What is DLP® technology?
While Texas Instruments is known worldwide for high-quality projection applications, including award-winning DLP Cinema®, the imaging choice for nearly 90 percent of the world’s digital theatre screens, TI’s DLP technology enables a diverse range of display and advanced light control applications. The Digital Micromirror Device (DMD), or DLP chip, is a high speed, efficient MEMS light steering device that can work with any type of light, including visible, infrared and ultraviolet. Using TI’s proven semiconductor manufacturing capabilities, each DMD contains up to 8.8 million individually controlled micromirrors built on top of an associated CMOS memory. Since 1996, TI has produced more than 40 million DLP chipsets for customers around the world.

Video and data display
Based on the same award-winning DLP display technology used in digital movie theatres, classrooms, and businesses worldwide, DLP® Pico™ chipsets enable developers to incorporate bright, efficient, high-definition projection into the smallest applications. To accelerate end product development, TI maintains the most extensive pico ecosystem of optical engine manufacturers in the industry. From cinemas to classrooms to cellphones, TI’s DLP technology offers a way to satisfy virtually any application or form factor requirement and can display on freeform, curved surfaces.

Advanced light control
With a portfolio of chipsets optimized for speed, resolution, and wavelength, DLP advanced light control technology enables high-performance solutions that help customers solve difficult problems across the spectrum of ultraviolet, visible, and near-infrared light. Built upon an industry-leading position in digital cinema and consumer projection, the DLP advanced light control product portfolio is highly differentiated for digital lithography, machine vision, 3D printing, spectroscopy and several other emerging applications. With TI’s powerful yet easy-to-use development tools, customers are now able to introduce innovative products to market faster and more easily.

Automotive
TI’s state-of-the-art semiconductor products help manufacturers and system suppliers deliver world-class features to the automotive market. This extensive automotive portfolio includes analog power management, interface and signal chain solutions, along with DLP displays, ADAS and infotainment processors, Hercules™ TMS570 microcontrollers and wireless connectivity solutions.

DLP chipsets for automotive are based on award-winning DLP Cinema technology and deliver robust solutions, bright and vivid image quality for head-up display and flexibility for adaptive headlight applications. From large-scale digital dashboards and center console touchscreens that seamlessly integrate with curved interiors, to smart headlamps that improve visibility during inclement weather, DLP technology can help automobile manufacturers differentiate their unique safety features and enhance the driver experience.
How DLP technology works
During operation, the DMD controller loads each underlying memory cell with a “1” or a “0”. Next, a micromirror clocking pulse is applied, causing each micromirror to switch to a plus or minus 12° landed state. In a projection system, the +12° landed state corresponds to an “on” pixel, and the -12° landed state corresponds to an “off” pixel. Grayscale patterns are created by programming the on/off-duty cycle of each mirror. And simultaneously, multiple light sources are multiplexed to create full RGB color images. In advanced light control applications, the ±12° states offer two general purpose output ports with a pattern and its inverse.

The DMD works in concert with an optical module containing optics and illumination to create the heart of the projection engine. The controller is installed on the electronics board near the optical module to control the DMD and perform necessary data formatting and processing functions.

TRP architecture explained
TI's proprietary TRP architecture and adaptive DLP® IntelliBright™ suite of algorithms enable developers to increase brightness or consume less power. TI chipsets incorporating TRP architecture can incorporate twice the number of pixels and deliver 30 percent greater optical efficiency and up to 50 percent power savings on a frame-by-frame basis than previous TI architectures of comparable resolution.

TRP architecture benefits
- Twice the pixels
- 30 percent greater optical efficiency
- Up to 50 percent power savings

Each DLP TRP pixel is 1/20°, the width of a human hair
DLP Technology and Products

Capabilities

**Video and data display capabilities**
DLP video and data display products empower developers to incorporate bright, efficient, high-definition projection into the smallest applications. The DLP chip offers extremely flexible and programmable light management, enabling a wide range of display applications.

- **Great image quality** – DLP video and data display chipsets are based on proven DLP Cinema technology and provide unique advantages, including outstanding readability, precise color, fast digital video performance, HD resolution, and the ability to work with any light source, including lamp, LED or laser.
- **Any size** – DLP chips are available in several resolutions and package sizes to enable developers to innovate a broad range of industrial, enterprise and consumer electronics applications. With optical modules as thin as 5.5 mm, the DLP ecosystem of optical engine manufacturers offers a wide range of turnkey optical modules to serve virtually any size requirement.
- **Any shape** – The unique micromirror structure of DLP chips enables projected display on virtually any surface shape, including curved and freeform surfaces.
- **Robust touch** – DLP technology can enable the transformation of virtually any surface into an interactive display and can incorporate wire-free physical knobs within a free-form rear-projection display.

