

Using TI DLP[®] technology to make digital signage more effective



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Digital signage is changing the way viewers and consumers receive information as companies look for new techniques to engage and attract people to their products and services. Incorporating DLP projection technology can help increase the effectiveness of digital signage solutions and provide a more engaging viewing experience.

Digital signage has transformed how information is conveyed in a public setting. Currently, digital signage provides the ability to display real-time data, such as product and price updates, which drives more relevant information to people faster and greener than printed materials. Adding projection solutions based on DLP technology to digital signage offers several benefits. For example, ordinary surfaces and objects can be used to convey information, and a product display can be transformed into an immersive experience and informational tool.

TI DLP technology

Texas Instruments DLP technology is a micro-electro-mechanical systems (MEMS) technology that modulates light using a digital micromirror device (DMD). Each DMD, as shown in **Figure 1**, contains millions of mirrors that are independently switched, in sync with color sequential illumination, to create one or more pixels on a screen that results in bright, colorful displays. DLP technology powers display products worldwide, from digital cinema projectors to tablets.

The evolution of digital signage

The transition from print to digital signage has greatly affected the way information is conveyed. Taking signage from its classic form of billboards, flyers, and pamphlets, to a digital format brings information sharing into the modern era. The ability of digital signage to convey information and update numerous displays from a web-based system instantaneously brings a new level of engagement to consumers.

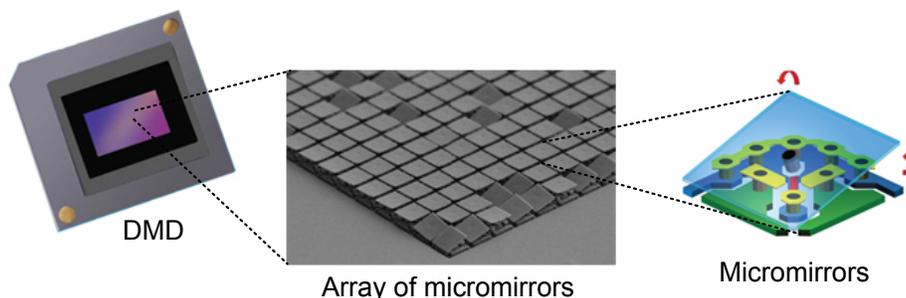


Figure 1. Digital Micromirror Device (DMD).

Today most digital signage is implemented with flat panel displays, but there can be inherent limitations to this approach. Flat panels are by their nature flat and rectangular. They can be large and have bezels on the border that prevent a seamless image to the viewer. Flat panel displays were a practical solution to providing real-time information, but now, so much more is possible.

Projection based displays provide a flexibility beyond most other display technologies. They can be used on practically any surface in virtually any location. Projection devices can be mounted in more concealed positions so that if the information needs to be turned off, the display hardware is hidden from view. With projection based displays, companies can change the size of their display as needed or blend multiple images together seamlessly. All of these attributes enable more diverse and innovative digital signage solutions than ever before.

Capability of projection technology in digital signage

There are many examples of how projection can be used to enhance traditional digital signage. These include: the ability to display two-dimensional shapes, integrate information into common products, and seamlessly embed content into various settings or environments.

Two-dimensional shapes

A projection based display can deliver information in a variety of shapes and sizes. For example, an airport kiosk can be upgraded from a traditional rectangular panel display to a human-shaped surface with an image of a person projected onto it. This virtual assistant can give travelers help with an added personal connection. **Figure 2** shows an example of how projection can enable large oval-shaped displays at an exhibition or show floor. Projection provides the ability to show content on



Figure 2. Example of oval-shaped digital signage display.

both sides of a display surface and removes the installation complexity of hanging a large flat panel.

Convey information through entertainment

Digital signage can be integrated into existing products to convey information in new and interesting ways or be used as a form of entertainment. For example, restaurant owners can turn their ordinary tables into an entertaining dining experience by integrating projection into a light above the restaurant table as shown in **Figure 3**.



Figure 3. Digital signage integrated in a restaurant dining experience.

