

TI DLP® technology for laser TV displays



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Laser TV products use a laser light source to create large, bright displays from powerful yet compact devices. Adding DLP laser TV display capability to an entertainment or media device can increase its functionality and create an immersive viewing experience.

As flat panel TVs become larger and heavier, the need for a portable, large display that can easily be moved from room-to-room or house-to-house becomes crucial for our fast-paced society. Consumers need a display option that is flexible with their constantly changing daily lives. Products using TI DLP technology can provide captivating video and image displays greater than 100-inches in a compact and portable form. Using DLP technology, designers can create versatile display solutions in various forms and resolutions for many applications and settings.

What is DLP technology?

Texas Instruments DLP technology is a micro-electro-mechanical systems (MEMS) technology that modulates light using a digital micromirror device (DMD). DMDs vary in resolution and size and can contain over 8 million highly reflective, digitally switchable, micrometer-sized mirrors (micromirrors) organized in a two-dimensional array (Figure 1). Each micromirror on a DMD can represent one or more pixels on the screen and is independently modulated to create stunning displays. DLP technology powers the displays of products worldwide, from digital cinema and home theater projectors to virtual reality devices, digital signage, automotive heads-up displays, and more. TI DLP chipsets can enable bright, high resolution, portable displays of every size.

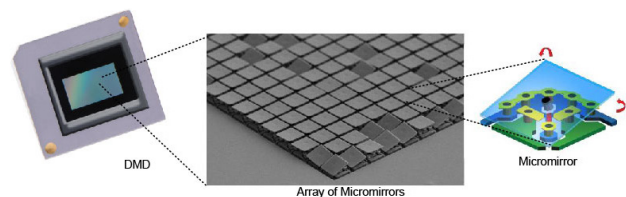


Figure 1. Digital micromirror device.

What is laser TV?

Laser TV is a new class of display products that combines innovations in three key areas: DLP technology with a laser light source, internet connectivity, and smart application-based operating systems. Combining these three technologies allows users to display a plethora of multimedia content onto screens or virtually any surface with typical display sizes of over 100-inches diagonal.



Figure 2. laser TV display examples.

Laser TVs can be configured with ultra short throw optical modules allowing the product to be placed inches away from a display surface while still displaying a stunning image (**Figure 2**).

For consumers who travel frequently or live in small homes, laser TVs with embedded wireless capabilities can stream all types of online content on a huge screen while remaining very portable. This new generation of TVs provides consumers with the flexibility to move their display anywhere, including outdoors. For example, imagine sharing the big game experience or your favorite streaming content on a garage door with your neighbors and friends (**Figure 2**).

Laser TV products can also be embedded into furniture (**Figure 2**) or inconspicuously blended with décor for consumers who do not want a TV mounted on the wall but still want a large display. Using DLP technology, developers can not only create a standalone laser TV but they can integrate a laser TV display to almost any electronic device.

Laser TV features

Laser phosphor light source – Laser phosphor technology has a long lifetime compared to other traditional light sources. It also has instant on and off capability so there is no need for the system to warm up or cool down when powering on or off.

Portable – Traditional big screen TVs are large and not easily moved or transported. With laser TVs incorporating DLP technology, customers can conveniently move their device from room-to-room.

Flexible display size – While traditional TVs have fixed display sizes, a laser TV image can be flexible and scales with distance from the display surface, enabling images ranging from a typical size of 80 to 100-inches up to 140-inches in diagonal. This gives consumers the ability to customize the display for different purposes.

Smart – Built-in video streaming applications and Wi-Fi can enable smart functionalities to compliment the viewing experience.

Easy installation – With ultra-short throw optics, consumers can simply place their portable unit inches away from a display surface and display beautiful content.

Optional screen – A fixed screen is not required to display stunning images or video on virtually any surface. If desired, a screen can be added to block ambient light, which can increase the brightness reflected off the screen.

Improved aesthetics – When laser TVs are embedded into furniture or décor, room aesthetics are kept in their natural state so there is no display panel obstructing the view.

DLP technology for laser TV

DLP technology offers several key advantages that make it a great fit for laser TV:

Form Factor – A laser TV system can be designed to fit into many form factors that allow for a range of system dimensions with powerful display capabilities.