**Advanced light control**
TI's advanced light control technology and extensive ecosystem enables flexible optical sensing and illumination.

- **Structured light** – DLP technology enables Programmable Structured Light. With this method, a series of patterns is projected upon a target object while a sensor detects the distortions of the patterns that result from a non-flat surface. Compared with Contact Coordinate Measurements (CCM) or scanning lasers, DLP systems can produce non-contact, highly accurate 3D data in real-time, facilitating 3D Machine Vision.

- **Wavelength selection** – With DLP technology, a dispersive optical element is used to spread light into spatially separated wavelengths on the surface of the DMD chip. The number of mirrors turned on/off in each DMD column is used to select and attenuate the corresponding wavelength. One common example of wavelength selection is a spectrometer that can analyze liquids and solids in areas such as food, agriculture, pharmaceuticals and plastics.

- **Digital exposure** – Systems based on DLP technology project digital patterns from the DMD that selectively cure and harden a layer of photopolymer or resin in one shot. These systems have higher throughputs than point-by-point technologies while achieving micron-scale patterns. PCB Lithography and 3D Printers use this capability today.

**Light source agnostic**
DLP technology can support a broad range of light sources, including LED, laser, UHP, and xenon, depending on the application need. DLP technology can also support a wide spectrum of wavelengths from ultraviolet (365 nm wavelength) to near infrared (2500 nm); in some cases, DLP chips are designed for a specific wavelength.

[Images of embedded projection from tablet, spectroscopy, PCB lithography]
DLP Technology and Products

Development tools

TI offers many versatile and flexible platforms that help accelerate development time. At the heart of every evaluation module (EVM) is a DLP chipset, which includes a DMD and a controller.

The DLP LightCrafter™ Display 2010 EVM is an easy-to-use evaluation module for the 0.2” TRP WVGA display chipset. It includes an optical module (~25 lum), an HDMI interface (for input data) and the DLP LightCrafter Display GUI for configuration.

DLP LightCrafter Display 2010 EVM

0.2” TRP WVGA display chipset
– DLP2010 DMD
– DLPC3435 display controller
– DLPA2000 power management/LED driver

The DLP LightCrafter 4500 EVM provides a flexible light steering solution with high brightness and resolution for industrial, medical and scientific applications. The DLP LightCrafter 4500 features the 0.45” WXGA chipset and offers a compelling combination of resolution, brightness, and programmability in a small form factor.

Developers can easily create, store, and display high-speed pattern sequences through the EVM’s USB-based application programming interface (API) and easy-to-use graphical user interface (GUI).

DLP LightCrafter 4500 EVM

0.45” WXGA chipset
– DLP4500 DMD
– DLPC350 digital controller

EVM catalog

<table>
<thead>
<tr>
<th>Name</th>
<th>Device Included</th>
<th>Software</th>
<th>Features</th>
<th>Price ($ U.S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video and data display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLP LightCrafter Display 2010</td>
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<td>DLPC3435/3435</td>
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<td>DLPA3005</td>
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<td>Advanced light control</td>
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<td></td>
<td></td>
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<tr>
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<td>Yes</td>
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<td>DLPC350</td>
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<td>Yes</td>
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<td>DLPC800</td>
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<td>Yes</td>
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<tr>
<td>DLP LightCrafter 9000</td>
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<td>DLPC900</td>
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<td>Yes</td>
</tr>
<tr>
<td>DLP NIRscan</td>
<td>DLP4500NIR</td>
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<td>Yes</td>
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<tr>
<td>DLP NIRscan Nano</td>
<td>DLPC2010NIR</td>
<td>DLPC150</td>
<td>NO</td>
<td>Yes</td>
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<tr>
<td>DLP Discovery 4100</td>
<td>DLPC000, DLPC000U, DLPC500, DLP500U</td>
<td>DLPC410</td>
<td>No</td>
<td>Fast pattern rates for light exposure and image capture; Maximum flexibility to format and sequence light patterns</td>
</tr>
</tbody>
</table>

TI Designs

TI Designs, TI’s comprehensive reference design library, helps jump-start system design. Designs include schematics or block diagrams, BOMs, design files and test reports that support a broad range of applications. Examples of TI Designs pertaining to DLP technology include:

DLP Products TI Designs

Video and data display

Ultra Mobile, Ultra Low Power Display Reference Design Using DLP Technology
Portable, Low Power HD Projection Display using DLP Technology
Full HD 1080p Projection Display Reference Design using DLP Pico Technology
Portable, High Brightness HD Projection Display Reference Design using DLP Technology

Advanced light control

DLP Near-Infrared Spectrometer for Optical Analysis of Liquids & Solids Reference Design
DLP Ultra-mobile NIR Spectrometer for Portable Chemical Analysis with Bluetooth Connectivity
Portable Point Cloud Generation for 3D Scanning using DLP Technology Reference Design
High Res, Portable Light Steering Reference Design using DLP Technology
Accurate Point Cloud Generation for 3D Machine Vision Applications using DLP Technology
High Resolution 3D Scanner for Factory Automation using DLP Technology
Best-in-class Combination Stereolithography 3D Printer Development Using DLP Technology
High Speed DLP Sub-system for Industrial 3D Printing and Digital Lithography Reference Design
DLP Technology and Products

DLP technology ecosystem

The DLP ecosystem, consisting of the DLP Design Network and optical engine manufacturers, aids developers in accelerating product development and time to market.

