, it's a big step in the right direction.

WUXGA resolution (1920 x 1200)

VPL-FHZ700L, FHZ65, FHZ60, FHZ55

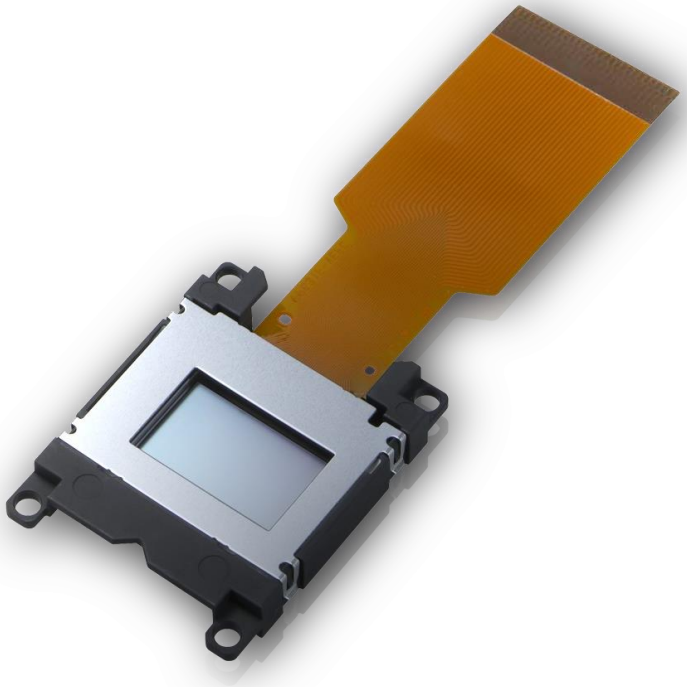


Look closely at the screen and the difference between WXGA and WUXGA resolution becomes completely clear. Simulated images. Licensed by Tokyo Tower.

Resolution, along with contrast, is a primary determinant of picture quality. But resolution also has a profound impact on the end-user experience. High resolution can make the difference between seeing beautiful images—or pixels. And a higher-resolution projector can display more of a computer window without the need to scroll around. You get more rows and columns of a spreadsheet and more room for engineering drawings, charts, diagrams and images for medical education. That's why, from the very outset, Sony engineers designed the 3LCD Z-Phosphor projectors for high resolution: WUXGA (1920 x 1200).

Sony’s BrightEra™ panels

VPL-FHZ700L, FHZ65, FHZ60, FHZ55



Great projectors begin with great microdisplays. And Sony is one of the very few companies in the world to design and manufacture its own microdisplays, including the BrightEra panel shown here.

Search online and you’ll find dozens and dozens of projector brands. But how many of them actually manufacture the microdisplay chips at the very heart of their projectors? Almost none. Sony is one of the tiny handful to build not only projectors, but also projector microdisplays. And that makes all the difference. Our Kumamoto Technology Center specializes in projector microdisplays and camera image sensors – both technologies focused on fabricating microscopically small pixels in silicon. This expertise, which has few equals anywhere in the world, gives our projector engineers a strategic advantage. Our projection teams and our microdisplay teams work hand-in-hand to invent the future of projection. A case in point is Sony’s version of the High Temperature Polysilicon (HTPS) LCD panel: Sony’s unique BrightEra™ design.

More than a decade ago, Sony’s Kumamoto engineers identified two critical issues in LCD panel performance. First, brightness was being limited by the large inter-pixel gaps (low fill factor) of conventional LCD designs. The gap size was particularly noticeable in high-resolution chips, where brightness was severely throttled down. Second, the materials of conventional LCD panels could be sensitive to the projection lamp’s heat, again limiting ultimate brightness. After years of research, the engineers responded in 2006 with our original BrightEra™ microdisplays. Substantially reduced inter-pixel gaps, substantially increased fill factor, and a new ultra-stable inorganic alignment layer all contributed to dramatic increases in projector brightness and resolution.

In 2010, the second-generation BrightEra system incorporated an array of on-chip micro-lenses to pass through an even higher percentage of incoming light and a chemically stronger liquid crystal formulation to further resist degradation from exposure to heat.

Today, Sony’s 3LCD laser projectors incorporate third-generation BrightEra™ microdisplays. These take advantage of a refined inorganic alignment layer that resists the process of photolysis—molecular breakdown in bright light. The benefits are profound.

High brightness without sacrificing resolution

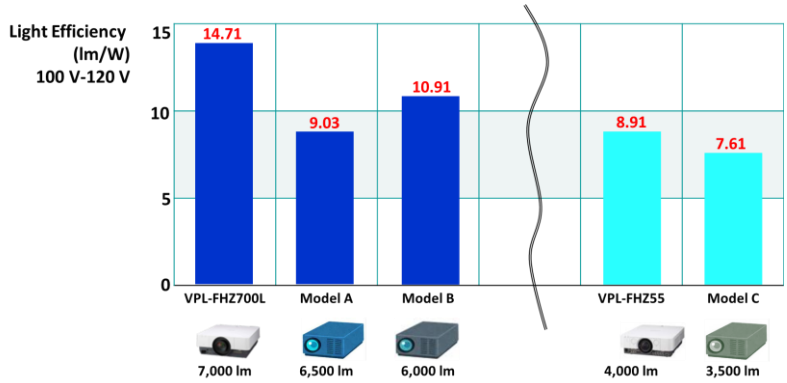
The early pages of this document describe the engineering tradeoff between brightness and resolution. Third-generation BrightEra™ panels enable Sony to overcome the tradeoff. Sony achieves both high brightness (up to 7,000 lumens) and high resolution (WUXGA 1920 x 1200) at the same time.