Wide choice of display resolution chipsets –

The portfolio of DLP chips ranges across multiple resolutions including: HD, Full HD, and Ultra-HD. This provides a developer with the flexibility to design differentiating products across different brightness, size, resolution, and cost levels.

High contrast – DLP technology can enable a high contrast ratio, which creates deep blacks and improves perceived brightness and image quality.

High speed – Each DLP micromirror can switch thousands of times per second, enabling fast refresh rates and high frame rates that result in low display latency making DLP laser TV solutions a great fit for fast action movies and gaming.

Advanced image processing algorithms –

The DLP® Brilliant Color™ suite of algorithms provides illumination efficiency which makes use of additional color filters to improve brightness.

For more information, see the [Introducing BrilliantColor™ Technology](#) white paper.

If an application requires size optimization or ultra portability in controlled lighting environments, check out the [DLP® Pico™ Technology for Screenless Display](#) white paper.

System and electronics

A typical laser TV projection system is comprised of four main components:

- Front end processor
- Formatter board
- DMD board
- DLP optical module

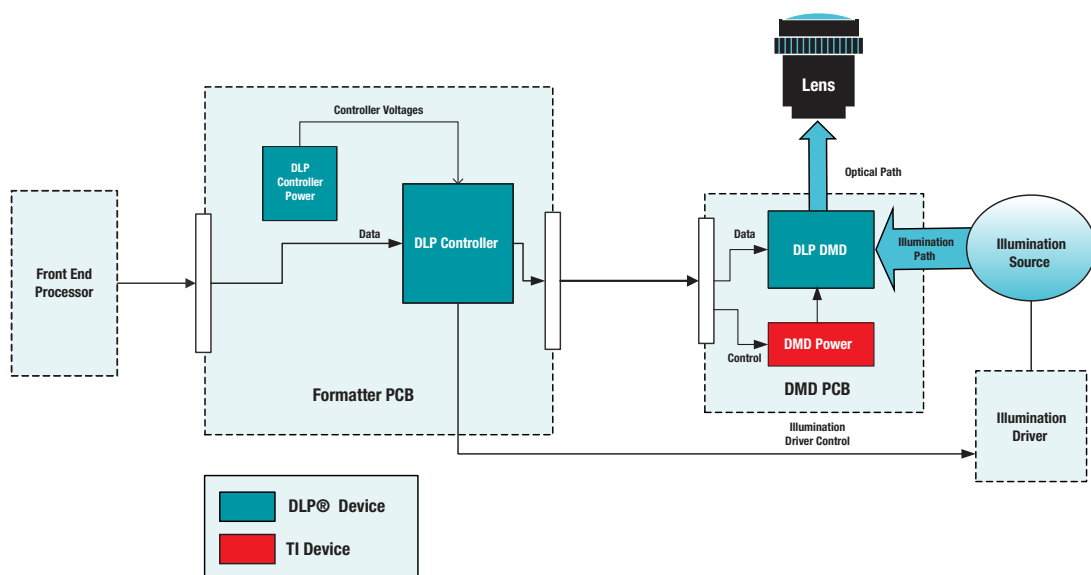


Figure 3. Typical laser TV system diagram.