• The DLP Design Network is a group of independent, well-established companies that provide hardware/software integration, optics design, system integration, prototyping, manufacturing services, and turnkey solutions to a worldwide customer base to accelerate product development and time to market with DLP technology. Visit ti.com/dlp-design-house for more information.

• DLP optical engine manufacturers are independent, well-established companies that provide turnkey optical modules to a worldwide customer base. These modules incorporate a Digital Micromirror Device (DMD), an LED-based illumination source, and the necessary optical elements that form the core of a projection system. TI customers can procure optical modules directly from these optical engine manufacturers to accelerate product development and time to market. Visit ti.com/dlp-modules for more information.

Market opportunities

TI’s DLP technology is highly flexible and enables a diverse range of display and advanced light control applications for industrial, automotive, enterprise, medical and consumer market segments.

<table>
<thead>
<tr>
<th>Industrial</th>
<th>Enterprise</th>
<th>Personal electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Control panels</td>
<td>• Government</td>
<td>• Gaming: dual console, interactive</td>
</tr>
<tr>
<td>• Human machine interface</td>
<td>• Education</td>
<td>• Wearable display</td>
</tr>
<tr>
<td>• 3D machine vision</td>
<td>• Cinema</td>
<td>• Mobile phones</td>
</tr>
<tr>
<td>• Spectroscopy</td>
<td>• Large venue</td>
<td>• Tablets</td>
</tr>
<tr>
<td>• 3D printing</td>
<td>• Mobile projection</td>
<td>• Camcorders</td>
</tr>
<tr>
<td>• PCB Lithography</td>
<td>• Laptops</td>
<td>• 3D printing</td>
</tr>
<tr>
<td>• Digital signage: interactive surface, storefront, retail</td>
<td></td>
<td>• Smart home</td>
</tr>
<tr>
<td>• Commercial gaming</td>
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</table>

<table>
<thead>
<tr>
<th>Automotive</th>
<th>Medical</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Head-up display</td>
<td>• Spectroscopy</td>
</tr>
<tr>
<td>• Center console</td>
<td>• 3D printing</td>
</tr>
<tr>
<td>• Smart headlights</td>
<td>• 3D machine vision</td>
</tr>
</tbody>
</table>

DLP video and data display technology enables a broad range of industrial and consumer electronics wearable display applications, including augmented reality and immersive full field of view.

Affordable near-infrared spectrometer with more than 30,000:1 signal-to-noise ratio for <1 second measurements.
DLP Technology and Products

Chipset catalog - video and data display

<table>
<thead>
<tr>
<th>DMD Number</th>
<th>Resolution</th>
<th>Array Diagonal</th>
<th>Controller</th>
<th>Micromirror Driver</th>
<th>Max Pattern Rate</th>
<th>Max Pixel Data Rate</th>
<th>Optimization Wavelengths</th>
<th>Pixel Pitch</th>
<th>Pixel Orientation</th>
<th>EVM</th>
<th>DMD Package Dimensions (lxwxh)</th>
<th>DMD Price ($U.S.)</th>
<th>Controller Price ($U.S.)</th>
<th>PMIC Price ($U.S.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLPC2010</td>
<td>854 x 480</td>
<td>0.20&quot;</td>
<td>DLPC3434/3435</td>
<td>DLPA2000/05</td>
<td>RGB 120 Hz</td>
<td>420-700 nm (visible)</td>
<td>5.4 μm Orthogonal</td>
<td>TRP</td>
<td>Plug and play</td>
<td>DLP IntelliBright</td>
<td>LightCrafter Display 7100</td>
<td>15.9 x 5.3 x 3.18 mm</td>
<td>40.60FJ</td>
<td>80.07</td>
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<tr>
<td>DLPC3000</td>
<td>854 x 480</td>
<td>0.30&quot;</td>
<td>DLPC2607</td>
<td>PD1000</td>
<td>RGB 120 Hz</td>
<td>420-700 nm (visible)</td>
<td>7.6 μm Diamond</td>
<td>VSP</td>
<td>Parallel interface</td>
<td>DLP2607 DISPLAY EVM</td>
<td>DLP2607 DISPLAY EVM</td>
<td>17.6 x 5.92 x 3.1 mm</td>
<td>50.62FG</td>
<td>85</td>
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<tr>
<td>DLPC3010</td>
<td>1280 x 720</td>
<td>0.30&quot;</td>
<td>DLPC3433/38</td>
<td>DLPC3000</td>
<td>RGB 120 Hz</td>
<td>420-700 nm (visible)</td>
<td>5.4 μm Orthogonal</td>
<td>TRP</td>
<td>Plug and play</td>
<td>DLP IntelliBright</td>
<td>LightCrafter Display 3010</td>
<td>18.2 x 7.1 x 3.78 mm</td>
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<td>DLPC4501</td>
<td>1280 x 800</td>
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<td>DLPC4001</td>
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<td>RGB 120 Hz</td>
<td>420-700 nm (visible)</td>
<td>7.6 μm Diamond</td>
<td>VSP</td>
<td>Parallel interface</td>
<td>DLP4001 DISPLAY EVM</td>
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<td>80.62FG</td>
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<td>DLPC4710</td>
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<td>DLPC3439</td>
<td>DLPC3005</td>
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<td>420-700 nm (visible)</td>
<td>5.4 μm Orthogonal</td>
<td>TRP</td>
<td>DLP IntelliBright</td>
<td>Display 4710</td>
<td>DLP2607 Display EVM</td>
<td>24.5 x 11.1 x 3.78 mm</td>
<td>100.62FG</td>
<td>179</td>
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</table>