Long operating life

Built to take the heat, the BrightEra panels are well matched to the 20,000-hour operating life of the Z-Phosphor™ laser light source. (Actual hours will vary depending on usage environment and operational settings.)

Superb energy efficiency

Because less light is blocked by inter-pixel gaps, you get very high light output per watt of electricity input. Not only is this kinder to the environment, but it also helps lower your total cost of ownership across the life of the projector.



Sony's exclusive BrightEra™ panels help deliver high energy efficiency in terms of lumens per Watt.

Sony’s SXRD® panels

VPL-GTZ280, GTZ270, GTZ1, VW5000ES, LSPX-W1S

Over 17,000 movie theaters are equipped with Sony SXRD projectors.

We’ve seen that Sony is among the tiny handful of projector companies that also designs and builds the projection microdisplay chips. The BrightEra™ LCD microdisplay is just one half of the story. The other is Sony’s Silicon Crystal (X-tal) Reflective Display, the SXRD® chip. The many SXRD technology milestones demonstrate just how intimately Sony’s breakthrough video projectors are linked to Sony’s breakthrough projection chips.

- 2004. World’s first digital home theater projector to achieve Full HD (1920 x 1080) resolution (QUALIA™ 004 projector).
- 2005. World’s first commercial 4K projectors (SRX-R110 and R105).
- 2007. World’s first dedicated digital cinema 4K projectors (SRX-R220 and R210).
- 2011. World’s first 4K digital cinema projection system to be declared compliant with the DCI Specification (SRX-R320 and LMT-300 media block).
- 2011**.** World’s first 4K projector optimized for home theater (VPL-VW1000ES).
- 2014**.** World’s first 4K ultra short throw laser projector (VPL-GTZ1).

SXRD microdisplays are now proven in the most grueling test of all: over 17,000 digital cinema 4K installations, where the technology accomplishes day-in/day-out mission-critical operation. In basic principle, the SXRD chip uses an ultra-thin layer of liquid crystal to control grayscale for each pixel. Light shines into the chip, passes through the liquid crystal, reflects off the aluminum surface of the chip and back through the liquid crystal, out toward the projection lens.

High pixel density (maximum resolution at moderate cost)

SXRD technology represents a tremendous feat in micro-miniaturization. Sony is able to fit 8.8 million pixels onto a chip measuring just 0.74” (18.8 mm) diagonal. This means each pixel is about 4 x 4 micrometers. If you can’t envision how small that is, it would take over 4,000 of these pixels to cover the period at the end of this sentence. This amazing pixel density is made possible by the chip’s reflective design. This density enables maximum resolution at moderate cost. This is the secret ingredient behind Sony’s continued leadership in 4K projection.

High fill factor

The SXRD reflective design also minimizes inter-pixel gaps. This maximizes the “fill factor,” the proportion of the chip surface devoted to live picture area. In this way, SXRD panels enable Sony to deliver 4K resolution while still achieving reasonable brightness.

Superb picture quality

Picture quality means more than resolution and brightness. That’s why the SXRD microdisplays are also designed for high contrast (up to ∞:1 dynamic contrast), accurate motion rendering and low dark levels.

Over the years, Sony has refined planarization, improved the inter-pixel gap filler and upgraded the aluminum pixel pads, eliminating contrast-reducing bevels and contact divots. The result is even higher contrast, with deeper, richer black levels.

3D capability

VPL-GTZ280, GTZ270, GTZ1, VW5000ES, LSPX-W1S

By projecting separate Left-Eye and Right-Eye images, Sony can deliver 3D simulation, scientific visualization and entertainment. A complete 3D system requires 3D glasses, sold separately.

- HD/3D capability: VPL-GTZ1, LSPX-W1S
- 4K/3D capability: VPL-GTZ280, GTZ270, VW5000ES

Home theater

VPL-VW5000ES, LSPX-W1S

Home theater enthusiasts can also take advantage of Sony's Z-Phosphor technology. Not your ordinary consumer products, Sony's VPL-VW5000ES 4K projector and LSPX-W1S 4K Ultra Short Throw Projector are destined for the discriminating few. In fact, the LSPX-W1S is only available in limited areas as of November 2015, while we expect the VPL-VW5000ES to become available in Spring 2016. More information at **sony.com**

Picture simulated. Actual appearance of projection varies depending on content and ambient light.