Imagine a video of the culinary process or the entrée ingredients displayed on the table while customers wait for their food to be made. Information can

be displayed such that from the perspective of the viewer, the content appears 3D. In this way, information or entertainment can become integrated into an existing environment to provide an unforgettable experience.

Seamlessly integrate into product environments

Projection-based digital signage has many unique benefits which allow information to be integrated directly into a setting or product environment.

Figure 4 illustrates how in a retail atmosphere, projection based displays can be used to show product information instantaneously and dynamically appear when someone picks up a product.



Figure 4. Digital signage in a retail setting displaying shoe information.

Retailers can communicate sizes, colors, available inventory and other information without the customer having to ask. Projection-based signage allows the display unit to be hidden away and the information shown can be turned on or off as needed. While this is just one example, there are many other possibilities for how projection can be used to communicate information on demand without the need to hang panels and take up space.

System considerations for digital signage

Some common design considerations to take into account when creating a projection-based signage solution include: optical engine size, brightness,

resolution and aspect ratio, illumination source, and image processing software.

Optical engine size

The physical dimensions of the optical engine can vary greatly depending on the desired image size and performance. Typically the more brightness that is required, the larger the optical architecture has to be to accommodate more lasers, LEDs or a larger lamp and additional thermal management components. Some applications may require a larger display chip to withstand greater thermal loads and achieve higher levels of brightness. Also, the size of the optics, which fundamentally depends on the diagonal length of the display chip, has a significant effect on the overall system size. With the system requirements in mind, designers need to weigh all of their options and trade-offs to determine the final system size.

Brightness

Projector brightness, measured in lumens, affects how easy it is to see a displayed image based on a given ambient light setting. Image size and projection surface are also key parameters that influence brightness and should be factored in when designing a signage solutions for a specific use case. For every 100% increase in the screen size diagonal, projector brightness must increase by 400% to maintain constant image brightness. In the same respect, brighter projection systems are often necessary to compensate for well-lit ambient environments or non-white, glossy projection surfaces. To learn more about the brightness specification and its impact on system tradeoffs, please read the [Brightness Requirements and Tradeoffs application note](#).

Resolution and aspect ratio

Resolution fundamentally impacts the amount of detail shown. In general, as the resolution is increased at a fixed image size, more content and finer details can be shown. If the desired image size greatly increases, a higher resolution display becomes necessary in order to deliver the same level of detailed content.

Another characteristic of resolution is the aspect ratio which is defined as the ratio of an image's width to its height. Depending on the dimensions of an image shape, the aspect ratio can have an effect on how efficiently various shapes are displayed. The maximum amount of light projected onto a screen will take place when the desired shape takes up the most area possible on the imager. For example, **Figure 5** illustrates how a 4:3 aspect ratio displays a circle more efficiently, with less light wasted, than a 16:9 aspect ratio. In other cases, for a more elongated shape, a 16:9 or 16:10 aspect ratio can be more efficient. Also, all high resolution options are in 16:9 and 16:10 formats.

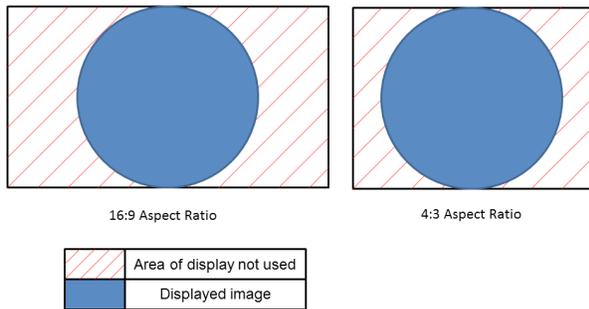


Figure 5. A 4:3 aspect ratio displays a circle more efficiently, with less light wasted, than a 16:9 aspect ratio.

Illumination source

The illumination source within a digital signage system can have a significant impact on the product's lifespan and maintenance costs. The most common illumination source types for projection systems are lamp, LED, laser phosphor, and direct laser. Lamp illumination tends to be the most cost effective initially, but often requires periodic bulb replacement resulting in an increased maintenance cost over time. LED illumination provides excellent color with the longest lasting performance, but can have limited brightness capabilities depending on

the use case. Laser phosphor also has good lifetime performance and can deliver much higher lumens than LED. Finally, direct lasers are a very efficient, high brightness illumination source, but they tend to be substantially more expensive to implement than other options. These cost and performance tradeoffs must be taken into account when deciding the correct illumination choice for a particular system design.

Image processing software

There are many image processing solutions, such as projection mapping and edge blending that can increase the potential options for projection in digital signage. Projection mapping can turn any geometric shape into a display surface. For example, the curved exterior of an automobile can be used as a canvas to display an array of images using projection mapping. Edge blending is used to seamlessly blend multiple displayed images together to create an immersive display experience. An example is in large venues where the entire side of a building is converted into a sign. Projection mapping and edge blending are just two examples of how software can be used to expand traditional digital signage. Overall, with the latest cutting edge software solutions from third parties, the opportunities for unique, innovative and customized digital signage systems are almost endless.

DLP technology for digital signage

DLP technology has a broad portfolio of DMD devices to meet the display requirements for many digital signage systems and applications. **Figure 6** shows a typical DLP display system block diagram consisting of electronics and an optical engine. The electronics includes a front end processor, formatter PCB, and illumination driver while the optical engine includes a DMD PCB, illumination source, and optics.

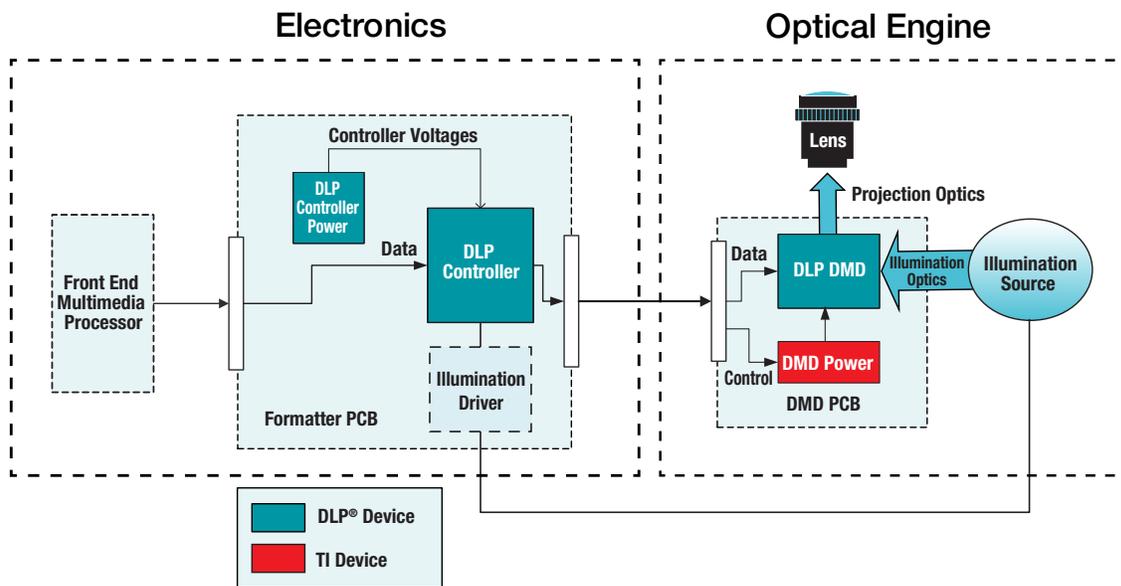


Figure 6. Typical DLP display system block diagram.

Front end multimedia processor

A front end multimedia processor is used to accept incoming data and convert it to the correct format before being sent to the DLP controller. The front end multimedia processor may also include an application processor that will provide, depending on the application, customized functionality ranging from image processing features to Wi-Fi connectivity.

Formatter PCB

The formatter printed circuit board (PCB) contains the DLP controller and other electronics required to accept the outgoing data from the front end multimedia processor before converting it into the correct format to be sent to the DMD printed circuit board (PCB). The front end multimedia processor and illumination driver may be located on the same board as the DLP controller and its associated electronics or they may be located on a separate board.