*Third Party EVM

Chipset catalog - advanced light control

<table>
<thead>
<tr>
<th>DMD Number *</th>
<th>Micromirror Array</th>
<th>Array Diagonal</th>
<th>Controller</th>
<th>Micromirror Driver</th>
<th>Max Pattern Rate</th>
<th>Max Pixel Data Rate</th>
<th>Optimization Wavelengths</th>
<th>Pixel Pitch</th>
<th>Pixel Orientation</th>
<th>EVM</th>
<th>DMD Package Dimensions (lxwxh)</th>
<th>DMD Price ($U.S.)</th>
<th>Controller Price ($U.S.)</th>
<th>PMIC Price ($U.S.)</th>
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<td>DLPC300</td>
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<td>4,000 Hz (binary)</td>
<td>1.7 Gbps</td>
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<td>LightCrafter</td>
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<td>DLPC4500</td>
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<td>4.4 Gbps</td>
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<td>7.6 μm Diamond</td>
<td>LightCrafter</td>
<td>20.7 x 9.1 x 3.33 mm</td>
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<td>4,225 Hz (binary)</td>
<td>4.4 Gbps</td>
<td>700 - 2500 nm</td>
<td>7.6 μm Diamond</td>
<td>NIRscan Nano</td>
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<td>3.8 Gbps</td>
<td>420-700 nm (visible)</td>
<td>10.8 μm Orthogonal</td>
<td>LightCrafter</td>
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<td>140</td>
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<td>9,500 Hz (binary)</td>
<td>19.7 Gbps</td>
<td>420-700 nm (visible)</td>
<td>7.6 μm Orthogonal</td>
<td>LightCrafter</td>
<td>40.6 x 31.8 x 6 mm</td>
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<td>9,500 Hz (binary)</td>
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<td>DLPC200</td>
<td>32,552 Hz (binary)</td>
<td>25.2 Gbps</td>
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<td>38 Gbps</td>
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<td>61.1 Gbps</td>
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<td>363-420 nm (visible)</td>
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<td>Discovery 4100</td>
<td>42.2 x 42.2 x 7 mm</td>
<td>6,999</td>
<td>193</td>
<td>12.36</td>
<td></td>
</tr>
</tbody>
</table>

*Addressable pixels  Note: Multiple package types exist for DMDs. Visit ti.com/dlp to see all packages.

DLP Products DMD Catalog

Video and data display

- Array diagonal: 0.2" Resolution: WVGA 854x480
- Array diagonal: 0.3" Resolution: XGA 1024x768
- Array diagonal: 0.45" Resolution: WXGA 1280x800
- Array diagonal: 0.47" Resolution: 1920x1080

Advanced light control

- Array diagonal: 0.2" Micromirror array: 920x1080
- Array diagonal: 0.3" Micromirror array: 1024x768
- Array diagonal: 0.45" Micromirror array: 1280x800
- Array diagonal: 0.55" Micromirror array: 1920x1080
- Array diagonal: 0.65" Micromirror array: 1920x1080

ti.com/dlp

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TI Worldwide Technical Support

Internet
TI Semiconductor Product Information Center
Home Page
support.ti.com

TI E2ETM Community Home Page
ti.com/dlp-e2e

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Fax +1(972) 927-6377
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(00800 275 83927)
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Russian Support +7 (4) 95 98 10 701

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