

Latest MEMS Technology Enables Innovative New Uses for Portable HD Projection Displays



Anshul Jain

Imagine an aftermarket head-up display (HUD) clipped to your automobile visor projecting driving directions onto your windshield. Envision a tablet with a [built-in pico projector](#), allowing you to share big screen content with others, anytime and virtually anywhere. Visualize near-eye display eyewear that displays information such as navigation and social media updates right in front of your eyes. These are just a few examples of innovative applications that are possible with recent advancement in micro-electro-mechanical systems (MEMS)-based projection display technology.



The heart of MEMS-based TI DLP® Pico™ projection display technology is an array of highly reflective aluminum micromirrors called a digital micromirror device (DMD). A DMD can contain millions of individually controlled micromirrors, each built on top of an associated complementary metal-oxide semiconductor (CMOS) memory cell. Along with an illumination source, a DMD acts as an electrical input-optical output device that lets developers perform high speed, efficient and reliable spatial light modulation to create a projected image.

Advancements in MEMS Technology

The continued innovation in MEMS-based DMDs is giving developers more opportunities to incorporate projection-based display technology across a variety of applications for industrial, personal electronics, wearables, digital signage and enterprise markets.

One of the latest innovations is the reduction in size of the MEMS-based aluminum micromirror – a critical component of the DMD. This reduction has enabled full-HD 1080p resolution in a small MEMS package for use in microdisplay applications. Simply scaling down the size of the micromirrors can reduce diffraction efficiency and system brightness and contrast if no other mirror or system parameters are changed to account for it. However, increasing mirror tilt angle to enable faster system collection optics has offset the potential loss in diffraction efficiency and maintains system brightness. Advancements in manufacturing processes

have minimized impacts to system contrast. [Pico projection technology](#) continues to get smaller, brighter and more power efficient, enabling innovative high-definition projection display applications from small form-factor products.

Innovative Display Applications Using MEMS Technology

Advances in MEMS for use in projection are paving the way for new applications. From laptops to smartphones to tablets, personal computing devices can now be equipped with MEMS display technology. Beyond typical, personal computing tasks, these devices can now transform virtually any surface into a home theater or a display for a business presentation.

These plug-and-play products offer extreme portability, HD resolution, low-power and are ideal for numerous enterprise and consumer uses. Such versatile devices address a wide range of consumer needs, from road warriors who want to deliver memorable presentations to clients around the world to parents who are hosting a neighborhood movie night in their backyard.

When MEMS technology is combined with motion sensing capabilities, the display becomes interactive, giving users the ability to manipulate and interact with the display.

Beyond turning walls and other flat surfaces into usable screens, the small size, high resolution, low latency and low power consumption capability of this new generation of MEMS devices is also ideal for augmented and virtual reality [near-eye display applications](#). MEMS technology can enable wearable computing experiences for consumer applications, such as hyper-realistic video game systems and 3D movies -- or industrial applications, such as warehouse inventory management and training simulators.

As the demand for smaller, brighter and more efficient HD display solutions continues, [MEMS technology](#) continues to evolve to the point where it can be incorporated into small form factor devices that would not have been possible just a few years ago. It will be exciting to see the innovative new uses for this extremely flexible and versatile display technology in the future.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated