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PRESS RELEASE
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Mirrorcle's tip-tilt-piston MEMS mirror development kit now commercially available

Mirrorcle Technologies, Inc (MTI), the California-based manufacturer of patented, gimbal-less micromirrors, today announced the commercial availability of tip/tilt/piston devices fully supported by a plug-and-play development kit. The company's MEMS-based beam-steering micromirrors now feature 'third dimension' agility – in addition to tipping and tilting the the X and Y axes, these devices are now available with a third, pistoning movement. While these gimbal-less devices have increasingly been deployed around the globe, not many users have taken advantage of their third dimension pistoning capability. "This is exciting news," said Dr. Milanovic, Founder and CEO of Mirrorcle Technologies. "While we have been marketing our devices as the world's fastest and lowest power-consuming quasi-static (Point-to-Point) dual-axis optical beam steering solutions, some of our customers requested if we could also offer specialized hardware and software to also offer access to their intrinsic capability to move up and down in the Z direction. You can truly say that this was a customer-inspired achievement, and we are excited to announce the availability of standard products that allow for either X/Y beam-steering or pistoning (up and down) movement – and of course any combinations of the three degrees of freedom at the same time!"

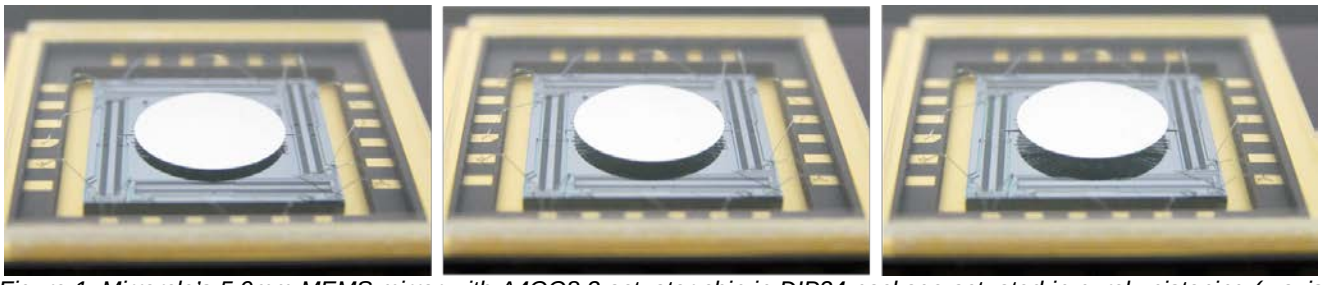

Figure 1. Mirrorcle's 5.0mm MEMS mirror with A4QQ8.3 actuator chip in DIP24 package actuated in purely pistoning (z-axis or up/down) motion. Middle image is taken at the origin/rest position. Left image at maximum down position of ~-0.1mm and the right image at the maximum up position of ~+0.1mm.

Gimbal-less MEMS actuator design allows for maximum liberty of action

Mirrorcle Technologies has been offering high-quality dual-axis MEMS mirror devices for over a decade, with its unique, proprietary gimbal-less design that offers not only highest speed tip/tilt capability, but thanks to the freely suspended actuator 'stage' also pistoning or z-axis freedom. This is applicable for both integrated, monolithically fabricated MEMS mirrors, as well as for bonded, modular devices consisting of an actuator die (=the 'engine' that moves the mirror) and a 'bonded' mirror of various sizes up to 5.0mm in diameter. The central area of Mirrorcle's actuator chips is suspended by four bi-axial single-crystal silicon (Si) linkages, which connect to powerful comb-drive rotators. For the 'standard' operation, tipping and tilting the X and/or Y axes to arbitrary angles at high speeds, whether in quasi-static operation of

