

**PRESS RELEASE**

For immediate publication

01/31/18

**Mirrorcle introduces small and capable OEM MEMS mirror drivers for easy integration**

Mirrorcle Technologies has commercially offered dual-axis MEMS mirrors for optical beam-steering applications since company founding more than 13 years ago. The patented, dual-axis devices are electrostatically actuated and require specialized bias-differential high-voltage driving which is supported by the company's proprietary drive electronics. A variety of hardware solutions are offered to ensure finely controllable tip/tilt movement of MEMS mirrors at large angles. The electrostatic combdrive actuators offer a maintenance-free operation with no known limit on device lifetime. There are no rubbing parts, no magnets, currents, piezo- or similar materials on device level that have known degradation over time – only single-crystal silicon beams that bend well with this material's elastic limitations which translates to tip/tilt in X and Y axes. Mirrorcle mirrors are most efficiently driven by 4-channel bias-differential driving scheme which substantially linearizes their voltage vs. angle response. There are 4 channels biased to a certain voltage, in many cases 80V, which leaves the mirror at its 'origin / rest' position. By changing the voltage to mirror's combdrives in a differential fashion about that bias point, a voltage-proportional torque is created which results in rotation of the combdrives. These in turn control the position of silicon linkages which connect to the central chip area which is the mirror (in case of 'integrated' MEMS design) or the 'stage' (in case of the 'bonded' MEMS device design).

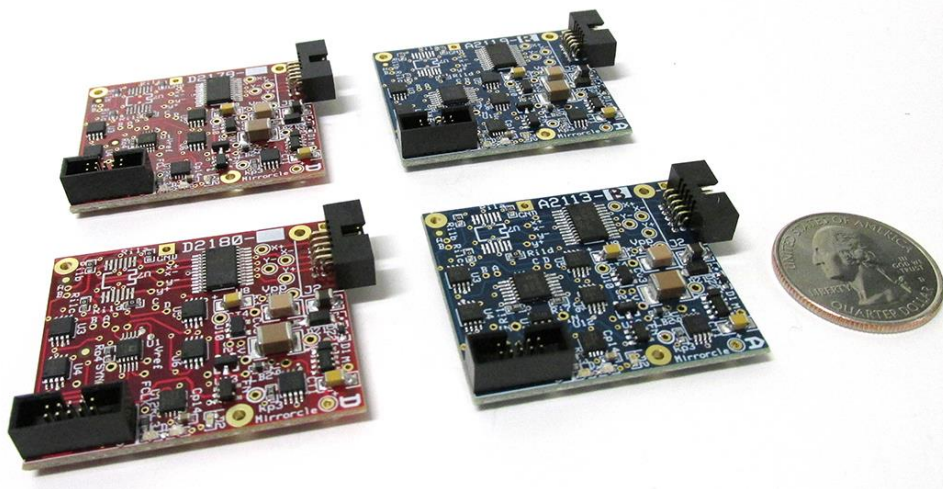


Figure 1. Mirrorcle's OEM MEMS drivers, BDQ PicoAmp 5.x and PicoAmp 5.x.

**New MEMS drivers are more compact and offer lower power consumption**

Established MEMS hardware include the USB-powered and -controlled 'USB-SL MZ' MEMS controllers with embedded MEMS drivers, as well as OEM MEMS drivers that accept either analog or digital input signals. Mirrorcle has continually revised and improved MEMS driver

designs and introduces the latest generation 5.x, which are commercially available starting in Q1 2018. The PCB footprint was shrunk from 60mm x 40mm to now 35mm x 40mm, almost half the size of a credit card, and the input and output connectors were updated to the more compact 10-pin, 0.05" pitch connectors which allow for direct connection via ribbon cable of the driver output to connectorized MEMS packages ("TinyPCB"). The new boards are optimized to safely drive the company's MEMS mirrors and include programmable 5<sup>th</sup> order low-pass filters for smoothing output voltages. They output two bias-differential voltage pairs on four channels that range from 0V to 200V, allowing for V<sub>bias</sub> voltages as high as 100V to drive mirrors to maximum angles. Taking advantage of the latest components and design, Mirrorcle's OEM MEMS drivers consume less than ~80mW of power and require only +5VDC voltage supply, making them especially suitable for mobile, battery-powered applications. This is approximately 50% of the power consumption of the previous, 4.x version which was already impressively easy to power from batteries, USB, etc.

### **Features include power supply monitoring and auto-shutdown to ensure safe MEMS driving**

The new OEM MEMS drivers theoretically allow for MEMS mirror driving up to 25kHz, however, depending on mirror size and type, actual bandwidth depends on the user-provided setting of the onboard low-pass filters (LPFs). On-board power supply monitoring ensures safe device driving and includes an auto-shutdown feature to prevent possible device damage when off-spec voltages are applied. The analog-input MEMS drivers are available with three different preset voltage ranges, matching recommended driving schemes, namely 'B160' (80V<sub>bias</sub>), 'T180' (90V<sub>bias</sub>) or 'X200' (100V<sub>bias</sub>), suitable for different MEMS actuator designs. The digital input drivers have a range up to X200 driving and users can select the desired V<sub>bias</sub> and V<sub>difference</sub> via software. The new drivers now also come with LEDs which signal the status of the +5VD power supply (green LED), MEMS Driver enable (red LED) and filter clock status for X and Y axes.

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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 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.