DMD PCB

The DMD printed circuit board (PCB) includes the DMD chip, the power supply circuitry for the DMD and communication interfaces between the DLP

controller and the DMD. It accepts data from the DLP controller and drives the DMD to display an image.

Illumination source and optics

In addition to the front end multimedia processor, formatter PCB, and DMD PCB, there are other components such as an illumination source and optics needed to create a complete DLP display system. The illumination source and optics along with the DMD PCB compose the optical engine. The elements required for the illumination optics include lenses, fold mirrors, and dichroic mirrors to collect light from the illumination source and guide it along the illumination path onto the DMD at an appropriate angle. The lens components in the projection optics collect light reflected by the DMD along the projection path and focus the light onto a display surface. The optical engine can vary in size depending on the application and system requirements. DLP optical engines of various designs, sizes, capabilities, and performance are available from a number of optical module manufacturers (OMMs) that are part of the DLP ecosystem. The availability of existing optical

engines allows for end equipment producers to accelerate a product development cycle without requiring specific expertise or resources.

DLP technology advantages

DLP technology has several key advantages that make it ideal for digital signage:

- **Resolution and Form Factor** – Various DLP imager resolutions, from nHD to 4 K UHD, and package types are available to enable a range of signage system dimensions and performance capabilities all while delivering beautiful video and images.
- **High Contrast** – DLP technology can enable a high contrast ratio up to 2000:1, which creates deep blacks, improves perceived brightness, and image quality.
- **Brightness** – DLP technology is used in projectors that display from 500 lumens up to 60,000 lumens. DLP chipsets have thermal properties capable of large, high brightness displays for vivid and attention-grabbing digital signage.

- **Power Efficiency** – DLP digital micromirror devices (DMDs) incorporate highly reflective, aluminum micromirrors, which enable bright, power efficient, digital signage products.
- **Light Source Agnostic** – DLP technology is compatible with virtually any light source, including lasers and LEDs, allowing designers maximum versatility across signage use cases.

DLP chipsets for digital signage

Texas Instruments offers a wide portfolio of DLP DMD devices that suit the versatile needs of digital signage applications. Please visit ti.com/dlp for the most current list of DLP chips offered from Texas instruments. **Table 1** shows a snapshot of DMDs that are well suited for digital signage applications.

DMD	DLP3010	DLP4501	DLP4710	DLP650LE	DLP650NE	DLP660TE
Display resolution	1280x720	1280x800	1920x1080	1280x800	1920x1080	3840x2160
Native aspect ratio	16:9	16:10	16:9	16:10	16:9	16:10
Micromirror array diagonal (inch)	0.3	0.45	0.47	0.65	0.65	0.66
Typical brightness (lumens)	150-300	150-1000	150-1500	1500-4000	1500-4000	1500-5000
Controller	DLPC3433	DLPC6401	DLPC3439 (2)	DLPC4422	DLPC4422	DLPC4422 (2)
Power management/ illumination driver	—	—	DLPA3000/ DLPA3005	DLPA100	DLPA100	DLPA100
Micromirror or type	Orthogonal	Orthogonal	Orthogonal	Orthogonal	Orthogonal	Orthogonal
Micromirror pitch (µm)	5.4	7.6	5.4	10.8	7.6	5.4
Design support	Pico Design Network			Standard Display Design Network		

Table 1. DLP chipset portfolio for digital signage – visit ti.com/dlp for all DLP chip options.

Reference material to get started with DLP technology for digital signage solutions

1. Learn more about DLP technology

[How DLP Technology Works Video](#)

[Getting Started](#)

2. Download a TI Design reference design to speed product development using DLP schematics, layout files, BOM, and test reports

[4K UHD High Brightness Display Reference Design](#)

[Compact Full HD 1080p Projection Display Reference Design](#)

[Portable, Low Power HD Projection Display using DLP Technology](#)

3. Check out TI's E2E community to search for solutions, get help, share knowledge, and solve problems with fellow engineers and TI experts

[TI's E2E™ Community](#)

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