e.g. for raster-scans or vector graphics, two opposite rotators receive bias differential voltages which makes one rotator go ‘UP’ and the other go ‘DOWN’, resulting in tilting of the stage/mirror via the Si suspensions. For the pistoning movement, a new USB MEMS (TTP) Controller with 8 instead of the standard 4 channels was designed, allowing users to address each rotator’s UP and DOWN section individually and thereby enabling independent control of pistoning in the Z direction. This 8-channel drive methodology allows devices to move with 3 DoF (three degrees of freedom), and with the same >=14-bit resolution customers are used to from tip/tilt-only MEMS mirrors by Mirrorcle. The company’s Electronics Engineers designed and realized this specialized TTP control unit to match very closely the standard USB MEMS Controller, however utilizing 2 embedded (digital-input) PicoAmp MEMS drivers instead of one. Astonishingly, although the new Controller utilizes a fast 32-bit MCU as well as two Mirrorcle MEMS drivers, it is still fully powered from a regular USB port which the software also uses to communicate with the Controller. “We designed a motherboard with suitable connectors to accommodate the two embedded PicoAmp MEMS drivers, and fitted it all into a compact box which directly connects to a user’s USB port,” said Abhishek Kasturi, Senior Electronics Engineer at Mirrorcle. “The existing layout and hardware concepts were optimized and we fit everything into a compact and easy-to use USB-powered package that is appealing to all customers”.

Specialized MEMS driver for tip/tilt/piston operation now available from Mirrorcle

While the pistoning motion, as well as the combination of tip/tilt combined with Z axis movement have been demonstrated and published in the past, Mirrorcle engineers recently decided to offer this capability optionally to all of its customers. One of the key reasons is that the new approach is fully supported with the comprehensive software suite and Software Development Kit (SDK), which features additional examples in C++ that allow users to freely expand and realize their own tip/tilt/pistoning mirror movements. Any of the company’s dual-axis devices are able to piston when used with the new USB MEMS TTP Controller and the new software suite. Beside the TTP Controller, also required are modified versions of the company’s TinyPCB connectorized packages and/or MiniPCB MEMS mounts to allow all 8 drive-channels to reach the MEMS devices’ actuator terminals. Dr. Milanovic further explains: “Actually we have delivered Tip-Tilt-Piston prototype systems on several occasions in the past years, however it required specialized multi-channel data acquisition cards, software, and output boards. Now we have fully streamlined tip-tilt-piston driving in our standard software API to provide a very simple access to applications programming to users that is nearly identical to our standard systems. For our present customers it would be a seamless transition to the new API and Controllers. Basically every command that previously involved setting x, y, (tip-tilt) and m (digital port) data, now involves setting x, y, p (tip-tilt-piston), and m (digital port) data. It is that simple!”

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About Mirrorcle Technologies, Inc.

Mirrorcle Technologies, Inc. (MTI), founded in 2005, is a California corporation that commercially provides products and services based on its proprietary optical microelectromechanical system (MEMS) technology. Since its founding, and supported by its continuous investment in R&D, MTI has been offering the world's fastest point-to-point (quasi-static) two-axis beam-steering mirrors, as well as resonating-type micromirror devices with rates up to HD video display. MTI is globally the only provider of tip-tilt MEMS actuators in combination with mirrors from submillimeter to several mm in diameter, offering customers a wide selection of specifications to optimize their paths to successful commercialization. In addition to a variety of existing designs and in-stock products, MTI also contracts to create specialty designs and fabricate custom units as well as full system solutions.

MTI maintains a laboratory at its headquarters and has year-round, 24-7 access to wafer-based CMOS and MEMS fabrication facilities. MEMS mirror fabrication, wafer-level and die-level testing, packaging and outgoing inspections are all performed in clean-rooms. MTI has an established manufacturing service cooperation with a leading MEMS wafer foundry ensuring streamlined, high-quality volume production.

As a privately held company, MTI is able to act efficiently, offering creative and highly responsive service to customers. The company provides highest-quality products and support to facilitate customers’ product development and successful commercialization. The team draws on several decades of combined experience in MEMS design, fabrication, and testing.