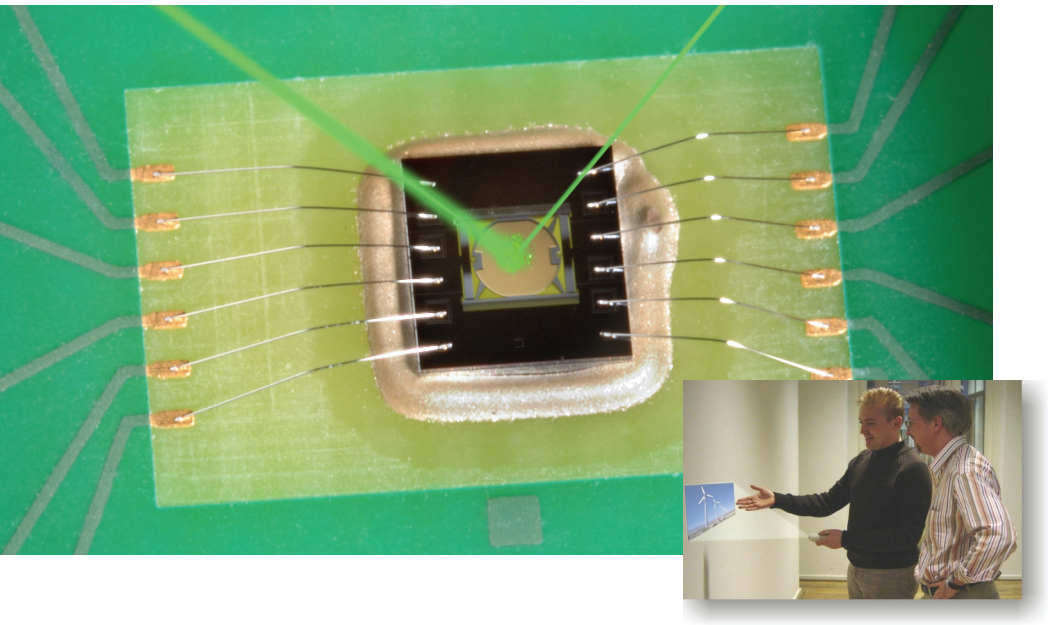
MEMS technology

A high-frequency scanning micro-mirror for projection displays



If you want the ultimate in mechanical precision and integration coupled to high-volume low-cost manufacturing, MEMS (Micro Electro-Mechanical Systems) technology could be the answer you've been looking for.

Philips Applied Technologies has designed a high-frequency resonant-scanning MEMS micro-mirror for handheld projection displays and successfully integrated it into a full system architecture – just one example of how we help our customers to realize the potential of MEMS devices in their products.

PROPOSITION

- *Electrostatically actuated, small diameter, high frequency laser-scanning micro-mirror*
- *Large rotation angle, excellent mirror flatness, dynamic performance, life-time and reliability specifications*
- *Fully integrated suspension, actuation and angle sensing*

APPLICATION

Small form-factor laser projector, as add-ons for portable devices such as notebooks and mobile phones, but also applicable in automotive head-up displays

BENEFIT

- *a fully-integrated compact solution*
- *much better scalability, dynamic performance and mirror flatness than conventional cantilever beam suspended tilting micro-mirrors*
- *silicon-based wafer-scale fabrication for fast ramp-up to large-scale manufacturing at low cost*

PHILIPS

sense and simplicity

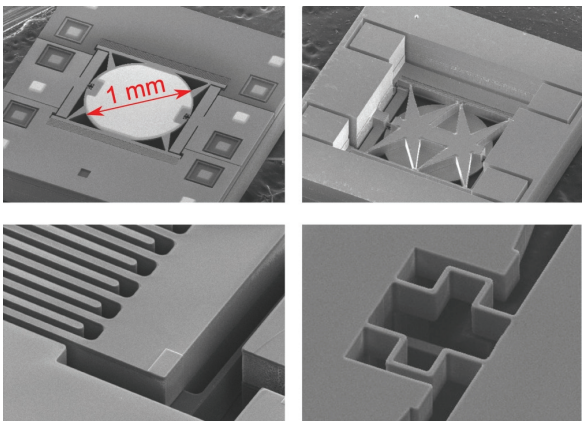
Laser-scanning displays

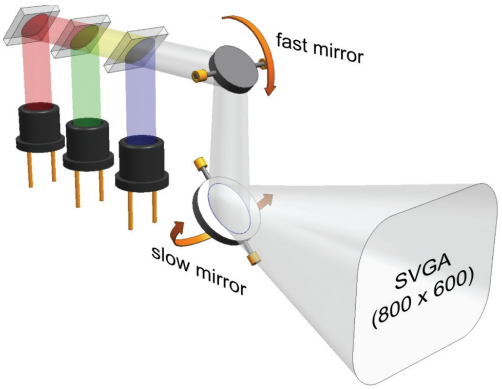
Laser beam deflection using one or more tilting mirrors is already widely used in large-scale laser projection display devices, image generation being achieved by synchronizing the intensity of an RGB laser source to the mirror oscillation. The challenge for Philips Applied Technologies was to miniaturize the required mechanics into a format small enough to be used in handheld laser projection display devices. This level of electro-mechanical device integration is also becoming increasingly important in a wide range of other applications.

Innovative mirror design

Philips Applied Technologies' novel micro-mirror design achieves better dynamic performance and mirror flatness than conventional cantilever beam suspended micro-mirrors. It also has a low driving-voltage requirement, suiting it for use in battery powered equipment.

The micro-mirror's integrated suspension system is based on four leaf springs rather than the conventional cantilever torsion beams. In addition to providing the desired high-frequency fundamental oscillating mode, this arrangement forces other parasitic modes to much higher frequencies, leading to a very clean and well defined angular oscillation, around a single rotation axis.





The micro-mirror is driven by an integrated electrostatic comb-drive actuator that applies torque to the tilting mirror assembly. This assembly features a star-shaped mirror support that maximizes the stiffness-to-mass ratio of the mirror structure and also decouples comb deflection from the mirror.

Design specifications for SVGA resolution

Scanning resolution:	800 x 600 pixels
Mirror size:	ø 1 mm
Maximum scan angle:	± 8°
Operation frequency:	18.5 kHz
Maximum drive voltage:	60 V
Dynamic deformation:	max ± 40 nm

Winning MEMS solutions

Using advanced device and system level simulation techniques, Philips Applied Technologies fully validates MEMS at the design stage, leading to first-time-right implementation and hassle-free transfer to production. Leveraging its unique system-level application expertise it is able to integrate the resultant MEMS into total system solutions that accurately match customer requirements in terms of cost/performance ratios and manufacturability.

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