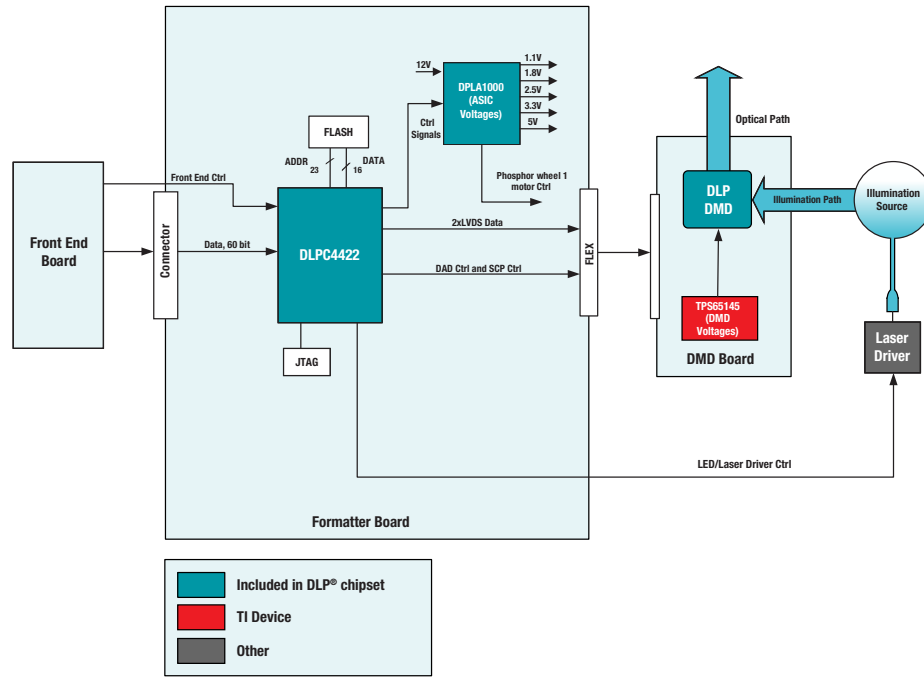


Figure 4. Typical DLP electronics system block diagram.

Front end processor – consists of an application processor that provides customized functionality such as:

- Wi-Fi and Bluetooth
- HDMI
- IR remote control
- Audio control
- Fan control
- Motor control for autofocus

Formatter board – The Formatter board contains the DLP controller and other electronics required to format the data to be displayed on the DMD.

DMD board – The DMD board houses the DMD chip, the power supply circuitry for the DMD, and communication interfaces between the DLP controller and the DMD.

DLP optical module – The DLP chip, along with its associated laser-illumination sources, optical elements, and necessary mechanical components are combined into a compact and rugged assembly known as an optical module or light engine (**Figure 5**). The optical module is the core display component of the system. Optical modules can be of various sizes depending on the application and requirements. In general, the higher the brightness, the larger the optical module due to larger illumination sources, optics, DMD, and thermal management in the form of heat sinks and fans.

DLP optical modules of various designs, sizes, capabilities, and performance are available from a number of optical module manufacturers (OMMs) who are part of the DLP ecosystem. The availability

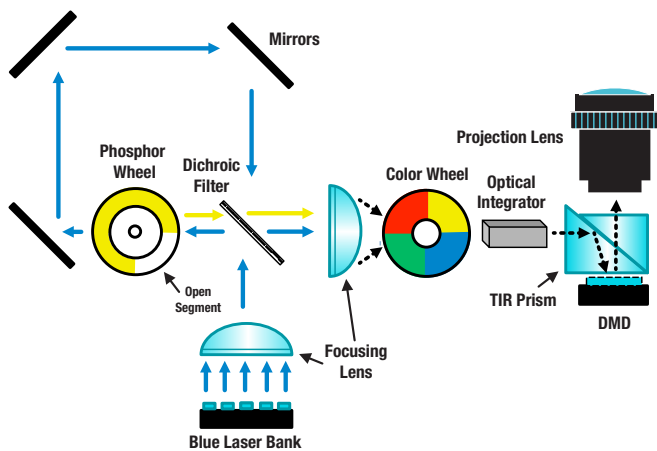


Figure 5. Simplified optical module diagram.

of existing optical modules accelerates the product development cycle of an end equipment producer because an appropriate DLP optical module can be utilized or adapted for use in the end product without requiring in-house expertise or resources. DLP design houses and some OMMs also have the ability to design and build a custom optical module for applications that require it.

Design considerations

Brightness

Brightness is a measure of how much light is perceived by the human eye in a given scene and it is an important consideration when selecting a DLP chipset. This is a function of the amount of light (number of photons) and its spread across the color spectrum (photon energy), as well as the varying sensitivity of the human eye across the visible spectrum. The SI unit of brightness is the lumen.

Figure 6 can help determine the requirements based on screen size and ambient light conditions.

Resolution

The level of detail available in an image is determined by the number of pixels which make up the displayed image. In a DLP system, this is a function of the number of mirrors on the DMD which can represent one or more pixels on the display. Resolution is

the number of pixels that can be displayed. The level of detail displayed is not only dependent on the projector system but it is also dependent on the resolution of the source content. If the source content does not match the resolution of the projector system, then the source content is mapped by the controller to make maximum usage of the resolution displayed.

Contrast

The quality of a viewed image is greatly determined by the distinction between the brightest and the darkest areas of the viewed image. This is quantified by the contrast ratio. While the contrast ratio specification of a DLP system is based on system performance, the viewing experience can also be greatly impacted by ambient light. The more ambient light on the screen, the lower the viewable contrast of the image. Together, system contrast and ambient light determine the true viewable contrast of the image. Special attention must be given to the optical design, and quality of optics used in the optical module to maximize contrast.

Throw Ratio

In many projection applications, the placement of the projector with respect to the viewing screen is important. The throw ratio of the projector determines how far away the projector must be placed in order to achieve a certain screen size (**Figure 7**). The width of

Image Diagonal	Suggested Brightness of Display (in lumens)			
	250 nits Lit Room	300 nits Bright Room	350 nits	400 nits Very Bright Room
140"	5590	6700	7820	8930
120"	4100	4930	5750	6570
100"	2850	3420	3990	4560
80"	1820	2190	2550	2920
60"	1030	1230	1440	1640

Figure 6. Brightness table.

the projected image (W) with respect to the distance from the lens to the center of the screen (D) is the throw ratio (T), which is shown in **Figure 7**. Laser TV applications typically have ultra-short throw optical modules that allow for throw ratios of less than 0.4.

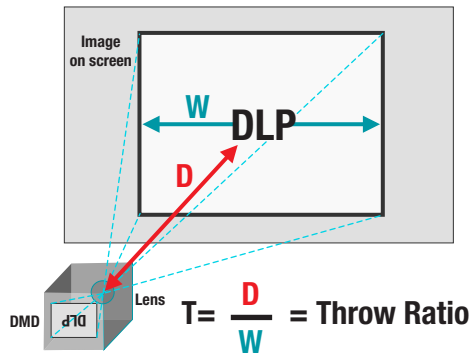


Figure 7. Throw ratio.

Size and form factor

A major advantage of laser TVs is the ability to transport the compact device to any location versus a heavy traditional display system.

Depending on the design, the size and form factor of a laser TV device can be reduced. Higher brightness and resolution can result in additional thermal management in the form of heat sinks and fans which add to the overall size. When the right design considerations and trade-offs are made, a laser TV can be put into a form factor that can satisfy most every use case.

Display surfaces

With a laser TV, any surface, whether it is a wall, portable screen, or a permanent wall-mounted screen, can enable a viewing experience. Projection screens are usually made of white fabric or even as screen paint that is applied to a wall. Adding a screen can limit how ambient light affects the projected image, having a significant impact on image quality. Projection screens can even be custom made to fit a specific design.

DLP chipsets for laser TV

The DLP chipsets in **Table 1** are well suited for laser TV applications.

DMD	DLP470NE	DLP650NE	DLP470TE	DLP660TE
Display resolution	1920x1080	1920x1080	3840x2160	3840x2160
Micromirror array diagonal (inch)	0.47	0.65	0.47	0.66
Controller	DLPC4422	DLPC4422	DLPC4422 (2)	DLPC4422 (2)
FPGA			•	•
Power management/illumination driver	DLPA100	DLPA100	DLPA100	DLPA100
Micromirror type	Orthogonal	Orthogonal	Orthogonal	Orthogonal
Micromirror pitch (µm)	5.4	7.6	5.4	5.4
Typical brightness (lumens)	1000-4000	1000-4000	1000-4000	1000-5000

Table 1. DLP chipset portfolio for laser TV.

Next Steps

1. Learn more about DLP Technology
 - Read the [Getting Started with DLP Technology](#) white paper
 - Browse [products and datasheets](#)
2. Find optical modules and design support
 - Contact [OMMs](#) for production-ready optical modules
 - Contact [Design Houses](#) for custom solutions
3. [Contact](#) your local TI salesperson or TI distributor representative
4. Check out TI's [E2E community](#) to search for solutions, get help, share knowledge, and solve problems with fellow engineers and TI experts

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