Meet the family

VPL-FHZ700L
- 7,000 lumens
- 3LCD BrightEra™ panels
- WUXGA (1920 x 1200)

VPL-FHZ65
- 6,000 lumens
- 3LCD BrightEra panels
- WUXGA (1920 x 1200)

VPL-FHZ60
- 5,000 lumens
- 3LCD BrightEra panels
- WUXGA (1920 x 1200)

VPL-FHZ55
- World’s first 3LCD laser projector
- 4,000 lumens; 3LCD BrightEra panels
- WUXGA (1920 x 1200)

VPL-GTZ280
- IR output and 4K 120 Hz capability for simulations
- 5,000 lumens; 3 SXRD® panels
- 4K (4096 x 2160)

VPL-GTZ270
- Wide color mode for entertainment
- 5,000 lumens; 3 SXRD panels
- 4K (4096 x 2160)

VPL-GTZ1
- World’s first 4K laser ultra-short throw
- 2,000 lumens; 3 SXRD panels
- 4K (4096 x 2160)

VPL-VW5000ES
- High Dynamic Range, Wide Color Gamut
- 5,000 lumens; 3 SXRD panels
- 4K (4096 x 2160)

LSPX-W1S
- 4K Ultra Short Throw Projector
- 2,000 lumens; 3 SXRD panels
- 4K (4096 x 2160)

Sony projectors compared

	VPL-FHZ700L	VPL-FHZ65	VPL-FHZ60	VPL-FHZ55	VPL-GTZ280	VPL-GTZ270	VPL-GTZ1	VPL-VW 5000ES	LSPX-W1S
Z-Phosphor™ laser light source	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Projection microdisplays	3 LCD BrightEra ™ chips	3 LCD BrightEra chips	3 LCD BrightEra chips	3 LCD BrightEra chips	3 SXRD® chips	3 SXRD chips	3 SXRD chips	3 SXRD chips	3 SXRD chips
Microdisplay effective size (diagonal)	0.95" (24 mm)	0.76" (19 mm)	0.76" (19 mm)	0.76" (19 mm)	0.74" (18.8 mm)	0.74" (18.8 mm)	0.74" (18.8 mm)	0.74" (18.8 mm)	0.74" (18.8 mm)
Microdisplay native resolution	WUXGA; 1920 x 1200 x 3	WUXGA; 1920 x 1200 x 3	WUXGA; 1920 x 1200 x 3	WUXGA; 1920 x 1200 x 3	4K; 4096 x 2160 x3	4K; 4096 x 2160 x3	4K; 4096 x 2160 x3	4K; 4096 x 2160 x3	4K; 4096 x 2160 x3
Screen size (measured diagonally)	40 to 600" (1.02 to 15.24 m)	40 to 600" (1.02 to 15.24 m)	40 to 600" (1.02 to 15.24 m)	40 to 600" (1.02 to 15.24 m)	n/s	n/s	66 to 147" (1.68 to 3.73 m)	n/s	66 to 147" (1.68 to 3.73 m)
Ultra-short-throw: distance, wall to rear of cabinet	-	-	-	-	-	-	0 to 7" (0 to 178 mm)	-	0 to 7" (0 to 178 mm)
3D capability	-	-	-	-	Yes	Yes	Yes	Yes	Yes
Throw Ratio, supplied lens	Lens sold separately	1.39:1 to 2.23:1	1.39:1 to 2.23:1	1.39:1 to 2.23:1	Lens sold separately	Lens sold separately	0.16:1 to 0.25:1	1.27:1 to 2.73:1	n/s
Light output, high / standard / low modes	7,000 lm 5,600 lm 3,000 lm	6,000 lm 4,000 lm	5,000 lm 3,500 lm	4,000 lm	5,000 lm	5,000 lm	2,000 lm	5,000 lm	2,000 lm
Color light output, high / standard / low modes	7,000 lm 5,600 lm 3,000 lm	6,000 lm 4,000 lm	5,000 lm 3,500 lm	4,000 lm	5,000 lm	5,000 lm	2,000 lm	5,000 lm	2,000 lm
Contrast ratio	8,000:1 (full W/ full B average)	10,000:1 (full W/ full B average)	10,000:1 (full W/ full B average)	8,000:1 (full W/ full B average)	∞:1 dynamic contrast	∞:1 dynamic contrast	∞:1 dynamic contrast	∞:1 dynamic contrast	n/s
Acoustic noise, high / standard modes	39 dB 33 dB	34 dB 28 dB	34 dB 28 dB	40 dB 35 dB	35 dB	35 dB	26 dB	35 dB	n/s
Interchangeable lenses	Yes	Yes	Yes	Yes	Yes	Yes	-	Yes	-

A final word

Rarely do products so completely rewrite the rules of installing, operating, maintaining, funding—and ultimately enjoying—video projection. But that's exactly what our 3-chip laser projectors accomplish. To understand what all the excitement is about, we invite you to visit an authorized reseller. Start your experience at **sony.com/laser** or **sony.com/premiumhome**.

SONY

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sony.com/premiumhome

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